Llimoniella caloplacae sp. nova (Leothiales), a new lichenicolous fungus on *Caloplaca borysthenica* sp. nova (Lecanorales, Ascomycota)

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Received 16 January 2006 / Accepted 28 June 2006

Abstract. *Llimoniella caloplacae* S. Kondr. & Khodosovtsev sp. nova growing on *Caloplaca borysthenica* Khodosovtsev & S. Kondr. sp. nova from naked loess and mosses in the *Festuco-Limonetea* plant communities of the southern part of Ukraine are described, illustrated, and compared with allied taxa.

Key words: *Caloplaca,* lichenicolous fungi, *Llimoniella,* taxonomy, Ukraine

Introduction

The genus *Llimoniella* Hafellner & Nav.-Ros. was introduced for two species, namely *L. scabridula* (Müll. Arg.) Hafellner & Nav.-Ros. and *L. adnata* Hafellner & Nav.-Ros. which occur as parasites in epigeous lichen communities over gypsaceous soils in southwestern and central Europe (Hafellner & Navarro-Rosinés 1993) (Table 1). A number of species, i.e. *L. neglecta* (Vain.) Triebel & Rambold, *L. groenlandiae* (Alstrup & D. Hawksw.) Triebel & Hafellner, *L. fuscoatrae* Hafellner, *L. stereocaulorum* (Alstrup & D. Hawksw.) Hafellner, and *L. pubescens* Diederich & Etayo, were later added to the genus (Kümmerling *et al.* 1993; Hafellner 1996; Diederich & Etayo 2000). However, Diederich & Etayo (2000) showed that these species were not congeneric with *L. scabridula* and *L. adnata,* and transferred them to the genera *Rhymbocarpus* or *Unguiculariopsis.*

According to Diederich & Etayo (2000) the genus *Llimoniella* is characterized by blackish, superficial apothecia with a ± regular, smooth, striate or scabrous margin lacking hairs and a slightly concave to convex disc; an upper exciple composed of radiating, thick, catenate cells; the combination of very characteristic pigments; thin-walled asci without any hemi-amyloid reactions; and ellipsoid or elongate, straight or curved to sigmoid, 0-3-septate, 1-2- or multiguttulate, hyaline ascospores lacking a distinct perispore. Diederich & Etayo (2000) added four more species to this genus. Two of these were described as new, i.e. *Llimoniella pertusariae* Diederich & Etayo and *L. pyrenulae* Diederich & Etayo, and two further species were transferred from the genera *Skyttea* and *Spirographa,* i.e. *L. ramalinae* (Müll. Arg.) Etayo & Diederich and *L. vinosa* (Holien & Triebel) Diederich & Etayo.

The parasite infected the type collection of *Caloplaca borysthenica,* sp. nova described in this paper was found to host a further representative of the genus *Llimoniella,* namely *L. caloplacae* sp. nova. The new species *Caloplaca borysthenica* sp. nova is characterized by large ascospores, a poorly developed septum and occurs in the rather unique lichen communities growing on naked loess banks and slopes together with a scattered cover of vascular plants in the southern Ukraine. More than 30 species of lichens are found on such loess surfaces. They include *Rinodina mucronatula, Caloplaca albolutescens, Placidiopsis cinerascens,* and *Collema coccophorum,* all of which are reported for the first time for lichen biota of the Ukraine.

Prominent loess outcrops are rather common in the extreme south of Ukraine, along the banks of the Dnieper and South Bug Rivers near the Black Sea. A wide range of loess outcrops are observed, ranging from minor undulations on the surface of the plain to small gullies with a dense cover of vascular plants. *Festuceta-Brometea* communities are recorded

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from smaller gullies while *Festuco-Limonetea* communities are more common in ravines. The following rare vascular plants are characteristic for these habitats, e.g. *Eremogone rigida, Stipa capillata, Hyacyntella leucophea,* and *Ephedra distachia.*

Materials and Methods

The results presented here are based mainly on herbarium material kept in KW, LD, BM, TSB, LE, and KHER. Fragments of lichens were sectioned by hand or with a Kryomat, Leitz freezing microtome. The sections were mounted in water or in lactophenol cottonblue. Anatomical structure and hymenial characters were studied with a Zeiss Axioscope light microscope.

Taxonomy

Llimoniella caloplacae S. Kondr. & Khodosovtsev, **sp. nov.**

Type: **UKRAINE:** Kherson oblast, Belozersky district, near Shirokaya Balka village, on loess slopes, on *Caloplaca borysthenica* areoles and apothecia, 7 May 2002, A. Khodosovtsev (KW – holotype; LD, KHER – isotypes).

Llimoniella insignis ascomatibus superficialibus, atris, 150-230 (–500) µm diam., disco concavo, margine prominenti, ascosporis anguste ellipsoideis vel bacilliformibus, 0-1 septatis, biguttulatis, 9,5-13 (–16) × 2,85-3,5 (–4) µm.

Ascomata lichenicolous, commensalistic, usually aggregated, superficial, brown to blackish, 150-230 (–500) µm diam, round to compressed, dispersed to crowded, plane or concave, margin more or less prominent. Exciple dark brown to orange-brown, K- or K+ shortly violet-brown, N+ yellowish- or orange-brown, basally 15-17 (–30) µm thick, pseudoparaplectenchymatous, of isodiametric cells with lumina 4-8 (–9) µm wide, with cell walls strongly gelatinized, lateral portion (12–) 15-19 (–22.8) µm thick, in the upper part of more elongate, conglutinated, narrow cells, becoming paler or hyaline in K. The outer layer of the lateral and uppermost portion of exciple is hyaline in K and 10-17 µm thick.

Hypothecium indistinct. Subhymenium hyaline, 5-10 µm thick. Hymenium hyaline, (40–) 55-65 (–70) µm high, KI-. Epihymenium yellow, yellowish brown to brownish, 15-20 µm tall, K-, N-. Paraphyses simple or branched, septate, 1-1.5 µm diam, apically slightly swollen (Fig. 1b), without pigments, easily separating in K under slight pressure; apical cells 1.9-2.6 µm diam. Asci clavate to subcylindrical, thin-walled, 35-50 × 8-9 µm (Fig. 1a), wall apically not thickened, I- and KI-, 8-spored. Ascospores hyaline, 0-1-septate, smooth, without a distinct perispore, ellipsoid, cylindric sometimes somewhat with attenuated one end, straight or slightly curved, usually biguttulate, (9–) 9.5-13 (–16) × 2.85-3.5 (–4) µm (Fig. 1c). Conidiomata and conidia unknown.

Host. Growing on *Caloplaca borysthenica.* It is difficult to determine the level of influence of parasite on lichen host. Some lichen thalli and apothecia were without any damaging influence while they were covered by several ascomata of parasite.

Distribution. The new species is known only from the type locality in the southern part of Ukraine (South-East Europe).

Etymology. The new species is named after its lichen host.

Taxonomic notes. *Llimoniella caloplacae* appears to be most closely related to *L. scabridula* (Müll. Arg.) Nav.-Ros. & Hafellner, which occurs on terricolous *Acarospora* species and *L. adnata* Hafellner & Nav.-Ros., known from terricolous *Placidium squamulosum* (Table 1, Hafellner & Navarro-Rosinés 1993). However, *Llimoniella caloplacae* differs from both these species by the much narrower, septate ascospores (Table 1, Fig. 1c).

The growth habit of *L. caloplacae* resembles that of *Rhymbocarpus fuscoatrae* (Hafellner) Diederich & Etayo including the small ascospores, and the aggregated and superficial ascomata (Diederich & Etayo 2000). *Llimoniella caloplaceae,* however, differs from *R. fuscoatrae* in having superficial ascomata, a different exciple anatomy, slightly narrower ascospores, the lack of a greenish or olivaceous green epihymenium and a greenish tinge in the upper layer close to the epihymenium, as well as a different host.

Llimoniella caloplacae is also very similar to *Rhymbocarpus pertusariae* Diederich, Zhurb. & Etayo, being of similar size and in having 1-septate ascospores (Diederich & Etayo 2000). However, the ascospores in *R. pertusariae* are much narrower, and the ascomata are immersed becoming superficial. *Llimoniella caloplacae* also differs from *Rhymbocarpus neglectus* and *R. makarovae* by having superficial ascomata, a different exciple anatomy, much larger ascospores and by parasitizing an alternative host. *Llimoniella caloplacae* differs from species of the genus *Phaeopyxis* by lacking a distinctly thickened ascus wall near the apex, by containing pigments which are not coarsely granular, in having 0-1-septate ascospores, a hyaline hypothecium and a different exciple anatomy.

Caloplaca borysthenica Khodosovtsev & S. Kondr., **sp. nov.**

Type: **UKRAINE:** Kherson oblast, Belozersky district, near Shirokaya Balka village, loess banks, on loess and on mosses, 7 May 2002, A. Khodosovtsev (KW – holotype; LD, KHER – isotypes).

A simili Caloplaca psammophyla differt: asci 2-4 (–6) spori, ascosporae (13,5–) 15-20 (–21,5) × (7,5–) 9-11 (–11,5), septum tenubium saepe imperfecti, (1,5–) 1-0 µm.

Thallus crustose, small, areolate over mosses or squamulose on naked loess, yellow-orange, forming spots among other lichens or over mosses, up to 3-15 (–20) mm diam. Areoles and squamules rather convex, aggregated, (0.1–) 0.25-0.5 (–0.7) mm wide, sometimes well developed with crenulated edges. Apothecia lecanorine to zeorine, 0.2-0.5 mm diam, disc flat to slightly convex, orange, surrounded by a yellowish orange thalline margin.

Cortex paraplectenchymatous 10-14 µm thick, comprising 2-3 cell layers, cells 3.5-4.5 µm diam. Parathecium thin, prosoplectenchymatous, 22-25 µm thick in the upper part

Table 1. Diagnostic characters of *Llimoniella caloplacae* and allied species

Character	*L. adnata*	*L. caloplacae*	*L. scabridula*
ascomata			
diam/across (µm)	200-500	150-230	200-500
exciple	reddish brown, K+ briefly violet, then dark brown, N+ becoming paler, red-brown	dark brown, K- or + briefly slightly violet, N+ orange-brown	dark purplish, K+ briefly purplish violet to dark matt brown, N+ becoming paler to bright pinkish red, then orange-red
hymenium (height, µm)	100-120	55-65	*ca* 90
epihymenium	pale brown, K+ briefly violet, then dark brown, N+ becoming paler, red- brown	yellow to brownish, K-, N-	reddish brown, K+ briefly dark violet to dark matt brown, N+ becoming paler to bright pinkish red, then orange-red
ascospores	non-septate, 1-guttulate, rarely 2-3-guttulate	0-1-septate, biguttulate	non-septate, 1-2-guttulate
µm	(9–) 11-13 × (5–) 6-7	9.5-13 × 2.85-3.5	9-11 × 4-5 (–6)
ecology	*Placidium squamulosum*	*Caloplaca borysthenica*	*Acarospora nodulosa, A. placidiiformis*
distribution	Spain, Russia (Sibiria, Yakutia)	Ukraine	Spain, Switzerland
references	Hafellner & Navarro-Rosinés (1993)	present paper	Hafellner & Navarro-Rosinés (1993)

Table 2. Diagnostic characters of *Caloplaca borysthenica* and allied species

Character	*C. borysthenica*	*C. psammophila*	*C. heterospora*	*C. crenulatella*
thallus	areolate to squamulose	squamulose	squamulose	areolate to squamulose
areoles/squamules (mm across)	0.3-0.5	0.5-0.8	? [data not provided by authors]	0.2-0.5
vegetative diaspores	not developed	not developed	soredia and blastidia	not developed
asci	2-4 (–6) spored	8-spored	8-spored ?	8-spored
ascospores (µm)	15-20 × 9-11	12-17 × 6-8	9-20 × 6-12	15-20 × 6-8
septum (µm)	0-1.5	2-3	0-1	1.5-3.5
paraphyse apices	3-5	5-7	6-9	3-5
ecology	on loess in arid locations	on calcareous sandy soil in arid locations	on calcareous soil in arid locations	on siliceous and calcareous rocks
references	present paper	Poelt & Hinterreger (1993)	Poelt & Hinterreger (1993)	Navarro-Rosinés & Hladun (1996)

and 10-16 µm thick in the lower portion, with slightly swollen apical cells, up to 3.2-3.7 µm diam. Amphithecium 90-110 (–120) µm thick, with a paraplectenchymatous cortex. Hypothecium hyaline, with numerous oil drops, 50-70 µm thick. Hymenium 52-62 µm high. Asci 2-4 (–6)-spored (Fig. 2a), ascospores (13.5–) 15-20 (–21.5) × (7.5–) 9-11 (–11.5) µm, septum invisible to very thin 0-1.0 (–1.5) µm (Fig. 2c). Paraphyses 2.2-2.5 µm thick, with apical cells up to 3.0-5.0 µm wide (Fig. 2b). Spermogonia immersed in areoles, with dark orange apices, spermatia 2-4 × 1 µm.

Ecology. The new species occurs on naked loess and mosses in the *Festuco-Limonetea* plant communities on the banks of Dnieper and South Bug Rivers in the southern part of Ukraine. The dominant plants included *Artemisia santonica, Kochia prostrata, Limonium* spp., *Festuca pseudo-dalmatica.* Associated lichens included *Megaspora verrucosa, Caloplaca albolutescens, Rinodina mucronatula, Fulgensia fulgens, Collema tenax, C. coccophorum, C. crispum, Squamarina lentigera,* etc.

Distribution. The new species is only known from several localities in the southern part of Ukraine.

Etymology. The new species is named after old Greek name of the Dnieper River basin, where it has been found growing.

Taxonomic notes. The new species resembles several terricolous species of *Caloplaca* described from other arid regions of Eurasia, e.g. *C. heterospora* and *C. psammophyla* described from Pakistan (Poelt & Hinterreger 1993). However, these species can be distinguished from *C. borysthenica* by ascospore characters (Table 2). Generally the ontogeny of the

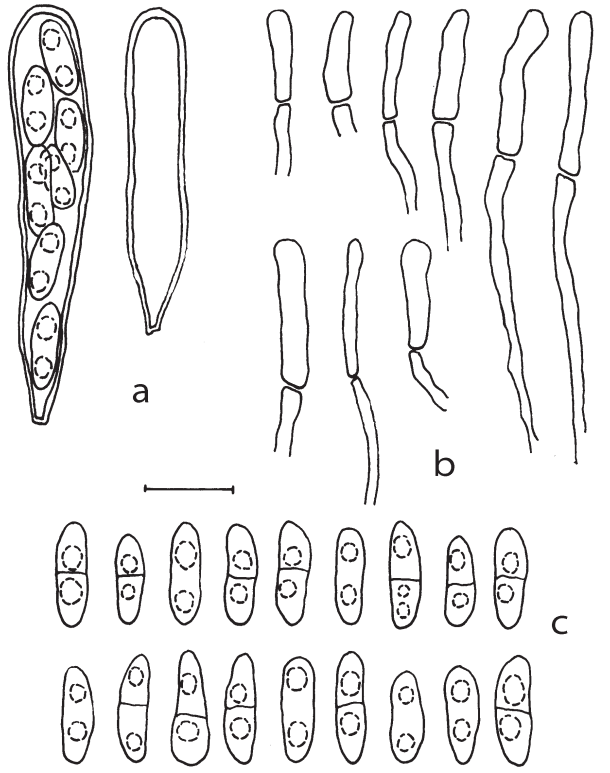

Fig. 1. *Llimoniella caloplacae* (holotype): **a** – asci, **b** – apical portions of paraphyses, **c** – ascospores. Bar 10 µm

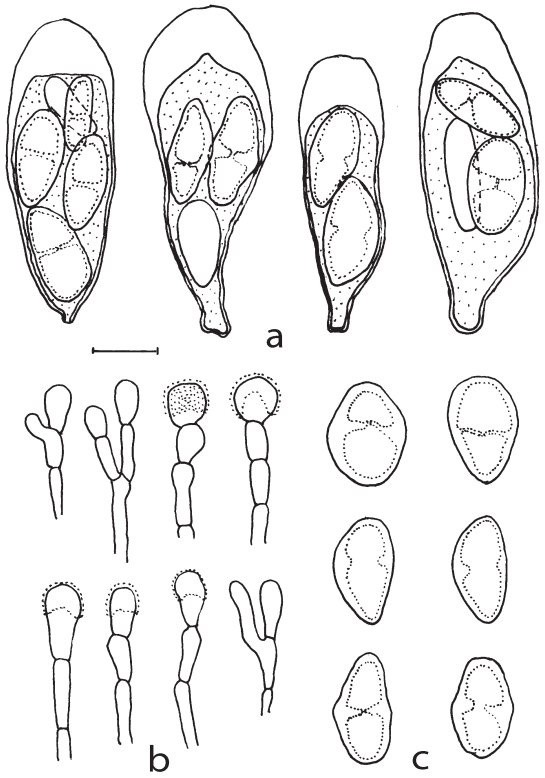

Fig. 2. *Caloplaca borysthenica* (holotype): **a** – asci, **b** – apical portions of paraphyses, **c** – ascospores. Bar 10 µm

septum is an important character in the Teloschistaceae (Poelt & Hinterreger 1993; Nimis *et al.* 1994). Ascospores with an undeveloped septum were previously known from species with a grey-green thallus, e.g. *C. nivalis, C. tornoensis,* and *C. siphonospora* (Olech & Søchting 1993), from orange pigmented isidiate-lobulate species, e.g. *C. wetmori* (Nimis *et al.* 1994), and from yellow or orange lobate species, e.g. *C. paulii* and *C. aurea.* A similar, almost invisible or very thin septum, is also developed in *C. heterospora* and *C. borysthenica.* However, *C. heterospora* is distinguished by the vegetative diaspores and the apical cells of the paraphyses being more distinctly swollen than those in *C. borysthenica.* In *C. psammophila* and *C. crenulatella* the ascospores are much narrower and the septum is wider than observed in *C. borysthenica* (Table 2).

Measurements (and drawing of shape) of spores are done from apothecia of *Caloplaca* which were not infected by parasite. Much larger collection without lichen parasite, and only smaller part of specimens damaged by fungus were studied. Thus parasite may not have caused the fewer spores.

Additional specimen examined: **UKRAINE:** Kherson oblast, Belozersky district, near Stanislav town, on loess slopes, on loess outcrops, 4 Apr 2001, A. Khodosovtsev (KHER).

Acknowledgement. We sincerely thank Prof. J.A. Elix (Canberra, Australia) for kindly checking the English expression and reviewer for valuable comments to the manuscript.

References

Diederich, P. & Etayo, J. 2000. A synopsis of the genera *Skyttea, Llimoniella* and *Rhymbocarpus* (lichenicolous Ascomycota, Leothiales). – Lichenologist **32**(5): 423-485.

Hafellner, J. 1996. Bemerkenswerte Funde von Flechten und lichenicolen Pilzen auf makaronesischen Inseln V. Über einige Neufunde und zwei neue Arten. – Herzogia **12**: 133-145.

Hafellner, J. & Navarro-Rosinés, P. 1993. *Llimoniella* gen. nov. – eine weitere Gattung lichenicoler Discomyceten (Ascomycotina, Leotiales). – Herzogia **9**: 769-779.

Kümmerling, H., Triebel, D. & Rambold, G. 1993. *Lepraria neglecta* and its lichenicolous fungi. – In: G.B. Feige & H.T. Lumbsch [eds]. Phytochemistry and chemotaxonomy of lichenized ascomycetes. A Festschrift in Honour of Siegfried Huneck. Bibliotheca Lichenologica, pp. 147-160. J. Cramer, Berlin, Stuttgart.

Navarro-Rosinés, P. & Hladun, N. 1996. Las especies saxicolo-calcicolas grupo de *Caloplaca lactea* (Teloschistaceae, liquenes), en las regiones mediterranea y medioeuropea – Bulletin de la Société Linnéenne de Provence **47**: 139-166.

Nimis, P.L., Poelt, J. & Tretiach, M. 1994. *Caloplaca wetmorei,* a new lichen species from western North America. – The Bryologist **97**(2): 182-185.

Olech, M. & Søchting, U. 1993. Four new species *Caloplaca* from Antarctica. – Lichenologist **25**(3): 261-269.

Poelt, J. & Hinterreger, E. 1993. Beitrage zur Kenntnis der Flechtenflora des Himalaya. VII. Die Gattungen *Caloplaca, Fulgensia* und *Ioplaca.* – Bibliotheca Lichenologica **50**: 1-265.