

**Diversity and ecology of epiphytic and terricolous lichen mycota in Gorski kotar and Kvarner littoral (Croatia)**

Raznolikost in ekologija epifitskih in talnih lišajskih gliv na območju Gorskega Kotarja in Kvarnerja (Hrvaška)

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**Abstract:** This paper lists a total of 264 taxa of lichenized and non-lichenized fungi recorded for Gorski kotar and Kvarner littoral; specifically, 184 for Gorski kotar and 170 for Kvarner littoral. Nine taxa are new to Croatia. The list is based on literature records and field work carried out in periods 2000–2002, and 2009–2010. Taxonomic analyses as well as ecological and phytogeographical analyses are presented. The ecological characterization of the lichen flora was determined by assessing the indicator values, and comparing them to values determined for adjacent areas in Slovenia and Italy. Due to particularities in relief and climate, percentage of lichens of oceanic/suboceanic distribution is higher along the eastern Adriatic coast, in relation to the west Adriatic coast.

**Keywords:** lichen, diversity, ecology, Gorski kotar, Kvarner, Croatia

**Izvleček:** Prispevek navaja 264 taxonov z območja Gorskega kotarja in Kvarnerja; 184 z območja Gorskega kotarja in 170 z območja Kvarnerja. Devet taksonov je novih za Hrvaško. Seznam je narejen na podlagi literaturnih podatkov in terenskih raziskav v obdobjih 2000–2002 in 2009–2010. Podani so rezultati taksonomskih, ekoloških in fitogeografskih analiz. Ekološka karakterizacija lišajске flore temelji na oceni indikatorskih vrednosti ter primerjave z vrednostmi, določenimi na območju Slovenije in Italije. Zaradi posebnosti v reliefu in klimi, je delež lišajev oceanske/suboceanske razširjenosti večji na vzhodni obali Jadrana v primerjavi z zahodno.

**Ključne besede:** lišaj, raznolikost, ekologija, Gorski kotar, Kvarner, Hrvaška

## Introduction

In the first paper on lichen mycota of Kvarner littoral, Friedrich Wilhelm Noè reported 56 lichens in the area of city of Rijeka (Noè 1858), but without any stated localities. Paolo Matković reported on results of his researches into cryptogamic flora of Rijeka and its surrounding (Matković 1879),

and recorded 58 lichen species, some of which are collected for the first time in Gorski kotar. Hungarian lichenologist Frigyes Hazslinszky listed 80 lichen taxa from Rijeka and Lokve in Gorski kotar, according to data from various collectors (Hazslinszky 1884). First Croatian botanists who mentioned lichens in the floristic papers is Dragutin Hirc. In the publication „Vegetation of

Gorski kotar“ (Hirc, 1896) he recorded *Cetraria islandica* on Velika Viševica and Suhi vrh. A major contribution to the knowledge of lichen mycota of Rijeka and Gorski kotar was made by Johann Schuler, who provided a list of 329 taxa with associated localities (Schuler 1902). According to actual administrative division of that time, localities have been grouped in four parts: area of Rijeka, Istria, Carniola and Croatia. The lichen material collected by Schuler were discussed by the outstanding world lichenologist, Alexander Zahlbruckner, whose important contribution is description of several new lichen species (Zahlbruckner 1905, 1906, 1909). Hungarian lichenologist Ödön Szatala (Szatala 1927, 1929) listed lichens from Gorski kotar. During research into the vegetation of the massifs of Risnjak and Snježnik in Gorski kotar, Ivo Horvat recorded the presence of lichens in composition of the grassland alliance *Seslerion tenuifoliae* (Horvat 1962). The most distinguished Croatian lichenologist Fran Kušan recorded lichens on Bijeje stijene (Kušan 1933) in Gorski kotar, and in Sušak near Rijeka (Kušan 1953).

There is a record of *Dimerella lutea* from Risnjak, collected in 1968 by Czech lichenologist Antonín Vězda (Vězda 1969). Danish lichenologists Steen N. Christensen and Eric Steen Hansen reported on lichens collected on few localities in Gorski kotar and Kvarner littoral (Christensen 1987, Christensen and Hansen 1994). Alebić-Juretić and Arko-Pijevac (1989, 2005) used lichen thalli as bioindicators for the assessment of air pollution in Rijeka and its surrounding. Five new lichens to Croatia, collected in Gorski kotar, were reported by Ozimec (2000), while the list of 80 taxa recorded for the Risnjak National Park has been published recently by Ozimec et al. (2010). These researches are complementary with those of the Austrian and Slovenian lichenologists in adjacent Dinaric parts of Slovenia.

## Material and methods

### Study area

Gorski kotar and Kvarner littoral are situated in western Croatia, administratively in Primorsko-Goranska County with a seat in City of Rijeka

(Fig. 1). Both regions belong to the western Karst Dinarides, stretching in NW-SE direction. North and NW border of Gorski kotar is also the state border between Croatia and Slovenia, while the west and SW border to Kvarner stretches along the mountains range of Obruč and Kamenjak in Rijeka hinterland, Tuhobić, Medvidak and Viševica. The highest peaks of Gorski kotar are Risnjak (1,528 m a.s.l.) and Snježnik (1,506 m) in the western part, and Bjelolasica (1,534 m) and Viševica (1,428 m) in the SE part (Munić et al. 1996). Towards the NW, there is a lowland area along the Dobra and Kupa river valleys. The Karst Dinarides are made up of pure Jurassic carbonates (Bucković 2006), and typical karst relief with its specific morphology is developed in the area.

The Kvarner littoral represents a semi closed part of the northern Adriatic Sea, lying between eastern part of the Istrian peninsula and the Vinodol-Velebit coastlines. It is divided by the island chains of Cres-Lošinj and Krk-Rab-Pag into the Rijeka Bay, the Kvarner Bay, the Kvarnerić and the Velebit-Vinodol Channel (Benac et al. 2006).

Two climate types, defined under the Köppen's climatic classification, are present

in Gorski kotar: moderately warm and humid climate with warm summers (Cfsbx<sup>o</sup>), and wet boreal climate (Dfsbx<sup>o</sup>) in the altitudinal zone above 1,200 m. Climate in Kvarner littoral is classified into Cfsax<sup>o</sup> type, characterised as moderately warm and humid climate with hot summer. In both areas, dry period occur during the warm half of the year, while the maximum precipitation is recorded in late autumn. The amount of precipitation increases abruptly with altitude on the windward side, from the coast to the Risnjak and Snježnik massifs, while going further inland, the amount of precipitation decreases. Gorski kotar is region with the highest annual precipitation in Croatia: Lividraga (3,728 mm), Risnjak (3,449 mm), Snježnik (3,302 mm). Based on data from Parg (863 m) meteorological station (1971-2000), mean air temperature is 7.2 °C, annual precipitation is 1,841 mm, and air humidity is 80%. Mean air temperature is lowest at high altitudes: 2.4 °C at 1,400 m, and only 1.4 °C above 1,500 m (Horvat 1962). Although some characteristics of Mediterranean climate are present in Kvarner littoral, the impact of vicinity of the coastal mountain range is pronounced in relatively low temperatures during the winter,

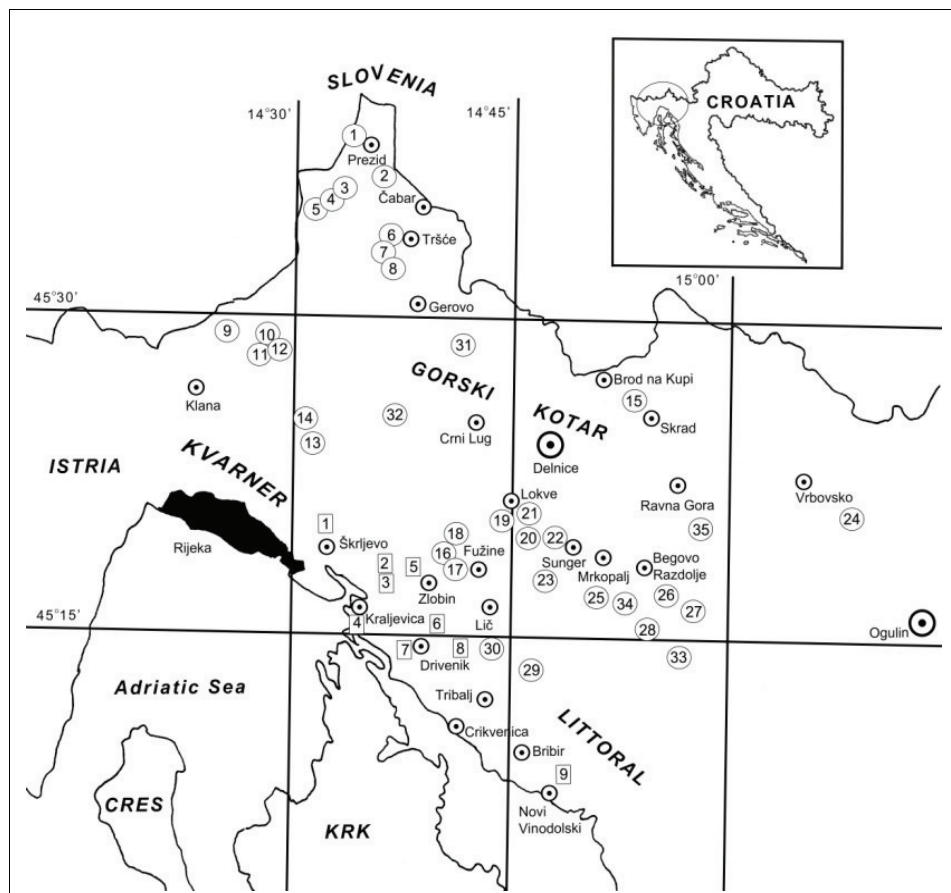


Figure 1: Map of the study area with indicated collection sites.  
Slika 1: Zemljovid območja z označenimi lokacijami vzorčevanja.

increased precipitation, occasionally with snow cover, and cold windbreaks. At Rijeka (120 m) meteorological station (1971–2000), mean annual temperature is 13.8 °C, annual precipitation is 1,552 mm, and air humidity is 63% (Zaninović et al. 2008).

Regarding the phytogeographical division of Croatia, the most of the Gorski kotar area belongs to the Illyrian province of the Eurosiberian-North American region, while the most exposed and highest mountain peaks exhibit influences from Alpine-Nordic region, but without zonal belt (Topić and Šegulja 2005). The largest part of Gorski kotar situated between 600 and 1,100 m altitude is covered by mixed Dinaric beech and

fir forests (*Omphalodo-Fagetum*). In management sense, these forests have permanent and ongoing regeneration, so their sustainability is in no way threatened (Vukelić et al. 2008). Subalpine beech forest (*Ranunculo platanifolii-Fagetum*) cover large areas made up of limestone rock at 1,200–1,400 m altitude. The highest zonal vegetation belt above 1,350 m consists of the special Dinaric stands of mountain pine (*Loniceroborbosianae-Pinetum mugii*). The highest mountain peaks are covered by alpine grasslands of the order *Seslerietalia tenuifoliae*. Steep and warmer limestone blocks at 950–1,350 m covers fir forests (*Calamagrosti-Abietetum*). The subalpine spruce forest (*Listero-Piceetum abietis*) grows in

wet and cold locations in the shallow depressions, and on the edge of dolines. Acidophilous fir forest (*Blechno-Abietetum*) grows on acid soil at 650–950 m. The warmer climatic influence of the Kupa valley favours the occurrence of thermophilous forest associations such as hop hornbeam forests (*Erico-Ostryetum* and *Ostryo-Fagetum*). Pure Illyrian beech forests (*Lamio orvalae-Fagetum*) grow on heights between 350 and 600 m. Littoral beech forest (*Seslerio autumnalis-Fagetum*) is developed on skeletal carbonate soils on the southern slopes of the Dinarids, mostly above 700 m. It is a bordering forest community between Gorski kotar and Kvarner littoral, as well as between two phytogeographical regions in Croatia.

Some parts of the forests in Gorski kotar remained as primeval due to their inaccessibility and are being protected at national level, such as: Bijeke and Samarske Stijene Strict Nature Reserve and Risnjak National Park.

Kvarner littoral belongs to the Adriatic province of the Mediterranean region. Relatively cold winters cause the absence of the evergreen forest vegetation of the *Quercion ilicis* alliance, typical for the Eumediterranean zone (Topić and Šegulja 2005). Lower belt of the sub-Mediterranean zone up to 300–400 m altitude is characterized by deciduous forest and scrub of pubescent oak and oriental hornbeam (*Quercus-Carpinetum orientalis*). Horizontal continuation of this belt in the direction of hinterland is mixed forest and scrub of pubescent oak and hop hornbeam (*Ostryo-Quercetum pubescens*) in Mediterranean-montane belt at 400–950 m altitude.

#### Lichenological survey

Epiphytic lichens were collected on trees and shrubs, while terricolous lichens were collected on soil, some being together with the mosses. The lichen material was collected in the period 2000–2002 and 2009–2010 at 35 different sites across Gorski kotar (Tab. 1), and 9 in Kvarner littoral (Tab. 2).

#### Identification of the collected material

Identification in the field was made with a hand lens, and in the laboratory using a dissecting microscope, a light microscope and the usual

spot tests, according to the reference books: Clerc (1998), Purvis et al. (1992), Vitikainen (1994) and Wirth (1995). Some specimens were analysed by thin-layer chromatography following Orange et al. (2001). The lichen collections from the herbaria: ZA, ZAHO, GZU and W have been studied. Nomenclature follows Suppan et al. (2000), Santesson et al. (2004), Knežević and Mayrhofer (2009), and modern treatments. Vouchers are kept in the Herbarium Croaticum (ZA) of Botanical Institute, Faculty of Science in Zagreb.

#### Floristic and ecological analyses

The comprehensive list of lichen mycota is given in alphabetical order. Non-lichenized fungi are marked with a plus sign (+). New records to Croatia are marked with (\*HR), to Gorski kotar with (\*GK), and to Kvarner littoral with (\*KL).

The indicator values with relation to distinct environmental factors are given in range of 5-class ordinal scale for each taxon, according to Nimis and Martellos (2008), as follows:

Substrate reaction (R): 1 = on very acid substrata; 2 = on acid substrata; 3 = on subacid to subneutral substrata; 4 = on slightly basic substrata; 5 = on basic substrata

Light (L): 1 = in very shaded situations; 2 = in shaded situations; 3 = in sites with plenty of diffuse light; 4 = in sun-exposed sites; 5 = in sites with very high direct solar irradiation

Moisture (F): 1 = hygrophytic; 2 = rather hygrophytic; 3 = mesophytic; 4 = xerophytic; 5 = very xerophytic

Eutrophication (N): 1 = no eutrophication; 2 = very weak eutrophication; 3 = weak eutrophication; 4 = rather high eutrophication; 5 = very high eutrophication

Altitudinal range (A): 1 = eu-Mediterranean belt with evergreen *Quercus ilex* forest; 2 = sub-mediterranean belt with deciduous *Quercus* and *Carpinus* forests; 3 = montane belt with *Fagus* forests; 4 = oroboreal belt of the Alps; 5 = above treeline, both Alpine and oromediterranean).

Phytoclimatic range in Europe: oc = restricted to oceanic areas; suboc = in suboceanic areas

Table 1: List of collection sites in Gorski kotar area and their description.

Tabela 1: Seznam mest vzorčevanja v Gorskem kotarju in njihov opis.

Site	Description	MTB	Date
GK1	Prezid (765 m) and Vražji vrtec (904 m), near the road border crossing to Slovenia	0353/3	27 Sep. 2001
GK2	Kozji vrh (916 m) near Prezid	0353/4	27 Sep. 2001
GK3	Surrounding of forest house Milanov vrh (1,011 m)	0353/3	27 Sep. 2001
GK4	Forest area Ivica (1,000 m), 2 km from Milanov vrh to Jarmovac	0453/1	29 Apr. 2002
GK5	Forest area Jarmovac (1,000 m), 4 km from Milanov vrh	0453/1	29 Apr. 2002
GK6	Surrounding of Frbežari (824 m) near Tršće	0453/2	4 Nov. 2000
GK7	Rudnik (1,052 m) above Frbežari	0453/2	4 Nov. 2000
GK8	Surrounding of Sokoli (733 m) near Tršće	0453/2	4 Nov. 2000
GK9	Trstenik bog (960 m)	0552/2	8 Jun. 2001
GK10	Rečičko (c. 1,140 m), near the forest road Platak–Trstenik	0553/1	8 Jun. 2001
GK11	Rečice (c. 950 m), near the forest house Suho, 13 km from Platak	0553/1	8 Jun. 2001
GK12	Donji Medvejeci (1,395 m)	0553/1	19 Sep. 2001
GK13	Kripanjski path, Mala Peša (c. 900 m)	0553/3	28 Sep. 2001
GK14	Kripanjski path, near the forest house Crni Vrh (1,087 m), and Primorski Klek (1,210 m)	0553/3	28 Sep. 2001
GK15	Zeleni vir area near Skrad (345 m)	0555/3	22 Jun. 2001
GK16	Path from Benkovac Fužinski (880 m) to the summit of Tuhobić (1,106 m),	0653/4	7 Nov. 2000
GK17	Path from Zlobinsko Brdo to the summit of Jelenčić (1,106 m)	0654/3	30 Sep. 2001
GK18	Surrounding of Fužine, near the forest road along the Lepenice Lake (c. 730 m)	0654/3	6 Sep. 2000
GK19	Sljeme, chappel by the road to Fužine, near the extension to Slavica (c. 700 m)	0654/4	29 Sep. 2001
GK20	Fajeri above Brestova Draga (c. 1,050 m)	0654/4	22 Jun. 2001
GK21	Park-forest "Golubinjak" (c. 800 m)	0654/2	9 Jun. 2001
GK22	Surrounding of Sunger (804 m), forest „Sungerski lug“, chappel by the Sopač–Mrkopalj road	0654/4	9 Jun. 2001 29 Sep. 2001
GK23	Path above Brestova Draga to the summit of Bitoraj (1,385 m)	0654/4 0754/2	1 May 2002
GK24	Surrounding of Vrbovsko, by the road to Ogulin (c. 450 m)	0656/2	3 May 2002
GK25	Southern surrounding of Mrkopalj (c. 950 m)	0755/1	18 Aug. 2001
GK26	By the forest road from Begovo Razdolje to Vrbovska poljana (c. 1,150 m)	0755/2	3 May 2002
GK27	Path from Vrbovska poljana to the summit of Bjelolastica (1,534 m)	0755/2	3 May 2002
GK28	Path from Ratkovo sklonište (1,184 m) to the summit of Samarske stijene (1,302 m)	0755/4	22 Jun. 2001
GK29	By the road Lič–Lukovo–Novi Vinodolski, near the extension to the forest house Marin vjetar (c. 840 m)	0754/4	1 May 2002
GK30	By the road between Drivenik railway station and Lukovo, near the foresthouse Bukova Draga (c. 920 m)	0754/3	1 May 2002
GK31	National Park „Risnjak“, Razloge village (c. 500 m)	0554/1	3 Aug. 2010
GK32	National Park "Risnjak", path from Južni Mali Risnjak to the mountain hut (c. 1,400 m)	0553/4	12 Jun. 2009
GK33	Path from the road Mrkopalj–Plana-Jasenak to the summit of Bijele Stijene (1,335 m)	0755/4	11 Jun. 2009
GK34	Calcareous grassland in the vicinity of Tuk (c. 880 m)	0755/1	11 June 2009
GK35	Southeastern surrounding of Ravna Gora (c. 900 m)	0655/4	5 Oct. 2010

Table 2: List of collection sites in Kvarner littoral area and their description.

Tabela 2: Seznam mest vzorčevanja v Kvarnerju in njihov opis.

Site	Description	MTB	Date
KL1	By the path from Škrljevo railway station (263 m) to Trebestin (542 m)	0653/3	9 Nov. 2000
KL2	Satničko area (704 m), at crossroad of paths from Zlobin and Plase towards Tuhobić	0653/4	28 Apr. 2002
KL3	Surrounding of Meja railway station (445 m), by the path to Satničko	0653/4	28 Apr. 2002
KL4	Surrounding of hotel "Uvala Scott" near the Krk bridge (c. 50 m)	0753/1	15 Sep. 2001
KL5	Surrounding of Zlobin railway station, Draževo area by the path to Satničko (c. 750 m)	0753/2	28 Apr. 2002
KL6	Lipove šume area (c. 700 m), by the road from Plase, above the Vinodol	0753/2	20 Sep. 2001
KL7	Old fortress Drivenik (182 m)	0753/4	23 Jun. 2001
KL8	Medvidak (1,027 m)	0754/1	20 Sep. 2002
KL9	Above Novi Vinodolski, Gusta Draga area (c. 350 m), near the extension to Bribir	0854/2	20 Sep. 2002

## Results

### List of taxa

*Acrocordia gemmata* (Ach.) A.Massal.

Gorski kotar: Schuler (1902):141; GK23

Kvarner littoral: Schuler (1902):140

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

Kvarner littoral: Schuler (1902):151 as *Buellia punctiformis*

*Anaptychia ciliaris* (L.) Körb

Gorski kotar: Schuler (1902):227 as *Physcia ciliaris*; GK1, GK30

Kvarner littoral: Matković (1879):37; Schuler (1902):227 as *Physcia ciliaris*

\*GK *Aplotomma turgida* (A. Massal.) A. Massal.

Gorski kotar: GK14, GK20

*Arthonia caesia* (Flot.) Arnold;

Kvarner littoral: Schuler (1902):142

+ *Arthonia punctiformis* Ach.

Kvarner littoral: Schuler (1902):142 as *Arthonia punctiformis*, *Arthopyrenia atomaria*

*Arthonia radiata* (Pers.) Ach.

Gorski kotar: Kušan (1953):111; Christensen and

Hansen (1994):104; Ozimec et al. (2010):22

Kvarner littoral: Schuler (1902):142 as *Arthonia astroidea*

\*GK *Arthonia spadicea* Leight.

Gorski kotar: GK8

*Arthopyrenia analepta* (Ach.) A.Massal.

Kvarner littoral: Schuler (1902):143 as *Arthopyrenia fallax*; Zahlbruckner (1907): 108.

*Arthopyrenia cerasi* (Schrad.) A.Massal.

Kvarner littoral: Matković (1879):41; Schuler (1902):143

*Arthopyrenia cinereopruinosa* (Schaer.) A. Massal.

Kvarner littoral: Schuler (1902):143

+ *Arthopyrenia platypyrenia* (Nyl.) Arnold

Kvarner littoral: Zahlbruckner (1906):218

*Arthothelium ruanum* (A.Massal.) Körb.

Gorski kotar: Schuler (1902):144

*Bacidia arceutina* (Ach.) Arnold

Kvarner littoral: Schuler (1902):144

*Bacidia fumensis* Zahlbr.

Kvarner littoral: Zahlbruckner (1909b):474; Printzen (1995):239



*Bacidia laurocerasi* (Duby) Zahlbr.

Kvarner littoral: Schuler (1902):145 as *Bacidia endoleuca*

*Bacidia rubella* (Hoffm.) A.Massal.

Gorski kotar: Schuler (1902):145 as *Bacidia rubella*; GK27

Kvarner littoral: Schuler (1902):145 as *Bacidia rubella*

*Bacidia subincompta* (Nyl.) Arnold

Gorski kotar: Schuler (1902):144 as *Bacidia atosanguinea*

Kvarner littoral: Schuler (1902):144 as *Bacidia atosanguinea*

*Bacidina phacodes* (Körb.) Vězda

Gorski kotar: Schuler (1902):144 as *Bacidia albescens*

Kvarner littoral: Schuler (1902):144 as *Bacidia albescens*, *Bilimbia chlorotica*

\*GK *Baeomyces rufus* (Huds.) Rehent.

Gorski kotar: GK8; GK18

Kvarner littoral: Schuler (1902):239 as *Sphyridium byssoides*.

*Bilimbia sabuletorum* (Schreb.) Arnold

Gorski kotar: Schuler (1902):147 as *Bilimbia hypnophila*; Kušan (1933):110 as

*Bacidia sabuletorum*; GK27

Kvarner littoral: Schuler (1902):147 as *Bilimbia hypnophila*

+ *Blastodesmia nitida* A.Massal.

Kvarner littoral: Schuler (1902):150

*Bryoria capillaris* (Ach.) Brodo & D. Hawksw.

Gorski kotar: Schuler (1902):141 as *Alectoria cana*

*Bryoria fusceccens* (Gyeln.) Brodo & D. Hawksw.

Gorski kotar: Schuler (1902):141 as *Alectoria jubata*

\*HR; \*GK *Bryoria implexa* (Hoffm.) Brodo & D.Hawksw.

Gorski kotar: GK6

*Buellia disciformis* (Fr.) Mudd

Gorski kotar: Schuler (1902):150 as *Buellia parasema*

Kvarner littoral: Matković (1879):38 as *Buellia parasema*; Schuler (1902):150 as *Buellia parasema*

\*HR; \*GK *Calicium glaucellum* Ach.

Gorski kotar: GK14

*Caloplaca cerina* (Hedw.) Th.Fr. var. *cerina*

Gorski kotar: Schuler (1902):153; Ozimec et al. (2010):22

Kvarner littoral: Schuler (1902):153

*Caloplaca cerinella* (Nyl.) Flagey

Kvarner littoral: Schuler (1902):154

*Caloplaca ferruginea* (Huds.) Th.Fr

Gorski kotar: Schuler (1902):154

Kvarner littoral: Schuler (1902):154; Christensen and Hansen (1994):105

*Caloplaca flavorubescens* (Huds.) J. R. Laundon

Kvarner littoral: Zahlbruckner (1923):40 as *Caloplaca salicina*

*Caloplaca haematites* (St.-Amans) Zwackh  
Kvarner littoral: Schuler (1902):155; Zahlbruckner (1913):274.

*Caloplaca herbidella* (Hue) H.Magn.

Gorski kotar: Ozimec et al. (2010):22; GK10; GK14; GK17

*Caloplaca luteoalba* (Turner) Th.Fr.

Kvarner littoral: Matković (1879):40 as *Calloporisma luteo album*

*Caloplaca obscurella* (Körb.) Th.Fr.

Kvarner littoral: Schuler (1902):156 as *Caloplaca sarcopidoides*

*Caloplaca pollinii* (A.Massal.) Jatta

Kvarner littoral: Schuler (1902):149 as *Blastenia pollinii*; Christensen and Hansen (1994):105

*Caloplaca pyracea* (Ach.) Th.Fr.

Kvarner littoral: Schuler (1902):155

*Caloplaca sinapisperma* (Lam. & DC.) Maheu & A. Gillet

Gorski kotar: Schuler (1902):148 as *Blastenia leucoraea*

*Caloplaca stilicidiorum* (Vahl.) Lynge

Gorski kotar: Kušan (1933):115 as *Caloplaca cerina* var. *stilicidiorum*

\*GK *Candelaria concolor* (Dicks.) Stein

Gorski kotar: GK1; GK2

Kvarner littoral: Zahlbruckner (1901):85; Schuler (1902):248 as *Xanthoria concolor*; Christensen and Hansen (1994):105; KL4; KL5; KL9

*Candelariella reflexa* (Nyl.) Lettau

Gorski kotar: Ozimec (2000):135; Ozimec et al. (2010):22

*Candelariella vitellina* (Hoffm.) Müll. Arg.

Kvarner littoral: Schuler (1902):160 as *Caloplaca vitellina*

*Candelariella xanthostigma* (Ach.) Lettau

Kvarner littoral: Christensen and Hansen (1994):106

*Catapyrenium cinereum* (Pers.) Körb.

Gorski kotar: Kušan (1933):106 as *Dermatocarpon hepaticum*

Kvarner littoral: Schuler (1902):173 as *Dermatocarpon hepaticum*

*Catillaria croatica* Zahlbr.

Gorski kotar: Zahlbruckner (1906b):487; Printzen (1995):168

*Catillaria erysiboides* (Nyl.) Th. Fr.

Gorski kotar: Schuler (1902):162

*Catillaria nigroclavata* (Nyl.) Schuler

Kvarner littoral: Schuler (1902):163

*Catinaria atropurpurea* (Schaer.) Vězda & Poelt

Kvarner littoral: Schuler (1902):162 as *Catillaria atropurpurea*

*Cetraria aculeata* (Schreb.) Fr.

Gorski kotar: Schuler (1902):165

Kvarner littoral: Schuler (1902):165

*Cetraria islandica* (L.) Ach.

Gorski kotar: Schuler (1902):166; Horvat (1930):24; Kušan (1933):114; GK23; GK27

*Cetraria sepincola* (Ehrh.) Ach.

Gorski kotar: Schuler (1902):166

*Cetrelia cetrarioides* (Duby) W. L. Culb. & C. F. Culb.

Gorski kotar: GK5; GK26

*Cetrelia olivetorum* (Nyl.) W. L. Culb. & C. F. Culb.

Gorski kotar: Ozimec et al. (2010):22; GK2; GK4; GK16

*Chaenotheca brachypoda* (Ach.) Tibell

Kvarner littoral: Hazslinszky (1884):242 as *Coniocybe furfuracea* ( $\gamma$ ) *sulphurella*

*Chaenotheca brunneola* (Ach.) Müll. Arg.

Gorski kotar: Ozimec (2000):135; GK8

*Chaenotheca furfuracea* (L.) Tibell

Kvarner littoral: Matković (1879):41 as *Coniocybe furfuracea*

+ *Chaenothecopsis pusilla* (Ach.) A. F. W. Schmidt

Kvarner littoral: Matković (1879):41 as *Calicium pusillum*

*Cladonia cariosa* (Ach.) Spreng.

Gorski kotar: Schuler (1902):166

Kvarner littoral: Schuler (1902):166

*Cladonia ciliata* Stirt.

Gorski kotar: Schuler (1902) as *Cladonia pycnoclada*

*Cladonia coniocraea* (Flörke) Spreng.

Gorski kotar: Schuler (1902):167 as *Cladonia fimbriata* var. *apolepta*; Kušan (1933):111; Ozimec et al. (2010):22; GK11; GK12; GK14; GK17; GK18; GK22

*Cladonia convoluta* (Lam.) Anders

Gorski kotar: Schuler (1902):167

Kvarner littoral: Matković (1879):37 as *Cladonia endiviaefolia*; Schuler (1902):167; Kušan (1953); KL1



*Cladonia deformis* (L.) Hoffm.

Gorski kotar: Kušan (1933):111

*Cladonia digitata* (L.) Hoffm.

Gorski kotar: Schuler (1902):167

*Cladonia fimbriata* (L.) Fr.

Gorski kotar: Matković (1879):37; Kušan (1933):111; Ozimec et al. (2010):23; GK8; GK16

Kvarner littoral: Schuler (1902):167

*Cladonia foliacea* (Huds.) Willd.

Kvarner littoral: Matković (1879):37 as *Cladonia alcornis*; Schuler (1902):167; KL4

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

Gorski kotar: Hazslinszky (1884):41; Schuler (1902):168; Kušan (1933):111, Kušan (1953):296 as *Cladonia furcata* var. *pinnata* f. *foliolosa*; Ozimec et al. (2010):23

Kvarner littoral: Matković (1879):37; Schuler (1902):168

*Cladonia gracilis* (L.) Willd.

Gorski kotar: Kušan (1933):111 as *Cladonia gracilis* var. *elongata*

*Cladonia macilenta* Hoffm. subsp. *macilenta*

Gorski kotar: Schuler (1902):166 as *Cladonia bacillaris*

*Cladonia macilenta* Hoffm. subsp. *floerkeana* (Fr.) V.Wirth

Gorski kotar: Kušan (1933):111 as *Cladonia floerkeana*; Ozimec et al. (2010):23; GK22

*Cladonia pocillum* (Ach.) O.J.Rich.

Gorski kotar: Schuler (1902):169 as *Cladonia pyxidata* subsp. *pocillum*; Kušan (1933):111 as *Cladonia pyxidata* var. *pocillum*; Kušan (1953):306 as *Cladonia pyxidata* subsp. *pocillum*

Kvarner littoral: Schuler (1902):169 as *Cladonia pyxidata* subsp. *pocillum*

*Cladonia polycarpoides* Nyl.

Kvarner littoral: Schuler (1902):171 as *Cladonia subcariosa*

*Cladonia pyxidata* (L.) Hoffm.

Gorski kotar: Matković (1879):37; Schuler (1902):169; Kušan (1933):111 as *Cladonia pyxidata* var. *neglecta*; Kušan (1953):306; Ozimec et al. (2010):23; GK1; GK4; GK6; GK8; GK12; GK14; GK15; GK18; GK17; GK21; GK22; GK26; GK27

Kvarner littoral: Matković (1879):37; Schuler (1902):169; Kušan (1953):306; KL8

*Cladonia ramulosa* (With.) J. R.Laundon

Gorski kotar: Schuler (1902):169 as *Cladonia pityrea*

*Cladonia rangiferina* (L.) F. H. Wigg.

Gorski kotar: Matković (1879):37; Hazslinszky (1884):42; Schuler (1902):179; Kušan (1933):111; Ozimec et al. (2010):23; GK6

*Cladonia rangiformis* Hoffm.

Gorski kotar: Schuler (1902):170

Kvarner littoral: Matković (1879):37 as *Cladonia pungens*; Schuler (1902):170; Kušan (1953):297

\*KL *Cladonia squamosa* Hoffm.

Gorski kotar: Schuler (1902):170; GK1; GK27  
Kvarner littoral: KL3

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

Gorski kotar: Schuler (1902):167 as *Cladonia fimbriata* var. *cornutoradiata*

Kvarner littoral: Schuler (1902):167 as *Cladonia fimbriata* var. *cornutoradiata*

*Collema auriforme* (With.) Coppins & J.R.Laundon

Gorski kotar: Hazslinszky (1884):290 as *Collema granosum*; Szatala (1929):890 as *Collema auriculatum* f. *membranaceum*; Kušan (1933):108 as *Collema auriculatum*; Ozimec et al. (2010):23; GK15; GK21

Kvarner littoral: Schuler (1902):171 as *Collema granosum*; KL7

*Collema crispum* (Huds.) F.H.Wigg.

Kvarner littoral: Matković (1879):42 as *Collema cheileum* α *verum*; Schuler (1902): 171 as *Collema cheileum*

*Collema cristatum* (L.) F.H.Wigg.

Gorski kotar: Kušan (1933):108 as *Collema multifidum*; Ozimec et al. (2010):23

*Collema fasciculare* (L.) F.H.Wigg.

Kvarner littoral: Schuler (1902):240 as *Synechoblastus conglomeratus*

*Collema flaccidum* (Ach.) Ach.

Gorski kotar: Hazslinszky (1884):292 as *Synechoblastus flaccidus*; Schuler (1902):240 as *Synechoblastus flaccidus*; Szatala (1929): 887 as *Collema rupestre*; Kušan (1933):109 as *Collema rupestre*; GK27

Kvarner littoral: Schuler (1902):240 as *Synechoblastus flaccidus*

*Collema fragrans* (Sm.) Ach.

Kvarner littoral: Schuler (1902):172 as *Collema microphyllum*

*Collema nigrescens* (Hudson) DC.

Gorski kotar: Hazslinszky (1884):293 as *Synechoblastus vespertilio*; Schuler (1902): 241 as *Synechoblastus nigrescens*

Kvarner littoral: Matković (1879):42 as *Collema nigrescens* α *vespertilio*; Schuler (1902):241 as *Synechoblastus nigrescens*

*Collema occultatum* Bagl.

Gorski kotar: Schuler (1902):172 as *Collema quadratum*

*Collema subflaccidum* Degel.

Gorski kotar: Ozimec et al. (2010):23

Kvarner littoral: Christensen and Hansen (1994):107

*Collema tenax* (Sw.) Ach.

Gorski kotar: Kušan (1933):108 as *Collema pulposum*

Kvarner littoral: Schuler (1902):172 as *Collema pulposum*

*Degelia plumbea* (Lightf.) P.M.Jørg & P.James

Gorski kotar: Schuler (1902):212 as *Pannaria plumbea*; Ozimec et al. (2010):23; GK3; GK4; GK5; GK7; GK18

Kvarner littoral: Hazslinszky (1884):81 as *Pannaria plumbea*; Beck and Zahlbruckner

(1898):462 as *Parmeliella plumbea* var. *myriocarpa*; Schuler (1902):212 as *Pannaria plumbea*

*Dibaeis baeomyces* (L.fil.) Rambold & Hertel

Gorski kotar: Schuler (1902):146 as *Baeomyces roseus*

Kvarner littoral: Schuler (1902):146 as *Baeomyces roseus*

*Dimerella lutea* (Dicks.) Trevisan

Gorski kotar: Vězda (1969) in Lich. Sel. Exs. 730

*Dimerella pineti* (Ach.) Vězda

Kvarner littoral: Schuler (1902):174

*Diploschistes muscorum* (Scop.) R.Sant.

Gorski kotar: Hazslinszky (1884):136 as *Urceolaria scruposus c) bryophila*; Kušan (1933):107 as *Diploschistes bryophilus*

Kvarner littoral: Schuler (1902):175 as *Diploschistes scruposus* var. *bryophilus*

*Diplotomma alboatrum* (Hoffm.) Flot.

Kvarner littoral: Matković (1879):40

*Endocarpon pallidum* Ach.

Kvarner littoral: Schuler (1902):176

*Endocarpon pusillum* Hedw.

Kvarner littoral: Schuler (1902):176

*Evernia divaricata* (L.) Ach.

Gorski kotar: Schuler (1902):176; GK22

*Evernia illyrica* (Zahlbr.) Zahlbr.

Gorski kotar: Schuler (1902); Kušan (1933):115; GK22

*Evernia prunastri* (L.) Ach.

Gorski kotar: Schuler (1902):177; Ozimec et al. (2010):23; GK1; GK6; GK7; GK8; GK17; GK18

Kvarner littoral: Schuler (1902):177; KL4; KL5 \*HR; \*GK *Fellhanera bouteillei* (Desm.) Vězda

Gorski kotar: GK15

*Flavoparmelia caperata* (L.) Hale

Gorski kotar: Schuler (1902):214 as *Parmelia*

*caperata*; Ozimec et al. (2010):23; GK2; GK6; GK16; GK17; GK18

Kvarner littoral: Matković (1879):38 as *Imbri-caria caperata*; Schuler (1902):214 as *Parmelia caperata*; Zahlbruckner (1913):270 as *Parmelia caperata*; Christensen and Hansen (1994): 109 as *Parmelia caperata*; KL1; KL3; KL4; KL5; KL7

*Fulgensia fulgida* (Nyl.) Szatala

Kvarner littoral: Schuler (1902):191 as *Lecanora fulgidum*; Zahlbruckner (1912):177 as *Caloplaca fulgida*

*Fuscidea stiriaca* (A.Massal.) Hafellner

Gorski kotar: Schuler (1902):197 as *Lecidea rivulosa*; Ozimec et al. (2010):23; GK2

\*GK *Fuscopannaria ignobilis* (Anzi) P.M.Jørg.  
Gorski kotar: GK8; GK31

*Fuscopannaria olivacea* (P.M.Jørg.) P.M.Jørg.

Kvarner littoral: Schuler (1902):211 as *Pannaria leucosticta*

*Graphis scripta* (L.) Ach.

Gorski kotar: Schuler (1902):178; Zahlbruckner (1909a):224; Szatala (1929):859; Christensen (1987): 163 as *Graphis scripta* var. *serpentina*; Ozimec et al. (2010):23; GK4; GK10; GK11; GK12; GK14; GK16; GK17; GK16; GK17; GK26.

Kvarner littoral: Schuler (1902):178

*Gyalecta derivata* (Nyl.) H.Olivier

Gorski kotar: Zahlbruckner (1905b):5 as *Gyalecta croatica*

*Gyalecta truncigena* (Ach.) Hepp

Kvarner littoral: Schuler (1902):178

*Gyalecta ulmi* (Swartz) Zahlbr.

Gorski kotar: Kušan (1933):108

*Heppia lutosa* (Ach.) Nyl.

Kvarner littoral: Schuler (1902):179 as *Heppia virescens*

*Hyperphyscia adglutinata* (Flörke)

H.Mayrhofer & Poelt

Kvarner littoral: Schuler (1902):226 as *Physcia adglutinata*

*Hypocenomyce scalaris* (Ach.) M.Choisy

Gorski kotar: Matković (1879):40 as *Psora ostreata*

*Hypogymnia physodes* (L.) Nyl.

Gorski kotar: Schuler (1902):218 as *Parmelia physodes*; Kušan (1933):114 as *Parmelia physodes*; Ozimec et al. (2010):23; GK1; GK4; GK6; GK8; GK9; GK10; GK11; GK12; GK14; GK16; GK17; GK18; GK21; GK22; GK27

Kvarner littoral: Matković (1879):38 as *Imbri-caria physodes*; Schuler (1902):218 as *Parmelia physodes*; KL4; KL6

*Hypogymnia tubulosa* (Schaer.) Hav.

Gorski kotar: Ozimec et al. (2010):23; GK17; GK22

*Hypogymnia vittata* (Ach.) Parrique

Gorski kotar: Schuler (1902):218 as *Parmelia physodes* var. *vittata*

*Icmadophila ericetorum* (L.) Zahlbr.

Gorski kotar: Hazslinszky (1884):123 as *Icmadophila aeruginosa*; Schuler (1902): 179; Kušan (1933):113

+ *Julella lactea* (A.Massal.) M.E.Barr

Kvarner littoral: Schuler (1902):231 as *Polyblastia lactea*

*Koerberia biformis* A.Massal.

Kvarner littoral: Beck and Zahlbruckner (1898):467; Schuler (1902):179

*Lecania cyrtella* (Ach.) Th.Fr.

Gorski kotar: Ozimec et al. (2010):23

*Lecania naegelii* (Hepp) Diederich & van den Boom

Kvarner littoral: Schuler (1902):148 as *Bilimbia naegelii*

*Lecanographa amylicata* (Pers.) Egea & Torrente

Gorski kotar: Matković (1879):41 as *Lecanactis illecebrosa*

*Lecanora albella* (Pers.) Ach.

Gorski kotar: Schuler (1902):188 as *Lecanora pallida*

Kvarner littoral: Matković (1879):40 as *Lecanora scrupulosa*; Schuler (1902):188 as *Lecanora pallida*

*Lecanora argentata* (Ach.) Malme

Gorski kotar: Christensen (1987):166; Ozimec et al. (2010):23; GK6

Kvarner littoral: Matković (1879):40 as *Lecanora subfusca* var. *argentea*

*Lecanora carpinea* (L.) Vain.

Gorski kotar: Schuler (1902):185 as *Lecanora angulosa*; Ozimec et al. (2010):23; GK1; GK8; GK11

Kvarner littoral: Schuler (1902):185 as *Lecanora angulosa*; KL5

*Lecanora chlarotera* Nyl.

Gorski kotar: Schuler (1902):190 as *Lecanora subfusca* f. *rugosa*; Ozimec et al. (2010):24; GK1; GK4; GK27

Kvarner littoral: Schuler (1902):190 as *Lecanora subfusca* f. *rugosa*

*Lecanora expallens* Ach.

Kvarner littoral: Schuler (1902):186 as *Lecanora conizaeae*

*Lecanora glabrata* (Ach.) Malme

Gorski kotar: Schuler (1902):190 as *Lecanora subfusca* f. *glabrata*

*Lecanora hagenii* var. *fallax* Hepp

Kvarner littoral: Schuler (1902):187 as *Lecanora hageni*

*Lecanora intumescens* (Rebent.) Rabenh.

Gorski kotar: Schuler (1902):187

*Lecanora pulicaris* (Pers.) Ach.

Gorski kotar: Christensen (1987): 163; GK10

Kvarner littoral: Schuler (1902):189

*Lecanora sambuci* (Pers.) Nyl.

Kvarner littoral: Schuler (1902):188

*Lecanora subcarpinea* Szatala

Gorski kotar: Ozimec et al. (2010):24

*Lecanora symmicta* (Ach.) Ach.

Kvarner littoral: Zahlbruckner (1914):145 as *Lecanora symmictera*

*Lecidea exigua* Chaub.

Kvarner littoral: Schuler (1902):195

*Lecidella elaeochroma* (Ach.) M.Choisy

Gorski kotar: Schuler (1902):201 as *Lecidea olivacea*, 202 as *Lecidea parasema*; Christensen (1987):163 as *Lecidella euphorea*; Ozimec et al. (2010):24; GK1; GK5; GK17; GK27

Kvarner littoral: Schuler (1902):201 as *Lecidea olivacea*, 202 as *Lecidea parasema*; Christensen and Hansen (1994):108 as *Lecidella achristotera*

\*HR; \*GK *Lepraria eburnea* J.R.Laundon

Gorski kotar: GK14

*Lepraria incana* (L.) Ach.

Gorski kotar: Christensen (1987):167; Ozimec et al. (2010):24

\*HR; \*GK *Lepraria rigidula* (de Lesd.) Tøn-  
sberg

Gorski kotar: GK10; GK22

*Leptogium cyanescens* (Rabenh.) Körb.

Kvarner littoral: Christensen and Hansen (1994):108

*Leptogium gelatinosum* (With.) J.R.Laundon

Kvarner littoral: Schuler (1902):205 as *Leptogium sinuatum*

*Leptogium lichenoides* (L.) Zahlbr.

Gorski kotar: Szatala (1929):899; Kušan (1933):109; Ozimec et al. (2010):24

Kvarner littoral: Hazslinszky (1884):294 as *Leptogium lacerum* c) *lophaeum*; Schuler (1902):205 as *Leptogium atrocoeruleum*.

*Leptogium saturninum* (Dicks.) Nyl.

Gorski kotar: Hazslinszky (1884):296 as *Mallo-  
tium saturninum*; Schuler (1902):207 as *Mallo-  
tium saturninum*

*Lobaria amplissima* (Scop.) Forssell

Gorski kotar: Hazslinszky (1884):61 as *Stic-  
ta amplissima*; Schuler (1902):206; Zahl-

bruckner (1914):145 as *Lobaria laciniata*; Szatala (1929):914; Ozimec et al. (2010): 24; GK1; GK23; GK29

*Lobaria pulmonaria* (L.) Hoffm.

Gorski kotar: Schuler (1902):206 as *Lobaria pulmonacea*; Szatala (1929):916; Kušan (1933):109; Ozimec et al. (2010):24; GK3; GK4; GK5; GK7; GK8; GK10; GK11; GK12; GK15; GK16; GK17; GK20; GK23; GK24; GK25; GK26; GK27; GK28; GK29; GK30; GK33; GK35

Kvarner littoral: Matković (1879):38 as *Sticta pulmonaria*; Schuler (1902):206 as *Lobaria pulmonacea*.

\*HR; \*GK *Lobaria virens* (With.) J.R.Laundon  
Gorski kotar: GK29

*Lobarina scrobiculata* (Scop.) Nyl.

Gorski kotar: Hazslinszky (1884):60 as *Sticta scrobiculata*; Schuler (1902):240 as *Sticta scrobiculata*; Ozimec et al. (2010):24

Kvarner littoral: Schuler (1902):240 as *Sticta scrobiculata*

*Lopadium disciforme* (Flot.) Kullh.

Gorski kotar: Schuler (1902):206 as *Lopadium pezizoideum*

*Maronea constans* (Nyl.) Hepp

Gorski kotar: Schuler (1902):207

Kvarner littoral: Schuler (1902):207 as *Maronea berica*

*Megalaria laureri* (Th.Fr.) Hafellner

Gorski kotar: Schuler (1902):165 as *Catillaria laureri*; Ozimec et al. (2010):24

*Megaspora verrucosa* (Ach.) Hafellner & V.Wirth

Gorski kotar: Schuler (1902):184 as *Lecanora verrucosa*

*Melanelixia fuliginosa* (Duby) O.Blanco et al. subsp. *fuliginosa*

Gorski kotar: Schuler (1902):216 as *Parmelia fuliginosa*

Kvarner littoral: Schuler (1902):216 as *Parmelia fuliginosa*

*Melanelixia fuliginosa* (Duby) O.Blanco et al. subsp. *glabratula* (Lamy) J.R.Laundon

Gorski kotar: Schuler (1902):216 as *Parmelia fuliginosa* var. *laetevirens*; 217: as *Parmelia glabratula*; Christensen (1987):163 as *Parmelia glabratula*; Ozimec et al. (2010):24; GK11; GK14; GK16; GK18; GK27; GK28; GK33

Kvarner littoral: Schuler (1902):216 as *Parmelia fuliginosa* var. *laetevirens*; Christensen and Hansen (1994):109 as *Parmelia glabratula* subsp. *glabratula*

*Melanelixia glabra* (Schaer.) O.Blanco et al.  
Gorski kotar: Schuler (1902) as *Parmelia glabra*

Kvarner littoral: Schuler (1902) as *Parmelia glabra*

*Melanelixia subaurifera* (Nyl.) O.Blanco et al.

Kvarner littoral: Schuler (1902) as *Parmelia subaurifera*; Christensen and Hansen (1994):109 as *Parmelia subaurifera*

*Melanohalea exasperata* (De Not.) O.Blanco et al.

Gorski kotar: Schuler (1902):216 as *Parmelia exasperata*; GK26

Kvarner littoral: Schuler (1902):216 as *Parmelia exasperata*; Christensen and Hansen (1994):109 as *Parmelia exasperata*

*Melaspilea urceolata* (Fr.) Almb.

Kvarner littoral: Schuler (1902):207 as *Melaspilea arthonioides*

*Menegazzia terebrata* (Hoffm.) A.Massal.

Gorski kotar: Schuler (1902):218 as *Parmelia pertusa*; Ozimec et al. (2010):24

*Micarea lignaria* (Ach.) Hedl.

Gorski kotar: Hazslinszky (1884):175 as *Bilimbia milliaria*; Schuler (1902):148 as *Bilimbia lignaria*.

*Micarea prasina* Fr.

Gorski kotar: Schuler (1902):164 as *Catillaria prasina*

Kvarner littoral: Schuler (1902):164 as *Catillaria prasina*

*Moelleropsis nebulosa* (Hoffm.) Gyeln.

Kvarner littoral: Schuler (1902):212 as *Pannaria nebulosa*

*Mycobilimbia berengeriana* (A.Massal.) Hafellner & V.Wirth

Gorski kotar: Kušan (1933):110 as *Lecidea berengeriana*

*Mycobilimbia hypnorum* (Lib.) Kalb & Hafellner

Gorski kotar: Schuler (1902):195 as *Lecidea fusca*

Kvarner littoral: Schuler (1902):195 as *Lecidea fusca*

*Mycobilimbia pilularis* (Körb.) Hafellner & Türk

Kvarner littoral: Schuler (1902):164 as *Catillaria sphaeroides*.

\*HR; \*GK *Mycobilimbia sanguineoatra* auct.

Gorski kotar: GK27

*Mycobilimbia tetramera* (De Not) Hafellner & Türk

Gorski kotar: Schuler (1902):148 as *Bilimbia obscurata*

\*GK *Mycoblastus sanguinarius* (L.) Norman

Gorski kotar: GK22

*Nephroma laevigatum* Ach.

Gorski kotar: Schuler (1902):208 as *Nephromium lusitanicum*; Kušan (1933):109 as *Nephroma lusitanicum*; GK5; GK29

Kvarner littoral: Schuler (1902):208 as *Nephromium lusitanicum*

*Nephroma parile* (Ach.) Ach.

Gorski kotar: Schuler (1902):208 as *Nephromium laevigatum* var. *parile*; Ozimec et al. (2010):24; GK13; GK17; GK27

Kvarner littoral: Schuler (1902):208 as *Nephromium laevigatum* var. *parile*

*Nephroma resupinatum* (L.) Ach.

Gorski kotar: Hazslinszky (1884):54 as *Nephroma tomentosum*; Schuler (1902):209 as *Nephromium resupinatum*; Kušan (1933): 110; GK17; GK23; GK29; GK30

*Normandina pulchella* (Borrer) Nyl.

Gorski kotar: Hazslinszky (1884):79; Schuler (1902):209; Ozimec et al. (2010):24; GK8; GK17; GK29

Kvarner littoral: Schuler (1902):209; Zahlbruckner (1911):239; KL7

\*GK *Ochrolechia androgyna* (Hoffm.) Arnold

Gorski kotar: Ozimec et al. (2010):24; GK10; GK17; GK27

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

Gorski kotar: GK17

*Opegrapha atra* Pers.

Gorski kotar: Hazslinszky (1884):222; Szatala (1929):843; Christensen (1987):163

Kvarner littoral: Matković (1879):41; Schuler (1902):209; Zahlbruckner (1907):109.

*Opegrapha rufescens* Pers.

Kvarner littoral: Schuler (1902):210

*Opegrapha varia* Pers.

Kvarner littoral: Schuler (1902):210

*Opegrapha viridis* (Ach.) Behlen & Desberger

Gorski kotar: Schuler (1902):210

*Pannaria conoplea* (Ach.) Bory

Gorski kotar: Schuler (1902):211 as *Pannaria coeruleobadia*; Ozimec et al. (2010):24; GK8

Kvarner littoral: Schuler (1902):211 as *Pannaria coeruleobadia*

*Pannaria rubiginosa* (Ach.) Bory

Kvarner littoral: Schuler (1902):213

*Parmelia saxatilis* (L.) Ach.

Gorski kotar: Matković (1879):38 as *Imbricaria saxatilis*; Schuler (1902):219; Ozimec et al. (2010):24; GK1; GK5; GK6; GK9; GK10; GK11; GK12; GK14; GK16; GK20; GK22; GK26; GK27, GK29

Kvarner littoral: Matković (1879):38 as *Imbri-*



*caria saxatilis*; Schuler (1902); Alebić-Juretić and Arko-Pijevac (1989):30; Christensen and Hansen (1994):109; KL5

*Parmelia submontana* Hale

Gorski kotar: Ozimec et al. (2010):24; GK15; GK22; GK26

*Parmelia sulcata* Taylor

Gorski kotar: Ozimec et al. (2010):24; GK1; GK2; GK4; GK6; GK7; GK8; GK11; GK14; GK16; GK17; GK20; GK22; GK27; GK29

Kvarner littoral: Hazzslinszky (1884):63 as *Imbricaria saxatilis* a) *leucochroa*; Christensen and Hansen (1994):109; KL2; KL3; KL

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

Gorski kotar: Hazzslinszky (1884):83 as *Pannaria triptophylla*; Schuler (1902):214 as *Pannaria corallinoides*; GK8

Kvarner littoral: Schuler (1902):214 as *Pannaria corallinoides*

\*KL *Parmelina pastillifera* (Harm.) Hale

Gorski kotar: Ozimec et al. (2010):25; GK13; GK16; GK22

Kvarner littoral: KL2; KL6

*Parmelina quercina* (Willd.) Hale

Kvarner littoral: Christensen and Hansen (1994):109 as *Parmelia quercina*; KL4

*Parmelina tiliacea* (Hoffm.) Hale

Gorski kotar: Schuler (1902):219 as *Parmelia tiliacea*; GK1; GK2; GK8; GK13; GK14

Kvarner littoral: Hazzslinszky (1884):62 as *Imbricaria tiliacea* c) *quercifolia*; Schuler (1902):219 as *Parmelia tiliacea*; Alebić-Juretić and Arko-Pijevac (1989):27; KL3; KL4; KL5

*Parmeliopsis ambigua* (Wulfen) Nyl.

Gorski kotar: Matković (1879):38 as *Imbricaria diffusa*; Schuler (1902):215 as *Parmelia diffusa*; Ozimec et al. (2010):25

*Parmotrema perforatum* (Jacq.) A.Massal.

Gorski kotar: Schuler (1902):218 as *Parmelia perforata*

Kvarner littoral: Schuler (1902):218 as *Parmelia perforata*

*Parmotrema perlatum* (Huds.) M. Choisy

Gorski kotar: Matković (1879):38 as *Imbricaria perlata*; Hazzslinszky (1884); Ozimec et al. (2010):25; GK11; GK16; GK17; GK18; GK26; GK27

Kvarner littoral: Matković (1879):38 as *Imbricaria perlata*; Alebić-Juretić and Arko-Pijevac (1989):30; Christensen and Hansen (1994):109 as *Parmelia coniocarpa*; KL5; KL7

*Peltigera aphthosa* (L.) Willd.

Gorski kotar: Schuler (1902):220 as *Peltidea aphthosa*

Kvarner littoral: Matković (1879):38

*Peltigera canina* (L.) Willd.

Gorski kotar: Hazzslinszky (1884):56; Schuler (1902):220

Kvarner littoral: Matković (1879):38; Schuler (1902):220

*Peltigera collina* (Ach.) Schrad.

Gorski kotar: Hazzslinszky (1884):56 as *Peltigera propagulifera*; Schuler (1902):221 as *Peltigera scutata*; Kušan (1933):110 as *Peltigera scutata*; Ozimec et al. (2010):25; GK4; GK8; GK18; GK20; GK22; GK23; GK29.

*Peltigera horizontalis* (Hudson) Baumg.

Gorski kotar: Hazzslinszky (1884):57; Schuler (1902):220; Kušan (1933):110; Ozimec et al. (2010):25; GK3; GK5; GK19; GK27

Kvarner littoral: Matković (1879):38; Schuler (1902):220

\*GK *Peltigera leucophlebia* (Nyl.) Gyeln.

Gorski kotar: GK21; GK32; GK33

\*GK *Peltigera neckeri* Müll.Arg

Gorski kotar: GK7

*Peltigera polydactyla* (Neck.) Hoffm.

Gorski kotar: Ozimec et al. (2010):25

Kvarner littoral: Schuler (1902):221

*Peltigera praetextata* (Sommerf.) Zopf

Gorski kotar: Kušan (1933); Ozimec et al. (2010):25; GK1; GK3; GK5; GK8; GK12; GK17; GK19; GK20; GK22; GK27; GK29.

*Peltigera rufescens* (Weiss) Humb.

Gorski kotar: Schuler (1902):221; Kušan (1933):110; GK34

Kvarner littoral: Hazszlinszky (1884):56; Schuler (1902):221; Christensen and Hansen (1994):109; KL3

*Pertusaria albescens* (Hudson) M.Choisy & Werner

Gorski kotar: Schuler (1902):222 as *Pertusaria globulifera*; Kušan (1933):112 as *Pertusaria globulifera*; Ozimec et al. (2010):25; GK5; GK6; GK10; GK14; GK16; GK17; GK18; GK19; GK26

Kvarner littoral: KL5

*Pertusaria amara* (Ach.) Nyl.

Gorski kotar: Schuler (1902); Kušan (1933):112 as *Pertusaria amara* f. *isidiata*; Ozimec et al. (2010):25; GK7; GK8; GK10; GK11; GK16; GK17; GK18; GK19; GK20; GK22

Kvarner littoral: Schuler (1902):221

\*GK *Pertusaria coccodes* (Ach.) Nyl.

Gorski kotar: GK8

\*GK *Pertusaria flavida* (DC.) J.R.Laundon

Gorski kotar: GK26

*Pertusaria hemisphaerica* (Flörke) Erichsen

Gorski kotar: Ozimec et al. (2010):25; GK5; GK17

*Pertusaria hymenea* (Ach.) Schaer.

Gorski kotar: Schuler (1902):224 as *Pertusaria wulfenii*

Kvarner littoral: Schuler (1902):224 as *Pertusaria wulfenii*

*Pertusaria leioplaca* DC.

Gorski kotar: Schuler (1902):224; GK12; GK14

Kvarner littoral: Schuler (1902):224

*Pertusaria pertusa* (Weigel) Tuck.

Gorski kotar: Matković (1879):42 as *Pertusaria communis*; Hazszlinszky (1884):248 as *Pertusaria communis*; Schuler (1902):222 as *Pertusaria communis*; Ozimec et al. (2010):25; GK4; GK6; GK7; GK10; GK12; GK13; GK14; GK16; GK17; GK18; GK19; GK26; GK27

Kvarner littoral: Schuler (1902):222 as *Pertusaria communis*; KL2

\*HR; \*GK *Pertusaria pupillaris* (Nyl.) Th. Fr.

Gorski kotar: GK14

*Pertusaria pustulata* (Ach.) Duby

Kvarner littoral: Schuler (1902):224

*Pertusaria trachythallina* Erichsen

Kvarner littoral: Schuler (1902):223 as *Pertusaria laevigata*

*Phaeographis dendritica* (Ach.) Müll.Arg.

Kvarner littoral: Matković (1879):41

*Phaeophyscia hirsuta* (Mereschk.) Essl.

Kvarner littoral: Christensen and Hansen (1994):109

*Phaeophyscia insignis* (Mereschk.) Moberg

Kvarner littoral: Christensen and Hansen (1994):109

*Phaeophyscia orbicularis* (Neck.) Moberg

Kvarner littoral: Schuler (1902):228 as *Physcia obscura*

*Phlyctis agelaea* (Ach.) Flot.

Kvarner littoral: Schuler (1902):225

\*KL *Phlyctis argena* (Spreng.) Flot.

Gorski kotar: Christensen (1987):163; Ozimec et al. (2010):25; GK4; GK8; GK10; GK11; GK13; GK14; GK17; GK18; GK19; GK22; GK27; GK29

Kvarner littoral: KL2

\*GK *Physcia adscendens* H.Olivier

Gorski kotar: GK2

Kvarner littoral: Christensen and Hansen (1994):110; KL2; KL5

*Physcia aipolia* (Humb.) Fürnrh.

Gorski kotar: Schuler (1902):226; Ozimec et al. (2010):25; GK6

Kvarner littoral: Schuler (1902):226; Zahlbruckner (1913):274; Christensen and Hansen (1994):110; KL2

*Physcia clementei* (Turner) Maas Geest.

Kvarner littoral: Schuler (1902):227 as *Physcia astroidea*

\*GK *Physcia dubia* (Hoffm.) Lettau

Gorski kotar: GK14

*Physcia leptalea* (Ach.) DC.

Kvarner littoral: Schuler (1902):230 as *Physcia stellaris* var. *leptalea*

*Physcia stellaris* (L.) Nyl.

Gorski kotar: Schuler (1902):229; GK8

Kvarner littoral: Matković (1879):38 as *Parmelia stellaris*; Schuler (1902):229; Christensen and Hansen (1994):110

*Physcia tenella* (Scop.) DC.

Kvarner littoral: Schuler (1902):230

*Physconia distorta* (With.) J.R.Laundon

Gorski kotar: Schuler (1902):229 as *Physcia pulverulenta*; Ozimec et al. (2010):25; GK1; GK19; GK22

Kvarner littoral: Matković (1879):39 as *Parmelia pulverulenta*; Schuler (1902):229 as *Physcia pulverulenta*; Christensen and Hansen (1994):110; KL3; KL7

\*GK *Physconia venusta* (Ach.) Poelt

Gorski kotar: GK1; GK27

Kvarner littoral: Schuler (1902) as *Physcia pulverulenta* var. *venusta*

*Placynthiella icmalea* (Ach.) Coppins & P.James

Gorski kotar: Ozimec (2000):136

*Platismatia glauca* (L.) W.L.Culb. & C.F.Culb.

Gorski kotar: Schuler (1902):165 as *Cetraria glauca*; Kušan (1933):114 as *Cetraria glauca*; Ozimec et al. (2010):25; GK4; GK6; GK9; GK10; GK12; GK18; GK20; GK22; GK27

*Pleurosticta acetabulum* (Neck.) Elix & Lumbsch

Gorski kotar: Hazslinszky (1884):65 as *Imbricaria acetabulum*; Schuler (1902):214 as *Parmelia acetabulum*; Ozimec et al. (2010):25; GK1; GK16

Kvarner littoral: Schuler (1902):214 as *Parmelia acetabulum*; Christensen and Hansen (1994):108 as *Parmelia acetabulum*; KL2; KL6

*Polyblastia sendtneri* Kremp.

Gorski kotar: Schuler (1902):231.

*Polyblastiopsis meridionalis* Zahlbr.

Kvarner littoral: Zahlbruckner (1909a): 223.

*Porina aenea* (Wallr.) Zahlbr.

Kvarner littoral: Schuler (1902):237 as *Sagedia carpinea*; Zahlbruckner (1923):39 as *Porina carpinea*

*Protopannaria pezizoides* (Weber) P.M.Jørg & S.Ekman

Gorski kotar: Schuler (1902):212 as *Pannaria pezizoides*; Kušan (1933):109 as *Pannaria pesisoides*

Kvarner littoral: Matković (1879):39 as *Pannaria brunnea*

*Psora decipiens* (Hedw.) Hoffm.

Kvarner littoral: Schuler (1902):203 as *Lecidea decipiens*

*Pseudevernia furfuracea* (L.) Zopf

Gorski kotar: Schuler (1902); Kušan (1933):114 as *Parmelia furfuracea*; Ozimec et al. (2010):26; GK1; GK2; GK3; GK5; GK6; GK8; GK9; GK10; GK11; GK12; GK13; GK17; GK20; GK21; GK22; GK25; GK26; GK27, GK29

Kvarner littoral: Schuler (1902); KL4; KL6; KL8

*Punctelia subrudecta* (Nyl.) Krog

Gorski kotar: Ozimec et al. (2010):26

Kvarner littoral: Schuler (1902):215 as *Parmelia dubia*; Christensen and Hansen (1994):109 as *Parmelia subrudecta*; KL1; KL3; KL4; KL9

*Pyrenula laevigata* (Pers.) Arnold

Kvarner littoral: Schuler (1902):232

*Pyrenula nitida* (Weigel) Ach.

Gorski kotar: Schuler (1902):232; Szatala (1927); Ozimec et al. (2010):26; GK16

Kvarner littoral: Schuler (1902):232

*Ramalina calicaris* (L.) Fr. var. *calicaris*  
Gorski kotar: Schuler (1902):232

*Ramalina farinacea* (L.) Ach.  
Gorski kotar: Schuler (1902):233; Ozimec et al. (2010):26; GK5; GK6; GK7; GK8; GK16; GK17; GK22  
Kvarner littoral: Schuler (1902):233; KL4

*Ramalina fastigiata* (Pers.) Ach.  
Gorski kotar: Schuler (1902):233; Ozimec et al. (2010):26; GK1; GK2; GK6; GK16; GK17; GK19; GK33  
Kvarner littoral: Schuler (1902):233

*Ramalina fraxinea* (L.) Ach.  
Gorski kotar: Schuler (1902):233; Ozimec et al. (2010):26; GK6; GK16; GK22; GK33  
Kvarner littoral: Schuler (1902):233

*Ramalina thrausta* (Ach.) Nyl.  
Gorski kotar: Schuler (1902):234  
*Rinodina colobina* (Ach.) Th.Fr.  
Kvarner littoral: Schuler (1902):235

*Rinodina dalmatica* Zahlbr.  
Kvarner littoral: Schuler (1902):236

*Rinodina exigua* (Ach.) Gray  
Kvarner littoral: Schuler (1902):236; Christensen and Hansen (1994):110

*Rinodina plana* H. Magn.  
Kvarner littoral: Zahlbruckner (1909a):230 as *Rinodina metabolica*; Magnusson (1947): 298; Ropin and Mayrhofer (1993):812

*Rinodina pyrina* (Ach.) Arnold  
Kvarner littoral: Christensen and Hansen (1994):111

*Rinodina sophodes* (Ach.) A.Massal.  
Gorski kotar: Schuler (1902):237.  
Kvarner littoral: Matković (1879):39; Schuler (1902):237; Zahlbruckner (1915):478.

*Scolicosporum umbrinum* (Ach.) Arnold  
Gorski kotar: Schuler (1902):146 as *Bacidia umbrina* var. *compacta*

*Solorina saccata* (L.) Ach.  
Gorski kotar: Schuler (1902):239; Kušan (1933):109; GK28; GK32; GK33  
Kvarner littoral: Schuler (1902):239

*Sphaerophorus globosus* (Huds.) Vain.  
Gorski kotar: Schuler (1902):239 as *Sphaerophorus coralloides*; Szatala (1927):434; Kušan (1933):107; GK22; GK33

*Squamarina cartilaginea* (With.) P.James  
Gorski kotar: Kušan (1933):113 as *Lecanora crassa*; Ozimec et al. (2010):26  
*Strigula stigmatella* (Ach.) R.C.Harris  
Gorski kotar: Schuler (1902):237 as *Strigula faginea*  
Kvarner littoral: Schuler (1902):237 as *Strigula faginea*

*Teloschistes chrysophthalmus* (L.) Th.Fr.  
Kvarner littoral: Schuler (1902):241

*Thelenella muscorum* (Fr.) Vain.  
Gorski kotar: Schuler (1902):207 as *Microglæna muscicola*  
Kvarner littoral: Schuler (1902):207 as *Microglæna muscicola*

*Thelotrema lepadinum* (Ach.) Ach.  
Gorski kotar: Hazslinszky (1884):137; Schuler (1902):242; Ozimec et al. (2010):26; GK4; GK5; GK11; GK12; GK22

*Toninia sedifolia* (Scop.) Timdal  
Gorski kotar: Kušan (1933):111 as *Toninia caeruleonigricans*; Ozimec et al. (2010):26  
Kvarner littoral: Schuler (1902):243 as *Toninia caeruleonigricans*

*Usnea diplotypus* Vain.  
Gorski kotar: Ozimec (2000):136

*Usnea filipendula* Stirt.  
Gorski kotar: Matković (1879):37; Ozimec et al. (2010):26; GK6; GK8; GK25  
*Usnea florida* (L.) F.H.Wigg.  
Gorski kotar: Schuler (1902):245 as *Usnea barbata*

*Usnea hirta* (L.) Weber ex F. H. Wigg.

Kvarner littoral: Schuler (1902):245 as *Usnea barbata* var. *hirta*

\*HR; \*GK *Usnea intermedia* (A.Massal.) Jatta  
Gorski kotar: GK3; GK22

*Usnea rubicunda* Stirt.

Kvarner littoral: Motyka (1936-1938):343

*Usnea subfloridana* Stirt.

Gorski kotar: Ozimec (2000):136; GK6

*Xanthoria candelaria* (L.) Th.Fr.

Kvarner littoral: Schuler (1902):249 as *Xanthoria lichnea*

*Xanthoria parietina* (L.) Th.Fr.

Gorski kotar: Schuler (1902):249; Ozimec et al. (2010):26; GK1; GK2; GK6; GK22

Kvarner littoral: Matković (1879):39 as *Physcia parietina*; Schuler (1902):249; Christensen and Hansen (1994):111; KL2; KL4

*Xylographa parallela* (Ach.) Behlen & Desberger

Gorski kotar: Schuler (1902):250; Szatala (1929):842

### Analysis of the flora

According to literature, collection records at herbaria and field survey results, the currently known epiphytic and terricolous lichen mycota of Gorski kotar and Kvarner littoral comprises 264 taxa (260 lichenized fungi and 4 non-lichenized fungi traditionally included in the lichenological literature), classified into 110 genera.

The lichen mycota of Gorski kotar consists of 184 taxa, and of Kvarner littoral contains 170 taxa.

The most diverse genera are: *Cladonia* (20 taxa); *Caloplaca* and *Lecanora* (12 taxa each); *Pertusaria* (11); *Collema* (10); *Peltigera* (9); *Physcia* and *Usnea* (7 taxa each); *Rinodina* (6); and *Bacidia*, *Mycobilimbia* and *Ramalina* (5 taxa each).

Nine species: *Bryoria implexa*, *Calicium glaucellum*, *Fellhanera bouteillei*, *Lepraria eburnea*, *Lepraria rigidula*, *Lobaria virens*, *Mycobilimbia sanguineoatra*, *Pertusaria pupillarlis* and *Usnea intermedia*, are new to Croatia.

Twenty-four species: *Aplotomma turgida*, *Arthonia spadicea*, *Baeomyces rufus*, *Bryoria implexa*, *Calicium glaucellum*, *Candelaria concolor*, *Fellhanera bouteillei*, *Fuscopannaria*

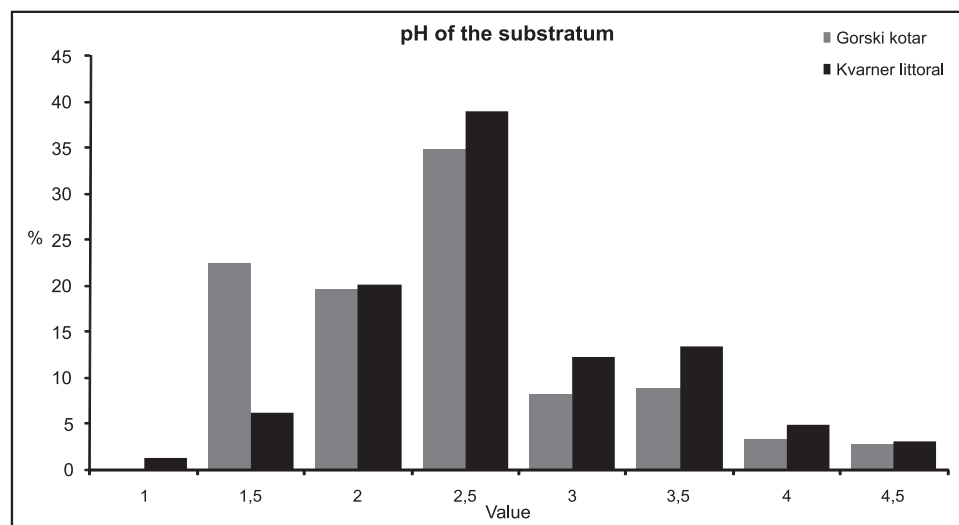


Figure 2: Distribution of indicator values for substrate reaction.

Slika 2: Razširjenost indikatorskih vrednosti glede na reakcijo substrata.

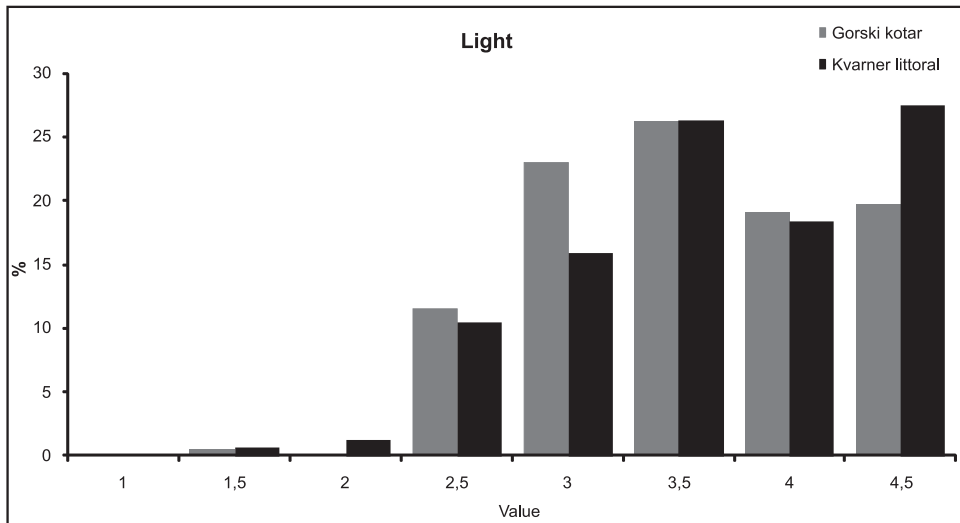


Figure 3: Distribution of indicator values for the lichens for light.

Slika 3: Razširjenost indikatorskih vrednosti za lišaje glede na potrebe po svetlobi.

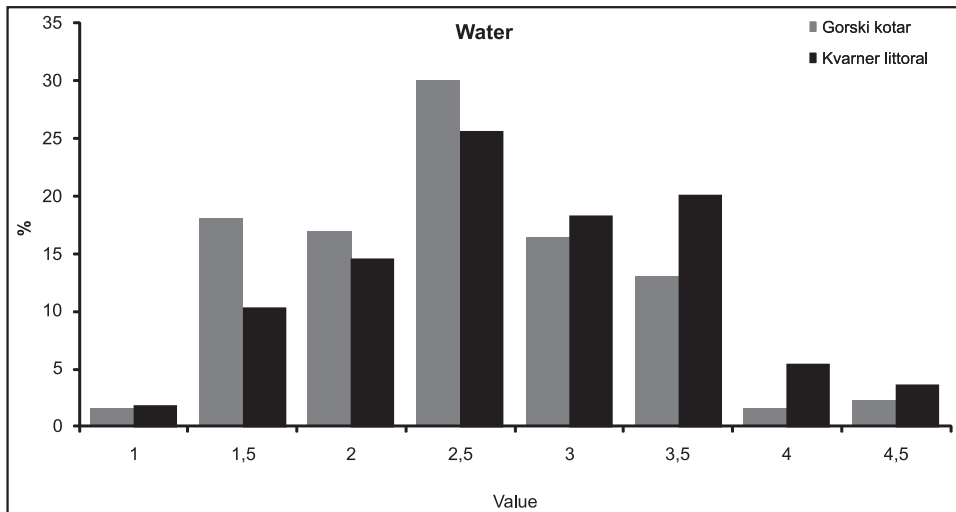


Figure 4: Distribution of indicator values for the lichens for moisture.

Slika 4: Razširjenost indikatorskih vrednosti za lišaje glede na vlažnostne razmere.

*ignobilis*, *Lepraria eburnea*, *Lepraria rigidula*, *Lobaria virens*, *Mycobilimbia sanugineoatra*, *Mycoblastus sanguinarius*, *Ochrolechia androgyna*, *Ochrolechia turneri*, *Peltigera leucophaebla*, *Peltigera neckeri*, *Pertusaria coccodes*, *Pertusaria flavida*, *Pertusaria pupillaris*, *Physcia*

*adescendens*, *Physcia dubia*, *Physconia venusta* and *Usnea intermedia*, are new to Gorski kotar, while three species: *Cladonia squamosa*, *Parmelina pastillifera* and *Phylctis argena* are new to Kvarner littoral.



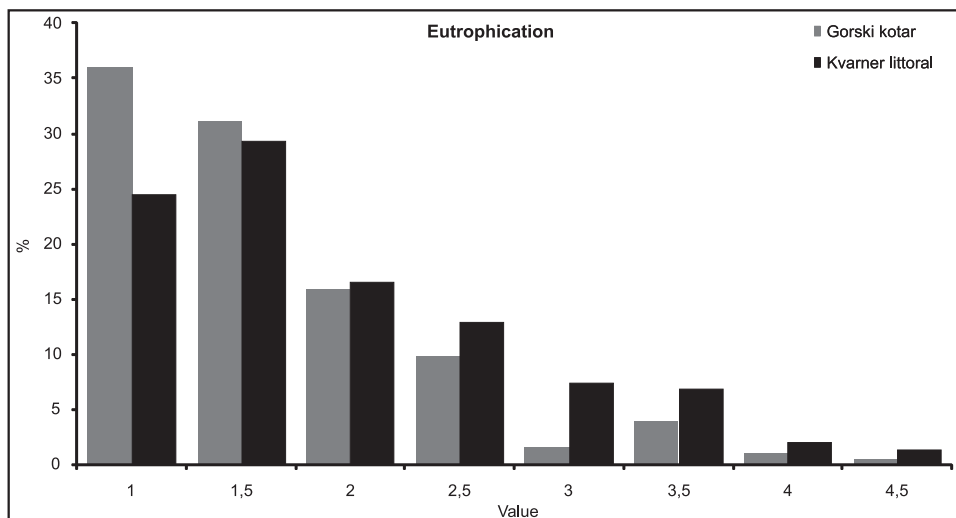


Figure 5: Distribution of indicator values for eutrophication.

Slika 5: Razširjenost indikatorskih vrednosti glede na trofične razmere.

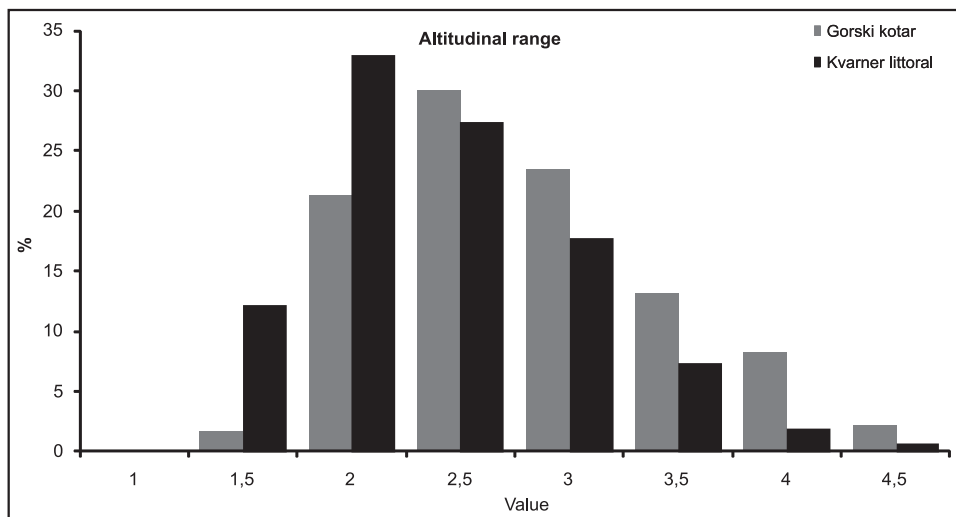


Figure 6: Distribution of indicator values for the lichens for altitudinal range.

Slika 6: Razširjenost indikatorskih vrednosti za lišaje glede na nadmorsko višino.

### Ecological analyses

Distribution of mean indicator values of the environmental factors for the lichens recorded in Gorski kotar and Kvarner littoral is presented in Figs 2–6.

Mean indicator values of the lichen flora of Gorski kotar and Kvarner littoral (Tab. 1) were compared to those reported for selected areas in Dinaric floristic region of Slovenia: Snežnik, Goteniški Snežnik, Krokar, Trnovski gozd (Prügger 2005), and in the Alpine floristic area of Slovenia:

Table 3: Mean indicator values of the lichen flora of Gorski kotar, Kvarner littoral and areas in Slovenia.  
 Tabela 3: Srednje indikatorske vrednosti lišajске flore Gorskega kotarja, Kvarnerja in območij v Sloveniji.

Region	Substrate reaction – R	Light L	Moisture F	Eutrophication N	Altitudinal range – A
Gorski kotar	2,37	3,49	2,45	1,62	2,75
Kvarner littoral	2,60	3,59	2,69	1,88	2,37
Slovenia – Dinaric area	2,45	3,47	2,45	1,90	2,58
Slovenia – Alpine area	2,24	3,66	2,60	1,95	2,65

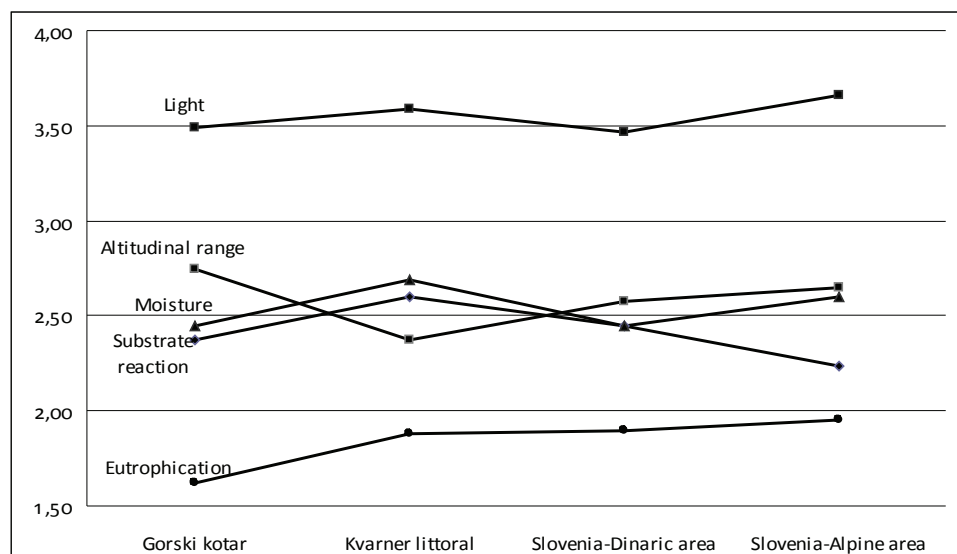


Figure 7: Comparison of mean indicator values of lichen flora of Gorski kotar and Kvarner littoral with regions in Slovenia.

Slika 7: Primerjava indikatorskih vrednosti lišajске flore Gorskega kotarja in Kvarnerja z območji v Sloveniji.

Pohorje (Mayrhofer et al. 1996, 1998), and Uršlja gora (Suppan and Mayrhofer 2002). Comparison is shown in Fig. 7.

to oceanic and suboceanic elements, which makes 26.5% of total lichen flora.

### Phytogeographical analyses

Relief variety and climate with abundant rainfalls, high air humidity and frequent fog and dew, enables the occurrence of lichens classified into oceanic and suboceanic elements (Schauer 1965). Numbers of such species are: 46 or 25.0% of total recorded for the lichen flora of Gorski kotar and 42 (24.7%) for Kvarner littoral. Taking into account both areas, there are 70 species belonging

### Discussion

The epiphytic and terricolous lichen flora of Gorski kotar and Kvarner littoral was compared to the lichenologically better investigated areas in Dinaric part of neighbouring Slovenia, as well as with areas in NE Italy. The number of 184 taxa reported for Gorski kotar is lower, compared to total of 330 taxa (excluding saxicolous) recorded for Snežnik and Javorniki area in southern Slov-

enia (Prügger 2005). For Goteniški Snežnik and Krokara area, total of 134 and 141 taxa, respectively, were reported by Grube et al. (1998). In Trnovski gozd, situated near the Italian-Slovenian border, Prügger et al. (2000) reported 203 taxa. Number of 170 lichen taxa recorded up today for Kvarner littoral is higher, compared to similar regions in Italy, situated in the vicinity of the Adriatic Sea. In NE Italy, 60 epiphytic lichen species were reported for the Province of Gorizia (Badin and Nimis 1996), 121 species from the Province of Trieste (Nimis 1982), and 80 species from the Veneto Region (Nimis et al. 1991).

Analyses of indicator values for substrate reaction (Fig. 2) shows that acidophilic lichens are more present in Gorski kotar than in Kvarner littoral, because the environmental conditions in Gorski kotar favorize growth of acid bark conifers, such as fir, spruce and pine. Lichens of weak acid to subneutral reaction dominates in both area, which is related to bark characteristics of deciduous trees as the most frequent phorophytes. Higher incidence of basophilous lichens in Kvarner littoral is result of bark pH modification due to effect of impregnation of trees with calcareous dust, as well as influence of dispersal of salt particles and ammonia by wind near the sea.

Analyses of indicator values for light (Fig. 3) shows negligible presence of lichens living in shade. The most of lichens in both areas lives on sites which are well exposed to light. Incidence of lichens requiring diffuse light is higher in Gorski kotar, where such light conditions are specific for the closed beech forests. Heliophytic lichens are largely present in Kvarner littoral, where low thermophilous forests, thickets and open landscapes dominates.

Analyses of indicator values for humidity (Fig. 4) shows a higher presence of hygrophytic and moderately hygrophytic lichens in Gorski kotar. This indicates climate specificities of the area, with high air humidity (> 80%), abundant rainfalls and frequent fogs. The lichens indicating dryness are more present in the subalpine and alpine belt, where higher solar irradiation, strong wind and frost during the winter cause rapid desiccation of thalli surface. The climate in Kvarner littoral is subhumid and warm, with pronounced dry period and low relative air humidity (60-70%), so the mesophytic and xerophytic lichens prevails in the area.

Analyses of indicator values for eutrophication (Fig. 5) shows dominance of lichens indicating absence or very weak eutrophication in both areas. Due to specificity in relief and climate, like short vegetational period, Gorski kotar is a region not suitable for intensive agricultural production, and human population density is low. Areas of Gorski kotar at 1,100-1,500 m altitude can be considered as least impacted by anthropogenic eutrophication. Higher percentage of lichens indicating weak to middle eutrophication in Kvarner littoral is a consequence of continuous anthropogenic impact, especially from the middle of 19th century up to present days. Characteristics of this impact are increased urbanisation, mainly in tourism, and industrialisation. Significant sources of eutrophication are emissions into air from road and marine transport, and industrial facilities, as well as long-range transboundary air pollution.

Analyses of indicator values for altitudinal range (Fig. 6), shows low presence of eumediterranean belt, and dominance of submediterranean belt in Kvarner littoral.

This corresponds to phytogeographical position of the area. The most of the coastal and insular area of Kvarner belongs to submediterranean vegetational zone, while the Eumediterranean vegetational zone is at boundary of its distribution (Vukelić et al. 2008). Lichens indicating montane and oroboreal vegetational belt prevails in Gorski kotar. Number of lichens decline in subalpine and alpine belt due to harsh weather conditions and lack of suitable phorophytes for epiphytic lichens, so terricolous and muscicolous are the most frequent (Prügger 2005).

In relation to substrate reaction, mean indicator value for the lichen flora of Gorski kotar is almost equal to that for Dinaric area in Slovenia, mainly due to similarities in relief, climate and phytogeographical position. Alpine area in Slovenia has lower value due to difference in forest cover and dominance of spruce, characterized with acid bark. The mean value for Kvarner littoral is higher than for areas in Slovenia (Tab 3). Mean values for light are almost equal for Gorski kotar and Dinaric area in Slovenia, while the values are higher in Kvarner littoral and Alpine area in Slovenia (Fig. 7). Both areas in Slovenia and Gorski kotar are moderately hygrophytic, while Kvarner littoral is dryer. Comparison of mean indicator values for

eutrophication shows that all of the areas are characterized by weak eutrophication. Kvarner littoral has the lowest mean value for altitudinal range, which corresponds to thermophillic submediterranean vegetation belt. Gorski kotar and Dinaric and Alpine areas in Slovenia have mean values indicating montane and subalpine belts, whose climazonal forest vegetation prevails.

High incidences of oceanic and suboceanic elements in the lichen flora of Gorski kotar and Kvarner littoral (70 species or 26.5%), shows significant similarity with the lichen flora of the Italian regions along the Tyrrhenian Sea. Nimis and Tretiach (1999) reported following values: 21.2% for Campania, 25.2% for Calabria, 27.1% for Tuscany and 27.5% for Lazio. Compared to Tyrrhenian coast and the eastern (Croatian) Adriatic coast, oceanic and suboceanic elements are significantly less frequent in the lichen flora of the western (Italian) Adriatic coast, with percentage of 11.1% in Molise, 14.0 % in Veneto, 15.2% in Emilia-Romagna and Marche and 16.6% in Venezia Giulia. Impact of orography on amount and precipitation pattern in the Adriatic Sea area is significant. The eastern Adriatic coast is characterized by the proximity of the coastal Dinaric Mountains, enabling humid climate with annual precipitation from 1,000 mm to above 3,000 mm. The western Adriatic coast has less broken relief and its inland is covered by lowlands. The climate is more drier with annual precipitation of 600–900 mm. Thus, the occurrence of oceanic and suboceanic

lichens is reliable indicator of the climate humidity, as reported by Loppi et al. (1999).

## Conclusions

1. A total of 264 taxa of epiphytic and terricolous lichen mycota were recorded for Gorski kotar and Kvarner littoral (western Croatia). The lichen mycota of Gorski kotar consists of 184 taxa, and of Kvarner littoral contains 170 taxa.
2. Nine species: *Bryoria implexa*, *Calicium glaucellum*, *Fellhanera bouteillei*, *Lepraria eburnea*, *Lepraria rigidula*, *Lobaria virens*, *Mycobilimbia sanguineoatra*, *Pertusaria pupillaris* and *Usnea intermedia*, are new to the lichen flora of Croatia.
3. Relief of the Karst Dinarides and climate characteristics along the eastern Adriatic coast enables high incidence (70 species or 26.5%) of oceanic and suboceanic elements in the lichen flora of Gorski kotar and Kvarner littoral.

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