

PhD Thesis

**THE LICHEN GENUS *Caloplaca* (*Teloschistales*) AND ITS
LICHENICOLOUS FUNGI: CONTRIBUTIONS TO THEIR
TAXONOMY, NOMENCLATURE AND BIODIVERSITY**

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INTRODUCTION

During recent years, our Lichenological 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 thesis), (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* harbors 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), Pavel Hrouzek (Třeboň, CZ), Pavel Říha (České Budějovice), Ulrik Sochting (Copenhagen), Ulf Arup (Lund, S) and Sasha Khodosovtsev (Kherson, UA).

TAXONOMY

Vondrák J., Říha P., Arup U. & Søchting U.: **Taxonomy of the *Caloplaca citrina* group (*Teloschistaceae*) in the Black Sea region; contribution to the cryptic species problematic in lichenology.** (manuscript; principal project of the PhD thesis)

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 characters. 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 morphological characters are of very limited value in this group. The variability and taxonomic importance of particular features is discussed. No significant differences in secondary chemistry were observed among the species.

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

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.

Vondrák J., Khodosovtsev A. & Říha P.: *Caloplaca concreticola* (*Teloschistaceae*), a new species from anthropogenic substrata in Eastern Europe. (accepted by The Lichenologist).

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.

Vondrák J., Šoun J., Palice Z., Hrouzek P., Říha P., Kubásek J. & Söchting U.: *Caloplaca subalpina* and *C. thracopontica*, two new saxicolous species from the *Caloplaca cerina* group (*Teloschistales*). (submitted to The Lichenologist).

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.

NOMENCLATURE

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

Sample no. 54 of Flagey: Lichenes Algeriensis exsiccati represents the syntype of *Placodium aurantiomurorum* (\equiv *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.

Vondrák J. & Vitikainen O.: Typification of names of selected infrageneric taxa described by Acharius and placed now in *Caloplaca*. (submitted to Taxon).

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* β . *rubescens*, *Lecidea caesiorufa*, *Lichen erythrellus* and *Parmelia microthelia* and holotypes identified for *Lecanora inalpina*, *Lecanora teicholyta*, *Lecidea turneriana* and *Lecidea viridirufa*. *Lecidea caesiorufa* β . *festiva* and *Lichen craspedius* are illegitimate names and both are automatically typified by the type of *Lichen arenarius*.

BIODIVERSITY

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.

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

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. tirolensis*, and *C. xerica*. *C. aff. furax* is probably an undescribed taxon resembling the Mediterranean *C. furax*, but differing in particular characters.

LICHENICOLOUS FUNGI ON *Caloplaca*

Vondrák J. & Kocourková J.: **New lichenicolous *Opegrapha* species on *Caloplaca* from Europe**. (accepted by *The Lichenologist*)

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.

EXSICCATES

Vondrák J. (2007): **Selected exsiccates of *Caloplaca*, Fasc. 1 (Nos 1–25)**. – *Fritschiana* 56: 1–10.

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 littleknown species are included. All samples were collected and identified by the author.

CURRICULUM VITAE

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1998 – 2001 – bachelor degree;

Bachelor work: [Flora and vegetation of kryogenous rocks in South Bohemia (Czech Republic).] - 68 p., 13 illustrations (in Czech)

Supervisor: Prof. Karel Prach

2001 – 2004 – master degree;

Master work: Selected saxicolous species of the genus *Caloplaca* (lichenized fungi) occurring in the Czech Republic. - 69 p.

Supervisor: Mgr. Zdeněk Palice

Scientific research: Taxonomy and nomenclature and biodiversity in the genus *Caloplaca* (*Teloschistaceae*, lichenized fungi).

Lichenofloristic research in Central and Eastern Europe (currently the Black Sea region).

Project in progress:

Diversity of the genus *Caloplaca* (lichenized fungi) on seashore rocks of the western Black Sea coast

GA AV ČR no KJB601410701 (2007-2009)

Presentations on symposia:

Vondrák J. (2002): [Rare and overlooked lichen species of rocks in the valley of Vltava river and its affluents.] (poster in Czech). Abstract in: Mlezivová R.M. [ed.]: Floras, distribution atlases and vegetation Surveys in central Europe. Abstracts from the IXth Congress of the Czech Botanical Society, 2002. – Czech Botanical Society, Praha.

- Vondrák J. & Liška J. (2002): [Ways to investigation of the lichen biodiversity in the Czech Republic.] (talk in Czech). Abstract in: Mlezivová R.M. [ed.]: Floras, distribution atlases and vegetation Surveys in central Europe. Abstracts from the IXth Congress of the Czech Botanical Society, 2002. – Czech Botanical Society, Praha.
- Vondrák J., Hrouzek P. & Arup U. (2006): *Caloplaca soralifera*, a new sorediate species of *Caloplaca* (Lichenized Fungi, *Teloschistaceae*) lacking anthraquinones in its thallus. – International Mycological Congress 8 (Cairns, Australia).

Lectures:

- Vondrák J. (with contribution of U. Arup, U. Sochting, J. Šoun, P. Hrouzek, P. Říha & A. Khodosovtsev): **The genus *Caloplaca* in the Black Sea region.** – Graz (January, 2007).
- Vondrák J. (with contribution of J. Šoun, E. Knotková & P. Hrouzek): **Lichenological field trip around the Black Sea with detour to Iran.** – Graz (January, 2008).

Publications:

- Czarnota P., Guttová A., Halda J. P., Kukwa M., Liška J., Palice Z., Peksa O., Svoboda D. & Vondrák J. (2006): Lišejníky zaznamenané počas 13. jarného stretnutia Bryologicko-lichenologickej Sekcie ČBS na exkurzii v Tematínskych vrchoch (Považský Inovec, Slovensko) [Lichens recorded during 13th Spring Meeting of the Bryological and Lichenological Section CBS on an excursion to the Tematínske vrchy hills (Považský Inovec Mts., Slovakia)]. – Bryonora 38: 26–39.
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- Liška, J., Palice, Z., Dětínský, R. & Vondrák, J. (2006): Changes in distribution of rare and threatened lichens in the Czech Republic II. – In: Lackovičová A., Guttová A., Lisická E. & Lizoň P. (eds.), Central European lichens – diversity and threat, p. 241–258. Mycotaxon Ltd., Ithaca.
- Peksa O., Bouda F., Halda J. P., Kocourková J., Liška J., Malíček J., Müller A., Palice Z., Slavíková-Bayerová Š., Svoboda D. & Vondrák J. (2007): Lišejníky zaznamenané během 19. podzimních bryologicko-lichenologických dnů na Kokořínsku. – Bryonora 39: 12–20.
- Sochting U., Alstrup V., Kocourková J., Vondrák J. & Larsen R.S. (2007): Additions to the lichen and lichenicolous flora of Denmark VII. – Graphis Scripta 19: 40–47.
- Svoboda D., Czarnota P., Bouda F., Halda J. P., Liška J., Kukwa M., Müller A., Palice Z., Peksa O., Šoun J., Zelinková J. & Vondrák J. (2007): Lišejníky zaznamenané během 13. jarního setkání Bryologicko-lichenologické sekce ČBS na exkurzích v Bílých Karpatech a dalších lokalitách na JV Moravě. – Bryonora 39: 39–49.
- Šoun J., Halda J., Kocourková J., Liška J., Palice Z., Peksa O., Slavíková-Bayerová Š., Svoboda D., Uhlík P. & Vondrák J. (2006): Lišejníky zaznamenané během 16. bryologicko-lichenologických dnů v Kameničkách (CHKO Žďárské vrchy, 2.-5.10.2003) [Lichens recorded during the 16th Bryological and Lichenological Days in Kameničky (Žďárské vrchy Mts, Czech Republic) in 2003]. – Bryonora 38: 39–47.
- Vondrák J. (2003): Příspěvek k poznání rozšíření druhu *Caloplaca demissa* v Čechách [Notes on the distribution of *Caloplaca demissa* in Bohemia, Czech Republic]. – Bryonora 31: 24–27.
- Vondrák J. (2005): *Caloplaca cremulata*, *Rinodina pityrea* and *Verrucaria macrostoma* f. *fulvifuracea* - three taxa of lichenised fungi new to Romania. – Contribuții Botanice 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 (South Bohemia)]. – Bryonora 37: 9–18.
- Vondrák J. (2006): *Lichenostigma elongatum* a *Stigmidium rouxianum*, dva druhy lichenikolních hub zjištěných na *Acarospora cervina* v ČR [*Lichenostigma* aff. *elongatum* and *Stigmidium rouxianum*, two species of lichenicolous fungi found on *Acarospora cervina* in the Czech Republic]. – Bryonora 37: 7–9.
- Vondrák J. (2006): Contribution to the lichenized and lichenicolous fungi in Bulgaria. I. – Mycologia Balcanica 3: 7–11.
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- Vondrák J. & Etayo J. (2007): A contribution to the diversity of lichen-forming and lichenicolous fungi in the Spanish Pyrenees. – Herzogia 20: 189–198.
- Vondrák J., Halda J., Malíček J., Müller A. & Uhlík P. (2006): Lišejníky zaznamenané během 18. bryologicko-lichenologických dnů v Moravskoslezských Beskydech (22.-25.9.2005) [Lichens recorded during the 18th Bryological and Lichenological Days in the Moravskoslezské

Beskydy Mts (North-east Moravia, Czech Republic) in 2005]. – *Bryonora* 37: 19–23.

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Non-lichenological publications

Foít J. & Vondrák J. (2003): [The Arithit Mts. (Albania) - splendid and vulnerable.] – *Živa*, Praha 2003/1: 23–24. (in Czech)

Vondrák J. (1999): [*Potamogeton* × *alternifolius* – the new taxon in the district Písek (Czech Republic).] – *Zprávy České bot. společnosti*, Praha 34: 49–50. (in Czech)

Vondrák J. (2000): [*Antitrichia curtispindula* (Hedw.) Brid. – the vulnerable species of the Czech Republic?] – *Bryonora*, Praha 26: 1–3. (in Czech)

Vondrák J. & Prach K. (2006): Occurrence of heliophilous species on isolated rocky outcrops in a forested landscape: relict species or recent arrivals? – *Preslia* 78: 115–121.

Information on activities of the lichenological group at Faculty of Science, University of South Bohemia is available on web: <http://botanika.bf.jcu.cz/lichenology/index.php?page=1>