Vondrák J. (2008): **The lichen genus *Caloplaca* (*Teloschistales*) and its lichenicolous fungi: contributions to their taxonomy, nomenclature and biodiversity**. PhD Thesis - 133 p., University of South Bohemia, Faculty of Science, České Budějovice, Czech Republic.

Annotation: Papers and manuscripts included in this PhD thesis should represent a starting point for author's future investigations in taxonomy, nomenclature and biodiversity of the lichen genus *Caloplaca* (*Teloschistales*) and its lichenicolous fungi. The crucial part of this work is entitled "**The taxonomy of the *Caloplaca citrina* group (*Teloschistaceae*) in the Black Sea region; with contributions to the cryptic species problems in lichenology"**. Nine other papers are included.

Prohlašuji, že svoji disertační práci jsem vypracoval samostatně pouze s použitím pramenů uvedených v seznamech citované literatury.

Prohlašuji, že v souladu s § 47b zákona č. 111/1998 Sb. v platném znění souhlasím se zveřejněním své disertační práce, a to v úpravě vzniklé vypuštěním vyznačených částí archivovaných Přírodovědeckou fakultou elektronickou cestou ve veřejně přístupné části databáze STAG provozované Jihočeskou univerzitou v Českých Budějovicích na jejích internetových stránkách.

V Českých Budějovicích, 26. dubna 2008

Jan Vondrák

CONTENTS

INTRODUCTION

During recent years, our Lichenlogical Research Group (see web site: http://botanika.bf.jcu.cz/lichenology) has collected data on the genus *Caloplaca*, which has resulted in several published papers organized here in five chapter titles: 1 Taxonomy (principal part), 2 Nomenclature, 3 Biodiversity, 4 Lichenicolous fungi on *Caloplaca*, and 5 Exsiccates.

Taxonomy at the species level to determine their boundaries or to recognize between phenotypic and genotypic variability is the most crucial part of this work, resulting a thesis entitled: **The taxonomy of the *Caloplaca citrina* group (*Teloschistaceae*) in the Black Sea region; with contributions to the cryptic species problems in lichenology**. This is a complex study reflecting the author's approach to the taxonomic investigation of a critical group. In the *C. citrina* group, we revealed a significant cryptic biodiversity, the number of its species in the Black Sea region being considerably higher expected and five species being described as new for the region.

The nomenclature of species names within the genus *Caloplaca* is still far from being clear, with many former names forgotten or incorrectly used. Thus we need to study old names and supporting type material to avoid establishing new names for species already described.

Biodiversity of *Caloplaca* is an open topic since many regions, even in Europe, are poorly surveyed, as illustrated here by two papers providing new data for Bulgaria and the Czech Republic.

As a species-rich genus, *Caloplaca* harbours many different lichenicolous fungi. Although such fungi have been intensively studied in recent years, knowledge on them on *Caloplaca* is still limited. One paper included here deals with lichenicolous *Opegrapha* species on *Caloplaca*.

The last chapter of this thesis pays attention to selected exsiccates which have been produced to make sets of *Caloplaca* samples accessible worldwide for comparative purposes. Isotype material of some newly described species is being distributed within these exsiccates.

It is hoped that the papers and manuscripts included in this PhD thesis represent a starting point for future investigations. It is intended to continue with all the aspects presented here in co-operation with Czech and foreign lichenologists, namely Jaroslav Šoun (České Budějovice, CZ), Pavel Hrouzek (Třeboň, CZ), Pavel Říha (České Budějovice, CZ), Ulrik Søchting (Copenhagen, DK), Ulf Arup (Lund, S) and Sasha Khodosovtsev (Kherson, UA).

ACKNOWLEDGEMENTS

Without the unfailing support of my colleagues, friends and family, I would have found it difficult to complete this thesis. I therefore wish to record my most grateful thanks to Ulrik Søchting, Ulf Arup, Mark Seaward, Jaroslav Šoun, Pavel Říha, Pavel Hrouzek, Jiří Kubásek, Sasha Khodosovtsev, Jana Kocourková, Zdeněk Palice, Harrie Sipman, Helmut Mayrhofer, Walter Obermayer, Josef Hafellner, Martin Grube, Orvo Vitikainen, Scott LaGreca, Kerry Knudsen, Mauro Tretiach, Lucia Muggia, Marek Stibal, and Jiří Liška for their professional help.

TAXONOMY

MAIN PROJECT

VONDRÁK J., ŘÍHA P., ARUP U. & SØCHTING U.:

THE TAXONOMY OF THE *Caloplaca citrina* GROUP (*Teloschistaceae*) IN THE BLACK SEA REGION; WITH CONTRIBUTIONS TO THE CRYPTIC SPECIES PROBLEMS IN LICHENOLOGY

ADDITIONAL PAPERS

VONDRÁK J. & HROUZEK P. (2006):

***Caloplaca soralifera*, A NEW SPECIES FROM EUROPE**
Graphis Scripta 18: 6–15.

VONDRÁK J., KHODOSOVTSEV A. & ŘÍHA P.:

***Caloplaca concreticola* (*Teloschistaceae*), A NEW SPECIES FROM ANTHROPOGENIC SUBSTRATA IN EASTERN EUROPE**
Lichenologist 40: 97–104

VONDRÁK J., ŠOUN J., PALICE Z., HROUZEK P., ŘÍHA P., KUBÁSEK J. & SØCHTING U.:

***Caloplaca subalpina* AND *C. thracopontica*, TWO NEW SAXICOLOUS SPECIES FROM THE *Caloplaca cerina* GROUP (*Teloschistales*)**
(acctepted in The Lichenologist)

THE TAXONOMY OF THE *Caloplaca citrina* GROUP (*Teloschistaceae*) IN THE BLACK SEA REGION; WITH CONTRIBUTIONS TO THE CRYPTIC SPECIES PROBLEMS IN LICHENOLOGY

JAN VONDRÁK[1,5], PAVEL ŘÍHA[2], ULF ARUP[3] & ULRIK SØCHTING[4]

[1] Department of Botany, Faculty of Science, University of South Bohemia, Branišovská 31, České Budějovice, CZ-370 05, Czech Republic

[2] Department of Zoology, Faculty of Science, University of South Bohemia, Branišovská 31, České Budějovice, CZ-370 05, Czech Republic

[3] Botanical museum, Lund Univeristy, Östra Vallgatan 18, SE-223 61 Lund, Sweden

[4] Section for Microbiology, Department of Biology, University of Copenhagen, Ø. Farimagsgade 2D, DK-1353 Copenhagen, Denmark

[5] Corresponding author: J. Vondrák (j.vondrak@seznam.cz)

Abstract. A new taxonomy of the *Caloplaca citrina* group in the Black Sea region is presented here. It is based on the nrDNA ITS molecular data, chemistry (anthraquinone contents) and 20 morphological charcters. Six known species were revealed in the region: *Caloplaca arcis*, *C. calcitrapa*, *C. dichroa*, *C. flavocitrina*, *C. geleverjae*, *C. limonia* and five species are new to science: *Caloplaca arcisproxima*, *C. austrocitrina*, *C. communis*, *C. confusa* and *C. nigromarina Caloplaca britannica*, *C. citrina*, *C. marina*, *C. maritima*, *C. microthallina*, *C. ora*, and *C. phlogina* are treated extensively. Some maritime species known from the Atlantic coast of Europe are absent from the region, and, surprisingly, *Caloplaca citrina* s. str. could not be confirmed from the region.

Many convergences and some cryptic species were revealed by molecular data. A key to the species present in the region is provided, but the utility of morphological characters is very limited in this group. The variability and taxonomic importance of particular features is discussed. No significant differences were observed among the species in their secondary chemistry.

Key words: alveolate cortex, *Caloplaca citrina* clade, *Caloplaca citrina* morphology, nrDNA ITS, *Teloschistales*.

INTRODUCTION

A number of lichenological papers, dealing with taxonomy or biodiversity, have touched the lichen species inhabiting sea shore habitats, but only some of these have dealt with particular taxonomical groups specifically occurring on coastal cliffs, e.g. *Ramalina* in Sheard (1978), *Roccella* in Tehler et al. (2004), *Verrucaria* in e.g. Brodo & Santesson (1997), Harada (2004) or McCarthy (1991), and *Xanthoria* in Lindblom & Ekman (2005). However, marine and maritime lichens are rather well-known in some regions, for instance in the British Isles, where some ecological and generalized studies have been made (e.g. Fletcher 1973a, b, 1975a, b). The genus *Caloplaca* has been more intensively investigated on North American shores (Arup 1992a, b, 1993a, b, 1994, 1995a, b) and rather extensively in Europe (e.g. Arup 1997a, Laundon 1992b, Navarro-Rosinés & Roux 1993, 1995, Roux & Navarro-Rosinés 1992, Tavares 1956). In East Mediterranean and the Black Sea region, some papers, mainly contributing to lichen biodiversity, partially concern maritime species, including *Caloplaca* (e.g. Güvenc & Öztürk 1999, John & Breuss 2004, Khodosovtsev 2001, 2002, 2003, Khodosovtsev et al. 2002, 2003, 2007, Redchenko 2002, Roux & Navarro-Rosinés 1992, Sipman & Raus 1999, 2002, Sipman et al. 2005, Szatala 1943a, b, Vězda 1975, Vondrák & Slavíková-Bayerová 2006, Vondrák et al. 2008, Yazici 1999), but the knowledge about maritime species of this area remains scarce.

When the first author tried to identify lichen material collected on his first field trip to the Black Sea region, he was unsuccessful in many cases. For instance, some species of the genera *Candelariella*, *Catillaria*, *Lecania*, and *Toninia* could not be keyed out using the available "West European" literature. This fact was particularly obvious in the genus *Caloplaca*, which appeared to be extremely species-rich in the area. Currently, we estimate that more than 50 species occur in coastal habitats around the Black Sea. The huge, but largely unknown diversity, led us to initiate a complex project on the biodiversity of the genus *Caloplaca* in the Black Sea region and this part is focused on the taxonomy of the *Caloplaca citrina* group in the area. Arup (2006a) already solved the taxonomy of this group in Scandinavia and his results are utilized and further developed here. This study describes the main part of species

diversity in the *C. citrina* group, but some species probably remain unrevealed. Our investigations, which are based on molecular data, also have some general implications exceeding the frame of a taxonomical study in a restricted area.

MATERIALS AND METHODS

Material from the Atlantic coast of Europe used for comparison (mainly of *Caloplaca britannica*, *C. littorea*, *C. marina*, *C. maritima*, and *C. microthallina*) was borrowed from BM, CBFS, LD, and herb. A. Aptroot (ABL). Material from Central Europe, the Black Sea region and the Mediterranean was borrowed from B, BP, CBFS, GZU, KHER, PRM, SAV and W. The main part of the material from the Black Sea region was collected by the first author during field excursions in July 2004 (Bulgaria), July and November 2005 (Romania, Bulgaria, European part of Turkey), June 2006 (Ukraine: Crimea), and April, May 2007 (Romania, Bulgaria, Turkey, Georgia, Russia, Ukraine). Vouchers are deposited in CBFS.

Citations of examined specimens are abbreviated and for common species only selected samples are presented. Data on additional samples and full sample information is available on the web page: http://botanika.bf.jcu.cz/lichenology/data.php.

Morphology. In total, 20 characters were measured and used in the detailed characterization of the *Caloplaca citrina* group, but only 11 traits were important for species separation: width of areoles, thickness of thallus and cortex/alveolate cortex, size of vegetative diaspores, size of apothecia, exciple width, hymenium height, size of ascospores, width of spore septa, width of paraphyses tips, and size of conidia.

Sections for morphological examination were cut by hand and observed in water. Measurements were made with an accuracy of 0.5 µm (for cells, e.g. ascospores, conidia and paraphyses), 1 µm for cortex thickness and 10 µm for larger structures (e.g. hymenium thickness and exciple width) were achieved. All measurements of cells were taken with their walls, not only lumina. Paraphyses tips and cortical tissues were observed after pretreatment of KOH. Measurements are given as (min.-) X±SD (-max.), where X = mean value and SD = standard deviation. Total numbers of measurements (n) are given in parentheses. At least five measurements were taken from all available samples; in the morphologically indistinguishable species (*Caloplaca confusa*, *C. nigromarina*), only samples confirmed by molecular data were used for measurements.

Morphological terminology follows Ryan et al. (2002) and Bungartz (2002). The term “alveolate cortex” is established here for the hyaline tissue similar to phenocortex (sensu Ryan et al. 2002: 23), formed by living fungal cells among dead algal cells or gaps after dead algal cells. It is situated below the true cortex or directly below epinecral layer.

DNA extraction and amplification. Direct PCR was used for PCR-amplification of the nuclear ITS regions including the 5.8S region of the nuclear ribosomal DNA gene (further in text abbreviated as ITS) following Arup (2006). Primers for amplification were ITS1F (Gardes & Bruns 1993) and ITS4 (White et al. 1990). PCR cycling parameters followed Ekman (2001).

Phylogenetic analyseés. The ITS sequences used in the phylogenetic analyses are listed in Table 1. These were aligned using MAFFT 6 (on-line version in the Q-INS-i mode; see Katoh et al. 2002) and manually cut in BioEdit 7.0 (Hall 1999) to eliminate the unalignable ends. A total of 674 positions were retained.

The main phylogenetic analysis was carried out using MrBayes 3.0 (Ronquist and Huelsenbeck 2003). In accordance with the best-fit likelihood settings proposed by hLRT algorithm in Mr Modeltest 2.2 (Nylander et al. 2004), we used the general time reversible model with some sites assumed to be invariable and the others following the gamma distribution of rates (GTR+I+G) and approximated to four discrete categories. A flat Dirichlet prior distribution with all values set to 1.0 was used to model the prior probability densities of the substitution rates as well as the stationary nucleotide frequencies. In order to assess the stability of the MCMC process, we monitored the standard deviation of split frequencies of two simultaneous independent runs, each including six parallel chains (one “cold” and five incrementally heated by a temperature of 0.3). Every 100th count of the total of 5,000,000 generations was sampled for both runs and the first quarter of samples was discarded as burn-in.

An additional heuristic parsimony search was conducted in PAUP 4.0b10 (Swofford 2002), assessing

the credibility of branches via non-parametric bootstrapping. This analysis employed the TBR swapping algorithm and the random sequence addition (100 replicates). All gaps were treated as missing data, the steepest descent option was not in effect and the analysis ran under the MulTrees option. The maximum number of trees in memory was restricted to 2500 using the MaxTrees option in order to reduce the computational demands. Bootstrap analysis encompassed 1,000 resamplings and only branches occurring in more then 50% of the partial bootstrap trees are regarded as resolved and are shown in Fig. 1, however, some below 50 scores are discussed in the text.

Chemistry. For detection of anthraquinones, HPLC-MS analysis was used (for details see Søchting 1997); examined samples are listed in Table 2.

RESULTS AND DISCUSSION

Phylogeny. We restricted the "*Caloplaca citrina* clade" to a group of morphologically variable species, to which we found *C. holocarpa* as closest outgroup. According to Gaya et al. (2008), *Caloplaca granulosa* is a closer relative to "*Caloplaca citrina* clade", but it is probably too close to the ingroup or even belong within it. In fact, the circumscription of "*Caloplaca citrina* clade" was made arbitrarily to cover the majority of taxa with the "*Caloplaca citrina* morphology" (see the part concerning the general morphology) in the Black Sea region.

The phylogenetic tree, based on the Bayesian inference analysis of 105 ITS sequences of 18 species, is presented here (Fig. 1) along with the posterior probabilities (PP) for the nodes. Since the parsimony bootstrap search yielded a tree topologically congruent with Fig. 1, yet less resolved, we are adopting only bootstrap values (BS) from this analysis. Two groups, recognized by the parsimony bootstrapping, but collapsed in the Bayesian inference (clade with *C. arcisproxima* and a grouping of three *C. austrocitrina* sequences) are also depicted in Fig. 1, using additional brackets. Molecular data revealed eleven, mostly cryptic species present in the Black Sea region, five of which are proposed here as species new to science (*Caloplaca arcisproxima*, *C. austrocitrina*, *C. communis*, *C. confusa*, and *C. nigromarina*). Three specimens were classified as *Caloplaca* sp. because they do not fit any recognized species and they do not constitute sufficient material for proposing new species. We are convinced that we have not been able to find all possible species of the group in the Black Sea area and that even more species will be found in the near future.

Above species level, the molecular analysis revealed three large, internally diverse groups in the "*Caloplaca citrina* clade". The first, basal-most, comprises *C. citrina*, *C. havaasii*, *C. ora* p.p., *C. maritima* and *C. communis* (PP=0.99 and BS=97). The second clade, formed by *C. calcitrapa*, *C. nigromarina*, *C. marina*, *C. microthallina* and *C. confusa* has a rather low support (PP=0.91, BS=37). The last clade includes *C. flavocitrina*, *C. geleverjae*, *C. dichroa*, *C. austrocitrina*, *C. limonia*, *C. arcis* and *C. arcisproxima* and has the weakest support (PP=0.84, BS=31).

Morphology. The thallus morphology of the *Caloplaca citrina* clade is very variable. It contains species with soredia (47% of examined species), blastidia (12%), granular thallus surface (12%), and thallus without vegetative diaspores (29%). The size of soredia/blastidia/granules is a useful key character in some species (Fig. 5). The thallus is always autotrophic and lichenicolous species are probably absent from this group. It varies from yellow to orange (only exceptionally grey, in *Caloplaca geleverjae*) and may be continuous, or formed of discrete granules, areoles or squamules, up to 550 µm thick and up to 2.7 mm in diam. The true cortex is usually inconspicuous, formed of 1-2 layers of cells. The alveolate cortex (explained in Materials and Methods) is more distincly developed, up to *c.* 50 µm thick, paraplectenchymatous formed of thin-walled cells, (3.0-) 5.4 ± 1.1(-10.0) µm in diam. (n=479). The epinecral layer is mostly present, but thin, up to *c.* 20 µm thick. The algal layer fills most of thallus interior and contains algal cells (5.0-) 11.4 ± 3.3 (-32.0) µm in diam. (n=537) as well as ± isodiametric fungal cells, (3.0-) 5.2 ± 1.2 (-9.0) µm in diam. (n=537). The medulla is mostly inconspicuous, formed of loose hyphal strands. In sorediate species, the development of the soralia differs strongly between species and offers important key characters. Three different types are described here (Fig. 2); 1. the "*confusa*-type" development, where blastidia are produced first at the margins of the areoles and ± labriform soralia develop consequently, when the blastidia have eroded or have been shed; 2. the "*flavocitrina*-type", where soredia are directly produced in well-delimited labriform or rarely laminal soralia; 3. the "*limonia*-type", where blastidia first build up on the thallus surface, and true soralia are produced from cracked blastidia or after the blastidia have eroded. These types of development are hardly recognizable when the thallus is too young or over matured and forms an entire sorediate crusts. Soredia may be single, *c.* 20-60 µm in diam., or grouped in consoredia.

The apothecia are rather small, but up to 1.6 mm diam., sessile, with flat to slightly convex, ± uniformly orange discs and *c.* 40-210 µm thick, ± persistent margins. The apothecial margins are zeorine, formed of a ± prosoplectenchymatous true exciple and a thalline exciple, which may be indistinct and hidden below the true exciple in young apothecia, but raised and distinct in older ones. The hypothecium (including subhymenium) is (30-) 102 ± 31 (-230) µm thick (n=103), formed of dense, intricate, translucent hyphae. The hymenium is *c.* 60-90 µm thick, the asci are of *Teloschistes*-type, cylindrical, (34-) 51 ± 6 (-72) × (7-) 11.5 ± 2 (-18) µm (n=99). The ascospores are *c.* 9-17 × 4-8 µm large and belong to one of two types: the common, thin-walled "*citrina*-type" or the rare, thick-walled "sand-glass type" (Fig. 3). The ascospore septa are *c.* 3-7 µm wide. The paraphyses are simple, branched or anastomosed, *c.* 1-2.5 µm thick, with widened tips, up to 7 µm.

The pycnidia are inconspicuous, hardly recognizable as dots with different tinge of yellow or orange; their centrums are *c.* 80-130 µm diam. The conidiophores are variable in height, branched and anastomosed in parts (Fig. 3). The conidiogenous cells are variable in shape, but mostly obtuse triangular, *c.* 4-6 µm diam. The conidia are acro- or pleurogenous, ellipsoid to bacilliform, *c.* 2-4 × 1-1.5 µm.

Short diagnostical description. The thallus is yellow to orange (except of *Caloplaca geleverjae*), continuous or of dispersed granules, areoles or squamules. Vegetative diaspores, such as soredia and blastidia are often present. The apothecia have orange discs, are rather small, and have zeorine margin. The true exciple consists of ellongated cells. The ascospores are thin-walled (except of some specimens in *C. calcitrapa* and *C. dichroa*), with thick septa.

Unfortunatelly, these morphological characters are shared with other, phylogenetically unrelated species, e.g. members of the *Caloplaca dolomiticola* group. The position of each species must therefore be confirmed by molecular data. Some superficially similar species of the *Caloplaca lactea* group (e.g. *C. crenulatella* and *C. interfulgens*) and of the *C. squamulosa* group (e.g. *C. subsoluta*) do not fit the "*Caloplaca citrina* morphology". The former has large, narrow ellipsoid ascospores with thin septa (Navarro-Rosinés & Hladun 1996) and the latter has a paraplectenchymatous true exciple (Arup 1992b, Wetmore 2003).

Species with the "*Caloplaca citrina* morphology" occurring on seashore cliffs are listed in Table 3. It is shown there, which species belong to the *Caloplaca citrina* clade.

Chemistry. All treated species contain anthraquinones of the chemosyndrome A (sensu Søchting 1997); with parietin as a dominant compound, and small amounts of emodin, fallacinal, parietinic acid and teloschistin. This chemistry is the most common within *Teloschistaceae*. No significant differences were observed among the treated species (Table 2); some minor differences are of quantitative character only, such as larger amounts of fallacinal in *Caloplaca arcis*, *C. austrocitrina*, *C. flavocitrina* and *C. nigromarina*, than in the rest of treated species. Exceptionally, in *Caloplaca geleverjae*, anthraquinones are absent from the thallus. The thallus cortex and the apothecia are K+ violet, C-, P-, UV ± orange. In sections, the hymenium and the subhymenium are I+ blue, but true exciple is I-.

Phenotypic variability and the taxonomical value of the characters. In most of the examined characters, strong phenotypic variability was observed. Some extreme examples of variability in width of the areoles, size of vegetative diaspores, width of the exciple, the hymenium thickness, paraphyses tips width and ascospore characters are shown for particular species in Fig. 4. In these characters, there are no or only small overlaps in the variation between different samples of the same species. This fact makes it difficult to find diagnostic characters.

A comparison of the treated species in vegetative diaspores, thallus thickness and ascospore characters is shown in Fig 5. Some species may be discriminated as a unite, such as *Caloplaca communis*, *C. geleverjae* and *C. limonia* that have larger vegetative diaspores, or *C. austrocitrina*, *C. communis* and *C. limonia* that have larger areoles, whereas *C. dichroa* has somewhat wider ascospores and *C. arcis* and *C. dichroa* have thinner spore septa. However, the characters are much less utilizable in a single sample, which posses only a part of a variability. For instance, samples of *C. limonia* from shaded places have significantly smaller soredia than samples from sun-exposed rock faces, which rather produce blasidia than soredia.

Useful key characters are mainly vegetative, such as thallus colour, presence of different vegetative diaspores of different size, development of soredia and thickness of the thallus and size of areoles. Apothecial characters (e.g. ascospore size and width of spore septa) are less useful, there are often strong phenotypic variability and small differences between species. Moreover, the sorediate species are rather sparingly fertile and *C. arcisproxima* is not known fertile.

KEY TO THE SAXICOLOUS SPECIES OCCURRING ON COASTAL CLIFFS IN THE BLACK SEA REGION

1a. Thallus pale grey, rarely slightly yellow, formed of areoles ± entirely covered by blastidia. - ***Caloplaca geleverjae***

1b. Thallus yellow to orange, only in shaded sites pale-yellow to yellow-grey. - **2**

2a. Soredia absent, but blastidia may be present. - **3**

2b. Soredia present, thallus sometimes blastidiate only, but in well-developed populations, soredia always present where blastidia have eroded (*limonia*-type of soralia) - **5**

3a. Vegetative diaspores absent, but large thallus granules may be present. - **4**

3b. Blastidia present on surface and at margins of inner areoles, (30-) 75 ± 21 (-130) µm, thallus usually with short-lobed margins. - ***Caloplaca arcis***

4a. Thallus variable: consisting of convex areoles, (90-) 190 ± 75 (-450) µm thick, with granular surface, or formed by dispersed granules, (70-) 180 ± 66 (-380) µm, apothecia usually abundant, common on hard siliceous coastal rocks. - ***Caloplaca communis***

4b. Thallus of flat to convex areoles, only (80-) 129 ± 36 (-210) µm thick; surface smooth, not granular, on coastal limestone or lime-rich schistose rocks. - ***Caloplaca calcitrapa***

5a. Thallus areolate, never squamulose, composed only of a thin, up to 200 µm thick, greyish-yellow to yellow sorediate crust, soredia small (20-) 42 ± 14 (-63) µm, epiphytic or on loess and concrete; not found on rock. - ***Caloplaca phlogina***

5b. Thallus mainly thicker, up to 550 µm thick, soredia on average larger, 23-320 µm, of *confusa*, *flavocitrina* or *limonia*-type (Fig. 2), known from coastal cliffs. - **6**

6a. Soralia ± delimited, developing mainly from margins of areoles (*confusa* or *flavocitrina*-type of soralia), but old thalli may be entirely sorediate. - **8**

6b. Soralia not delimited, of *limonia*-type; thallus often entirely sorediate/blastidiate. - **7**

7a. Thallus dull to bright yellow, (100-) 248 ± 111 (-550) µm thick, sometimes with minute marginal lobes, thallus sorediate, soredia coarse, (26-) 85 ± 54 (-320) µm, old thalli may form thick, entirely sorediate crust. - ***Caloplaca limonia***

7b. Thallus (70-) 118 ± 36 (-210) µm thick, yellow or orange, without marginal lobes, areoles ± entirely sorediate/blastidiate, vegetative diaspores smaller, (23-) 40 ± 11 (-61) µm in diam, usually both, orange and yellow thallus morphs are present in the localities. - ***Caloplaca dichroa***

8a. Thallus of ± umbilicate squamules, with margins divided into minute lobes. - ***Caloplaca arcisproxima***

8b. Thallus areolate or squamulose, but not with margins divided into minute lobes. - **9**

9a. Thallus areolate (rarely squamulose), (80-) 192 ± 70 (-380) µm thick, areoles (squamules) large, (0.25-) 0.74 ± 0.32 (-1.7) mm wide, old thalli usually entirely covered by soredia, mainly on concrete. - ***Caloplaca austrocitrina***

9b. Areoles/squamules smaller, up to 180 µm thick and up to 1.4 mm wide, usually not forming entirelly sorediate crust. - **10** (difficult species, without sufficient diagnostical characters in their morphology)

10a. Thallus mostly yellow, soralia of *flavocitrina* type prevail, if on coast, then usually on calcareous substrata (concrete, calcareous sandstones, etc.) - ***Caloplaca flavocitrina***

10b. Thallus mostly yellow-orange (in shaded sites yellow), on siliceous coastal cliffs. - **11**

11a. *Confusa, flavocitrina* and *limonia* types of soralia present. - ***Caloplaca confusa***

11b. Only *confusa* and *flavocitrina* types of soralia present - ***Caloplaca nigromarina***

TAXONOMY

Caloplaca arcis (POELT & VĚZDA) ARUP, LICHENOLOGIST 38: 8 (2006)

Bas.: *Caloplaca citrina* var. *arcis* Poelt & Vězda in Vězda, Lichenes Selecti Exsiccati, fasc. 99 (1990); type: Austria, Styria, distr. Feldbach, Riegersburg, alt. 400 m, on andesite rock, 1990, *G. Kantvilas, H. Mayrhofer & A. Vězda* (A. Vězda: Lich. Sel. Exsicc. 2470, BM!, PRM! - isotypi).

Fig. 6 A, B

Thallus yellow, areolate or formed of tightly aggregated squamules; marginal areoles have ± lobate character. Areoles/squamules (80-) 150 ± 39 (-220) µm thick (n=21) and (0.3-) 1.11 ± 0.7 (-3.0) mm wide (n=47). Thallus surface even or covered by granules and blastidia; in old thalli, vegetative diaspores may cover the majority of the thallus surface. Granules/blastidia (30-) 75 ± 21 (-130) µm in diam. (n=31). Cortex indistinct, alveolate cortex (7-) 18 ± 8 (-32) µm high (n=18).

Apothecia present in 37% of investigated samples, (0.41-) 0.6 ± 0.13 (-0.88) mm broad (n=19). Exciple (70-) 105 ± 21 (-140) µm thick (n=15), zeorine, the true exciple/thalline exciple ratio very variable; thalline exciple enlarged with age. Hymenium 70-100 µm thick (n=12). Paraphyses tips widened to (3.0-) 4.4 ± 0.6 (-5.5) µm (n=27). Ascospores (9.0-) 12.0 ± 1.25 (-14.0) × (4.5-) 5.5 ± 0.9 (-7.5) µm (n=20); length/width ratio *c.* 2.2. Ascospore septa (3.0-) 4.0 ± 0.5 (-5.0) µm thick (n=20), *c.* 0.33 of ascospore length.

Conidia (1.5-) 2.4 ± 0.5 (-3.0) × (1.0-) 1.25 ± 0.25 (-1.5) µm (n=26).

Remarks. The species is mainly characterized by its blastidiate thallus with short-lobed margins. In some cases, the species is hardly distinguishable from *Caloplaca limonia*, but in well-developed populations, *C. arcis* has distinct marginal lobes, and blastidia (soredia are absent) are restricted to central parts of thallus; whereas *C. limonia* has often entirely sorediate/blastidiate thallus surface.

Phylogeny. According to the DNA analyses, *Caloplaca arcis* forms a well-supported monophylletic group (PP 1.00, BS=98) with two sequences of *C. arcisproxima* in a sister position and *C. limonia* as the second closest taxon.

Ecology and distribution. This species occurs mainly on inland sun-exposed, hard siliceous, but usually base-rich rock faces. Although it is also known from pure limestone (Arup 2006a), it was not found on calcareous substrata in the Black Sea region. When it occurs on coastal rocks, it usually avoids the supralittoral zone (Kiten, Bulgaria, extremely sheltered shore: from 1 m upwards; Sinop, Turkey, extremely exposed shore: from 130 m upwards). Accompanying species: *Caloplaca* aff. *furax*, *C. teicholyta*, *C. thracopontica*, *Candelariella plumbea*, *Catillaria chalybeia*, *Diplotomma alboatrum* s.l., *Lecanora albescens*, *L. campestris*, *Phaeophyscia orbicularis*, *Verrucaria macrostoma* f. *furfuracea*, and *Xanthoria* cf. *calcicola*. The species is widely distributed in Europe. Here, it is newly recorded for Bulgaria, Italy, the Netherlands, Slovakia, Turkey and the Canary Islands.

Specimens examined: **Bulgaria.** *Black Sea coast.* Burgas, Tsarevo, Rezovo, 2005, *J. Vondrák* (CBFS JV3036); Burgas, Kiten, rocks near mouth of Karaagach river S of town, 2007, *J. Vondrák* (CBFS JV6093). **Italy.** *Sardinia.* Arburese, on volcanic rock in alt. 320-380 m, 1986, *W. Brunnbauer* (GZU, sub *C. citrina*). **The Netherlands.** Liemers, 2003, *A. Aptroot* 59582 (ABL); Zwartemeerdijk, 2004, *A. Aptroot* 59871 (ABL). **Slovakia.** *Muránská planina* Mts. In valley Hrdzavá, a1t. 1220-1270 m, 1999, *A. Guttová, J. Halda & Z. Palice* (SAV, sub *C. citrina*). **Spain.** *Canary Islands*. Teneriffe, Aguamansa, 1986, *W. Brunnbauer* (W, sub *Caloplaca* sp.). **Turkey.** *Black Sea coast*. Sinop, alt. *c.* 100 m, 2007, *J. Vondrák* (CBFS JV5426, 6106).

Caloplaca arcisproxima VONDRÁK, ARUP & SØCHTING NOM. PROV.

Typus. **Ukraine.** *Crimean Peninsula*. Alushta, coastal rocks SW of Ribachye, 44°45'35.36"N, 34°35'10.30"E, on supralittoral diabasic rock, 27 May 2007, *J. Vondrák* (CBFS JV5473 - Holotypus; CBFS JV6038, herb. C & LD - Isotypi).

Proposed diagnosis. Thallus of umbilicate squamules, (0.44-) 0.78 ± 0.21 (-1.18) mm wide, with margins divided into minute lobes. Soralia of *confusa* to *flavocitrina* type present.

Fig. 1 C, D

Thallus yellow to yellow-orange, of solitary or rarely aggregated, ± umbilicate squamules. Squamules (80-) 129 ± 36 (-240) µm thick (n=29) and (0.44-) 0.78 ± 0.21 (-1.18) mm wide (n=22). Squamules flat, smooth, with margins divided into minute lobes. Marginal soralia of *confusa* or *flavocitrina* type Soredia/blastidia (25-) 48 ± 16 (-86) µm in diam. (n=26). Cortex indistinct, alveolate cortex (8-) 24 ± 9 (-46) µm thick (n=36).

Apothecia absent in investigated samples. Conidia (2.5-) 3.0 ± 0.3 (-4.0) × (0.5-) 1.0 ± 0.25 (-1.5) µm (n=15).

Etymology. *Arcisproxima* = close to *arcis*. The new species is phylogenetically close to *Caloplaca arcis* and the species also share some morphological characters (distinct squamules).

Remarks. The species is mainly characterized by its umbilicate squamules, with margins divided into minute lobes and by the prsence of soralia of *confusa* to *flavocitrina* type. The species may be confused with *Caloplaca confusa*, *C. flavocitrina* or *C. nigromarina*, but it differs in ± umbilicate squamules, with somewhat raised margins. It somewhat resembles *C. arcis* in its sqamules, which are often divided into minute lobes, but *C. arcisproxima* differs in the presence of *confusa* to *flavocitrina* type of soralia.

Phylogeny. The monophyly of two obtained sequences of *Caloplaca arcisproxima* was not confirmed by the parsimony analysis (BS=70%) or the Bayesian inference. However, this may be due to poor lineage sorting in a young species or to the fact that only two specimens have been analysed. A close affinity to *C. arcis* is shown (PP=1.00), but the two species are clearly different from each other in morphology.

Ecology and distribution. In the known localities, the species prefers base-rich, hard siliceous rocks (e.g. diabase), but was found also on ± soft, lime-rich claystone. It is known only from maritime sites, usually from the supralittoral zone. Accompanying species: *Caloplaca* cf. *aegea*, *C. biatorina* s.l., *Caloplaca* aff. *furax*, *C. teicholyta*, *Candelariella plumbea*, *C. vitellina*, *Catillaria chalybeia*, *Diplotomma alboatrum* s.l., *Lecanora albescens*, *L. dispersa* s.l., *Phaeophyscia orbicularis*, *Verrucaria macrostoma* f. *furfuracea*, and *Xanthoria* cf. *calcicola*. The species is so far known from the Crimean Peninsula in the Black Sea region and Crete in eastern Mediterranean.

Specimens examined: **Ukraine.** *Crimean Peninsula*. Cape Meganom, 2002, *A. Khodosovtsev* (KHER 3030, sub *C. citrina*). **Greece.** *Crete*. Agios Pavlos, alt. *c.* 215-240 m, 1997, *H. Mayrhofer* (GZU); Ano Viannos, Sidonia, alt 10-50 m, 2005, *J. Vondrák* (CBFS JV4125); Mires, Kali Limenes, siliceous rock, alt. *c.* 100 m, 2005, *J. Vondrák* (CBFS JV3877).

Caloplaca austrocitrina VONDRÁK, ARUP & SØCHTING NOM. PROV.

Type. **Ukraine.** *Crimean Peninsula*. Alushta, slopes above sea *c.* 1 km SW of Semidvorje, alt. *c.* 100 m, 44°42'48.10"N, 034°27'12.10"E, on vertical side of concrete wall, 13 June 2006, *J. Vondrák* (CBFS JV5236 - Holotypus, CBFS JV5285 - Isotypus).

Proposed diagnosis. Thallus areolate (rarely squamulose), (80-) 192 ± 70 (-380) µm thick. Areoles (squamules) large, (0.25-) 0.74 ± 0.32 (-1.7) mm wide, sorediate. Soralia of *flavocitrina* type. Old thalli usually entirely covered by soredia. Mainly on concrete.

Fig. 1 E, F

Thallus yellow, rarely orange (e.g. the sample from Crete), areolate or formed of tightly aggregated squamules. Areoles/squamules (80-) 192 ± 70 (-380) µm thick (n=22) and (0.25-) 0.74 ± 0.32 (-1.7) mm wide (n=51). Squamules flat, smooth, with marginal soralia of *flavocitrina* type; in old thalli, soralia may cover the whole thallus surface. Soredia (22-) 36 ± 10 (-61) µm in diam. (n=34), sometimes gathered to consoredia. Cortex or alveolate cortex developed, (6-) 19 ± 8 (-40) µm thick (n=30).

Apothecia present in 50% of the investigated samples, (0.32-) 0.46 ± 0.1 (-0.65) mm broad (n=16). Exciple (50-) 86 ± 20 (-130) µm thick (n=16), zeorine. In young apothecia, the thalline exciple is hidden below the true margin, in old apothecia, the thalline exciple is well-developed and prevailing. Hymenium 60-80 µm thick (n=5). Paraphyses tips widened to (3.0-) 4.4 ± 0.9 (-6.0) µm (n=15). Ascospores (8.5-) 11.25 ± 1.5 (-14.0) × (4.5-) 6.0 ± 0.5 (-6.5) µm in size (n=16); length/width ratio *c.* 1.88. Ascospore septa (3.0-) 4.5 ± 1.0 (-5.5) µm tick (n=16), *c.* 0.4 of ascospore length. Conidia (2.0-) 2.8 ± 0.5 (-4.0) × (1.0-) 1.2 ± 0.2 (-1.5) µm in size (n=15).

Etymology. The name reflects the distribution of the species in Europe.

Remarks. The species is distinguished by its thick, areolate thallus (rarely squamulose), its large areoles (squamules), and its soralia of *flavocitrina* type. Old thalli are usually entirely covered by soredia. *Caloplaca flavocitrina*, occurring on the same kind of substrate (predominantly concrete), differs in its thinner and smaller squamules.

Phylogeny. Although morphologically distinguishable, the specimens of *C. austrocitrina* do not receive any support as a monophylletic taxon. More work on other genes may resolve the phylogeny of *C. austrocitrina*, but the lineage sorting among other genes may be poor too. In the anaylsis the species seems to be close to the group with *C. limonia*, *C. arcisproxima* and *C. arcis* (PP=0.92).

Ecology and distribution. Most of the records are from lime-rich artificial substrata, e.g. concrete and mortar, but the species is also known from limestone. It occurs inland as well as in coastal areas and do not avoid substrata close to sea level, e.g. concrete faces in harbors. Accompanying species: *Caloplaca aurantia*, *C. biatorina* s.l., *C. crenulatella*, *Candelariella aurella*, *Lecania leprosa*, *Lecanora albescens*, *L. dispersa*, *L. muralis*, *Rinodina pityrea*, *Verrucaria macrostoma* f. *furfuracea*, and *V. muralis*. The species is probably common in Southeastern Europe and is known also from central Europe (Austria, Czech Republic and Germany) and the European part of Russia.

Selected specimens examined. **Austria**. *Styria*. Joglland, Miesenbach, alt. *c.* 1040 m, 2003, *J. Hafellner* (GZU, sub *C. citrina)*. **Bulgaria.** *Black Sea coast*. Burgas, Pomorie, 2005, *J. Vondrák* (CBFS JV4631). **Czech Republic**. *South Bohemia*. České Budějovice, 2003, *J. Vondrák* (CBFS JV991). **Germany**. *Bavaria*. Munich, 1978, *E. Albertshofer & H. Hertel* (W, Lich. Alpium 328, sub *C. citrina*). **Greece**. *Crete*. Rethimno, ruin of fort Fortezza, 2005, *J. Vondrák* (CBFS JV4195). **Romania**. *Dobrogea*. Romania, Tulcea, near shore of Razim Lake (Lacul Razim), 2007, *J. Vondrák* (CBFS JV6168). **Russia**. *Black Sea coast*. Novorossiysk, coastal rocks near Dyurso, 2007, *J. Vondrák* (CBFS JV5474, dupl. in herb. U. Søchting); Sochi, coast 2 km SE of Loo, 2007, *J. Vondrák* (CBFS JV6097, 6166). **Slovakia**. *Bukovské vrchy hills*. Nová Sedlica, 1989, *I. Pišút* (SAV, sub *C. citrina*); *Podunajská nížina lowland*. Vrakúň, 1990, *I. Pišút* (SAV, sub *C. citrina*). **Ukraine**. *Black Sea coast*. Odessa, Czernomorskoye, 2007, *J. Vondrák* (CBFS JV5476, dupl. in herb. U. Arup).

Caloplaca calcitrapa Nav.-Ros., Gaya & Cl. Roux, Bull. Soc. linn. Provence 51: 147 (2000);

Type: France, Eastern Pyrenees, Tautavel, alt. 400-450 m, on calcareous rock (BCC 13385, holotype).

Fig. 7 A, B

Thallus yellow, rarely orange, areolate or bullate. Occasionally, the thallus may be thin with rather endolithic character. Snail-grazed forms with flat areoles are common. Areoles (80-) 129 ± 36 (-210) µm thick (n=26) and (0.32-) 0.52 ± 0.16 (-0.97) mm wide (n=20). Vegetative diaspores absent. Cortex indistinct, alveolate cortex (8-) 25 ± 9 (-35) µm thick (n=15); epinecral layer usually with intermixed crystals.

Apothecia frequent, (0.28-) 0.46 ± 0.15 (-0.75) mm in diam. (n=20). Disc convex in old apothecia. Exciple (40-) 100 ± 34 (-210) µm thick (n=57), zeorine, the true exciple/thalline exciple ratio very variable; thalline exciple enlarged with age. Hymenium (60-) 68 ± 6 (-80) µm thick (n=15). Paraphyses tips widened to (4.0-) 5.5 ± 0.75 (-7.0) µm (n=25). Ascospores (7.0-) 11.0 ± 2.0 (-14.0) × (4.5-) 6.0 ± 0.75 (-7.5) µm (n=32); length/width ratio c. 1.83. Ascospores usually thin-walled; thick-walled, sand-glass spores observed only in two samples. Ascospore septa (3.0-) 4.5 ± 1.0 (-6.5) µm thick (n=32), *c.* 0.4 of ascospore length. Conidia (2.5-) 3.3 ± 0.4 (-4.0) × (1.0-) 1.3 ± 0.25 (-1.5) µm (n=15).

Remarks. According to Navarro-Rosinés et al. (2000), the species is mainly characterized by thick-walled, sand-glass ascospores, but these were only rarely observed in specimens from the Black Sea and Marmara Sea regions (samples CBFS JV6109 & JV6112). More common forms with thin-walled spores were confirmed by the DNA-analysis (samples CBFS JV3408, JV5486 & JV6100).

The areolate or bullate thallus of *Caloplaca calcitrapa* may be confused with the inland and facultatively lichenicolous species *C. inconnexa*, but *C. calcitrapa* seems to be ± maritime and not lichenicolous.

Phylogeny. The four very divergent ITS sequences of *Caloplaca calcitrapa* form a monophylletic group with a good PP support (1.00) but a poor bootstrap support (BS=53) in a sister position to a clade including *C. confusa*, *C. marina*, *C. microthallina*, and *C. nigromarina* (PP=0.91, BS<50).

Ecology and distribution. In the Black Sea region, the species inhabits strongly calcareous substrata, e.g. hard limestone and lime-rich schist. In coastal areas, it specifically occurs in the supralittoral zone (Rusalka, Bulgaria, sheltered shore: from 1 m upwards; Kamen Brjag, Bulgaria, exposed shore: from 6 m upwards). In western Mediterranean, it is also known from inland localities (Navarro-Rosinés et al. 2000). Accompanying species: *Caloplaca* cf. *aegea*, *C. biatorina* s.l., *C. decipiens*, *C. erythrocarpa*, *C. ferrarii*, *C. limonia*, *C. navasiana*, *Candelariella aurella*, *Diplotomma alboatrum* s.l., *Lecanora albescens*, *L. campestris*, *L. dispersa*, *Rinodina gennarii*, *Verrucaria nigrescens*, and *Xanthoria* cf. *calcicola*. The species is known from Algeria, France, Italy, Morrocco and Spain (Navarro-Rosinés et al. 2000, Roux et al. 2003). Here, it is newly recorded for Bulgaria, Turkey and Ukraine.

Specimens examined: **Bulgaria.** *Black Sea coast*. Kavarna, limestone cliffs on seashore 1.5 km NE of Kamen Brjag, 2007, *J. Vondrák* (CBFS JV5486, 6117, 6130). **Turkey**. *Black Sea coast*. Istanbul, Kemerburgaz, Karaburun, 2005, *J. Vondrák* (CBFS JV3408); Kandıra, coastal limestone rocks 6 km E of Cebeci, 2007, *J. Vondrák* (CBFS JV6112); *Marmara Sea coast*. Armutlu, coastal rocks 5.5 km SW of Esenköy, 2007, *J. Vondrák* (CBFS JV6100, 6109); Bandırma, coastal rocks near Yenice, 2007, *J. Vondrák* (CBFS JV6118, 6123, 6125, 6129, 6180); Gallipoli peninsula, coastal limestone cliffs 1 km NE of Abide monument, 2007, *J. Vondrák* (CBFS JV6103). **Ukraine**. *Crimean Peninsula*. Sudak, coastal rocks at W part of Cape Meganom, 2007, *J. Vondrák* (CBFS JV5906); Sea of Azov coast, 1995, *A. Redchenko* (KHER 2986, sub *C. marina*).

Caloplaca communis VONDRÁK, ARUP & SØCHTING NOM. PROV.

Typus. **Bulgaria.** *The Black Sea coast*. Burgas, Tsarevo, coastal rocks SE of town, near small boat-factory, 42°08'49.7''N, 27°52'48.2''E, on siliceous rock in supralitoral zone, 30 Nov. 2005, *J. Vondrák* (CBFS JV4620 - Holotypus, Isotypi will be distributed in J. Vondrák: Sel. Exs. *Caloplaca*, fasc. 2).

Proposed diagnosis. Similar to *Caloplaca calcitrapa* and *C. maritima*, but differs in its thallus with coarsely granular surface; granules (70-) 180 ± 66 (-380) µm in size. Restricted to sea-shore cliffs, mainly siliceous.

Fig. 7 C, D

Thallus yellow (with shade of orange in populations from Crete) areolate, bullate to minutely squamulose. Areoles dispersed or contiguous and then overgrowing each other, forming thick crusts in luxuriant populations, (90-) 190 ± 75 (-450) µm thick (n=53) and (0.32-) 0.86 ± 0.43 (-2.8) mm wide (n=121). When thallus well-developed, its surface is coarsely granular; granules (70-) 180 ± 66 (-380) µm in diam. (n=135). Cortex present, (5-) 17 ± 7.5 (-46) µm thick (n=134).

Apothecia frequent, (0.2-) 0.6 ± 0.2 (-1.3) mm in diam. (n=97). Exciple (40-) 100 ± 34 (-210) µm thick (n=57); true exciple fills *c.* 1/3 - 1/2 of the exciple width, thalline exciple prominent. Hymenium (50-) 68 ± 12 (-100) µm thick (n=48). Paraphyses tips widened to (3.0-) 5.0 ± 1.0 (-7.0) µm (n=80). Ascospores (10.0-) 13.0 ± 1.5 (-18.0) × (4.0-) 6.5 ± 1.0 (-9.0) µm (n=78); length/width ratio *c.* 2.0. Ascospore septa (3.0-) 5.0 ± 1.0 (-7.0) µm thick (n=78), *c.* 0.4 of ascospore length. Conidia (2.0-) 2.8 ± 0.3 (-3.5) × (1.0-) 1.2 ± 0.2 (-2.0) µm (n=52).

Etymology. The name reflects a common occurrence of this species on siliceous sea-shore cliffs.

Remarks. The yellow thallus, covered by coarse granules, together with its occurrence restricted to coastal habitats (mainly siliceous rocks), are the main characters distinguishing *Caloplaca communis* from the similar *C. calcitrapa* and *C. inconnexa*. Nevertheless, some morphotypes of *C. communis* have a thallus with an indistinctly granular surface and if such a morphotype occurs on calcareous substrate, then it is hardly distinguished from the likewise coastal *C. calcitrapa*. When the areoles/squamules are dispersed, *C. communis* may remind the North and West European *C. microthallina*, but this species has smaller squamules, *c.* 0.5-2 mm wide (Laundon 1992a). Morphotypes with more compact thallus and less distinct granular surface resemble *C. maritima*, which is not confirmed from the region.

Phylogeny. All sampled sequences of *C. communis* but one form a monophylletic group in the molecular analysis but with low support (PP=0.87, BS<50)). The position of the remaining sequence assigned to this species (EU563409) is left controversial in a polytomy between *C. communis*, *C. maritima* and *C. ora* p. p. As in the case of *C. austrocitrina*, sampling of more loci could be helpful for making this part of molecular tree more consistent. The molecular affinity of *C. maritima*, *C. ora* p. p. and *C. communis* is rather strong (PP=0.99, BS= 78).

Ecology and distribution. It is one of the commonest species in the lichen communities in the lower supralittoral zone on hard siliceous rocks. Only very rarely, it occurs on sandstone, claystone and limestone cliffs. The species is restricted to a thin zone close to sea level; sheltered shores: 2-4 m (Tuapse, Russia), 1-2 m (Kiten, Bulgaria); exposed shores: 3-7 m (Sarp, Turkey), 4-17 m (Bulgaria, Rezovo), 4-19 m (Sinop, Turkey). In eastern Mediterranean, where the salinity is higher and the climate warmer and dryer, the species may occur higher above the sea level; *c.* 20-50 m (Agia Pelagia, northern Crete), *c.* 100 m (Kali Limenes, southern Crete). Accompanying species: *Amandinea punctata*, *Caloplaca* cf. *aegea*, *C. confusa*, *C. fuscoatroides*, *C. limonia*, *Lecanora campestris*, *Rinodina confragosa*, *R. gennarii*. It is widely distributed in the Black Sea region, at Marmara Sea and in eastern Mediterranean. It is known from Bulgaria, Greece, Italy, Russia, Turkey and Ukraine.

Specimens examined: **Bulgaria.** *Black Sea coast*. Burgas, Kiten, 2007, *J. Vondrák* (CBFS JV6088); Burgas, Sozopol, 2007, *J. Vondrák* (CBFS JV6121); Burgas, Tsarevo, 2005, *J. Vondrák* (CBFS JV3369); Burgas, Tsarevo, Rezovo, 2005, *J. Vondrák* (CBFS JV3043). **Greece.** *Crete*. Ano Viannos, Sidonia, 2005, *J. Vondrák* (CBFS JV4114); Iraklio, Agia Pelagia, 2005, *J. Vondrák* (CBFS JV3803, 3836); Mires, Kali Limenes, 2005, *J. Vondrák* (CBFS JV3763). **Italy.** *Sardinia*. Planargia, 1983, *W. Brunnbauer* (W, sub *C. microthallina*). **Russia.** *Black Sea coast*. Tuapse, coastal rocks NW of town, Tuapse, 2007, *J. Vondrák* (CBFS JV6108); *Sea of Azov coast*. Taman Peninsula, clay coast 4.5 km NW of Kuchugury, 2007, *J. Vondrák* (CBFS JV6104). **Turkey.** *Black Sea coast*. Amasra, coastal rocks near Çakrazboz, 2007, *J. Vondrák* (CBFS JV6127); Cide, coastal rocks near Denizkonak, 2007, *J. Vondrák* (CBFS JV6115); Istanbul, Kemerburgaz, Kilyos, 2005, *J. Vondrák* (CBFS JV3367, 3467, 3471, 3472); Kandıra, sand dunes and coastal limestone rocks 6 km E of Cebeci, 2007, *J. Vondrák* (CBFS JV6119); Lülenburgaz, Demirköy, Limanköy, 2005, *J. Vondrák* (CBFS JV3037); Lülenburgaz, Vize, Kiyiköy, 2005, *J. Vondrák* (CBFS JV3042); Ordu, coastal rocks near Mersin, 2007, *J. Vondrák* (CBFS JV6128); Zonguldak, coastal rocks near Ilıksu, 2007, *J. Vondrák* (CBFS JV6116); *Marmara Sea coast*. Armutlu, coastal rocks 5.5 km SW of Esenköy, 2007, *J. Vondrák* (CBFS JV6114); Karabiga, 2007, *J. Vondrák* (CBFS JV6110, 6111, 6124). **Ukraine.** *Crimean Peninsula*. Cape Alushtinska miska, 2000, *A. Khodosovtsev* (KHER 2979, sub *C. microthallina*); Cape Meganom, 1999 & 2002, *A. Khodosovtsev* (KHER 2977, 2980, 2981, sub *C. microthallina*); Cape Plaka, 1999, *A. Khodosovtsev* (KHER 2982, sub *C. microthallina*); Karadag, 2000, *A. Khodosovtsev* (KHER 2976, sub *C. microthallina*).

Caloplaca confusa Vondrák, Arup & Søchting nom. prov.

Typus. **Bulgaria.** *Black Sea coast*. Burgas, Kiten, rocks near mouth of Karaagach river S of town, 42°13'31.26"N, 27°46'40.46"E, on coastal, base-rich, siliceous rock, 9 April 2007, *J. Vondrák* (CBFS JV6206 - Holotypus; BM, C, GZU, LD - Isotypi).

Proposed diagnosis. Hardly distinguished from *Caloplaca flavocitrina* and *C. nigromarina*, but differs in presence of all *confusa*, *flavocitrina* and *limonia* types of soralia. Restricted to coastal siliceous cliffs.

Fig. 7 E

Thallus yellow to yellow-orange, of dispersed squamules, or continuous, areolate. Areoles/squamules (80-) 121 ± 28 (-180) µm thick (n=16) and (0.2-) 0.65 ± 0.3 (-1.4) mm wide (n=34). Areoles and squamules flat, smooth or

covered by blastidia, with laminal or marginal soralia of *confusa*, *flavocitrina* or *limonia* type, soredia (18-) 31 ± 9 (-43) µm in diam. (n=28), sometimes gathered to small consoredia. Cortex poorly developed; alveolate cortex (7-) 18 ± 8.5 (-40) µm thick (n=15).

Apothecia infrequent (25% of samples fertile), *c.* 0.4-1.0 mm broad (n=7). Exciple 50-110 µm thick (n=7), zeorine, but seemingly biatorine; in young apothecia, true exciple fills whole exciple width, as the thalline exciple is hidden below the true exciple. Hymenium 70-80 µm thick (n=9). Paraphyses tips widened to (3.5-) 4.5 ± 0.5 (-5.5) µm (n=18). Ascospores (10.0-) 11.5 ± 1.0 (-13.0) × (4.5-) 5.5 ± 1.0 (-7.0) µm in size (n=17); length/width ratio *c.* 2.1. Ascospore septa (3.5-) 5.0 ± 1.0 (-7.0) µm thick (n=17), *c.* 0.43 of ascospore length. Conidia *c.* 3-3.5 × 1-1.5 µm in size.

Etymology. The name should express the confusing position of the new species in the phylogenetic tree; although extremely similar to *Caloplaca flavocitrina* and *C. nigromarina*, it is not closely related to them.

Remarks. The species may be characterized by its squamulose to areolate thallus with all three types of soralia (*confusa*, *flavocitrina* and *limonia* types), but in some cases, it is indistinguishable from *Caloplaca flavocitrina* and *C. nigromarina.*

Phylogeny. The sequences of *Caloplaca confusa* form a monophylletic group, but the support is not very strong (PP=0.89, BS=46). However, it is morphologically distinct from the genetically closest relative, *C. microthallina*, in the analyses. The support for this sister relationship is not very strong though (PP=0.88, BS=47).

Ecology and distribution. The species is restricted to hard siliceous, mainly volcanic, sea shore cliffs in the supralitoral zone; from *c.* 2 m upwards in sheltered shores and 5-18 m on an exposed shore (Sinop, Turkey). Accompanying species: *Caloplaca* cf. *aegea*, *C. communis*, *C.* cf. *holocarpa*, *C. limonia*, *C. thracopontica*, *Catillaria chalybeia*, *Hyperphyscia adglutinata*, *Lecania* cf. *aipospila*, *Lecanora campestris*, *L. dispersa*, *L.* cf. *salina*, *Rinodina gennarii*, and *Xanthoria* cf. *calcicola*.

It is probably widely distributed in the Black Sea region and the Mediterranean, and it is also known from the Atlantic coast. Records from Azores, Bulgaria, France and Italy are confirmed by molecular data. There are also collections from Georgia, Russia, Turkey and Ukraine, but these were not confirmed by molecular data and have been omitted from the study.

Specimens confirmed by ITS data: **Bulgaria.** *Black Sea coast.* Burgas, Tsarevo, coastal rocks between Tsarevo and Ahtopol, 2005, *J. Vondrák* (CBFS JV3435) **France**. *Corsica*. Ajaccio, on volcanic rock in alt. 50 m, 1993, *J. Hafellner* (GZU, sub C. *citrina*). **Italy**. *Sicily*. Isole Pelagie, Linosa, 1992, *J. Poelt* (GZU, sub *C. citrina*). **Portugal**. *Azores*. Sao Jorje, 1992, *F. Berger* (herb. Berger).

Caloplaca dichroa **Arup,** Lichenologist 38: 13 (2006)

Type: Sweden, Västergötland, Klefva infra Mösseberg. In saxis calcaris, 1914, *Vrang*. Malme: *Lichenes suecici exsiccati* 525 (LD - Holotypus).

Fig. 7 F

Thallus areolate, of two colour forms, yellow and orange. Areoles (70-) 118 ± 36 (-210) µm thick (n=19) and (0.24-) 0.6 ± 0.3 (-1.2) mm wide (n=20), ± entirely covered by blastidia/soredia of *limonia* type, (23-) 40 ± 11 (-61) µm in diam. (n=30). Cortex indistinct, composed of 1-2 layers of cells; a thicker alveolate cortex developed in spots.

Apothecia frequent, (0.42-) 0.49 ± 0.06 (-0.64) mm broad (n=15). Disc orange-yellow or dark orange to reddish-orange. Exciple (50-) 83 ± 18 (-110) µm thick (n=15), zeorine, the true exciple/thalline exciple ratio very variable; thalline exciple often covered by blastidia/soredia, enlarged with age. Hymenium *c.* 70-80 µm thick (n=5). Paraphyses tips widened to (2.5-) 4.5 ± 1.0 (-6.0) µm (n=34). Ascospores thick-walled (walls up to 2 µm) or thin-walled (walls less than 0.5 µm), (11.0-) 14.0 ± 1.5 (-16.0) × (6.0-) 7.25 ± 0.75 (-9.0) µm in size (n=15); length/width ratio *c.* 1.93. Ascospore septa (3.5-) 4.0 ± 0.4 (-4.5) µm thick (n=15), *c.* 0.29 of ascospore length.

Conidia (1.5-) 2.5 ± 0.5 (-3.0) × (1.0-) 1.25 ± 0.25 (-1.5) µm in size (n=20).

Remarks. The species is characterized by its sorediate/blastidiate thallus surface, *limonia* type of soralia and thin thallus without marginal lobes. The yellow and orange thallus forms, often grow side by side, are also diagnostic. It can be confused with *Caloplaca austrocitrina* and *C. limonia*, but the former has generally thicker thallus and a different type of soralia, and the latter has thicker thallus, larger vegetative diaspores and lacks the orange morphotype. For differences from *C. citrina* see Arup (2006a). The thick-walled ascospores seem to be diagnostic in the Nordic coutries (Arup 2006), but in the Black Sea region some specimens have thin-walled spores. A similar pattern has also been observed in some British specimens.

Phylogeny. *Caloplaca dichroa* forms one of the best-supported clades in our analysis, it has full support (PP=1.00, BS= 100). This branch as a sister taxon to a clade including *C. arcis*, *C. arcisproxima, C. austrocitrina* and *C. limonia* with fairly good support in the Bayesian analysis (PP=0.93).

Ecology and distribution. Although the species is known also from concrete and mortar (Arup 2006a, Vondrák et al. 2007), in the Black Sea region, it was only collected from ± sun-exposed, hard or soft calcareous stones or cliffs. It is a typical inland species avoiding maritime conditions; on coastal cliffs it grows from 6 m upwards in sheltered shores (Rusalka, Bulgaria) and from 16 m and upwards in more exposed shores (Kamen Brjag, Bulgaria). Accompanying species: *Candelariella aurella*, *C. rhodax*, *Lecanora albescens*, *L. dispersa*, *Phaeophyscia nigricans*, *P. orbicularis*, *Physcia adscendens*, *Physconia grisea*, *Verrucaria macrostoma* f. *furfuracea*, and *V. nigrescens* s.l.

Selected specimens examined: **Austria.** *Styria*. Eisenerzer Alpen, Kammern im Liesingtal, 1997, *J. & A. Hafellner* (GZU, sub *C. citrina*); Grazer Bergland, Mixnitz, alt. 1620 m, 2005, *J. Hafellner* (GZU, sub *C. citrina*); Fischbacher Alpen, Rettenegg, 2002, *J. Hafellner* (GZU, sub *C. citrina*); *Tirolia*. Hohe Tauern Mts, Matrei, alt. 1000 m, 1998, *J. Hafellner* (GZU, sub *C. citrina*). **Bulgaria.** Kavarna, Cape Kaliakra, 2007, *J. Vondrák* (CBFS JV6177). **Great Britain.** Bristol, rocks on right side of Avon River near Clifton suspension bridge, 2006, *J. Vondrák* (CBFS JV4155). **Hungary.** *Mt Bakony*. Hárskut, 1968, *K. Verseghy* (BP 75193, 75204). **Romania.** *Dobrogea*. Jurilovca, rocky cliff at Doloşman Cape, 2007, *J. Vondrák* (CBFS JV5324, 5337); Tulcea, Popina Island (Insula Popina) in Razim Lake (Lacul Razim), 2007, *J. Vondrák* (CBFS JV6178, 6179). **Russia.** *Sea of Azov coast*. Taman Peninsula, on soft limestone, 4.5 km NW of Kuchugury, 2007, *J. Vondrák* (CBFS JV6176). **Ukraine.** *Crimean Peninsula*. Feodosia, Karadag, near village Kurortnoye, 2007, *J. Vondrák* (CBFS JV5477).

Caloplaca flavocitrina (Nyl.) H. Olivier, Lich. d'Europe 2: 110 (1908-1910)

Bas.: *Lecanora flavocitrina* Nyl., Flora 69: 461 (1886); type: Great Britain, Staveley. 1886, *Martindale* (H-Nyl.!, lectotype)

Fig. 8 A

Thallus yellow, of dispersed squamules, rarely continuous, areolate. Squamules (70-) 96 ± 17 (-140) µm thick (n=16) and (0.12-) 0.4 ± 0.17 (-0.75) mm wide (n=60). Squamules flat, smooth, with marginal soralia of *flavocitrina* type, but the soralia sometimes expand and cover the complete surface of the squamules. Soredia (16-) 29 ± 9 (-65) µm in diam. (n=56), sometimes gathered to consoredia. Cortex thin, usually of 1-2 layers of cells; alveolate cortex (4-) 9 ± 5 (-25) µm thick (n=44). A white or yellow fibrillar prothallus was observed on smooth substrates.

Apothecia infrequent (30% of samples fertile), (0.3-) 0.43 ± 0.1 (-0.75) mm in diam. (n=24). Exciple (70-) 85 ± 13 (-110) µm thick (n=16), zeorine, the true exciple/thalline exciple ratio very variable; thalline exciple enlarged with age. Hymenium (65-) 75 ± 6 (-80) µm thick (n=14). Paraphyses tips widened to (3.0-) 5.0 ± 1.0 (-7.0) µm (n=32). Ascospores (10.0-) 11.5 ± 1.25 (-14.5) × (4.0-) 5.5 ± 1.0 (-7.0) µm in size (n=27); length/width ratio *c.* 2.1. Ascospore septa (3.0-) 4.5 ± 1.0 (-7.0) µm thick (n=27), *c.* 0.39 of ascospore length. Conidia (2.0-) 3.25 ± 0.5 (-4.0) × (1.0-) 1.15 ± 0.25 (-1.5) µm (n=14).

Remarks. The species has squamuloase to areolate thallus with prevailing *flavocitrina* type of soralia. It is hardly distinguishable from *C. confusa* and *C. nigromarina*, but its thallus is usually yellow and the *flavocitrina* type of soralia persist. It differs also in its ecology, being mainly an inland species, and is rather rare on sea-shore rocks.

Phylogeny. The sequences of *Caloplaca flavocitrina* form a well-supported monophylletic group according to the Bayesian analysis (PP=0.99), but the parsimonious analysis gave a weaker support (BS=61). Together with *C. geleverjae* and an undescribed taxon, represented by the sequence EU563389, it forms a well supported clade (PP=1.00, BS=89), that appears as a sister group to a large clade with e.g. *C. dichroa* and *C. arcis*, but with rather poor support (PP=0.84, BS<50).

Ecology and distribution. *Caloplaca flavocitrina* is one of most opportunistic species in the *C. citrina* group; it occurs on bark, wood, concrete and on broad scale of rocks. In maritime conditions, it is mainly restricted to concrete or calcareous rocks. It is confirmed from siliceous coastal cliffs only in the most humid part of the Black Sea region, in Georgia and NE Turkey. Accompanying species in coastal localities: *Caloplaca albolutescens*, *Candelariella aurella*, *Diplotomma alboatrum* s.l., *Lecanora dispersa*, *Rinodina gennarii*, and *Verrucaria macrostoma* f. *furfuracea*. As known throughout Europe and from the Hawaiian Islands, we suppose its circumpolar distribution. It is new to Georgia, Italy, Russia, and Turkey.

Specimens confirmed by ITS nrDNA data: **Bulgaria.** *Black Sea coast*. Burgas, Pomorie, on concrete, 2005, *J. Vondrák* (CBFS JV3425); Burgas, Tsarevo, Sinemorets, epiphytic, 2004, *J. Vondrák* (CBFS JV2106). **Georgia.** *Adjara*. Batumi, valley of river Acharistskali near Shuakhevi, 2007, *J. Vondrák* (CBFS JV6094); Batumi, rocks near coast on S periphery of Gonio, 2007, *J. Vondrák* (CBFS JV6098). **Italy.** *Livorno*, volcanic coastal rock, alt. 20-50 m, 1993, *J. Hafellner* (GZU, sub C. citrina). **Russia.** *Black Sea coast*. Gelendzhik, coastal rocks W of Krinitsa (near Betta), 2007, *J. Vondrák* (CBFS JV6089); Sochi, coast 2 km SE of Loo, 2007, *J. Vondrák* (CBFS JV6095). **Turkey.** *Black Sea coast*. Rize, coastal outcrops close to city, 2007, *J. Vondrák* (CBFS JV6090). **U.S.A.** *Hawaiian Islands*. Maui, Haleakala, volcanic rock in alt. 1700 m, 1996, *C. Wetmore* (GZU, sub *C. citrina*).

Caloplaca geleverjae **Khodosovtsev & S. Kondr.,** Ukr. Botan. Journ. 60: 294 (2003)

Type: Ukraine, Crimea AR, Feodosia region, Cape Meganom, on conglomerates in supralittoral zone, 2002, *A. Khodosovtsev* (KW, holotype, KHER!, CBFS!, isotypes).

Fig. 8 B

Thallus pale grey, rarely yellowish (mainly at apothecial primordia), consisting of dispersed areoles or continuous, areolate. Areoles (110-) 147 ± 18 (-180) µm thick (n=15) and (0.34-) 0.63 ± 0.16 (-0.87) mm wide (n=15). Squamules ± entirely covered by blastidia, (48-) 85 ± 31 (-148) µm in diam. (n=15); true soredia absent. Cortex indistinct; alveolate cortex (18-) 28 ± 9 (-50) µm thick (n=15).

Apothecia frequent in the known population, (0.37-) 0.48 ± 0.07 (-0.62) mm in diam. (n=15). Exciple (70-) 93 ± 14 (-110) µm thick (n=14), zeorine, but thalline exciple hidden below the true exciple in young apothecia. Hymenium *c.* 60-80 µm thick (n=5). Paraphyses tips widened to (5.0-) 6.0 ± 0.75 (-7.0) µm (n=15). Ascospores (10.0-) 13.25 ± 1.5 (-15.0) × (5.0-) 6.5 ± 1.0 (-8.0) µm (n=15); length/width ratio *c.* 2.04. Ascospore septa (3.0-) 4.75 ± 0.75 (-6.0) µm thick (n=15), *c.* 0.36 of ascospore length. Conidia (2.5-) 3.0 ± 0.4 (-3.5) × (1.0-) 1.3 ± 0.2 (-1.5) µm (n=15).

Remarks. The predominantly greyish thallus colour distinguishes *Caloplaca geleverjae* from the other related species. The blastidiate species, *Caloplaca thamnoblasta*, is somewhat similar in thallus structure, but its thallus is usually yellow and it does not belong to the *C. citrina* group (Vondrák & Šoun, *unpublished molecular data*).

Phylogeny. *Caloplaca geleverjae* (one sequence included in the analysis) is a sister species to *C. flavocitrina* (PP=0.98; BS=60).

Ecology and distribution. The species is only known from the type locality in the Crimean Peninsula, where it occurs on ± shaded, base-rich conglomerate in the lower supralittoral zone, at altitudes below 10 m. The accompanying species on the type locality were few and include e.g. *Caloplaca limonia* and *C.* cf. *nigromarina*.

Specimen examined: **Ukraine**. *Crimean Peninsula*. Cape Meganom, 2007, *J. Vondrák & A. Khodosovtsev* (CBFS JV5415 – topotype)

Caloplaca limonia **NIMIS & POELT** IN NIMIS, POELT, TRETIACH, OTTONELLO, PUNTILLO & VĚZDA, BULL. SOC. LINN. PROVENCE 45: 252 (1994).

Type: Italy, Isole Egadi, Marettimo, 1991, *J. Poelt* (GZU!, holotype)

Fig. 8 C, D

Thallus dull to bright yellow, often white-pruinose, forming continuous areolate crust. Areoles/squamules (100-) 248 ± 111 (-550) µm thick (n=44) and (0.18-) 0.98 ± 0.51 (-2.6) mm wide (n=140). Areoles and squamules flat, covered by blastidia or by laminal soralia of *limonia* type; soredia/blastidia (26-) 85 ± 54 (-320) µm in diam. (n=138). Cortex/alveolate cortex (4-) 15 ± 10 (-55) µm thick (n=109).

Apothecia frequent, *c.* (0.25-) 0.6 ± 0.25 (-1.6) mm broad (n=114). Exciple (70-) 121 ± 31 (-200) µm thick (n=25), zeorine, true exciple prevailing in old apothecia, often covered by blastidia/isidia. Hymenium (60-) 78 ± 17 (-130) µm thick (n=50). Paraphyses tips widened to (3.0-) 4.5 ± 0.5 (-6.0) µm (n=72). Ascospores (9.0-) 13.0 ± 1.5 (-16.0) × (3.0-) 6.5 ± 1.0 (-9.0) µm in size (n=77); length/width ratio *c*. 2.0. Ascospore septa (3.0-) 5.5 ± 1.0 (-8.0) µm thick (n=77), *c*. 0.42 of ascospore length. Conidia (2.5-) 3.5 ± 0.8 (-5.5) × (1.0-) 1.15 ± 0.25 (-1.5) µm (n=33).

Remarks. The diagnostic characters of this species are large soredia/blastidia, *limonia* type of soralia, ± pale yellow thallus and thick apothecial margin often covered by blastidia/isidia. *Caloplaca citrina*, that has a more northern distribution, is probably the most similar species, but it differs on average in the smaller vegetative diaspores, which are often blastidia and not soredia.

Phylogeny. The sequences of *Caloplaca limonia* form a well-supported monophylletic group (PP=1.00, BS=94). It is a sister group to *C. arcis* and *C. arcisproxima* (PP=0.80, BS<50) and is more distantly releted to *C. austrocitrina* sequences (PP=0.92, BS<50).

Ecology and distribution. The species occurs mainly on coastal calcareous rocks, but also on base-rich, hard siliceous cliffs), in dry sun-exposed to shaded and damp situations, including twigs of maritime shrubs or soil. It is also known from inland localities, but it is often abundant in maritime habitats, where it occurs on sheltered shores from 2 m upwards (Rusalka, Bulgaria); on exposed shores from 20 m (Sinop, Turkey), 21 m (Rezovo, Bulgaria). Accompanying species: *Caloplaca* cf. *aegea*, *C. albolutescens*, *C. communis*, *C. confusa*, *C. flavescens*, *Caloplaca thracopontica*, *Catillaria chalybeia*, *Diploecia canescens*, *Diplotomma alboatrum* s.l., *Lecanora albescens*, *L. dispersa*, *Physcia adscendens*, *Rinodina gennarii*, *R. pityrea*, *Verrucaria macrostoma* f. *furfuracea*, and *V. nigrescens* s.l.

Caloplaca limonia is so far reported from Greece (Sipman & Raus 2002), Italy (e.g. Nimis et al. 1994) and Ukraine (Khodosovtsev 2001), but it is a common species in the Mediterranean and the Black Sea region. New to Bulgaria, Croatia, Czech Republic, Georgia, Morrocco, Romania, Russia, and Turkey.

Selected specimens examined: **Bulgaria.** *Black Sea coast*. Kavarna, limestone cliffs on seashore 1.5 km NE of Kamen Brjag, 2007, *J. Vondrák* (CBFS JV6138). **Croatia**. *Island of Arbe*. Arbe, 1927, *J. B. Kümmerte* (BP 27347). **Czech Republic**. *South Bohemia*. Písek, in town, 2005, *J. Vondrák* (CBFS JV2515). **Georgia**. *Black Sea coast*. Batumi, Sarpi (Georgian-Turkish border), 2007, *J. Vondrák* (CBFS JV6150). **Italy**. Distr. Verona, *Massalongo* (BP 27353, ex herb. A. Massal.). **Morrocco**. Rabat, 1930, *Andreánszky* (BP 46517). **Romania**. *Dobrogea*. Tulcea, Jurilovca, rocky cliff at Doloşman Cape, 2007, *J. Vondrák* (CBFS JV5376). **Russia**. *Black Sea coast*. Tuapse, coastal rocks NW of town, 2007, *J. Vondrák* (CBFS JV6160). **Turkey**. *Black Sea coast*. Sinop, coastal rocks on E coast of peninsula, 2007, *J. Vondrák* (CBFS JV6143); *Aegean Sea coast*. Gallipoli peninsula, coastal rocks near Güneyli, 2007, *J. Vondrák* (CBFS JV6148); *Marmara Sea coast*. Karabiga, S-exposed coastal rocks on headland E of town, 2007, *J. Vondrák* (CBFS JV6147). **Ukraine**. *Crimean Peninsula*. Sudak, coastal rocks at W part of cape Meganom, 2007, *J. Vondrák* (CBFS JV6019).

Caloplaca nigromarina **VONDRÁK, ARUP & SØCHTING NOM. PROV.**

Typus. **Georgia**. *Adjara*. Sarpi (Georgian-Turkish border), coastal cliffs N of village, 41°31'58.19"N, 41°32'58.35"E, on siliceous rock, 25 April 2007, *J. Vondrák* (CBFS JV6091 - Holotypus).

Proposed diagnosis. Against *Caloplaca flavocitrina*, it has usually bright yellow-orange squamules and against *C. confusa*, it differs in presence of only *confusa* and *flavocitrina* types of soralia. Restricted to coastal siliceous cliffs.

Fig. 8 E

Thallus yellow-orange (in shaded sites yellow), of dispersed squamules, or continuous areolate. Areoles/squamules (60-) 106 ± 25 (-170) µm thick (n=39) and (0.18-) 0.44 ± 0.19 (-1.25) mm wide (n=89). Areoles and squamules flat, smooth, with marginal soralia of *confusa* or *flavocitrina* type; soredia/consoredia (16-) 31 ± 9 (-50) µm in diam. (n=89). Cortex developed, (5-) 17 ± 8 (-37) µm thick (n=90).

Apothecia infrequent (40% of samples fertile), (0.45-) 0.6 ± 0.1 (-0.8) mm broad (n=15). Exciple (40-) 75 ± 33 (-150) µm thick (n=15), zeorine; true exciple fills *c*. 1/2 of the exciple width. In young apothecia, thalline exciple may be hidden below true margin. Hymenium (50-) 70 ± 10 (-90) µm thick (n=13). Paraphyses tips widened to (3.0-) 4.5 ± 1.0 (-6.5) µm (n=29). Ascospores (9.0-) 11.5 ± 1.5 (-15.0) × (4.0-) 6.0 ± 1.0 (-8.5) µm in size (n=17); length / width ratio *c*. 1.9. Ascospore septa (3.5-) 5.0 ± 1.0 (-7.0) µm thick (n=17), *c*. 0.43 of ascospore length.

Conidia (2.0-) 3.2 ± 0.5 (-4.5) × (1.0-) 1.25 ± 0.25 (-1.5) µm (n=29).

Etymology. The name is derived from the distribution of the new species on shores of the Black Sea.

Phylogeny. The sequences of *Caloplaca nigromarina* form a fairly well-supported monophyletic group (PP=0.94, BS=66). At the base of this clade there is a single specimen (EU563433) that can not be asigned to any known species, but it is appearantly related to *C. nigromarina* (PP=1.0, BS=84). However, it differs clearly in morphology. These two taxa form a sister group to a clade formed by *C. confusa*, *C. marina* and *C. microthallina* (PP=0.99, BS=97).

Remarks. *Caloplaca nigromarina* shares the squamulose thallus and marginal soralia with the extremly similar species *Caloplaca confusa* and *C. flavocitrina*. However, from the former species, it differs in absence of *limona* type of soralia, and from the latter, in its yellow-orange thallus and in ecology.

Ecology and distribution. This species is restricted to siliceous sea shore cliffs in the lower supralitoral zone. Accompanying species are usually few, only, e.g. *Caloplaca* cf. *aegea*, *C. fuscoatroides*, *Lecanora albescens*, and *L. dispersa*. The species is so far only known from the Bulgarian, Georgian and Turkish Black and Aegean Sea coast.

Specimens examined: **Bulgaria.** *Black Sea coast*. Burgas, Tsarevo, Sinemorets, coastal rocks, 2004, *J. Vondrák* (CBFS JV4983). **Turkey**. *Aegean Sea coast*. Gallipoli Peninsula, coastal rocks near Güneyli, 2007, *J. Vondrák* (CBFS JV5482); *Black Sea coast*. Istanbul, Kemerburgaz, Kilyos, 2005, *J. Vondrák* (CBFS JV3354); Lülenburgaz, Vize, Kiyiköy, coastal rocks, 2005, *J. Vondrák* (CBFS JV3035); Zonguldag, Sazköy, 1992, *V. John & E. Sauer* (GZU, Lich. Anatol. Exsicc. 80, sub *C. citrina*).

EXTENSIVELY TREATED SPECIES

Caloplaca britannica R. SANT., IN LAUNDON, LICHENOLOGIST 24: 2 (1992)

Type: Great Britain, Caithness (UPS, holotype; GZU, isotype!)

This taxon was recently misunderstood by Aptroot & van Herk (2004), who considered *Caloplaca britannica* conspecific with *C. limonia*, that is widely distributed in coastal as well as inland Europe as well as in the Black Sea region: Crimea (Khodosovtsev 2001, sub *C. limonia*). However, *C. britannica* is a blastidiate-isidiate species that does not belong to the *C. citrina* clade (Arup, *unpublished data*) and is restricted to coastal cliffs. We investigated two samples from the Netherlands, named *C. britannica* by A. Aptroot, and both samples belong to *C. arcis*.

Caloplaca citrina (HOFFM.) TH. FR., ACTA SOC. REGIAE SCI. UPSAL. 3: 218 (1860)

Bas.: *Verrucaria citrina* Hoffm. Deutschlands Flora: 198 (1796); type: *Lecanora citrina*, Svecia (H, neotype)

According to the GBIF web site (www.gbif.org), this species is considered a cosmopolite. However, according to molecular data, provided by Arup (2006a) and this study, *Caloplaca citrina* may be a species with rather restricted distribution. The species has so far been confirmed only from North and Central Europe. In the Mediterranean and the Black Sea region it is replaced by other species, e.g. *C. limonia*.

***Caloplaca marina* (WEDD.) ZAHLBR.,** IN DU RIETZ, ZUR METHODOLOGISCHEN GRUNDLAGE DER MODERNEN PFLANZENZOCIOLOGIE, 170 (1921)

Bas.: *Lecanora marina* Wedd., Mém. Soc. Nat. Sc. Cherb. 19: 275 (1875); type: France, Vendée, 1875, *Weddell* (PC, lectotype; TUR, hb.Vainio 7188, isotype)

This morphologically distinct species was not confirmed from the Black Sea region and is probably absent there. Reports from Turkey (John & Breuss 2004) and Ukraine (e.g. Redchenko 2002) are probably incorrect. Turkish material was not revised by us, but the Ukrainian samples in KHER (collected by A. Khodosovtsev or A. Redchenko) were revised as *Caloplaca calcitrapa* or *C. irrubescens* (Arnold) Zahlbr.

***Caloplaca maritima* (DE LESD.) DE LESD.,** REV. BRYOL. LICHÉNOL. 22, FASC. 3-4: 313 (1953)

Bas.: *Caloplaca citrina* var. *maritima* B. de Lesd., Sched. ad Krypt. exsicc., Cent. 17 (1909); type: France, Dunkerque, on calcareous stone, *de Lesdain* (Krypt. exsicc. 1667, W!, lectotype)

Based on molecular data, this species is closely related to *Caloplaca communis*. Whereas, *C. communis* occurs in the Black Sea region and Eastern Mediterranean, *C. maritima* is probably restricted to the Atlantic coast of Europe. Samples from southern France named *C. maritima* by Arup (1997a), need confirmation. Some specimens of *C. communis* with smooth thallus without granules are morphologically indistinguishable from a well-developed material of *C. maritima* from the Atlantic coast of Europe.

***Caloplaca microthallina* (WEDD.) ZAHLBR.,** CAT. LICH. UNIV. 7: 247 (1931)

Bas.: *Lecanora microthallina* Wedd., Mém. Soc. Nat. Sc. Cherb. 19: 276 (1875); type: France, Vendée, 1875, *Weddell* (PC, lectotype)

This species may morphologically resemble some morphotypes of *Caloplaca communis*, but *C. microthallina* has not been confirmed from the Black Sea region by molecular data and it is probably absent there. Records from Bulgaria (Vězda 1975) and Ukraine (e.g. Redchenko 2002) are based on *C. communis*.

***Caloplaca ora* POELT & NIMIS,** IN NIMIS & POELT, STUDIA GEOBOTANICA 7: 70 (1987)

Type: France, Corse, Ajaccio, on granite coastal cliff, 1969, Lambinon, *Rondon & Vězda* (A. Vězda: Lich. Sel. Exs. 849, W!, isotype)

Based on the samples from GZU and W, we consider this Mediterranean taxon heterogenous. Various specimens with orange, areolate to bullate thallus, otherwise similar to *Caloplaca maritima*, are placed here. However, at least part of samples, named as *C. ora*, belong to the *C. citrina* group (Fig. 1). The taxon must be further studied.

***Caloplaca phlogina* (ACH.) FLAG.,** MÉM. SOC. EMULAT. DOUBS: 250 (1886)

Bas.: *Lecanora phlogina* (Ach.) Nyl., Act. Soc. Linn. Bord. 21: 324 (1857); type: Sweden. Skåne: Lund, on *Ulmus*, 2005, *Arup L05001* (LD!, neotype)

Fig. 8 F

Although extremely similar to *Caloplaca citrina*, the species does not belong to the *Caloplaca citrina* clade. The species, known as an epiphyte from the North Europe (Arup 2006) and northern France (Sérusiaux et al. 1999), also occurs in the Black Sea region as an epiphyte, but also on loess soil and on concrete.

Specimens confirmed by ITS nrDNA data: **Romania**. Constanta, Mangalia, on concrete, 2005, *Vondrák* (CBFS JV3437, sub *C. citrina*, GenBank nr EU563460). **Russia**. *Taman Peninsula*. on loess and on *Salicornia* shrubs, 2007, *Vondrák* (CBFS JV6060, 6061, 6224).

General results from the phylogenetic analysis

Even if this study is mainly a taxonomic one, the results can be viewed upon in a broader perspective than just the species level. Some general conclusions and observations are discussed below.

1. **Convergences**. There are strong convergences in morphology in sorediate species, which are not related to each other. For instance *Caloplaca flavogranulosa*, *C. phlogina*, *C. sorediella*, and *C. soropelta* are morphologically extremely similar to some members of the *C. citrina* clade, but belong to different, unrelated groups. It is therefore very unpredicatble to asign a species to the *C. citrina* clade without molecular anlyses. Even within this clade there are similar species in distant positions in the phylogenetic tree. (Fig. 1).

2. **Changes in vegetative characters**. It is surprising how frequent are the shifts from sorediate to non-sorediate states or switches between different kinds of soralia (*flavocitrina*-type vs. *limonia*-type). Whether these shifts are due to mutations or variations in the expression of genes is not known, but it causes problems in the understanding of the taxonomy. If we assume that the *C. citrina* clade evolved from a non-sorediate ancestor, which seems possible, there has been, for instance, one gain of soredia and four subsequent, independent losses of soredia.

3. **Cryptic species**. The molecular analysis revealed a number of ± cryptic species, where the morphological and chemical diagnostic characters are hard to be provided, for instance, the squamulose sorediate species *C. confusa*, *C. flavocitrina*, and *C. nigromarina*.

4. **Biodiversity**. The number of species in the *C. citrina* clade will probably increase strongly, if this group is surveyed in another geographical area using molecular data. This is also confirmed by new data from the British Isles (Arup, *unpublished data*).

5. **Species distribution**. Distributions of some taxa, which were supposed to be wide-spread or even cosmopolitan, have in fact very restricted natural ranges. For instance, *C. citrina* s. str. is absent from the Black Sea region and its range may be restricted to some parts of Europe. This situation seems to be true also for some maritime species; e.g. *Caloplaca marina*, *C. maritima*, and *C. microthallina*, which are absent from the Black Sea region and very probably from the eastern Mediterranean.

6. **Appraisal of taxonomical importance of some morphological characters**. Our molecular data also suggest that some ascospore characters appear to be of less taxonomical importance, than previously thought. It concerns mainly the "sand glass ascospores" with thick walls, which were used as a diagnostic character of *C. calcitrapa* (Navarro-Rosinés et al. 2000) and *C. dichroa* (Arup 2006a). In some specimens of both species, confirmed by molecular data, only thin-walled "*citrina*-type ascospores" were observed. This topic is of particularly high taxonomical importance and we plan to study this phenomenon further.

Acknowledgements

We are grateful to Pavel Hrouzek (Třeboň, CZ) for providing analyses of anthraquinones and Jaroslav Šoun (České Budějovice, CZ) for his help with molecular lab work. The project was supported by the Grant Agency of the Academy of Sciences of the Czech Republic (KJB 601410701) by the Ministry of Education, Youth and Sports (MSM 6007665801) and by a grant from the European Commission's (FP 6) Integrated Infrastructure Initiative programme SYNTHESYS (DK-TAF).

REFERENCES

Aptroot, A. & van Herk, C. M. (2004) *Caloplaca britannica* common in non-maritime environments. *Lichenologist* **36**: 261-264.

Arup, U. (1992a) *Caloplaca marina* and *C. rosei*, two difficult species in North America. *The Bryologist* **95**: 148-160.

Arup, U. (1992b) *Caloplaca stantonii* sp. nov. and its relationship to *Caloplaca bolacina* and other lobate to squamulose species in North America. *The Bryologist* **95**: 449-457.

Arup, U. (1993a) *Caloplaca flavogranulosa* sp. nov. and *C. citrina*, two sorediate species on seashore rocks in western North America. *The Bryologist* **96**: 598-603.

Arup, U. (1993b) *Caloplaca luteominia* and *C. bolanderi* in western North America. *The Bryologist* **96**: 463-470.

Arup, U. (1994) The genus *Caloplaca* on seashore rocks in eastern North America. *The Bryologist* **97**: 377-392.

Arup, U. (1995a) Eight species of *Caloplaca* in coastal western North America. *The Bryologist* **98**: 92-111.

Arup, U. (1995b) Littoral species of *Caloplaca* in North America: a summary and key. *The Bryologist* **98**: 129-140.

Arup, U. (1997a) *Caloplaca maritima*, a misunderstood species in western Europe. *Lichenologist* **29**: 503-512.

Arup, U. (1997b) [1998] Correction of reports of two *Caloplaca* species from North America. *The Bryologist* **100**: 516.

Arup, U. (2006a) A new taxonomy of the *Caloplaca citrina* group in the Nordic countries, except Iceland. *Lichenologist* **38**: 1-20.

Arup, U. (2006b) *Caloplaca sorediella* Arup, a new sorediate species from western Britain. *Lichenologist* **38**: 499-502.

Brodo, I. M. & Santesson, R. (1997) Lichens of the Queen Charlotte Islands, British Columbia, Canada. 3. marine species of *Verrucaria* (Verrucariaceae, Ascomycotina). *Journal of the Hattori Botanical Laboratory* **82**: 27-37.

Bungartz, F. (2002) Morphology and anatomy of the fertile structures. In *Lichen Flora of the Greater Sonoran Desert Region*. *I.* (T. H. Nash III, B. D. Ryan, C. Gries & F. Bungartz, eds): 24-35. Tempe: Lichens Unlimited, Arizona State University.

Ekman, S. (2001) Molecular phylogeny of the *Bacidiaceae* (*Lecanorales*, lichenized Ascomycota). *Mycological Research* **105**: 783-797.

Fletcher, A. (1973a) The ecology of marine (littoral) lichens on some rocky shores of Anglesey. *Lichenologist* **5**: 368-400.

Fletcher, A. (1973b) The ecology of maritime (supralittoral) lichens on some rocky shores of Anglesey. *Lichenologist* **5**: 401-422.

Fletcher, A. (1975a) Key for the identification of British marine and maritime lichens. I. Siliceous rocky shore species. *Lichenologist* **7**: 1-52.

Fletcher, A. (1975b) Key for the identification of British marine and maritime lichens. II. Calcareous and terricolous species. *Lichenologist* **7**: 73-115.

Foucard, T. (2001) *Svenska Skorplavar*. Interpublishing, Stockholm. 392 pp.

Gardes, M. & Bruns, T. D. (1993) ITS primers with enhanced specificity for basidiomycetes. Application for the identification of mycorrhizae and rusts. *Molecular Ecology* **2**: 113-118.

Gaya, E., Navarro-Rosinis, P., Llimona, X., Hladun, N. & Lutzoni, F. (2008) Phylogenetic reassessment of the *Teloschistaceae* (lichen-forming Ascomycota Lecanoromycetes). *Mycological Research* **112** (in press)

Güvenc, S. & Öztürk, S. (1999) Lichens in the north-east regions of Cyprus. *Feddes Repertorium* **110**: 455-463.

Hall, T. A. (1999) BioEdit: a user-friendly biological sequence alignment editor and analysis program for Windows 95/98/NT. *Nucleic Acids Symposium Series* **41**: 95-98.

Hansen, E. S., Poelt, J. & Søchting, U. (1987) Die Flechtengattung *Caloplaca* in Gronland. *Meddelelser om Gronland*, *Bioscience* **25**: 1-52.

Harada, H. (2004) Revision of marine and maritime species of *Verrucaria* in Japan. *Lichenology* **2**: 177.

John, V. & Breuss, O. (2004) Flechten der östlichen Schwarzmeer-Region in der Türkei (BLAM-Exkursion 1997) *Herzogia* **17**: 137-156.

Katoh, K., Kuma, K., Toh, H. & Miyata, T. (2002) MAFFT: a novel method for rapid multiple sequence alignment based on fast Fourier transform. *Nucleic Acids Research* **30**: 3059-3066.

Khodosovtsev, O. Y. (2001) [A new for Ukraine species of the genus *Caloplaca* Th. Fr. (*Teloschistaceae*).] *Ukrayinskyi Botanichnyi Zhurnal* **58**: 460-465. (in Ukrainian)

Khodosovtsev, O. Y. (2002) [A new for Ukraine and rare species of the genus *Caloplaca* Th. Fr. (*Teloschistaceae*) from southern Ukraine.] *Ukrayinskyi Botanichnyi Zhurnal* **59**: 321-329. (in Ukrainian)

Khodosovtsev, O. Y. (2003) [A new for Crimea and Ukraine species of lichens from siliceous outcrops.] *Ukrayinskyi Botanichnyi Zhurnal* **60**: 70-78. (in Ukrainian)

Khodosovtsev, A. Y., Kondratyuk, S.Y. & Karnefelt, I. (2002) *Caloplaca albopustulata*, a new lichen from Crimea peninsula (Ukraine). *Graphis Scripta* **13**: 5-8.

Khodosovtsev, O. Y., Kondratyuk, S. Y. & Kärnefelt, I. (2003): New species of *Caloplaca* from Crimean Peninsula (Ukraine). *Ukrayinskyi Botanichnyi Zhurnal* **60**: 293-297.

Khodosovtsev, O. Y., Vondrák, J., Šoun, J. (2007) New lichenized and lichenicolous fungi for the Crimean Peninsula (Ukraine). *Chornomorskyi Botanichnyi Zhurnal* **3**: 109-118.

Laundon, J. R. (1992a) *Caloplaca*. In *The Lichen Flora of Great Britain and Ireland*. (O. W. Purvis, B. J. Coppins, D. L. Hawksworth, P. W. James & D. M. Moore, eds.): 141-159. London: Natural History Museum Publications & British Lichen Society.

Laundon, J. R. (1992b) New British species of *Caloplaca*. *Lichenologist* **24**: 1-5.

Laundon, J. R. (1976) Lichens new to the British flora: 5. *Lichenologist* **8**: 139-150.

McCarthy, P. M. (1991) Notes on Australian *Verrucariaceae* (Lichenes): 2. *Muelleria* **7**: 317-332.

Navarro-Rosinés, P., Gaya, E. & Roux, C. (2000) *Caloplaca calcitrapa* sp. nov. (*Teloschistaceae*) un nuevo liquen saxícolo-calcícola mediterráneo. Bulletin de la Société Linnéenne de Provence 51: 145-152.

Navarro-Rosinés, P. & Hladun, N. L. (1996) Les especies saxícolo-calcícolas del grupo de *Caloplaca lactea* (*Teloschistacceae*, líquenes), en las regiones mediterranea y medioeuropea. *Bulletin de la Société Linéenne de Provence* **47**: 139-166.

Navarro-Rosinés, P. & Roux, C. (1993) *Caloplaca tavaresiana* Nav.-Ros. et Roux sp. nov., espèce nouvelle de lichen du littoral de la région méditerranéenne. *Nova Hedwigia* **57**: 169-177.

Navarro-Rosinés, P. & Roux, C. (1995) *Caloplaca navasiana* Nav.-Ros. et Roux sp. nov., espèce nouvelle de lichen du littoral Méditerranéen. *Cryptogamie*, *Bryologie-Lichénologie* **16**: 89-97.

Nimis, P. L. & Poelt, J. (1987) The lichens and lichenicolous fungi of Sardinia (Italy): an annotated list. *Studia Geobotanica* **7**: 1-269.

Nimis, P. L., Poelt, J., Tretiach, M., Ottonello, D., Puntillo, D. & Vězda, A. (1994) Contributions to lichen floristics in Italy. VII - The lichens of Marettimo (Egadi Islands, Sicily). *Bulletin de la Société Linnéenne de Provence* **45**: 247-262.

Nordin, I. (1972) *Caloplaca sect. Gasparrinia in Nordeuropa. Taxonomiska och Ekologiska Studier*. Uppsala: Skriv Service AB.

Nylander, J. A. A., Ronquist, F., Huelsenbeck, J. P. & Nieves-Aldrey, J. L. (2004) Bayesian phylogenetic analysis of combined data. *Systematic Biology* **53**: 47-67.

Redchenko, A. A. (2002) The lichens of seaside part of Kerchen Peninsula. *Ukrayinskyi Botanichnyi Zhurnal* **59**: 426-436.

Ryan, B. D., Bungartz, F. & Nash, T. H. III (2002) Morphology and anatomy of the lichen thallus. In *Lichen Flora of the Greater Sonoran Desert Region*. I. (T. H. Nash III, B. D. Ryan, C. Gries & F. Bungartz, eds): 8-23. Tempe: Lichens Unlimited, Arizona State University.

Ronquist, F. & Huelsenbeck, J. P. (2003) MRBAYES 3: Bayesian phylogenetic inference under mixed models. *Bioinformatics* **19**: 1572-1574.

Roux, C., Bricaud, O., Ménard, T., Gueidan, C., Coste, C. & Navarro-Rosinés, P. (2003) Champignons lichénisés et lichénicoles de la France méridionale (Corse comprise): espèces nouvelles et intéressantes (9). *Bulletin de la Société Linnéenne de Provence* **54**: 125-141.

Roux, C. & Navarro-Rosinés, P. (1992) *Caloplaca egeana* Roux et Nav.-Ros. sp. nov. kaj *Caloplaca veneris* Roux et Nav.-Ros. sp. nov., du novaj likenspecioj de la mediteranea marbordo. *Bulletin de la Société Linnéenne de Provence* **43**: 97-103.

Sérusiaux, E., Diederich, P., Brand, A. M. & van den Boom, P. (1999): New or interesting lichens and lichenicolous fungi from Belgium and Luxembourg. VIII. *Lejeunia* **162**: 1-95.

Sheard, J. W. (1978) The taxonomy of the *Ramalina siliquosa* species aggregate (lichenized Ascomycetes). *Canadian Journal of Botany* **56**: 916-938.

Sipman, H. & Raus, T. (1999) A lichenological comparison of the Paros and Santorini island groups (Aegean, Greece), with annotated checklist. *Willdenowia* **29**: 239-297.

Sipman, H. & Raus, T. (2002) An inventory of the lichen flora of Kalimnos and parts of Kos (Dodecanisos, Greece). *Willdenowia* **32**: 351-392.

Sipman, H., Raus, T. & Scharlau, A. (2005) Some lichens have incomplete distribution ranges in the Aegean (Greece). *Folia Cryptogamica Estonica* **41**: 97-104.

Søchting, U. (1992) *Caloplaca soropelta* (E. S. Hansen, Poelt & Søchting) Søchting comb. nov. *Graphis Scripta* **4**: 35-36.

Søchting , U. (1997) Two major anthraquinone chemosyndromes in *Teloschistaceae*. *Bibliotheca Lichenologica* **68**: 135-144.

Swofford, D. L. (2002) PAUP*. *Phylogenetic Analysis Using Parsimony (*and Other Methods). Version 4*. Sunderland, Massachusetts: Sinauer Associates.

Szatala, Ö. (1943a) Lichens. In K. H. Rechinger, Flora Aegaea - Flora der Inseln und Halbinseln des Ägäischen Meeres. *Denkschriften: Akademie der Wissenschaften Wien, Mathematisch-Naturwissenschaftliche Classe* **105**: 16-58.

Szatala, Ö (1943b) Lichenes. In K. H. Rechinger, Neue Beiträge zur Flora von Kreta (Ergebnisse einer biologischen Forschungsreise nach dem Peloponnes und nach Kreta 1942, im Auftrage des Oberkommandos der Wehrmacht und des Reichsforschungsrates, Nummer 6). *Denkschriften: Akademie der Wissenschaften Wien, Mathematisch-Naturwissenschaftliche Classe* **105**, 2. Halbband, 1. Abt.: 27-47.

Tavares, C. N. (1956) Notes lichenologiques-IX. *Revista da Faculdade de Ciências de Lisboa. 2. ser. (C)* **5**: 123-134.

Tehler, A., Dahlkild, A., Eldenas, P. & Feige, G. B. (2004) The phylogeny and taxonomy of Macaronesian, European and Mediterranean *Roccella* (*Roccellaceae, Arthoniales*). *Symbolae Botanicae Upsalienses* **34**: 405-428.

Vězda, A. 1975: *Lichenes selecti exsiccati. Fasc. 55 (ns 1351-1375)*. Instituto Botanico Academiae Scientiarum Čechoslovacae, Průhonice prope Pragam.

Vězda, A. (1993) *Lichenes rariores exsiccati. Fasc. 6 (ns 51-60)*. Brno.

Vondrák, J. & Slavíková-Bayerová, Š. (2006) Contribution to the lichenized and lichenicolous fungi in Bulgaria. II, the genus *Caloplaca*. *Mycologica Balcanica* **3**: 61-69.

Vondrák, J., Kocourková, J., Palice, Z. & Liška, J. (2007) New and noteworthy lichens in the Czech Republic - genus *Caloplaca*. *Preslia* **79**: 163-184.

Vondrák, J., Guttová, A. & Mayrhofer, H. (2008) A contribution to the knowledge of lichen-forming and lichenicolous fungi in Crete. *Herzogia* **21** (*in press*).

Wetmore, C. M. (2003) The *Caloplaca squamulosa* group in North and Central America. *The Bryologist* **106**: 147-156.

White, T. J., Bruns, T. D., Lee, S. & Taylor, J. (1990) Amplification and direct sequencing of fungal ribosomal DNA genes for phylogenies. In *PCR Protocols: a Guide to Methods and Applications* (M. A. Innis, D. H. Gelfand, J. J. Sninsky & T. J. White, eds): 315-322. San Diego: Academic Press.

Yazici, K. (1999) Trabzon ili likenleri [Lichen flora of Trabzon]. *Turkish Journal of Botany* **23**: 97-112. (in Turkish)

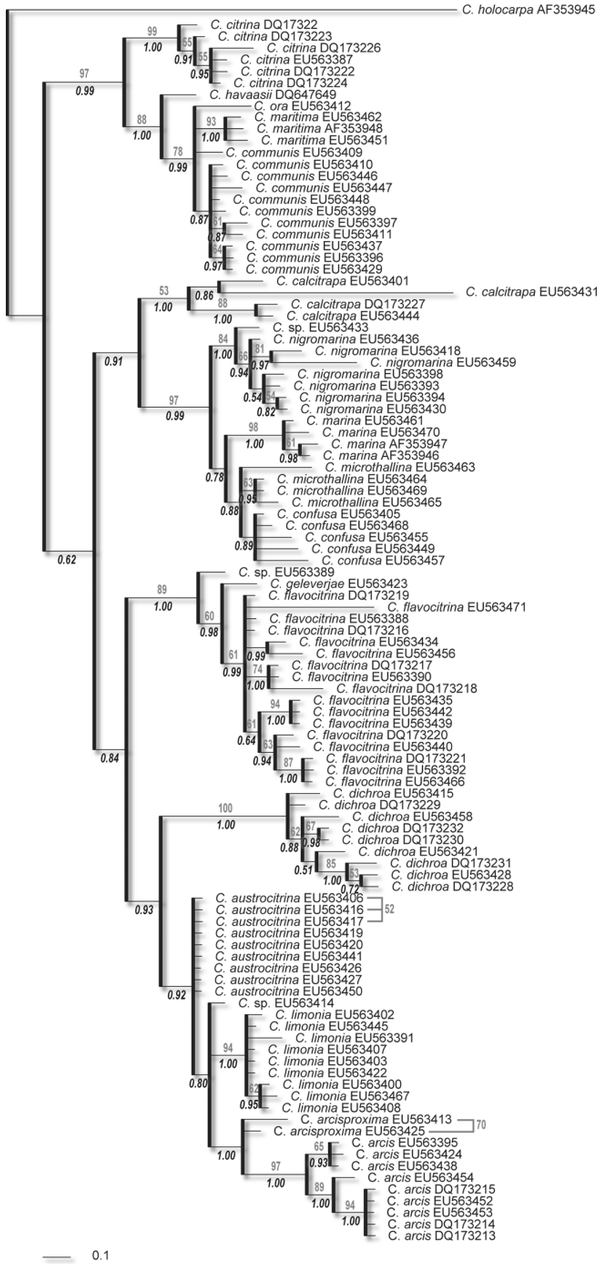

Fig. 1. Bayesian consensus phylogeny of the *Caloplaca citrina* group inferred from 105 nuclear ITS sequences. Node support values (in black) are Bayesian posterior probabilities and numbers in gray represent bootstrap values obtained after 1000-times resampled parsimony heuristics (bootstrap values under 50% are not shown). Groupings recovered by parsimony heuristics yet not by the Bayesian inference are depicted as gray lines right to the tree.

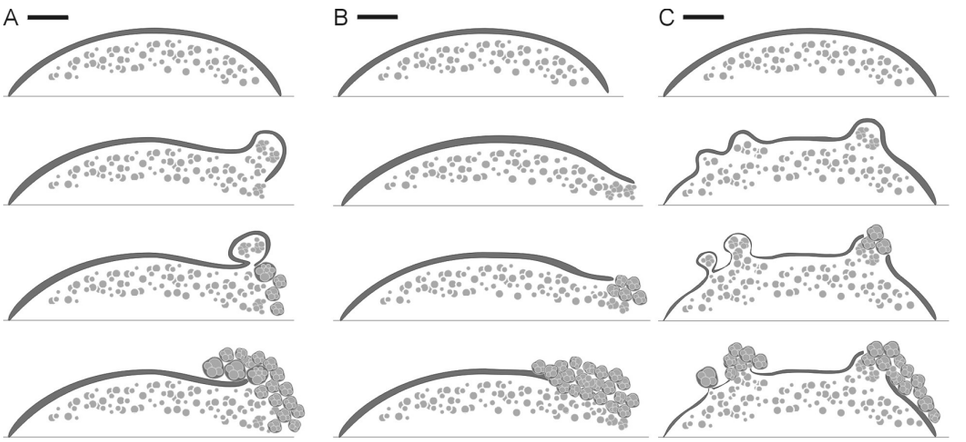

Fig. 2. Development of soralia occurring in the *Caloplaca citrina* group. A, *confusa* type; B, *flavocitrina* type; C, *limonia* type. Note that initial and late stages are almost identical in all types. Scales: 100 μm.

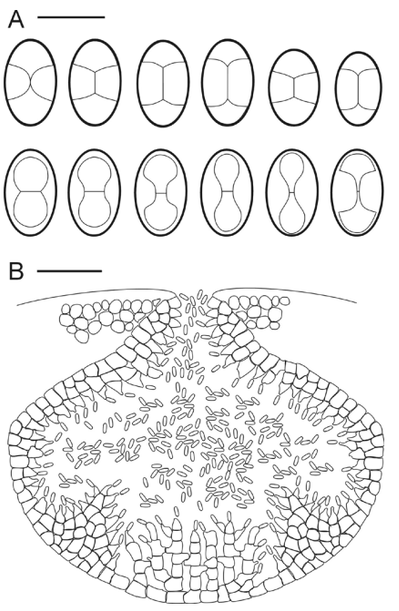

Fig. 3. A, ascospores of *Caloplaca calcitrapa*; upper row, *citrina* type spores (CBFS JV5486); lower row, sand glass type spores (CBFS JV6112); B, vertical section of a pycnidium in *C. communis* (CBFS JV3369). Scales: A, 10 μm; B, 20 μm.

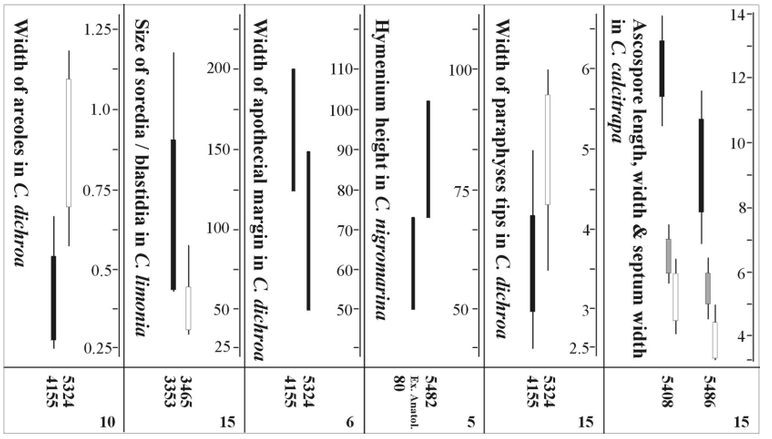

Fig. 4. Diagrams showing intraspecific variability in selected characters in some species. Distributions of data are expressed by means ± SD (boxes) and extremes, when n ≥ 10. Sample accession numbers and numbers of measurements are given below graphs. Scales in µm (at widt of areoles in mm).

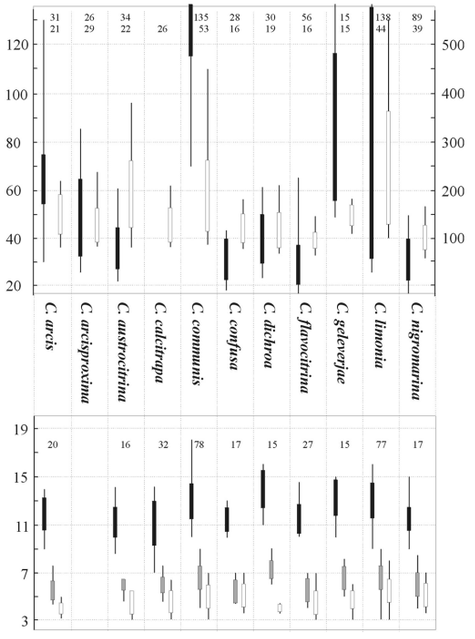

Fig. 5. Diagrams showing interspecific variability in some characters for treated species. Distributions of data are expressed by means ± SD (boxes) and extremes. Black boxes, above: sizes of vegetative diaspores (left scale); white boxes, above: thallus height (right scale); black boxes, below: ascospore length; grey boxes: ascospore width; white boxes: width of septa. Scales in µm.

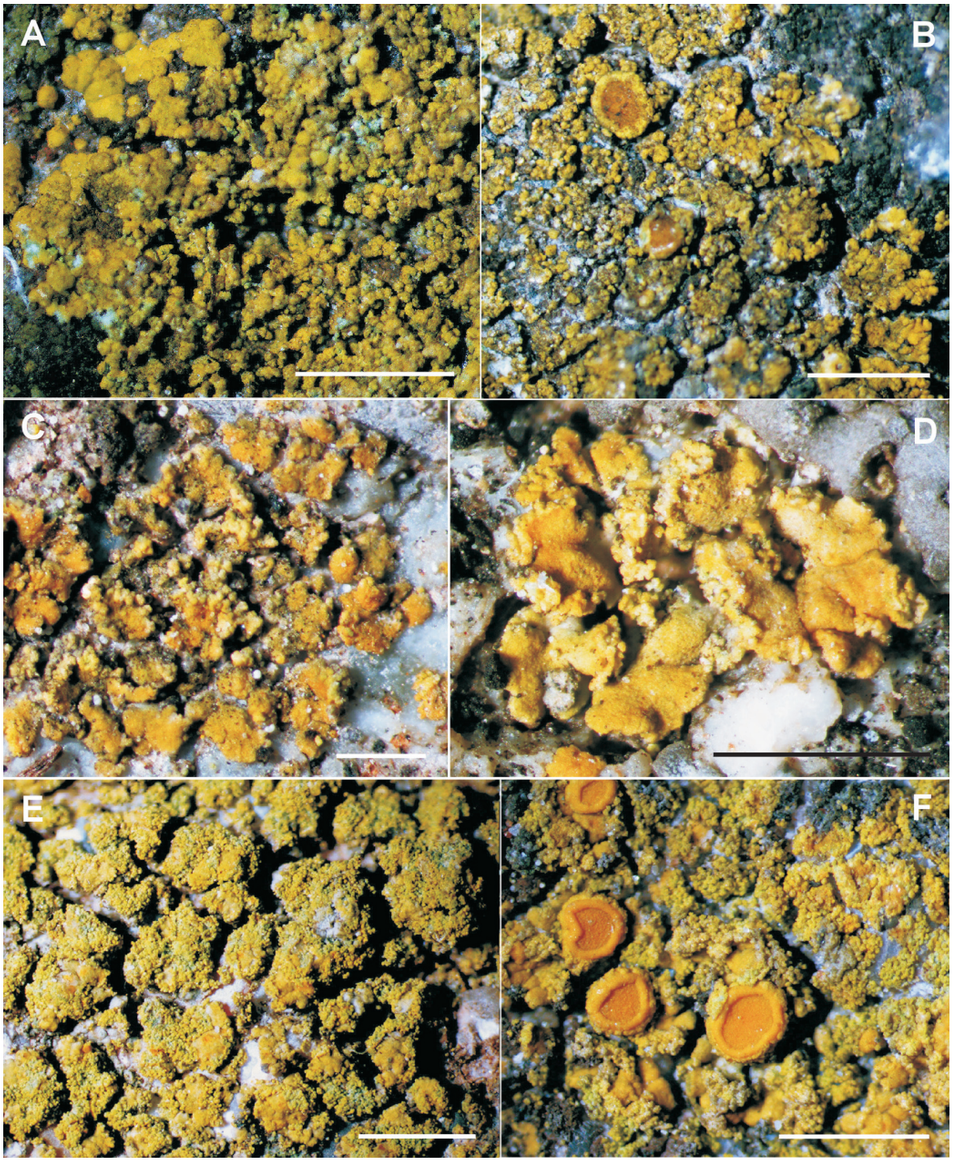

Fig. 6. Morphology of treated *Caloplaca* species. A, B, *Caloplaca arcis*; C, D, *C. arcisproxima*; E, F, *C. austrocitrina*. Scales: 1 mm.

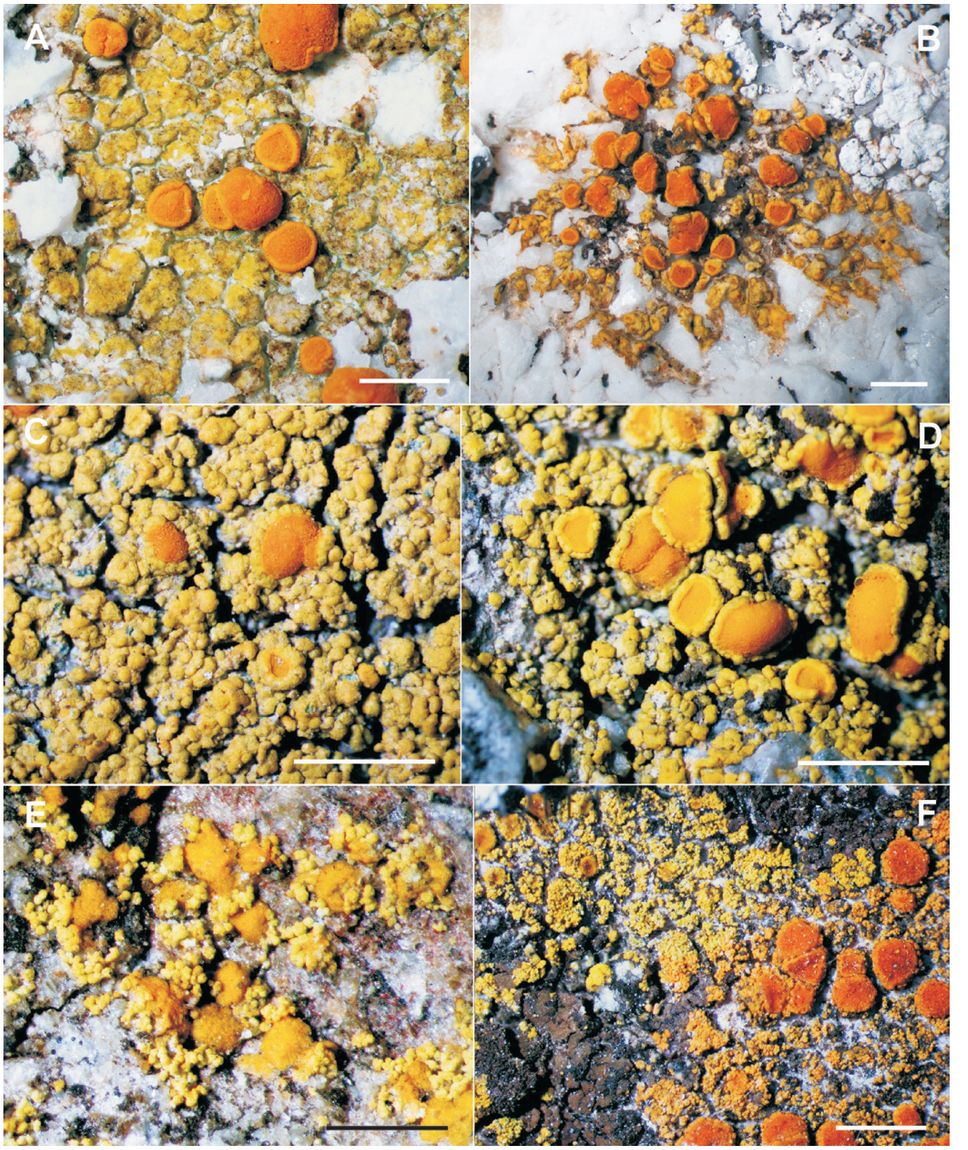

Fig. 7. Morphology of treated *Caloplaca* species.A, B, *Caloplaca calcitrapa*; C, D, *C. communis*; E, *C. confusa*; F, *C. dichroa*. Scales: 1 mm.

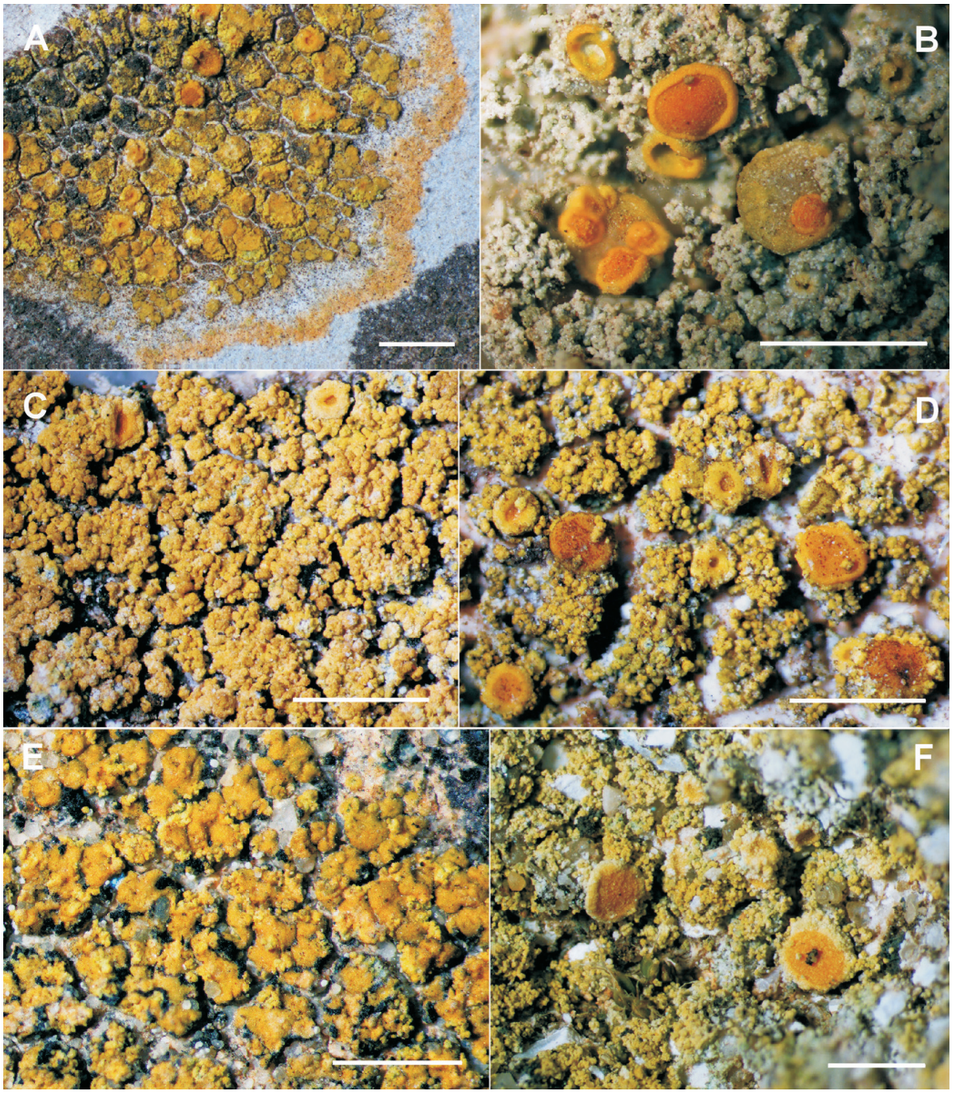

Fig. 8. Morphology of treated *Caloplaca* species. A, *Caloplaca flavocitrina*; B, *C. geleverjae*; C, D, *C. limonia*; E, *C. nigromarina*; F, *C. phlogina*. Scales: 1 mm.

Tab. 1. Sample data and GenBank accession numbers of the ITS sequences used in the phylogenetic analysis.

Species & Herbarium Accession No.	Source	GenBank Accession No.
Caloplaca arcis	**Austria**. (Arup 2006a)	DQ173213
Caloplaca arcis	**Sweden**. (Arup 2006a)	DQ173214
Caloplaca arcis	**England**. (Arup 2006a)	DQ173215
Caloplaca arcis W1990-00525	**Italy**. Sardinia (coll. W. Brunnbauer 1986)	EU563454
Caloplaca arcis CBFS JV3036	**Bulgaria**. Black Sea coast (coll. Vondrák 2005)	EU563395
Caloplaca arcis CBFS JV4985	**The Netherlands**. Noordoostpolder (coll. A. Aptroot 59871, 2004)	EU563453
Caloplaca arcis CBFS JV4986	**The Netherlands**. Gelderland (coll. A. Aptroot 59582, 2003)	EU563452
Caloplaca arcis CBFS JV5426	**Turkey**. Black Sea coast (coll. Vondrák 2007)	EU563424
Caloplaca arcis CBFS JV6093	**Bulgaria**. Black Sea coast (coll. Vondrák 2007)	EU563438
Caloplaca arcisproxima CBFS JV4125	**Greece**. South Crete (coll. Vondrák 2005)	EU563413
Caloplaca arcisproxima CBFS JV5473	**Ukraine**. Black Sea coast (coll. Vondrák 2007)	EU563425
Caloplaca austrocitrina CBFS JV991	**Czech Republic**. České Budějovice (coll. Vondrák 2003)	EU563450
Caloplaca austrocitrina CBFS JV3436	**Romania**. Black Sea coast (coll. Vondrák 2005)	EU563406
Caloplaca austrocitrina CBFS JV4195	**Greece**. North Crete (coll. Vondrák 2005)	EU563416
Caloplaca austrocitrina CBFS JV4631	**Bulgaria**. Black Sea coast (coll. Vondrák 2005)	EU563417
Caloplaca austrocitrina CBFS JV5236	**Ukraine**. Black Sea coast (coll. Vondrák 2006)	EU563419
Caloplaca austrocitrina CBFS JV5285	**Ukraine**. Black Sea coast (coll. Vondrák 2006)	EU563420
Caloplaca austrocitrina CBFS JV5474	**Russia**. Black Sea coast (coll. Vondrák 2007)	EU563426
Caloplaca austrocitrina CBFS JV5476	**Ukraine**. Black Sea coast (coll. Vondrák 2007)	EU563427
Caloplaca austrocitrina CBFS JV6097	**Russia**. Black Sea coast (coll. Vondrák 2007)	EU563441
Caloplaca calcitrapa	**France**. Languedoc-Roussellon, isotype (Arup 2006a)	DQ173227
Caloplaca calcitrapa CBFS JV3408	**Turkey**. Black Sea coast (coll. Vondrák 2005)	EU563401
Caloplaca calcitrapa CBFS JV5486	**Bulgaria**. Black Sea coast (coll. Vondrák 2007)	EU563431
Caloplaca calcitrapa CBFS JV6100	**Turkey**. Marmara Sea coast (coll. Vondrák 2007)	EU563444
Caloplaca citrina	**Sweden**. (Arup 2006a)	DQ173222
Caloplaca citrina	**Sweden**. (Arup 2006a)	DQ173223
Caloplaca citrina	**Sweden**. (Arup 2006a)	DQ173224
Caloplaca citrina	**Sweden**. (Arup 2006a)	DQ173225
Caloplaca citrina	**Sweden**. (Arup 2006a)	DQ173226
Caloplaca citrina CBFS JV1138	**Czech Republic**. Andělská Hora (coll. Vondrák 2003)	EU563387
Caloplaca communis CBFS JV3471	**Turkey**. Black Sea coast (coll. Vondrák 2005)	EU563409
Caloplaca communis CBFS JV3042	**Turkey**. Black Sea coast (coll. Vondrák 2005)	EU563397
Caloplaca communis CBFS JV3037	**Turkey**. Black Sea coast (coll. Vondrák 2005)	EU563396
Caloplaca communis CBFS JV3367	**Turkey**. Black Sea coast (coll. Vondrák 2005)	EU563399
Caloplaca communis CBFS JV3763	**Greece**. South Crete (coll. Vondrák 2005)	EU563410
Caloplaca communis CBFS JV3803	**Greece**. North Crete (coll. Vondrák 2005)	EU563411
Caloplaca communis CBFS JV5481	**Turkey**. Gallipoli Peninsula (coll. Vondrák 2007)	EU563429
Caloplaca communis CBFS JV6092	**Turkey**. Gallipoli Peninsula (coll. Vondrák 2007)	EU563437
Caloplaca communis CBFS JV6113	**Bulgaria**. Black Sea coast (coll. Vondrák 2007)	EU563447
Caloplaca communis CBFS JV6119	**Turkey**. Black Sea coast (coll. Vondrák 2007)	EU563448
Caloplaca confusa CBFS JV3435	**Bulgaria**. Black Sea coast (coll. Vondrák 2005)	EU563405
Caloplaca confusa CBFS JV6206	**Bulgaria**. Black Sea coast (coll. Vondrák 2007)	EU563449
Caloplaca confusa herb. F. Berger	**Azores**. Sao Jorje (coll. F. Berger 1992)	EU563468
Caloplaca confusa GZU Haf31862	**France**. Corse (coll. J. Hafellner 1993)	EU563457
Caloplaca confusa GZU	**Italy**. Sicily (coll. J. Poelt 1992)	EU563455
Caloplaca dichroa	**Sweden**. (Arup 2006a)	DQ173228
Caloplaca dichroa	**Sweden**. (Arup 2006a)	DQ173229
Caloplaca dichroa	**Sweden**. (Arup 2006a)	DQ173230
Caloplaca dichroa	**Sweden**. (Arup 2006a)	DQ173231
Caloplaca dichroa	**Sweden**. (Arup 2006a)	DQ173232
Caloplaca dichroa CBFS JV5324	**Romania**. Black Sea coast (coll. Vondrák 2007)	EU563421
Caloplaca dichroa CBFS JV5477	**Ukraine**. Karadag (coll. Vondrák 2007)	EU563428
Caloplaca dichroa CBFS JV4155	**Great Britain**. Bristol (coll. Vondrák 2006)	EU563415
Caloplaca dichroa GZU Haf43519	**Austria**. Tirolia, alt. c. 1000 m (coll. J. Hafellner 1997)	EU563458
Caloplaca aff. *flavocitrina* CBFS JV2051	**Bulgaria**. Lyubimets (coll. Vondrák 2004)	EU563389
Caloplaca flavocitrina	**Sweden**. (Arup 2006a)	DQ173216

Caloplaca flavocitrina	**Sweden**. (Arup 2006a)	DQ173217
Caloplaca flavocitrina	**Sweden**. (Arup 2006a)	DQ173218
Caloplaca flavocitrina	**Sweden**. (Arup 2006a)	DQ173219
Caloplaca flavocitrina L03203 (Herb. Arup)	**Sweden**. Halland: Värö par., Stavder harbour, on concrete (coll. Arup 2003)	DQ173220
Caloplaca flavocitrina CBFS JV1495	**Czech Republic**. Husinec (coll. Vondrák 2002)	EU563388
Caloplaca flavocitrina CBFS JV2106	**Bulgaria**. Black Sea coast, epiphytic (coll. Vondrák 2004)	EU563390
Caloplaca flavocitrina CBFS JV2536	**Czech Republic**. Kalubice (coll. Vondrák 2005)	EU563392
Caloplaca flavocitrina CBFS JV3425	**Bulgaria**. Black Sea coast, concrete (coll. Vondrák 2005)	EU563404
Caloplaca flavocitrina CBFS JV6089	**Russia**. Black Sea coast (coll. Vondrák 2007)	EU563434
Caloplaca flavocitrina CBFS JV6090	**Turkey**. Black Sea coast (coll. Vondrák 2007)	EU563435
Caloplaca flavocitrina CBFS JV6094	**Georgia**. Shuakhevi (coll. Vondrák 2007)	EU563439
Caloplaca flavocitrina CBFS JV6095	**Russia**. Black Sea coast (coll. Vondrák 2007)	EU563440
Caloplaca flavocitrina CBFS JV6098	**Georgia**. Black Sea coast (coll. Vondrák 2007)	EU563442
Caloplaca flavocitrina GZU Haf31888	**Italy**. Livorno, coastal rock (coll. J. Hagellner 1993)	EU563456
Caloplaca flavocitrina GZU Wetm76242	**Hawaii**. alt. c. 1700 m (coll. C. Wetmore 1996)	EU563471
Caloplaca geleverjae CBFS JV5415	**Ukraine**. Black Sea coast, topotype (coll. Vondrák 2007)	EU563423
Caloplaca havaasii BG	**Norway**. topotype (Arup 2006b)	DQ647649
Caloplaca limonia GZU	**Italy**. Marettimo, paratype (coll. Poelt 1991)	EU563467
Caloplaca limonia CBFS JV2515	**Czech Republic**. Písek (coll. Vondrák 2005)	EU563391
Caloplaca limonia CBFS JV3388	**Bulgaria**. Black Sea coast (coll. Vondrák 2005)	EU563400
Caloplaca limonia CBFS JV3410	**Turkey**. Black Sea coast (coll. Vondrák 2005)	EU563402
Caloplaca limonia CBFS JV3413	**Turkey**. Black Sea coast (coll. Vondrák 2005)	EU563403
Caloplaca limonia CBFS JV3438	**Bulgaria**. Black Sea coast (coll. Vondrák 2005)	EU563407
Caloplaca limonia CBFS JV3465	**Bulgaria**. Black Sea coast (coll. Vondrák 2005)	EU563408
Caloplaca limonia CBFS JV5352	**Romania**. Black Sea coast (coll. Vondrák 2007)	EU563422
Caloplaca limonia CBFS JV6101	**Turkey**. Black Sea coast (coll. Vondrák 2007)	EU563445
Caloplaca marina	**Great Britain**. England (Arup & Grube 1999)	AF353946
Caloplaca marina	**North America**. western coast (Arup & Grube 1999)	AF353947
Caloplaca marina BM 730882	**Great Britain**. Wales (2004)	EU563461
Caloplaca maritima C US7520	**Iceland**. S-Múlasýla (coll. U. Søchting 1997)	EU563470
Caloplaca maritima	**Great Britain**. Wales (Arup & Grube 1999)	AF353948
Caloplaca maritima CBFS JV4943	**Great Britain**. Wales (coll. U. Arup L92256, 1992)	EU563462
Caloplaca maritima CBFS JV4987	**The Netherlands**. Walcheren (coll. A. Aptroot 59408, 2003)	EU563451
Caloplaca microthallina C US7480	**Sweden**. Halland (coll. U. Søchting 1997)	EU563469
Caloplaca microthallina CBFS JV4939	**Great Britain**. England (coll. U. Arup L92274, 1992)	EU563464
Caloplaca microthallina CBFS JV4940	**Great Britain**. England (coll. U. Arup L92291, 1992)	EU563463
Caloplaca microthallina CBFS JV4941	**Great Britain**. Wales (coll. U. Arup L92307, 1992)	EU563465
Caloplaca nigromarina GZU Lich.Anat.Exsic. 80	**Turkey**. Black Sea coast (coll. V. John & E. Sauer 1992)	EU563459
Caloplaca nigromarina CBFS JV3035	**Turkey**. Black Sea coast (coll. Vondrák 2005)	EU563393
Caloplaca nigromarina CBFS JV3354	**Turkey**. Black Sea coast (coll. Vondrák 2005)	EU563398
Caloplaca nigromarina CBFS JV5482	**Turkey**. Gallipoli Peninsula (coll. Vondrák 2007)	EU563430
Caloplaca nigromarina CBFS JV4983	**Bulgaria**. Black Sea coast (coll. Vondrák 2004)	EU563418
Caloplaca nigromarina CBFS JV6091	**Georgia**. Black Sea coast (coll. Vondrák 2007)	EU563436
Caloplaca cf. *ora* CBFS JV3836	**Greece**. North Crete (coll. Vondrák 2005)	EU563412
Caloplaca phlogina CBFS JV3437	**Romania**. Black Sea coast (coll. Vondrák 2005)	EU563460
Caloplaca sp. CBFS JV4146	**Greece**. South Crete (coll. Vondrák 2005)	EU563414
Caloplaca sp. CBFS JV6086	**Turkey**. Black Sea coast (coll. Vondrák 2007)	EU563433
Caloplaca sp. CBFS JV6099	**Russia**. Black Sea coast (coll. Vondrák 2007)	EU563443

Tab. 2. Anthraquinone contents in selected species in the *Caloplaca citrina* clade.

	teloschistin	fallacinal	parietinic acid	emodin	parietin
Caloplaca arcis					
CBFS JV3036 (AP)	0.6	2.3	1.1	1	93.9
CBFS JV3036 (TH)	1	8.1	1	0.7	89.3
CBFS JV5426 (AP)	1	7.5	1.4	0.4	88.8
Caloplaca austrocitrina					
CBFS JV991 (TH)	1.4	5.4	0	1	92.2
CBFS JV4195 (AP)	3.3	16.8	2.1	1.3	76.5
CBFS JV4195 (TH)	3.4	26.7	1.3	1.5	67.1
CBFS JV5474 (AP)	2.3	14.1	1.6	0.8	80.1
Caloplaca calcitrapa					
CBFS JV3408 (AP)	0.6	2	0.7	0.8	96
Caloplaca citrina s.str.					
CBFS JV1138 (AP)	0.6	1.6	0.6	0.7	96.5
Caloplaca communis					
CBFS JV3367 (AP)	0.7	1.6	0.9	0.8	96
CBFS JV3367 (TH)	1.4	2.1	0	2.1	94.4
CBFS JV3467 (AP)	2	4.6	1.1	0.7	91.6
CBFS JV3763 (AP)	2.2	6.2	1.9	0.8	88.6
CBFS JV3803 (AP)	2.3	4.1	1.3	0.6	91.5
CBFS JV4114 (AP)	4.6	6.7	1.7	0.5	86.5
Caloplaca confusa					
CBFS JV3435 (TH)	1.2	3.8	1	1	93
Caloplaca dichroa					
CBFS JV5337 (AP)	1.2	2.5	1	1.1	94.3
CBFS JV5337 (TH)	0.6	4.1	0.7	0.6	93.9
Caloplaca flavocitrina					
CBFS JV3425 (AP)	5.3	12.1	1.4	0.7	80.4
CBFS JV3425 (TH)	1.5	9.6	0	0	88.8
Caloplaca geleverjae					
CBFS JV5415 (AP)	1.1	2.2	0.6	1.4	94.7
Caloplaca limonia					
CBFS JV2515 (AP)	0.4	1.2	0.5	0.5	96.3
CBFS JV2515 (TH)	0.4	1	0	0.7	95
CBFS JV3388 (AP)	0.5	2.4	0.6	0.6	95.9
CBFS JV3388 (TH)	0.9	2.9	1.4	1.9	92.9
CBFS JV3438 (AP)	0.9	3	1.7	0.9	93.4
CBFS JV3465 (AP)	0.5	1.8	0.8	0.8	96
Caloplaca nigromarina					
CBFS JV3035 (TH)	1.2	9.4	0.9	0.7	87.8
CBFS JV3354 (TH)	1.4	2.5	0.3	0.7	95.1
CBFS JV3399 (TH)	1.6	13.6	0.5	0.5	83.7
CBFS JV3478 (TH)	1.4	6.2	0.7	0.8	90.9
GZU, Lich. Anatol. Exs. 80 (AP)	1.4	5.9	2	1.1	89.7
GZU, Lich. Anatol. Exs. 80 (TH)	2.2	12.8	0	0	85
Caloplaca ora					
GZU, Isotype (AP)	0.7	1.9	0.8	0.6	96
GZU, Isotype (TH)	0	0	0	0.9	99.1
GZU, A. Vězda: Lich. Rar. Exs. 34 (AP)	0.4	1.3	0.9	0.4	97
GZU, A. Vězda: Lich. Rar. Exs. 34 (TH)	0.4	1.3	0.7	0.4	97.1
Caloplaca phlogina					
CBFS JV3437 (AP)	0.6	2.2	1.2	0.7	95.3
CBFS JV3437 (TH)	0.6	2.2	1.2	0.7	95.3

Tab. 3. List of species with the *Caloplaca citrina* morphology occurring on seashore cliffs in the northern hemisphere, with references and data on their distributions. Species marked by double asterisk are treated here in detail; those marked by single asterisk are treated extensively. The second column indicate if the species belong in (**in**) or outside (**out**) of the *Caloplaca citrina* clade. Position of species marked by **?** is unclear.

Species		Distribution (+ ecology)	References
Caloplaca arcis (Poelt & Vězda) Arup **	**in**	Europe, Mediterranean, the Black Sea region	Arup 2006a, this paper
Caloplaca arcisproxima Vondrák, Arup & Søchting **	**in**	the Black Sea coast, eastern Mediterranean	this paper
Caloplaca austrocitrina Vondrák, Arup & Søchting **	**in**	central, eastern and southern Europe, mostly on concrete	this paper
Caloplaca bolacina (Tuck.) Herre	**out**	western coast of North America	Arup 1993b, 1995b
Caloplaca britannica R. Sant. *	**out**	British Isles, restricted to maritime rocks	Laundon 1992b
Caloplaca calcitrapa Nav.-Ros., Gaya & Cl. Roux) **	**in**	the Black Sea coast, Mediterranean, on calcareous sea-shore rocks, if inland?	Navarro-Rosinés et al. 2000, this paper
Caloplaca citrina (Hoffm.) Th. Fr. *	**in**	northern and central Europe, elsewhere not confirmed	Arup 2006a
Caloplaca communis Vondrák, Arup & Søchting **	**in**	the Black Sea coast, eastern Mediterranean	this paper
Caloplaca confusa Vondrák, Arup & Søchting **	**in**	the Black Sea coast, Mediterranean, Azores	this paper
Caloplaca coronata (Kremp. ex Körb.) J. Steiner	**out**	Europe, mostly on inland calcareous rocks	e.g. Foucard 2001
Caloplaca dichroa Arup **	**in**	Europe, mostly on inland calcareous rocks	Arup 2006a, this paper
Caloplaca flavocitrina (Nyl.) H. Olivier **	**in**	Europe, North America (confirmed from Haway), Asia?, epiphytic or epilithic, mostly inland species	Arup 2006a, Vondrák et al. 2007, this paper
Caloplaca flavogranulosa Arup	**out**	western coast of North America	Arup 1993a, 1995b
Caloplaca geleverjae Khodosovtsev & S. Kondr. **	**in**	the Crimean Peninsula, coastal cliffs	Khodosovtsev et al. 2003, this paper
Caloplaca havaasii H. Magn.	**in**	Norway, only known from type locality, inland. Occurrence on maritime cliffs not confirmed	Arup 2006c
Caloplaca inconnexa (Nyl.) Zahlbr.	**out**	Mediterranean, Europe, often lichenicolous, e.g. on *Acarospora cervina*	Vondrák et al. 2007
Caloplaca inconnexa var. *nesodes* Poelt & Nimis (?= *C. necator* Poelt & Clauzade)	**out**	the Black Sea coast, Mediterranean, lichenicolous on *Aspicilia*	Nimis & Poelt 1987
Caloplaca inconspecta Arup	**out**	western coast of North America	Arup 1995a, b
Caloplaca limonia Nimis & Poelt **	**in**	Mediterranean, Black Sea region, East and Central Europe	Nimis et al. 1994, this paper
Caloplaca littorea Tav.	**?**	Atlantic coast of Europe	Laundon 1992a, Tavares 1956
Caloplaca luteominia (Tuck.) Zahlbr.	**out**	western coast of North America	Arup 1993b, 1995b
Caloplaca ludificans Arup	**out**	western coast of North America	Arup 1995a, b
Caloplaca marina (Wedd.) Zahlbr. (= *C. marina* subsp. *americana* Arup) *	**in**	western coast of North America and Atlantic coast of Europe	Arup 1992a, 1995b, 1997, Nordin 1972
Caloplaca maritima (de Lesd.) De Lesd. *	**in**	Atlantic coast of Europe, West Mediterranean	Arup 1997
Caloplaca microthallina (Wedd.) Zahlbr. *	**in**	Scandinavian coast, Atlantic coast of Europe and North America	Arup 1994, 1997b. Laundon 1992a, Nordin 1972
Caloplaca nigromarina Vondrák, Arup & Søchting **	**in**	the Black Sea coast	this paper
Caloplaca ora Poelt & Nimis*	**?**	Mediterranean	Nimis & Poelt 1987
Caloplaca phlogina (Ach.) Flag.*	**out**	Europe, mostly on bark or shrub twigs but also on concrete close to sea shore	Arup 2006a, Vondrák et al. 2007
Caloplaca rosei Hasse	**out**	western coast of North America	Arup 1992a, 1995b
Caloplaca ruderum (Malbr.) J. R. Laundon	**?**	Great Britain (records from continental Europe need confirmation), on mortar and soft limestone in walls, if on coastal cliffs?	Laundon 1976
Caloplaca sorediella Arup	**out**	Great Britain, coastal rocks	Arup 2006b
Caloplaca soropelta (Hansen, Poelt & Søchting) Søchting	**out**	Greenland and Svalbard	Hansen et al. 1987, Søchting 1992
Caloplaca thamnoblasta Nimis & Poelt	**out**	Mediterranean, on calcareous sea-shore rocks	Vězda 1993, this paper

Caloplaca soralifera, A NEW SPECIES FROM EUROPE

JAN VONDRÁK[1] AND PAVEL HROUZEK[2]

[1] Department of Botany, Faculty of Biological Sciences, University of South Bohemia, Branišovská 31, CZ-370 05, České Budějovice, Czech Republic.
j.vondrak@seznam.cz

[2] Institute of Microbiology, ASCR, Department of Autotrophic Microorganisms, Opatovický mlýn, CZ-379 81 Třeboň, Czech Republic

Vondrák, J. & Hrouzek, P. 2006: *Caloplaca soralifera*, a new species from Europe. *Graphis Scripta* **18**: 6–15.

Absctract. *Caloplaca soralifera* Vondrák & Hrouzek is described as new. It belongs to a group of sorediate *Caloplaca* species lacking anthraquinones in the thallus. It has been found in six countries in Europe. An overview of similar *Caloplaca* species from Europe and North America is presented. *C. chlorina* and *C. xerica* are compared with the new species in detail. Based on HPLC-MS analysis the anthraquinone contents in *C. chlorina*, *C. soralifera*, and *C. xerica* were investigated.

INTRODUCTION

Within the large genus *Caloplaca*, there is a group of sorediate *Caloplaca* species lacking anthraquinones in their thalli including soralia. Without yellow, orange or reddish pigments in the thallus, the members of this group are often rather inconspicuous – especially when they form sterile populations. This group is not homogeneous and includes species with different apothecial morphology and anatomy (Tab. 1).

In 2002, we first found some strange specimens of a species belonging to this group growing on asphalt pathways and old concrete panels in urbanized areas. We found that these samples belonged to a taxon which failed to fit any of the previously known species, and that it needed to be described.

MATERIALS AND METHODS

The new species is described mainly on material collected by the first author in 2002–2005. Vouchers are currently deposited in the herbarium of the Faculty of Biological Sciences at the University of South Bohemia in České Budějovice (CBFS). Several samples from BM, PRM, and GZU were also included in the study. For HPLC-MS analysis, *Caloplaca chlorina* samples CBFS 1982, 2055, 2056, 3120, *C. soralifera* samples CBFS 1169, 1199, 1200, 1474, 1760, 2527, 2795, and *C. xerica* samples CBFS 1124, 1798, 2181, 2496 were used.

The light microscopy measurements used for statistical calculations were performed with an oil-immersion lens on material mounted in water and achieved an accuracy of 0.5 µm or 1 µm, eventually 10 µm in larger structures. The measurements are given as (min.–)X–SD –X– X+SD(–max.), where X = mean value and SD = standard deviation. Total numbers of measurements (n) are given in parentheses. In each specimen, two to five measurements were done.

HPLC-MS analysis: Thirteen samples of apothecia and three thallus samples were extracted with pure acetone as described by Søchting (1997). Extracts composition was analyzed with HP Agilent mass spectrometer HP 100 MSD SL-Ion trap. The extracts were subjected to analysis on reversed phase column (Zorbax XBD C8, 46×150 mm, 5 µm) at 35 °C using gradient MeOH/30 % MeOH + 1 % phosphoric acid (Søchting 1997). Absorbance was read at 270 nm. The peaks were identified according to retention times, absorbance spectra and in some cases according to obtained molecular weights.

The nomenclature follows Nimis & Martellos (2003).

Caloplaca soralifera VONDRÁK & HROUZEK SP. NOV.

Caloplacae xericae similis sed differt thallo soredioso. Soralia ad marginem areolarum thalli disposita, raro

totam superficiem thalli obducentia. Soredia grisea vel griseo-violacea, (22–)26–34–42(–50) µm diametro, pigmentum "*Sedifolia*-grey" dictum continentia.

Type: **Czech Republic**. *Central Bohemia*, Rakovník Distr., Křivoklát, Kalubice, by the small pond in the village, alt. 348 m, 50°02'56.3"N, 13°49'30.4"E, on horizontal side of concrete wall, 28 December 2004, *J. Vondrák 3332* (PRM holotype; isotypes will be distributed in the first fascicle of Selected exsiccates of *Caloplaca*, no 22).

Thallus crustose and areolate to subsquamulose, (50–)80–104.5–120(–140) µm thick (n=15), dark to pale grey, but often whitish pruinose (Fig. 1). Areoles flat to convex, (0.2–)0.3–0.45–0.6(–0.8) mm in diameter (n=30). Dark grey to violet-grey soralia are produced on the margins of the areoles and squamules. Occasionally, the soralia expand to cover the whole thallus surface. Soredia (22–)26–34–42(–50) µm in diameter (n=40). Cortex greyish to violet-grey in section, (5–)9–18–27(–35) µm thick (n=15), consisting of a loose or tight paraplectenchymatous tissue of cells (3.5–)4.0–5.0–6.0(–7.0) µm in diameter (n=15) and covered by a thin epinecral layer, 2.0–5.0–8.0(–12.0) µm thick (n=15). Algal layer consisting of a mixture of algal cells (4.0–)6.0–10.0–14.0(–20.0) µm in diameter (n=40) and ± isodiametric fungal cells (2.5–)3.5–5.0–6.5(–11.0) µm in diameter (n=30). Medulla inconspicuous. Soredia and cortex K+ violet, C+ violet, N+ grey-violet, containing the pigment *Sedifolia*-grey (Meyer & Printzen 2000).

Apothecia (0.2–)0.35–0.5–0.65(–1.0) mm in diameter (n=30) with orange, dark orange or brown disc, yellow to orange true exciple and grey or whitish pruinose thalline exciple (Fig. 2) without anthraquinones. True exciple always well-developed, (30–)48–69.5–91(–110) µm thick (n=15), consisting of long and narrow, thin-walled cells. Outer cells (3.0–)3.5–4.5– 5.5(–6.0) µm wide and inner cells (1.0–)2.0– 3.0–4.0(–5.0) µm wide (both n=30). True exciple continuing into hypothecium as a *c*. 10–30 µm thick tight tissue of long and narrow cells in the lowermost part of hypothecium. Thalline exciple (50–)60–90–120(–130) µm thick (n=15), often covered by a pruinose layer, up to 35 µm thick. True exciple/thalline exciple ratio strongly fluctuating and depending on the apothecium development. Hypothecium hyaline, (40–)60–80–100(–110) µm high (n=15), consisting of irregular arranged hyphae. Hymenium hyaline, (70–)72–83–94(–100) µm high (n=15). Oil drops commonly occurring in hymenium and hypothecium. Asci (50–)52– 60–69(–80) × (12–)13–17–20(–23) µm in size (n=15). Paraphyses *c*. 1.5–3.0 µm wide, branched and rarely anastomosed. Paraphyses tips 2.5–3.5–4.5(–6.5) µm wide (n=30), 1–4 upper cells broadened. Spores polarilocular, hyaline, (11.5–)12.0–13.0–14.0(–15.5) × (4.0–)5.0–6.5–8.0(–10.0) µm (n=30). Septum of mature spores 3.5–4.5–5.5(–7.5) µm thick (n=30). Apothecia C– (epihymenium weakly and slowly C+ orange-red in cross-section), K+ violet-red, PD–.

Pycnidia chambered, immersed in the thallus surface, *c*. 100–150 µm in diameter, of the same colour or somewhat darker than the thallus. Wall of pycnidia grey in section, containing *Sedifolia*-grey. Conidiophores branched and anastomosed. Conidia produced terminally and laterally, ellipsoid, (2.5–)2.75– 3–3.25(–3.5) × 1.0–1.25–1.5 µm (n=15). Conidiogenous cells isodiametric, triangular or elongated, (3.0–)3.5–4.5–5.5(–6.5) µm in diameter (n=18).

For apothecial anatomy, shape of spores and conidiophores, see Fig. 3.

Chemistry. No antraquinone content was recorded in the thallus of *Caloplaca soralifera* but the presence of the pigment *Sedifolia*-grey, which is insoluble in acetone, was detected in the cortex and the soredia. In the apothecia of *C. soralifera*, the dominant component was parietin (81.8±4.7 %). Lower contents (0–12 %) of other anhraquinones (fragilin, emodin, emodial, emodic acid and 7-chloremodin) were found (Tab. 2). Similar composition was observed in apothecia of *C. chlorina*, where parietin was the dominant component (88.1±6.5 %) and presence of fragilin (4.5±3.2 %) and emodin (5.1±2.6 %) was confirmed. Although these two species have similar composition, differences can be found in less abundant anthraquinones (emodic acid and 7- chloremodin) and also in concentrations of parietin, fragilin and emodin. The composition of *C. soralifera* and *C. chlorina* is clearly different from the anthraquinone content of *C. xerica*, where fragilin is the dominant component, whereas emodin and especially parietin are missing (total absence of parietin ion m/z=285). According to our observation, these species belong to different chemosyndroms, as defined by Søchting (1997, 2001). While the anthraquinone content of the apothecia in *C. xerica* is similar to chemosyndrom B (Søchting 2001), *C. chlorina* and *C. soralifera*, containing parietin as a major compound, belong to chemosyndrom A (Søchting 1997). HPLC-chromatograms of *Caloplaca chlorina*, *C. soralifera*, and *C. xerica* are given in Fig. 4.

Variability. The thallus colour of *Caloplaca soralifera* varies noticeably from very pale to dark grey. When growing on lime-rich substrates, most commonly on concrete, it has almost a whitish colour caused by a pruina.

The colour of the apothecia changes during the development. Young apothecia usually have orange discs and yellowish exciples with whitish pruina on the outer margin, while older apothecia can have dark red or almost black discs and reddish true exciples. The darkening of older apothecia is often caused by the parasitic hyphomycete *Intralichen christiansenii* (D.Hawksw.) D.Hawksw. & M.S.Cole. Strong variability is also observable in the ratio of thalline exciple vs. true exciple. While the young apothecia appear to be biatorine (without outer thalline margin), the proportion of outer grey margin increases in older apothecia. In extreme cases, the old ascocarps can resemble lecanorine apothecia.

Ecology. *Caloplaca soralifera* usually grows on artificial substrata, such as asphalt, concrete, mortar or nutrient-rich siliceous stones, very often on pebbles on railroads. Only rarely it occurs in natural habitats such as calcareous and base-rich siliceous rocks. It was once recorded on bark of a lime tree and on a dust impregnated wood. It occurs most frequently on exposed horizontal sides, but some records come from vertical sides of various expositions. The species *Caloplaca crenulatella*, *C. flavocitrina*, *Lecanora muralis* and *Verrucaria nigrescens* frequently occur together with *C. soralifera*.

Distribution. *C. soralifera* is currently known from Austria, Bulgaria, the Czech Republic, Germany, Slovakia and Romania (Fig. 5). In the Czech Republic, where the species has been most frequently recorded, it seems to be very common. Its vertical distribution ranges from 220 to 1450 m.

DISCUSSION

Caloplaca furax, *C. spalatensis* (syn. *C. areolata*) and *C. xerica* are very similar to *C. soralifera* in the apothecium structure. All three species have zeorine apothecia with an excipular tissue that continues in the lowermost part of the hypothecium (Fig. 3A). *C. furax* irregularly produces large lobules on the thallus surface, its thallus is delimited by conspicuous marginal lobes and it never produces soredia (GZU, isotype!, Murc. lichenotheca no. 3039). In addition, Egea & Llimona (1983) considered *C. furax* a strictly parasitic species on *Aspicilia* sp. *Caloplaca spalatensis* does not produce any structures for vegetative dispersal and has flat areoles (W, holotype of C. areolata!, samples in GZU!). It occurs on calcareous bird perching boulders in the Mediterranean (Martellos & Nimis 2000). We consider *C. xerica* (GZU, holotype!) the most similar species to *C. soralifera*, even if the former never produces soredia. Based on morphology, *C. soralifera* represents a sorediate counterpart to *C. xerica*, thus the belonging to different chemosyndromes is surprising.

When sterile, *C. soralifera* can be confused also with *C. chlorina* but this species usually has a non-pruinose thallus. When fertile, *C. chlorina* clearly differs in its typical lecanorine apothecial margin. Morphological characters of *C. chlorina*, *C. soralifera* and *C. xerica* are given in Tab. 3.

In the investigated localities, *C. soralifera* is usually a common or even predominant species. Therefore, it is surprising that it has not been described so far. During three years of collecting this species, the abundance of *C. soralifera* has obviously increased in some localities. As investigated by van Herk et al. (2002), many nitrophilous and basiphilous lichen species have recently extended their distribution areas because of increasing temperatures. Some species recently described from Western Europe are reported to be rapidly spreading as neophytics (e.g. Aptroot & van Herk 1999a, b). Possibly, the extending of the substratum range of *C. soralifera* to include various artificial substrata has recently taken place. Its distribution range is apparently expanding. We suppose it will be found in many new European countries in the future.

Specimens examined: **Austria**. Steiermark: Ennstal, Pichl bei Schladming, eiszeitliche Moränen N Pichlmayrgut, alt. 800 m, on nutrient-rich sunny limestone, 1991, Berger (GZU, sub *Caloplaca albolutescens*). **Bulgaria**. Kurdzhali, Shiroko Pole, protected area "Sredna Arda", *c.* 5 km E of village, 41°37'N, 25°31'E, alt. *c.* 240 m, on concrete near railway station "Sredna Arda" and on concrete wall above railway, 2004, Vondrák (CBFS 2009, 2012); Plovdiv, Asenovgrad, Dobrostan, Sv. Iliya chapel above village, 41°56'N, 24°54'E, alt. 1320 m, on mortar, 2004, Vondrák (CBFS 1994); Stara Zagora, Mihaylovo, railway station, 42°16'N, 25°31'E, on horizontal side of concrete, 2004, Vondrák (CBFS 2068). **Czech Republic**. Benešov u Prahy, railway station, on horizontal side of concrete panel, 2005, Vondrák (CBFS 3008); Beroun, Nižbor, small rocky outcrop in S edge of village, 49°59'57.2"N, 14°00'03.6"E, alt. 220 m, on S-exposed base-rich, schist rock, 2005, Vondrák (CBFS 2501); Choceň, in town, on Tichá Orlice riverside, alt. *c.* 300 m, on horizontal side of concrete wall, 2005, Vondrák (CBFS 3033); České Budějovice, park "Stromovka", 48°58'20"N, 14°27'30"E, alt. 390 m, on concrete wall, 2003, Vondrák (CBFS 960); České Budějovice, Dubné,

Záboří, in village, on horizontal side of concrete panel, 2003, Vondrák (CBFS 1199); Frýdlant nad Ostravicí, Čeladná, Podolánky, nearby hotel "Srdce Beskyd", alt. c. 700 m, on concrete in pathway, 2005, Vondrák (CBFS 3154); Hořovice, Točník, in village, 49°53'20"N, 13°53'10"E, alt. 340 m, on horizontal side of concrete panel, 2003, Vondrák (CBFS 1197); Jindřichův Hradec, Jarošov nad Nežárkou, weir on Nežárka river near town, alt. 475 m, on granite stones in concrete wall, 2005, Vondrák (CBFS 3117); Jindřichův Hradec, Kamenice nad Lipou, "Hutě" settlement, alt. *c.* 620 m, on vertical side of concrete panel, 2004, Vondrák (CBFS 3118); Kaplice, Benešov nad Černou, in town, alt. 670 m, on silicate stones in dust impregnated wall (CBFS 2305, 2312, 2326); Kyjov, at airport, on asphalt, 2003, Vondrák (CBFS 1306); Milevsko, N edge of town, 49°28'N, 14°22'E, alt. 450 m, on concrete on pond-dam, 2004, Vondrák (CBFS 1758); Písek, railway station, on horizontal side of concrete wall, 2003, Vondrák (CBFS 2538); Planá u Mariánských Lázní, in railroad near railway station, on iron-rich pebbles, 2005, Vondrák (CBFS 2996); Prachatice, Husinec, weir on river Blanice above town, alt. *c.* 520 m, on granite stones and concrete on horizontal side of wall, 2005, Vondrák (CBFS 3002); Prachatice, Husinec, outdoor swimming-pool, 49°03'12.5"N, 13°59'38.8"E, alt. 500 m, on SW-exposed concrete panel, 2005, Vondrák (CBFS 3000); Prachatice, Husinec, Výrov, in village, 49°03'00"N, 13°59'50"E, alt. 520 m, on gneiss stones in garden, 2003, Vondrák (CBFS 1322, CBFS 1352); Prachatice, Těšovice, railway station, 49°02'40"N, 14°01'40"E, alt. 480 m, on asphaltic pathway, 2005, Vondrák (CBFS 2527); Příbram, Jince, in village, on asphalt, 2003, Vondrák (CBFS 1200); Příbram, Jince, "Jinecké Hřebeny" hills, alt. 700 m, concrete on roof of military building, 2003, Vondrák (CBFS 1360); Rakovník, Kalubice, in village, alt. 370 m, 50°03'N, 13°49'40"E, on mortar, 2003, Vondrák (CBFS 1318); on horizontal side of dust-impregnated wooden planks, 2006, Vondrák (CBFS 4232); Rakovník, Pustověty, in village, 50°03'20"N, 13°49'E, on horizontal side of concrete panel, 2003, Vondrák (CBFS 1201); Rakovnik, Skryje, ruin of castle Týřov, 49°58'24.6"N, 13°47'24.1"E, alt. 295 m, on lime-enriched andesitic rock under ruin walls, on sunny S-exposed slope, 2005, Vondrák (CBFS 2762); Rýmařov, Karlov, Mt Vysoká hole, 50°03'40"N, 17°14'E, alt. *c.* 1450 m, on concrete, 2005, Vondrák & Bartoš (CBFS 1920); Vodňany, Bavorov, small bridge S of village, on horizontal side of concrete panel, 2002, Vondrák (CBFS 1474); Vodňany, Čížčenice, railway station, 49°09'30"N, 14°13'20"E, alt. 390 m, on iron-rich pebbles in railroad, 2003, Vondrák (CBFS 1884, 3013); Vyškov, airport, on asphalt and on vertical concrete plate, 2003, Vondrák (CBFS 1301, 1303); Zdice, in railroad near railway station, 49°54'30.0"N, 13°58'54.1"E, alt. 250 m, on iron-rich pebbles in railroad, 2005, Vondrák (CBFS 2977). **Germany**. Hamburg, Vierlande, Warwisch, on calcareous stone, 1925, Erichsen (PRM 581205, sub *Caloplaca turneriana*). **Slovakia**. Banská Štiavnica, in valley "Kalvaria", alt. 600–700 m, on bark of Tilia, 1926, Suza (PRM 640930, in sample of *Physcia teretiuscula*); Malacky, Kuchyňa, Mt Vysoká, alt. 650 m, on limestone rock, 1976, Pišút (BM, PRM, Lich. Slov. Exsic. 275, sub *Caloplaca isidiigera*). **Romania**. Arad, Nadlac, railway station, 46°09'N, 20°47'E, on N-exposed mortar, 2004, Vondrák (CBFS 2132).

ACKNOWLEDGEMENTS

We thank Prof. Jiří Komárek and Dr Tereza Poštová for the Latin translation of the diagnosis, Dr Marek Stibal for linguistic corrections, and the reviewers for valuable comments to the manuscript.

REFERENCES

Aptroot, A. & van Herk, C. M. 1999a. *Bacidia neosquamulosa*, a new and rapidly spreading corticolous lichen species from western Europe. *Lichenologist* **31**: 121– 127.

Aptroot, A. & van Herk, C. M. 1999b. *Lecanora barkmaneana*, a new nitrophilous sorediate corticolous lichen from the Netherlands. *Lichenologist* **31**: 3–8.

Arup, U. & Grube, M. 1999. Where does *Lecanora demissa* (Ascomycota, *Lecanorales*) belong? *Lichenologist* **31**: 419–430.

Coppins, B. J. & James, P. W. 1979. New or interesting British lichens IV. *Lichenologist* **11**: 139–179.

Egea, J. M. & Llimona, X. 1983. *Caloplaca furax* Egea et Llimona, un nuevo liquen parasito sobre *Aspicilia* silicilolas, en la Sierra del Relumbrar (Albacete, SE de Espana). *Collectanea Botanica* **14**: 265– 269.

Hansen, E. S., Poelt, J. & Søchting, U. 1987. Die Flechtengattung *Caloplaca* in Gronland. *Meddelelser om Gronland*, *Bioscience* **25**: 1–52.

Kondratyuk, S. Y., Søchting, U., Khodosovtsev, O. Y. & Kärnefelt, I. 1998. *Caloplaca scythica*, a new species from southern Ukraine. *Graphis Scripta* **9**: 15– 19.

Laundon, J. R. 1992. *Caloplaca* Th. Fr. (1860). In: Purvis, O. W., Coppins, B. J., Hawksworth, D. L., James, P. W. & Moore, D. M. (eds), *The Lichen Flora of Great Britain and Ireland*. Natural History Museum Publications & British Lichen Society, London, pp. 141–159.

Martellos, S. & Nimis, P. L. 2000. ITALIC – The Information System on Italian Lichens. Iconographical archive. (http://dbiodbs.univ.trieste.it/global/italic_ico). [last visit September 3, 2005]

Meyer, B. & Printzen, C. 2000. Proposal for a standardized nomenclature and standardization of insoluble lichen pigments. *Lichenologist* **32**: 571–583.

Nimis, P. L. & Martellos, S. 2003. *A second checklist of the lichens of Italy with thesaurus of synonyms*. Museo Regionale di Scienze Naturali, Aosta.

Poelt, J. 1955. Mitteleuropäische Flechten III. *Mitteilungen der Botanischen Staatssammlung München* **2**: 46–56.

Søchting, U. 1994. *Caloplaca ahtii* Søchting spec. nova and other *Caloplaca* species with greenish-bluish soredia from the northern hemisphere. *Acta Botanica Fennica* **150**: 173–178.

Søchting, U. 1997. Two major anthraquinone chemosyndromes in *Teloschistaceae*. *Bibliotheca Lichenologica* **68**: 135–144.

Søchting, U. 1999. *Caloplaca alstrupii*, a new lichen species from Denmark. *Graphis Scripta* **10**: 59–64.

Søchting, U. 2001. Chemosyndromes with chlorinated anthraquinones in the lichen genus *Caloplaca*. *Bibliotheca Lichenologica* **78**: 395–404.

Tretiach, M., Pinna, D. & Grube, M. 2003. *Caloplaca erodens* [sect. *Pyrenodesmia*], a new lichen species from Italy with an unusual thallus type. *Mycological Progess* **2**: 127–136.

Tønsberg, T. 1992. The sorediate and isidiate, corticolous, crustose lichens in Norway. *Sommerfeltia* **14**: 1–331.

van Herk, C. M., Aptroot, A. & van Dobben, H. F. 2002. Long-term monitoring in the Netherlands suggests that lichens respond to global warming. *Lichenologist* **34**: 141– 154.

Wade, A. E. 1965. The genus *Caloplaca* Th. Fr. in the British Isles. *Lichenologist* **3**: 1–28.

Wetmore, C. M. 1996. The *Caloplaca sideritis* group in North and Central America. *Bryologist* **99**: 292–314.

Wetmore, C. M. 2004. The sorediate corticolous species of Caloplaca in North and Central America. *Bryologist* **107**: 505– 520.

Wirth, V. 1995. *Die Flechten Baden-Württembergs, Teil 1 & 2*. Eugen Ulmer, Stuttgart.

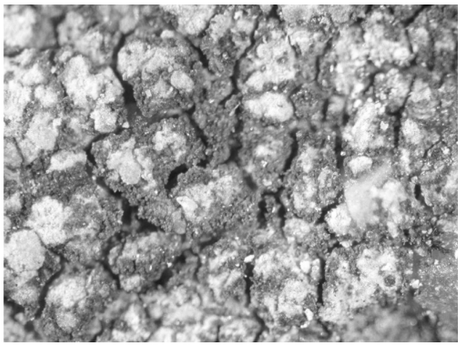

Fig. 1. Thallus of *Caloplaca soralifera* with abundant soralia (isotype material).

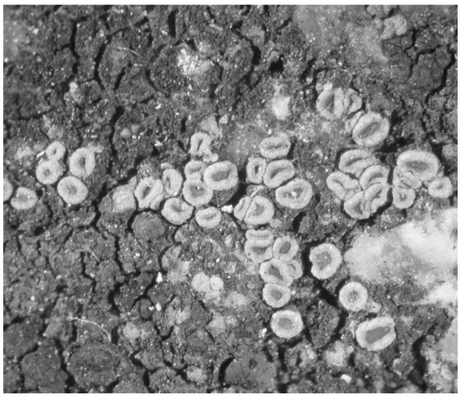

Fig. 2. Apothecia of *Caloplaca soralifera* (isotype material).

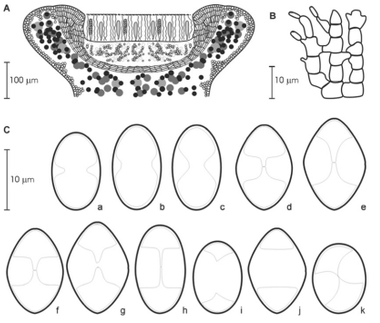

Fig. 3. *Caloplaca soralifera*. A, Vertical cross-section through apothecium. B, Conidiophores with lateral and apical conidiogenous cells and with attached conidia. C, Ascospores (a-c, young spores; d-h, mature spores; i-k, old and deformed spores).

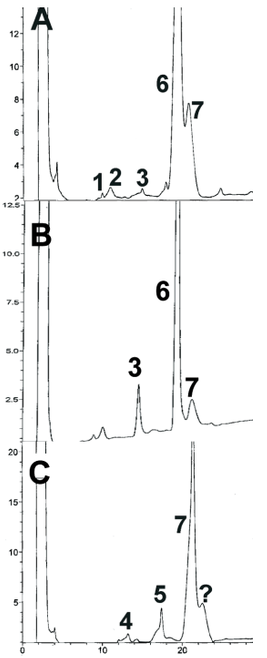

Fig. 4. HPLC-chromatograms. A. *Caloplaca soralifera* (CBFS 1169). B. *Caloplaca chlorina* (CBFS 3120). C. *Caloplaca xerica* (CBFS 1798). (1. citreorosein, 2. emodial, 3. emodin, 4. emodic acid, 5. 7-chloremodin, 6. parietin, 7. fragilin).

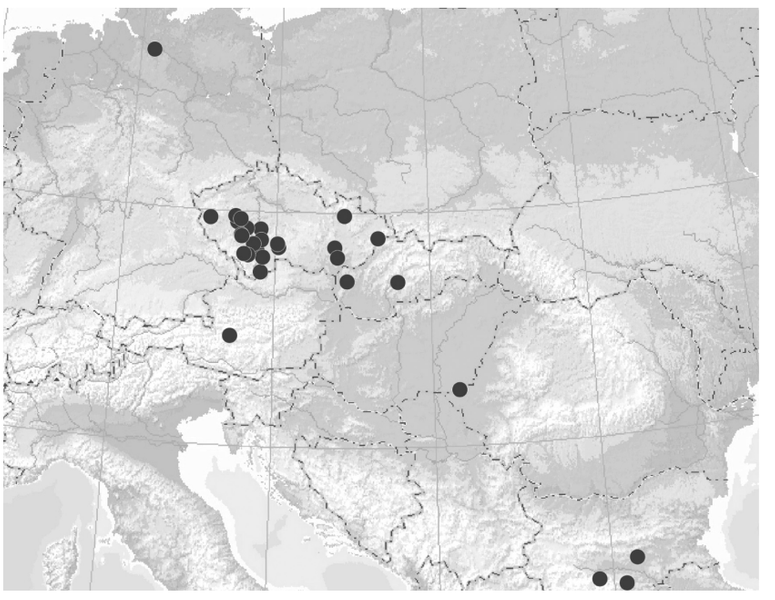

Fig. 5. Known distribution of *Caloplaca soralifera* in Europe.

Table 1. List of the European and North American sorediate *Caloplaca* species, which lack anthraquinones in their thalli and soralia. The ecology given follows the references in the last column.

Species	Substrate	References
Caloplaca ahtii Søchting	bark	Søchting 1994
Caloplaca albolutescens (Nyl.) H.Olivier	concrete, calcareous sandstones, rarely other base-rich rocks	Wade 1965, Wirth 1995
Caloplaca alstrupii Søchting	bark	Søchting 1999
Caloplaca chlorina (Flot.) H.Olivier	nutrient-rich siliceous stones and rocks in rather damp situations, bark of trees	Wetmore 1996, Søchting 1994, Tønsberg 1992
Caloplaca demissa (Körb.) Arup & Grube	vertical or overhanging base-rich siliceous rocks	Arup & Grube 1999
Caloplaca erodens Tretiach, Pinna & Grube	hard limestone	Tretiach et al. 2003
C. jemtlandica var. *cerinosora* Hansen, Poelt & Søchting	bark of *Salix glauca* in Greenland	Hansen et al. 1987, Søchting 1994
Caloplaca obscurella (Lahm ex Körb.) Th.Fr.	bark	Søchting 1994, Tønsberg 1992
Caloplaca pinicola Wetmore	bark and wood of conifers in North America	Wetmore 2004
Caloplaca scythica Khodosovtsev & Søchting	twigs of small shrubs in steppe habitats near the Black Sea	Kondratyuk et al. 1998
Caloplaca soralifera Vondrák & Hrouzek	concrete, asphalt, base-rich siliceous rocks and pebbles	this study
Caloplaca sorocarpa (Vain.) Zahlbr.	twigs of alpine shrubs	Poelt 1955, Søchting 1994
Caloplaca teicholyta (Ach.) J.Steiner	base-rich siliceous and calcareous rocks; calcareous stone, mostly walls and monuments; concrete and mortar	Laundon 1992, Wirth 1995
Caloplaca ulcerosa Coppins & P.James	bark of *Acer* and *Ulmus*	Coppins & James 1979, Søchting 1994
Caloplaca virescens (Sm.) Coppins	bark	Laundon 1992

Table 2. Anthraquinone composition of apothecia samples of *Caloplaca chlorina*, *C. soralifera*, and *C. xerica*. Abbreviations: CIR – citreorosein, EML – emodial, EMC – emodic acid, PRC – parietinic acid, EMD – emodin, CLE – 7-chloremodin, PAR – parietin, FRG – fragilin.

	CIR	EML	EMC	PRC	EMD	CLE	PAR	FRG
Caloplaca soralifera								
CBFS 1169	0,9	3	0,9	0	2,7	0	81,5	11
CBFS 1328	1	2,6	1	0	2,4	4,5	80,2	8,3
CBFS 1199	0,3	0	0,5	0	1,1	0,6	81	16,5
CBFS 1200	7,1	0	0,9	0	1,8	0	83,7	6,6
CBFS 1474	0,6	0,9	0	0	1,3	1	73	23,1
CBFS 1760	0	0	0	0	0	5,5	89,6	4,8
CBFS 2795	0,4	1,6	0,4	0	5	0	84,8	7,8
	1,5±2,5	1,2±1,3	0,5±0,4	0±0	2,0±1,4	1,7±2,3	82,0±5	11,2±6,5
Caloplaca chlorina								
CBFS 1982	0,9	2,1	0,0	0,0	6,9	0,0	83,2	6,9
CBFS 3120	0,9	1,7	0,0	0,0	3,1	0,0	87,6	6,8
CBFS 2055	0,0	0,0	0,0	0,0	2,6	0,0	97,4	0,0
CBFS 2056	1,1	2,2	0,0	0,0	7,9	0,0	84,3	4,5
	0,7±0,5	1,5±1,0	0±0	0±0	5,1±2,6	0±0	88,1±6,5	4,5±3,2
Caloplaca xerica								
CBFS 1124	0,0	0,0	0,5	1,7	0,0	5,1	0,0	92,7
CBFS 1798	0,0	0,0	0,4	1,1	0,0	6,4	0,0	92,1
CBFS 2128	0,0	0,0	1,5	3,5	0,0	5,8	0,0	89,2
CBFS 2496	0,0	0,0	1,3	1,7	0,0	8,5	0,0	88,5
	0±0	0±0	0,9±0,6	2,0±1,0	0±0	6,5±1,5	0±0	90,6±2,1

Table 3. Comparison of *Caloplaca chlorina*, *C. soralifera* and *C. xerica* in selected characters and substrate ecology.

Character	***Caloplaca chlorina***	***Caloplaca soralifera***	***Caloplaca xerica***
Ascospores	11–14(–15.5) × 5.5–7 µm	(11.5–)12–13–14(–15.5) × (4–)5–6.5–8(–10) µm	11–18 × 5.5–7 µm
Ascospore septum	3.5–5.5 µm	3.5–4.5–5.5(–7.5) µm	2.5–6 µm
Exciple	lecanorine	zeorine	zeorine
Thallus colour	olive grey to dark grey	grey or whitish pruinose	dark grey or blackish
Thallus pigmentation	*Sedifolia*-grey	*Sedifolia*-grey	*Sedifolia*-grey
Thallus surface	smooth or rarely pruinose, areoles flat to convex	smooth or pruinose, areoles mostly convex	blastidiate
Vegetative reproduction	soredia, consoredia, isidia-like projections	soredia	isidia, blastidia
Chemosyndrome	A	A	B
Substrate	nutrient-rich siliceous stones and rocks in rather damp situations, bark of trees	concrete, asphalt,mortar (rarely on base-rich siliceous rocks)	xerothermic habitats on base-rich siliceous rocks
References	Tønsberg (1992), Wetmore (1996)	this study	Poelt (1975)

Caloplaca concreticola (*Teloschistaceae*), A NEW SPECIES FROM ANTHROPOGENIC SUBSTRATA IN EASTERN EUROPE

JAN VONDRÁK[1], ALEXANDER KHODOSOVTSEV[2] & PAVEL ŘÍHA[3]

[1] Department of Botany, Faculty of Science, University of South Bohemia, Branišovská 31, 370 05, České Budějovice, Czech Republic, j.vondrak@seznam.cz

[2] Chair of Botany, Kherson State University, 40 Let Oktyabrya str., 27, 73000, Kherson, Ukraine, khodosovtsev@ksu.ks.ua

[3] Department of Zoology, Faculty of Science, University of South Bohemia, Branišovská 31, 370 05, České Budějovice, Czech Republic, pavel.riha.cb@centrum.cz

Vondrák, J., Khodosovtsev, A. & Říha, P. 2008: *Caloplaca concreticola* (*Teloschistaceae*), a new species from anthropogenic substrata in Eastern Europe. Lichenlogist 40: 97–104.

Abstract: *Caloplaca concreticola* is described here as new. It is a morphologically well-characterized, sorediate species of the subgenus *Pyrenodesmia*, that comprises a part of the "black-fruited" taxa with an absence of anthraquinones in their apothecia. Currently it is known only from concrete and always occurs close to water (mainly on the walls of water channels). Analysis of nuclear ribosomal ITS sequence data of the new species, together with most European species of the subgenus, supports the recognition of the new species as a monophyletic taxon within the *Pyrenodesmia* clade.

Keywords: ITS, lichenized fungi, taxonomy, *Teloschistales*, Ukraine

INTRODUCTION

The subgenus *Pyrenodesmia* of the large genus *Caloplaca* is mainly characterized by the absence of anthraquinones in all parts of the thallus. Apothecial discs of its members are usually dark coloured, often containing dark acetone-insoluble pigments (most frequently K+ violet *Sedifolia*-grey). *Pyrenodesmia*, containing rather few species, has beeen monographically studied in Europe including the Mediterranean and the Near East (Wunder 1974) and in North America (Wetmore 1994); recently some new species from Europe have been described (Khodosovtsev et al. 2002, Tretiach et al. 2003, Tretiach & Muggia 2006). Molecular analyses using ITS data for this group were presented in Arup & Grube (1999), Tretiach et al. (2003), and Muggia & Grube (2007).

In southern Ukraine, we discovered some populations of black-fruited, sorediate *Caloplaca*, restricted to concrete water channels. It could not be assigned to any known species, and is therefore formally described as new here.

MATERIALS AND METHODS

Investigated material collected by the authors is deposited in CBFS and KHER.

Morphology. In total, 20 characters were quantitatively analysed for the new species: size of areoles, width of thallus, phenocortex and epinecral layer, size of soredia, size of algal and fungal cells in algal layer, size of apothecia, thalline and true exciple width, size of outer cells in true exciple, hypothecium and hymenium hight, size of asci and ascospores, width of spore septa, width of paraphyses tips, and size of conidiomata, conidiogenous cells and conidia. For qualitative traits, characters of each tissue (e.g. paraplectenchymatous vs. prosoplectenchymatous type, occurrence of anastomoses, and presence of thin-walled vs. thick-walled cells), and colour of thallus and apothecia were used. The term phenocortex (sensu Ryan et al. 2002) is used here in a modified sense for the hyaline tissue between the epinecral layer and algal layer, formed by living fungal cells among dead algal cells or gaps after dead algal cells (Fig. 1D).

Sections for morphological examination were cut by hand and observed in water. Measurements were made with an accuracy of 0.5 µm (for cells, e.g. conidia and ascospores), 1 µm (for asci and true exciple) and 10 µm (larger structures: e.g. hymenium and hypothecium hight, size of apothecia) were achieved. All measurements of cells were taken with their walls, not only lumina. Ascospores were examined after short heating (Steiner & Peveling 1984), but without pretreatment of KOH. Measurements are given as (min.–) X±SD (–max.), where X = mean value and SD = standard deviation. Total numbers of measurements (n) are given in parentheses. At least five measurements were taken from all available samples; pycnidia and well-developed asci and ascospores were not always observed.

Chemistry. For detection of acetone-soluble compounds, HPLC-MS analysis was used on the samples CBFS JV4637 and the holotype. Acetone-insoluble pigments were examined and named according to Meyer & Printzen (2000). Crystalline pruina on thallus and apothecia were investigated by polarized light before and after washing with 5% acetic acid (Giordani et al. 2003).

Phylogeny. Phylogenetic analysis. A fairly large number of nuclear ribosomal ITS sequences of the subgenus *Pyrenodesmia* is available in GenBank (Fig. 2). In addition to these, five new ITS sequences of the new species were produced together with one each of *C. albopustulata* and *C. transcaspica* (highlighted in Fig. 2); extraction, amplification, purification and sequencing follow Søchting & Figueras (2007). Sequences were aligned using MAFFT 6 (on-line version in the Q-INS-i mode; see Katoh et al. 2002) and manually cut to eliminate the unaligned ends; 530 positions were retained. Parsimony analysis was conducted with PAUP 4.0b10 (Swofford 2002) with tree bisection reconnection (TBR) branch swapping, sequence addition option set to random (with 10 replicates at each step) and maxtrees unrestricted. Steepest descent option was not in effect and the analysis ran under the MulTrees option. All gaps were treated as missing data. Bootstrap analysis adopted the full heuristic search settings and included 1,000 resamplings.

To test the stability of nodes, we computed Bayesian posterior probabilities in the program MrBayes 3.0 (Ronquist and Huelsenbeck 2003). In accord with the best-fit likelihood settings proposed by hLRT algorithm in MrModeltest 2.2 (Nylander 2004), the analysis was conducted under general time reversible model with some sites assumed to be invariable and the others varying in rates according to the gamma distribution approximated by four categories. The prior probability densities of the substitution rates and the stationary nucleotide frequencies were let as preset: a flat Dirichlet with all values set to 1.0. The Markov chain Monte Carlo run included four parallel chains, three of which were incrementally heated by a temperature of 0.2. The MCMC process was in progress for 10,000,000 generations and every 100th generation was sampled. In order to assess stationarity of the MCMC run, two simultaneous independent analyses were conducted and the standard deviation of split frequencies was monitored; finally we decided to discard the first 10% samples as burn-in.

THE SPECIES

Caloplaca concreticola VONDRÁK & KHODOSOVTSEV SP. NOV.

Apotheciis nigro-brunneis (subg. *Pyrenodesmia*), pigmentis anthraquinoneis in thallo et apotheciis nullis. Thallus areolatus, areolae soraliis marginalibus; soredia (17–) 31 ± 7 (–53) µm diametro. Ascosporae (13.0–) 15.7 ± 2.0 (–20.5) µm longae, (5.0–) 7.1 ± 1.0 (–9.0) µm latae; conidia late ellipsoidea vel subglobosa (1.5–) 2.1 ± 0.4 (–2.5) µm longa (1.0–) 1.5 ± 0.2 (–2.0) µm lata.

Typus: **Ukraine**. *Khersonska oblast*: Chaplinskiy district, *c.* 4.5 km W of village Zaozerne, Kakhovskiy kanal water channel, alt. *c.* 30 m, 46°35'44.37"N, 033°53'13.21"E, on dry surface of concrete water channel, *c.* 1 m above water level, 7 June 2006, *J. Vondrák & J. Šoun* (CBFS JV4636 - Holotypus, Isotypi distributed in Selected exsiccates of *Caloplaca*, fasc. 2: http://botanika.bf.jcu.cz/lichenology/index.php?pg=7).

Thallus crustose, areolate, forming patches up to 1.5 cm broad, whitish-grey (by pruina) to grey, greenish when wet, (50–) 170 ± 50 (–270) µm high (n=28). Areoles angular to minutely squamiform, (0.26–) 0.56 ± 0.21 (–0.99) mm in diam. (n=31), flat or with raised margins, sorediate (Fig. 1A); old areoles sometimes overgrown by young

thalli (Fig. 1C). Soralia marginal, erupting from lower surfaces of areoles, dark-grey to green-grey, darker than surfaces of areoles (containing *Sedifolia*-grey), old areoles sometimes completely sorediate, often confluent and forming a dark grey sorediate crust. Soredia (17–) 31 ± 7 (–53) µm in diam. (n=46). True cortex not developed or rarely present, thin, up to 10 µm, formed of 1–2 rows of paraplectenchymatous, thin-walled cells. Phenocortex (explained in Materials and Methods) usually present, *c.* 20–40 µm high (Fig. 1D). Epinecral layer *c.* 5–10 µm thick, crystalline pruina white, sometimes strongly developed, up to 25 µm thick. Algal layer formed of Algal cells (6.0–) 14.0 ± 4.5 (–23.0) µm in diam. (n=43), surrounded with thin-walled, isodiametric fungal cells, (2.0–) 4.9 ± 1.6 (–8.5) µm in diam. (n=34), or elongated cells *c.* 3–5 µm thick. Medulla inconspicuous, ± prosoplectenchymatous, loose, formed by hyphal strands of rather elongated cells, *c.* 2.5–5 µm thick, intergrowing among substrate particles.

Apothecia first urceolate, later flat, (0.26–) 0.54 ± 0.18 (–1.1) mm broad (n=43), with brown to black disc (darker apothecia contain more *Sedifolia*-grey in epihymenium) and whitish margin (Fig. 1B). Apothecial margin zeorine, sometimes seemingly lecanorine, but both true and thalline exciples always present. True exciple (35–) 64 ± 18 (–100) µm thick (n=28), formed of (2.0–) 4.0 ± 0.9 (–5.0) µm wide (n=21), thin-walled, elongated cells that may be almost isodiametric in uppermost part. Upper part of true exciple grey-brown (*Sedifolia*-grey). Thalline exciple (70–) 103 ± 37 (–210) µm thick (n=29), without cortex, sometimes crenulate when old. Hypothecium (40–) 119 ± 48 (–230) µm high in central part (n=23), hyaline, ± paraplectenchymatous, of cells (3.0–) 6.25 ± 2.5 (–12.0) µm in diam. (n=16). Hymenium (70–) 92 ± 10 (–110) µm high (n=27), with epihymenium ± slightly grayish, usually covered by crystalline pruina. Paraphyses *c.* 1.5–3.5 µm wide, but terminal and subterminal cells usually inflated, (2.5–) 4.0 ± 0.9 (–5.5) µm thick (n=33). Asci of *Teloschistes*-type, clavate to cylindrical, 8-spored, (47–) 59 ± 6 (–71) × (13–) 17 ± 3 (–24) µm (n=31). Ascospores polarilocular (Fig. 1E, left), (13.0–) 15.7 ± 2.0 (–20.5) × (5.0–) 7.1 ± 1.0 (–9.0) µm in size (n=31); length/width ratio *c.* 2.2. Ascospore walls *c.* 0.2–0.5 µm wide; septa (2.0–) 3.2 ± 0.5 (–4.0) µm thick (n=31), *c.* 0.2 of spore length. Deformed ascospores with three loculi (Fig 1E, right) rarely observed (CBFS JV5306).

Conidiomata pycnidia, *c.* 80–100 µm in diam. (n = 4); wall around ostiolum slightly grayish (*Sedifolia*-grey). Conidiophores usually arranged in tight tissue (Fig. 1F), variable in length, formed of 2–5 thin-walled ± isodiametric cells. Conidiogenous cells often obtuse triangular, (3–) 4.15 ± 0.6 (–5) µm (n=20). Conidia broadly ellipsoid to subglobose (Fig. 1F), (1.5–) 2.1 ± 0.4 (–2.5) × (1.0–) 1.5 ± 0.2 (–2.0) µm (n=28).

Chemistry. No acetone-soluble compound was detected by HPLC in the thallus and apothecia. *Sedifolia*-grey, an acetone-insoluble pigment, was detected in the soralia, upper part of the true exciple (strong reactions), epihymenium, and the walls of pycnidia (weak reactions). Thallus upper surface (incl. phenocortex) and surface of the thalline exciple does not contain *Sedifolia* grey, except for rare patches with true cortex (weak reactions). The chemical composition of the crystalline pruina is unknown, but some crystals in epihymenium are observed in polarized light, and most of them dissolved after treatment with 5% acetic acid.

Phylogeny. Based on nuclear ITS data, *Caloplaca concreticola* forms a well-supported monophyletic group (100% bootstrap support) within *Pyrenodesmia* (Fig. 2). Although morphologically highly dissimilar, *Caloplaca badioreagens* (together with the sequence AY313973 assigned to *C. alociza* in the GenBank) is shown here to be the most closely related known species, possibly having a paraphyletic position in relation to *C. concreticola*. However, the low bootstrap support (60%) does not exclude that *C. badioregens* could be monophyletic. *Caloplaca chalybaea* (together with the sequence AY233224 assigned to *C. variabilis* in the GenBank) appears to be the most closely allied species to the *C. badioreagens* / *C. concreticola* group, although the bootstrap support is below 50% and this grouping is sustained only by the measure of Bayesian posterior probabilities (BPP = 0.56).

Etymology. Named after its specific substratum, concrete.

Ecology and distribution. The new species grows on concrete, usually on surfaces of water channels in dry areas; it is not yet known from natural habitats. Most records are from channels with permanent water, usually in a zone 1–3 m above the water level, but some sterile populations were found in channels with only periodic water. Phytosociologically *C. concreticola* belongs to the pioneer unit *Lecanorion dispersae* described by Laundon (1967). This is a pioneer community on artificial calcareous substrata in urban areas throughout Europe (e.g. Christensen 2004). Accompanying species are *Caloplaca crenulatella*, *C. decipiens*, *C. flavocitrina*, *C. saxicola*, *C. teicholyta*, *Candelariella aurella*, *Lecanora albescens*, *L. crenulata*, *L. dispersa*, *Sarcogyne regularis*, *Staurothele frustulenta*, *Verrucaria macrostoma* f. *furfuracea*, *Verrucaria muralis*, and *V. nigrescens* s.l. The new species is

probably widespread on concrete in the semi-arid landscapes of Eastern Europe, but was overlooked because of its small and often sterile thalli.

Remarks. The new species is easily distinguished by the combination of marginal sorediate grey areoles and brown to black apothecia lacking anthraquinone. Only a few known species of the subgenus *Pyrenodesmia* produce vegetative diaspores: *Caloplaca albopustulata*, *C. demissa*, *C. diplacioides* (sorediate morphotype of *C. diplacia*), *C. erodens*, *C. fuscoblastidiata*, *C. gambiensis*, *C. obscurella*, *C. turkuensis*, and *C. wrightii*. These, morphologically very different species are listed in Tab. 2.

When sterile, *C. concreticola* is very similar to *C. soralifera*; the two species being almost indistinguishable in the field, but the former differs in the K- reaction of the phenocortex, instead of K+ violet (Sedifolia-grey) true cortex in *C. soralifera* (Vondrák & Hrouzek 2006). *C. soralifera* also has a similar ecology and may occur with *C. concreticola*. The sterile crust (K+ violet) of *Rinodina pityrea* on concrete is separated by its blue-green, entirely blastidiate thallus.

Additional specimens examined. **Romania**. *Dobrogea*: Constanţa, water channel SW of Basarabi, alt. 25 m, 44°09'48.87"N, 28°23'25.21"E, on dry surface of concrete water channel, *c.* 4 m above water level, with *C. teicholyta*, 6 April 2007, *J. Vondrák & J. Šoun* (CBFS JV5298). **Slovakia**. *Slovenský kras karst*: Rožňava, Turňa nad Bodvou, on road to Hosťovce, ca 2 km SW of town, alt. 170 m, 48°35'13"N, 20°51'23"E, on concrete on bridge over brook, 5 August 2006, *J. Vondrák* (CBFS JV4637). **Ukraine**. *Crimean Peninsula*: Krasnoperekopskiy district, Armiansk, 6.5 km NW of town, at North-Crimean channel, alt. 10 m, 46°08'57.36"N, 33°37'40.25"E, on dry surface of concrete water channel, 1-2 m above water level, 29 May 2007, *J. Vondrák & J. Šoun* (CBFS JV5297); Dzhankoyskiy district, North-Crimean channel near road bridge N of Kondratovo, alt. *c.* 20 m, 45°42'11.54"N, 34°26'27.00"E, on concrete of channel wall, 23 May 2007, *J. Vondrák & J. Šoun* (CBFS JV5301); Kirovskiy district, North-Crimean channel near road bridge S of Kirovske, alt. *c.* 20 m, 45°10'55.34"N, 35°13'21.89"E, on concrete of channel wall, 23 May 2007, *J. Vondrák & J. Šoun* (CBFS JV5302, dupl. GZU, UPS); *Khersonska oblast*: Chaplinskiy district, 10 km W of village Askania-Nova, R-2 channel, on concrete of channel wall, 15 November 2006, *A. Khodosovtsev* (KHER, dupl. CBFS JV5305); 4.5 km W of village Zaozerne, Kakhovskiy kanal water channel, on concrete of channel wall, 15 November 2006, *A. Khodosovtsev* (KHER, dupl. CBFS JV5304, 5306, topotypi); *Mykolaivska oblast*: Ochakovskiy district, Radsad, at stadium in town, bank of river Pivdenniy Bug, on concrete, 23 December 2006, *A. Khodosovtsev* (KHER).

ACKNOWLEDGEMENTS

We are grateful to Ulrik Søchting (Copenhagen) and Pavel Hrouzek (Třeboň, CZ) for providing of HPLC analysis, Jiří Danihelka (Brno, CZ) for the Latin translation of the diagnosis, and Mark Seaward (Bradford, UK) for helpful criticism and linguistic corrections. Miroslava Hrbstová (České Budějovice, CZ) kindly helped us with the molecular laboratory work. Both reviewers provided valuable comments to the manuscripts. The project was supported by the grants KJB601410701 and MSM6007665801 (J. Vondrák) and a grant of the President of Ukraine no. GP/F13/0196 (A. Khodosovtsev).

REFERENCES

Aptroot, A. (2001) Lichens from Gambia, with a new black-fruiting isidiate *Caloplaca* on savannah trees. *Cryptogamie, Mycologie* **22**: 265-270.

Arup, U. & Grube, M. (1999) Where does *Lecanora demissa* (Ascomycota, *Lecanorales*) belong? *Lichenologist* **31**: 419-430.

Christensen, S.N. (2004) Epilithic lichen vegetation of corrugated asbestos-cement roof tiles in the Copenhagen area. *Graphis Scripta* **15**: 7-13.

Clauzade, G. & Roux, C. (1985) Likenoj de Okcidenta Europo. Ilustrita determinlibro [Lichens of the Western Europe]. *Bulletin de la Société Botanique du Centre-Ouest, Nouvelle Série, Numéro Spécial* **7**: 1–893.

Giordani, P., Modenesi, P. & Tretiach, M. (2003) Determinant factors for the formation of the calcium oxalate minerals, weddellite and whewellite, on the surface of foliose lichens. *Lichenologist* **35**: 255-270.

Hafellner, J. & Muggia, L. (2006) Über Vorkommen von *Caloplaca erodens* in der Steiermark (Österreich). *Mitteilungen der Naturwissenschaftlichen Vereines für Steiermark* **135**: 33-49.

Katoh, K., Kuma, K., Toh, H. & Miyata, T. (2002) MAFFT: a novel method for rapid multiple sequence alignment based on fast Fourier transform. *Nucleic Acids Res*. **30**: 3059-3066.

Khodosovtsev, A., Kondratyuk, S. & Kärnefelt, I. (2002) *Caloplaca albopustulata*, a new saxicolous lichen from Crimea Peninsula, Ukraine. *Graphis Scripta* **13**: 5-8.

Laundon, J.R. (1967) A study of the lichen flora of London. *Lichenologist* **3**: 277-327.

Laundon, J. R. (1992) *Caloplaca* Th. Fr. (1860). In: Purvis, O. W., Coppins, B. J., Hawksworth, D. L., James, P. W. & Moore, D. M. (eds), *The Lichen Flora of Great Britain and Ireland*. Natural History Museum Publications & British Lichen Society, London, pp. 141–159.

Meyer, B. & Printzen, C. (2000) Proposal for a standardized nomenclature and characterization of insoluble lichen pigments. *Lichenologist* **32**: 571-583.

Muggia, L., Grube, M. & Tretiach, M. (2007) A combined molecular and morphological approach to species delimitation in black-fruited, endolithic *Caloplaca*: high genetic and low morphological diversity. *Mycological Research* (*in press*).

Nylander, J. A. A., Ronquist, F., Huelsenbeck, J. P. & Nieves-Aldrey, J. L. (2004) Bayesian phylogenetic analysis of combined data. *Systematic Biology* **53**: 47–67.

Ryan, B. D., Bungartz, F. & Nash, T. H. III (2002) Morphology and anatomy of the lichen thallus. In *Lichen Flora of the Greater Sonoran Desert Region. I.* (T. H. Nash III, B. D. Ryan, C. Gries & F. Bungartz, eds): 8-23. Tempe: Lichens Unlimited, Arizona State University.

Ronquist, F. & Huelsenbeck, J. P. (2003) MRBAYES 3: Bayesian phylogenetic inference under mixed models. *Bioinformatics* **19**: 1572-1574.

Søchting, U. (1994) *Caloplaca ahtii* Søchting spec. nova and other *Caloplaca* species with greenish-bluish soredia from the northern hemisphere. *Acta Botanica Fennica* **150**: 173-178.

Søchting, U. & Figueras, G. (2007) *Caloplaca lenae* sp. nov., and other *Caloplaca* species with caloploicin and vicanicin. *Lichenologist* **39**: 7-14.

Steiner, M. & Peveling, E. (1984) Lagerungsbedingte Änderungen der Sporenstrucktur bei einigen Arten der Gattung *Caloplaca* (Lichenes, *Teloschistaceae*). *Beiheft zur Nova Hedwigia* **79**: 775-791.

Swofford, D. L. (2002) *PAUP*. Phylogenetic Analysis Using Parsimony (*and Other Methods). Version 4*. Sunderland, Massachusetts: Sinauer Associates.

Talavera, G. & Castresana, J. (2007) Improvement of phylogenies after removing divergent and ambiguously aligned blocks from protein sequence alignments. *Systematic Biology* **56**: 564-577.

Tretiach, M., Pinna, D. & Grube, M. (2003) *Caloplaca erodens* [sect. *Pyrenodesmia*], a new lichen species from Italy with an unusual thallus type. *Mycological Progress* **2**: 127-136.

Tretiach, M. & Muggia, L. (2006) *Caloplaca badioreagens*, a new calcicolous, endolithic lichen from Italy. *Lichenologist* **38**: 223-229.

van den Boom, P. P. G. & Etayo, J. (1995) A new epiphytic species of the lichen genus *Caloplaca* from southwestern Europe. *Mycotaxon* **56**: 125-132.

Vondrák, J. & Hrouzek, P. (2006) *Caloplaca soralifera*, a new species from Europe. *Graphis Scripta* **18**: 6-15.

Vondrák, J., Kocourková, J., Palice, Z. & Liška, J. (2007) New and noteworthy lichens in the Czech Republic – genus *Caloplaca*. *Preslia* **79**: 163-184.

Wetmore, C. M. (1994) The lichen genus *Caloplaca* in North and Central America with brown or black apothecia. *Mycologia* **86**: 813-838.

Wetmore, C. M. (2004) The isidiate corticolous *Caloplaca* species in North and Central America. *The Bryologist* **107**: 284-292.

Wunder, H. (1974) Schwartzfruchtige, saxicole Sippen der Gattung *Caloplaca* (Lichenes, *Teloschistaceae*) in Mitteleuropa, dem Mittelmeergebiet und Vorderasien. *Bibliotheca Lichenologica* **3**: 1-186.

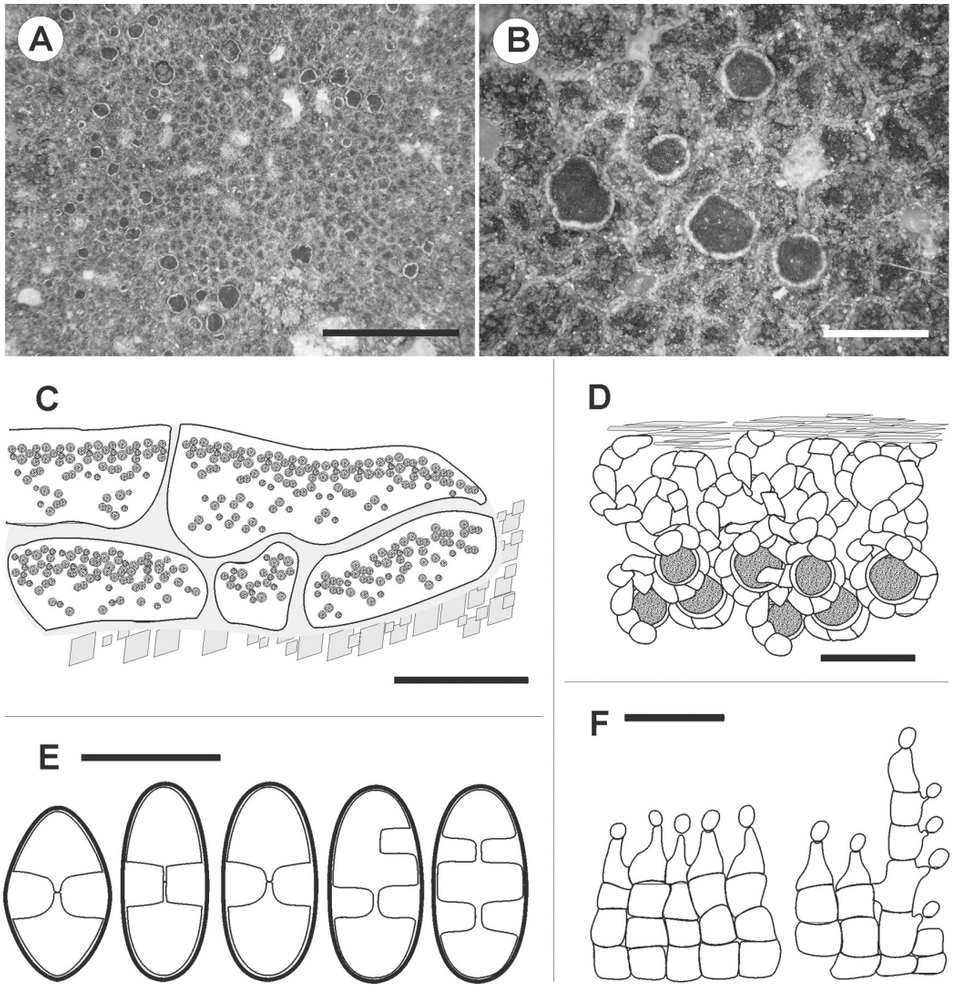

Fig. 1. *Caloplaca concreticola*. A, thallus with apothecia (isotypus); B, detail of apothecia and areoles with marginal soralia (isotypus); C, section of a thallus composed of old but living areoles overgrown by younger areoles. (CBFS JV5301); D, section of phenocortex formed of loose tissue with gaps after dead algal cells (CBFS JV5298); E, ascospores, right ascospores deformed, 3-locular (CBFS JV5306); F, conidiophores with conidia (left - CBFS JV5301, right - CBFS JV5304). In Figs C and D, shapes of cells and substrate crystals and structure of epinecral layer are schematic, not realistic. Scales: A = 5 mm, B = 1 mm, C = 100 μm, D, E, F = 10 μm.

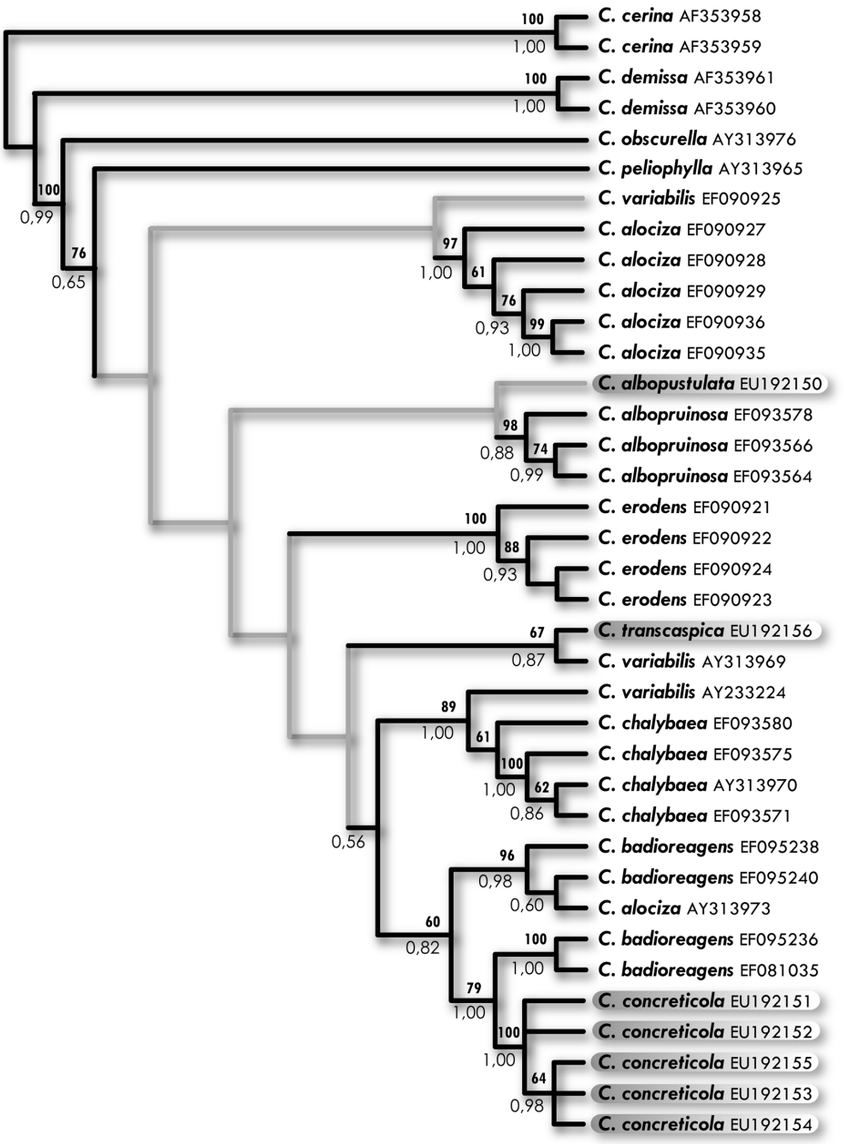

Fig. 2. Phylogeny of *Caloplaca* subg. *Pyrenodesmia* including the new species *Caloplaca concreticola*. Majority-rule consensus of sixteen most parsimonious cladograms based on 530x37-nucleotide matrix plus biparitions found during bootstrap analysis; heuristic search option in PAUP was employed using random sequence addition and TBR algorithm (more in text). Numbers in bold are bootstrap portions for clades present in 500 or more of 1000 bootstrap replicates. Light numbers below branches denote posterior probabilities for the following node calculated in MrBayes (90 000 trees were sampled among 10 000 000 generations). The highly ambiguous mid portion of the cladogram with low statistical support is drawn in gray. Shaded terminals represent new sequences acquired for this work.

Tab. 1. Sample data and GenBank accession numbers of the new ITS sequences used in the phylogenetic tree.

Species / Herbarium Accession No.	Locality	GenBank Accession No.
C. albopustulata CBFS JV5468 (Topotype)	**Ukraine**. Crimea, Alushta (coll. Vondrák 2007)	EU192150
C. concreticola CBFS JV4636 (Holotype)	**Ukraine**. Kakhovskiy magistral channel (coll. Vondrák & Šoun 2006)	EU192151
C. concreticola CBFS JV4637	**Slovakia**. Rožňava (coll. Vondrák 2006)	EU192152
C. concreticola CBFS JV5297	**Ukraine**. Crimea, Armiansk (coll. Vondrák & Šoun 2007)	EU192153
C. concreticola CBFS JV5298	**Romania**. Dobrogea, Constanţa (coll. Vondrák & Šoun 2007)	EU192154
C. concreticola CBFS JV5306	**Ukraine**. Kakhovskiy magistral channel (coll. Khodosovtsev 2006)	EU192155
C. transcaspica CBFS JV5466	**Ukraine**. Crimea, Feodosia (coll. Vondrák 2007)	EU192156

Tab. 2. List of *Caloplaca* subg. *Pyrenodesmia* species producing vegetative diaspores.

Species	Type of vegetative diaspores / Key character	Substrata and distribution	References
Caloplaca albopustulata Khodosovtsev & S.Y. Kondr.	blastidia or schizidia / K+ violet cortex	calcareous conglomerates in Crimean Peninsula	Khodosovtsev et al. (2002)
C. demissa (Körb.) Arup & Grube	soredia / thallus runded, placodioid, apothecia not known	non-calcareous rocks in Europe and North America	Arup & Grube (1999)
C. diplacioides (Vain.) Zahlbr. (= sorediate form of *C. diplacia* (Ach.) Riddle)	soredia / dense granules in apoth. margin, disolv. in KOH; thallus K+ yellow (atranorin)	non-calcareous, rarely calcareous rocks in North America	Wetmore (1994)
C. erodens Tretiach, Pinna & Grube	soredia / thallus endolithic, causing specific depressions in substrate	calcareous rocks in Europe	Tretiach et al. (2003), Hafellner & Muggia (2006), Vondrák et al. (2007)
C. fuscoblastidiata van den Boom & Etayo	blastidia (isidia) / apothecia similar to *C. obscurella*, epithecium K-, N-, ascospores 10–14 × 5.5–7 µm	on bark of e.g. *Olea* and *Ceratonia* in Portugal and Spain	van den Boom & Etayo (1995), Wetmore (2004)
C. gambiensis Aptroot	isidia / all parts of apothecia and thallus K-, C-, N-, ascospores 14–15.5 × 5.5–7 µm, septum 5.5–7 µm thick	on savannah trees in tropical Africa and Taiwan	Aptroot (2001), Wetmore (2004)
C. obscurella (J. Lahm ex Körb.) Th. Fr.	soredia / K- crater-like soralia, ascospores 10–13 × 6–8 µm	nutrient-rich, basic bark in Europe and North America	Laundon (1992), Søchting (1994), Wetmore (1994)
C. turkuensis (Vain.) Zahlbr.	soredia / ascospores 9–12 × 5–7 µm	bark of *Ulmus* in Finland	Clauzade & Roux (1985)
C. wrightii (Tuck.) Fink (= *C. neotropica* Wetmore)	isidia / usual presence of pseudocyphellae, ascosp. with thickened end walls	on bark in tropical and subtropical America	Wetmore (1994, 2004)

Caloplaca subalpina AND *C. thracopontica*, TWO NEW SAXICOLOUS SPECIES FROM THE *Caloplaca cerina* GROUP (*Teloschistales*)

JAN VONDRÁK[1,8], JAROSLAV ŠOUN[1,8], PAVEL HROUZEK[1,4], PAVEL ŘÍHA[2], JIŘÍ KUBÁSEK[3], ZDENĚK PALICE[5,6] & ULRIK SØCHTING[7]

[1] Department of Botany, Faculty of Science, University of South Bohemia, Branišovská 31, České Budějovice, CZ-370 05, Czech Republic

[2] Department of Zoology, Faculty of Science, University of South Bohemia, Branišovská 31, České Budějovice, CZ-370 05, Czech Republic

[3] Department of Plant Physiology, Faculty of Science, University of South Bohemia, Branišovská 31, České Budějovice, CZ-370 05, Czech Republic

[4] Department of Autotrophic Microorganisms, Institute of Microbiology, Academy of Sciences, Opatovický mlýn, Třeboň, CZ-379 81, Czech Republic

[5] Institute of Botany, Academy of Sciences, Průhonice, CZ-252 43, Czech Republic

[6] Department of Botany, Faculty of Natural Sciences, Charles University, Benátská 2, Praha 2, CZ- 12801 Czech Republic

[7] Section for Microbiology, Department of Biology, University of Copenhagen, Ø. Farimagsgade 2D, DK-1353 Copenhagen, Denmark

[8] Corresponding authors: J. Vondrák (j.vondrak@seznam.cz), J. Šoun (jasoun@centrum.cz)

Abstract: *Caloplaca subalpina* Vondrák, Šoun & Palice and *C. thracopontica* Vondrák & Šoun are described here as new to science. The former is sorediate, often sterile, saxicolous species inhabiting subalpine base-rich overhanging rocks in European mountains; the latter grows on maritime cliffs of the Black Sea and is conspicuous by the lobules and pustules which are usually present on its thallus and by its apothecia which are typically large and abundant. Their positions in the *C. cerina* group were molecularly confirmed using nrDNA ITS sequences; chemosyndromes of both new species correspond to chemosyndrome A, which is in accordance with the position of treated species in the *C. cerina* group. A key to the saxicolous species of the *C. cerina* group is provided.

Key Words: Black Sea, Europe, lichenized fungi, nrDNA ITS, *Teloschistaceae*.

INTRODUCTION

Here we present partial data to a major project on the taxonomy of the *Caloplaca cerina* group in Europe. The concept of this group varied with different authors; e.g. Clauzade & Roux (1985) and more recently Wetmore (2007) used it in a broad sense including species with zeorine apothecia, which are not related to *C. cerina*. We consider the *C. cerina* group in its strict sense, as a monophyletic group, which is morphologically characterized by lecanorine apothecia with strongly reduced, superficially ± invisible true exciple. The thallus is not placodioid and does not contain anthraquinones. This group possesses low variability in apothecial characters, but is highly variable in thallus morphology, such as vegetative diaspores (lobules, pustules, isidia, consoredia, soredia); thus the diagnostic characters of particular species are mainly concerned with thallus structures. Some species with the morphology of *C. cerina* group does not, however, belong to *C. cerina* clade, e.g. *C. squamuloisidiata* van den Boom & V. J. Rico (Šoun, *unpublished data*).

Not many species have been described in the *Caloplaca cerina* group (majority from Europe), but such species are to be found on a wide range of substrata (corticolous, lignicolous, muscicolous, saxicolous and occurring on plant debris). This paper concerns two new saxicolous species, which specifically grow beneath base-rich overhanging rocks in the subalpine mountain belt in Europe and maritime cliffs of the Black Sea, respectively. Both new species are shown here as two well-supported clades in a brief phylogenetic tree of the *Caloplaca cerina* group. A key to the saxicolous species of this group is provided.

MATERIALS AND METHODS

Morphology. In total, 19 characters were measured in the new species: size of areoles, height of thallus, cortex, algal layer, size of vegetative diaspores, size of cortex cells and of algal and fungal cells in algal layer, size of apothecia, thalline and true exciple width, hypothecium and hymenium height, size of asci and ascospores, width of spore septa, width of paraphyses tips, and size of conidiomata, conidiogenous cells and conidia. Among qualitative traits, characters of each tissue (e.g. paraplectenchymatous vs. prosoplectenchymatous type, occurrence of anastomoses, and presence of thin-walled vs. thick-walled cells), and colour of thallus and apothecia were used.

Sections for morphological examination were cut by hand and observed in water. Accuracies of 0.5 µm (for cells, e.g. conidia and ascospores), 1 µm (asci size and cortex height) and 10 µm (larger structures, e.g. hymenium and hypothecium height) were achieved; all measurements of cells were taken with their walls, not only lumina. Paraphyses tips and thallus characters were observed after pretreatment of KOH. Ascospores with well-developed septum (loculi only connected with thin cytoplasmatic channel, but not disconnected) were measured. Measurements are given as (min.–) X±SD (–max.), where X = mean value and SD = standard deviation. Total numbers of measurements (n) are given in parentheses. Morphological data were taken from all available samples; in *C. subalpina*, only two populations with well-developed ascocarps were investigated. For both species, at least 15 measurements of each character were determined, except for pycnidial size in *Caloplaca subalpina*, where n=6.

New morphological term. Algonecral medulla is established here for the hyaline tissue below the algal layer, formed by paraplectenchymatous thin-walled fungal cells among dead algal cells or gaps created after the death of algal cells (Fig. 2A). The true medulla is loose prosoplectenchymatous tissue situated lowermost. The algonecral medulla is present in both new species, mainly in places where the thallus height is above-average.

Chemistry. The lichen substances of apothecia were extracted in 150 ml of acetone at room temperature. The extract was subjected to high-performance liquid chromatography analysis. Reverse phase column (C18, 5 µm, Lichrocart 250-4) was eluted with MeOH/30%MeOH+1%H3PO4 for 77 min and the absorbance at 270 nm was recorded (for details see Søchting 1997). The compounds were determined on the basis of their retention times and absorption spectra. Acetone-insoluble pigments were examined according to Meyer & Printzen (2000).

DNA extraction, amplification and sequencing. Direct PCR was used for PCR-amplification of the ITS regions including the 5.8S gene of the nuclear rDNA following Arup (2006). Primers for amplification were ITS1F (Gardes & Bruns 1993) and ITS4 (White et al. 1990). PCR cycling parameters follow Ekman (2001). Products were cleaned using JETquick PCR purification Spin Kit (Genomed). Both complementary strands were sequenced with the BigDye Terminator v3.1 Cycle Sequencing Kit (Applied Biosystems) using the primers mentioned above, and run on an ABI 3130xl Genetic Analyzer.

Phylogenetic analysis. Newly obtained ITS sequences were included in the phylogenetic analysis of the ingroup (Tab. 1) and *C. crenularia* along with *C. demissa* (AF353965 and AF353961 downloaded from the GenBank database) were used as the outgroup. On-line version of MAFFT 6 in the Q-INS-i mode (Katoh et al. 2002) was employed to align the sequences. The resulting alignment contained 880 positions and no manual cutting was necessary.

Maximum parsimony analysis was conducted using PAUP*4.0b10. Gaps were treated as missing data and all characters were equally weighed. A heuristic search was performed with 100 random-addition-sequences (RAS), using tree bisection-reconnection (TBR) branch-swapping. The steepest descent option was not in effect and the analysis ran under the MulTrees option; no restriction was applied to the maximum number of trees in memory using the MaxTrees option. Non-parametric bootstrap analysis encompassed 1,000 resamplings and kept the same settings as the parsimony heuristic search.

An additional analysis aimed to test the credibility of nodes was conducted in MrBayes 3.0 (Ronquist and Huelsenbeck 2003), set in accordance with the best-fit model suggested by MrModeltest 2.2 (Nylander 2004) to GTR+Γ (gamma approximated by four categories). A flat Dirichlet prior distribution with all values set to 1.0 was used to model the prior probability densities of the substitution rates as well as the stationary nucleotide frequencies. In order to assess the stability of the MCMC process, we monitored the standard deviation of split frequencies of two simultaneous independent runs, each including four parallel chains (one "cold" and three incrementally heated by a temperature of 0.2). Each parallel run proceeded 5,000,000 generations and 75 000 trees were selected from both runs after sampling every 100th count and excluding the first 25 000 trees (burn-in) in order to avoid trees that

might have been sampled prior to convergence of the Markov chains. A majority-rule consensus tree was obtained by pooling the selected trees; Bayesian posterior probabilities for its nodes are shown in Fig 4.

Nomenclature generally follows Nimis & Martellos (2003) and Santesson et al. (2004), but Hansen et al. (1987) for *Caloplaca jemtlandica* var. *cerinosora*, and van den Boom & Rico (2006) for *C. squamuloisidiata*. Names, we use with quotation marks, are incorrect or unclear. For instance, corticolous samples commonly named *Caloplaca isidiigera* or *C. chlorina* belong to different species (Šoun, *unpublished data*), thus both names are in inverted commas, when used for corticolous material.

Material used for comparison.

Caloplaca aractina: e.g. **Bulgaria**. *Black Sea coast*. Tsarevo, 2004, *J. Vondrák* (CBFS JV2248); **Czech Republic**. *Central Bohemia*. Křivoklát, 2003, *J. Vondrák* (CBFS JV1163); **Ukraine**. *Crimean Peninsula*. Karadag, 2007, *J. Vondrák* (CBFS JV5948).

C. chlorina: e.g. **Bulgaria**. *Rhodopes*. Madzharovo, 2004, *J. Vondrák* (CBFS JV2055); **Czech Republic**. *South Bohemia*. Milevsko, 2004, *J. Vondrák* (CBFS JV2056).

C. conversa: e.g. **Iran**. *East Azerbaijan*. Khalkhal, 2007, *J. Vondrák* (CBFS JV5566); **Ukraine**. *Crimean Peninsula*. Alushta, 2007, *J. Vondrák* (CBFS JV6007).

C. furax: **Spain**. *Sierra del Relumbrar*. 1978, *J. Egea & X. Llimona* (Isotype, Murc. Lichenotheca 3039, GZU)

C. isidiigera: **Austria**. *Eastern Alps*. Seckauer Alpen Mts, 2007, *J. Vondrák* (CBFS JV6081); **Ukraine**. *Eastern Carpathians*. Svidovets Mts, 2007, *J. Vondrák* (CBFS JV6073). **Slovakia**. *Low Tatras Mts*. Mt Veľký Bok, 1974, *A. Vězda* (Isotype, Vězda Lich. sel. exs. no. 1494, PRM).

C. pellodella: **Bulgaria**. *Rhodopes*. Madzharovo, 2004, *J. Vondrák* (CBFS JV2114); **Morocco**. *Anti-Atlas* Mts. Tafraoute, 2003, *J. Vondrák* (CBFS JV1429).

C. percrocata: **Italy**. *Southern Alps*. Castelnuovo, 1902, *J. Baumgartner* (Holotype of *C. cerina* var. *areolata* W); Trento, 2006, *Š. Hulová* (CBFS JV4634); **Ukraine**. *Eastern Carpathians*. Svidovets Mts, 2007, *J. Vondrák* (CBFS JV6082).

C. squamuloisidiata: **Spain**. Extremadura. Sierra de las Villuercas, 2001, P. & B. v. d. Boom (Paratype, hb. v. d. Boom 27264).

C. xerica: e.g. **Bulgaria**. *Rhodopes*. Lyubimets, 2004, *J. Vondrák* (CBFS JV2177); **Czech Republic**. *Central Bohemia*. Točník, 2003, *J. Vondrák* (CBFS JV1124); **Iran**. *East Azerbaijan*. Nir, 2007, *J. Vondrák* (CBFS JV5607); **Romania**. *Munţii Zărandului Mts*. Şoimoş, 2005, *J. Vondrák* (CBFS JV3647); **Ukraine**. *Mykolaivska oblast*. Pervomaisk, 2006, *J. Vondrák* (CBFS JV5650).

THE SPECIES

Caloplaca subalpina VONDRÁK, ŠOUN & PALICE NOM. PROV.

Typus. **Ukraine**. *Eastern Carpathians*: Svidovets Mts, glacial cirque in NE slope below Mt Bliznitsa, alt. *c.* 1500 m, 48°14'21"N, 24°14'E, on lime-rich schist outcrop, beneath overhang, in subalpine belt, 29 Jun 2007, *J. Vondrák* (CBFS JV6072 - Holotypus, Isotypi in GZU, L).

Thallus (Fig. 1B, C) areolate, but often distinctly squamulose in thallus margins, sorediate, grey to green-grey, usually white pruinose in spots or over most of thallus surface, up to several cm broad. Areoles / squamules flat (mainly in central part of tightly closed areoles) to convex, (60–) 164±74 (–450) µm high (n=37) and (0.16–) 0.58±0.32 (–2.04) mm wide (n=52). Areoles close to thallus margin usually larger and more discrete. Grey to black prothallus sometimes visible around marginal areoles. Soralia lead-grey, rising from margins of areoles, sometimes spreading over whole areoles. Soredia strongly K+ violet in section, (18–) 30±8 (–54) µm in diam. (n=40); consoredia rare and small. Epinecral layer up to *c.* 15 µm high. Cortex conspicuous, (5–) 17±11 (–53) µm high (n=54), hyaline in lower part, sordid-grey (K+ violet in section) in upper part, formed of tight paraplectenchymatous tissue of 0.5–1.5 µm thick-walled, large, isodiametric cells, (4.0–) 6.5±1.0 (–8.5) µm in diam. Cortex in lower part of thalline exciple distinctly thickened, up to 70 µm. Algal layer (30–) 65±20 (–110) µm high (n=15), formed of algal cells (6.0–) 11.0±4.0 (–21.0) µm in diam. (n=32) and mostly isodiametric fungal cells, (3.5–) 5.5±1.5 (–9.0) µm in diam. (n=15), with walls up to 1 µm thick. Medulla not always conspicuous, formed by loose prosoplectenchymatous tissue, of thin-walled, 2–4 µm thick hyphae. Algonecral medulla (Fig. 2A) derivated from decaying algal layer is present in thick thalli.

Apothecia lecanorine (Fig. 1A), medium-sized, (0.26–) 0.48±0.11 (–0.70) mm in diam. (n=33), found in three of four populations, but usually not abundant. Apothecia almost always white-pruinose but grow mainly on non-pruinose parts of thallus, discs orange or yellowish when white-pruinose. Thalline exciple of thallus color, raised above discs when young, lowered in old apothecia, (80–) 100±16 (–140) µm thick (n=18). True exciple indistinct, very thin, up to 40 µm thick, formed of thin-walled, *c.* 2–4 µm thick, prosoplectenchymatous cells. This prosoplectenchymatous tissue is usually continuous to the lowermost part of the hypothecium. Hypothecium hyaline, very variable in height, (30–) 90±40 (–160) µm high (n=15), formed by mixture of isodiametric and elongated hyphal cells. Hymenium hyaline, (60–) 69±7 (–80) µm high (n=15). Epihymenium orange from granules of anthraquinones dissolving in K; crystalline priuna non-dissolving in K often present. Asci 8-spored, (41–) 49±6 (–61) × (10–) 12±1.5 (–17) µm in size (n=19). Paraphyses of thin-walled, *c.* 1.5–2 µm thick cells; somewhat branched and anastomosed; upper 1–2 (–3) cells swollen; terminal cells (2.5–) 3.5±0.5 (–5.0) µm wide (n=17). Ascospores (Fig. 2B) polarilocular, ellipsoid, (9.0–) 11.5±1.5 (–15.0) × (4.5–) 6.0±1.0 (–7.0) µm in size (n=21), length / width ratio *c.* 1.9. Ascospore septa (3.0–) 4.0±0.75 (–5.5) µm thick (n=21), septa / spore length ratio *c.* 0.35. Ascospore wall thin, but thicker in old spores (up to *c.* 0.5 µm).

Conidiomata pycnidia, with centrum *c.* 50–90 µm wide (n=6). Conidiophores tightly closed together forming paraplectenchymatous tissue (Fig. 2D) or rarely solitarily arising. Conidiogenous cells smaller than cortex cells, thin-walled, isodiametric, (2.5–) 4.0±1.0 (–5.5) µm in diam. (n=16). Conidia mostly acrogennous, bacilliform, (2.0–) 3.5±0.75 (–5.0) × (0.5–) 1.0±0.25 (–1.5) µm in size (n=17).

Chemistry. Anthraquinones are only present in apothecial discs. Parietin was found to be the dominant antraquinone (mean=91% of total anthraquinone content). Low proportions of teloschistin, fallacinal, parietinic acid and emodin were recorded. This anthraquinone content corresponds with chemosyndrome A (Søchting 1997). *Sedifolia*-grey, pigment insoluble in acetone, is present in the thallus cortex and soralia.

Etymology. All known localities are situated on intermediate rocks in **subalpine** vegetation belt.

Ecology and Distribution. The species is known from base-rich, schist and conglomerate outcrops in glacial cirques and similar localities in the subalpine vegetation belt (alt. 1190–1800 m). It prefers vertical-faced, sheltered, but well-lit rocks beneath overhangs; only a few lichen species are usually associated, e.g. *Caloplaca arenaria*, *C. obliterans*, *C. saxicola* s. l., and *Physcia dubia*. The known distribution in the Alps, Carpathians, Pyrenees and Sudetes is shown in Fig. 3.

Remarks. Only a few sorediate species from *Caloplaca cerina* group are known. Corticolous species producing soredia, identified as "*C. chlorina*", "*C. virescens*" and *C. jemtlandica* var. *cerinosora* differ in the character of their soralia, which originate from blastidia or are less delimited, often forming sorediate crust on whole surface of areoles. Australian corticolous *C. hanneshertelii* should differ among others in K- cortex and soralia erupting from pustules on thallus surface (Kärnefelt & Kondratyuk 2004). North American corticolous *C. pinicola* differs in, for example, its thinner, 70–85 µm thick thallus and thinner ascospore septa, *c.* 2.0–3.5 µm (Wetmore 2004). Differences from the predominantly saxicolous *C. chlorina* are shown in the key below.

Additional specimens examined. **Austria**. *Seckauer Alpen*: Knittelfeld, Seckau, at chalet Ober Boden Alm below Mt Hämmer Kogel, alt. *c.* 1630 m, 47°21'16"N, 14°46'34"E, on base-rich overhanged schist outcrop in subalpine belt, 10 Aug. 2007, *J. Vondrák* (CBFS JV6071, Dupl. in BM). **Czech Republic**: *North Moravia*: Hrubý Jeseník Mts, glacial cirque "Velká kotlina", outcrop named "Beckeho skála", alt. 1190 m, 50°03'22"N, 17°14'20.5"E, on dry overhanged SE-exposed phyllitic schist rock, 23 Sept. 2001, *Z. Palice* (hb. Palice 6983, dupl. in B, BM). **Spain**: *The Pyrenees*: Jaca, Candanchu, valley of Rio de Canal Roya, alt. 1800 m, 42°47'30"N, 0°28'W, on base-rich, N-exposed conglomerate, under overhang, 13 July 2002, *J. Vondrák* (CBFS JV692).

Caloplaca thracopontica VONDRÁK & ŠOUN NOM. PROV.

Typus. **Turkey**. *Black Sea coast*: Sinop, coastal rocks on NE coast of peninsula, alt. *c.* 100 m, 42°01'57.81"N, 35°11'34.42"E, on coastal volcanic rock, 21 Apr. 2007, *J. Vondrák* (CBFS JV5419 - Holotypus, Isotypi in GZU, hb. M. Seaward).

Thallus (Fig. 1D, E) grey to dark grey (rarely with whitish spots from crystalline pruina, sample CBFS JV5421), conspicuous, several cm in diam., areolate and occasionally minutely sublobate in thallus margins. Thallus surface usually covered by pustules or lobules (Fig. 1E), *c.* 100–400 µm wide and up to 150 µm high. Areoles (90–) 184±65

(–350) µm high (n=40) and (0.29–) 1.32±0.75 (–3.40) mm wide (n=38). Prothallus conspicuous, glossy lead-grey, rarely with whitish outer margin. Epinecral layer usually distinct, up to 30 µm high. Cortex conspicuous, (5–) 23±14 (–75) µm high (n=54), hyaline in lower part, sordid-grey (K+ violet in section) in upper part, formed of tight paraplectenchymatous tissue of 0.5–2 µm thick-walled, large, isodiametric cells, (5.0–) 7.5±1.5 (–11.0) µm in diam. (n=22). Cortex in lower part of thalline exciple distinctly thickened, up to 90 µm. Algal layer (40–) 81±37 (–210) µm high (n=20), formed of algal cells (6.5–) 12.5±3.0 (–18.0) µm in diam. (n=22) and mostly isodiametric fungal cells with thin-walls (up to 0.5 µm). Medulla not always conspicuous, formed by loose prosoplectenchymatous tissue, of thin-walled, 2–4 µm thick hyphae. Algonecral medulla derivated from decaying algal layer is present in thick thalli, mainly below pustules.

Apothecia (Fig. 1D, F) lecanorine, often abundant, large, (0.22–) 0.71±0.28 (–1.52) mm in diam. (n=46), with orange to dark red, flat discs. Thalline exciple of thallus colour, raised above discs when young, somewhat reduced in old apothecia, (50–) 100±24 (–170) µm thick (n=35). True exciple indistinct, very thin, up to 25 µm thick, formed of thin-walled prosoplectenchymatous cells, up to 6 µm thick in uppermost part, *c.* 2–4 µm thick in lower part. This prosoplectenchymatous tissue usually extending to the lowermost part of hypothecium. Hypothecium hyaline, very variable in height, (40–) 116±37 (–180) µm high (n=34), formed by mixture of isodiametric and elongated hyphal cells. Hymenium hyaline, (60–) 81±11 (–110) µm high (n=34). Epihymenium orange from granules of anthraquinones dissolving in K; crystalline priuna non-dissolving in K rarely present (sample CBFS JV5421). Asci 8-spored, (39–) 51±6 (–64) × (8–) 13±3 (–21) µm in size (n=37). Paraphyses of thin-walled, *c.* 1.5–2.5 µm thick cells; branched (in upper one-third) and somewhat anastomosed; upper 1–4 (–7) cells swollen; terminal cells (2.5–) 5.0±1.0 (–6.5) µm wide (n=52). Ascospores (Fig. 2C) polarilocular, ellipsoid (rarely narrowly ellipsoid), (10.0–) 12.5±1.5 (–15.5) × (3.0–) 6.0±1.0 (–10.0) µm in size (n=62), length / width ratio *c.* 2.1. Ascospore wall thin, but thicker in old spores (up to *c.* 0.5 µm). Ascospore septa (2.5–) 5.0±1.0 (–7.0) µm thick (n=62), septa / spore length ratio *c.* 0.4.

Conidiomata pycnidia, with centrum (80–) 132±27 (–180) µm wide (n=22). Conidiophores tightly packed forming paraplectenchymatous tissue or ± solitary. Conidiogenous cells smaller than cortex cells, thin-walled, isodiametric, (3.5–) 5.0±1.0 (–7.5) µm in diam. (n=24) or elongated, up to *c.* 7 µm long. Conidia acro- or pleurogennous, bacilliform, (2.5–) 3.5±1.0 (–5.5) × (1.0–) 1.25±0.25 (–1.5) µm in size (n=44). Detached conidia sometimes form a conglutinated mass on thallus surface around ostiola (blackish dots, translucent when wet, when observed by stereomicroscope).

Chemistry. Similarly to the previous species, the anthraquinone composition of *C. thracopontica* is consistent with chemosyndrome A, with parietin as the principal component (94%) and teloschistin, fallacinal, parietinic acid and emodin in lower concentrations. Anthraquinones are absent from thallus. *Sedifolia*-grey, pigment insoluble in acetone, is present in thallus cortex.

Etymology. **Thracia** and **Pontus** are the Latin names for the areas around the Black Sea, where the new species was collected.

Ecology and distribution. *C. thracopontica* is a maritime species, mainly inhabiting the supralittoral zone of coastal cliffs at alt. 14-180 m (Sinop, Turkey, extremely exposed shore), and at alt. 3-10 m (Sinemorets, Bulgaria, sheltered shore). It occurs on exposed, hard siliceous outcrops associated, for example, with *Caloplaca aractina*, *C.* aff. *crenularia*, *C. fuscoatroides*, *C. maritima*, *C.* aff. *thallincola*, *Candelariella plumbea*, *Catillaria chalybeia*, *Rinodina gennarii*, and *Xanthoria calcicola*. It is distributed at the Black Sea coast (Fig. 3) in South Bulgaria (several localities between Burgas and Rezovo) and in NE Turkey (very abundant on localities between Sinop and the Georgian border). According to our fieldwork, its absence from Romanian, North Bulgarian, Georgian, and Russian coast of the Black Sea is probably caused by the scarcity of suitable substrata, but surprisingly, it was not found on numerous hard siliceous rocks in NW Turkey and the well-surveyed Crimean Peninsula.

Remarks. The species is well-characterized by its wide and tall areoles usually covered by pustules or small lobules. Corticolous specimens of *C. cerina* s. l. differ in their thin thallus devoid of vegetative diaspores; corticolous specimens named "*C. chlorina*", "*C. isidiigera*" and "*C. virescens*" posses soredia or blastidia, but not pustules or lobules as vegetative diaspores. Some terricolous or muscicolous *C. stillicidiorum* s. l. produce pustule-like structures, but their thallus is clearly different, being significantly less conspicuous. For differences from the saxicolous species see the key below.

Additional specimens examined. **Bulgaria**. *Black Sea coast*: Burgas, Sozopol, siliceous cliffs at seashore *c.* 4 km S of town, 42°22'58.86"N, 27°42'43.81"E, on siliceous coastal rock, 9 Apr. 2007, *J. Vondrák* (CBFS JV6066); *Ibid*.: coastal rocks near camp Veselie, 42°22'46.2"N, 27°43'19"E, on siliceous rock in upper supralitoral zone in alt. *c.* 15-25 m, 30 Nov. 2005, *J. Vondrák* (CBFS JV3419, 3420); Burgas, Tsarevo, Sinemorets, coastal rocks *c.* 2 km SE of village, alt. 3-10 m, 42°00'30"N, 28°00'E, on coastal rocks in mesic-supralitoral zone, 23 Aug. 2004, *J. Vondrák* (Sel. Exs. *Caloplaca*, 15, sub *Caloplaca* aff. *chlorina*). **Turkey**. *Black Sea coast*: Giresun, 40°58'15.75"N, 38°38'15.95"E, on siliceous coastal rock, 23 Apr. 2007, *J. Vondrák* (CBFS JV6065); Sinop, coastal rocks on E coast of peninsula, alt. 180 m, 42°01'12.86"N, 35°12'19.56"E, on siliceous coastal rock, 21 Apr. 2007, *J. Vondrák* (CBFS JV5623); *Ibid*.: alt. *c.* 100 m, 42°01'13"N, 35°12'20"E (CBFS JV6067); Sarp (Turkish-Georgian border), coastal rocks 1.3 km SW of village, alt. *c.* 10 m, 41°30'34.44"N, 41°32'14.80"E, on siliceous coastal rock, 25 Apr. 2007, *J. Šoun* (CBFS JV6107, JŠ302); Trabzon, coastal rocks in village Akçakale, 41°04'56.69"N, 39°30'08.72"E, on siliceous coastal rock, 24 Apr. 2007, *J. Vondrák* (CBFS JV5621).

PHYLOGENY

The dataset of 18 aligned ITS sequences included 842 positions, with 154 variable positions 68 of which were parsimony informative. The parsimony analysis yielded six equally parsimonious trees with the length of 207 steps, all belonging to the same island (hit 100 times). The consistency index (CI) of the trees was 0.859, with a retention index (RI) of 0.717. The bootstrap tree showed 9 supported internodes (BS > 50%), 3 of which give evidence of interspecific relationships, 4 confirm conspecificity of multiple isolates (in the case of *C. chlorina*, *C. isidiigera*, *C. subalpina* and *C. thracopontica*) and 2 message the intraspecific relationships among isolates. The Bayesian inference revealed only 8 supported internodes, one of which represents additional resolution to the bootstrap tree (grouping of *C. cerina* with *C. subalpina*, further in text).

C. subalpina and *C. thracopontica* form two well-supported clades among analyzed sequences (Fig. 4), with bootstrap support 100% in the former and 97% in the latter species; the monophyly of *C. subalpina* sequences is moreover supported by the Bayesian posterior probabilities equal to 1.00. Bayesian inference statistically proves the grouping of *C. subalpina* with *C. cerina* (BPP = 0.94), in spite of the bootstrap support, which is quite low for this clade (BS = 45%, not shown in the fig. 4). We propose *C. chlorina* as the sister taxon to *C. thracopontica*, but further work is necessary as bootstrap support values show low credibility (BS = 68%) and this clade was not revealed by the Bayesian analysis.

KEY TO SAXICOLOUS SPECIES OF THE *Caloplaca cerina* GROUP

The key is focused on those species of the *Caloplaca cerina* group, characterized by lecanorine, anthraquinone pigmented apothecia with strongly reduced true exciple, never with placodioid thalli and without anthraquinones in the thallus and thalline margin. It deals with the species occurring in Europe, but as we know, no saxicolous species of the *C. cerina* group have been described outside of Europe, at least not from North America (Wetmore 2007). Only fertile lichens can be identified by the key.

1a Apothecia zeorine, with distinct anthraquinone-containing true exciple. However, old apothecia may have a lecanorine appearance, with strongly magnified thalline margin. – e.g. ***C. furax***, ***C. percrocata***, ***C. xerica*** (not in the *Caloplaca cerina* group)

1b Apothecia lecanorine or zeorine, but without distinct anthraquinone-containing true exciple. – **2**

2a Apothecia zeorine, with brown to black true exciple (dark excipular ring between disc and thalline exciple) devoid of anthraquinones, but with strong concentration of *Sedifolia*-grey (K+ deeply violet in section). – e.g. ***C. aractina*** p.p., ***C. conversa***, ***C. pellodella*** (not in the *Caloplaca cerina* group)

2b Apothecia lecanorine, with strongly reduced true exciple. – **3**

3a Thallus without vegetative diaspores. Rare morphotypes without pustules and lobules. – ***C. thracopontica***

3b Thallus with soredia, consoredia, isidia, pustules or lobules as vegetative diaspores – **4**

4a With isidia, pustules or lobules on thallus surface. – **5**

4b Soredia or consoredia produced. – **7**

5a With abundant branched coralloid isidia or branched upstanding thin lobules. Sedifoila-grey (K+ violet in section) restricted to cortex at pycnidia and apothecial primordia. – ***C. squamuloisidiata***

5b Cortex distinctly pigmented by *Sedifolia*-grey (K+ violet in section). Isidia, when present, not branched and not distinctly coralloid. – **6**

6a Thallus surface with small globose to shortly vertically elongated isidia, (37–) 62±17 (–97) µm wide (n=30). – ***C. isidiigera***

6b Thallus surface with pustules and lobules, 100–400 µm wide. – ***C. thracopontica***

7a Thallus usually non-pruinose. Soredia (18–) 38±11 (–67) µm in diam. (n=40), often united to consoredia. Large consoredia resemble isidia superficially, but microscopically, they are formed of soredia-like units. Well-developed cortex only in lower part of thalline exciple; in thallus surface, cortex formed only by 1-2 rows of cells (up to 10 µm high). Apothecia common, non-pruinose. – ***C. chlorina***

7b Thallus, at least in marginal parts, white-pruinose. Soredia usually simple, rarely in consoredia, (18–) 30±8 (–54) µm in diam. Cortex well-developed, (5–) 17±11 (–53) µm high. Apothecia rare, usually white-pruinose. – ***C. subalpina***

ACKNOWLEDGEMENTS

We are grateful to Jana Kocourková and Zdeněk Pouzar (Prague, CZ) for providing the Latin transcriptions of diagnoses, Harrie Sipman (Berlin, D), Pieter van den Boom (Son, NL) and Ulf Arup (Lund, S) for providing useful materials for our investigation and sequencing, and Mark Seaward (Bradford, UK) for the linguistic corrections. Our work was financially supported by the Grant Agency of the Academy of Sciences of the Czech Republic (KJB 601410701, AV0Z60050516) and Ministry of Education, Youth and Sports (MSM 6007665801). The work in Copenhagen by the first two authors was supported by a grant from the European Commission's (FP 6) Integrated Infrastructure Initiative programme SYNTHESYS (DK-TAF).

REFERENCES

Arup, U. (2006) A new taxonomy of the *Caloplaca citrina* group in the Nordic countries, except Iceland. *Lichenologist* **38**: 1–20.

Clauzade, G. & Roux, C. (1985) Likenoj de Okcidenta Europo. Ilustrita Determinlibro. *Bulletin de la Société Botanique du Centre-Ouest, Nouvelle Série, Numéro Spécial* **7**: 1-893.

Ekman, S. (2001) Molecular phylogeny of the *Bacidiaceae* (*Lecanorales*, lichenized Ascomycota). *Mycological Research* **105**: 783–797.

Gardes, M. & Bruns, T. D. (1993) ITS primers with enhanced specificity for basidiomycetes. Application for the identification of mycorrhizae and rusts. *Molecular Ecology* **2**: 113–118.

Hansen, E. S., Poelt, J. & Søchting, U. (1987) Die Flechtengattung *Caloplaca* in Grönland. *Meddelelser om Gronland, Bioscience* **25**: 1–52.

Kärnefelt, I. & Kondratyuk, S. Y. (2004) Contribution to the lichen genus *Caloplaca* (*Teloschistaceae*) from Australia. *Bibliotheca Lichenologica* **88**: 255–265.

Katoh, K., Kuma, K., Toh, H. & Miyata, T. (2002) MAFFT: a novel method for rapid multiple sequence alignment based on fast Fourier transform. *Nucleic Acids Res*. **30**: 3059–3066.

Meyer, B. & Printzen, C. (2000) Proposal for a standardized nomenclature and characterization of insoluble lichen pigments. *Lichenologist* **32**: 571–583.

Nimis, P. L. & Martellos, S. (2003) *A second checklist of the lichens of Italy with thesaurus of synonyms*. Museo Regionale di Scienze Naturale, Aosta.

Nylander, J. A. A., Ronquist, F., Huelsenbeck, J. P. & Nieves-Aldrey, J. L. (2004) Bayesian phylogenetic analysis of combined data. *Systematic Biology* **53**: 47–67.

Ronquist, F. & Huelsenbeck, J. P. (2003) MRBAYES 3: Bayesian phylogenetic inference under mixed models. *Bioinformatics* **19**: 1572–1574.

Santesson, R., Moberg, R., Nordin, A., Tønsberg, T. & Vitikainen, O. (2004) *Lichen-forming and lichenicolous fungi of Fennoscandia*. Museum of Evolution, Uppsala University, Uppsala.

Søchting, U. (1997) Two major anthraquinone chemosyndromes in *Teloschistaceae*. *Bibliotheca Lichenologica* **68**: 135–144.

Swofford, D. L. (2002) *PAUP*. Phylogenetic Analysis Using Parsimony (*and Other Methods). Version 4*. Sinauer Associates. Sunderland, Massachusetts.

van den Boom, P. P. G. & Rico, V. J. (2006) *Caloplaca squamuloisidiata*, a new lichen from Portugal and Spain. *Lichenologist* **38**: 529–535.

Wetmore, C. M. (2004) The sorediate corticolous species of *Caloplaca* in North and Central America. *The Bryologist* **107**: 505–520.

Wetmore, C. M. (2007) Notes on *Caloplaca cerina* (*Teloschistaceae*) in North and Central America. *The Bryologist* **110**: 798–807.

White, T. J., Bruns, T. D., Lee, S. & Taylor, J. (1990) Amplification and direct sequencing of fungal ribosomal DNA genes for phylogenies. In *PCR Protocols: a Guide to Methods and Applications* (M. A. Innis, D. H. Gelfand, J. J. Sninsky & T. J. White, eds): 315–322. Academic Press, San Diego.

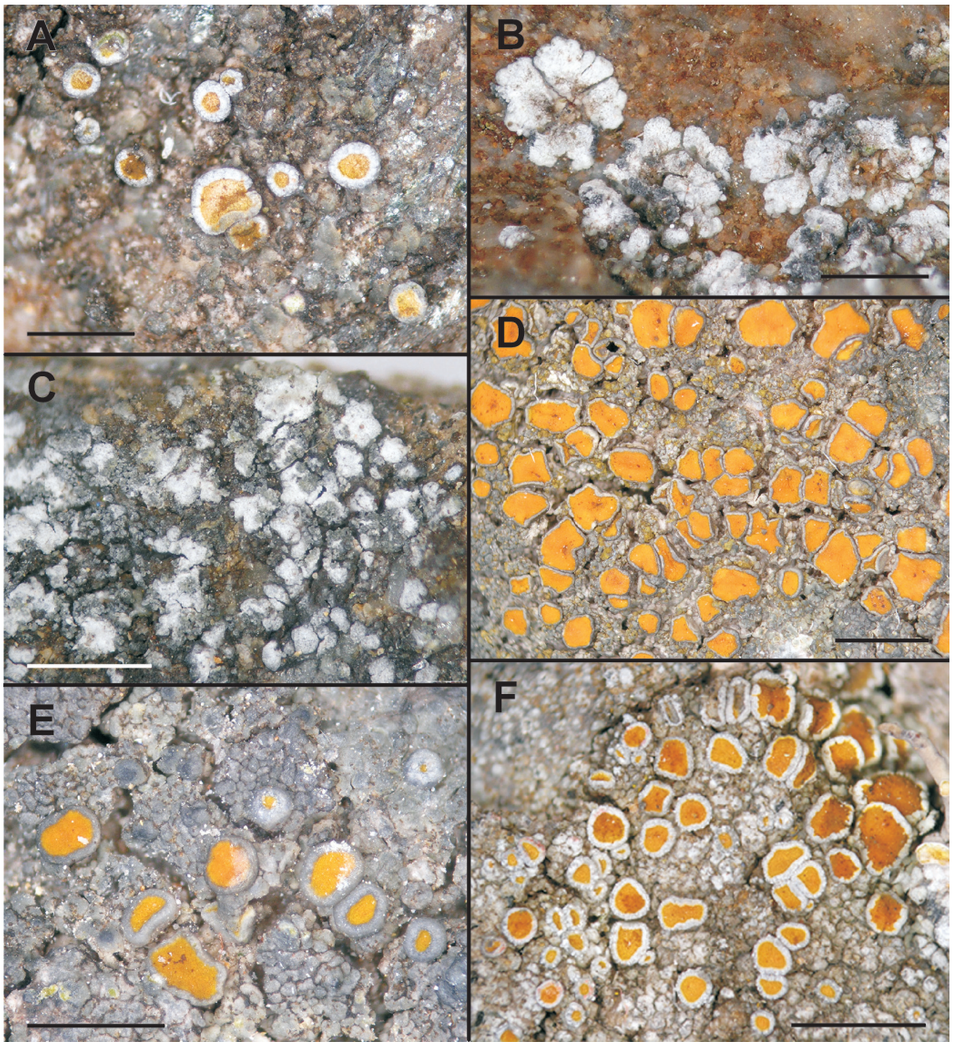

Fig. 1. A-C, *Caloplaca subalpina*. A, apothecia (CBFS JV6071); B, sublobate marginal parts of thallus (CBFS JV6071); C, thallus with soralia (Isotype). D-F, *Caloplaca thracopontica*. D, thallus with abundant apothecia (CBFS JV3419); E, detail of a thallus with pustules and apothecia (CBFS JV6066); F, non-typical specimen with crystalline pruina on thallus and apothecia (CBFS JV5421). Scales: A-C, E = 1 mm, D, F = 2 mm.

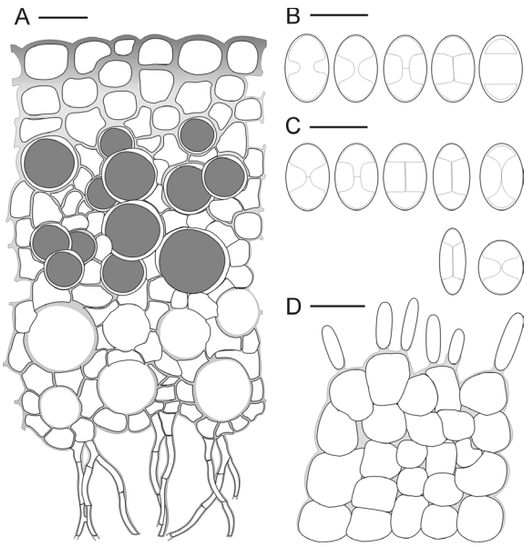

Fig. 2. A, B, D, *Caloplaca subalpina*. A, vertical section through a thallus with thick-walled cortex cells and with algonecral medulla in lower part (CBFS JV692); B, development of ascospores; D, conidiophores with attached conidia (Holotype); C, *Caloplaca thracopontica*. Ascospore variability, lower spores non-typical, with extreme shapes. Scales: A-C = 10 µm, D = 5 µm.

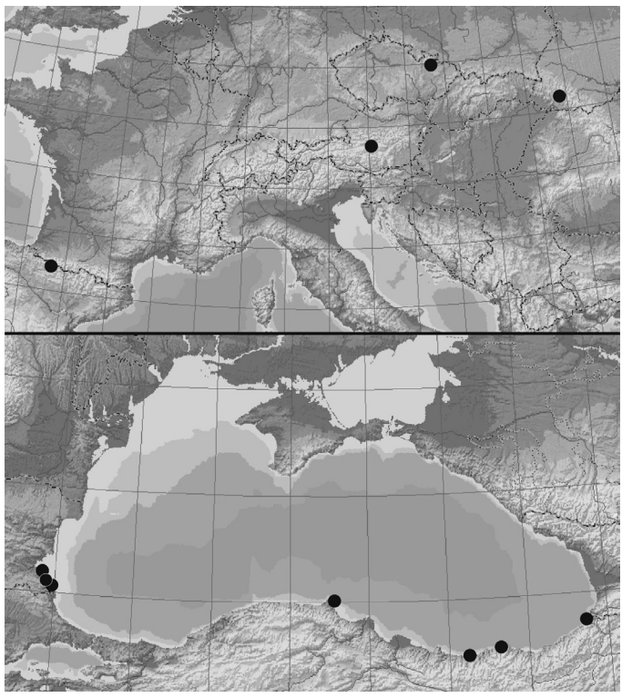

Fig. 3. Distribution of *Caloplaca subalpina* (upper map) and *Caloplaca thracopontica* (lower map).

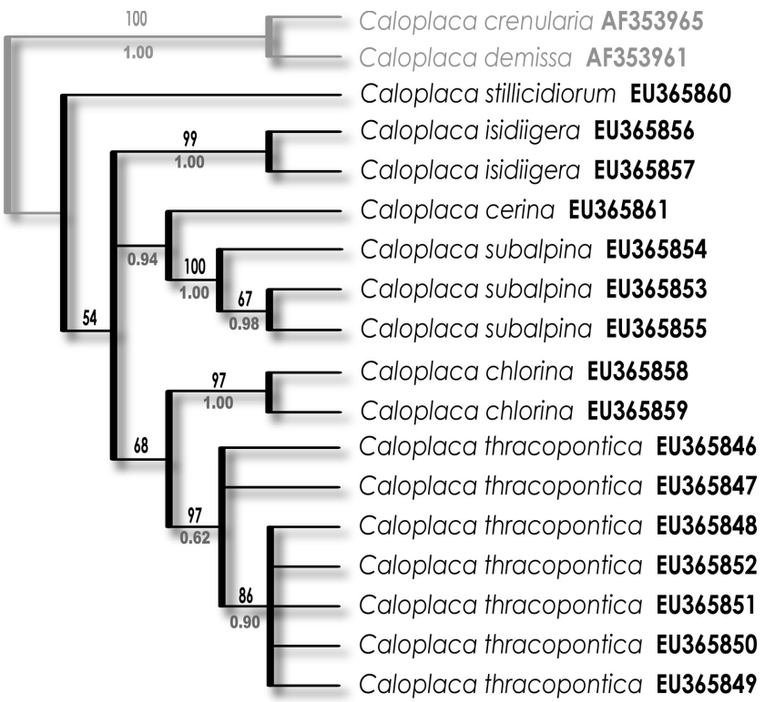

Fig. 4. Phylogenetic relationships of newly acquired ITS sequences of the *C. cerina* group, rooted by the *C. crenularia* and *C. demissa* (outgroup shown in gray, names of taxa accompanied by their GenBank accession numbers). Topology respects the strict consensus tree of the equally most parsimonious trees generated by the maximum parsimony analysis or the Bayesian tree. Numbers above each internode are bootstrap supports, lighter numbers below branches are Bayesian posterior probabilities.

Tab. 1. Sample data and GenBank accession numbers of the new ITS sequences used in the phylogenetic tree.

Species / Herbarium Accession No.	Locality	GenBank Accession No.
C. cerina LD L03347	Sweden. Lycksele Lappmark, Rönäs (coll. Arup 2003)	EU365861
C. chlorina CBFS JV2055	Bulgaria. The Rhodopes, Haskovo (coll. Vondrák 2004)	EU365859
C. chlorina CBFS JV3120	Czech Republic. Českomoravská vrchovina upland, Kamenice nad Lipou (coll. Vondrák 2005)	EU365858
C. isidiigera CBFS JV6073	Ukraine. Zakarpatska oblast region, Svidovets Mts (coll. Vondrák 2007)	EU365857
C. isidiigera LD L04227	Sweden. Lule Lappmark, Padjelanta national park (coll. Arup 2004)	EU365856
C. stillicidiorum CBFS, Sel. Exs. Caloplaca , 12	Bulgaria. The Rhodopes, Asenovgrad (coll. Vondrák 2004)	EU365860
C. subalpina CBFS JV6072 (Holotype)	Ukraine. Zakarpatska oblast region, Svidovets Mts (coll. Vondrák 2007)	EU365855
C. subalpina CBFS JV692	Spain. Pyrenees, Jaca (coll. Vondrák 2002)	EU365854
C. subalpina Herb. Palice 6983	Czech Republic. Jeseníky Mts, Velký kotel corrie (coll. Palice 2001)	EU365853
C. thracopontica CBFS JV3419	Bulgaria. Black Sea coast, Sozopol (coll. Vondrák 2005)	EU365847
C. thracopontica CBFS JV5419 (Holotype)	Turkey. Black Sea coast, Sinop (coll. Vondrák 2007)	EU365848
C. thracopontica CBFS JV5621	Turkey. Black Sea coast, Trabzon (coll. Vondrák 2007)	EU365852
C. thracopontica CBFS JV5623	Turkey. Black Sea coast, Sinop (coll. Vondrák 2007)	EU365851
C. thracopontica CBFS JV6065	Turkey. Black Sea coast, Giresun (coll. Vondrák 2007)	EU365849
C. thracopontica CBFS, Sel. Exs. Caloplaca , 15 (sub C. aff. chlorina)	Bulgaria. Black Sea coast, Tsarevo (coll. Vondrák 2004)	EU365846
C. thracopontica Herb. Šoun 302	Turkey. Black Sea coast, Sarp (coll. Šoun 2007)	EU365850

NOMENCLATURE

VONDRÁK J. & ŠOUN J. (2006):

AN APPRAISAL OF THE SYNTYPE MATERIAL OF *Caloplaca aurantiomurorum* (*Teloschistaceae*, LICHENIZED FUNGI)
Mycotaxon 97: 67–71.

VONDRÁK J. & VITIKAINEN O.:

TYPIFICATION OF NAMES OF SELECTED TAXA DESCRIBED BY ACHARIUS AND NOW PLACED IN *Caloplaca*
(submitted to Taxon)

AN APPRAISAL OF THE SYNTYPE MATERIAL OF *Caloplaca aurantiomurorum* (*Teloschistaceae*, LICHENIZED FUNGI)

JAN VONDRÁK[1] & JAROSLAV ŠOUN

Department of Botany, Faculty of Biological Sciences, University of South Bohemia,
Branišovská 31, CZ-370 05, České Budějovice, Czech Republic,
[1] j.vondrak@seznam.cz

Vondrák J. & Šoun J. 2006. An appraisal of the syntype material of *Caloplaca aurantiomurorum* (*Teloschistaceae*, lichenized fungi). *Mycotaxon* **97**: 67-71.

Abstract: Sample no. 54 of Flagey: Lichenes Algerienses exsiccati represents the syntype of *Placodium aurantiomurorum* (= *Caloplaca aurantiomurorum*). However, the samples of this exsiccatum distributed to FH, H, M, PC and UPS contain different lichen species. The lectotype of *P. aurantiomurorum* is selected here (sample in UPS) and this name is treated as a synonym to *Caloplaca aurantia*. In this exsiccatum, *Candelariella senior* has been identified (in H, FH, and PC), which is reported here as a new species to Algeria. The known distribution of *Can. senior* is described.

Key words: lichens, nomenclature, typification

INTRODUCTION

Placodium aurantiomurorum was described by Flagey (1891: 112) from Algeria "Rochers humides de Sidi-Mecid et seulement là") in the exsiccatum "Flagey: Lichenes Algerienses exsiccati (no 54)". This exsiccate collection was distributed to the herbaria FH (nos 1-200), H, M, PC, and UPS (Grummann 1974: 277). The specimen in the herbarium of the University of Helsinki (H) was investigated, it being the only representative of *Caloplaca aurantiomurorum* (Flagey) Zahlbr. in the section. Surprisingly, it clearly belonged to the genus *Candelariella*, which we later determined as *Can. senior* Poelt. Subsequently, we investigated more samples of this exsiccatum (FH, M, PC, UPS) and found that individual exsiccates represent different species of *Caloplaca* (= *Cal.*) and *Candelariella* (= *Can.*).

MATERIALS AND METHODS

Apart from the investigated exsiccates, reference materials of *Caloplaca aurantia* (Pers.) Hellb., *Cal. flavescens* (Huds.) J.R.Laundon, *Cal. saxicola* (Hoffm.) Nordin, and *Candelariella senior* from the herbaria CBFS, GZU, M, PRC, and PRM were used. Light microscopy measurements of ascospore characteristics, to an accuracy of 1 µm, were performed on hand-made sections examined in water at a magnification of ×1000. These measurements are given as MIN–X(±SD)–MAX, where X = mean value, SD = standard deviation, and MIN and MAX = extremes. Ten measurements (five ascospores in two apothecia) were examined in all samples except that from H, where the numbers of measurements (n) are given in parentheses.

RESULTS

The material in FH has a yellow-orange, rosette-like thallus with broad and flat lobes. Mature, well-developed ascospores are citriform, 12–14.2(±1.1)–16 × 8–9.3(±0.7)–10 µm, with septa 3–4.2(±0.6)–5 µm wide. This specimen is morphologically identical with typical *Caloplaca aurantia*. *Candelariella senior* (morphologically identical with the material from H) and a small piece of an undetermined *Caloplaca* with a granular thallus are also present in this collection.

The material in H has *Candelariella*-type asci, simple ascospores, and a thallus and apothecia devoid of anthraquinones; therefore it belongs to *Candelariella*, not to *Caloplaca*. This rosette-like lichen was morphologically and anatomically compared with the holotype specimen of *Candelariella senior* (M 0099854). Both samples are identical in most characters, diferences were only observed in the thallus thickness [100–170

(±44)–250 µm (n=12) in "*Cal. aurantiomurorum*" vs. 120–228(±66)–310 µm (n=10) in *Can. senior*] and in the spore width [10–12.5(±1.2)–15 × 4–5.3(±0.6)–6 µm (n=18) in "*Cal. aurantiomurorum*" vs. 10–12.0(±1.7)–16 × 3–4.0(±0.5)–5 µm (n=10) in *Can. senior*].

The material in M (M 0100101) has an orange, rosette-like thallus with short broad marginal lobes. Mature ascospores are ellipsoid, never citriform, 10–11.0(±0.5)–12 × 6–6.1(±0.3)–7 µm, with septa 3–3.4(±0.5)–4 µm wide. This specimen is morphologically identical with typical *Caloplaca saxicola*.

The material in PC (PC 0107050) is on two pieces of stone (glued on a sheet). The upper one is only covered by a fertile lichen with yellow-orange, rosette-like thallus with broad and flat marginal lobes. Mature, well-developed ascospores are citriform 13–14.1(±1.2)–16 × 9–10.4(±1.0)–12 µm, with septa 4–4.5(±0.7)–6 µm wide. This specimen is morphologically identical with typical *Caloplaca aurantia*. The lichenicolous fungus *Cercidospora caudata* Kernst. occurs in its apothecia. *Cal. aurantia* also prevails on the lower stone, but *Candelariella senior* and an undetermined granulose *Caloplaca* are admixed.

The material in UPS has a yellow-orange, rosette-like thallus with broad and flat lobes. Mature, well-developed ascospores are citriform, 13–14.6(±0.8)–16 × 8–9.7(±0.9)–11 µm, with septa 4–4.9(±0.7)–6 µm wide. This specimen is morphologically identical with typical *Caloplaca aurantia*. This sample is selected here as the lectotype.

DISCUSSION

The short Latin diagnosis of *Placodium aurantiomurorum* (Flagey 1891: 112) is translated as follows: "Thallinal lobes flatter than in *P. murorum* (= *Caloplaca saxicola*); spores 16–18 × 8–9 µm, wider than in *P. murorum* and with a shape as in *Physcia aurantia* (= *Cal. flavescens*)". The extended French description (Flagey 1896: 28), where *Placodium aurantiomurorum* was compared with *P. murorum*, *P. callopismum* (= *Cal. aurantia*) and *P. heppianum* (= *Cal. flavescens*), is translated as follows: "Thallus fairly yellow suede with lobes larger and more flattened than in *P. murorum*, resembling lobes of *P. callopismum*, but with lobes yellow, less reddish. Spores ovoid, 'placodial' 16–18 × 8–9 µm, larger than in *P. murorum*, strongly resembling spores of *P. heppianum*, whose thallus is clearly different".

Based on these descriptions, *Cal. aurantiomurorum* is distinct from *Cal. saxicola* by having a different shape and size of the thallus and a different shape of spores and from *Cal. flavescens* by having a different shape of lobes. However, *Cal. aurantiomurorum* is distinguished from *Cal. aurantia* only by the yellow colour of the thallus. Based on this and the syntype investigation, we decided to place the name *Cal. aurantiomurorum* into the synonymy of *Cal. aurantia*.

In the protologue, Flagey (1891: 112) described one locality but did not designate the holotype. His main herbarium is located in PC and following the usual practice for exsiccates, the sample placed there should be regarded as the holotype and the others as isotypes. In this case, however, due to the heterogeneity of the respective material, we treat all exsiccate samples as syntypes. We have selected the sample in UPS as the lectotype, because it is well-preserved and without any admixture of similar lichen species (cf. the mixture represented by the specimen in PC). The sample in UPS was already revised as *Cal. aurantia* and mentioned in the list of exsiccates of this species by Nordin (1972: 80). This specimen was indicated as an isotype although the typification was not published.

Cal. aurantiomurorum has only been reported on calcareous rocks in Sidi-Mecid near Azéba fort and in Djebel Akar Mts in Algeria (Flagey 1896: 28) and in Upper Galilee, Mt Carmel in Israel (Alon & Galun 1971: 287-288). *Cal. aurantiomurorum* was accepted in two lichen checklists of Israel (Galun & Mukhtar 1996: 152, Kondratyuk et al. 1996: 35), until the voucher material from Israel was redetermined as *Cal. flavescens* (Wasser & Nevo 2005: 100) and the name *Cal. aurantiomurorum* was excluded from the Israel lichen flora (Wasser & Nevo 2005: 321) and erroneously put into the synonymy of *Cal. flavescens* (Wasser & Nevo 2005: 99).

The sample in H and parts of the samples in FH and PC belong to the lobate species of *Candelariella*. In southern Europe, three lobate species are known, *Can. medians*, *Can. rhodax*, and *Can. senior*. While the two former species are clearly different (Poelt & Vězda 1976, 1977), the latter fits well with the respective samples. The diferences in the thallus thickness and spore width between the holotype specimen of *Can. senior* and the sample in H can be easily accounted for by intraspecific variation. Having seen more material of *Can. senior* from GZU, we consider them conspecific with the samples of the investigated exsiccatum. Previously, *Can. senior* was only

known from the type locality in Spain (Poelt 1958: 440-441), and from Libya (Thor, unpublished data) and Tunisia (cf. Seaward 1996: 123) so far.

Other samples of *Can. senior* seen: **Algeria**. on limestone in "d'Azeba" (GZU, intermixed in sample Flagey: Lich. Alg. Exsic. 93, *Rinodina subconfragosa*). **Libya**. On calcareous stone near Derna (Darnah), Thor, 1982 (GZU). **Tunisia**. Douggha, Poelt, 1968 (GZU); Djebel Goraa Mts, between Thibar and Teboursouk, Poelt, 1968 (GZU).

CONCLUSIONS

Flagey's exsiccatum of *Placodium aurantiomurorum* is composed of heterogeneous material. The samples in FH, PC and UPS are taxonomically indistinguishable from *Cal. aurantia*, and the sample in M is indistinguishable from *Cal. saxicola*. The sample in UPS is selected here as the lectotype of *Placodium aurantiomurorum* and we propose to put the name *Cal. aurantiomurorum* into the synonymy of *Cal. aurantia*. We consider the sample of *Cal. aurantiomurorum* in H and the admixed lichens in samples from FH and PC conspecific with *Candelariella senior*, which is newly reported from Algeria.

In the light of this work, more attention should be given not only to examining distributed material of this particular exsiccatum in other herbaria, but also to appraising the homogeneity of exsiccati in general.

ACKNOWLEDGEMENTS

We thank the curators of the herbaria mentioned in the text for their valuable help with the loans of material, Prof. Mark Seaward, Dr Walter Obermayer, and Prof. Solomon P. Wasser for their valuable comments on the manuscript. We are grateful to Marek Stibal and Prof. Mark Seaward for linguistic corrections.

LITERATURE CITED

Alon G, Galun M. 1971. The genus *Caloplaca* in Israel. *Israel Journal of Botany* **20**: 273-292.

Flagey C. 1891. Lichenes Algerienses exsiccati. *Revue Mycologique* **13**: 107-117.

Flagey C. 1896. Catalogue des lichens de l'Algérie. 1-140, in: Battandier JA, Trabut L., *Flore de l'Algérie. 2.*

Galun M, Mukhtar A. 1996. Checklist of the lichens of Israel. *Bocconea* **6**: 149-171.

Grummann V. 1974. *Biographisch-bibliographisches Handbuch der Lichenologie*. Lehre, Verlag von J. Cramer.

Kondratyuk SY, Navrotskaya IL, Zelenko SD, Wasser SP, Nevo E. 1996. *The first checklist of lichen-forming and lichenicolous fungi of Israel*. Kyiv, M. G. Kholodny Institute of Botany & International Centre for Cryptogamic Plants and Fungi.

Nordin I. 1972. *Caloplaca sect. Gasparrinia in Nordeuropa*. Uppsala, Taxonomiska och Ekologiska Studier. Skriv Service AB.

Poelt J. 1958. Die lobaten Arten der Flechtengattung *Lecanora* Ach. sensu ampl. in der Holarktis. *Mitteilungen der Botanischen Staatssammlung München* **2**: 411-573.

Poelt J, Vězda A. 1976. *Candelariella plumbea* und *C. rhodax* sp. novae, zwei neue Arten der europäischen Flechten-Flora. *Folia Geobotanica et Phytotaxonomica* **11**: 87-92.

Poelt J, Vězda A. 1977. Bestimmungsschlüssel europäischer Flechten. Ergänzungsheft I. *Bibliotheca Lichenologica* **9**: 1-258.

Seaward MRD. 1996. Checklist of Tunisian lichens. *Bocconea* **6**: 115-148.

Wasser SP, Nevo E. (eds.) 2005. *Lichen-forming, lichenicolous and allied fungi of Israel*. Ruggell, A.R.G. Gantner Verlag K.G.

TYPIFICATION OF NAMES OF SELECTED TAXA DESCRIBED BY ACHARIUS AND NOW PLACED IN *Caloplaca*

JAN VONDRÁK* & ORVO VITIKAINEN#

* Department of Botany, Faculty of Biological Sciences, University of South Bohemia, Branišovská 31, CZ-370 05 České Budějovice, Czech Republic, e-mail: j.vondrak@seznam.cz

Finnish Museum of Natural History, Botanical Museum, P.O. Box 7, FI-00014 Helsinki University, Finland, e-mail: Orvo.Vitikainen@helsinki.fi

Summary: Typification of names of lichen-forming fungi referring to taxa currently placed in the genus *Caloplaca* was undertaken by examination of material from the Acharius herbaria (BM-ACH, H-ACH, and UPS-ACH). Lectotypes are selected for *Lecidea aurantiaca* var. *rubescens*, *Lecidea caesiorufa*, *Lichen erythrellus* and *Parmelia microthelia* and holotypes identified for *Lecanora inalpina*, *Lecanora teicholyta*, *Lecidea turneriana* and *Lecidea viridirufa*. *Lecidea caesiorufa* var. *festiva* and *Lichen craspedius* are illegitimate names and both are automatically typified by the type of *Lichen arenarius*.

Keywords: Acharius, *Caloplaca*, lectotype selection, illegitimate names, lichen-forming fungi, nomenclature, typification.

All the lectotypes selected in this paper are only proposed. They will be designated in the Taxon.

INTRODUCTION

The genus *Caloplaca* Th. Fr. (*Teloschistaceae*), one of the most species-rich genera of lichen-forming fungi, may comprise as many as 1000 species (Arup, 2006). Among the innumerable names for particular *Caloplaca* species (cf. Lamb, 1960; Zahlbruckner, 1931), many old names still lack typification. In the Acharius herbaria (BM-ACH, H-ACH, and UPS-ACH), we have found unidentified specimens that represent original material of some names now placed in *Caloplaca*.

Only a few Acharius names now included in *Caloplaca* have been typified: *Lecanora alpestris* Ach. (1810) [= *C. variabilis* (Pers.) Müll. Arg.] by Wunder (1974), *L. callopisma* Ach. (1810) [= *C. aurantia* (Pers.) Hellb.] by Wetmore & Kärnefelt (1998), *L. cinnabarina* Ach. (1810) [≡ *C. cinnabarina* (Ach.) Zahlbr.] by Wetmore & Kärnefelt (1999), *L. cirrochroa* Ach. (1814) [≡ *C. cirrochroa* (Ach.) Th. Fr.] by Nordin (1972: 123), *Parmelia murorum* var. *steropea* Ach. (1803) [= *C. saxicola* (Hoffm.) Nordin] by Nordin (1972: 88–89), *Lecanora rubelliana* Ach. (1810) [≡ *C. rubelliana* (Ach.) Lojka] by Wetmore & Kärnefelt (1999), and *Lepraria bassiae* Willd. ex Ach. (1803) [≡ *C. bassiae* (Ach.) Zahlbr.] by Wetmore (2004). Typification of *Parmelia cerina* var. *pyracea* Ach. (1803) [≡ *C. pyracea* (Ach.) Th. Fr. (1867)] is currently in preparation (U. Arup, *pers. comm.*). We have been seeking for typification of the remaining names.

MATERIALS

Most of the specimens from Acharius's original herbarium are currently deposited in the herbaria of BM (BM-ACH), H (H-ACH) and UPS (UPS-ACH). Apart from these, some specimens are scattered among other European herbaria (C, L, LAU, LD, M, MB, PC and S) (Tibell, 1987). We have examined the samples referring to *Caloplaca* from the main three collections. Information on the Acharius herbaria is taken mainly from Galloway (1988) and Tibell (1987).

BM-ACH, containing 893 numbers, represents material donated by Acharius to the Linnean Society of London in 1807 but probably not arriving there earlier than 1809. This collection actually represents voucher material for taxa described in Methodus (Acharius, 1803) and Lichenographia Universalis (Acharius, 1810). The advantage of this collection is that its samples are well-preserved, since it was largely neglected until 1961. The drawback of the collection is that no information about locality or collector is attached to the specimens.

H-ACH, the main Acharius collection, contains 2017 numbered sheets, frequently with more than one specimen on a sheet sometimes representing more than one taxon. The material on the sheets is often heterogeneous, but the origin and collector of the separate pieces are usually provided. When received in 1834, this collection had been arranged according to Synopsis Lichenum (Acharius, 1814) by its vendor G.J. Billberg. It is probable that Acharius renamed and rearranged specimens during his lifetime according to his latest concepts (see e.g. Weber & Mohr, 1804: 76). This may be one explanation why the types of some names described in earlier publications by Acharius have not been found.

UPS-ACH, containing 1270 sheets, previously included in the general herbarium, was separated as a unit by Dr R. Santesson and Dr R. Moberg. The main part of this collection consists of the herbarium of A.J. Agrelius (1788-1833), son-in-law of Acharius. Other material in UPS-ACH originates from the herbaria of G. Wahlenberg, E. Fries and others. The status of the UPS-ACH material is often problematic since few labels were written by Acharius himself and numerous collections lack information on the locality and collector.

Images of the Acharius specimens studied in this paper are for the most part presented at the web site: http://botanika.bf.jcu.cz/lichenology/index.php?pg=5. The currently accepted name for the taxon to which each type refers is given in bold, parenthetically where the accepted name is not homotypic.

RESULTS AND DISCUSSION

1. ***Lecanora inalpina*** Ach., Lichenogr. Universalis: 388. 1810 ≡ *Caloplaca aurantiaca* var. *inalpina* (Ach.) Servít in Zprávy Kommis. Přír. Prozk. Moravy 6: 71. 1910 ≡ *Caloplaca flavovirescens* var. *inalpina* (Ach.) Zahlbr., Catal. Lich. Univ. 7: 136. 1931. (= ***Caloplaca flavovirescens*** (Wulfen) Dalla Torre & Sarnth., Fl. Tirol: 180. 1902: *Lichen flavovirescens* Wulfen in Schriften Ges. Naturf. Freunde Berlin 8: 122. 1787).

Holotype: Helvetia [Switzerland], Schleicher 425 (H-ACH 1046; isotypi: BM-ACH 494, UPS-ACH 666)

Three samples of *Lecanora inalpina* have been investigated (BM-ACH 494, H-ACH 1046, and UPS-ACH 666). The sample in H-ACH labelled "Helvetiae, Schleicher" corresponds with the locality and collector in the protologue; it consists of a small piece of lichen with a yellowish, white-pruinose thallus and few dark red, convex apothecia, which are mostly parasitized by *Muellerella lichenicola* (Sommerf.: Fr.) D. Hawksw. Although the sample is small and in bad condition, its macroscopic characters fit well with those of *Caloplaca flavovirescens*. Fries (1871: 178); more recently, e.g. Nimis & Martellos (2003), have included *Lecanora inalpina* as a synonym of *C. flavovirescens*. The samples BM-ACH 494 and UPS-ACH 666 are very probably duplicates of H-ACH 1046 and are considered as isotypes. These lichens grow on the same kind of substrate, look morphologically identical and are also frequently parasitized by *Muellerella lichenicola*.

2. ***Lecanora teicholyta*** Ach., Lichenogr. Universalis: 425. 1810 ≡ *Caloplaca teicholyta* (Ach.) J. Steiner in Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Cl., Abt. 1, 104: 388. 1895.

Holotype: Gallia [France], Dufour (H-ACH 1229)

The sample of *Lecanora teicholyta* in H-ACH consists of well-preserved, fertile pieces of a lichen which clearly correspond with the recent concept of *Caloplaca teicholyta*. The locality description accords with the protologue. The sample in UPS-ACH (no. 681) also represents *C. teicholyta*; its locality description is restricted to "Gallia" and this specimen might be considered as an isotype.

3. ***Lecidea aurantiaca*** **var.** ***rubescens*** Ach.: Methodus: 69. 1803 ≡ *Lecanora erythrella* var. *rubescens* (Ach.) Ach., Lichenogr. Universalis: 402. 1810 ≡ *Caloplaca erythrella* var. *rubescens* (Ach.) H. Olivier, Exposé Syst. Lich. 1: 239. 1897 (= ***Caloplaca flavovirescens*** (Wulfen) Dalla Torre & Sarnth., Fl. Tirol: 180. 1902: *Lichen flavovirescens* Wulfen, Schriften Ges. Naturf. Freunde Berlin 8: 122. 1787).

Lectotype: Suecia [Sweden] (H-ACH 1241C).

The H-ACH 1241A–C collection of *Lecanora erythrella* var. *rubescens* is composed of three lichen pieces, all of which are identified as *Caloplaca flavovirescens* (see also Fries 1871: 178). Samples 1241 A and B come from "Helvetia" and 1241 C from "Suecia". Cl. Roux (in 1982) determined samples A and C as *C. flavovirescens*, but he did not select the lectotype. We have selected sample 1241 C as the lectotype, since Acharius (1810) mentioned this taxon only from "saxis Sueciae".

4. ***Lecidea caesiorufa*** Ach., Methodus: 71. 1803 ≡ *Caloplaca caesiorufa* (Ach.) Flagey in Revue Mycol. 17: 104. 1895. (= ***Caloplaca crenularia*** (With.) J. R. Laundon in Lichenologist 16: 231. 1984: *Lichen crenularius* With. Arr. Brit. Pl. 4: 22, 405. 1796).

Lectotype: Suecia [Sweden] (H-ACH 337B).

Material present in Acharius's herbaria under this name is unusually rich (BM-ACH 150A–C, H-ACH 337A–J, 338A–G, and UPS-ACH 221A–G) but heterogeneous. For example, the collection in BM-ACH consists of *Caloplaca crenularia* (150A), *C. atroflava* (Turner) Mong. (150B) and *C.* cf. *scotoplaca* (Nyl.) H. Magn. (150C).

In H-ACH, samples 337A and B, from "Suecia" represent *Caloplaca crenularia*; 337C, "Anglia, Harriman, *L. crenularius* With." represents *C. ceracea* J. R. Laundon, and 337D from "Suecia" is *C. scotoplaca*; Magnusson made the note "orig.?" under this specimen, but he did not publish the typification (Magnusson, 1944: 55–56). Specimens 337E from "Suecia" and G from "Helvetia" are missing. 337F from "Suecia" is probably conspecific with *C. scotoplaca*, 337H is an indeterminable small piece of lichen from "Helvetia", and samples 337I and J from "Helvetia" represent *C. crenularia*.

Samples H-ACH 338A and B representing *Caloplaca arenaria* (Pers.) Müll. Arg. are labelled "β. *discoidalis* Suecia", a herbarium name. Sample 338C is labelled "δ. *festiva* Gallia, d'Angers Persoon misit *Patellaria lamprocheila* Decandolle" and probably represents a part of the original material of *Patellaria lamprocheila* DC. (Lamarck & De Candolle, 1805: 557–558), as suggested by Magnusson (1944: 47), and also corresponds with the recent concept of *Caloplaca arenaria*. Sample 338D is labelled "Σ. *arenaria* Germania, *L. arenarius* Pers."; it was probably sent by Persoon to Acharius and thus may represent Persoon's concept of *Lichen arenarius* Pers. (Persoon, 1794: 27); however, the sample clearly belongs to *C. albolutescens* (Nyl.) H. Olivier. Sample 338E, from "Helvetia", represents *C. arenaria*. Samples 338F and G are labelled "γ. *marginalis* [herbarium name] Suecia" and belong to *C. scotoplaca* (Nyl.) H. Magn. and *C. viridirufa* (Ach.) Zahlbr., respectively.

The collection in UPS-ACH contains *Caloplaca ceracea* (221F), *C. crenularia* (221A–C, E, G), and *C.* aff. *concilians* (Nyl.) H. Olivier (201D). The material is labelled "Suecia in Omberg"; however, it is not clear, which of the samples actually come from this locality.

We have selected the well-preserved specimen H-ACH 337B (*C. crenularia*) as the lectotype with respect to nomenclatural stability and to the original description, which runs as follows: [thallus effuse, crustose-rimose, ash-grey, apothecia deep red, finally convex, margin concolours with disc, flexuose] (Acharius 1803: 71). No locality is mentioned in the protologue. Deep red apothecia and a flexuose margin correspond with the concept of *Caloplaca crenularia* (bas.: *Lichen crenularius* With. 1796), which is an older name and has priority; it was also listed as a synonym of *Lecidea caesiorufa* in Acharius (1810: 203; 1814: 44).

Magnusson (1944: 55) pointed out that the name *C. caesiorufa* (Ach.) Flagey, which Zahlbruckner (1931: 80) accepted, had been applied to so many different species that it was a nomen confusum, and discussed the uncertainties surrounding the names *Lichen caesiorufus* Schrader and *L. caesiorufus* Ach. Since then, *C. caesiorufa* has been more or less abandoned.

It is true that *Lichen caesiorufus* Ach. (1799) is an illegitimate name (Art. 53.1 of ICBN) because it is a later homonym of *L. caesiorufus* Schrader (1794: 80). However, *Lecidea caesiorufa* Ach. (1803) is an independent and legitimate name because Acharius then definitely excluded *Lichen caesiorufus* Schrader and synonymised it with *Parmelia craspedia*, which is illegitimate name (see under *Lichen craspedius*).

5. ***Lecidea caesio-rufa*** **var.** ***festiva*** Ach., Syn. Meth. Lich.: 44. 1814, nom. illegit. ≡ *Lichen arenarius* Pers. in

Ann. Bot. (Usteri) 7: 27. 1794 ≡ ***Caloplaca arenaria*** (Pers.) Müll. Arg. in Mém. Soc. Phys. Hist. Nat. Genéve 16: 387. 1862.

Caloplaca festiva "auct." or "(Ach.) Zwackh" has commonly been used for the species *C. crenularia* (With.) J. R. Laundon (cf. Laundon, 1984, 1992a, Nimis & Martellos, 2003, Santesson et al., 2004). However, Acharius (1814: 44) cited older synonyms in the protologue (*Lecanora craspedia* var. *arenaria* Ach. 1810, *Lichen arenarius* Pers. 1794, *Patellaria lamprocheila* DC. 1805, *Verrucaria arenaria* Hoffm. 1796) and made the name *Lecidea caesio-rufa* var. *festiva* illegitimate homotypic synonym of *Lichen arenarius* Pers. Also the diagnosis (...apotheciis minutis planis... margine integerrimo dilutiori persistente) suggest that Acharius intended *Caloplaca arenaria*, not *C. crenularia*. This conflict with the established concept was also noted by Magnusson (1944: 59), who advocated *Biatora ferruginea* var. *festiva* Fr. as the basionym of *C. festiva*.

6. ***Lecidea turneriana*** Ach., Lichenogr. Universalis: 206. 1810 ≡ *Caloplaca turneriana* (Ach.) Zahlbr., Catal. Lich. Univ. 7: 190. 1931 (= ***Caloplaca atroflava*** (Turner) Mong. in Bull. Acad. Int. Géogr. Bot. 23: 192. 1914: *Lecidea atroflava* Turner in Trans. Linn. Soc. London 9: 142. 1808).

Holotype: Anglia [England], Turner (H-ACH 371; isotype: UPS-ACH 239).

Samples H-ACH 371 and UPS-ACH 239 are extremely similar in their morphology, grow on the same substrate and both are labelled “Anglia, Turner”. We assume that they were collected by Turner from the same locality on the same date. Therefore, the material in H-ACH can be regarded as the holotype, and the specimen in UPS-ACH as its duplicate.

As suggested by Magnusson (1944: 52) and Laundon (1992b: 5), *Lecidea turneriana* is conspecific with *L. atroflava* Turn. [≡ *Caloplaca atroflava* (Turn.) Mong.]. The first author had the opportunity to study the holotype of *Lecidea atroflava* (England, flints on the Sussex Downs, Turner, BM 000730327!), and regards both specimens as conspecific.

7. ***Lecidea viridirufa*** Ach., Lichenogr. Universalis: 204. 1810 ≡ ***Caloplaca viridirufa*** (Ach.) Zahlbr., Catal. Lich. Univ. 7: 198. 1931.

Holotype: Helvetia [Switzerland]. Schleicher 544 (H-ACH 336).

The locality, Helvetia, is in keeping with the protologue; the corresponding collection, H-ACH 336, is a small, partially damaged fragment having only two apothecia. Its thallus is pale grey, crustose-rimose, rather glossy, the apothecia have an outer thalline margin of the same colour as the thallus, and the true exciple is blackish-grey. We consider this specimen conspecific with the holotype of *C. aractina* (bas.: *Parmelia aractina* Fr.; type: Sweden, Halland. 1825. UPS 63456!).

Since 1972, the name *Caloplaca aractina* (Fr.) Häyren has commonly been used for this species. Nordin (1972: 159) presented *C. viridirufa* as a similar but different species without further discussion of the characters distinguishing these species. Since then, the name ‘*C. viridirufa* (Ach.) Zahlbr.’ has largely been forgotten and ‘*C. viridirufa* auct.’ has been used as a synonym of *C. aractina*. (e.g. Nimis, 1993, Hafellner & Türk, 2001, Santesson et al., 2004).

Caloplaca aractina was described from coastal rocks, while the type of *C. viridirufa* was collected inland. Therefore, we checked additional samples from inland and coastal rocks, but did not find any considerable differences between these populations. Similar conclusions are already seen in the treatments of *C. aractina* by Laundon (1992a) and Nimis (1993), and the name *C. viridirufa* (Ach.) Zahlbr. was accepted in the German checklist by Scholz (2000), with *C. aractina* as a synonym. However, it can be argued that additional study and molecular comparisons of continental and coastal populations are needed to support this synonymization.

8. ***Lichen craspedius*** Ach., Lichenogr. Suec. Prodr.: 45. 1799, nom. illeg. ≡ *Lichen arenarius* Pers. in Ann. Bot. (Usteri) 7: 27. 1794 ≡ ***Caloplaca arenaria*** (Pers.) Müll. Arg. in Mém. Soc. Phys. Hist. Nat. Genéve 16: 387. 1862.

When coining *Lichen craspedius*, Acharius cited older names *L. arenarius* Pers. (1794) and *Verrucaria caesiorufa* Hoffm. (1796) in synonymy, thus making his new name illegitimate. However, his material, as well as the diagnosis of *Lichen craspedius* ("crustaceus rimosus albido-caesius; scutellis rufescenti ferrugineis demum convexis, margine flexuoso albescente"), does not correspond with the recent concept of *C. arenaria*, and his (unlocalized) specimen BM-ACH 493, for example, represents *C. soralifera* Vondrák & Hrouzek.

9. ***Lichen erythrellus*** Ach., Lichenogr. Suec. Prodr.: 43. 1799 ≡ *Caloplaca erythrella* (Ach.) Kieff. in Bull. Soc. Hist. Nat. Metz 19: 67. 1895 (= ***Caloplaca flavovirescens*** (Wulfen) Dalla Torre & Sarnth., Fl. Tirol: 180. 1902: *Lichen flavovirescens* Wulfen in Schriften Ges. Naturf. Freunde Berlin 8: 122. 1787).

Lectotype: [Sweden] Suecia (H-ACH 1240D; isolectotype H-ACH 1240E)

The material of *Lichen erythrellus* consists of the samples BM-ACH 481 and H-ACH 1240A–G. The material in BM-ACH contains five pieces of rock (slate) covered by well-preserved thalli of typical *Caloplaca flavovirescens*. The lichens have a pale yellow thin thallus, which contrasts with the deep orange convex apothecia. Anatomical notes made by A. Fletcher (in 1973) which accompany the specimens, are consistent with *C. flavovirescens*. Apothecia are moderately parasitized by *Muellerella lichenicola.*

Sample H-ACH 1240A from "Helvetia" belongs to the group of *Caloplaca velana* (A. Massal.) Du Rietz. Samples 1240B and C from "Helvetia" represent *C. flavovirescens*. Samples 1240D and E, labelled "Suecia" and obviously collected in the same locality, are *C. flavovirescens*. Samples 1240F and G are also from "Suecia", but belong to *Candelariella vitellina* (Hoffm.) Müll. Arg. The collection was checked by Cl. Roux (in 1982), who determined samples B and C as *C. flavovirescens*; however, he did not select a lectotype. Although no locality was mentioned in the protologue (Acharius 1799: 43), we have chosen sample 1240D labelled "Sweden" as the lectotype, because *L. erythrellus* was described in the 'Prodromus' of Swedish lichens. Acharius probably received the material from Switzerland at a later date.

10. ***Parmelia microthelia*** Ach., Methodus: 174. 1803 ≡ *Lecanora salicina* var. *microthelia* (Ach.) Ach., Lichenogr. Universalis: 401. 1810 ≡ *Lecanora aurantiaca* var. *microthelia* (Ach.) Nyl., Lich. Scand.: 142. 1861 (***Caloplaca flavorubescens*** (Huds.) J. R. Laundon in Lichenologist 8: 147. 1976: *Lichen flavorubescens* Huds., Fl. Angl.: 443. 1762).

Lectotype: [Sweden, "in truncis Populi Tremulae, Salicis"] specimen without collecting data (BM-ACH 485)

Original material of *Parmelia microthelia* consists of samples BM-ACH 485, H-ACH 1239G and UPS-ACH 659. The specimens in BM-ACH and UPS-ACH are without locality details. The sample in BM-ACH consists of three pieces of a corticolous lichen, which is *Caloplaca flavorubescens*, as is the sample, a single piece, in UPS-ACH. Specimen H-ACH 1239 from "Suecia" is only a small piece of sterile *C. flavorubescens*. Since specimen BM-ACH 485 is well-preserved, it is selected here as the lectotype; no locality was mentioned in the protologue (Acharius, 1803: 174) but in later publication (Acharius, 1810: 410), Sweden was the sole area indicated.

ACKNOWLEDGEMENTS

We are grateful to John McNeill (Edinburgh, UK) for his valuable comments and corrections, the curators of the herbaria mentioned in the text for their valuable help with the loans of material, Mark Seaward (Bradford, UK) for helpful advice and linguistic corrections, and to John Hunnex (Natural History Museum, London, UK) for providing images of the material in BM-ACH.

LITERATURE CITED

Acharius, E. 1799 ('1798'). *Lichenographiae Suecicae Prodromus*. Linköping.

Acharius, E. 1803. *Methodus qua Omnes Detectos Lichenes secundum Organa Carpomorpha ad Genera, Species et Varietates Redigere atque Observationibus Illustrare Tentavit Erik Acharius*. Stockholm.

Acharius, E. 1810. *LichenographiaUniversalis*. Göttingen.

Acharius, E. 1814. *Synopsis Methodica Lichenum, sistens Omnes Hujus Ordinis Naturalis Detectas Plantas, quas, secundumGgenera, Species et Varietates disposuit, characteribus et differentiis emendatis definivit, nec non synonymis et observationibus selectis illustravit auctor*. Lund.

Arup, U. 2006. *Caloplaca sorediella* Arup, a new sorediate species from western Britain. *Lichenologist* **38**: 499—502.

Fries, Th.M. 1871. *Lichenographia Scandinavica. I.* Uppsala.

Galloway, D.J. 1988. Erik Acharius and his influence on English lichenology. *Bull. Brit. Mus. (Nat. Hist.), Bot*. **18**: 149—194.

Hafellner, J. & Türk, R. 2001. Die lichenisierten Pilze Österreichs - eine Checkliste der bisher nachgewiesenen Arten mit Verbreitungsangaben. *Stapfia* **76**: 1—167.

Lamarck, J.B.A.P.M. de & Candolle, A.P. de. 1805. *Flore Française. Ed. 3. Vol. 2.* Paris.

Lamb, I.M. 1960. *Index Nominum Lichenum Inter Annos 1932 et 1960 Divulgatorum*. The Ronald Press Company, New York.

Laundon, J.R. 1984. The typification of Withering's neglected lichens. *Lichenologist* **16**: 211—239.

Laundon, J.R. 1992a. *Caloplaca*. In: O. W. Purvis, B. J. Coppins, D. L. Hawksworth, P. W. James & D. M. Moore [eds]. *The Lichen Flora of Great Britain and Ireland*, pp. 141—159. Natural History Museum Publications & British Lichen Society, London.

Laundon, J.R. 1992b. New British species of *Caloplaca. Lichenologist* **24**: 1—5.

Magnusson, A.H. 1944. Studies in the *ferruginea*-group of the genus *Caloplaca*. *Göteborgs Kungl. Vetensk. Samhälles Handl. ser. 6,* **B 3(1)**: 3—71.

Nimis, P.L. 1993. *The Lichens of Italy*. Museo Regionale di Scienze Naturali, Torino.

Nimis, P.L. & Martellos, S. 2003. *A Second Checklist of theLichens of Italy with Thesaurus of Synonyms*. Museo Regionale di Scienze Naturale, Aosta.

Nordin, I. 1972. *Caloplaca sect. Gasparrinia i Nordeuropa. Taxonomiska och Ekologiska Studier*. Skriv Service AB, Uppsala.

Persoon, C.H. 1794. Einige Bemerkungen über die Flechten: Nebst Beschreibungen einiger neuer Arten aus dieser Familie der Aftermoose. *Ann. Bot. (Usteri)* **7**: 1—32.

Santesson, R., Moberg, R., Nordin, A., Tønsberg, T. & Vitikainen, O. 2004. *Lichen-forming and Lichenicolous Fungi of Fennoscandia*. Museum of Evolution, Uppsala University, Uppsala.

Scholz, P. 2000. Katalog der Flechten und flechtenbewohnenden Pilze Deutschlands. *Schriftenreihe Vegetationsk*. **31**: 1—298.

Schrader, H. A. 1794. *Spicilegium Florae Germanicae*. Hannover.

Tibell, L. 1987. Typification of names of infrageneric taxa described by Acharius and placed by him in *Caliciales*. *Ann. Bot. Fenn* **24**: 257—280.

Weber, F. & Mohr, D.M.H. 1804. *Naturhistorische Reise durch einen Theil Schwedens*. Göttingen.

Wetmore, C.M. 2004: The isidiate corticolous *Caloplaca* species in North and Central America. *Bryologist* **107**: 284—292.

Wetmore, C.M. & Kärnefelt, E.I. 1998. The lobate and subfruticose species of *Caloplaca* in North and Central America. *Bryologist* **101**: 230—255.

Wetmore, C.M. & Kärnefelt, E.I. 1999. What is *Caloplaca cinnabarina*? *Bryologist* **102**: 683—691.

Wunder, H. 1974: Schwarzfrüchtige, saxicole Sippen der Gattung *Caloplaca* (Lichenes, *Teloschistaceae*) in Mitteleuropa, der Mittelmeergebiet und Vorderasien. *Bibl. Lichenol*. **3**: 1—186.

Zahlbruckner, A. 1931. *Catalogus Lichenum Universalis 7.* Borntraeger, Leipzig.

BIODIVERSITY

VONDRÁK J., KOCOURKOVÁ J., PALICE Z. & LIŠKA J. (2007):

NEW AND NOTEWORTHY LICHENS IN THE CZECH REPUBLIC – GENUS *Caloplaca*
Preslia 79: 163-184.

VONDRÁK J. & SLAVÍKOVÁ-BAYEROVÁ Š. (2006):

CONTRIBUTION TO THE LICHENIZED AND LICHENICOLOUS FUNGI IN BULGARIA. II, THE GENUS *Caloplaca*
Mycologia Balcanica 3: 61–69.

NEW AND NOTEWORTHY LICHENS IN THE CZECH REPUBLIC – GENUS *Caloplaca*

NOVÉ A POZORUHODNÉ LIŠEJNÍKY Z ČESKÉ REPUBLIKY – ROD *Caloplaca*

JAN VONDRÁK[1], JANA KOCOURKOVÁ[2], ZDENĚK PALICE[3,4] & JIŘÍ LIŠKA[3]

[1] Department of Botany, Faculty of Biological Sciences, University of South Bohemia, Branišovská 31, České Budějovice, CZ-370 05 Czech Republic, e-mail: j.vondrak@seznam.cz;

[2] National Museum, Department of Mycology, Václavské nám. 68, Praha 1, CZ-115 79 Czech Republic, e-mail: jana.kocourkova@nm.cz;

[3] Institute of Botany, Academy of Sciences, Průhonice, CZ-252 43 Czech Republic, e-mail: palice@ibot.cas.cz, liska@ibot.cas.cz;

[4] Department of Botany, Faculty of Natural Sciences, Charles University, Benátská 2, Praha 2, CZ-128 01 Czech Republic

Vondrák J., Kocourková J., Palice Z. & Liška J. (2007): New and noteworthy lichens in the Czech Republic – genus *Caloplaca*. – Preslia **79**: 163–184.

New information is provided on the distribution of 19 species of lichens belonging to the genus *Caloplaca* (*Teloschistales*) in the Czech Republic. Six species are new to this country: *C. epithallina*, *C. erodens*, *C. inconnexa*, *C. phlogina*, *C. polycarpa* and *C. thuringiaca*. The species *C. albolutescens*, *C. cerinella*, *C. chlorina*, *C. chrysodeta*, *C. dichroa*, *C. flavocitrina*, *C. herbidella* and *C. marmorata* are reported from the Czech Republic, but little is known about their distribution in this country. *Caloplaca biatorina*, *C. obliterans*, *C. rubelliana*, and *C. xantholyta* are rediscovered after more than 50 years. The presence of *Caloplaca crenulatella*, recently reported as new to this country, is confirmed and is actually one of the most common species of this genus. Ecological and chorological data are given for each species, and taxonomic and nomenclatural notes for *C. albolutescens* and *C. chlorina* are amended.

Keywords: biodiversity, distribution, ecology, lichen-forming fungi, nomenclature, taxonomy

INTRODUCTION

Caloplaca is a large cosmopolitan genus represented by presumably more than 800 species worldwide (Kärnefelt et al. 2002).Within *Teloschistales*, it is characterized by its polarilocular ascospores and the absence of a lower cortex. However, modern molecular phylogenetic studies (Arup & Grube 1999, Gaya et al. 2003, Søchting & Lutzoni 2003) indicate that the present classification is unnatural and found the genus *Caloplaca* to be paraphyletic.

Fifty-four *Caloplaca* species are reported from the Czech Republic to date (Vězda & Liška 1999, Liška 2005, Vondrák & Hrouzek 2006). However, some of them were only recorded once or a few times (e.g. *Caloplaca arnoldii*, *C. conversa*, *C. granulosa*, *C. nivalis*, and *C. magni-filii*), some are very poorly known (e.g. *Caloplaca caesiorufa* auct. and *C. vitellinula* auct.) and others erroneously reported from this country (*C. ferrarii* and *C. tetraspora*). *Caloplaca fimbriata* (Eitner) Zahlbr. is described from the Czech Republic as *Gasparrinia fimbriata* (Eitner 1911), but this name was never used later and the type material is probably missing from Eitner's collections in W, WA, and WRSL (respective curators, *personal communication*). Furthermore, *Caloplaca dvorakii* Suza, nom. nudum, was once reported from serpentinite rocks in SW Moravia (Suza 1927), but not validly published and the respective material was not found in Suza's herbarium in PRM.

A revision of the whole genus *Caloplaca* in the Czech Republic is not feasible at the moment, mainly because of the lack of distribution data for many species, a need to revise many species and unsolved taxonomic difficulties at the generic (Arup & Grube 1999, Gaya et al. 2003, Søchting & Lutzoni 2003) and species levels; only *Caloplaca variabilis* and *C. citrina* groups are partially resolved by molecular methods (Arup 2006, Tretiach et al. 2003). Hence, this study focus on selected species, which are new to this country, rare or poorly known.

The lack of information on some species is partly explained by the fact that many of them were only described recently (*C. dichroa*, *C. erodens* and *C. thuringiaca*) or were not widely accepted until recently (*C. flavocitrina* and *C. phlogina*). The nitrophilous species *C. crenulatella* and *C. flavocitrina* were collected mainly from man-made substrates, which are not frequently studied by lichenologists. Moreover, the species *C. epithallina*, *C. herbidella* and *C. rubelliana* are genuinely rare in Central Europe.

MATERIALS AND METHODS

Material for this study was mostly collected by the authors and voucher specimens are currently deposited in the herbaria CBFS, PRM, PRC, PRA (hb. Liška, hb. Palice) and private herbaria of A. Vězda (hb. Vězda) and J. Šoun (hb. Šoun).

All the species are followed by short notes on important characters, ecology, distribution, taxonomy and nomenclature. Species new to the Czech Republic are indicated by an asterisk before the name. The list of recorded localities is added in the Appendix.

The nomenclature follows, with some exceptions, Nimis & Martellos (2003); the nomenclature of insoluble lichen pigments follows Meyer & Printzen (2000). Author abbreviations are taken from Brummitt & Powell (1992).

RESULTS

Caloplaca albolutescens (NYL.) H. OLIVIER

This species is characterized by a thin whitish thallus irregularly covered with clusters of grey soredia. The cortex is not developed. Soredia are K+ sordid violet in section due to the presence of *Sedifolia*-grey pigment. The red to brown red apothecia are similar to those of *C. teicholyta*.

British authors (Laundon 1992a, Coppins 2002) consider *C. albolutescens* to be a synonym of *C. teicholyta*. However, most European lichenologists distinguish *C. albolutescens* as a separate species (e.g. Wade 1965, Clauzade & Roux 1985, Wirth 1995, Diederich & Sérusiaux 2000, Nimis & Martellos 2003). Our investigation of herbarium material supports a separation of these two species, because the specimens are well characterized with no intermediates. *C. albolutescens* has a thin leprose thallus, the cortex is absent or poorly differentiated at margins, and marginal lobes are missing, whereas *C. teicholyta* has a rather thick thallus sorediate in the centre, marginal lobes are more or less present and the cortex is well-developed, at least marginally. An examination of the holotype of *C. albolutescens* (Supra saxa quarcitosa ad Stockfield, Northumberland in Anglia, coll.W. Johnson, H-Nyl. 29845, sub *Lecanora albolutescens*) and of the type material of *C. teicholyta* ("in muris et ad lapides calcarios Galliae. Du Four", sub *Lecanora teicholyta*, H-Ach. 1229, holotype!, UPS-ACH 681, isotype!) by the first author of this paper has shown that the respective type specimens are not conspecific.

Outside Europe, the species is known from Syria (John et al. 2004) and Turkey (Breuss & John 2004). It occurs on man-made substrates like bricks and concrete as well as natural habitats, e.g. calcareous sandstone rocks. Van den Boom (2005) recorded this species growing on compact sandy soil in Portugal. In the Czech Republic, *C. albolutescens* was recently reported for the first time from the karst area "Český kras" in central Bohemia (Svoboda 2007). Our new findings are from central Bohemia (Bakov nad Jizerou, Křivoklát, Kokořín, Liběchov, Netovice u Slaného), S Bohemia (Písek) and S Moravia (Milotice near Kyjov), from calcareous sandstone rocks or anthropogenous habitats.

Caloplaca biatorina J. STEINER

This species belongs to the section *Gasparrinia* and strongly resembles *C. saxicola*. However, it is clearly characterized by ascospores with thin septa when mature. Clauzade & Roux (1985) recognized two subspecies: subsp. *biatorina* with apothecia lacking pruina and subsp. *gyalolechioides* (Müll. Arg.) Clauzade et Cl. Roux with pruinose ascocarps.

C. biatorina subsp. *biatorina* grows mostly on exposed and sunny calcareous rocks while subsp.

gyalolechioides occurs on less sunny vertical or overhanging rocks. Both subspecies usually do not co-occur. Sometimes the subsp. *gyalolechioides* is regarded as a distinct species (Nimis 2003).

According to Nimis (1993) the centre of distribution of both subspecies is located in the Mediterranean area. Apart from S Europe, it is known from N Africa (Egea 1996, Seaward 1996) and Asia Minor (John 1996) extending to Central Asia (see distributional map in Poelt & Hinteregger 1993). The distribution in central and N Europe is very patchy with the northernmost outlier in Kuusamo province in Finland (Santesson et al. 2004). Previously *C. biatorina* in the Czech Republic was restricted to S Moravia. A few authors (Ginzberger 1913, Suza 1925, Podpěra 1928) mention its occurrence in the Pavlovské vrchy hills, but only Podpěra (1928) gives an exact locality: Galgenberg [= Šibeničník]. Vězda & Gruna (2000) reported *C. biatorina* from several sites in the Podyjí National park. We newly record this species from Central Bohemia (subsp. *biatorina*) and confirm its occurrence in S Moravia; in each area only one subspecies was detected: the nominate subspecies in the Pavlovské vrchy hills, and subsp. *gyalolechioides* in the Podyjí National park.

Caloplaca cerinella (Nyl.) Flagey

Syn.: *Candelariella cerinella* (Nyl.) Mig. [non (Flörke) Zahlbr.]

This species superficially resembles taxa of the *C. holocarpa* complex. It is easily recognizable as it has 12–16 spores per ascus. Corticolous forms of *C. holocarpa* s.l. (including *C. cerinelloides*) frequently occur in the same habitats and it is necessary to study the asci in order to distinguish these species.

Caloplaca cerinella is mostly found on bark of *Sambucus nigra* in communities of nitrophilous lichens, such as *Lecania cyrtella*, *Phaeophyscia orbicularis* and *Strangospora ochrophora*. It is a widely distributed species in Europe (Laundon 1992a, Wirth 1995, Santesson et al. 2004) but probably overlooked. Recently, it was reported from Slovakia (Guttová&Palice 2002) and only previously reported twice from the Czech Republic. Servít (1910) recorded *C. cerinella* near Tišnov (S Moravia) on bark of *Populus* sp.; although we have not seen the voucher material, this identification is likely to be correct, as the author noted the important character, 10–12 spores in the asci. Recently, this species was reported by Peksa et al. (2004) from the Novohradské hory Mts (S Bohemia). All the new localities are in S Bohemia (Prachatice, Tábor, Protivín).

Presently, *C. cerinella* is considered to be a strictly corticolous species (Laundon 1992a, Wirth 1995). Therefore the records referring to saxicolous occurrences in papers listed by Vězda & Liška (1999) under *Caloplaca cerinella* or its synonym *Candelariella cerinella* (Nyl.) Mig. (Kovář 1910, Los 1924, Kuťák 1927, Podzimek 1929, Müller 1951) are presumably *Candelariella aurella* [= *Candelariella cerinella* (Flörke) Zahlbr.].

Caloplaca chlorina (Flot.) H. Olivier

Syn.: *Caloplaca cerina* var. *chlorina* (Flot.) Müll. Arg., *C. cerina* var. *cyanolepra* (DC.) J. J. Kickx

The *Caloplaca chlorina* complex is in urgent need of modern taxonomic revision as is the whole *C. cerina* group to which it belongs. The characterization of *C. chlorina* is not completely clear (Poelt & Hinteregger 1993) and interpretation of this species differs among contemporary authors and the present nomenclature is rather confusing. Ecological requirements and the production of isidia/soredia serve as the main criteria for delimiting some narrower species. Since our specimens form a continuum from coarsely isidiate to finely sorediate thalli, we prefer to treat them in a broad sense, as in some recent checklists (e.g. Diederich & Sérusiaux 2000, Santesson et al. 2004) and await further taxonomic studies and their resultant nomenclatural changes. Tønsberg (1992) characterizes it as a variable species, which can form well-developed, flat areolae with marginal soredia, consoredia, or isidia-like projections, as well as completely leprose thalli. Our clearly sorediate or leprose specimens key out as *C. virescens* following Laundon (1992a). However, his description does not fully match our specimens.

Caloplaca chlorina is a widely distributed species in the Northern Hemisphere (Poelt & Hinteregger 1993, Wetmore 1996). In the Catalogue of Czech lichens (Vězda & Liška 1999), *C. chlorina* is included as a synonym of *C. cerina* and was rarely reported from the Czech Republic in the past. Recently, it was recorded a few times, both as an epiphyte (Dětinský 1997, Halda 1999) and rock-growing species (Vězda 1998, Vondrák & Palice 2004,

Vondrák 2006). Additional recent findings of *C. chlorina* indicate this species is rather common and widely distributed in this country. Siliceous stones in old walls, pebbles on railroads, bricks, roofing-tiles and bases of hardwood tree trunks are the most favourable habitats.

Caloplaca chrysodeta (VAIN. EX RÄSÄNEN) DOMBR.

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

Caloplaca chrysodeta is always sterile, with a more or less ochraceous leprose thallus containing K+ anthraquinones. It typically grows under the overhangs of lime-rich rocks, often accompanied by *C. xantholyta*. It occurs mostly on hard limestones but also on schist, sandstones and basalts. It may also occupy anthropogenic habitats like mortar or concrete on shaded walls (Laundon 1974; see also one locality mentioned above) and may occasionally switch to dry bark of trees or wood (Poelt & Hinteregger 1993). It is a widespread, apparently subcosmopolitan species occurring in both Hemispheres (Laundon 1992b).

In the Czech Republic, *C. chrysodeta* is reported from the Bohemian cretaceous basin: the Metuje river valley (Bayerová & Kukwa 2004), České Švýcarsko (Palice et al. 2007), Český kras karst (Svoboda 2007) and the limestone area near Český Krumlov (Vondrák 2006). According to our observations, *C. chrysodeta* is a widely distributed but local species within the Czech Republic, which was probably overlooked in the past due to its sterile leprose habit.

Caloplaca crenulatella (NYL.) H. OLIVIER

This species belongs to the *C. lactea* group and is characterized by its ascospores [(10.0–) 11.5–22.0 (–28.0) × (3.0–) 4.0–7.5 µm in size, septum only 1.5–2.0 µm thick] and its thallus usually forming a yellow "collar" surrounding older apothecia. For the differences between *C. crenulatella* and related species, mainly *C. aquensis* Houmeau et Cl. Roux and *C. ferrarii* (Bagl.) Jatta, see Navarro-Rosinés & Hladun (1996).

Caloplaca crenulatella is a widely distributed species in Europe (Navarro-Rosinés & Hladun 1996, Scholz 2000, Hafellner & Türk 2001, Santesson et al. 2004). It was recently discovered in Bulgaria (Vondrák & Slavíková-Bayerová 2006), Estonia (Jüriado et al. 2002), Poland (Kukwa 2000), Romania (Vondrák 2005), Slovakia (Pišút 2002) and Ukraine (Khodosovtsev 2001). The only published record for the Czech Republic until recently refers to the type specimen of *C. ferrarii* var. *diabasicola* Servít et Černohorský collected on a diabase rocky outcrop near Loděnice in central Bohemia (Servít & Černohorský 1935). It was examined and synonymized with *C. crenulatella* by Navarro- Rosinés & Hladun (1996). The recent records come from limestone outcrops near Český Krumlov (Vondrák 2006) and two anthropogenous sites: Kostelní (near Kraslice) in the Krušné hory Mts (Bayerová et al. 2004) and Chvaletice in E Bohemia (Palice & Soldán 2004). According to our field observations, *C. crenulatella* is one of the most frequent *Caloplaca* species in the Czech Republic. It occurs on calcareous and base-rich siliceous rocks as well as on concrete, mortar and bitumen. We have confirmed two samples of *C. crenulatella* from Vězda's herbarium, which were collected from loess. In one case, we found it on the basal part of a tree-trunk (*Quercus robur*) growing together with the *C. cerina* agg.

Caloplaca dichroa ARUP

This recently described species (Arup 2006) belongs to the *C. citrina* group. It is well-defined by the granular, blastidiate or sorediate thalline surface and occurs in two colour variants, yellow and orange. When fertile, thick-walled ascospores of sand-glass type are characteristic. In the somewhat similar *C. coronata*, true isidia are developed and the ascospores have thin walls. Also, *C. citrina* s. str. has thin-walled ascospores.

Caloplaca dichroa occurs in Austria, Denmark, Finland, Germany, Norway and Sweden (Arup 2006). In the Czech Republic, this species is not rare and occurs on natural lime-rich rocks as well as on concrete and mortar. It was recently reported from S Bohemia (Vondrák 2006), but not highlighted as a new species for the Czech Republic.

**Caloplaca epithallina* LYNGE

Caloplaca epithallina is a lichenicolous lichen, which does not form its own thallus. The rust-red apothecia are sessile on the host thallus and the lichen does not cause any conspicuous damage to its hosts. It is known to grow on thalli of the crustose and foliose lichens *Dimelaena oreina*, *Lecanora muralis*, *L. polytropa*, *Lecidea* sp., *Melanelia disjuncta*, *Psorinia conglomerata*, *Rhizoplaca melanophthalma*, *R. subdiscrepans* and *Umbilicaria cylindrica*.

It is a widely distributed holarctic-alpine species known also from the Canary Islands (Poelt 1985). The record from the Krkonoše Mts (Mt Sněžka) is the first from the mountain range of the Sudetes.

**Caloplaca erodens* TRETIACH, PINNA ET GRUBE

Caloplaca erodens is a recently described species placed in the section *Pyrenodesmia*. It has a mostly sterile bluish-grey orbicular thallus, which is mostly endolithic but sorediate centrally and delimited by an epilithic, obscurely lobate prothallus. The *Sedifolia*-grey pigment is present in soredia. Thalli of *C. erodens* typically form shallow depressions in calcareous substrates. Apothecia were only observed at the type locality (Tretiach et al. 2003).

Caloplaca erodens occurs in Italy, in the montane and subalpine belt of the Apennines and the S Alps (Tretiach et al. 2003), Austria (Hafellner & Muggia 2006) and Bulgaria (Vondrák & Slavíková-Bayerová 2006). In the Czech Republic, it has only been found in the limestone area of the Pavlovské vrchy hills (S Moravia, distr. Břeclav) and on several sites in central Bohemia. However, this species is a very common lichen at most of the listed localities and predominates in lichen communities. *Caloplaca erodens* grows exclusively on exposed hard limestone rocks at altitudes between 250 and 450 m.

Samples were compared with the isotype specimen (Vězda: Lich. Rar. Exsic. 499).

Caloplaca flavocitrina (NYL.) H. OLIVIER

This species is characterized by a thallus composed of irregularly lobed yellow squamules, which become sorediate at the edges. Most authors place this taxon within the variable *C. citrina* (e.g. Wade 1965, Santesson et al. 2004, Wetmore 2004b), but some recent studies consider *C. flavocitrina* to be a separate species (van den Boom et al. 1998, Sérusiaux et al. 1999, Sparrius & Vervoort 2003). This concept was confirmed by Arup (2006) using molecular methods. *Caloplaca flavocitrina* is already accepted in the checklists of Coppins (2002) and Diederich & Sérusiaux (2000).

Caloplaca flavocitrina is considered to be less nitrophilous than *C. citrina* by Diederich & Sérusiaux (2000). In the Czech Republic, it commonly occurs on concrete walls, mortar and on natural lime-rich rocks and pebbles. We have also observed the species on the bases of trees and *Sambucus nigra* trunks and twigs. *Caloplaca flavocitrina* is occasionally accompanied by *C. citrina*, but it is more frequent on man-made substrates than *C. citrina* s. str. Reported earlier only by Palice & Soldán (2004) and Vondrák (2006).

Caloplaca herbidella (HUE) H. MAGN.

Caloplaca herbidella shares important characters with *C. ferruginea* and *C. furfuracea*, e.g. flexuose and strongly anastomosed paraphyses, a C+ violet reaction of apothecial margin and the red pycnidia. However, *C. herbidella* is clearly characterized by its isidia, which are in part elongated (Wetmore 2004a).

Growing on bark of coniferous and deciduous trees or rarely on wood, *C. herbidella* is distributed throughout Europe (e.g. Magnusson 1944, van Herk 1993, Thor & Nordin 1998, Diederich & Sérusiaux 2000, Czarnota 2002, Motiejunaite & Andersson 2003). It is reported also from Tunisia (cf. Seaward 1996), Morocco (Burgaz et al. 2002), Turkey (e.g. John 1996), Syria (John et al. 2004) and Japan (Harada et al. 2004). Previous North American records are misidentifications of other species (Wetmore 2004a). Wetmore regards *C. herbidella* as a European species and compares it to the widely distributed *C. furfuracea*. *Caloplaca herbidella* has recently been recorded from the

Czech Republic for the first time from old-growth forest in the Šumava Mts (Palice 1999) in S Bohemia. It is reported here from the Hrubý Jeseník Mts in N Moravia. Records published by Suza (1921) and Vězda (1961) as *Blastenia/Caloplaca ferruginea* from the Hrubý Jeseník Mts also belong to this species on account of the well developed isidiate thalli of the specimens (PRM 631059! and hb. Vězda!).

**Caloplaca inconnexa* (NYL.) ZAHLBR.

This species is characterized by a yellow to yellow-orange, parasitic thallus, which is usually incorporated among the areoles of a host lichen species (Poelt 1958). Photographs of typical specimens are available in Nimis (2003). The host lichen is most frequently *Acarospora cervina*, but can also be *Aspicilia calcarea*, *Lecanora muralis*, *Lobothallia radiosa*, *Placocarpus schaereri* or other calciphilous crustose lichens. The anatomical structures of the apothecia are similar to those of *C. dolomiticola* s.l.

This lichen is traditionally regarded as a parasitic species (e.g. Poelt 1958, Clauzade & Roux 1985, Nimis & Poelt 1987, Nimis 1993, Wirth 1995, Nimis 2003) but mature thalli are often non-parasitic in later stages as implied by the comments of several authors (e.g. Vězda 1970, Diederich & Sérusiaux 2000) and observed in luxuriantly developed populations in S Europe by the first author. Furthermore, its holotype (France, Montpellier, H-Nyl. 29575!, sub *Lecanora inconnexa*) does not show any traces of parasitism. As this lichen forms a thallus of its own, the extent of parasitism and autotrophy cannot be exactly determined as stated by Sipman & Raus (1999). When parasitic, *C. inconnexa* does not cause any visible damage to the thallus of the host.

Caloplaca inconnexa is distributed mainly in the Mediterranean area (e.g. Nimis 1993) with outliers in W and central Europe. The northern distribution limit is in Slovakia (Vězda 1970, Guttová & Palice 2005), the Czech Republic (this paper), Germany (e.g. Wirth 1995) and Belgium (Diederich & Sérusiaux 2000). It is a species of xerothermic sites in the Czech Republic. Most localities are known from the Pavlovské vrchy hills (S Moravia), where *C. inconnexa* commonly grows on limestone rocks at altitudes between 250 and 450 m. Additionally, we have recorded *C. inconnexa* on calcareous rock in S Moravia (Brno) and central Bohemia (Praha, Český kras karst).

Caloplaca marmorata (BAGL.) JATTA

This species has a whitish endolithic thallus and small, deep red apothecia. It belongs to the *Caloplaca lactea* group and strongly resembles *C. lactea*, which however differs in rather orange apothecia, and broadly ellipsoid and shorter ascospores (Navarro-Rosinés & Hladun 1996). According to Navarro-Rosinés & Hladun (1996), *C. marmorata* is widely distributed in Europe, the Near East and N Africa. In the Czech Republic, it was previously reported only once from the Pavlovské vrchy hills (S Moravia) by Navarro-Rosinés & Hladun (1996), but the specimen (leg. A. Vězda, 1957) was erroneously attributed to Slovakia. Recently, *C. marmorata* was found in several new localities in the region of the Český kras karst in central Bohemia (Svoboda 2007). Our observations show that this species commonly occurs in the larger limestone areas in central Bohemia (Praha, Český kras karst) and S Moravia (Moravský kras karst, Pavlovské vrchy hills).

During the revision of herbarium material of *C. lactea* and *C. pyracea*, we found additional records of *C. marmorata* from central Bohemia: Beroun, Císařská rokle, coll. J. Podpěra (PRC 283!, sub *C. pyracea*), and S Moravia: Blansko, Jestřebí, coll. J. Suza (PRM580938!, sub *C. lactea*), Mikulov, the hill Svatý kopeček, coll. J. Suza (PRM 580935!, sub *C. lactea*), and Mikulov, the hill Šibeničník, coll. J. Suza (PRM580937!, sub *C. lactea*).

Caloplaca obliterans (NYL.) BLOMB. ET FORSSELL

This species resembles *C. cirrochroa* and *C. proteus* and is mainly a montane lichen of shaded and mineral/lime-rich siliceous rocks (for details of ecology seeWirth 1995). It is widely distributed in the Northern Hemispere but is very rare and local (Laundon 1992a, Khodosovtsev et al. 2004). It is also known from Australia (Kalb 1996).

Only three localities at lower altitudes were previously reported from the Czech Republic: Tišnov, the hill Čebínka, on limestone (Servít 1910), Mohelno, on serpentinite (Suza 1931) and Sv. Jan pod Skalou, on limestone (Servít & Černohorský 1935). The two Moravian records are revised here but we were unable to locate the

Bohemian specimen in the PRM herbarium. The voucher specimen from Čebínka (PRC 53!) belongs to *C. cirrochroa*, whereas the identity of the specimen from Mohelno was confirmed (PRM 631205!). Reports from sites at lower altitudes exist for neighbouring countries (e.g. Verseghy 1971, Berger 2000). The new findings presented here are from high altitudes in the Krkonoše Mts (E Bohemia) and the Hrubý Jeseník Mts (N Moravia).

**Caloplaca phlogina* (Ach.) Flagey

Sérusiaux et al. (1999) considered *C. phlogina* a separate, well-defined species of the *C. citrina* group. Based on molecular data, *C. phlogina* forms a monophyletic, well-supported clade next to the *Xanthoria candelaria* group (Arup 2006) and is thus not closely related to the other species of *C. citrina* group.

Apart from its corticolous occurrence, it differs from *C. citrina* by smaller soredia (25–50 µm in diameter), slightly smaller ascospores and the yellow colour of the apothecial disc. However, the morphological differences are slight, thus the substrate ecology seems to be the best way to separate these two species (Arup 2006). Another similar species, *C. flavocitrina*, has a different thallus consisting of distinct squamules, which become sorediate at the margin. The general distribution of *C. phlogina* is unknown, because this taxon was previously synonymized with *C. citrina*.

The two records presented here, from central and S Bohemia, establish that this is a new species for the Czech Republic (identification confirmed by U. Arup, Lund). Care should be taken to distinguish corticolous *C. flavocitrina*, which is more common than *C. phlogina* in the Czech Republic.

**Caloplaca polycarpa* (A. Massal.) Zahlbr.

Syn.: *Caloplaca tenuatula* (Nyl.) Zahlbr.

This species belongs, according to Wirth (1995), to the *Caloplaca dolomiticola* group and is characterized by reduced areoles and inconspicuous marginal lobes. *Caloplaca polycarpa* grows mostly parasitically on *Verrucaria calciseda*, but we have observed freeliving mature thalli.

Caloplaca polycarpa is distributed in N Africa (Egea 1996), the Near East (John et al. 2004) and S to central Europe (e.g. Nimis 1993, Wirth 1995), with the northernmost occurrence on the islands of Gotland and Öland (Santesson et al. 2004). *Caloplaca polycarpa* is obviously a common inhabitant of limestone areas in the Czech Republic, but largely overlooked and probably confused with the similar *C. holocarpa*. Recently it was found in central Bohemia (Praha, Český kras karst), S Bohemia (Český Krumlov) and S Moravia (Moravský kras karst, Pavlovské vrchy hills).

Caloplaca rubelliana (Ach.) Lojka

Caloplaca rubelliana is a very characteristic species having immersed apothecia and a rust-red thallus. Its crustose-rimose thalli usually form orbicular patches with a grey marginal prothallus. According to Nimis (2003) it is a warm-temperate to subtropical, widespread lichen, found on steeply inclined, hard, basic siliceous rocks (especially basalt), often with species of *Peltula*.

Caloplaca rubelliana is known from W North America (Wetmore & Kärnefelt 1999), N and S Africa (Egea 1996, Wirth et al. 2005), the Near East (John et al. 2004) and S to central Europe; the northernmost occurrence is in Estonia (Randlane & Saag 1999).

In the Czech Republic, its distribution is restricted to xerothermic rocks in Central Bohemia and SW Moravia. In Bohemia, the species is reported from the central and lower part of the Vltava river valley (Suza 1934, 1940) and Berounka river valley (Suza 1934, Wirth 1972, Vězda 1996). Additionally, Kuťák (1927) reports *C. rubelliana* from E Bohemia growing on diorite rock in Vrbatův Kostelec (distr. Chrudim) but the voucher specimen is missing from the Kuťák's herbarium (depon. in PRM). In Moravia, the species is only known from the locality "Ivančice, Biskoupky, on granulite rock in the Jihlavka river valley" (Suza 1932a, 1932b, 1935, 1944, 1947). This occurrence was recently confirmed by Vězda (1998). We found the species in two new localities in central Bohemia (Křivoklátsko).

**Caloplaca thuringiaca* Søchting et Stordeur

Caloplaca thuringiaca is closely related to the widespread *C. holocarpa*, from which it differs by its "delicate apothecia that are initially immersed in the thallus" (Søchting & Stordeur 2001). The other morphological characters studied in *C. thuringiaca* fall within the variability of *C. holocarpa* s.l. *Caloplaca thuringiaca* is otherwise characterized ecologically, as a species growing on plant-debris and bryophytes in steppe-like grasslands in xerothermic habitats.

Caloplaca thuringiaca is only known from several localities in E Austria, central Germany, N Italy and Switzerland (Stordeur 2003) and was recently reported from Mongolia (Hauck & Javkhlan 2006). In the Czech Republic, we found it in the Pavlovské vrchy hills in southernmost Moravia, where it commonly occurs on the woody stems of perennials (e.g. *Thymus*) and tiny shrubs growing in rocky steppes on limestone, associated with other calciphilous lichens, such as *Agonimia opuntiella*, *Bacidia bagliettoana*, *B. herbarum* and *Caloplaca stillicidiorum*. Additionally, we recorded the species at localities in S Moravia (Tišnov) and central Bohemia (Praha, Český kras karst).

Caloplaca xantholyta (Nyl.) Jatta

Syn.: *Leproplaca xantholyta* (Nyl.) Hue

Caloplaca xantholyta is always sterile, with a bright yellow leprose thallus containing K+ anthraquinones. The thallus is clearly delimited into circular patches, sometimes with a sublobate margin. It grows typically under overhangs of lime-rich rocks, often accompanied by *C. chrysodeta*. Laundon (1992b) reports this species from Europe, the Middle East and New Zealand. It is also known from Tajikistan (Kudratov & Mayrhofer 2002) and Tibet (Obermayer 2004). According to Wetmore (2001) it is a European species not occurring in North America.

From the Czech Republic, it was previously reported only by Suza (1922) as a common species in the Moravský kras karst (S Moravia). According to our observations, it occurs also in central Bohemia (Křivoklát, Zruč nad Sázavou).

Acknowledgements

We are grateful to Antonín Vězda (Brno) and Jaroslav Šoun (České Budějovice) for letting us study several *Caloplaca* samples from their private herbaria. Ulf Arup (Lund) is thanked for revision of our samples of *Caloplaca phlogina*. Walter Obermayer (Graz), Orvo Vitikainen and Leena Myllys (Helsinki), the curators of herbaria GZU and H, promptly helped us with loans of material. Alan Orange (Cardiff) and Marek Stibal (Bristol) kindly corrected the English, Tony Dixon the final version of the manuscript. The study was financially supported by the Grant Agency of the Academy of Sciences of the Czech Republic (AV0Z60050516), the Grant Agency of the Czech Republic (206/03/1214), the Ministry of Culture of the Czech Republic (MK00002327201 and RK01P03OMG003) and the Ministry of Education, Youth and Sports of the Czech Republic (0021620828).

Souhrn

Práce přispívá k poznání diverzity lichenizovaných hub rodu *Caloplaca* (*Teloschistales*) na území České republiky. Zahrnuto je 19 druhů, z nichž 6 je pro území nových: *C. epithallina*, *C. erodens*, *C. inconnexa*, *C. phlogina*, *C. polycarpa* a *C. thuringiaca*. Druhy *C. albolutescens*, *C. cerinella*, *C. chlorina*, *C. chrysodeta*, *C. dichroa*, *C. flavocitrina*, *C. herbidella* a *C. marmorata* byly pro území objeveny v nedávné době a znalosti o jejich ekologii a rozšíření v ČR jsou nedostatečné. *Caloplaca biatorina*, *C. obliterans*, *C. rubelliana* a *C. xantholyta* uvádíme jako znovuobjevené po více než padesáti letech. Teprve nedávno z ČR publikovaný druh *C. crenulatella* považujeme za dosud přehlížený a velmi běžný na antropogenních substrátech.

REFERENCES

Arup U. (2006): A new taxonomy of the *Caloplaca citrina* group in the Nordic countries, except Iceland. – Lichenologist 38: 1–20.

Arup U. & Grube M. (1999): Where does *Lecanora demissa* (Ascomycota, *Lecanorales*) belong? – Lichenologist 31: 419–430.

Bayerová Š. & Kukwa M. (2004): New leprarioid lichens in the Czech Republic. – Biologia (Bratislava) 59: 19–23.

Bayerová Š., Halda J., Liška J. & Uhlík P. (2004): Příspěvek k poznání lichenoflóry Krušných hor [A contribution to the knowledge of lichen flora of the Krušné hory Mts]. – Bryonora 33: 28–35.

Berger F. (2000): Die Flechtenflora der Schlögener Schlinge im oberösterreichischen Donautal. – Beitr. Naturk. Oberösterreichs 9: 369–451.

Breuss O. & John V. (2004): New and interesting records of lichens from Turkey. – Österr. Zeitschr. Pilzk. 13: 281–294.

Brummitt R. K. & Powell C. E. (1992): Authors of plant names. – Royal Bot. Gardens, Kew.

Burgaz A. R., Aharchi Y. & Enabili A. (2002): Epiphytic lichens of *Cedrus atlantica* in the Rif Mountains (N Morocco). – Nova Hedwigia 74: 429–437.

Clauzade G. & Roux C. (1985): Likenoj de Okcidenta Europo. Ilustrita determinlibro [Lichens of theWestern Europe]. – Bull. Soc. Bot. Centre-Ouest, nouv. ser. num. spec. 7: 1–893.

Coppins B. J. (2002): Checklist of lichens of Great Britain and Ireland. – British Lichen Society, London.

Czarnota P. (2002): *Caloplaca herbidella* (Hue) H. Magn. – In: Bielczyk U., Cieśliński S. & Fałtynowicz W. (eds), Atlas of the geographical distribution of lichens in Poland. Part 3, p. 25–28,W. Szafer Institute of Botany, Polish Academy of Sciences, Kraków.

Dětinský R. (1997): Některé aspekty bioindikačních metod využívajících epifytické lišejníky [Some aspects of bioindication methods using epiphytic lichens]. – Příroda, Praha, 11: 17–28.

Diederich P. & Sérusiaux E. (2000): The lichens and lichenicolous fungi of Belgium and Luxembourg. An annotated checklist. – Musée National d'Histoire Naturelle, Luxembourg.

Egea J. M. (1996): Catalogue of lichenized and lichenicolous fungi of Morocco. – Bocconea 6: 19–114.

Eitner E. (1911): Dritter Nachtrag zur schlesischen Flechtenflora. – Jber. Schles. Ges. Vaterl. Cult. 88: 20–60.

Gaya E., Lutzoni F., Zoller S. & Navarro-Rosinés P. (2003): Phylogenetic study of *Fulgensia* and allied *Caloplaca* and *Xanthoria* species (*Teloschistaceae*, lichen-forming Ascomycota). – Amer. J. Bot. 90: 1095–1103.

Ginzberger A. (1913): Excursions zu der pflanzengeographischen Reservationen bei Nikolsburg und Ottenthal. – Verh. Zool. Bot. Ges. Wien 63: 143–150.

Guttová A. & Palice Z. (2002): Lišajníky Národného parku Muránska planina II – Javorníková dolina [Lichens of the Muránska planina II – Javorníková dolina]. – Výsk. Ochr. Prír. Murán. Planiny 3: 53–68.

Guttová A. & Palice Z. (2005): Lišajníky Národného parku Muránska planina III – Cigánka [Lichens of the Muránska planina national park III – Cigánka]. – Reussia 1, Suppl. 1/2004: 5–40.

Hafellner J. & Muggia L. (2006): Über Vorkommen von *Caloplaca erodens* in der Steiermark (Österreich). – Mitt. Naturwiss. Ver. Steiermark 135: 33–49.

Hafellner J. & Türk R. (2001): Die lichenisierten Pilze Österreichs – eine Checkliste der bisher nachgewiesenen Arten mit Verbreitungsangaben. – Stapfia 76: 1–167.

Halda J. (1999): Příspěvek k poznání lichenoflóry Orlických hor. 2. Údolí horních toků řek Bělé, Zdobnice a Divoké Orlice [A contribution to the lichenoflora of the Orlické hory Mts. 2]. – Acta Mus. Richnov., sect. natur. 6: 1–32.

Harada H., Okamoto T. & Yoshimura I. (2004): A checklist of lichens and lichen-allies of Japan. – Lichenology 2: 47–165.

Hauck M. & Javkhlan S. (2006): Additions to the lichen flora of Mongolia: records from Khentey and Khangay. – Willdenowia 36: 895–912.

John V. (1996): Preliminary catalogue of lichenized and lichenicolous fungi of Mediterranean Turkey. – Bocconea 6: 173–216.

John V., Seaward M. R. D., Sipman H. J. M. & Zedda L. (2004): Lichens and lichenicolous fungi of Syria, including a first checklist. – Herzogia 17: 157–177.

Jüriado I., Randlane T. & Saag L. (2002): NewEstonian records – Lichens. – Folia Cryptog. Estonica 39: 62–63.

Kalb K. (1996): Additional lichen records from Australia. 29. – Australasian Lichenol. Newslett. 39: 28–34.

Kärnefelt I., Kondratyuk S., Søchting U., Frödén P. & Arup U. (2002): Two new species of *Caloplaca* (*Teloschistaceae*) from the Southern Hemisphere. – Bryologist 105: 301–309.

Khodosovtsev O. Y. [= Khodosovtsev A.] (2001): Novi dlja Ukrajiny vydy rodu *Caloplaca* Th. Fr. (*Teloschistaceae*) [A new for Ukraine species of the genus *Caloplaca* Th. Fr. (*Teloschistaceae*)]. – Ukr. Bot. Zh. 58: 460–465.

Khodosovtsev A., Kuznetsova E. & Himelbrant D. (2004): Lichen genus *Caloplaca* on Kamchatka Peninsula (Russian Far East). – Bot. Lith. 10: 195–208.

Kovář F. (1910): Čtvrtý příspěvek ku květeně lišejníků moravských [The fourth contribution to the lichen diversity in Moravia]. – Věstn. Klubu Přírod. Prostějov 13: 1–40.

Kudratov I. & Mayrhofer H. (2002): Catalogue of the lichenized and lichenicolous fungi of Tajikistan. – Herzogia 15: 91–128.

Kukwa M. (2000): Pierwsze stanowisko *Caloplaca crenulatella* (Nyl.) H. Olivier (*Teloschistaceae*, Ascomycota lichenisati) w pólnocnej Polsce [The first locality of *Caloplaca crenulatella* (Nyl.) H. Olivier (*Teloschistaceae*, Ascomycota lichenisati) in northern Poland]. – Acta Bot. Cassub. 1: 139–142.

Kuťák V. (1927): Třetí příspěvek ku květeně českých lišejníků [The third contribution to the lichen diversity in Bohemia]. – Preslia 5: 36–51.

Laundon J. R. (1974): *Leproplaca* in the British Isles. – Lichenologist 6: 102–105.

Laundon J. R. (1992a): *Caloplaca*. – In: Purvis O.W., Coppins B. J., Hawksworth D. L., James P.W. & Moore D. M. (eds), The lichen flora of Great Britain and Ireland, p. 141–159, Natural History Museum Publications & British Lichen Society, London.

Laundon J. R. (1992b): *Leproplaca*. – In: Purvis O.W., Coppins B. J., Hawksworth D. L., James P.W. & Moore D. M. (eds), The lichen flora of Great Britain and Ireland, p. 349–350, Natural History Museum Publications & British Lichen Society, London.

Liška J. (2005): Katalog lišejníků ČR – korekce a doplňky [A catalogue of lichens of the Czech Republic – corrections and additions]. – Bryonora 35: 1–5.

Los V. (1924): Lichenografický ráz Brd [Brdy Mts from a lichenological point of view]. – Mus. Spisy 6: 1–20.

Magnusson A. H. (1944): Studies in the *ferruginea*-group of the genus *Caloplaca*. – Kungl. Vetenskaps-och Vitterhets-samhälles Handl., Sjätte Följden, ser. B 3: 3–71.

Meyer B. & Printzen C. (2000): Proposal for a standardized nomenclature and standardization of insoluble lichen pigments. – Lichenologist 32: 571–583.

Motiejunaite J. & Andersson L. (2003): Contribution to the Lithuanian flora of lichens and allied fungi. – Bot. Lith. 9: 71–88.

Müller J. (1951): Výsledky botanického výzkumu vápenců severozápadního Slezska [Results of the botanical survey in limestone areas of NW Silezia]. – Přírod. Sborn. Ostrav. Kraje 12: 48–73.

Navarro-Rosinés P. & Hladun N. L. (1996): Les especies saxícolo-calcícolas del grupo de *Caloplaca lactea* (*Teloschistacceae*, líquenes), en las regiones mediterranea y medioeuropea. – Bull. Soc. Linn. Provence 47: 139–166.

Nimis P. L. (1993): The lichens of Italy. – Museo Regionale di Scienze Naturali, Torino.

Nimis P. L. (2003): Checklist of the lichens of Italy 3.0. – University of Trieste, Dept. of Biology, URL [http://dbiodbs.univ.trieste.it, accessed December 2006].

Nimis P. L. & Martellos S. (2003):Asecond checklist of the lichens of Italy with thesaurus of synonyms. – Museo Regionale di Scienze Naturale, Aosta.

Nimis P. L. & Poelt J. (1987): The lichens and lichenicolous fungi of Sardinia (Italy): an annotated list. – Stud. Geobot. 7 /Suppl. 1: 1–269.

Obermayer W. (2004): Additions to the lichen flora of the Tibetan region. – Bibl. Lichenol. 88: 479–526.

Palice Z. (1999): New and noteworthy records of lichens in the Czech Republic. – Preslia 71: 289–336.

Palice Z. & Soldán Z. (2004): Lichen and bryophyte species diversity on toxic substrates in the abandoned sedimentation basins of Chvaletice and Bukovina. – In: Kovář P. (ed.), Natural recovery of human-made deposits in landscape: Biotic interactions and ore/ash-slag artificial ecosystems, p. 200–221, Academia, Praha.

Palice Z., Slavíková-Bayerová Š., Peksa O., Svoboda D. & Kučerová L. (2007): The lichen flora of the Bohemian Switzerland National Park. – In: Härtel H., Cílek V., Herben T., Jackson A. & Williams R. B. G. (eds), Sandstone landscapes, Academia, Praha (in press).

Peksa O., Svoboda D., Palice Z., Dětinský R. & Zahradníková M. (2004): Lišejníky [Lichens]. – In: Papáček M. (ed.), Biota Novohradských hor: modelové taxony, společenstva a biotopy [Biota of the Novohradské hory Mts], p. 100–104 & 293–297, Jihočeská univerzita v Českých Budějovicích.

Pišút I. (2002): Nachträge zur Kenntnis der Flechten der Slowakei. 16. – Zborn. Slov. Nár. Múz., Prír. Vedy 48: 5–11.

Podpěra J. (1928): Die Vegetationsverhältnisse der Pollauer Berge. – Acta Bot. Bohem. 6–7: 77–132.

Podzimek J. (1929): Druhý příspěvek k lichenografii severovýchodních Čech [A second contribution to the lichen diversity of NE Bohemia]. – Čas. Nár. Mus., sect. natur. 103: 44–50 & 134–140.

Poelt J. (1958): Über parasitische Flechten. II. – Planta 51: 288–307.

Poelt J. (1985): *Caloplaca epithallina*. Porträt einer parasitischen Flechte. – Bot. Jahrb. Syst. 107: 457–468.

Poelt J. & Hinteregger E. (1993): Beiträge zur Kenntnis der Flechtenflora des Himalaya. VII. Die Gattungen *Caloplaca*, *Fulgensia* und *Ioplaca* (mit englischem Bestimmungsschlüssel). – Bibl. Lichenol. 50: 1–247.

Randlane T. & Saag A. (eds) (1999): Second checklist of lichenized, lichenicolous and allied fungi of Estonia. – Folia Cryptog. Eston. 35: 1–132.

Santesson R., Moberg R., Nordin A., Tønsberg T. & Vitikainen O. (2004): Lichen-forming and lichenicolous fungi of Fennoscandia. – Museum of Evolution, Uppsala University, Uppsala.

Scholz P. (2000): Katalog der Flechten und flechtenbewohnenden Pilze Deutschlands. – Schr.-Reihe Vegetationsk. 31: 1–298.

Seaward M. R. D. (1996): Checklist of Tunisian lichens. – Bocconea 6: 115–148.

Sérusiaux E., Diederich P., Brand A. M. & van den Boom P. (1999): New or interesting lichens and lichenicolous fungi from Belgium and Luxembourg VIII. – Lejeunia 162: 1–95.

Servít M. (1910): První příspěvek k lichenologii Moravy [A first contribution to the lichen diversity in Moravia]. – Zpr. Kom. Přírod. Prozk. Moravy, sect. bot. 6: 1–83.

Servít M. & Černohorský Z. (1935): Flechten aus Čechoslovakei. IV. Malá Fatra, Velká Fatra und Choč-Gruppe in Slovakei nebst Nachträgen. – Věstn. Král. Čes. Společ. Nauk, cl. math.-natur., Praha, 1934: 1–34.

Søchting U. & Lutzoni F. (2003): Molecular phylogenetic study at the generic boundary between the lichen-forming fungi *Caloplaca* and *Xanthoria* (Ascomycota, *Teloschistaceae*). – Mycol. Res. 107: 1266–1276.

Søchting U. & Stordeur R. (2001): *Caloplaca thuringiaca* sp. nov., a species from the *Caloplaca holocarpa* complex. – Lichenologist 33: 467–472.

Sparrius L. B. & Vervoort M. (2003): A contribution to the lichen flora of East Jutland (Denmark). – Graphis Scripta 14: 59–61.

Stordeur R. (2003): Zur Ökologie und Verbreitung von *Caloplaca thuringiaca*. – Bibl. Lichenol. 86: 453–464.

Suza J. (1921): Čtvrtý příspěvek k lichenologii Moravy [A fourth contribution to the lichen diversity in Moravia] – Sborn. Klubu Přírod. Brno 3: 1–50.

Suza J. (1922): Pátý příspěvek k lichenologii Moravy [A fifth contribution to the lichen diversity in Moravia]. – Sborn. Klubu Přírod. Brno 4: 1–8.

Suza J. (1925): Nástin zeměpisného rozšíření lišejníků na Moravě vzhledem k poměrům evropským [An outline of the distribution of lichens in Moravia with relation to Europe]. – Spisy Přírod. Fak. Masaryk. Univ. Brno 1925/55: 1–152.

Suza J. (1927): Přírodní rezervace u Mohelna [A protected area at Mohelno]. – Příroda, Brno, 20: 239–244.

Suza J. (1931): Srovnávací studie o lišejníkové floře serpentinů (Mohelno, Gurhof a Kraubath) [A comparative study on lichens of serpentinites]. – Sborn. Přírod. Společ. Mor. Ostrava 6: 231–256.

Suza J. (1932a): Lichenes Bohemoslovakiae exsiccati. Fasciculus VII. Decades 19–21. – 4 pp., Brno [Schedae nos. 181–210].

Suza J. (1932b): Über das Vorkommen von *Tessellina pyramidata* Dum., eines mediterranen Lebermooses, in Mähren, Č.S.R. – Bot. Jber. 65: 60–74.

Suza J. (1934): Doplňky k rozšíření lišejníků v Čechách. Část I. [Additions to a distribution of lichens in Bohemia. I.]. – Čas. Nár. Mus., sect. natur. 108: 114–121.

Suza J. (1935): Das xerotherme Florengebiet Südwestmährens (ČSR.). – Beih. Bot. Cbl., sect. B 53: 440–484.

Suza J. (1940): Doplňky k rozšíření lišejníků v Čechách. Část V. [Additions to a distribution of lichens in Bohemia. V.]. – Čas. Nár. Mus., sect. natur. 114: 77–86.

Suza J. (1944): Sedmý příspěvek k lichenologii Moravy [A seventh contribution to the lichen diversity in Moravia]. – Sborn. Klubu Přírod. Brno 25: 78–89.

Suza J. (1947): Praebohemicum a lišejníky [Praebohemicum and lichens]. – Věstn. Král. Čes. Společ. Nauk, cl. math.-natur. 1946/1: 1–34.

Svoboda D. (2007): Lichens of the central part of the Bohemian karst. – Novit. Bot. Univ. Carol. (in press).

Thor G. & Nordin A. (1998): 16 lichens new to Estonia. – Folia Cryptog. Estonica 32: 123–125.

Tønsberg T. (1992): The sorediate and isidiate, corticolous, crustose lichens in Norway. – Sommerfeltia 14: 1–331.

Tretiach M., Pinna D. & Grube M. (2003): *Caloplaca erodens* (sect. *Pyrenodesmia*), a newlichen species from Italy with an unusual thallus type. – Mycol. Progr. 2: 127–136.

van den Boom P. P. G. (2005): Contribution to the flora of Portugal, lichens and lichenicolous fungi IV. – Cryptogamie, Mycologie 26: 51–59.

van den Boom P. P. G., Sérusiaux E., Diederich P., Brand M., Aptroot A. & Spier L. (1998): A lichenological excursion in May 1997 near Han-sur-Lesse and Saint-Hubert, with notes on rare and critical taxa of the flora of Belgium and Luxembourg. – Lejeunia 158: 1–58.

van Herk K. (1993): Interessante korstmosvondsten op eiken in Noord- en Oost Nederland. – Buxbaumiella 31: 56–66.

Verseghy K. (1971): *Gasparrinia*-Arten in Ungarn. II. Systematischer Teil (Erste Hefte). – Bot. Közlem. 58: 21–28.

Vězda A. (1961): Třetí příspěvek k rozšíření lišejníků v Jeseníku [A third contribution to the lichen diversity in the Jeseník Mts]. – Přírod. Čas. Slez. 22: 447–458.

Vězda A. (1970): Neue oder wenig bekannte Flechten in der Tschechoslowakei. I. – Folia Geobot. Phytotax. 5: 307–337.

Vězda A. (1996): Reliquiae Suzaianae e Museo Nationali Pragensi anno 1966 distributae (Nr. 1–100). – Praha. [schedae]

Vězda A. (1998): Flóra lišejníků v oblasti vlivu energetické soustavy Dukovany–Dalešice [Lichen flora in the area influenced by the Dukovany-Dalešice energy complex]. – Přírod. Sborn. Západomorav. Muz. Třebíč 30: 77–120.

Vězda A. & Gruna B. (2000): Lišejníky [Lichens]. – In: Antonín V., Gruna B., Hradílek Z., Vágner A. & Vězda A. (eds), Houby, lišejníky a mechorosty Národního Parku Podyjí [Mycobiota, lichens and bryophytes of the Podyjí National Park], p. 97–160, Masaryk. Univ. Brno.

Vězda A. & Liška J. (1999): Katalog lišejníků České republiky [A catalogue of lichens of the Czech Republic] – Botanický ústav AV ČR, Průhonice.

Vondrák J. (2005): *Caloplaca crenulatella*, *Rinodina pityrea* and *Verrucaria macrostoma* f. *furfuracea* – three taxa of lichenised fungi new to Romania. – Contr. Bot. 39: 37–39.

Vondrák J. (2006): Lišejníky chráněného území Vyšenské kopce u Českého Krumlova [Lichen-forming fungi of the protected area Vyšenské kopce near Český Krumlov (southern Bohemia)]. – Bryonora 37: 9–18.

Vondrák J. & Hrouzek P. (2006): *Caloplaca soralifera*, a newspecies from Europe. – Graphis Scripta 18: 6–15.

Vondrák J. & Palice Z. (2004): Lichenologicky významná lokalita Zábrdská skála v Prachatickém Předšumaví [A lichenologically outstanding locality "Zábrdská skála" in the northern foothills of the Bohemian Forest Mts (Czech Republic)]. – Bryonora 33: 22–26.

Vondrák J. & Slavíková-Bayerová Š. (2006): Contribution to the lichenized and lichenicolous fungi in Bulgaria. II, the genus *Caloplaca*. – Mycol. Balcan. 3: 61–69.

Wade A. E. (1965): The genus *Caloplaca* Th. Fr. in the British Isles. – Lichenologist 3: 1–28.

Wetmore C. M. (1996): The *Caloplaca sideritis* group in North and Central America. – Bryologist 99: 292–314.

Wetmore C. M. (2001): The *Caloplaca citrina* group in North and Central America. – Bryologist 104: 1–11.

Wetmore C. M. (2004a): The isidiate corticolous *Caloplaca* species in North and Central America. – Bryologist 107: 284–292.

Wetmore C. M. (2004b): The sorediate corticolous species of *Caloplaca* in North and Central America. – Bryologist 107: 505–520.

Wetmore C. M. & Kärnefelt E. I. (1999): What is *Caloplaca cinnabarina*? – Bryologist 102: 683–691.

Wirth V. (1972): Die Silikatflechten-Gemeinschaften im ausseralpinem Zentraleuropa. – Diss. Bot. 17: 1–306.

Wirth V. (1995): Die Flechten Baden-Württembergs, Teil 1 & 2. – Eugen Ulmer, Stuttgart.

Wirth V., Kärnefelt I., Thell A. & Arup U. (2005): *Caloplaca testudinea* V. Wirth & Kärnefelt sp. nov. and *C. rubelliana* (Ach.) Lojka, new to southern Africa. – Mycol. Progr. 4: 299–302.

Received 1 November 2006
Revision received 2 February 2007
Accepted 11 February 2007

APPENDIX 1. – LOCALITIES OF THE TAXA STUDIED.

Caloplaca albolutescens (NYL.) H. OLIVIER

Central Bohemia: Bakov nad Jizerou, railway station, alt. 220 m, 50°28'30"N, 14°25'30"E, on calcareous sandstone SE-exposed rock, 23. 4. 2003, coll. J. Vondrák (CBFS 1053); Bakov nad Jizerou, ruin of Zvířetice castle, alt. 250 m, 50°28'10"N, 14°25'10"E, on calcareous sandstone boulders in ruinwalls, 23. 4. 2003, coll. J. Vondrák (CBFS 1057); Beroun, Křivoklát, in village near castle, 50°02'10"N, 13°52'30"E, on horizontal side of brick in old wall, 23. 3. 2003, coll. J. Vondrák (CBFS 1152); Kladno, Netovice u Slaného, xerothermic slope, ca 600 m NE of village, 50°13'01"N, 14°06'05"E, on sandstone boulder, 12. 7. 2000, coll. J. Zázvorka (hb. Palice 5245); Mělník, Kokořín, ruin of Kokořín castle, alt. 260 m, 50°25'30"N, 14°34'E, on base-enriched sandstone in ruin wall, 12. 5. 2004, coll. J. Vondrák (CBFS 1871); Mělník, Liběchov, in town, alt. 170 m, 50°24'30"N, 14°28'E, on concrete, 12. 5. 2004, coll. J. Vondrák (CBFS 1893). **Southern Bohemia**: Písek, in town, alt. 370 m, 49°18'20"N, 14°09'E, on W-exposed, lime-enriched gneiss outcrops under town walls, 8. 1. 2005, coll. J. Vondrák (CBFS 2492). Southern Moravia: Kyjov, Milotice, on horizontal side of bricks in old wall, 2. 7. 2003, coll. J. Vondrák (CBFS 1307).

Caloplaca biatorina J. STEINER

Central Bohemia: Beroun, Tmáň, rocks in Kotýz protected area next to limestone quarry Čertovy schody, alt. 300-350 m, on sun-exposed limestone rock, 19. 7. 2006, coll. J. Vondrák (CBFS 4836, subsp. *biatorina*). **Southern Moravia**: Mikulov, limestone rocks under Svatý kopeček hill, ca 0.2 km E of town, alt. 290 m, 48°48'13.9"N, 16°38'28.9"E, on sunny limestone outcrop, 15. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2838; subsp. *biatorina*); Mikulov, Bavory, Tabulová protected area (rocks on W slope of Mt Stolová hora), alt. 445 m, 48°50'22.9"N, 16°38'09.3"E, on sunny limestone outcrop, 15. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2812; subsp. *biatorina*); Znojmo, Čížov, rock in Dyje river valley, under asphaltic road to Hardegg ca 2 km SSE of Čížov, alt. 325 m, 48°51'17.0"N, 15°52'14.8"E, on S-exposed lime-rich rock, 14. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2819, 2850; subsp. *gyalolechioides*).

Caloplaca cerinella (NYL.) FLAGEY

Southern Bohemia: Šumava Mts: Prachatice, near Horní Vltavice, at road, on twigs of *Acer pseudoplatanus*, alt. 880 m, 11. 5. 1996, coll. J. Horáková (PRM 890547); Šumava Mts: Volary, alley of old trees between Stožec and České Žleby, on bark of old *Fraxinus* together with *Rinodina pyrina*, alt. 850 m, 23. 4. 1994, coll. Z. Palice (hb. Palice 4088); Prachatice, Záblatí, Mlynářovice, above village, alt. ca 1000 m, 48°58'N, 13°52'E, on bark of *Salix caprea*, 29. 7. 2004, coll. J. Vondrák, det. M. Bartoš (CBFS 2277); Prachatice, Záblatí, Řepešín, nearby village, alt. ca 750 m, 49°00'N, 13°55'E, on bark of *Sambucus nigra* with *C. holocarpa*, 29. 7. 2004, coll. J. Vondrák, det. M. Bartoš (CBFS 2486); Protivín, Nuzov, near village, alt. 450 m, 49°14'20"N, 14°15'E, on bark of *Sambucus nigra* with *Lecania cyrtella*, 10. 1. 2003, coll. J. Vondrák (CBFS 1451); Tábor, Opařany, Skrýchov, near village, alt. 500 m, 49°25'30"N, 14°29'40"E, on twigs of *Sambucus nigra*, 8. 5. 2004, coll. J. Vondrák (CBFS 1869).

Caloplaca chlorina (FLOT.) H. OLIVIER

Central Bohemia: Beroun, Křivoklát, in village near castle, 50°02'10"N, 13°52'30"E, on nutrient-rich rock below castle, 23. 3. 2003, coll. J. Vondrák (CBFS 1196); Nový Knín, Velká Lečice, in valley of Kocába river NE of village, alt. 241 m, 49°49'47.5"N, 14°20'57.5"E, on sunny base of bulky trunk of *Ulmus laevis*, 30. 12. 2004, coll. J. Vondrák (CBFS 2513); Rakovník, Kalubice, in village, alt. 370 m, 50°03'N, 13°49'40"E, on schist stone, 12. 9. 2003, coll. J. Vondrák (CBFS 1320); Ibid., on old iron on agricultural machine, 5. 9. 2004 (CBFS 2166); Rakovník, Skryje, locality "Kouřimecká rybárna" ca 4 km NE of village, alt. 257 m, 49°59'29.4"N, 13°47'18.6"E, on remote volcanic stones around old settlement, 24. 4. 2005, coll. J. Vondrák & J. Liška (CBFS 2858); Rakovník, Skryje, ruin of Týřov castle, alt. 295 m, 49°58'24.6"N, 13°47'24.1"E, on half-shaded andesite rock, 22. 3. 2005, coll. J. Vondrák (CBFS 2764); Ibid., on bark of *Fraxinus excelsior*, 23. 4. 2005, coll. J. Vondrák (CBFS 2982); Sedlčany, Kamýk nad Vltavou,Velká, in Vltava river valley, N of village, alt. 278 m, 49°39'53.0"N, 14°14'55.2"E, on large granite stones, 14. 5. 2002, coll. J. Vondrák (CBFS 2957). **Northern Bohemia**: Česká Lípa, Bezděz: scree forest at SSW-facing slope below castle-ruin, 50°32.33'N, 14°43.22'E, on vertical part of shaded phonolite boulder, alt. 590 m, 4. 6. 2004, coll. Š. Bayerová & Z. Palice (hb. Palice 9209); Jablonec n. Nisou, Bedřichov, in village, at pond, on stone wall by side of waterfall, on granite, alt. 750 m, MTB 5256 B, 16. 7. 2001, coll. J. Kocourková (PRM 895910). **Southern Bohemia**: Český Krumlov, rock on top of hill Kleť, alt. 1080 m, S exp., 48°52'N, 14°17'10"E, on horizontal to overhanging rock, 9. 6. 2004, coll. J. Vondrák (CBFS 1971); Husinec, in Blanice river valley, under dam of "Husinecká přehrada" water reservoir, alt. 520 m, 49°02'20"N, 13°59'40"E, on granitic stones in steep concrete wall near river, 29. 6. 2004, coll. J. Vondrák (CBFS 1982); Milevsko, Chyšky, Střítež, in village, alt. 550 m, 49°30'N, 14°25'30"E, wet stones at base of old stony wall, 10. 9. 2004, coll. J. Vondrák (CBFS 2056); Novohradské hory Mts: Pohoří na Šumavě, near cemetery in village, alt. 905 m, on bark of *Acer platanoides*, 6. 7. 2005, coll. Z. Palice (hb. Palice 8906); Písek, in town, alt. 370 m, 49°18'20"N, 14°09'E, on W-oriented lime-enriched gneiss outcrops under town walls, 15. 5. 2003, coll. J. Vondrák (CBFS 1421, 2506); Písek, Zvíkovské Podhradí, Zvíkov castle, alt. 360 m, 49°26'20"N, 14°11'40"E, on stone in castle-wall, 8. 2. 2004, coll. J. Vondrák (CBFS 1279); Prachatice, Husinec, Výrov, in village, alt. 520 m, 49°03'00"N, 13°59'50"E, on gneiss stone in N-facing wall, 5. 6. 2003, J. Vondrák (CBFS 1292); Ibid., 4. 9. 2003 (CBFS 1323); Šumava Mts: Frymburk, Vítkův kámen, area of castle ruin, alt. 1030 m, on bark of *Acer platanoides*, 19. 4. 1997, coll. Z. Palice (hb. Palice); Šumava Mts: Volary, by road between villages České Žleby and Hliniště, alt. ca 850 m, on bark of *Acer pseudoplatanus*, 23. 6. 1995, coll. R. Dětinský, J. Horáková & Z. Palice (hb. Palice); Šumava Mts: Kvilda, at road-side, direction to Horská Kvilda near the turn of the blue marked tourist line, alt. 1065-1070 m, 49°02'N, 13°35'E, on bark of *Populus* sp., 22. 10. 2003, coll. Z. Palice (hb. Palice 8160); Týn nad Vltavou, in town, alt. 360 m, 49°13'30"N, 14°24'40"E, on upper side of brick wall, 29.4.2004, coll. J. Vondrák (CBFS 1770); Vimperk, Onšovice, Spulka river, alt. 590 m, 49°06'10"N, 13°46'E, on gneiss stones at river bank, 11. 6. 2003, coll. J. Vondrák (CBFS 1193). **Western Bohemia**: Karlovy Vary, Andělská Hora, ruin of medieval castle N of village, alt.

700 m, 50°12'20"N, 12°58'E, basaltic, S-oriented rock beneath castle, 21. 3. 2003, coll. J. Vondrák (CBFS 1103); Konstantinovy Lázně, Krasíkov, ruin of Krasíkov castle, alt. ca 600 m, 49°52'30"N, 12°57'E, on basaltic stones beneath ruin wall, 1. 11. 2004, coll. J. Vondrák (CBFS 2294); Šumava Mts: Kašperské Hory, Modrava, on top of Mt Medvěd, alt. 1130 m, on bark of *Acer pseudoplatanus* with *Bacidia beckhausii* and *Rinodina* cf. *exigua*, 1983, coll. J. Liška (hb. Liška, CBFS 2921); Šumava Mts: Prášily, Nová Hůrka, on solitary *Acer pseudoplatanus* at roadside (abundant on base of trunk), 23. 5. 1996, coll. Z. Palice (hb. Palice); Šumava Mts: Modrava, Javoří Pila, Medvědí hřbet (just W of Mt Medvěd) – a spruce plantation with dispersed old maples, alt. 1140 m, 49°00.38'N, 13°24.79'E, on bark of *Acer pseudoplatanus* snag, 26. 10. 2005, coll. F. Bouda, Z. Palice, O. Peksa & J. Steinová (hb. Palice 9335); Šumava Mts: Modrava, Modravské slatě, S-SE of Javoří slať bog, ca 0.8 km W of Smrkový vrch, spruce forest around a brooklet, alt. 1100 m, 49°01.72'N, 13°24.78'E, on bark of solitary *Acer pseudoplatanus*, 27. 6. 2006, coll. A. Kučera, E. Loskotová, Z. Palice & O. Peksa (hb. Palice 10901, 10902); Šumava Mts: Modrava, well-lit mixed forest in a saddle area NE of spot height 1132.6 m, 4 km WSW of village, alt. 1120 m, 49°00.96'N, 13°26.61'E, on bark of solitary old *Acer pseudoplatanus*, 28. 6. 2006, coll. E. Loskotová, Z. Palice & O. Peksa (hb. Palice 10909). **Southern Moravia**: Kyjov, Milotice, on top of brick wall, 2. 7. 2003, coll. J. Vondrák (CBFS 1373); Kroměříž, Buchlov castle, on sandstone boulder in shaded wall and on concrete, 5. 7. 2003, coll. J. Vondrák (CBFS 1294); Velká nad Veličkou, Vápenky, locality "Kamenná búda", 3 km NE from village, 48°53'30"N, 17°39'30"E, bark of old oak on road bifurcation, 29. 5. 2002, coll. J. Vondrák (CBFS 548).

Caloplaca chrysodeta (Vain. ex Räsänen) Dombr.

Central Bohemia: Beroun, Křivoklát, protected area Brdatka (rocks 2 km NE of village), alt. 300 m, 50°03'N, 13°53'40"E, under overhanging rock on lime-rich schist, 13. 12. 2004, coll. J. Vondrák (CBFS 2439); Beroun, Srbsko, rocks in bottom of Císařská rokle gorge ca 1-1.5 km S of village, alt. 230-320 m, on shaded dry limestone underhang, 20. 5. 2006, coll. J. Vondrák (CBFS 4443); Rakovník, Roztoky, U Eremita nature reserve, in slope above right bank of Berounka river, on base rich shale, 300 m, MTB 5949 C17, 25. 4. 1997, coll. J. Kocourková (PRM 907177); Ibid., 25. 4. 2005, coll. J. Vondrák (CBFS 2953). **Eastern Bohemia**: Choceň, Bezpráví, in Tichá Orlice river valley, alt. ca 320 m, on medium-lit vertical face of soft cretaceous limestone rock, 31. 7. 2005, coll. J. Vondrák (CBFS 3032); Náchod, 2 km NE of Nové Město n. Metují, valley of Metuje river, by path leading to Peklo settlement, 320 m, MTB 6356 A, on underhanging rock, on calcareous phyllite, 21. 4. 2001, coll. J. Kocourková & F. Berger (PRM 895845); Krkonoše Mts: Obří důl valley, Rudník, alt. ca 1150 m, 50°43.84'N, 15°43.93'E, on crystalline limestone outcrop above left bank of Rudný potok brook, 9. 6. 2005, coll. Z. Palice & Š. Bayerová (hb. Palice 9096). **Western Bohemia**: Šumava Mts, Železná Ruda, glacial cirque of Černé jezero lake, alt. ca 1230 m, on very shaded mica-schist overhang, 23. 10. 1996, coll. Z. Palice (PRC). **Northern Moravia**: Bystřice pod Hostýnem, Chvalčov, woodland of Smrdutá protected area, alt. 616 m, 49°20'38.0"N, 17°58'59.8"E, under overhanging sandstone rock, enriched by lime from carbonate inclusions, 16. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2855); Bystřice pod Hostýnem, Hostýnské vrchy Mts, near Čerňava virgin forest, alt. 580 m, on vertical face of concrete wall, 12. 5. 1995, coll. B. Gruna & Z. Palice (hb. Palice); Jeseník, Lipová Lázně, locality "Na Pomezí", alt. ca 600 m, 50°14'40"N, 17°08'20"E, on shaded, crystalline limestone rock in beech forest, 24. 4. 2004, coll. J. Vondrák (CBFS 1729). **Southern Moravia**: Blansko, 2 km W of Vilémovice, Vývěry Punkvy national nature reserve, Suchý žleb glen, above locality "Mastný flek", 49°21'40"N, 16°43'10"E, scree forest on S-facing slope, alt. 430 m, MTB 6666 A13, on calcareous outcrop, 16. 5. 2003, coll. J. Kocourková (PRM 907063); Blansko, 2.5 km W of Vilémovice, Vývěry Punkvy national nature reserve, Kateřinská jeskyně cave, S-facing vertical wall of calcareous rock at entrance to cave, alt. 400 m, MTB 6666 A13, on limestone, 17. 5. 2003, coll. J. Kocourková (PRM 907173); Blansko, Ostrov u Macochy, Pustý žleb valley, on shaded vertical limestone rock, with *Botryolepraria lesdainii*, 15. 5. 2004, coll. J. Vondrák (CBFS 1896); Brno, Ochoz u Brna, mouth of Pekárna cave, on limestone rock, 14. 5. 2004, coll. J. Vondrák (CBFS 1799); Brno, W of Veverská Bítýška, NW part of Brněnská přehrada water basin, Jelení žlíbek nature reserve, alt. 380 m, 49°16'28"N, 16°27'27"E, MTB 6763 B, on conglomerate rock at nature trail, 25. 6. 2005, coll. J. Kocourková & A. Vězda (PRM 907170); Znojmo, Čížov, rock in Dyje river valley, under asphaltic road to Hardegg ca 2 km SSE of Čížov, alt. 325 m, 48°51'17"N, 15°52'14.8"E, on overhanged lime-rich rock, 14. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2817).

Caloplaca crenulatella (Nyl.) H. Olivier

Central Bohemia: Bakov nad Jizerou, railway station, alt. 220 m, 50°28'30"N, 14°25'30"E, on concrete and on calcareous sandstone SE-exposed rock, 23. 4. 2003, coll. J. Vondrák (CBFS 1056, 1060); Beroun, Hudlice, small, sunny rock in valley of Libotický potok brook, ca 300 m ESE of Stará Ves protected area, alt. 295 m, 49°57'39.4"N, 13°59'54.7"E, on lime-rich, S-exposed diabase rock, 22. 4. 2005, coll. J. Vondrák (CBFS 2851); Beroun, Králův Dvůr, Trubín, S-exposed rocks in Trubínský vrch protected area, alt. 330-350 m, 49°56'40"N, 13°59'40"E, on basaltic rock, 25. 7. 2004, coll. J. Vondrák (CBFS 2380); Beroun,

Křivoklát, Amalín, in village, 50°02'10"N, 13°53'E, on concrete, 23. 3. 2003, coll. J. Vondrák (CBFS 1150); Beroun, Roztoky u Křivoklátu, WSW-exposed rocks "Na andělu", 1 km SW of village, alt. 250 m, 50°01'10"N, 13°51'40"E, on horizontal side of concrete wall beneath rock, 1. 6. 2003, coll. J. Vondrák (CBFS 1213); Beroun, Srbsko, S-exposed rocks in Koda protected area ca 1.5 km SW of village, alt. 300-350 m, 49°56'N, 14°08'E, on hard limestone rock, with *C. dolomiticola* s.l. and *C. marmorata*, 23. 7. 2004, coll. J. Vondrák (CBFS 2613); Beroun, Zdice, near railway station, alt. 260 m, 49°54'30"N, 13°59'E, on concrete, 26. 9. 2004, coll. J. Vondrák (CBFS 2297); Beroun, Zdice, S-facing rock on W edge of town, alt. 300 m, 49°54'30"N, 13°58'20"E, on sunny rock of basalt (diabase), with *Staurothele frustulenta*, 11. 9. 2003, coll. J. Vondrák (CBFS 1368); Hořovice, Točník, in village, 340 m, 49°53'20"N, 13°53'10"E, on horizontal side of concrete, 31. 5. 2003, coll. J. Vondrák (CBFS 1210); Mělník, Liběchov, Rimáň, in village, alt. 260 m, 50°24'30"N, 14°29'E, on concrete, 12. 5. 2004, coll. J. Vondrák (CBFS 1895); Milín, Solenice, rocks on left side of Vltava river, 1 km NE of village, alt. 300-400 m, 49°37'35"N, 14°12'20"E, on well-lit S-exposed base-rich rock, 6. 12. 2002, coll. J. Vondrák (CBFS 910); Praha, near Nová Ves settlement, Prokopské údolí valley, "Hemrovy skály" diabase rocks, on S-facing slope below steppe, alt. 280 m, MTB 5952, on low outcrop, 18. 4. 1988, coll. J. Horáková (PRM 760590, in specimen of *Caloplaca teicholyta*); Ibid., 24. 9. 1999, coll. J. Kocourková (PRM 761628); Praha, Podbaba, left bank of Vltava river, S-facing slope with low outcrops, alt. 250 m, MTB 5852 C, on small scree, on slightly calcareous pebbles, 1. 10. 2002, coll. J. Kocourková (PRM 907172); Praha, Trója, at canoe slalom course, on top of concrete post, alt. 178 m, MTB 5852, 24. 10. 1997, coll. J. Kocourková (PRM 760652); Příbram, in town, near Railway station, on horizontal face of concrete, coll. J. Vondrák (CBFS 2852); Příbram, Jince, in village, on asphalt in pathway, 31. 5. 2003, coll. J. Vondrák (CBFS 1183); Rakovník, Kalubice, in village, alt. 370 m, 50°03'N, 13°49'40"E, on mortar, 12. 9. 2003, coll. J. Vondrák (CBFS 1316, 1317) and on concrete wall, with *Aspicilia moenium*, 14. 4. 2004, coll. J. Vondrák (CBFS 1732); Rakovník, Skryje, "Jankovský mlýn" water-mill, alt. 310 m, 49°56'05"N, 13°44'50"E, on concrete wall, 21. 9. 2004, coll. J. Vondrák (CBFS 2069); Rakovník, Skryje, ruin of Týřov castle, alt. 295 m, 49°58'24.6"N, 13°47'24.1"E, on lime-enriched andesite rock under ruin walls, on sunny S-exposed slope, 22. 3. 2005, coll. J. Vondrák (CBFS 2760). **Northern Bohemia**: Lovosice, Třebenice, ruin of Košťál castle, 2 km N of village, alt. 470 m, 50°29'30"N, 13°59'10"E, on basaltic, S-oriented rock beneath castle, 9. 5. 2003, coll. J. Vondrák (CBFS 1111); Lovosice, Třebenice, Vlastislav, ruin of Skalka castle, alt. 310 m, 50°30'N, 13°58'E, on base-rich, soft inclusion in basaltic rock, with *Rinodina gennarii*, 9. 5. 2003, coll. J. Vondrák (CBFS 1142). **Southern Bohemia**: Bechyně, military airport SE of town, alt. 440 m, 49°17'N, 14°30'E, on horizontal side of concrete wall, 9. 9. 2004, coll. J. Vondrák (Sel. Exsic. of *Caloplaca*, no 21); České Budějovice, in town, alt. 390 m, 48°58'41"N, 14°27'30"E, on concrete wall, 20. 1. 2003 and 9. 4. 2003, coll. J. Vondrák (CBFS 964, 989, 986); České Budějovice, park Stromovka, alt. 390 m., 48°58'20"N, 14°27'30"E, on concrete wall, 1. 4. 2003, coll. J. Vondrák (CBFS 959); České Budějovice, Křemže, rocky outcrops S of town, alt. 510 m, 48°54'15"N, 14°18'40"E, on S-exposed serpentinite outcrop, 8. 11. 2003, coll. J. Vondrák (CBFS 1402); Kaplice, Benešov nad Černou, in town, alt. 670 m, on concrete, 27. 9. 2004, coll. J. Vondrák (CBFS 2334); Milevsko, northern edge of town, alt. 450 m, 49°28'N, 14°22'E, concrete on pond-dam, 1. 5. 2004, coll. J. Vondrák (CBFS 1757); Písek, in town, alt. 370 m, 49°18'20"N, 14°09'E, on W-oriented lime-enriched gneiss outcrops under town walls and on concrete, 15. 5. 2003, coll. J. Vondrák (CBFS 1171, 1413); Písek, Mirovice, "Nerestský lom" quarry, 49°30'30"N, 14°04'E, on limestone rock, 26. 8. 2003, coll. J. Vondrák (CBFS 1335); Písek, Protivín, Čačárky, 49°12'10"N, 14°13'40"E, on concrete, 3. 5. 2003, coll. J. Vondrák (CBFS 1051); Písek, Zvíkovské Podhradí, Zvíkov castle, alt. 360 m, 49°26'20"N, 14°11'40"E, on walls of castle, 4. 8. 2003, coll. J. Vondrák (CBFS 1285); Prachatice, Husinec, near town, alt. 480 m, on concrete, 23. 5. 2003, coll. J. Vondrák (CBFS 1168); Prachatice, Husinec, Těšovice, railway station, alt. 480 m, 49°02'40"N, 14°01'40"E, on concrete, with *Candelariella aurella*, 23. 5. 2003, coll. J. Vondrák (CBFS 1167); Prachatice, Husinec, Výrov, in village, alt. 507 m, 49°02'56.9"N, 13°59'47.9"E, vertical side of concrete panel, with *Caloplaca teicholyta*, 25. 12. 2004, J. Vondrák (CBFS 2523); Vimperk, Onšovice, rocky slopes on left side of Spulka river, alt. 610-630 m, 49°06'30"N, 13°46'E, on S-exposed crystalline limestone outcrop, 1. 2. 2004, coll. J. Vondrák (CBFS 1555); Vodňany, Čičenice, railway station, alt. 390 m, 49°09'30"N, 14°13'20"E, on concrete wall, 14. 4. 2003, coll. J. Vondrák (CBFS 966). **Western Bohemia**: Karlovy Vary, Andělská Hora, in village, alt. ca 620 m, 50°12'20"N, 12°58'E, on concrete wall, 21. 3. 2003, coll. J. Vondrák (CBFS 1407). **Northern Moravia**: Javorník ve Slezsku, railway station, alt. ca 300 m, 50°23'30"N, 17°01'E, pieces of slag in railway-line, with *Caloplaca citrina* and *C. soralifera*, 23. 4. 2004, coll. J. Vondrák (CBFS 1727); Vsetín, in town, on bank of Bečva river, 49°20'23"N, 17°59'44"E, on concrete, 15. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2821). **Southern Moravia**: Blansko, 2 km W of Vilémovice, Suchý žleb glen, above locality "Mastný flek", 49°21'40"N, 16°43'10"E, scree forest on S-facing slope, alt. 450 m, MTB 6666 A13, on semishady calcareous outcrop in *Antherico-Coryletum*, 16. 5. 2003, coll. J. Kocourková (PRM 907074); Ivančice, Biskoupky, in Jihlava river valley, alt. ca 250 m, on loess with *Endocarpon pusillum*, 1971, coll. A. Vězda (hb. Vězda: Lich. Bohemoslov. 15653, sub *C. ferrarii*); Ivančice, Řeznovice, in Jihlava river valley, alt. ca 250 m, on loess, 1969, coll. A. Vězda (hb. Vězda: Lich. Bohemoslov. 15652, sub *C. ferrarii*); Kroměříž, Buchlov castle, on sunny sandstone rock, 5. 7. 2003, coll. J. Vondrák (CBFS 1297, 1299); Kyjov, Milotice, horizontal side of bricks in wall, 2. 7. 2003, coll. J. Vondrák (CBFS 1361); Mikulov, rocks on E slope of Kozí hrádek ruin, on limestone rock, 19. 5. 2004, coll. J. Vondrák (CBFS 1849); Mikulov, Kočičí kámen protected area (rock ca 2 km N of town), alt. 345 m, 48°49'49.9"N, 16°38'12.7"E, on sunny limestone outcrop, 15. 4. 2005, coll. J. Vondrák & J. Šoun (2820); Mikulov, Svatý kopeček hill, 0.3 km E of town, 48°48'30"N, 16°39'05"E, on hard limestone

boulder, 24. 2. 2002, coll. J. Vondrák (CBFS 262); Mikulov, Sedlec, locality Skalky, 1.5 km SW of village, 48°53'40"N, 16°40'30"E, on soft limestone boulder, 23. 2. 2002, coll. J. Vondrák (CBFS 272, 1600); Tišnov, near Drásov, Drásovský kopeček hill, alt. 325 m, MTB6664 D, on calcareous rock, 1. 8. 1988, coll J. Horáková (PRM 887688); Vyškov, airport, on asphalt and concrete, 3. 7. 2003, coll. J. Vondrák (CBFS 1302, 1304); Znojmo, Čížov, S-exposed slope in Dyje river valley, above asphaltic road to Hardegg ca 2 km SSE of Čížov, alt. 350 m, 48°51'17.8"N, 15°52'09.7"E, on base of *Quercus robur* trunk, 14. 4. 2005, J. Vondrák & J. Šoun (CBFS 2845).

Caloplaca dichroa ARUP

Central Bohemia: Beroun, Srbsko, lower part of S-exposed rocks in Koda protected area ca 1.5 km SW of village, alt. 280-330 m, on limestone rock, 21. 5. 2006, coll. J. Vondrák (CBFS 4433). **Southern Bohemia**: České Budějovice, Brloh, Kuklov, in village, 48°55'50"N, 14°11'10"E, on mortar, 7. 2. 2002, coll. J. Vondrák (CBFS 241); České Budějovice, Křemže, graveyard N of town, 48°54'30"N, 14°18'20"E, concrete on old wall, 7. 2. 2002, J. Vondrák (CBFS 332, sub *C. coronata*); České Budějovice, Křemže, Holubov, Holubovské hadce protected area, alt. 470 m, 48°53'40"N, 14°20'20"E, on serpentinite outcrop, 9. 6. 2004, coll. J. Vondrák (CBFS 1962, sub *C. citrina*); Písek, Mirovice, "Nerestský lom" quarry, 49°30'30"N, 14°04'E, on limestone rock, 26. 8. 2003, coll. J. Vondrák (CBFS 1312, sub *C. flavogranulosa*); Týn nad Vltavou, in town, alt. 360 m, 49°13'30"N, 14°24'40"E, upper side of brick wall, 29. 4. 2004, coll. J. Vondrák (CBFS 1773, sub *C. citrina*). **Southern Moravia**: Kyjov, Milotice, upper side of brick wall, 2. 7. 2003, coll. J. Vondrák (CBFS 1308, sub *C. citrina*); Mikulov, Sedlec, Skalky protected area 1.5 km SW of village, 48°53'40"N, 16°40'30"E, on soft limestone boulder, 23. 2. 2002, coll. J. Vondrák (CBFS 245, sub *C. coronata*; 255, sub *C. citrina*).

**Caloplaca epithallina* LYNGE

Eastern Bohemia: Krkonoše Mts: N-facing slope of Mt Sněžka, carling at stairs, alt. 1510 m, MTB 5260 C, on mica schist rock, on thallus of *Lecanora polytropa*, 10. 5. 2002, coll. M. Skalka, det. J. Kocourková (PRM907178).

**Caloplaca erodens* TRETIACH, PINNA ET GRUBE

Central Bohemia: Beroun, Srbsko, lower part of S-exposed rocks in Koda protected area ca 1.5 km SW of village, alt. 280-330 m, on limestone rock, 21. 5. 2006, coll. J. Vondrák (CBFS 4434); Beroun, Srbsko, rocks ca 1 km NE of village center, 49°56'33.13"N, 14°08'33.32"E, on sun-exposed vertical-faced hard limestone rock, 21. 12. 2006, coll. J. Vondrák (CBFS 4918); Beroun, Svatý Jan pod Skalou,W-exposed rock E of village, alt. ca 350 m, on sunny limestone rock, 30. 9. 2005, coll. J. Vondrák (CBFS 3242); Beroun, Tmáň, rocks in protected area Kotýz next to limestone quarry Čertovy schody, alt. 300-350 m, on calcareous rock under overhang, 19. 7. 2006, coll. J. Vondrák (CBFS 4855). **Southern Moravia**: Dolní Věstonice, Pavlov, crest of Děvín towards Soutěska saddle, alt. 450 m, on exposed limestone rock, 13. 10. 2001, coll. L. Bičanová & Z. Palice (hb. Palice 8716); Mikulov, Bavory, protected area Tabulová, rocks on SW slope of Mt Stolová hora, alt. 375 m, 48°50'11.5"N, 16°38'14.8"E, on sunny limestone rock, affected by non-described *Opegrapha*, 15. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2839); Mikulov, northern peak of Mt Šibeničník ca 2 km S of town, alt. 249 m, 48°47'21.5"N, 16°37'48"E, on SW exposed limestone outcrop, affected by non-described *Opegrapha*, 14. 4. 2005, J. Vondrák & J. Šoun (CBFS 2849); Mikulov, limestone rocks under Svatý kopeček hill, ca 0.2 km E of town, 48°48'29"N, 16°39'00"E, 19. 5. 2004, coll. J. Vondrák, J. Šoun & M. Bartoš (CBFS 1529, Sel. Exsic. of *Caloplaca*, no 10); Mikulov, rocks on E slope of Kozí hrádek ruin, 19. 5. 2004, coll. J. Vondrák, J. Šoun & M. Bartoš (CBFS 1817); Mikulov, Svatý kopeček hill, 0.3 km E of town, 48°48'30"N, 16°39'05"E, 21. 8. 2002, coll. J. Vondrák, J. Šoun & M. Bartoš (CBFS 1839); Mikulov, Klentnice, ruin of Sirotčí hrádek castle, 20. 5. 2004, coll. J. Vondrák, J. Šoun & M. Bartoš (CBFS 1831); Mikulov, Klentnice, E slope of Mt Tabulová hora, 20. 5. 2004, coll. J. Vondrák, J. Šoun & M. Bartoš (CBFS 1838); Mikulov, Pavlov, ruin of Děvičky castle, ca 1 km W of village, alt. 422 m, 48°52'32.9"N, 16°39'41.6"E, onW-exposed limestone rock, affected by non-described *Opegrapha*, 15. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2829, 2831).

Caloplaca flavocitrina (NYL.) H. OLIVIER

Central Bohemia: Bakov n. Jizerou, ruin of Zvířetice castle, alt. 250 m, 50°28'10"N, 14°25'10"E, on calcareous sandstone boulders in walls, 23. 4. 2003, coll. J. Vondrák (CBFS 1058); Beroun, Hudlice, small, sunny rock in valley of Libotický potok

brook, ca 300 m ESE of protected area Stará Ves, alt. 295 m, 49°57'39.4"N, 13°59'54.7"E, on lime-rich S-exposed diabase rock, with *Lecania inundata*, 22. 4. 2005, coll. J. Vondrák (CBFS 2805); Beroun, Křivoklát, in village near castle, 50°02'10"N, 13°52'30"E, on bricks in old wall and on nutrient-rich rock under castle, 23. 3. 2003, coll. J. Vondrák (CBFS 1148, 1195); Praha, Jinonice, in quarry Kační, alt. 250 m, MTB 5952 C03, on diabase outcrop, 2. 11. 1999, coll. J. Kocourková (PRM 907165); Praha, Malá Chuchle, in forest Chuchelský háj, alt. 240 m, MTB 5952 C12, on calcareous rock at small brook, 6. 5. 1996, J. Horáková, det. J. Vondrák (PRM 758304); Rakovník, valley of Rakovnický stream, near Dolní Chlum, at path, on railway viaduct wall, alt. 300 m, MTB 5948 B12, on mortar, 3. 1. 1998, coll. J. Kocourková & P. Kocourek, det. J. Vondrák (PRM 892486); Rakovník, Kalubice, in village, alt. 370 m, 50°03'N, 13°49'40"E, on mortar, 31. 5. 2003, coll. J. Vondrák (CBFS 1185) and on base of old trunk of *Fraxinus excelsior*, 7. 1. 2005, J. Vondrák (CBFS 2531); Rakovník, Skryje, locality "Kouřimecká rybárna" ca 4 km NE of village, alt. 257 m, 49°59'29.4"N, 13°47'18.6"E, on bark and thin twigs of *Sambucus nigra*, 24. 4. 2005, J. Vondrák & J. Liška (CBFS 2822, 2835); Rakovník, Skryje, ruin of Týřov castle, alt. 295 m, 49°58'24.6"N, 13°47'24.1"E, on lime-enriched andesite rock under ruin walls, on sunny S-exposed slope, with sterile *C. chlorina* and on base of trunk of *Fraxinus excelsior* with sterile *Rinodina pityrea*, 22. 3. 2005, coll. J. Vondrák (CBFS 2756, 2761); Rakovník, Skřiváň, Valachov protected area, 1 km SE from village, in valley of Tyterský potok brook, 50°01'N, 13°46'30"E, on sulphate and carbonate layers in SW-exposed basaltic rock, 16. 9. 2002, coll. J. Vondrák (CBFS 619). **Southern Bohemia**: Bechyně, military airport SE of town, alt. 440 m, 49°17'N, 14°30'E, on horizontal side of concrete wall, with *Staurothele frustulenta*, 9. 9. 2004, coll. J. Vondrák (CBFS 2436); Český Krumlov, Staré Dobrkovice, Kalamandra protected area ca 1 km of village, on old wall built of crystalline limestone and silicate stones (without concrete), 22. 10. 2001, coll. J. Vondrák (CBFS 227); Prachatice, Husinec, Výrov, in village, alt. 530 m., 49°03'00"N, 13°59'50"E, on calcareous mortar on W-oriented wall, under arid conditions, 5. 4. 2003, coll. J. Vondrák (CBFS 962, Sel. Exsic. of *Caloplaca*, no 1); Prachatice, Těšovice, in village, alt. 420 m, 49°03'04.2"N, 14°01'21.5"E, on vertical side of S-exposed concrete wall, 3. 1. 2005, coll. J. Vondrák (CBFS 2520); Vodňany, Číčenice, railway station, alt. 390 m, 49°09'30"N, 14°13'20"E, on vertical W-oriented side of concrete wall, 14. 12. 2004, coll. J. Vondrák (CBFS 2473). **Western Bohemia**: Radnice, Bohy, ruin of Krašov castle in valley of Berounka river, alt. 300 m, 49°57'N, 13°35'30"E, on schist stone in wall of ruin, 14. 9. 2003, coll. J. Vondrák (CBFS 1336). **Southern Moravia**: Znojmo, Čížov, S-exposed slope in Dyje river valley, above asphaltic road to Hardegg ca 2 km SSE of Čížov, alt. 350 m, 48°51'17.8"N, 15°52'09.7"E, on base of trunk of *Quercus robur* trunk and on wooden remains of plants, 14. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2844, 2846).

Caloplaca herbidella (HUE) H.MAGN.

Northern Moravia: Jeseníky Mts, old-growth mixed forest with beech prevailing beneath Františkova myslivna (Bučina nature reserve), alt. 1050-1100 m, on bark of *Ulmus glabra*, 9. 6. 2002, coll. J. Halda & Z. Palice (hb. Palice 6701).

**Caloplaca inconnexa* (NYL.) ZAHLBR.

Central Bohemia: Beroun, Svatý Jan pod Skalou,WSW-facing xerothermic slope, steppe below view-point, alt. 380 m, 49°58'11"N, 14°08'13"E, associated with *Verrucaria* sp. on loose limestone pebble, 21. 4. 2005, coll. J. Halda & Z. Palice (hb. Palice 8843); Ibid., on *Acarospora cervina*, 30. 9. 2005, coll. J. Vondrák (CBFS 3240); Beroun, Tmáň, rocks in Kotýz protected area next to limestone quarry Čertovy schody, alt. 300-350 m, on limestone rock, locally parasitic on *Lobothallia radiosa*, 19. 7. 2006, coll. J. Vondrák (CBFS 4841); Praha, near Nová Ves settlement, Prokopské údolí valley, above "Bílé skály" calcareous rocks, on low calcareous outcrops of rocks at upper edge of rocks, alt. 300 m, MTB 5952, on thallus of *Acarospora cervina*, 24. 9. 1999, coll. J. Kocourková (PRM 907167). **Southern Moravia**: Mikulov, northern peak of Mt Šibeničník ca 2 km S of town, alt. 249 m, 48°47'21.5"N, 16°37'48.0"E, on SW-exposed limestone outcrop, parasitic on *Acarospora cervina*, 14. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2848); Mikulov, southern peak of Mt Šibeničník ca 2 km S of town, alt. 238 m, 48°47'15.2"N, 16°37'48.0"E, on flat limestone outcrop, parasitic on *Acarospora cervina*, 14. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2800); Mikulov, limestone rocks under Svatý kopeček hill, ca 0.2 km E of town, 48°48'29"N, 16°39'00"E, exposed hard limestone rock, on *Acarospora cervina*, 19. 5. 2004, coll. J. Vondrák, J. Šoun & M. Bartoš (CBFS 1806); Mikulov, Svatý kopeček hill, 0.3 km E of town, 48°48'30"N, 16°39'05"E, parasitic on *Acarospora cervina*, 24. 2. 2002, coll. J. Vondrák (CBFS 248); Mikulov, rocks on E slope of Kozí hrádek ruin, 21.8.2002, coll. J. Vondrák (CBFS 1531); Mikulov, Kočičí kámen protected area (rock ca 2 km N of town), alt. 345 m, 48°49'49.9"N, 16°38'12.7"E, on sunny limestone outcrop, parasitic on *Acarospora cervina*, 15. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2827); Mikulov, Kočičí skála protected area (rock ca 1.5 km N of town), alt. 361 m, 48°49'33.9"N, 16°38'30.3"E, on sunny SW-exposed limestone outcrop, free-living or parasitic on *Verrucaria* aff. *nigrescens* and *Acarospora cervina*, 15. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2813, 2842); Mikulov, Bavory, Tabulová protected area (rocks on SW slope of Mt Stolová hora), alt. 375 m, 48°50'11.5"N, 16°38'14.8"E, on sunny limestone outcrop, parasitic on *Acarospora cervina*,

15. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2824); Mikulov, Klentnice, E slopes of Mt Tabulová hora, 20. 5. 2004, coll. J. Vondrák, J. Šoun & M. Bartoš (CBFS 1830); Mikulov, Sedlec, locality Skalky, 1.5 km SW of village, 48°53'40"N, 16°40'30"E, on soft limestone boulder, 23. 2. 2002, coll. J. Vondrák (CBFS 253, 268).

Caloplaca marmorata (BAGL.) JATTA

Central Bohemia: Beroun, Srbsko, S-exposed rocks in Koda protected area ca 1.5 km SW of village, alt. 300- 350 m, 49°56'N, 14°08'E, on hard limestone rock, 23. 7. 2004, coll. J. Vondrák (CBFS 2606, 2614); Praha, near Nová Ves settlement, Prokopské údolí valley, "Bílé skály" calcareous rocks, alt. 280 m, MTB 5952, on vertical side of rock, 24. 9. 1999, coll. J. Kocourková (PRM 760579); Praha, Prokopské údolí valley, alt. 280 m, MTB 5951 C, on calcareous rocks above old swimming pool "Holyňské koupaliště", 6. 11. 1994, coll. J. Horáková (PRM 907187); Praha, Prokopské údolí valley, alt. 270 m, MTB 5952, on calcareous outcrops near "Stydlá voda" water spring, 22. 3. 1994, coll. J. Horáková (PRM 886370). **Southern Moravia**: Blansko, Ostrov u Macochy, ruin of Blansek castle, 15. 5. 2004, coll. J. Vondrák (CBFS 1888); Dolní Věstonice, Pavlov, Soutěska, alt. 330 m, on loose limestone pebble, 13. 10. 2001, coll. Z. Palice (hb. Palice 8717); Mikulov, rocks on eastern slope of Kozí hrádek ruin, 19. 5. 2004, coll. J. Vondrák, J. Šoun & M. Bartoš (CBFS 1800); Mikulov, between Svatý kopeček hill and limestone quarry, 1 km E of town, SE exp., 48°48'40"N, 16°39'20"E, 21. 8. 2002, coll. J. Vondrák (CBFS 921); Mikulov, limestone rocks under Svatý kopeček hill, ca 0.2 km E of town, 48°48'29"N, 16°39'00"E, 19. 5. 2004, coll. J. Vondrák, J. Šoun & M. Bartoš (CBFS 1816); Mikulov, Svatý kopeček hill, 0.3 km E of town, 48°48'30"N, 16°39'05"E, 24. 2. 2002, coll. J. Vondrák (CBFS 244); Mikulov, Bavory, Tabulová protected area (rocks on SW slope of Mt Stolová hora), alt. 375 m, 48°50'11.5"N, 16°38'14.8"E, on sunny limestone outcrop, 15. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2833); Mikulov, Klentnice, E slopes of Mt Tabulová hora, 20. 5. 2004, coll. J. Vondrák, J. Šoun & M. Bartoš (CBFS 1812, 1837).

Caloplaca obliterans (NYL.) BLOMB. ET FORSSELL

Eastern Bohemia: Krkonoše Mts: Pec pod Sněžkou, Obří důl valley, side gully in "Malá Čertova zahrádka" nature reserve, alt. 1150-1200 m, 50°43'30-35"N, 15°43'30"E, on shaded porphyric rock, 27. 7. 2000, coll. Š. Bayerová & Z. Palice (hb. Palice 4990). **Northern Moravia**: Jeseníky Mts: Mt Vysoká hole, NE part of Velký kotel corrie, "Beckeho skála" rock-face, alt. 1195 m, 50°03'23"N, 17°14'20"E, overhanging ESE-facing phyllitic rock, 23. 9. 2001, coll. Z. Palice (hb. Palice 9888); Ibid., central part of Velký kotel corrie, Vitásek ravine, third/fourth rock-ledge below wall of Šmarda, alt. 1260-1270 m, on overhanging schist rock, 11. 6. 2002, coll. Z. Palice (hb. Palice 7030); Ibid., 6. 5. 2004, coll. J. Vondrák (CBFS 1848).

**Caloplaca phlogina* (ACH.) FLAGEY

Central Bohemia: Rakovník, Skryje, locality "Kouřimecká rybárna" ca 4 km NE of village, alt. 257 m, 49°59'29.4"N, 13°47'18.6"E, abundant on bark of *Sambucus nigra*, 24. 4. 2005, coll. J. Vondrák & J. Liška, conf. U. Arup, 2006 (CBFS 2836). **Southern Bohemia**: Prachatice, Hracholusky, ca 1 km SE of village, alt. 510 m, 49°03'12.5"N, 14°06'08.45"E, on bark of *Populus nigra* f. *pyramidalis*, 2. 10. 2006, coll. J. Vondrák , conf. U. Arup, 2006 (CBFS 4625).

**Caloplaca polycarpa* (A.MASSAL.) ZAHLBR.

Central Bohemia: Beroun, Srbsko, S-exposed rocks in Koda protected area ca 1.5 km SW of village, alt. 300–350 m, 49°56'N, 14°08'E, on hard limestone rock with *Verrucaria calciseda*, 23. 7. 2004, coll. J. Vondrák (CBFS 2615); Praha, Hlubočepy, Prokopské údolí valley, Bašta, on south-facing slope, alt. 230 m, MTB 5952 C, parasitic on *Verrucaria calciseda*, 13. 11. 2004, coll. J. Kocourková (PRM 907175); Praha, Prokopské údolí valley, above "Holyňské koupaliště" swimming pool, S-facing slope of calcareous rocks, at upper edge in front of pine forest, on limestone, alt. 250 m, MTB 5951 C, on *Verrucaria calciseda*, 14. 11. 2004, coll. J. Kocourková (PRM 907176). **Southern Bohemia**: Český Krumlov, Nové Dobrkovice, on border of Vyšenské kopce protected area, alt. 478 m, 48°49'08.8"N, 14°17'30.8"E, parasitic on *Verrucaria* cf. *calciseda*, 24. 3. 2005, coll. J. Vondrák (CBFS 2725). **Southern Moravia**: Blansko, Vilémovice, Srnčí cave, S-facing grassy slope below cave, alt. 462 m, 49°22'21.8"N, 16°44'39.3"E, on calcareous outcrop on *Verrucaria calciseda*, 18. 9. 2003, coll. J. Kocourková (PRM 907009); Blansko, Ostrov u Macochy, Balcarka cave, alt. 455 m, on calcareous rock outcrop above parking place, on *Verrucaria calciseda*, 17. 9. 2003, coll. J. Kocourková (PRM 907012); Mikulov, Klentnice, ruin of Sirotčí hrádek castle, on hard limestone rock,

20. 5. 2004, coll. J. Vondrák, J. Šoun & M. Bartoš (CBFS 1818); Tišnov, Čebín, on south foot of hill Čebínka, on hard limestone rock, 16. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2854).

Caloplaca rubelliana (ACH.) LOJKA

Central Bohemia: Rakovník, Skryje, ruin of Týřov castle, alt. 295 m, 49°58'24.6"N, 13°47'24.1"E, on lime-enriched schist under ruin walls, on sunny S-exposed slope, MTB 6048 B13, 7. 6. 1996, coll. J. Horáková (PRM 907164); Ibid., 8. 8. 1999, coll. J. Kocourková (PRM 907189); Ibid., 22. 3. 2005, coll. J. Halda, P. Havránek, J. Liška, Z. Palice (hb. Palice 8821) & J. Vondrák (CBFS 2753); Rakovník, between Nezabudice and Roztoky villages, Nezabudické skály nature reserve, at SE margin of reserve, alt. 270 m, 50°01'17"N, 13°51'04"E, on steep SW-facing slope above Berounka river, in thin scree oak forest, on greywacke stone, 3. 9. 1997, coll. J. Kocourková (PRM 907163).

**Caloplaca thuringiaca* SØCHTING ET STORDEUR

Central Bohemia: Beroun, rocks above right bank of Berounka river between villages Karlštejn and Srbsko, close to hill Střevíc, alt. 250-300 m, on dead stems of plants in steppe-like grassland on limestone rock, 19. 7. 2006, coll. J. Vondrák (CBFS 4797, 4823); Beroun, Koněprusy, in steppe vegetation on south slope of hill Kotýz, alt. ca 410 m, 49°54'56.0"N, 14°02'56.6"E, on dead plant debris, 17. 5. 2006, coll. J. Šoun (hb. Šoun 52); Beroun, Svatý Jan pod Skalou – Sedlec, on SE-facing slope, alt. 310 m, MTB 6050, in steppe on diabase rocks, 15. 4. 1993, coll. J. Horáková (PRM 907185); Praha, Prokopské údolí valley, alt. 280 m, MTB5951 C, on limestone outcrops on slope W of old swimming pool "Holyňské koupaliště", 21. 10. 1994, coll. J. Horáková (PRM 907161). **Southern Moravia**: Mikulov, SE slope of Svatý kopeček hill ca 1 km E of town, alt. 340-350 m, on remains of dead plants, 15. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2841); Mikulov, limestone quarry 1 km E of town, 48°48'40"N, 16°39'30"E, on plant debris in steppe-like grassland on terrace of limestone quarry with *Caloplaca stillicidiorum* and *Bacidia bagliettoana*, 21. 8. 2002, coll. J. Vondrák (CBFS 2488); Mikulov, northern peak of Mt Šibeničník ca 2 km S of town, alt. 249 m, 48°47'21.5"N, 16°37'48.0"E, on remains of small shrubs and herbs, 14. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2908); Mikulov, Kočičí kámen protected area (rock ca 2 km N of town), alt. 345 m, 48°49'49.9"N, 16°38'12.7"E, on remains of small shrubs and herbs, 15. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2913); Mikulov, Kočičí skála protected area (rock ca 1.5 km N of town), alt. 361 m, 48°49'33.9"N, 16°38'30.3"E, on remains of small shrubs and herbs with *C. stillicidiorum*, 15. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2912); Mikulov, Bavory, Tabulová protected area (rocks on SW slope of Mt Stolová hora), alt. 375 m, 48°50'11.5"N, 16°38'14.8"E, on remains of small shrubs and herbs with *C. stillicidiorum*, 15. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2906); Mikulov, Pavlov, E slope under ruin of Děvičky castle, ca 1 km W of village, alt. 400 m, 48°52'34.1"N, 16°39'44.9"E, on wooden remains of dead small shrubs, 15. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2840); Znojmo, Čížov, S-exposed slope in Dyje river valley, above asphaltic road to Hardegg ca 2 km SSE of Čížov, alt. 350 m, 48°51'17.8"N, 15°52'09.7"E, on wooden remains of plants with *Agonimia opuntiella*, 14. 4. 2005, coll. J. Vondrák & J. Šoun (CBFS 2904).

Caloplaca xantholyta (NYL.) JATTA

Central Bohemia: Rakovník, Křivoklát, near school, at beginning of nature-trail, oak-hornbeam forest on S-facing slope, alt. 280 m, 50°01.85'N, 13°51.93'E, on underhanging shale outcrop, on calcareous inclusion, MTB5949 C07, 31. 3. 2002, coll. J. Kocourková (PRM900092); Zruč nad Sázavou, 1 km N of Bernartice, S of Švihov water basin, above bank, alt. 380 m, 49°41'03"N, 15°08'02"E, on serpentinite rock outcrop, 14. 5. 2005, coll. J. Kocourková & W. v. Brackel (PRM907171). **Southern Moravia**: Blansko, Moravský kras landscape protected area, 2.5 km W of Vilémovice, Kateřinská jeskyně cave, S-facing vertical wall of calcareous rock at entrance to cave, alt. 400 m, MTB 6666 A13, on limestone, 17. 5. 2003, coll. J. Kocourková (PRM 907174); Blansko, Moravský kras landscape protected area, 2 km W of Vilémovice, Vývěry Punkvy national nature reserve, Suchý žleb glen, above locality "Mastný flek", alt. 430 m, 49°21'40"N, 16°43'10"E, scree forest on S-facing slope, on calcareous outcrop, 17. 4. 2004, coll. J. Kocourková (PRM 907190); Brno, Moravský kras landscape protected area, Ochoz u Brna, nearby Pekárna cave, on overhanged limestone rock, 17. 5. 2002, coll. J. Vondrák (CBFS 2484).

CONTRIBUTION TO THE LICHENIZED AND LICHENICOLOUS FUNGI IN BULGARIA. II, THE GENUS *Caloplaca*

JAN VONDRÁK[1*] & ŠTĚPÁNKA SLAVÍKOVÁ-BAYEROVÁ[2]

[1] Department of Botany, Faculty of Biological Sciences, University of South Bohemia, Branišovská 31, CZ-370 05, České Budějovice, Czech Republic

[2] Institute of Botany, Academy of Sciences of the Czech Republic, CZ-252 43 Průhonice, Czech Republic

Received 12 November 2005 / Accepted 4 January 2006

Vondrák, J. & Slavíková-Bayerová, Š. (2007): Contribution to the lichenized and lichenicolous fungi in Bulgaria. II, the genus *Caloplaca*. *Mycologia balcanica* **3**: 61-69.

Abstract. An annotated list of *Caloplaca* species occurring in Bulgaria, mainly the Rhodopes, Black Sea coast, and Pirin Mountains, is provided. Based on our collections, 50 taxa are listed, of which 17 are reported for the first time from the country: *Caloplaca adriatica*, *C. albolutescens*, *C. cerinella*, *C. chrysodeta*, *C. crenulatella*, *C. erodens*, *C. flavocitrina*, *C.* aff. *furax*, *C. fuscoatroides*, *C. hungarica*, *C. inconnexa* var. *inconnexa*, *C. inconnexa* var. *nesodes*, *C. marmorata*, *C. obscurella*, *C. polycarpa*, *C. tiroliensis*, and *C. xerica*. *C.* aff. *furax* is probably an undescribed taxon resembling the Mediterranean *C. furax*, but differing in particular characters.

Key words: biodiversity, Black Sea coast, *Caloplaca*, lichens, Mount Strandzha, Pirin Mountains, the Rhodopes.

INTRODUCTION

The generic concept of the genus *Caloplaca* has been recently regarded as highly artificial (e.g. Gaya et al. 2003). Some recent works have found heterogeneity within *Caloplaca* (Kärnefelt 1989; Gaya et al. 2003; Søchting & Lutzoni 2003). Some *Caloplaca* species, namely those from the section *Gasparrinia*, should be taken into *Xanthoria* (Søchting & Lutzoni 2003), and some species of *Fulgensia* should be placed in *Caloplaca* (Gaya et al. 2003). Nevertheless, the classical conception (cf. Clauzade & Roux 1985) is used here.

This paper lists the species of *Caloplaca* collected in Bulgaria during four excursions in 2002, 2004, and 2005 in the Rhodopes, Pirin Mountains, Mt Strandzha, and on the Black Sea coast. Fifty taxa are discussed here, of which 17 are new to the country; a few samples remain undetermined. Some taxa occurring on the Black Sea coast belong to dificult groups (e.g. *C. citrina* agg.); they may represent undescribed taxa and would therefore be worthy of molecular study.

MATERIALS AND METHODS

All the samples detailed below were collected by the authors and vouchers are currently deposited in the herbarium of the Faculty of Biological Sciences at the University of South Bohemia in České Budějovice (CBFS) and in the private herbarium of Š. Slavíková-Bayerová. The nomenclature of taxa mentioned in the text that are not followed by an authority follows Nimis & Martellos (2003) and the nomenclature of insoluble lichen pigments follows Meyer & Printzen (2000). The floristic regions and fundamental knowledge on the distribution of species reported from Bulgaria are based on Mayrhofer et al. (2005).

SPECIAL PART

The species are followed by the list of recorded localities. Diagnostic characters and notes on taxonomy are given for selected taxa. More frequently used synonyms are mentioned under the current names. Species new to Bulgaria are indicated by an asterisk before the name.

**Caloplaca adriatica* (ZAHLBR.) SERVÍT (SYN. *C. schaereri* VAR. *adriatica* ZAHLBR.)

The Rhodopes: Distr. Plovdiv, Asenovgrad, Dobrostan, calcareous rocks in small polje ca 2 km W of village, alt. 1300 m, 41°56' N, 24°53' E, on hard limestone rock, 25 Aug 2004 (CBFS 2199).

Note: This species superficially resembles *C. velana* Flörke var. *schaereri* (Arnold) Clauzade & Cl. Roux or *C. subochracea* (Wedd.) Werner, but differs from both species in possessing thin septa in mature spores (Clauzade & Roux 1985).

**C. albolutescens* (NYL.) H. OLIVIER

The Rhodopes: Distr. Kurdzhali, Kurdzhali, Shiroko Pole, protected area "Sredna Arda", ca 5 km E of village, alt. ca 240 m, 41°37' N, 25°31' E, on concrete wall near railway station "Sredna Arda", 15 Aug 2004 (CBFS 2008, 2031).

Note: Laundon (1992a) considers *C. albolutescens* a synonym to *C. teicholyta*, but some authors recognize *C. albolutescens* as a different species (Wade 1965; Clauzade & Roux 1985; Wirth 1995; Nimis & Martellos 2003). After checking the variability of both species, we also consider it to be a good species. The Bulgarian specimens agree well with the type material (H-Nyl. 29845, holotype!).

C. alociza (A. MASSAL.) MIG. (SYN. *C. agardhiana* (A. MASSAL.) CL. ROUX)

The Rhodopes: Distr. Kurdzhali, Kirkovo, Starovo, ca 2 km E of village, alt. 390 m, 41°28' N, 25°25' E, concrete on well, 10 Aug 2004 (CBFS 2160).

Note: Some authors (Clauzade & Roux 1985; Nimis & Poelt 1987) distinguish *C. agardhiana* (without hymenial crystals) and *C. alociza* as the different species. However, we agree with Wunder (1974), who considers them as synonyms, the presence of hymenial crystals being ecologically derived.

C. arenaria (PERS.) MÜLL. ARG. (SYN. *C. lamprocheila* (DC.) FLAGEY)

Black Sea coast: Distr. Burgas, Rezovo, coastal rocks N of the village, alt. ca 5-10 m, 42°00' N, 28°00' E, on coastal siliceous rock, 13 Jul 2005 (CBFS 3245). **The Rhodopes**: Distr. Plovdiv, Asenovgrad, Gornoslav, in pine forest above village, alt. 650 m, 41°55' N, 24°59' E, on small schist outcrop in open pine forest, 26 Aug 2004 (CBFS 2124); Distr. Kurdzhali, Kurdzhali, Kaloyantsi, alt. 320 m, 41°38' N, 25°32' E, on acid exposed volcanic rocky outcrop, 16 Aug 2004 (CBFS 2073); Kaloyantsi, protected area "Yumrouk Skala", ca 5 km SW of village, alt. ca 320 m, 41°37' N, 25°31' E, on outcrop of base-rich volcanic rock above railroad and on acid volcanic stones in large stony debris on N-exposed slope, 15 Aug 2004 (CBFS 2019, Sel. exs. *Caloplaca*, no. 14); Distr. Kurdzhali, Kirkovo, Bregovo, in Vurbitsa river valley ca 2 km E of village, alt. 300 m, 41°28' N, 25°25' E, on rather acid volcanic rock, 11 Aug 2004 (CBFS 2137); Bregovo, in valley of small afluent to river Vurbitsa ca 1 km S of village, alt. 280 m, 41°28' N, 25°25' E, on base-rich volcanic rock, 11 Aug 2004 (CBFS 2002); Distr. Haskovo, Stambolovo, Byal Kladenets, protected area "Golemya Sipey" S of village, alt. 420 m, 41°37' N, 25°40' E, on acid volcanic pebbles conglomerated by calcareous cement and on acid volcanic rock, 17 Aug 2004 (CBFS 2084, 2093); Stambolovo, Rabovo rocks above village, alt. 340 m, 41°40' N, 25°40' E, acid, on strongly exposed volcanic rock, 18 Aug 2004 (CBFS 2024).

Note: We use this taxon in modern sense (cf. Wirth 1995), unlike older authors (e.g. Wade 1965) who used the name *C. arenaria* for the taxa *C. erythrocarpa* and *C. teicholyta*. However, the application of *C. arenaria* is misunderstood as the type of *Lichen arenarius* Pers. is missing in Persoon's herbarium (Thijsse, pers. comm.). Therefore, this taxon needs neotypification.

C. aurantia (PERS.) HELLB. (SYN. *C. callopisma* (ACH.) TH . FR.)

The Rhodopes: Distr. Kurdzhali, Kurdzhali, Dolishte, limestone rocks in valley ca 1 km W of village, alt. 300 m, 41°38' N, 25°35' E, 16 Aug 2004 (CBFS 2122); Distr. Haskovo, Stambolovo, Byal Kladenets, limestone rocks in valley below village, alt. 350 m, 41°37' N, 25°40' E, 17 Aug 2004 (CBFS 2072, 2086); Byal Kladenets, edge of protected area "Golemya Sipey" S of village, alt. 420 m, 41°37' N, 25°40' E, 17 Aug 2004 (CBFS 2083); Distr. Haskovo, Lyubimets, Malko Gradishte, nearby hill "Sveta Marina" ca 5 km SW of village, alt. 600 m, 41°44' N, 26°00' E, 19 Aug 2004 (CBFS 2046).

Note: This species is easily recognized by its large radial thallus delimited by flat lobes and by the absence of a grey crystalline layer beneath the layer of anthraquinones in the cortex (cf. Clauzade & Roux 1985).

C. biatorina (A. MASSAL.) J. STEINER

The Rhodopes: Distr. Plovdiv, Asenovgrad, Dobrostan, calcareous rocks around hut Martsiganitsa, ca 6 km W of village, alt. ca 1200 m, 41°56' N, 24°53' E, on hard limestone rock under overhang, 25 Aug 2004, parasited by *Bispora christiansenii* D. Hawksw. (CBFS 2252) and with *Xanthoria nowakii* S.Y. Kondr. & Bielczyk (CBFS 2258); Distr. Haskovo, Stambolovo, Byal Kladenets, limestone rocks in valley below village, alt. 350 m, 41°37' N, 25°40' E, vertical side of hard limestone rock, 17 Aug 2004 (CBFS 2240).

Note: All the collected samples belong to *C. biatorina* subsp. *gyalolechioides* (Müll. Arg.) Clauzade & Cl. Roux, characterized by its intensively white pruinose thallus and short ascospores. However, distinguishing *C. biatorina* subsp. *biatorina* versus subsp. *gyalolechioides* by the size and shape of ascospores (Clauzade & Roux 1985) is incorrect, since there is a wider variability in spore shape in *C. biatorina* subsp. *gyalolechioides* (Vondrák, *unpubl.*). There is only one previously published record from Bulgaria, namely Rila Mts (Pišút 2001).

C. cerina (EHRH. EX HEDW.) TH. FR.

The Rhodopes: Distr. Plovdiv, Asenovgrad, Dobrostan, forest under hut Martsiganitsa, ca 6 km W of village, alt. ca 1100 m, 41°56' N, 24°53' E, on bark of *Quercus petraea*, 25 Aug 2004 (CBFS 2244); Asenovgrad, Gornoslav, in forest above village, alt. 750 m, 41°55' N, 24°59' E, on bark of *Ostrya carpinifolia*, 26 Aug 2004 (CBFS 2127).

**C. cerinella* (NYL.) FLAGEY

The Rhodopes: Distr. Haskovo, Madzharovo, in valley of river Arda, alt. 200 m, 41°39' N, 25°51' E, on bark of *Salix caprea*, 19 Aug 2004 (CBFS 2207); Distr. Haskovo, Stambolovo, Rabovo in Arda river valley, alt. 190 m, 41°40' N, 25°40' E, on bark of *Salix fragilis*, 18 Aug 2004 (CBFS 2158).

Note: The species superficially resembles *C. holocarpa* (incl. *C. cerinelloides* and *C. pyracea*). It is clearly characterized by having 12-16 spores per ascus.

C. chalybaea (FR.) MÜLL. ARG.

The Rhodopes: Distr. Plovdiv, Asenovgrad, Dobrostan, calcareous rocks in small polje ca 2 km W of village, alt. 1300 m, 41°56' N, 24°53' E, 25 Aug 2004 (CBFS 2191); Distr. Haskovo, Stambolovo, Byal Kladenets, edge of protected area "Golemya Sipey" S of village, alt. 420 m, 41°37' N, 25°40' E, 17 Aug 2004 (CBFS 2081); Byal Kladenets, limestone rocks in valley below village, alt. 350 m, 41°37' N, 25°40' E, 17 Aug 2004 (CBFS 2090, 2168).

C. chlorina (FLOT.) H. OLIVIER (SYN. *C. cerina* VAR. *chlorina* (FLOT.) MÜLL. ARG.)

Black Sea coast: Distr. Burgas, Sinemorets, coastal rocks ca 2 km SE of village, alt. 3-10 m, 42°00'30'' N, 28°00' E, on coastal rocks under littoral-supralittoral conditions, 23 Aug 2004 (Sel. exs. *Caloplaca*, no. 15). **The Rhodopes**: Distr. Kurdzhali, Momchilgrad, Ptichar, near railway station, alt. 320 m, 41°28' N, 25°25' E, on bark of *Populus nigra*, 12 Aug 2004 (CBFS 2026); Distr. Haskovo, Madzharovo, protected area "Kovan Kaya" ca 3 km NNE of town, alt. 200 m, 41°39' N, 25°51' E, on bark of old *Quercus* sp., 29 Oct 2002 (CBFS 762 – sub *Caloplaca isidiigera* Vězda); Madzharovo, protected area "Momina Skala" ca 3 km WNW of town, alt. 200 m, 41°39' N, 25°51' E, on volcanic rocky outcrops just above water level of river Arda, 18 Aug 2004 (CBFS 2055); Madzharovo, Silen, Rabovo, valley of small brook N of village, alt. ca 250 m, 41°37' N, 25°40' E, corticolous on bark of *Populus nigra*, together with *Rinodina pityrea*, 18 Aug 2004 (Sel. exs. *Caloplaca*, no. 11, sub *C. virescens*). **Mt Strandzha**: Distr. Burgas, Gramatikovo, oak forest near village, 27°38' N, 42°03' E, on bark of old *Quercus frainetto*, 12 Jul 2005 (CBFS 3236).

Note: We follow the broad concept of *C. chlorina* proposed by Tønsberg (1992), who characterizes it as a variable species, which can form well developed, flat areolae with marginal soredia, consoredia, or isidia-like projections, as well as completely leprose thalli. On the coastal locality, *C. chlorina* is very abundant, but this population differs from typical *C. chlorina* by the scarcity of isidia and soralia. This morphotype occurs in the supralittoral zone together with *C. viridirufa*.

**C. chrysodeta* (VAIN. EX RÄSÄNEN) DOMBR. (SYN. *Leproplaca chrysodeta* (RÄSÄNEN) J. R. LAUNDON)

The Rhodopes: Distr. Plovdiv, Asenovgrad, Dobrostan, calcareous rocks around hut Martsiganitsa, ca 6 km W of village, alt ca 1200 m, 41°56' N, 24°53' E, 25 Aug 2004 (CBFS 2118); Dobrostan, calcareous rocks in small polje ca 5 km W of village, alt. 1300 m, 41°56' N, 24°53' E, 25 Aug 2004 (CBFS 1996); Distr. Kurdzhali, Kurdzhali, Kaloyantsi, alt. 320 m, 41°38' N, 25°32' E, 16 Aug 2004 (CBFS 2005).

C. cirrochroa (ACH.) TH. FR.

The Rhodopes: Distr. Plovdiv, Asenovgrad, Dobrostan, calcareous rocks around hut Martsiganitsa, ca 6 km W of village, alt. ca 1200 m, 41°56' N, 24°53' E, 25 Aug 2004 (CBFS 2123); Distr. Haskovo, Stambolovo, Byal Kladenets, limestone rocks in valley below village, alt. 350 m, 41°37' N, 25°40' E, 17 Aug 2004 (CBFS 1997).

C. citrina (HOFFM.) TH. FR.

The Rhodopes: Distr. Kurdzhali, Kurdzhali, Shiroko Pole, protected area "Sredna Arda", ca 5 km E of village, alt. ca 240 m, 41°37' N, 25°31' E, on concrete wall near railway station "Sredna Arda", 15 Aug 2004 (CBFS 2015); Distr. Kurdzhali, Momchilgrad, in Vurbitsa river valley, alt. 240 m, 41°31' N, 25°25' E, on calcareous stone in river bed, just above water level, 13 Aug 2004 (CBFS 2140); Distr. Haskovo, Stambolovo, Byal Kladenets, limestone rocks in valley below village, alt. 350 m, 41°37' N, 25°40' E, on hard limestone rocks, 17 Aug 2004 (CBFS 2101).

Note: We use the narrow concept of *C. citrina*; thus, *C. dichroa* Arup, *C. flavocitrina* (Nyl.) H. Olivier, and *C. phlogina* (Ach.) Nyl. are considered as separate species (Sérusiaux et al. 1999; Arup 2006).

C. coronata (KÖRB.) J. STEINER (SYN. *C. aurantiaca* VAR. *coronata* (KÖRB.) JATTA)

The Rhodopes: Distr. Kurdzhali, Kurdzhali, Dolishte, limestone rocks in valley ca 1 km W of village, alt. 300 m, 41°38' N, 25°35' E, 16 Aug 2004 (CBFS 2096); Distr. Haskovo, Stambolovo, Byal Kladenets, limestone rocks in valley below village, alt. 350 m, 41°37' N, 25°40' E, 17 Aug 2004 (CBFS 2075).

C. crenularia AUCT., NON (WITH.) J. R. LAUNDON (SYN. *C. festiva* AUCT., NON (TH. FR.) ZWACKH)

The Rhodopes: Distr. Kurdzhali, Dzhebel, Rogozche, rocks in Vurbitsa river valley near railway station, alt. 300 m, 41°28' N, 25°25' E, 12 Aug 2004 (CBFS 2037); Distr. Kurdzhali, Kirkovo, Bregovo, in valley of small afluent to river Vurbitsa ca 1 km S of village, alt. 280 m, 41°28' N, 25°25' E, 11 Aug 2004 (CBFS 2036); Bregovo, in Vurbitsa river valley ca 2 km E of the village, alt. 300 m, 41°28' N, 25°25' E, 11 Aug 2004 (CBFS 2000, 2039); Distr. Kurdzhali, Kirkovo, Starovo, in village, alt. 350 m, 41°28' N, 25°25' E, on calcareous sandstone rocky outcrop, 11 Aug 2004 (CBFS 2029); Distr. Kurdzhali, Kurdzhali, Kaloyantsi, protected area "Yumrouk Skala", ca 5 km SW of village, alt. ca 320 m, 41°37' N, 25°31' E, 15 Aug 2004 (CBFS 2027); Distr. Haskovo, Madzharovo, by river Arda, 41°40' N, 25°50' E, 29 Oct 2002 (CBFS 706); Madzharovo, protected area "Momina Skala" ca 3 km WNW of town, alt. 200 m, 41°39' N, 25°51' E, 18 Aug 2004 (CBFS 2065); Distr. Haskovo, Stambolovo, Rabovo nearby dam of lake "Studen Kladenets", alt. 250 m, 41°40' N, 25°40' E, 18 Aug 2004 (CBFS 2113).

Note: *C. crenularia* (With.) J. R. Laundon described from the British Isles (Isle of Wight, BM, lectotype!) differs from Bulgarian populations in particular characters: smaller spores with thinner septa, presence of distinct cortex and absence of algae in exciple. Moreover, *C. crenularia* (With.) J. R. Laundon has rather northern and western distribution in Europe and differs

strongly in ecology, preferring sheltered damp habitats (cf. Magnusson 1944; Laundon 1992a; Wetmore 1996). Therefore, the Bulgarian material from exposed xerothermic sites is provisionally named *C. crenularia* auct.

**C. crenulatella* (NYL.) H. OLIVIER

Black Sea coast: Distr. Burgas, Sinemorets, coastal rocks ca 2 km SE of village, alt. ca 20 m, 42°00'30'' N, 28°00' E, on coastal rocks in supralittoral zone, 22 Aug 2004 (CBFS 2232). **The Rhodopes**: Distr. Plovdiv, Asenovgrad, Dobrostan, Sv. Iliya chapel above village, alt. 1320 m, 41°56' N, 24°54' E, on hard limestone outcrops, 25 Aug 2004 (CBFS 2128); Distr. Kurdzhali, Krumovgrad, Bryagovets, stones on bank of Arda river, alt. 200 m, 41°39' N, 25°51' E, on volcanic boulders just above water level, 18 Aug 2004 (CBFS 2147); Distr. Kurdzhali, Dzhebel, Rogozche, rocks in Vurbitsa river valley near railway station, alt. 300 m, 41°28' N, 25°25' E, on sunny base-rich volcanic rock, 12 Aug 2004 (CBFS 2202); Distr. Kurdzhali, Kirkovo, Starovo, ca 2 km E of village, alt. 390 m, 41°28' N, 25°25' E, on concrete on well, 10 Aug 2004 (CBFS 2017); Distr. Kurdzhali, Kurdzhali, Shiroko Pole, protected area "Sredna Arda", ca 5 km E of village, alt. ca 240 m, 41°37' N, 25°31' E, on concrete wall near railway station "Sredna Arda", 15 Aug 2004 (CBFS 2032, 2033); protected area "Sredna Arda", ca 6 km E of village, alt. ca 240 m, 41°37' N, 25°31' E, on concrete on railway bridge across Perperek river, 15 Aug 2004 (CBFS 2016); Distr. Kurdzhali, Momchilgrad, in Vurbitsa river valley, alt. 240 m, 41°31' N, 25°25' E, calcareous stone in river bed, just above water level, 13 Aug 2004 (CBFS 2035). **Thracian Lowland**: Stara Zagora, Mihaylovo, railway station, 42°16' N, 25°31' E, on horizontal plate of concrete, 20 Aug 2004 (CBFS 2066).

Note: For the differences between *C. crenulatella* and related species, mainly *C. aquensis* Houmeau & Cl. Roux and *C. ferrarii* (Bagl.) Jatta, see Navarro-Rosinés & Hladun (1996).

C. decipiens (ARNOLD) BLOMB. & FORSSELL

The Rhodopes: Distr. Plovdiv, Asenovgrad, Dobrostan, Sv. Iliya chapel above village, alt. 1320 m, 41°56' N, 24°54' E, on mortar, 25 Aug 2004 (CBFS 1993); Distr. Haskovo, Stambolovo, Byal Kladenets, limestone rocks in valley below village, alt. 350 m, 41°37' N, 25°40' E, on hard limestone rocks, 17 Aug 2004 (CBFS 2071).

C. demissa (KÖRB.) ARUP & GRUBE (SYN. *Lecanora incusa* (FLOT.) WAIN., *L. demissa* (KÖRB. EX FLOT.) ZAHLBR.)

Black Sea coast: Distr. Burgas, Rezovo, coastal rocks N of the village, alt. ca 15 m, 42°00' N, 28°00' E, on coastal silicate rock, 13 Jul 2005 (CBFS 3206). **The Rhodopes**: Distr. Kurdzhali, Dzhebel, Rogozche, rocks in Vurbitsa river valley near railway station, alt. 300 m, 41°28' N, 25°25' E, 10 Aug 2004 (CBFS 2004); Distr. Kurdzhali, Kirkovo, Bregovo, in valley of small afluent to river Vurbitsa ca 1 km S of village, alt. 280 m, 41°28' N, 25°25' E, 11 Aug 2004 (CBFS 2028); Distr. Kurdzhali, Momchilgrad, Ptichar, rocks in Vurbitsa river valley, alt. 300 m, 41°28' N, 25°25' E, 12 Aug 2004 (CBFS 2018); Distr. Haskovo, Madzharovo, protected area "Kovan Kaya" ca 3 km NNE of town, alt. 200 m, 41°39' N, 25°51' E, 27 Oct 2002 and 19 Aug 2004 (CBFS 704, 2050); Distr. Haskovo, Stambolovo, Rabovo in Arda river valley, alt. 190 m, 41°40' N, 25°40' E, 18 Aug 2004 (CBFS 2040).

Note: *C. demissa* is a sterile species which was traditionally placed into the section *Placodium* of the genus *Lecanora*. It has been combined into *Caloplaca* on the base of several morphological characters (e.g. shape of conidia) and molecular data (Arup & Grube 1999).

C. dolomiticola (HUE) ZAHLBR. (INCL. *C. schaereri* (ARNOLD) CL. ROUX, *C. velana* (A. MASSAL.) DU RIETZ)

The Rhodopes: Distr. Plovdiv, Asenovgrad, Dobrostan, calcareous rocks in small polje ca 2 km W of village, alt. 1300 m, 41°56' N, 24°53' E, on hard limestone rock, 25 Aug 2004 (CBFS 2208); Distr. Kurdzhali, Kirkovo, Starovo, in village, alt. 350 m, 41°28' N, 25°25' E, on calcareous sandstone rocky outcrop, 11 Aug 2004 (CBFS 2153); Distr. Kurdzhali, Kurdzhali, Dolishte, limestone rocks in valley ca 1 km W of village, alt. 300 m, 41°38' N, 25°35' E, on hard limestone rock, 16 Aug 2004 (CBFS 2100); Distr. Haskovo, Stambolovo, Byal Kladenets, limestone rocks in valley below village, alt. 350 m, 41°37' N, 25°40' E, on hard limestone rocks, 17 Aug 2004 (CBFS 2076).

Note: *C. dolomiticola* is used here in a broad sense to include variable calcicolous specimens with a yellow areolated thallus. The *C. dolomiticola* complex is in urgent need of modern taxonomic revision.

**C. erodens* TRETIACH, PINNA & GRUBE

The Rhodopes: Distr. Plovdiv, Asenovgrad, Dobrostan, calcareous rocks around hut Martsiganitsa, ca 6 km W of village, alt. ca 1200 m, 41°56' N, 24°53' E, 25 Aug 2004 (CBFS 2104); Distr. Kurdzhali, Kurdzhali, Dolishte, limestone rocks in valley ca 1 km W of village, alt. 300 m, 41°38' N, 25°35' E, 16 Aug 2004 (CBFS 2108).

Note: *C. erodens* was recently described and placed in the section *Pyrenodesmia* (Tretiach et al. 2003). It usually has a sterile, bluish-grey orbicular thallus with endolithic central part, which is delimited by an epilithic, obscurely lobate prothallus. It contains the pigment *Sedifolia*-grey. Thalli of *C. erodens* form typical shallow depressions in calcareous substrata. Bulgarian specimens agree well with the isotype material (Vězda, Lich. rar. exs., no. 499!).

C. erythrocarpa (PERS.) ZWACKH (SYN. *C. arenaria* AUCT. P.P., NON (PERS.) MÜLL. ARG.)

Mt Strandzha: Distr. Burgas, Malko Tarnovo, wasteland near town, 42°00' N, 27°30' E, on calcareous stone, 11 Jul 2005 (CBFS 3208).

Note: The Bulgarian material is clearly conspecific with the sample of *Lecidea erythrocarpia* (Pers.) Ach. in Acharius's herbarium (H-Ach 353!) indicated by the note "ad lapides calcarios prope Dyjon, Galliae, Persoon". It can represent a piece of the type material.

**C. flavocitrina* (NYL.) H. OLIVIER (SYN. *C. citrina* VAR. *flavocitrina* (NYL.) A. E. WADE)

Black Sea coast: Distr. Burgas, Sinemorets, coastal rocks ca 2 km SE of village, alt. ca 20 m, 42°00'30'' N, 28°00' E, on shrub wood influenced by salty spray and on pebbles influenced by salty spray, 22 Aug 2004 (CBFS 2105, 2106). **The Rhodopes**: Distr. Plovdiv, Luki, Yugovo, in village, alt. 700 m, 41°55' N, 24°55' E, on N-exposed mortar, 24 Aug 2004 (CBFS 2230); Distr. Kurdzhali, Kurdzhali, Shiroko Pole, protected area "Sredna Arda", ca 5 km E of village, alt. ca 240 m, 41°37' N, 25°31' E, on concrete wall near railway station "Sredna Arda", 15 Aug 2004 (CBFS 2021); Distr. Haskovo, Stambolovo, Rabovo rocks above village, alt. 280 m, 41°40' N, 25°40' E, on base-rich volcanic rock, 18 Aug 2004 (CBFS 2185) and on bark of *Populus nigra* (2408); Distr. Haskovo, Lyubimets, Malko Gradishte, rocks nearby hill "Sveta Marina" ca 5 km SW of village, alt. 600 m, 41°44' N, 26°00' E, on exposed, lime-enriched porose volcanic rock, 19 Aug 2004 (CBFS 2051).

Note: The thallus of *C. flavocitrina* is composed of irregularly shaped yellow scales which become sorediate at the edges. Some authors consider this taxon as a variety of *C. citrina* (e.g. Wade 1965; Wetmore 2001; Santesson et al. 2004). However, we regard it as a species following van den Boom et al. (1998) and Sérusiaux et al. (1999), recently approved by molecular data (Arup 2006).

C. flavovirescens (WULFEN) DALLA TORRE & SARNTH. (SYN. *C. aurantiaca* VAR. *flavovirescens* (WULFEN) TH. FR.)

The Rhodopes: Distr. Plovdiv, Luki, Jugovo, rocky outcrops around village, alt. ca 700 m, 41°55' N, 24°55' E, common on lime-enriched schist stones, 24 Aug 2004 (recorded only); Distr. Haskovo, Stambolovo, Byal Kladenets, protected area "Golemya Sipey" S of village, alt. 420 m, 41°37' N, 25°40' E, on small limestone outcrops, 17 Aug 2004 (CBFS 1998).

**C. AFF. *furax* EGEA & LLIMONA

Black Sea coast: Distr. Burgas, Sinemorets, coastal rocks ca 2 km SE of village, alt. ca 20 m, 42°00'30'' N, 28°00' E, on coastal rocks, 22 Aug 2004 (CBFS 2045, 2047, 2048); Rezovo, coastal rocks N of the village, alt. ca 5-10 m, 42°00' N, 28°00' E, on coastal siliceous rock, 13 Jul 2005 (CBFS 3239). **The Rhodopes**: Distr. Kurdzhali, Kurdzhali, Shiroko Pole, protected area

"Sredna Arda", ca 5 km E of village, alt. ca 240 m, 41°37' N, 25°31' E, on concrete wall above railway, 15 Aug 2004 (CBFS 2011); Distr. Kurdzhali, Dzhebel, Rogozche, rocks in Vurbitsa river valley near railway station, alt. 300 m, 41°28' N, 25°25' E, on base-rich volcanic rock, 12 Aug 2004 (CBFS 2006); Distr. Kurdzhali, Kirkovo, Bregovo, in valley of small afluent to river Vurbitsa ca 1 km S of village, alt. 280 m, 41°28' N, 25°25' E, on base-rich volcanic rock, 11 Aug 2004 (CBFS 2030, 2043); Distr. Haskovo, Madzharovo, protected area "Kovan Kaya" ca 3 km NNE of town, alt. 200 m, 41°39' N, 25°51' E, on base-rich volcanic boulders in river valley, just above water level, 19 Aug 2004 (CBFS 2102); Distr. Haskovo, Stambolovo, Rabovo rocks above village, alt. 280 m, 41°40' N, 25°40' E, on base-rich volcanic rock, 18 Aug 2004 (CBFS 2023).

Note: This species belongs to the *C. ferruginea* group (sensu Clauzade & Roux 1985) and is most similar to *C. pellodella*, *C. spalatensis* (= *C. areolata*) and *C. xerica*. According to Egea & Llimona (1983), *C. furax* is a strict parasite on silicicolous species of *Aspicilia*. We have checked the isotype material of *C. furax* (GZU, Murc. Lichenotheca, no. 3039!) and conclude that the Bulgarian samples share the following characters with *C. furax*: thick grey thallus with irregular marginal lobes, presence of *Sedifolia*-grey in cortex, zeorine apothecia with grey outer margin and numerous dark grey immersed pycnidia. However, some other features of *C. furax*, such as the parasitic life-style and the blackish fibrilous prothallus, have been rarely observed in Bulgarian material. Investigation of more material of *C. furax* and using molecular methodes would be useful in clarifying the relationship between the different morphotypes.

**C. fuscoatroides* J. Steiner (syn. *C. caesiorufa* auct., non (Ach.) Flagey, ?*C. ceracea* J. R. Laundon)

Black Sea coast: Distr. Burgas, Sinemorets, coastal rocks ca 2 km SE of village, alt. 10-30 m, 42°00'30'' N, 28°00' E, on coastal rocks under supralittoral conditions, 23 Aug 2004 (Sel. exs. *Caloplaca*, no. 17); Rezovo, coastal rocks N of the village, alt. ca 15 m, 42°00' N, 28°00' E, on coastal silicate rock, 13 Jul 2005 (CBFS 3209, 3246).

Note: This species commonly occurs on Bulgarian seashore rocks. Although not previously published from Bulgaria, the record of *C. caesiorufa* from the locality "Burgas" (Popnikolov & Železova 1964) may refer to *C. fuscoatroides*. The name *C. caesiorufa* was also used for *C. ceracea* in the British Isles (Laundon 1992b); after checking the type material of *C. ceracea* (BM, holotype!), we consider this species morphologically indistinguishable from the specimens of *C. fuscoatroides* occurring on the Black Sea coast.

C. granulosa (Müll. Arg.) Jatta

The Rhodopes: Distr. Plovdiv, Asenovgrad, Dobrostan, calcareous rocks around hut Martsiganitsa, ca 6 km W of village, alt. ca 1200 m, 41°56' N, 24°53' E, 25 Aug 2004 (CBFS 2116); Dobrostan, calcareous rocks in small polje ca 2 km W of village, alt. 1300 m, 41°56' N, 24°53' E, 25 Aug 2004 (CBFS 1995).

C. grimmiae (Nyl.) H. Olivier (syn. *C. congrediens* auct., non (Nyl.) Zahlbr., *C. consociata* J. Steiner)

Black Sea coast: Distr. Burgas, Sinemorets, coastal rocks ca 2 km SE of village, alt. ca 20 m, 42°00'30'' N, 28°00' E, on coastal rocks, parasite on *Candelariella vitellina*, 22 Aug 2004 (CBFS 2054); Rezovo, coastal rocks N of the village, alt. ca 5-10 m, 42°00' N, 28°00' E, on coastal siliceous rock, parasitic on *C. vitellina*, 13 Jul 2005 (CBFS 3238). **The Rhodopes**: Distr. Plovdiv, Asenovgrad, Dobrostan, nearby small polje ca 5 km W of village, alt. 1300 m, 41°56' N, 24°53' E, on exposed silicate stone, 25 Aug 2004 (CBFS 2115); Distr. Kurdzhali, Kirkovo, Bregovo, in valley of small afluent to river Vurbitsa ca 1 km S of village, alt. 280 m, 41°28' N, 25°25' E, on base-rich volcanic rock, 11 Aug 2004 (CBFS 2001); Distr. Haskovo, Madzharovo, by river Arda, 41°40' N, 25°50' E, on sunny volcanic rock, parasitic on *C. vitellina*, 27 Oct 2002 (CBFS 707).

Note: This species is strictly parasitic on *Candelariella vitellina*, its thallus consisting of inconspicuous brown areoles, with apothecia superficially similar to those of *Caloplaca viridirufa*.

C. herbidella (Hue) H. Magn.

Pirin Mts: Distr. Blagoevgrad, N part of Pirin National Park, by green marked path from hut Banderitsa to bivouac Kazana, ca 400-500 m N of hut Banderitsa, alt. 1830 m, on bark of *Pinus nigra*, 25 Jun 2004 (herb. Slavíková-Bayerová 3292).

Note: This species belongs to the *C. ferruginea* group and is characterized by the presence of granular to vertically elongated isidia on a grey to whitish thallus. *C. furfuracea* is a very similar species, but it never produces elongated isidia and has some apothecia with an outer thalline margin (Wetmore 2004).

C. holocarpa (HOFFM. EX ACH.) A. E. WADE (INCL. *C. pyracea* (ACH.) TH. FR.)

Black Sea coast: Distr. Burgas, Sinemorets, coastal rocks ca 2 km SE of village, alt. ca 15 m, 42°00'30'' N, 28°00' E, on dead shrub bark influenced by salt from sea, 22 Aug 2004 (CBFS 2119). **The Rhodopes**: Distr. Haskovo, Madzharovo, protected area "Momina Skala" ca 3 km WNW of town, alt. 200 m, 41°39' N, 25°51' E, on soft limestone boulder nearby river Arda, 18 Aug 2004 (CBFS 2143); Distr. Haskovo, Stambolovo, Byal Kladenets, limestone rocks in valley below village, alt. 350 m, 41°37' N, 25°40' E, on smooth bark of young *Fraxinus excelsior*, 17 Aug 2004 (CBFS 2167); Stambolovo, Rabovo nearby dam of lake "Studen Kladenets", alt. 250 m, 41°40' N, 25°40' E, on base-rich veathered volcanic rock, 18 Aug 2004 (CBFS 2234). **Mt Strandzha**: Burgas, Gramatikovo, oak forest near village, 27°38' N, 42°03' E, on bark of old *Quercus cerris*, 12 Jul 2005 (CBFS 3222).

Note: Some authors place corticolous and lignicolous ecotypes into the separate taxon, *C. pyracea* beside the saxicolous *C. holocarpa* (e.g. Clauzade & Roux 1985; Nimis & Tretiach 1999). Nevertheless, we have investigated both ecological variants in detail and consider them to be morphologically identical; therefore, we follow the broader concept of *C. holocarpa* (e.g. Diederich & Sérusiaux 2000).

**C. hungarica* H. MAGN. (SYN. *C. ferruginea* VAR. *hungarica* (H. MAGN.) CLAUZADE & CL. ROUX)

Pirin Mts: Distr. Blagoevgrad, N part of Pirin National Park, by green marked path from hut Banderitsa to bivouac Kazana, ca 1100-1200 m NW of hut Banderitsa, alt. 2100-2150 m, on branch of *Pinus nigra*, 25 Jun 2004 (herb. Slavíková-Bayerová 3300). **The Rhodopes**: Distr. Haskovo, Stambolovo, Rabovo nearby dam of lake "Studen Kladenets", alt. 250 m, 41°40' N, 25°40' E, on bark of *Pistacia terebinthus*, 18 Aug 2004 (CBFS 2214).

Note: This species is similar to *C. ferruginea*, but differs in having a very thin whitish thallus and is less ferrugineous, C- apothecia (see also Magnusson 1944).

**C. inconnexa* (NYL.) ZAHLBR. VAR. *inconnexa* (SYN. *C. tenuatula* SUBSP. *inconnexa* (NYL.) CLAUZADE & CL. ROUX)

The Rhodopes: Distr. Kurdzhali, Kurdzhali, Dolishte, limestone rocks in valley ca 1 km W of village, alt. 300 m, 41°38' N, 25°35' E, on hard limestone rock, on *Acarospora cervina*, *Aspicilia calcarea*, and *Placocarpus schaereri*, 16 Aug 2004 (CBFS 2098, 2109, 2194); Distr. Haskovo, Stambolovo, Byal Kladenets, limestone rocks in valley below village, alt. 350 m, 41°37' N, 25°40' E, on exposed hard limestone rock, 17 Aug 2004 (CBFS 2080).

Note: This species is usually characterized by a yellow to yellow-orange, parasitic thallus, which is usually incorporated among the areoles of a host lichen species (Poelt 1958). Nevertheless, mature thalli can be non-parasitic in later stages (e.g. Vězda 1970; Diederich & Sérusiaux 2000). According to Sipman & Raus (1999), the extent of parasitism and autotrophy cannot be exactly determined.

**C. inconnexa* VAR. *nesodes* POELT & NIMIS

Black Sea coast: Distr. Burgas, Sinemorets, coastal rocks ca 2 km SE of village, alt. 10-30 m, 42°00'30'' N, 28°00' E, on coastal rocks under supralittoral conditions, parasitic on *Aspicilia* sp., 23 Aug 2004 (Sel. exs. *Caloplaca*, no. 18).

Note: Bulgarian specimens agree well with the type material of *C. inconnexa* var. *nesodes* [Italy, GZU, holotype!]. *C. necator* Clauzade & Poelt, another species parasitic on silicicolous *Aspicilia* species, is a smaller lichen with smaller spores (Nimis & Poelt 1987).

C. lactea (A. MASSAL.) ZAHLBR. (SYN. *Gyalolechia lactea* (A. MASSAL.) ARNOLD)

The Rhodopes: Distr. Kurdzhali, Kurdzhali, Dolishte, limestone rocks in valley ca 1 km W of village, alt. 300 m, 41°38' N, 25°35' E, 16 Aug 2004 (CBFS 2238); Distr. Kurdzhali, Kurdzhali, Shiroko Pole, protected area "Sredna Arda", ca 5 km E of village, alt. ca 240 m, 41°37' N, 25°31' E, on calcareous boulder, 14 Aug 2004 (CBFS 2197); Distr. Haskovo, Stambolovo, Byal Kladenets, limestone rocks in valley below village, alt. 350 m, 41°37' N, 25°40' E, 17 Aug 2004 (CBFS 2235).

Note: This lichen is similar to *C. marmorata*, but differs in having paler, orange-red apothecia and distinctly shorter and thicker spores (Navarro-Rosinés & Hladun 1996).

**C. marmorata* (BAGL.) JATTA (SYN. *C. lactea* F. *rubra* (DE LESD.) ZAHLBR.)

The Rhodopes: Distr. Kurdzhali, Kurdzhali, Dolishte, limestone rocks in valley ca 1 km W of village, alt. 300 m, 41°38' N, 25°35' E, 16 Aug 2004 (CBFS 2243); Distr. Haskovo, Stambolovo, Byal Kladenets, limestone rocks in valley below village, alt. 350 m, 41°37' N, 25°40' E, on hard limestone rocks, 17 Aug 2004 (CBFS 2103).

**C. obscurella* (KÖRB.) TH. FR.

The Rhodopes: Distr. Plovdiv, Asenovgrad, Dolnoslav, in village, alt. 400 m, 41°55' N, 24°59' E, on bark of *Platanus acerifolia*, 26 Aug 2004 (CBFS 2126); Distr. Kurdzhali, Kurdzhali, Kaloyantsi, alt. 320 m, 41°38' N, 25°32' E, on bark of *Quercus frainetto*, 16 Aug 2004 (CBFS 2088); Distr. Kurdzhali, Kirkovo, Starovo, in forest ca 2 km E of village, alt. 390 m, 41°28' N, 25°25' E, on bark of *Q. frainetto*, 10 Aug 2004 (CBFS 2003); Distr. Kurdzhali, Momchilgrad, Ptichar, near railway station, alt. 320 m, 41°28' N, 25°25' E, on bark of *Pyrus communis*, 13 Aug 2004 (CBFS 2044); Distr. Haskovo, Madzharovo, protected area "Kovan Kaya" ca 3 km NNE of town, alt. 300 m, 41°39' N, 25°51' E, in old oak forest, on bark of *Q. frainetto*, 19 Aug 2004 (CBFS 2053); Distr. Haskovo, Stambolovo, Rabovo nearby dam of lake "Studen Kladenets", alt. 250 m, 41°40' N, 25°40' E, on bark of *Acer monspessulanum*, 18 Aug 2004 (CBFS 2014); Rabovo in Arda river valley, alt. 190 m, 41°40' N, 25°40' E, on bark of *Salix fragilis*, 18 Aug 2004 (CBFS 2022) and on bark of *Populus nigra*, mostly in lower part of trunk and on aboveground parts of roots (Sel. exs. *Caloplaca*, no. 13). **Mt Strandzha**: Distr. Burgas, Gramatikovo, oak forest near village, 27°38' N, 42°03' E, on bark of old *Quercus cerris*, 11 Jul 2005 (CBFS 3207).

Note: This rather inconspicuous species from the section *Pyrenodesmia* is usually sterile, but it is characterised by its crater-like soralia.

C. ochracea (SCHAER.) FLAGEY (SYN. *Blastenia ochracea* (SCHAER.) TREVIS., *Gyalolechia ochracea* (SCHAER.) SYD., *Xanthocarpia ochracea* (SCHAER.) A. MASSAL. & DE NOT.)

The Rhodopes: Distr. Kurdzhali, Kurdzhali, Dolishte, limestone rocks in valley ca 1 km W of village, alt. 300 m, 41°38' N, 25°35' E, hard limestone rock, 16 Aug 2004 (CBFS 2254).

Note: This species is the only European *Caloplaca* with 4-celled ascospores (Hafellner & Poelt 1979). It superficially resembles *C. lactea* and some forms of *C. adriatica*.

C. pellodella (NYL.) HASSE (SYN. *C. conglomerata* (BAGL.) JATTA, *C. amabilis* ZAHLBR.)

The Rhodopes: Distr. Haskovo, Madzharovo, protected area "Kovan Kaya" ca 3 km NNE of town, alt. 200 m, 41°39' N, 25°51' E, on base-rich volcanic boulders in Arda river valley, just above water level, 27 Oct 2002 and 19 Aug 2004 (CBFS 703, 2114).

Note: The lead-grey, squamulose thallus and apothecia with dark grey exciple are typical characters of this species (cf. Wetmore 1996). Two records are known from Bulgaria: valley of river Strouma and western pathhills of Pirin Mts (Pišút 1971, 2001).

**C. polycarpa* (A. MASSAL.) ZAHLBR. (SYN. *C. tenuatula* (NYL.) ZAHLBR.)

The Rhodopes: Distr. Kurdzhali, Kurdzhali, Dolishte, limestone rocks in valley ca 1 km W of village, alt. 300 m, 41°38' N, 25°35' E, 16 Aug 2004 (CBFS 2251); Distr. Haskovo, Stambolovo, Byal Kladenets, limestone rocks in valley below village, alt. 350 m, 41°37' N, 25°40' E, 17 Aug 2004 (CBFS 2236); Byal Kladenets, protected area "Golemya Sipey" S of village, alt. 420 m, 41°37' N, 25°40' E, 17 Aug 2004 (CBFS 2227). **Mt Strandzha**: Distr. Burgas, Malko Tarnovo, wasteland near town, 42°00' N, 27°30' E, on limestone outcrop, 11 Jul 2005 (CBFS 3244).

Note: The species is mostly parasitic on *Verrucaria calciseda*. When its yellow areolated thallus is indistinct, it resembles *Caloplaca holocarpa*.

C. rubelliana (ACH.) LOJKA

Black Sea coast: Distr. Burgas, Sinemorets, coastal rocks ca 2 km SE of village, alt. ca 5 m, 42°00'30'' N, 28°00' E, on coastal rocks in supralittoral zone, 22 Aug 2004 (CBFS 2107).

Note: This species is characterized by immersed apothecia without a true exciple. The hymenium is only up to 70 µm high and spores only 7.5- 9.5 × 4-5 µm in size (Wetmore & Kärnefelt 1999). One record is known from Bulgaria: valley of river Strouma (Pišút 1995). We have seen *C. rubelliana* only once in the supralittoral zone of the Black Sea. It is also known from the Black Sea coastal rocks of the Crimea Peninsula of the Ukraine (Khodosovtsev 2002).

C. saxicola (HOFFM.) NORDIN (SYN. *C. murorum* (HOFFM.) TH. FR., *C. tegularis* AUCT., NON (EHRH.) ZAHLBR.)

Black Sea coast: Distr. Burgas, Sinemorets, coastal rocks ca 2 km SE of village, alt. ca 10 m, 42°00'30'' N, 28°00' E, sunny coastal silicate rock, 22 Aug 2004 (CBFS 2250). **The Rhodopes**: Distr. Kurdzhali, Kurdzhali, Dolishte, limestone rocks in valley ca 1 km W of village, alt. 300 m, 41°38' N, 25°35' E, on hard limestone rock, 16 Aug 2004 (CBFS 2085); Distr. Haskovo, Lyubimets, Malko Gradishte, rocks nearby hill "Sveta Marina" ca 5 km SW of village, alt. 600 m, 41°44' N, 26°00' E, on exposed, lime-enriched porose volcanic rock, 19 Aug 2004 (CBFS 2052).

Note: *C. saxicola* is a variable species from the section *Gasparrinia*. It contains conspicuously lobate forms as well as forms with strongly reduced thallus (Wade 1965; Nordin 1972). *C. saxicola* also includes forms strongly pruinose as well as apruinose.

C. saxifragarum POELT (SYN. *C. pyracea* F. *microcarpa* (ANZI) DALLA TORRE & SARNTH.)

Pirin Mts: Distr. Blagoevgrad, N part of Pirin National Park, by green marked path from hut Banderitsa to bivouac Kazana, ca 400 m E of bivouac Kazana, alt. 2413 m, 41°46'12.7'' N, 23°24'35.5'' E, on lignificated part of *Potentilla* growing on limestone with *C. tiroliensis*, 25 Jun 2004 (herb. Slavíková-Bayerová 3315, 3316; CBFS 3007).

Note: This little known taxon from the *C. holocarpa* group is characterized by its small apothecia and a specific ecology, being arctic-alpine lichen found on plant stems and debris (cf. Poelt 1955). Its relationship with other species of the *C. holocarpa* group, namely *C. thuringiaca*, is unclear and needs further investigation. Only a few records are known from Bulgaria, all from Pirin Mts (cf. Mayrhofer et al. 2005).

C. stillicidiorum (VAHL) LYNGE (SYN. *C. cerina* F. *chloroleuca* SM., *C. cerina* VAR. *stillicidiorum* (VAHL) TH. FR.)

The Rhodopes: Distr. Plovdiv, Asenovgrad, Dobrostan, calcareous rocks in small polje ca 5 km W of village, alt. 1300 m, 41°56' N, 24°53' E, muscicolous on *Homalothecium sericeum*, *Pseudoleskeella catenulate*, and *Schistidium* cf. *crassipilum*, 25 Aug 2004 (CBFS 1992, Sel. exs. *Caloplaca*, no. 12).

Note: This species belongs to the *C. cerina* group and differs from similar taxa by its yellow-grey pruinose apothecial discs. Such pruinose apothecia occasionally occur within populations of *C. cerina* s. str., therefore, the relation of both species needs further investigation.

C. subsoluta (NYL.) ZAHLBR. (SYN. *C. irrubescens* (NYL. EX ARNOLD) ZAHLBR.)

The Rhodopes: Distr. Kurdzhali, Dzhebel, Rogozche, rocks in Vurbitsa river valley near railway station, alt. 300 m, 41°28' N, 25°25' E, 12 Aug 2004 (CBFS 2007); Distr. Kurdzhali, Kirkovo, Bregovo, in valley of small afluent to river Vurbitsa ca 1 km S of village, alt. 280 m, 41°28' N, 25°25' E, 11 Aug 2004 (CBFS 2038); Distr. Kurdzhali, Momchilgrad, Ptichar, rocks in Vurbitsa river valley, alt. 300 m, 41°28' N, 25°25' E, 12 Aug 2004 (CBFS 2034); Distr. Haskovo, Madzharovo, protected area "Kovan Kaya" ca 3 km NNE of town, alt. 240 m, 41°39' N, 25°51' E, 19 Aug 2004 (CBFS 2149); Distr. Haskovo, Stambolovo, Rabovo rocks above village, alt. 280 m, 41°40' N, 25°40' E, 18 Aug 2004 (CBFS 2025).

Note: This easily recognisable taxon (Wetmore 2003) is one of the most frequent *Caloplaca* species on sunny volcanic rocks in the eastern Rhodopes.

C. teicholyta (ACH.) J. STEINER (SYN. *C. caliacrae* CREȚIOU, *C. arenaria* AUCT. P.P., NON (PERS.) MÜLL. ARG., *C. erythrocarpa* AUCT., NON (PERS.) ZWACKH)

The Rhodopes: Distr. Kurdzhali, Kurdzhali, Dolishte, limestone rocks in valley ca 1 km W of the village, alt. 300 m, 41°38' N, 25°35' E, on hard limestone rock, 16 Aug 2004 (CBFS 2087); Distr. Haskovo, Stambolovo, Byal Kladenets, limestone rocks in valley below village, alt. 350 m, 41°37' N, 25°40' E, on hard limestone rock, 17 Aug 2004 (CBFS 2074).

Note: *C. teicholyta* has an orbicular thallus delimited by short lobes; it has a roughly sorediate to blastidiate centre, and is usually sterile. Richly fertile forms have often been named *C. arenaria*.

C. thallincola (WEDD.) DU RIETZ

Black Sea coast: Distr. Burgas, Sinemorets, coastal rocks ca 2 km SE of village, alt. 0-10 m, 42°00'30" N, 28°00' E, on coastal rocks under littoral conditions, 23 Aug 2004 (CBFS 2247, Sel. exs. *Caloplaca*, no. 20).

Note: This species from the *C. aurantia* group forms a conspicuous component in maritime supralittoral lichen communities. It has already been reported from the Bulgarian Black Sea coast by Vězda (Lich. sel. exs., no. 1363, PRM!).

**C. tiroliensis* ZAHLBR.

Pirin Mts: Distr. Blagoevgrad, N part of Pirin National Park, by green marked path from hut Banderitsa to bivouac Kazana, ca 400 m E of bivouac Kazana, alt. 2413 m, 41°46'12.7" N, 23°24'35.5" E, on lignificated part of *Potentilla* growing on limestone, intermixed in populations of *Caloplaca saxifragarum*, 25 Jun 2004 (herb. Slavíková- Bayerová 3315, 3316).

Note: *C. tiroliensis* is chararacterized by its yellow-greyish apothecia and invisible thallus. It differs from species of the *C. holocarpa* group (incl. *C. saxifragarum* and *C. schoeferi*), by the yolk yellow colour of its apothecia and from *C. stillicidiorum* by its yellow apothecial margin (Poelt 1955). Bulgarian material has been compared with samples of *C. tiroliensis* from the Alps deposited in GZU.

C. variabilis (PERS.) MÜLL. ARG.

The Rhodopes: Distr. Kurdzhali, Kurdzhali, Dolishte, limestone rocks in valley ca 1 km W of village, alt. 300 m, 41°38' N, 25°35' E, 16 Aug 2004 (CBFS 2094); Distr. Haskovo, Stambolovo, Byal Kladenets, limestone rocks in valley below village, alt. 350 m, 41°37' N, 25°40' E, 17 Aug 2004 (CBFS 2077, 2089); Byal Kladenets, edge of protected area "Golemya Sipey" S of village, alt. 420 m, 41°37' N, 25°40' E, 17 Aug 2004 (CBFS 2082).

C. viridirufa (ACH.) ZAHLBR. (SYN. *C. aractina* (FR.) HÄYRÉN, *C. fuscoatra* AUCT., NON (DECUILLE) ZAHLBR.)

Black Sea coast: Distr. Burgas, Sinemorets, coastal rocks ca 2 km SE of village, alt. 0-10 m, 42°00'30" N, 28°00' E, on

coastal rocks in supralittoral zone, 23 Aug 2004 (CBFS 2248, Sel. exs. *Caloplaca*, no. 16). **The Rhodopes**: Distr. Haskovo, Stambolovo, Rabovo rocks above village, alt. 280 m, 41°40' N, 25°40' E, base-rich volcanic rock, 18 Aug 2004 (CBFS 2042).

Note: *C. viridirufa* is characterized by its grey thallus with conspicuous glossy blackish prothallus. Its apothecia have orange-red to black discs surrounded by a blackish true exciple. This taxon has been named *C. aractina* for a long time. However, *C. aractina* is conspecific with *C. viridirufa*, which has priority (Vondrák & Vitikainen, *unpubl.*). Apart from the inland locality, it is one of the dominant species on coastal rocks around the Black Sea. The occurrence of *C. viridirufa* on coastal rocks is well-known from Scandinavia (Nordin 1972).

C. xantholyta (NYL.) JATTA (SYN. *Leproplaca xantholyta* (NYL.) HUE)

The Rhodopes: Distr. Kurdzhali, Kurdzhali, Dolishte, limestone rocks in valley ca 1 km W of village, alt. 300 m, 41°38' N, 25°35' E, 16 Aug 2004 (CBFS 2091); Distr. Haskovo, Stambolovo, Byal Kladenets, limestone rocks in valley below village, alt. 350 m, 41°37' N, 25°40' E, 17 Aug 2004 (CBFS 2078).

**C. xerica* POELT & VĚZDA

The Rhodopes: Distr. Haskovo, Lyubimets, Malko Gradishte, rocks nearby hill "Sveta Marina" ca 5 km SW of village, alt. 600 m, 41°44' N, 26°00' E, on exposed Ca-enriched volcanic rock, 19 Aug 2004 (CBFS 2177, 2179, 2181).

Note: *C. xerica* is similar to *C. spalatensis* (= *C. areolata*), but clearly differs by its lobulate thallus surface. Moreover, *C. spalatensis* is a calcicolous species occurring on bird-perching places (Martellos & Nimis 2000), whilst *C. xerica* usually grows on base-rich xerothermic silicate rocks (Poelt 1975). At its only known Bulgarian locality, *C. xerica* forms a large population.

ACKNOWLEDGEMENTS

We are grateful to the curators of the herbaria mentioned in the text for their valuable help with the loan of material, to Dr Ulf Arup and Dr Pere Navarro-Rosinés for their comments on several *Caloplaca* samples, to Jiří Košnar for his determination of bryophytes, and to Prof. Mark Seaward for linguistic corrections to the text.

REFERENCES

Arup, U. 2006. A new taxonomy of the *Caloplaca citrina* group in the Nordic countries, except Iceland. – Lichenologist 38: 1-20.

Arup, U. & Grube, M. 1999. Where does *Lecanora demissa* (Ascomycota, *Lecanorales*) belong? – Lichenologist 31: 419-430.

Clauzade, G. & Roux, C. 1985. Likenoj de Okcidenta Europo. Ilustrita Determinlibro. – Bulletin de la Société Botanique du Centre-Ouest, Nouvelle Série, Numéro Spécial 7. Royan, France.

Diederich, P. & Sérusiaux, E. 2000. The lichens and lichenicolous fungi of Belgium and Luxembourg. An annotated checklist. Musée National d'Histoire Naturelle, Luxembourg.

Egea, J.M. & Llimona, X. 1983. *Caloplaca furax* Egea & Llimona, un nuevo liquen parasito sobre *Aspicilia* silicilolas, en la Sierra del Relumbrar (Albacete, SE de Espana). – Collectanea Botanica 14: 265-269.

Gaya, E., Lutzoni, F., Zoller, S. & Navarro-Rosinés, P. 2003. Phylogenetic study of *Fulgensia* and allied *Caloplaca* and *Xanthoria* species. – American Journal of Botany 90: 1095-1103.

Hafellner, J. & Poelt, J. 1979. Die Arten der Gattung *Caloplaca* mit plurilocularen Sporen (*Meroplacis*, *Triophthalmidium*, *Xanthocarpia*). – Journal of the Hattori Botanical Laboratory 46: 1-41.

Kärnefelt, I. 1989. Morphology and phylogeny in the *Teloschistales*. – Cryptogamic Botany 1: 147-203.

Khodosovtsev, O.Y. 2002. [New for Ukraine and rare species of the genus *Caloplaca* Th . Fr. (*Teloschistaceae*) from southern Ukraine]. – Ukrayinskyi Botanichnyi Zhurnal 59: 321-329. (In Ukrainian)

Laundon, J.R. 1992a. *Caloplaca*. – In: O.W. Purvis, B.J. Coppins, D.L. Hawksworth, P.W. James & D.M. Moore [eds]. The Lichen Flora of Great Britain and Ireland, pp. 141-159. Natural History Museum Publications & British Lichen Society, London.

Laundon, J.R. 1992b. New British species of *Caloplaca*. – Lichenologist 24: 1-5.

Magnusson, A.H. 1944. Studies in the *Ferruginea*-group of the genus *Caloplaca*. – Göteborgs Kungliga Vetenskaps- och Vitterhets Samhället Handlingar, Sjätte Följden, Ser. B, 3(1): 1-71.

Martellos, S. & Nimis, P.L. 2000. Checklist of Italian Lichens 3.0 (http://dbiodbs.univ.trieste. it/global/italic1). [last visit Oct., 2005]

Meyer, B. & Printzen, C. 2000. Proposal for a standardized nomenclature and standardization of insoluble lichen pigments. – Lichenologist 32: 571-583.

Mayrhofer, H., Denchev, C.M., Stoykov, D.Y. & Nikolova, S.O. 2005. Catalogue of the lichenized and lichenicolous fungi in Bulgaria. – Mycologia Balcanica 2: 3-61.

Navarro-Rosinés, P. & Hladun, N.L. 1996. Les especies saxícolo-calcícolas del grupo de *Caloplaca lactea* (*Teloschistacceae*, líquenes), en las regiones mediterranea y medioeuropea. – Bulletin de la Société Linnéenne de Provence 47: 139-166.

Nimis, P.L. & Martellos, S. 2003. A second checklist of the lichens of Italy with thesaurus of synonyms. Museo Regionale di Scienze Naturali, Aosta.

Nimis, P.L. & Poelt, J. 1987. The lichens and lichenicolous fungi of Sardinia (Italy): an annotated list. – Studia Geobotanica 7 (Supplement 1): 1-269.

Nimis, P.L. & Tretiach, M. 1999. Itinera Adriatica – Lichens from the eastern part of the Italian peninsula. – Studia Geobotanica 18: 51-106.

Nordin, I. 1972. *Caloplaca* sect. *Gasparrinia* in Nordeuropa. Taxonomiska och Ekologiska Studier. Skriv Service AB, Uppsala.

Pišút, I. 1971. Interessante Flechtenfunde aus Mittel-, Süd- und Südosteuropa. – Fragmenta Balcanica, Musei Macedonici Scientarum Naturalium 8: 165-169.

Pišút, I. 1995. Interessante Flechtenfunde aus Mittel-, Süd- und Südosteuropa 2. – In: Farkas, E.E., Lücking, R, & Wirth, V. [eds]: Scripta Lichenologica – Lichenological Papers Dedicated to Antonín Vězda. – Bibliotheca Lichenologica 58: 281-287.

Pišút, I. 2001. Beitrag zur Kenntnis der Flechten Bulgariens III. – Acta Rerum Naturalium Musei Nationalis Slovaci, Bratislava 47: 21-25.

Poelt, J. 1955. Mitteleuropäische Flechten III. – Mitteilungen der Botanischen Staatssammlung München 2: 46-56.

Poelt, J. 1958. Über parasitische Flechten. II. – Planta 51: 288-307.

Poelt, J. 1975. Mitteleuropäische Flechten X. – Mitteilungen der Botanischen Staatssammlung München 12: 1-32.

Popnikolov, A. & Železova, B. 1964. [Flora of Bulgaria. Lichens]. Narodna Prosveta, Sofia. (In Bulgarian)

Santesson, R., Moberg, R., Nordin, A., Tønsberg, T. & Vitikainen, O. 2004. Lichen-forming and Lichenicolous Fungi of Fennoscandia. Museum of Evolution, Uppsala University, Uppsala.

Sérusiaux, E., Diederich, P., Brand, A.M. & van den Boom, P. 1999. New or interesting lichens and lichenicolous fungi from Belgium and Luxembourg. VIII. – Lejeunia 162: 1-95.

Sipman, H. & Raus, T. 1999. A lichenological comparison of the Paros and Santorini island groups (Aegean, Greece), with annotated checklist. – Willdenowia 29: 239–297.

Søchting, U. & Lutzoni, F. 2003. Molecular phylogenetic study at the generic boundary between the lichen-forming fungi *Caloplaca* and *Xanthoria* (Ascomycota, *Teloschistaceae*). – Mycological Research 107: 1266-1276.

Tønsberg, T. 1992. The sorediate and isidiate, corticolous, crustose lichens in Norway. – Sommerfeltia 14: 1-331.

Tretiach, M., Pinna, D. & Grube, M. 2003. *Caloplaca erodens* [sect. *Pyrenodesmia*], a new lichen species from Italy with an unusual thallus type. – Mycological Progress 2: 127-136.

van den Boom, P., Sérusiaux, E., Diederich, P., Brand, M., Aptroot, A. & Spier, L. 1998. A lichenological excursion in May 1997 near Han-sur-Lesse and Saint-Hubert, with notes on rare and critical taxa of the flora of Belgium and Luxembourg. – Lejeunia 158: 1-58.

Vězda, A. 1970. Neue oder wenig bekannte Flechten in der Tschechoslowakei. I. – Folia Geobotanica et Phytotaxonomica 5: 307-337.

Wade, A.E. 1965. The genus *Caloplaca* Th. Fr. in the British Isles. – Lichenologist 3: 1-28.

Wetmore, C.M. 1996. The *Caloplaca sideritis* group in North and Central America. – The Bryologist 99: 292-314.

Wetmore, C.M. 2001. The *Caloplaca citrina* group in North and Central America. – The Bryologist 104: 1-11.

Wetmore, C.M. 2003. The *Caloplaca squamosa* group in North and Central America. – The Bryologist 106: 147-156.

Wetmore, C.M. 2004. The isidiate corticolous *Caloplaca* species in North and Central America. – The Bryologist 107: 284-292.

Wetmore, C.M. & Kärnefelt, I. 1999. What is *Caloplaca cinnabarina*? – The Bryologist 102: 683-691.

Wirth, V. 1995. Die Flechten Baden-Württembergs, Teil 1 & 2. Eugen Ulmer GmbH & Co., Stuttgart.

Wunder, H. 1974. Schwartzfrüchtige, saxicole Sippen der Gattung *Caloplaca* (Lichenes, *Teloschistaceae*) in Mitteleuropa, dem Mittelmeergebiet und Vorderasien. – Bibliotheca Lichenologica 3: 1-186.

LICHENICOLOUS FUNGI ON *Caloplaca*

VONDRÁK J. & KOCOURKOVÁ J.:

NEW LICHENICOLOUS *Opegrapha* SPECIES ON *Caloplaca* FROM EUROPE
(accepted in The Lichenologist)

NEW LICHENICOLOUS *Opegrapha* SPECIES ON *Caloplaca* FROM EUROPE

JAN VONDRÁK[1] & JANA KOCOURKOVÁ[2]

[1] J. Vondrák: Department of Botany, Faculty of Science, University of South Bohemia, Branišovská 31, 370 05, České Budějovice, Czech Republic, j.vondrak@seznam.cz

[2] National Museum, Department of Mycology, Václavské nám. 68, Praha 1, CZ-115 79 Czech Republic, jana_kocourkova@nm.cz

Abstract: Fifty-six known lichenicolous, non-lichenized *Opegrapha* (*Roccellaceae*, *Arthoniales*) species (containing some non-described taxa) are listed here, from which five are known from *Caloplaca* (*Teloschistaceae*, *Teloschistales*). *Opegrapha vulpina* is described here from Europe as a new lichenicolous fungus on endolithic *Caloplaca* subg. *Pyrenodesmia* (*Caloplaca erodens* and rarely *C. albopruinosa*). *Opegrapha hellespontica* lichenicolous on *Caloplaca aurantia* is described here from European part of Turkey. Two possible sibling species of *Opegrapha rupestris* s. l. lichenicolous on *Caloplaca cirrochroa*, resp. *C. variabilis* s. l. are involved in the paper but still remain undescribed.

Key words: *Arthoniales*, *Caloplaca*, lichenicolous fungi, *Opegrapha hellespontica*, *Opegrapha vulpina*, *Roccellaceae*.

INTRODUCTION

The large cosmopolitan genus *Opegrapha* (*Roccellaceae*, *Arthoniales*, sensu Eriksson 2006) contains mainly lichenized fungi, but a number of non-lichenized, lichenicolous fungi have also been described. Fifty-six lichenicolous species of *Opegrapha* are listed in Table 1 (with their heterotypic synonyms); more than one third were described from tropical regions, often from foliicolous lichens, and only 23 species are known from Europe. The majority of these lichenicolous *Opegrapha* species are strongly host specific (to one species or to a group of closely related species). Some lichenicolous species, formerly placed in *Opegrapha*, have been segregated into the genus *Plectocarpon* (Ertz et al. 2005) or are being replaced to *Phacothecium* (Hafellner, *pers. comm.*).

Only a few species are known from members of *Teloschistaceae*. *Opegrapha physciaria* (syn. *Phacothecium varium* (Tul.) Trevis.) was described from *Xanthoria parietina* (Nylander 1897). However, *O. physciaria* with its brown-black rounded apothecia and exposed discs seems, for example, to be closely related to *O. rotunda* and *O. zwackhii* (cf. Hafellner 1994a) and it is obviously different from species lichenicolous on *Caloplaca* discussed here. *O. physciaria* was also reported on *Caloplaca rosei* Hasse (Cole & Hawksworth 2001) from North America, but the respective specimen was revised by D. Ertz as *Stigmidium cerinae* s.l. (Ertz & Egea 2008).

In the protologue of *Opegrapha insidens*, three different hosts are indicated: *Caloplaca circumalbata* var. *candida*, *C. pyracea* and *Verrucaria buschirensis*, but this name needs neotypification (type specimen is missing from W and WU) and its type host should be selected.

During our fieldwork and revision of herbarium material, some lichenicolous *Opegrapha* on thalli of various species of *Caloplaca* (*Teloschistaceae*) were collected: *C. albopruinosa* (syn. *C. agardhiana* auct.), *C. aurantia*, *C. erodens*, *C. cirrochroa* and *C. variabilis* s. l. All investigated *Opegrapha* samples are morphologically similar and probably related to *O. rupestris*. *Opegrapha rupestris* s. l., is introduced here as a provisional group containing morphologically uniform species, lichenicolous on various calcicolous lichens and possessing slit-like, rather unexposed apothecial discs and 3-septate ascospores, 13–22 ± 5–8 µm, hyaline, but brown and finely granular when old.

MATERIALS AND METHODS

The majority of the examined material was collected by the authors; vouchers are deposited in CBFS and PRM. Additional material was obtained from herbaria C, GZU, PRM and TSB.

The light microscopy measurements used for statistical calculations were performed on hand-cut sections and squash preparations under an oil-immersion lens after pre-treatment with 10% KOH solution in water. Accuracies

of 0.5 µm (conidia and ascospores), eventually 1 µm (asci and exciple) and 10 µm (hymenium and apothecia) were achieved. The size of ascospores was determined without the perispore, and all cell measurements included their walls. The measurements are given as (min.–) X±SD (–max.), where X = mean value and SD = standard deviation. Total numbers of measurements (n) are given in parentheses. Measurements were taken from all available samples, but pycnidia were not observed in some samples.

Macro- and micro-photographs were taken with a digital camera Olympus C5050 on Olympus SZX 9 Stereomicroscope and Olympus BX 50 (to x 1250) fitted with a Nomarski differential interference contrast.

The nomenclature of lichenicolous *Opegrapha* species and their hosts follows the references in Table 1. The nomenclature of the other lichen-forming fungi and lichenicolous fungi follows Nimis & Martellos (2003) or Santesson et al. (2004).

Material used for comparison.

Opegrapha parasitica. **Romania**: *Dobrogea*: Tulcea, Enisala, on *Aspicilia calcarea*, 2007, *J. Vondrák* (CBFS JV5134, dupl. PRM 857468). **Turkey**: *Black Sea coast*: Sinop, Ayancik, on *A. calcarea*, 2007, *J. Vondrák* (CBFS JV5138, dupl. PRM 857469). **Ukraine**: *Crimean Peninsula*: Karadag, on *A. calcarea*, 2007, *J. Vondrák* (CBFS JV5133, dupl. PRM 857467); *Crimean Peninsula*: Demerji Yayla, on *A. calcarea*, 2006, *J. Vondrák* (CBFS JV5949).

Opegrapha rupestris. **Bulgaria***: The Rhodopes*: Devin, Trigrad, on *Verrucaria calciseda*, 2002, *J. Vondrák* (CBFS JV747). **Czech Republic**: *Central Bohemia*: Beroun, Srbsko, on *V.* cf. *calciseda*, 2004, Ibid. 2006, *J. Vondrák* (CBFS JV2470, 4917); *Ibid*., 2001, *J. Kocourková* (PRM 896009). *South Moravia*: Blansko, Skalní Mlýn, on *Verrucaria baldensis* and *V. parmigerella*, 2005, *J. Kocourková* (PRM 909041). **Italy**: *Sicily*: Distr. Cágliari, Beggerru, on endolithic *Verrucaria*, 1986, *H. Mayrhofer* (GZU); Distr. Siracusa, Cap Campolato, on *Verrucaria* sp., 1969, *S. Svane* (C). **Slovak Republic**: *Western Slovakia*: Západné Tatry Mts, on *Verrucaria* cf. *calciseda*, 1990, *J. Horáková* (PRM 758582). **Serbia**: *Cupria*, 1970, *S. Svane* (C, sub *Melaspilea elisae*). **Turkey**: *Black Sea coast*: Istambul, Kemerburgaz, on limestone rock in supralittoral zone, on *Verrucaria* sp., 2005, *J. Vondrák* (CBFS JV3378). **Ukraine**: *Crimean Peninsula*: Karadag, on *Verrucaria* cf. *calciseda*, 2007, *J. Vondrák* (CBFS JV5469).

THE SPECIES

Opegrapha hellespontica VONDRÁK & KOCOURK. NOM. PROV.

MycoBank no.: MB 511609

Typus. **Turkey**. *Gallipoli Peninsula* (*Gelibolu yarimadasi*): coast of Dardanelles, SE-exposed coastal limestone cliffs 1 km NE of Abide monument, alt. *c.* 5 m, 40°03'12.27"N, 26°13'41.24"E, on thallus of *Caloplaca aurantia*, 11 April 2007, *J. Vondrák* (CBFS JV5137 - Holotypus, PRM 857463 - Isotypus, other isotypi will be distributed in exs. Lichenotheca Graecensis).

Vegetative thallus non-lichenized, lichenicolous in the thallus of *Caloplaca aurantia* (Pers.) Hellb., inconspicuous, immersed in the host tissues, formed by colourless hyphae, hardly distinguishable from the host hyphae. Infection is most frequently observed in central part of the host thallus and avoids its marginal lobes (Fig. 1A). The fungus seems not to cause any conspicuous necroses, but strong infections may cause fragmentation of the host thallus (Fig. 1B). Ascomata lirelliform or ellipsoid apothecia (Fig. 1C), sessile, (0.24–) 0.46±0.13 (–0.73) × (0.15–) 0.24±0.04 (–0.31) mm (n=20), usually gathered into tight round aggregates (0.3–) 0.7±0.2 (–1.0) mm in diam. (n=10) (Fig. 1D). Apothecial primordia and young apothecia round, *c.* 0.13–0.18 mm in diam. Apothecial disc a slit or slightly exposed when old, black, epruinose. Exciple carbonized, (20–) 50±19 (–80) µm thick (n=19), formed of paraplectenchymatous irregularly thick-walled cells, (4.5–) 6.25±1.0 (–8.0) µm in diam. (n=15). Width of exciples increases proportionally to size of apothecia. Hymenium hyaline, (80–) 103±14 (–130) µm high (n=15). Epihymenium covered by brown granules non-dissolving in KOH and HNO_3. Subhymenium colourless, *c.* 30–40 µm high, formed of prosoplectenchymatous, *c.* 2–4 µm thick cells, oil-drops up to 4 µm in diam. occasionally present. Hypothecium brown-black, *c.* 20–30 µm high. Paraphysoids branched and anastomosing, *c.* 1.5–3 µm thick, with brown pigmented, broadened tips, up to 5 µm. Asci fissitunicate, narrowly clavate with a

tholus and internal apical beak, *Opegrapha*-type, (6–7–) 8-spored, (46–) 60±9 (–71) × (15–) 16±1 (–19) µm (n=12), length/width ratio *c.* 3.75. Ascospores 3-septate, narrowly ellipsoid to slightly clavate, up to maturity hyaline, (14.0–) 16.75±1.25 (–19.0) × (5.0–) 6.5±0.75 (–7.5) µm (n=26), length/width ratio *c.* 2.6, halonate, with perispore *c.* 0.5–1.5 µm thick (not always observable) and spore wall *c.* 0.5 µm thick. Old ascospores brownish, with fine granular ornamentation. Conidiomata not seen.

Chemical reactions. Hymenium and upper hypothecium I+ red (epihymenium I+ blue), hymenium KI+ blue. Granules in the exciple and epihymenium K-, N-.

Etymology. Hellespontos is an old Greek name for the famous Dardanelles between the Sea of Marmara and the Mediterranean Sea, where the type material of the new species was collected.

Ecology and distribution. The new species is apparently host specific on the thallus of *Caloplaca aurantia*, a common calcicolous lichen occurring throughout Europe, the Near East and North Africa. Since no lichenicolous *Opegrapha* have been reported on this widely distributed host, *O. hellespontica* may be a rare species currently known only from the type locality, on the European side of the Dardanelles. The type locality is on limestone in the xeric supralittoral zone, where the host species grows in a species-poor lichen community, with *Aspicilia contorta* subsp. *hoffmanniana*, *Caloplaca* cf. *navasiana*, *Candelariella oleaginescens*, *Diplotomma albotrum* s.l., *Lecanora dispersa* and *Toninia aromatica*. In the type locality, *C. aurantia* is infected with other lichenicolous fungi, namely *Cercidospora caudata*, *Intralichen christiansenii* and *Muellerella lichenicola*.

Remarks. Although known only from the type locality, we consider it as a good species, distinguished from the similar *Opegrapha rupestris* s. l. by its apothecia gathered in large round aggregations (Fig. 1D). It is also characterized by having long lirellae and a less exposed disc (compared with *O. parasitica*, *O. rupestris* and *O.* aff. *rupestris* 1 & 2; Table 2) and by larger ascospores and apothecia (compared with *O. vulpina*; Table 2).

Opegrapha vulpina VONDRÁK, KOCOURK. & TRETIACH NOM. PROV.

MycoBank no.: MB 511610

Typus: **Czech Republic**. *South Moravia*: Pavlovské vrchy hills, Mikulov, Pavlov, ruin of castle Děvičky, *c.* 1 km W of village, alt. 422 m, 48°52'32.9"N, 16°39'41.6"E, parasitic on thallus of *Caloplaca erodens*, on W-exposed limestone rock, 15 April 2005, *J. Vondrák & J. Šoun* (CBFS JV4926 - Holotypus; GZU - Isotypus).

Vegetative thallus non-lichenised, lichenicolous in the thallus of *Caloplaca erodens*, rarely in *C. albopruinosa*, inconspicuous, immersed in the host thallus, formed by colourless hyphae, hardly distinguishable from the host hyphae. The fungus appears not to cause any conspicuous damage to its host. Ascomata apothecia, usually gathered into irregular dark patches on host thallus (Fig. 2A-C), simple (or rarely loosely aggregated), always round, sessile, (0.11–) 0.2±0.04 (–0.3) mm in diam. (n=73). Apothecia perithecium-like at first (Fig. 2D), later discoid, with slightly exposed, black, epruionose disc up to 150 µm in diam. Exciple carbonized, (20–) 48±14 (–70) µm thick (n=30), broader in upper part, formed of ± paraplectenchymatous thick-walled cells in outer part (*c.* 4–8 µm in diam.) but of ± elongated cells in inner part adjacent to the hymenium. Hymenium hyaline, (70–) 90±11.5 (–110) µm high (n=17). Epihymenium covered by brown granules non-dissolving in KOH and HNO_3. Subhymenium pale to colourless, *c.* 30–40 µm high, formed of prosoplectenchymatous, *c.* 2.5–4 µm thick cells, oil-drops up to 4 µm in diam. occasionally present. Hypothecium brown-black, *c.* 20–30 µm thick. Paraphysoids strongly branched and anastomosing, *c.* 2–2.5 µm thick, with brown pigmented, broadened tips, up to 5.5 µm. Asci fissitunicate, narrowly clavate (Fig. 2E) with a tholus and internal apical beak, *Opegrapha*-type (Fig. 3A), 8-spored, (39–) 51±5 (–67) × (13–) 16±2 (–21) µm (n=33), length/width ratio *c.* 3.2. Ascospores 3-septate, narrowly ellipsoid to slightly clavate, up to maturity hyaline, (11.5–) 14.5±1.4 (–18.0) × (5.0–) 6.0±0.7 (–8.0) µm (n=74), length/width ratio *c.* 2.4, halonate (Fig. 2F), with perispore *c.* 0.5–1 µm thick (not always observable) and spore wall *c.* 0.5 µm thick. Old ascospores brownish, with fine granular ornamentation. Conidiomata black pycnidia, *c.* 80–130 µm in diam., semi-immersed. Conidiogenous cells elongate-ampulliform, arising singly, enteroblastic, acrogennous (Fig. 3B), *c.* 8–12 × 2–4 µm. Conidia narrowly ellipsoid to bacilliform, rarely somewhat curved, (3.0–) 4.5±0.6 (–5.0) ± (1.0–) 1.2±0.3 (–2.0) µm (n=33).

Chemical reactions. Hymenium and upper hypothecium I+ red (epihymenium I+ blue), hymenium KI+ blue. Granules in the exciple and epihymenium K-, N-.

Etymology. As the species is presently known mainly from the Czech Republic, it is named after the important Czech lichenologist and our friend, Jiří Liška (his surname means fox in English = *Vulpes* in Latin).

Ecology and distribution. *Opegrapha vulpina* is only known from from eight sites in the limestone area "Pavlovské vrchy" hills in South Moravia, Czech Republic (alt. *c.* 230–450 m), one locality in Dobrogea (alt. *c.* 70 m), East Romania, and three sites in Italian Apennines (alt. *c.* 900–1500 m). The species specifically affects thalli of *Caloplaca erodens* (or its related species *C. albopruinosa* in Dobrogean locality). Both hosts are often predominant in lichen communities on sun-exposed, hard limestone outcrops. The main accompanying species are *Arthonia lapidicola*, *Caloplaca aurantia*, *C. dichroa*, *C. saxicola*, *Candelariella aurella*, *C. medians*, *Catillaria lenticularis*, *Lecanora crenulata* and *L. dispersa*.

Apart from *Opegrapha vulpina*, *C. erodens* can be affected by *Intralichen christiansenii* (our observations), *Muellerella lichenicola* (Hafellner & Muggia 2006) and a *Polysporina* species (personal observations of Iranian and Turkish samples, CBFS JV5139, dupl. PRM 857465, CBFS JV5142, dupl. PRM 857464). Apothecia of the *Polysporina* species are superficially indistinguishable from those of *O. vulpina*. The central parts of the thallus of *C. erodens* are sometimes overgrown by *Caloplaca* sp., *Candelariella aurella* and young thalli of *Diplotomma venustum* agg. (Hafellner & Muggia 2006). *Intralichen christiansenii* was observed in the hymenium of *Opegrapha vulpina* (CBFS JV5135).

Contrary to the restricted and disjunct distribution of *O. vulpina*, its main host species, *Caloplaca erodens*, is already known from Austria (Hafellner & Muggia 2006), Bulgaria (Vondrák & Slavíková-Bayerová 2006), Czech Republic (Vondrák et al. 2007), Greece (Vondrák et al. 2008), Italy (Tretiach et al. 2003) and the Near East (Vondrák, unpubl. data).

Remarks. The new species is described as an *Opegrapha* since it possesses characteristic asci and carbonized raised true exciple. *Arthonia* differs in the absence of a carbonized exciple and in its broadly clavate ascus, and *Dactylospora* has asci with a non-amyloid ascus wall and amyloid gelatinous outer cap (e.g. Hafellner 1979, Triebel 1989). Other similar genera, *Bactrospora*, *Chiodecton*, *Enterographa*, *Lecanactis*, *Lecanographa*, *Phacothecium*, *Plectocarpon*, *Schismatomma* and *Sclerophyton* differ significantly in the characteristics of their ascospores, asci, exciple, etc. (Torrente & Egea 1989, Egea & Torrente 1994, Ertz et al. 2005).

Apart from its host specificity, *Opegrapha vulpina* is clearly characterized by its round apothecia and small ascospores (vs. *O.* aff. *rupestris* 1 & 2, and *O. hellespontica*), and by the small size of its apothecia, black disc, and thicker ascospores (vs. *O. physciaria*). *O. parasitica* (on *Aspicilia calcarea*) and *O. rupestris* (on *Verrucaria* sp.) occur in similar habitats as the new species, but differ in their larger and shortly lirelliform apothecia and larger ascospores (Table 2).

Additional specimens examined. **Czech Republic**: *South Moravia*: Mikulov, northern peak of Mt Šibeničník ca 2 km S of the town, alt. 249 m, 48°47'21.5"N, 16°37'48.0"E, 14 April 2005, *J. Vondrák & J. Šoun* (CBFS JV4925); Mikulov, limestone rocks at the foot of the hill Svatý kopeček, at the eastern edge of the town, alt. 300 m, 19 May 2004, *J. Vondrák, M. Bartoš & J. Šoun* (C, MIN, UPS: in samples Sel. Exs. *Caloplaca* 5, *Caloplaca erodens*), Mikulov, Bavory, protected area "Tabulová", rocks on SW slope of Mt Stolová hora, alt. 375 m, 48°50'11.5"N, 16°38'14.8"E, 15 April 2005, *J. Vondrák & J. Šoun* (CBFS JV4924); Mikulov, Horní Věstonice, rock Martinka at W-slope of hill Obora, alt. 400 m, 48°51'56.35"N, 16°38'5.94"E, 21 Jan. 2007, *J. Vondrák* (CBFS JV4960); *Ibid.*: alt. 420 m, 48°51'57.13"N, 16°38'8.37"E (CBFS JV4962, hb. L. Muggia); Mikulov, Klentnice, ruin of "Sirotčí hrádek" castle, 48°50'44.63"N, 16°38'25.59"E, 20 May 2004, *J. Vondrák* (CBFS JV4979); Mikulov, Klentnice, locality Soutěska, alt. 420 m, 48°51'52.45"N, 16°38'38.71"E, 21 Jan. 2007, *J. Vondrák* (CBFS JV4970, hb. L. Muggia). **Italy**. *Abruzzo*: prov. L'Aquila, Rocca Calascio, alt. *c.* 1200 m, 4 June 2004, *M. Tretiach* (TSB 38950, sub *Opegrapha saxatilis*); prov. L'Aquila, Rovere, alt. 1440 m, 23 June 2001, *M. Tretiach & D. Pinna* (TSB 34330, sub *Opegrapha saxatilis*); *Marche*: prov. Ascoli Piceno, Monti Sibillini, at road to Pretare, close to Piana di Castelluccio, alt. 920 m, 5 June 2004, *M. Tretiach* (TSB 38953, sub *Opegrapha saxatilis*). **Romania**. *Dobrogea*: Tulcea, Enisala, limestone outcrops *c.* 200 m SE of Enisala castle ruin, alt. 70 m, on *Caloplaca albopruinosa*, 44°52'56.03"N, 28°50'12.41"E, 3 April 2007, *J. Vondrák* (CBFS JV5135, dupl. PRM 857466).

***Opegrapha* AFF. *rupestris* 1** (ON *Caloplaca cirrochroa*, FIG. 4) **& *O.* AFF. *rupestris* 2** (ON *C. variabilis*

S.L.)

We are unable to distinguish these possibly distinct species from *O. rupestris* s. str., which is confined to calcicolous *Verrucaria* species, by means of only morphological characters and chemical reactions. Specimens on both hosts possess shortly lirelliform apothecia, up to 0.6 mm long, and 3-septate ascospores, *c.* 15–19 × 5–7 µm. For other characters see Table 2. Unfortunately, most of the examined material is not well developed and has only a few, poorly developed ascocarps. Better developed material and molecular investigations are needed to determine if these taxa are distinct species.

Specimens examined. ***Opegrapha*** **aff. *rupestris* 1**. **Czech Republic**: *West Bohemia*: Horažďovice, Žichovice, 2007, *J. Vondrák* (CBFS JV 5017); South Moravia: Blansko, "Pustý žleb" glen, rocks below Blansek castle ruin, 2004, *J. Kocourková* (PRM 909049). **Greece**: *Crete*: Lasithi, Vai, on coastal rocks, 1976, *H. Mayrhofer* (GZU). **Italy**: *Sicily*: Distr. Messina, Roccafiorita, 1969, *S. Svane* (C). **Malta**: *Mellieha*, 1989, *M.S. Christiansen* (C, sub *Opegrapha parasitica*).

Opegrapha **aff. *rupestris* 2. Czech Republic:** *South Moravia*: Blansko, "Suchý žleb" glen, 2003, *J. Kocourková* (PRM 909034); Blansko, "Pustý žleb" glen, rocks below Blansek castle ruin, 2004, *J. Kocourková* (PRM 909045). **Slovakia**: High Tatra Mts, Skalné vráta, 1999, *J. Kocourková* (PRM 909035).

ACKNOWLEDGEMENT

We are grateful to Dr Zdenek Pouzar (Praha, CZ) for checking Latin diagnoses, Josef Hafellner (Graz, A), Kerry Knudsen (Riverside, USA), Walter Obermayer (Graz, A) and Kateřina Švehlová (České Budějovice, CZ) for their useful comments, Mark Seaward (Bradford, UK) for his valuable comments and linguistic corrections and Mauro Tretiach (Trieste, I) for providing material of *Opegrapha vulpina* from Italy. This project was supported by the Grant Agency of the Academy of Sciences of the Czech Republic, KJB 601410701 to J. Vondrák and by the Ministry of Culture of the Czech Republic, MK00002327201 to J. Kocourková.

REFERENCES

Alstrup, V. & Hawksworth, D. L. (1990) The lichenicolous fungi of Greenland. *Meddelelser om Gronland, Bioscience* **31**: 1-90.

Aptroot, A., Diederich, P., Sérusiaux, E. & Sipman, H. (1997) Lichens and lichenicolous fungi from New Guinea. *Bibliotheca Lichenologica* **64**: 1-220.

Atienza, V. (1992) *Peridiothelia oleae* (Körber) D. Hawksw. and *Opegrapha physciaria* (Nyl.) D. Hawksw. & Coppins, two poorly known west Mediterranean fungal taxa. *Anales del Jardín Botánico de Madrid* **50**: 159-162.

Clauzade, G., Diederich, P. & Roux, C. (1989) Nelikenigintaj fungoj likenlogaj. Ilustrita determinlibro. *Bulletin de la Société Linnéenne de Provence, Numéro Spécial* **1**: 1-142.

Cole, M. S. & Hawksworth, D. L. (2001) Lichenicolous fungi, mainly from the USA, including *Patriciomyces* gen. nov. *Mycotaxon* **77**: 305-338.

Coppins, B. J. (1987) Two new lichenicolous species of *Opegrapha* from western Scotland. *Notes from the Royal Botanical Garden Edinburgh* **44**: 601-606.

Coppins, B. J. & James, P. W. (1979) New or interesting British lichens IV. *The Lichenologist* **11**: 139-179.

Coppins, B. J., James, P. W. & Hawksworth, D.L. (1992) New species and combinations in the lichen flora of Great Britain and Ireland. *The Lichenologist* **24**: 351-369.

Coppins, B. J. & Kondratyuk, S. Y. (1998) *Opegrapha trassii* sp. nov., a new lichenicolous fungus on *Heterodermia*. *Folia Cryptogamica Estonica* **32**: 9-14.

Diederich, P. (2003) New species and new records of American lichenicolous fungi. *Herzogia* **16**: 41–90.

Egea, J. M. & Torrente, P. (1994) El Género de Hongos Liquenizados *Lecanactis* (Ascomycotina). *Bibliotheca Lichenologica* **54**: 1-205.

Eriksson, O. E. (ed.) (2006) Outline of Ascomycota - 2006. *Myconet* **12**: 1-82.

Ertz, D., Christnach, C., Wedin, M. & Diederich, P. (2005) A world monograph of the genus *Plectocarpon* (*Roccellaceae, Arthoniales*). *Bibliotheca Lichenologica* **91**: 1-155.

Ertz, D. & Diederich, P. (2003) *Opegrapha cladoniicola*, a new lichenicolous fungus from Hawaii. *The Lichenologist* **35**: 147-

149.

Ertz, D., Diederich, P. & Miadlikowska, J. (2004) The lichenicolous *Opegrapha* species (*Roccellaceae*, Ascomycota) with 3-septate ascospores on *Pertusaria* and *Ochrolechia*. *Botanical Journal of the Linnean Society* **144**: 235-241.

Ertz, D., Egea, J. M. (2008) Opegrapha In: *Lichen Flora of the Greater Sonoran Region*, Vol. 3. (Nash III, T. H. et al., eds.): Lichens Unlimited, Arizona State University, Tempe. (*in press*)

Etayo, J. (1996) Aportación a la flora liquénica de las Islas Canarias. I. Hongos liquenícolas de Gomera. *Bulletin de la Société Linnéenne de Provence* **47**: 93-110.

Etayo, J. (2002) Aportación al conocimiento de los hongos liquenícolas de Colombia. *Bibliotheca Lichenologica* **84**: 1-154.

Etayo, J. & van den Boom, P. P. G., (2006) Some lichenicolous fungi from Guatemala, with the description of a new species. *Herzogia* **19**: 191-197.

Follmann, G. & Werner, B. C. (2003) lichenicolous fungi occurring on *Roccellaceae* (*Arthoniales*). I. New species from South America. *Journal of the Hattori Botanical Laboratory* **94**: 261-292.

Hafellner, J. (1979) *Karschia*. Revision einer Sammelgattung an der Grenze von lichenisierten und nichtlichenisierten Ascomyceten. *Beihefte zur Nova Hedwigia* **62**: 1-248.

Hafellner, J. (1985) Studien uber lichenicole Pilze und Flechten IV. Die auf *Brigantiaea*-Arten beobachteten Ascomyceten. *Herzogia* **7**: 163-180.

Hafellner, J. (1994a) Beiträge zu einem Prodromus der lichenicolen Pilze Österreichs und angrenzender Gebiete. I. Einige neue oder seltene Arten. *Herzogia* **10**: 1-28.

Hafellner, J. (1994b) Über Funde lichenicoler Pilze und Flechten auf Korsika (Frankreich). *Bulletin de la Société Linnéenne de Provence* **44**: 219-234.

Hafellner, J. (2002) Bemerkenswerte Funde von Flechten und lichenicolen Pilzen auf makaronesischen Inseln VI. Über einige Neufunde. *Fritschiana* **36**: 11-17.

Hafellner, J. & Muggia, L. (2006) Über Vorkommen von *Caloplaca erodens* in der Steiermark (Österreich). Mitteilungen der Naturwissenschaftlichen Vereines für Steiermark **135**: 33-49.

Harris, R. C. & Ladd, D. (2007) New taxa of lichens and lichenicolous fungi from the Ozark Ecoregion. *Opuscula Philolichenum* **4**: 57-68.

Isbrand, S. & Alstrup, V. (1992) *Opegrapha sphaerophoricola* sp. nov. *The Bryologist* **95**: 233-234.

Kalb, K. & Elix, J. A. (1995) The lichen genus *Physcidia*. *Bibliotheca Lichenologica* **57**: 265-296.

Kalb, K., Hafellner, J., Staiger, B. (1995) Lichenicole Pilze auf Arten der Flechtengattung *Haematomma*. *Bibliotheca Lichenoloica* **59**: 199-222.

Kondratyuk, S. Y. & Galloway, D. J. (1995) Lichenicolous fungi and chemical patterns in *Pseudocyphellaria*. *Bibliotheca Lichenologica* **57**: 327-345.

Kondratyuk, S. Y. & Kudratov, I. (2002) *Opegrapha romsae* sp. nova (*Arthoniales*), a new lichenicolous fungus from Tajikistan. *Ukrayins'kyi Botanichnyi Zhurnal* **59**: 420-425.

Lücking, R. (1998). Foliicolous lichens and their lichenicolous fungi collected during the Smithsonian International Cryptogamic Expedition to Guyana 1996. *Tropical Bryology* **15**: 45-76.

Lücking, R., Diederich, P. & Etayo, J (2000) *Checklist of foliicolous lichens and their lichenicolous fungi. Part* **2**: *Lichenicolous fungi*. (http://www.uni-bayreuth.de /departments/planta2/ass/robert/lichens/checkfun.html) [last visit July, 2007].

Matzer, M. (1996) *Lichenicolous Ascomycetes with Fissitunicate Asci on Foliicolous Lichens*. Wallingford: Mycological Papers, 171, CAB International.

Moreau, F. (1951) Sur une Dothidéacée parasite du lichen *Anaptychia speciosa* (Wulfen) Massalongo. *Bulletin de la Société Botanique de France* **98**: 208-209.

Navarro-Rosinés, P. & Hladun, N. L. (1995) *Opegrapha rouxiana* sp. nov., nelikeniginta fungo likenloga ce enpetraj *Polyblastia. Bulletin de la Société Linéenne de Provence* **46**: 85-90.

Nimis, P. L. (2003) *Checklist of the Lichens of Italy 3.0.* Trieste: University of Trieste, Dept. of Biology, IN3.0/2 (http://dbiodbs.univ.trieste.it/). [last visit July, 2007].

Nimis, P. L. & Martellos, S. (2003). *A second checklist of the lichens of Italy with thesaurus of synonyms*. Aosta: Museo Regionale di Scienze Naturale.

Nylander, W. (1897) *Supplément aux lichens des environs de Paris*. Paul Schmidt, Paris.

Pentecost, A. & James, P. W. (1992) *Opegrapha*. In: *The Lichen Flora of Great Britain and Ireland* (O. W. Purvis, B. J. Coppins, D. L. Hawksworth, P. W. James & D. M. Moore, eds.): 404–415. London: Natural History Museum Publications & British Lichen Society.

Santesson, R. (1952) Foliicolous lichens I. A revision of the taxonomy of the obligately foliicolous, lichenized fungi. *Symbolae*

Botanicae Upsalienses **12**: 1-590.

Santesson, R. (2001) Fungi Lichenicoli Exsiccati. Fascicles 13 & 14 (Nos 301-350). *Thunbergia* **31**: 1-18.

Santesson, R., Moberg, R., Nordin, A., Tønsberg, T. & Vitikainen, O. (2004) Lichen-forming and lichenicolous fungi of Fennoscandia. Uppsala: Museum of Evolution, Uppsala University.

Thor, G., Lücking, R. & Matsumoto, T. (2000) The foliicolous lichens of Japan. *Symbolae Botanicae Upsalienses* **32**: 1-72.

Torrente, P. & Egea, J. M. (1989) La familia *Opegraphaceae* en el Area Mediterránea de la Península Ibérica y Norte de Africa. *Bibliotheca Lichenologica* **32**: 1-282.

Tretiach, M., Pinna, D. & Grube, M. (2003) *Caloplaca erodens* (sect. *Pyrenodesmia*), a new lichen species from Italy with an unusual thallus type. *Mycological Progress* **2**: 127-136.

Triebel, D. (1989) Lecideicole Ascomyceten. Eine Revision der obligat lichenicolen Ascomyceten auf lecideoiden Flechten. *Bibliotheca Lichenologica* **35**: 1-278.

Vězda, A. (1969) Beitrage zur Kenntnis der flechtenbewohnenden Pilze in der Tschechoslowakei. II. -Zwei neue Arten: *Opegrapha rinodinae* sp. nov. und *Polycoccum galligenus* sp. nov. *Česká Mykologie* **23**: 104-109.

Vondrák, J. & Slavíková-Bayerová, Š. (2006) Contribution to the lichenized and lichenicolous fungi in Bulgaria. II, the genus *Caloplaca*. *Mycologia Balcanica* **3**: 61-69.

Vondrák, J., Kocourková, J., Palice, Z. & Liška, J. (2007) New and noteworthy lichens in the Czech Republic – genus *Caloplaca*. *Preslia* **79**: 163-184.

Vondrák, J., Mayrhofer, H. & Guttová, A. (2008) A contribution to the knowledge of lichen-forming and lichenicolous fungi in Crete. *Herzogia* **21** (*in press*).

Vouaux, A. (1913) Synopsis des champignons parasites des lichens. *Bulletin de la Société mycologique de France* **29**: 33-128, 399-494.

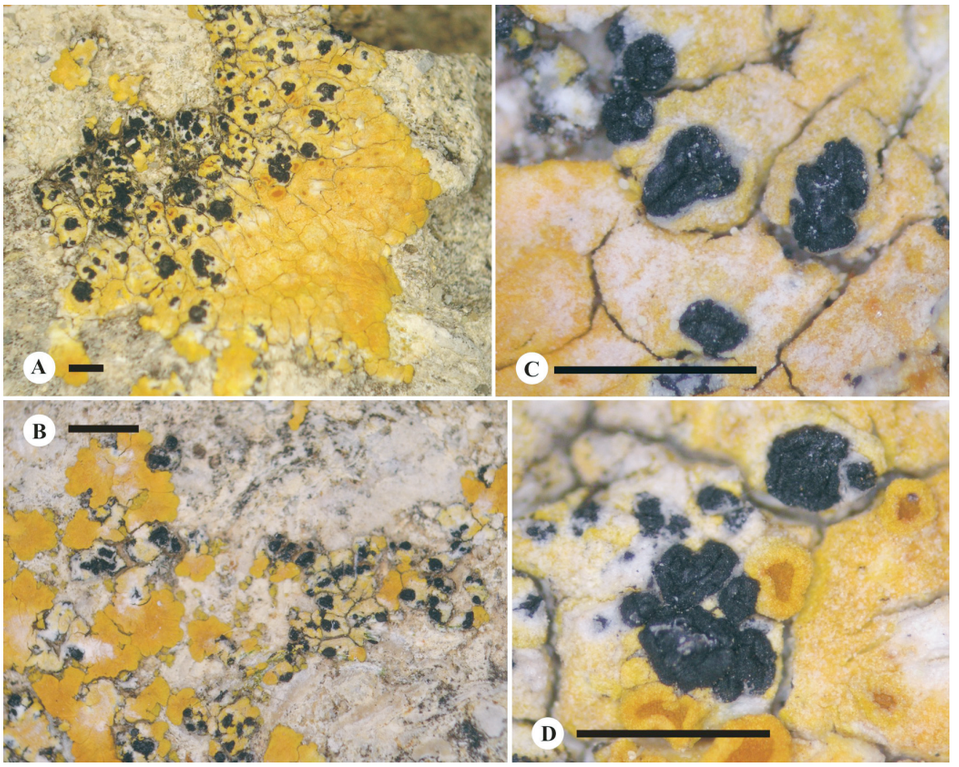

Fig. 1. *Opegrapha hellespontica* (holotype). A, strongly infected central part of host thallus; B, strong infection causing fragmentation of the host thallus; C, detail of apothecia; D, apothecia gathered into tight round aggregate. Scales: A, C, D = 1mm, B = 2mm.

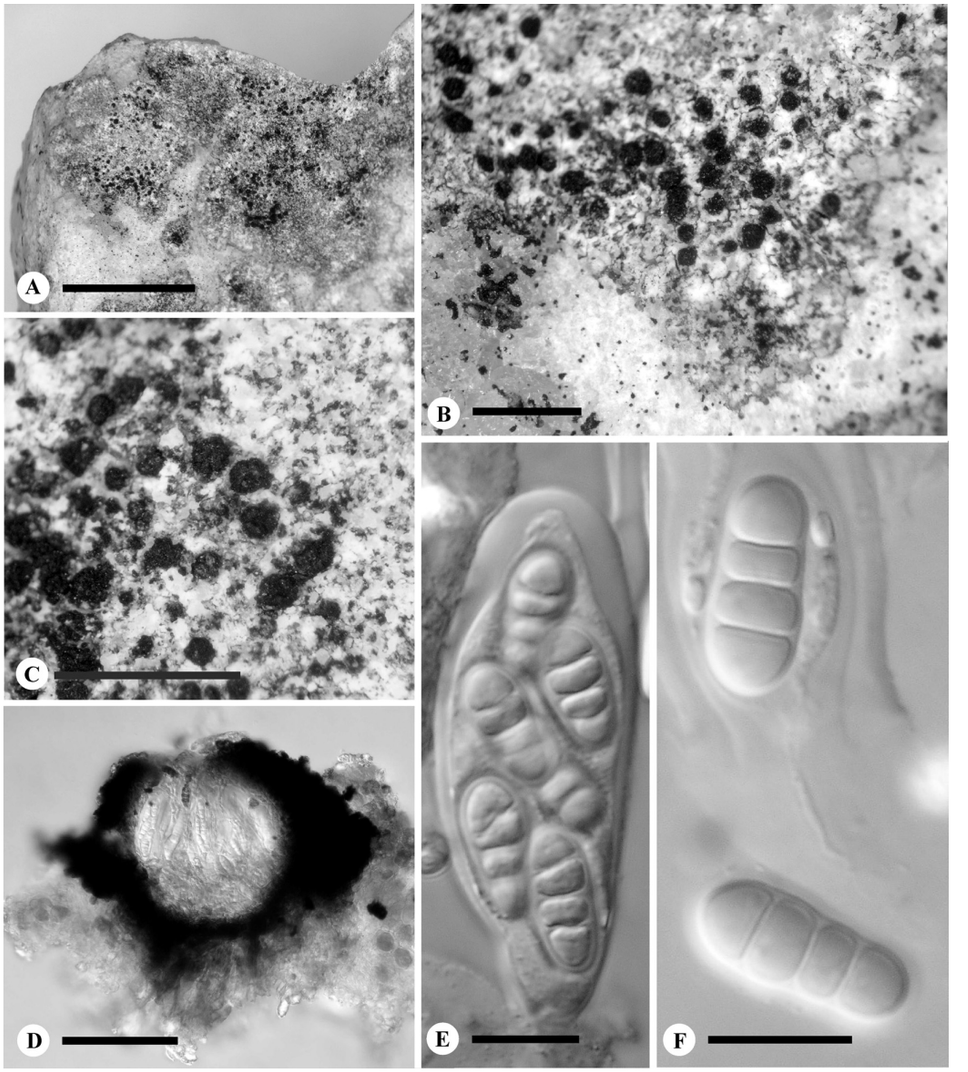

Fig. 2. *Opegrapha vulpina*. A, strongly infected host thallus (isotype); B, C, details of apothecia (isotype, holotype); D, section of an apothecium; E, ascus; F, young ascospores with perispore (CBFS JV4979). Scales: A = 5 mm, B, C = 1 mm, D = 50 µm, E, F = 10 µm.

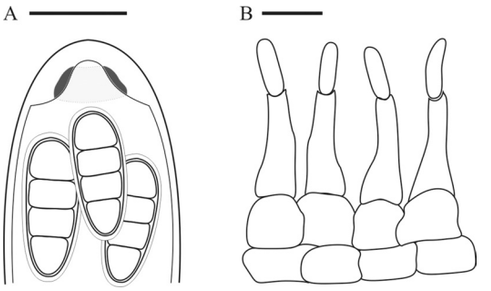

Fig. 3. *Opegrapha vulpina* (holotype). A, apical part of ascus with the ocular chamber and the amyloid ring structure in tholus, *Opegrapha*-type, observed in KI; B, conidiophores with attached conidia. Scales: A = 10 µm, B = 5 µm.

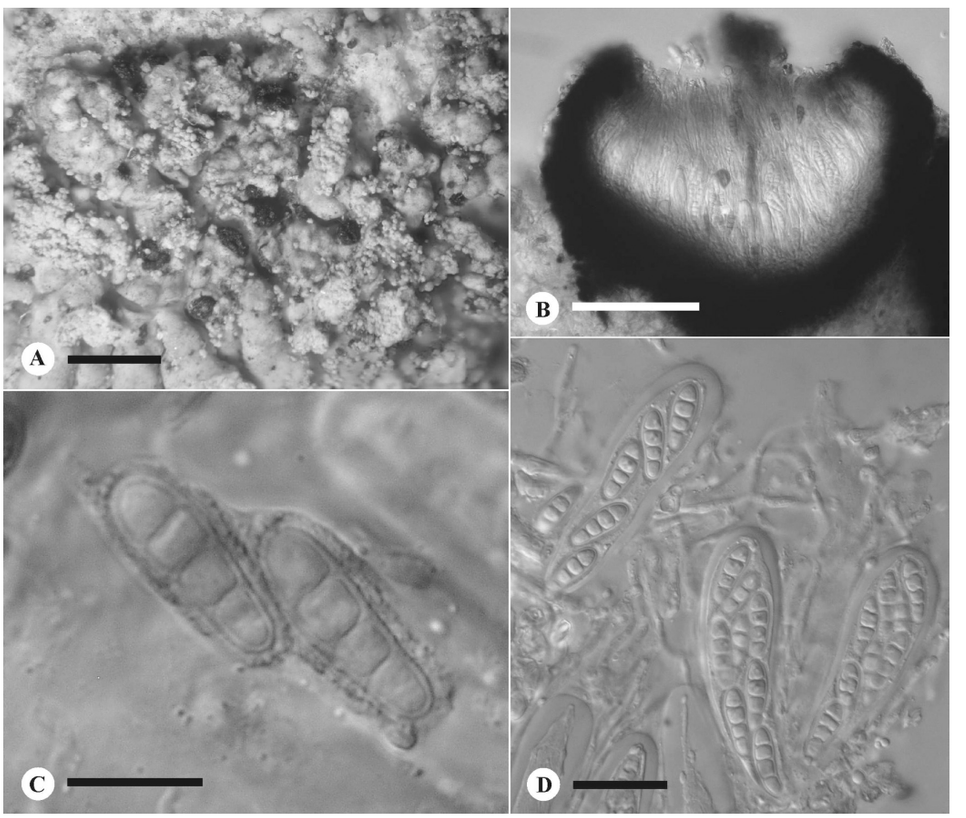

Fig. 4. *Opegrapha* aff. *rupestris* on *Caloplaca cirrochroa* (PRM 909034). A, apothecia in central part of host thallus; B, section of an apothecium; C, slightly overmature, pale brown ascospores; D, asci. Scales: A = 1 mm, B = 100 µm, C = 10 µm, D = 20 µm.

Tab. 1. List of lichenicolous, non-lichenized *Opegrapha* species. The species indicated by an asterisk are known from Europe. Type host species are in bold.

Species	Host	References
**Opegrapha anomea* Nyl. (syn.: *Opegrapha wetmorei* Cole & D. Hawksw., *O. pertusariae* (Vouaux) Hafellner, *O. quaternella* Nyl., and possibly *Leciographa weissii* Körb.)	***Pertusaria amara***, *P. epixantha*, *P. exalbescens*, *P. velata*, *Pertusaria* sp., *Ochrolechia trochophora*, *O. androgyna*, *Opchrolechia* sp.	Vouaux (1913: 440), Hafellner (1994a), Cole & Hawksworth (2001), Ertz et al. (2004), Santesson et al. (2004)
Opegrapha bacidiae R. Sant. nom. ined.	***"Bacidia" brasiliensis***	Santesson (1952), Clauzade et al. (1989), Matzer (1996)
Opegrapha blakii Ertz & Diederich	***Ochrolechia*** aff. ***androgyna***, sterile, corticolous, sorediate, K-, C+ red, KC+ red, UV-	Ertz et al. (2004)
**Opegrapha brevis* Coppins	***Thelotrema petractoides*** (syn. *Thelotrema subtile* auct. brit.)	Coppins (1987)
Opegrapha brevissima Kalb & Hafellner	***Haematomma hilare***	Kalb et al. (1995)
Opegrapha brigantina Hafellner	*Brigantiaea leucoxantha*, ***B. microcarpa***	Hafellner (1985)
Opegrapha cladoniicola Ertz & Diederich	***Cladonia ochrochlora***	Ertz & Diederich (2003)
Opegrapha cryptotheciae Matzer	***Cryptothecia candida***	Matzer (1996)
Opegrapha diffracticola R. C. Harris & Ladd	***Bacidia diffracta***	Harris & Ladd (2007)
Opegrapha ectolechiacearum Matzer (syn. *Opegrapha sporopodii* R. Sant. nom. inval.)	*Calopadia fusca*, *Loflammia flammea*, *Sporopodium flavescens*, ***S. leprieurii***	Matzer (1996), Lücking et al (2000)
Opegrapha epiporina Matzer (syn. *Opegrapha porinae* Lücking nom. inval.)	***Porina epiphylla***, *Phyllophiale alba*	Matzer (1996)
Opegrapha encephalographoidea Diederich & Aptroot	***Pyrenula sp***.	Aptroot et al. (1997)
Opegrapha foreaui (Moreau) Hafellner & R. Sant. (syn. *O. trassii* S.Y. Kondr. & Coppins)	*Heterodermia albicans*, *H. lepidota*, *H. leucomelaena*, *H. leucomela*, *H. leucomela* ssp. *boryi*, *H. magelanica*, *H. obscurata*, *H. pseudospeciosa*, ***H. speciosa***, *H*. sp.	Moreau (1951), Coppins & Kondratyuk (1998), Hafellner (2002)
**Opegrapha geographicola* (Arnold) Hafellner	***Rhizocarpon geographicum***	Hafellner (1994a)
**Opegrapha glaucomaria* (Nyl.) Källsten ex Hafellner (syn. *Opegrapha maculans* (Arnold) Hafellner)	*Lecanora bicincta*, ***Lecanora rupicola***, *Protoparmelia badia*	Hafellner (1994a, b), Santesson et al. (2004)
**Opegrapha hellespontica* Vondrák & Kocourk.	***Caloplaca aurantia***	this paper
Opegrapha insidens (J. Steiner) S. Y. Kondr.	*Verrucaria buschirensis*, *Caloplaca circumalbata* var. *candida*, *C. pyracea*	Vouaux (1913: 492), Kondratyuk & Kudratov (2002)
Opegrapha kalbii Matzer	***Byssoloma polychromum***	Matzer (1996)
**Opegrapha lamyi* (O.J. Rich. ex Nyl.) Triebel	**corticolous *Lecanora*** sp., (*Lecanora subfusca* gr.)	Triebel (1989), Hafellner (1994a)
Plectocarpon leuckertii (S.Y. Kondr. & Galloway) Ertz & Diederich (syn. *Opegrapha leuckertii* S. Y. Kondr. & Galloway)	***Pseudocyphellaria intricata***, *P. norvegica*	Kondratyuk & Galloway (1995), Ertz et al. (2005)
Opegrapha lichenicola Thor, Lücking & Tat. Matsumoto	***Porina*** sp.	Thor et al (2000)
Opegrapha maligna Triebel	***Lecidea fuscoatra***	Triebel (1989)
Opegrapha matzeri Lücking	***Amazonomyces sprucei***	Lücking (1998)
Opegrapha mazosiae Matzer	***Mazosia melanophtalma***, *M. phyllosema*, *M. rotula*	Matzer (1996)
Opegrapha melanospila Müll. Arg.	***Pertusaria perforata*** var. ***ciliata***, *Parmotrema* sp., *Rimelia reticulata*	Clauzade et al. (1989), Santesson (2001), Etayo (2002), Diederich (2003), Etayo & Boom (2006)
**Opegrapha parasitica* (A. Massal.) H. Olivier (syn. *O. parasitica* var. *mutilata* (Arnold) H. Olivier; *O. persoonii* auct. brit.)	***Aspicilia calcarea***	Hafellner (1994a)

**Opegrapha peltigerae* R. Sant. nom. ined.	***Peltigera aphtosa***	Santesson et al. (2004)
Opegrapha perturbans Follmann	***Ingaderia pulcherrima***	Folman & Werner (2003)
**Opegrapha pertusariicola* Coppins & P. James	***Pertusaria leioplaca***	Coppins & James (1979), Pentecost & James (1992)
**Opegrapha phlyctidicola* (Vouaux) Etayo	***Phlyctis agelaea***, *Phlyctis argena*	Etayo (1996)
Opegrapha phyllobathelii Matzer & R. Sant.	***Phyllobathelium epiphyllum***	Matzer (1996)
Opegrapha phylloporinae Müll. Arg.	***Porina epiphylla***, *P. conica*, *P. epiphylla* coll., *P.* cf. *lucida*, *P. similis*, *P. virescens*	Clauzade et al. (1989), Matzer (1996)
**Opegrapha physciaria* (Nyl.) D. Hawksw. & Coppins (syn. *Phacothecium varium* (Tul.) Trevis.)	***Xanthoria parietina***	Nylander (1897: 8, 9), Atienza (1992), Coppins et al. (1992)
Opegrapha physcidiae Kalb & Elix	***Physcidia australasica***	Kalb & Elix (1995)
Opegrapha plectocarpoidea Diederich	***Phaeographis*** sp.	Aptroot et al. (1997)
Opegrapha porinicola Matzer	***Porina epiphylla***, *P. mirabilis*, *Phyllophiale alba*	Matzer (1996), Lücking (1998)
**Opegrapha pulvinata* Rehm	*Catapyrenium*, ***Dermatocarpon miniatum***, *Endocarpon pusillum*, *Staurothele catalepta*	Pentecost & James (1992), Kondratyuk & Kudratov (2002), Nimis (2003)
Opegrapha reinkellae Follmann	***Roccella lirellina***	Folman & Werner (2003)
**Opegrapha rinodinae* Vězda	***Phaeorhiza nimbosa***	Vězda (1969), Clauzade et al. (1989), Hafellner (1994a)
Opegrapha romsae S.Y. Kondr. & Kudratov	***Staurothele areolata***	Kondratyuk & Kudratov (2002)
**Opegrapha rotunda* Hafellner	***Physconia distorta***	Hafellner (1994a)
**Opegrapha rouxiana* Nav.-Ros. & Hladun	***Polyblastia nidulans***	Navarro-Rosinés & Hladun (1995)
**Opegrapha rupestris* Fr. (syn. *O. centrifuga* A. Massal.; *Opegrapha persoonii* Ach.)	*Thelidium incavatum*, ***Verrucaria calciseda***, *Verrucaria* subg. *Baglietoa, V. hochstetteri*	Hafellner (1994a), Kondratyuk & Kudratov (2002)
**Opegrapha* aff. *rupestris* 1 (syn. *O. parasitica* auct. brit. p.p.)	*Caloplaca cirrochroa*	Pentecost & James (1992), this paper
**Opegrapha* aff. *rupestris 2*	*Caloplaca variabilis*	this paper
Opegrapha sipmanii Matzer	***Porina epiphylla***, *Porina epiphylla* coll., *P. mirabilis*	Matzer (1996), Lücking (1998)
**Opegrapha sphaerophoricola* Isbrand & Alstrup	***Sphaerophorus globosus***	Isbrand & Alstrup (1992)
Opegrapha sporopodiae R. Sant. nom. ined.	on foliose foliicolous lichens	Santesson (1952), Clauzade et al. (1989)
**Opegrapha stereocaulicola* Alstrup & D. Hawksw.	***Stereocaulon alpinum*** and *Stereocaulon* sp.	Alstrup & Hawksworth (1990)
Opegrapha stigmodes Nyl.	***Clathroporina eminentio***	Clauzade et al. (1989)
Opegrapha strigulae R. Sant. ex Matzer & R. Sant.	*Strigula nemathora*, *S. smaragdula*, ***S. subelegans***, *S. subtilissima*	Clauzade et al. (1989), Matzer (1996), Lücking (1998)
**Opegrapha thelotrematis* Coppins	***Thelotrema lepadinum***, *T. monosporum*	Coppins (1987)
Opegrapha uniseptata Matzer	*Porina atropuncta*, ***Strigula smaragdula*** and? ***S. scizospora***	Matzer (1996), Lücking (1998)
Opegrapha velata (Müll. Arg.) Vain.	***Actinoplaca vulgaris***, *Calenia* sp., ?*Echinoplaca* sp., ?*Gyalectidium caucasicum*, ***G. filicinum***, *Tricharia heterella*	Clauzade et al. (1989), Matzer (1996), Lücking (1998)
**Opegrapha vulpina* Vondrák & Kocourk.	***Caloplaca erodens***, *C. albopruinosa* (= *C. agardhiana* auct.)	this paper
**Opegrapha zwackhii* (A. Massal. ex Zwackh) Källsten in Hafellner	***Phlyctis argena***	Clauzade et al. (1989), Hafellner (1994a)

Tab. 2. Selected characters of closely similar lichenicolous *Opegrapha* species from calcicolous crustose lichens.

	Opegrapha hellespontica	***Opegrapha vulpina***	***Opegrapha parasitica****	***Opegrapha rupestris****	***Opegrapha* aff. *rupestris* (on *Caloplaca cirrochroa*)***	***Opegrapha* aff. *rupestris* (on *Caloplaca variabilis* s.l.)***
Apothecia (size)	(0.24–) 0.46±0.13 (–0.73) × (0.15–) 0.24±0.04 (–0.31) mm	(0.11–) 0.2±0. 04 (–0.3) mm in diam.	(0.28–) 0.41±0.12 (–0.64) × (0.18–) 0.24±0.04 (–0.3) mm	(0.19–) 0.34±0.07 (–0.44) × (0.15–) 0.23±0.05 (–0.33) mm	(0.19–) 0.27±0.06 (–0.36) × (0.1–) 0.13±0.03 (–0.21) mm	(0.22–) 0.39±0.09 (–0.59) × (0.17–) 0.24±0.07 (–0.44) mm
Aggregations of apothecia	commonly large aggregations, c. 0.3-1.0 mm	exceptionaly	rarely small aggregations	rarely small aggregations	rarely small aggregations	rarely small aggregations
Ascospores (size)	(14.0-) 16.75±1.25 (-19.0) × (5.0-) 6.5±0.75 (-7.5) µm	(11.5–) 14.5±1.4 (–18.0) × (5.0–) 6.0±0.7 (–8.0) µm	(15.0–) 17.25±1.5 (–21.0) × (6.5–) 7.25±0.6 (–9.0) µm	(13.5–) 17.75±2.5 (–21.0) × (5.0–) 6.25±0.7 (–7.5) µm	(15.0–) 17.0±1.3 (–19.0) × (5.0–) 6.5±0.7 (–7.0) µm	(15.0–) 16.25±1.0 (–18.0) × (5.5–) 6.25±0.5 (–7.0) µm
Apothecia & ascospores length/ width ratio	1.9 & 2.6	1.0 & 2.4	1.7 & 2.4	1.5 & 2.8	1.8 & 2.6	1.4 & 2.6
Apothecial disc	slit, only old apothecia with slightly exposed, black disc	exposed in mature stage, black	exposed in mature stage, black	exposed in mature stage, brown to black	exposed in mature stage, black	exposed in mature stage, black
Exciple (width)	(20-) 50±19 (-80) µm	(20–) 48±14 (–70) µm	(23–) 49±17 (–82) µm	(18–) 43±14 (–70) µm	(25–) 37±8 (–52) µm	(30–) 45±10 (–65) µm
Hymenium (height)	(80-) 103±14 (-130) µm	(70–) 90±11.5 (–110) µm	*c.* 100 µm	*c.* 50–100 µm	(119–) 150±29 (–218) µm	*c.* 80–150 µm

* basic statistic values for *Opegrapha parasitica*, *O. rupestris* and *O.* aff. *rupestris* are based on our observations of reference samples (see Materials and Methods) with n = 15, resp. 30 at *O.* aff. *rupestris* on *Caloplaca variabilis*.

EXSICCATES

VONDRÁK J. (2007):

SELECTED EXSICCATES OF *Caloplaca*, FASC. 1 (NOS 1–25)

Fritschiana 56: 1–10.

SELECTED EXSICCATES OF *Caloplaca*, FASC. 1

JAN VONDRÁK*

*Department of Botany, Faculty of Biological Sciences, University of South Bohemia,
Branišovská 31, 370 05, České Budějovice, Czech Republic

VONDRÁK J. 2007: Selected exsiccates of *Caloplaca*, Fasc. 1 (Nos 1– 25). - Fritschiana (Graz) 56: 1–10.

Abstract: Fascicle 1 of Selected exsiccates of *Caloplaca* comprises 25 collections of lichens from the following countries (and administrative subdivisions): Austria (Styria), Bulgaria (Burgas, Khaskovo, Kurdzhali, Plovdiv), and the Czech Republic (Central Bohemia, South Bohemia, North Moravia, South Moravia). The fascicle includes isotype material of *Caloplaca soralifera*. The recently described *C. erodens* and some little known species are included. All samples were collected and identified by the author.

INTRODUCTION

The exsiccate collection 'Selected exsiccates of *Caloplaca*' is aimed at including species of the genus *Caloplaca* (*Teloschistales*, lichenized fungi) from all over the world. Although modern molecular phylogenetic studies find the genus *Caloplaca* paraphyletic, the classic concept used in most recent checklists is followed here. 'Selected exsiccates of *Caloplaca*' is distributed on exchange basis to the following 15 herbaria and private collections (herbarium abbreviations follow http://sciweb.nybg.org/science2/IndexHerbariorum.asp): ASU, B, C, CANB, CBFS, F, GZU, H, HMAS, LE, M, MIN, TNS, UPS, herb. Lendemer. Contributions to this exsiccate are welcome.

Abbreviations of authors of plant names are taken from http://cms.huh.harvard.edu/databases/botanist_index.html. Names of countries and states (or provinces or principial subdivisions) are based upon a list from http://www.ars-grin.gov/cgi-bin/npgs/html/geolist.pl.

ACKNOWLEDGEMENT

I am grateful to Christian Scheuer and Walter Obermayer for editing the text.

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

1. Caloplaca arenaria (Pers.) Müll.Arg. (1862)

Bas.: *Lichen arenarius* Pers. (1794)
Syn.: *Caloplaca lamprocheila* (DC.) Flagey (1888), *Caloplaca oxfordensis* Fink ex J.Hedrick (1934), *Caloplaca subpallida* H.Magn. (1945)

CZECH REPUBLIC, Central Bohemia: Beroun District, Křivoklát, rocks in the protected area "Brdartka", 2 km NE of the village, alt. 300 m, 50°03'N, 13°53'40"E.

Saxicolous on a SE-exposed base-rich schist rock.

23.III.2003 leg. & det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

2. Caloplaca cerinelloides (Erichsen) Poelt (1993)

Bas.: *Caloplaca pyracea* (Ach.) Th.Fr. var. *cerinelloides* Erichsen (1930)

AUSTRIA, Steiermark: Leoben District, 2 km W of the village Proleb, Grillbichler Alm, alt. 800 m, 47°24'30"N, 15°06'40"E.

Corticolous on bark of *Sambucus nigra*, abundant on trunk and twigs.

24.VII.2004 leg. & det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

3. Caloplaca flavocitrina (Nyl.) H.Olivier (1909)

Bas.: *Lecanora flavocitrina* Nyl. (1886)
Syn.: *Caloplaca cirtrina* (Hoffm.) Th.Fr. var. *flavocitrina* (Nyl.) W.Watson

CZECH REPUBLIC, South Bohemia: pre-mountains of the Bohemian Forest (=Šumava), Prachatice District, Husinec, north facing stone wall in the village Výrov, alt. 520 m., 49°03'00"N, 13°59'50"E.

On weathered gneiss stones in an old wall, under dimly lit and humid conditions.

5.IV.2003 leg. & det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

4. Caloplaca demissa (Körb. ex Flot.) Arup & Grube (1999)

Bas.: *Placodium demissum* Körb. ex Flot. (1859)
Syn.: *Lecanora demissa* (Körb. ex Flot.) Zahlbr. (1898)

CZECH REPUBLIC, Central Bohemia: Beroun District, Křivoklát, rocks in the protected area "Brdartka", 2 km NE of the village, alt. 300 m, 50°03'N, 13°53'40"E.

Saxicolous on a SE-exposed base-rich schist rock.

23.III.2003 leg. & det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

5. Caloplaca erodens Tretiach, Pinna & Grube (2003)

CZECH REPUBLIC, South Moravia: Pavlovské vrchy hills, Břeclav District, Mikulov, limestone rocks at the foot of the hill Svatý kopeček, at the eastern edge of the town, alt. 300 m, 48° 48'29"N, 16°39'00"E.

Saxicolous on exposed, well-lit hard limestone rocks.

Note: Samples contain only sterile material, which morphologically agrees with the isotype specimens (Vězda: Lich. Rar. Exs. 499).

19.V.2004 leg. J. Vondrák, M. Bartoš & J. Šoun, det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

6. Caloplaca flavocitrina (Nyl.) H.Olivier (1909)

Bas.: *Lecanora flavocitrina* Nyl. (1886)
Syn.: *Caloplaca cirtrina* (Hoffm.) Th.Fr. var. *flavocitrina* (Nyl.) W.Watson

CZECH REPUBLIC, South Bohemia: pre-mountains of the Bohemian Forest (=Šumava), Prachatice District, Husinec, in the village Výrov, alt. 530 m, 49°03'00"N, 13°59'50"E.

On calcareous mortar on a W-exposed wall, under well-lit and arid conditions.

5.IV.2003 leg. & det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

7. *Caloplaca holocarpa* (Hoffm.) A.E.Wade (1965)

Bas.: *Verrucaria oblittera * holocarpa* Hoffm. (1796)

CZECH REPUBLIC, Central Bohemia: Rakovník District, in the village Kalubice, alt. 370 m, 50°03'N, 13°49'40"E.

Ferricolous on a metal plate leant against a N-exposed wall, in damp situation.

12.IX.2003 leg. J. Vondrák & Š. Hulová, det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

8. *Caloplaca holocarpa* (Hoffm.) A.E.Wade (1965)

Bas.: *Verrucaria oblittera * holocarpa* Hoffm. (1796)

CZECH REPUBLIC, North Moravia: Hrubý Jeseník Mountains, Bruntál District, Vrbno pod Pradědem, Karlova Studánka, alt. 880 m, 50°04'40"N, 17°17'E.

Lignicolous on a wooden railing alongside a road.

18.VI.2004 leg. J. Vondrák & M. Bartoš, det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

9. *Caloplaca holocarpa* (Hoffm.) A.E.Wade (1965)

Bas.: *Verrucaria oblittera * holocarpa* Hoffm. (1796)

AUSTRIA, Steiermark: Leoben District, 2 km NW of the village Proleb, Grillbichler Alm, alt. 800 m, 47°24'30"N, 15°06'40"E.

Saxicolous on schist stone below a N-exposed wall, in moist and partly shaded situation.

25.VII.2004 leg. & det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

10. Caloplaca obscurella (J.Lahm. ex Körb.) Th.Fr. (1871)

Bas.: *Blastenia obscurella* J.Lahm. ex Körb. (1860)
Syn.: *Placodium obscurellum* (J.Lahm. ex Körb.) Hepp (1867),
Callopisma obscurellum (J.Lahm. ex Körb.) J.Lahm (1887)

AUSTRIA, Steiermark: Leoben District, 2 km W of the village Proleb, Grillbichler Alm, alt. 800 m, 47°24'30"N, 15°06'40"E.

Corticolous on bark of *Fraxinus excelsior*, in lower part of trunk. Most abundant in SE exposition.

24.VII.2004 leg. & det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

11. Caloplaca virescens (Sm.) Coppins (1980)

Bas.: *Lepraria virescens* Sm. (1810)

BULGARIA, Khaskovo Province: Rhodope Mountains, Silen, valley of a small brook N of the village Rabovo, alt. 250 m, 41°37'N, 25°40'E.

Corticolous on bark of *Populus nigra*.

Note: *Caloplaca virescens* is dubiously distinguishable from *C. chlorina*. *Rinodina pityrea* is intermixed in the sample.

18.VIII.2004 leg. & det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

12. Caloplaca stillicidiorum (Vahl) Lynge (1921)

Bas.: *Lichen stillicidiorum* Vahl. (1792)
Syn.: *Caloplaca cerina* var. *stillicidiorum* (Vahl) Th.Fr. (1861),
Caloplaca cerina var. *chloroleuca* (Sm.) Th.Fr. (1871)

BULGARIA, Plovdiv Province: Rhodope Mountains, Asenovgrad, 5 km W of the village Dobrostan, calcareous rocks in a small polje, alt. 1300 m, 41°56'N, 24°53'E

Muscicolous on *Homalothecium sericeum, Pseudoleskeella catenulata*, and *Schistidium* cf. *crassipilum*.

25.VIII.2004 leg. & det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of Caloplaca**, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

13. Caloplaca obscurella (J.Lahm. ex Körb.) Th.Fr. (1871)

Bas.: *Blastenia obscurella* J.Lahm. ex Körb. (1860)
Syn.: *Placodium obscurellum* (J.Lahm. ex Körb.) Hepp (1867),
Callopisma obscurellum (J.Lahm. ex Körb.) J.Lahm (1887)

BULGARIA, Khaskovo Province: Rhodope Mountains, Madzharovo District, Silen, in the Arda river valley below the village Rabovo, alt. 200 m, 41°37'N, 25°40'E.

Corticolous on bark of *Populus nigra*, mostly in the lower part of the trunk and on above-ground parts of roots.

18.VIII.2004 leg. & det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

14. Caloplaca arenaria (Pers.) Müll.Arg. (1862)

Bas.: *Lichen arenarius* Pers. (1794)
Syn.: *Caloplaca lamprocheila* (DC) Flagey (1888), *Caloplaca oxfordensis* Fink ex J.Hedrick (1934), Caloplaca *subpallida* H.Magn. (1945)

BULGARIA, Kurdzhali Province: Rhodope Mountains, Kaloyantsi, protected area "Youmrouk Skala", 5 km SW of the village, alt. 500 m, 41°37'N, 25°31'E

Saxicolous on acidic volcanic stones in a large stony debris on a N-exposed slope.

15.VIII.2004 leg. & det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

15. Caloplaca aff. chlorina (Flot.) H.Olivier (1909)

Bas.: *Zeora cerina* var. *chlorina* Flot. (1849)
Syn.: *Caloplaca cerina* var. *chlorina* (Flot.) Müll.Arg. (1862)

BULGARIA, Burgas Province: Coast of Black Sea, Tsarevo, Sinemorets, coastal rocks 2 km SE of village, alt. 3–10 m, 42°00'30"N, 28°00'E.

Saxicolous on coastal rocks in the mesic-supralitoral zone.

Note: *Caloplaca* aff. *chlorina* is very abundant at the cited locality. This population differs from typical *C. chlorina* by the scarcity of isidia and soralia.

23.VIII.2004 leg. & det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

16. Caloplaca viridirufa (Ach.) Zahlbr. (1931)

Bas.: *Lecidea viridirufa* Ach. (1810)
Syn.: *Caloplaca aractina* (Fr.) Häyrén (1914)

BULGARIA, Burgas Province: Coast of Black Sea, Tsarevo, Sinemorets, coastal rocks 2 km SE of the village, alt. 0–10 m, 42°00'30"N, 28°00'E.

Saxicolous on coastal rocks in the mesic-supralitoral zone.

23.VIII.2004 leg. & det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

17. Caloplaca fuscoatroides J.Steiner (1919)

BULGARIA, Burgas Province: Coast of Black Sea, Tsarevo, Sinemorets, coastal rocks 2 km SE of the village, alt. 10–30 m, 42°00'30"N, 28°00'E.

Saxicolous on coastal rocks in the supralitoral zone.

Note: Although morphologically indistinguishable, *Caloplaca ceracea* J.R.Laundon (1992) differs from *C. fuscoatroides* in ITS sequences.

23.VIII.2004 leg. & det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

18. Caloplaca inconnexa var. nesodes Poelt & Nimis (1987)

[parasitic on *Aspicilia* spec.]

BULGARIA, Burgas Province: Coast of Black Sea, Tsarevo, Sinemorets, coastal rocks 2 km SE of the village, alt. 10–30 m, 42°00'30"N, 28°00'E.

Saxicolous on coastal rocks in the supralitoral zone.

Note: Bulgarian specimens agree well with the type material of *Caloplaca inconnexa* var. *nesodes* (Italy, GZU, holotype!).

23.VIII.2004 leg. & det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

19. Caloplaca aff. microthallina (Wedd.) Zahlbr. (1931)

Bas.: *Lecanora microthallina* Wedd. (1875)

BULGARIA, Burgas Province: Coast of Black Sea, Tsarevo, Sinemorets, coastal rocks 2 km SE of the village, alt. 0–5 m, 42°00'30"N, 28°00'E.

Saxicolous on coastal rocks in the mesic-supralitoral zone.

Note: This sample differs from typical *Caloplaca microthallina* by its continuous, partially rimose thallus. It also resembles *C. maritima* (de Lesd.) de Lesd.

23.VIII.2004 leg. & det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

20. Caloplaca thallincola (Wedd.) Du Rietz (1925)

Bas.: *Lecanora murorum* var. *thallincola* Wedd. (1875)

BULGARIA, Burgas Province: Coast of Black Sea, Tsarevo, Sinemorets, coastal rocks 2 km SE of the village, alt. 0–10 m, 42°00'30"N, 28°00'E.

Saxicolous on coastal rocks in the mesic-supralitoral zone.

Note: *Caloplaca thallincola* can hardly be distinguished from *C. aegaea* Sipman (2002).

23.VIII.2004 leg. & det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

21. Caloplaca crenulatella (Nyl.) H.Olivier (1909)

Bas.: *Lecanora crenulatella* Nyl. (1886)

CZECH REPUBLIC, South Bohemia: Tábor District, military airport SE of the town Bechyně, alt. 440 m, 49°17'N, 14°30'E.

Saxicolous on horizontal faces of a concrete wall.

9.IX.2004 leg. & det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

22. *Caloplaca soralifera* Vondrák & Hrouzek (2006) - isotype -

CZECH REPUBLIC, Central Bohemia: Rakovník District, Křivoklát, near a small pond in the village Kalubice, alt. 348 m, 50°02'56.3"N, 13°49'30.4"E.

Saxicolous on horizontal faces of a concrete wall.

28.XII.2004 leg. & det. J. Vondrák

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

23. *Caloplaca crenulatella* (Nyl.) H.Olivier (1909)

Bas.: *Lecanora crenulatella* Nyl. (1886)

CZECH REPUBLIC, Central Bohemia: Beroun District, in the town of Beroun at the railway station, alt. 230m, 49°57'N, 14°05'E.

Saxicolous on iron-enriched pebbles in a railway line.

21.XII.2006 leg. & det. J. Vondrák & J. Šoun

Vondrák J. 2007: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

24. *Caloplaca soralifera* Vondrák & Hrouzek (2006)

CZECH REPUBLIC, Central Bohemia: Beroun District, Kárlštejn, at the railway station, alt. 220 m, 49°55'53.36"N,14°10'9.78"E.

Saxicolous on iron-enriched pebbles in a railway line.

Note: *Caloplaca flavocitrina* and *Candelariella aurella* are intermixed.

28.IV.2006 leg. & det. J. Vondrák

Vondrák J. 2006: **Selected exsiccates of *Caloplaca***, Fasc. 1 (Nos 1–25).
Fritschiana 56: 1–10.
Distributed by the *Institut für Pflanzenwissenschaften, Karl-Franzens-Universität,* Graz (GZU)

25. *Caloplaca decipiens* (Arnold) Blomb. & Forssell (1880)

Bas.: *Physcia decipiens* Arnold (1867)

CZECH REPUBLIC, Central Bohemia: Rakovník District, Křivoklát, in the village Kalubice, alt. 350 m, 50°02'56.3"N, 13°49'30.4"E.

On old mortar.

28.XII.2004 leg. & det. J. Vondrák