

CALOPLACA ULCEROSA, A MARITIME SPECIES IN EUROPE WITH A REMARKABLE OCCURRENCE IN THE CZECH REPUBLIC***Caloplaca ulcerosa*, druh mořských pobřeží s pozoruhodným výskytem v České republice**Jan V o n d r á k ¹, Jaroslav Š o u n ¹, Ulf A r u p ², André Aptroot ³ & Olexii R e d c h e n k o ⁴

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Abstract. *Caloplaca ulcerosa*, known as an epiphytic species growing on the bark of broad-leaved trees, is newly recorded from stems of maritime shrubs and from shaded limestone rock. In Europe, ninety-five percent of 90 considered records are within 50 km from a sea coast, but the species does not show any other geographical tendencies. It is rather regularly distributed throughout Europe, North Africa and the Near East. The distribution pattern of *C. ulcerosa* is, therefore, considered maritime; it may be the first known example of a maritime distribution of a lichen generally growing on tree trunks. The remarkable occurrence in the Czech Republic with an abnormal ecology is discussed. The identity of the specimen is supported by molecular nrITS DNA data.

Specimens called *Caloplaca ulcerosa* collected in the inland of North America are related but not conspecific with *C. ulcerosa* s. str. *Caloplaca viperae*, considered by Nimis a possible synonym to *C. ulcerosa*, is a blastidiate-isidiate taxon probably conspecific with *C. herbidella*.

Keywords: *Caloplaca viperae*, maritime distribution, *Teloschistaceae*

Caloplaca ulcerosa Coppins & P. James (*Teloschistaceae*) is an inconspicuous but characteristic species with thin, grey to white thallus producing crater-like, grayish to pale green soralia resembling those of *C. obscurella* (Körb.) Th. Fr. In some cases, sterile specimens of *C. obscurella* and *C. ulcerosa* are indistinguishable. However, the latter species is easily recognized by orange to orange-red apothecia similar to *C. holocarpa* (Hoffm. ex Ach.) A. E. Wade.

Until now, this inconspicuous species has been known to grow solely on the bark of broad-leaved trees, e.g., *Ulmus*, *Fraxinus*, *Tilia* (Arup & Ekman 1991) and *Acer pseudoplatanus* (Coppins & James 1979). There are a number of records from the British Isles including Ireland (Coppins & James 1979), Italy (Nimis 2003), the Netherlands (BLWG Verspreidingsatlas korstmossen online, <http://www.blwg.nl/lichatlas>), Spain (sub *C. holocarpa*, Giralt 1996; Boqueras 2000, cf. Llimona & Hladun 2001, Gaya et al. 2008,) and southern Sweden (Arup & Ekman 1991). In other countries, records are sparse; Belgium (Van den Broeck et al. 2008), Denmark (Alstrup & Søchting 1989, Alstrup et al. 2004, Søchting et al. 2007), Estonia (Ekman et al. 1991), France (Van den Broeck et al. 2009), Germany (cf. Scholz 2000; Otte & Rätzel 2004), Greece (Crete; Vondrák et al. 2008), Israel (Navrotskaya et al. 1996), Morocco (Ravera 2001), Norway (Holien 1994), Portugal (Santos Silva 1994, Carvalho et al. 2002), Russia (Otte 2005) and Ukraine (Crimea; Kondratyuk et al. 1998, Khodosovtseva 2008). Wetmore (2004b, 2009) and Lendemer (2008) recorded the species from many places in central North America. Wetmore (2004b) also mentioned one specimen from Australia.

According to our investigations, the species is further distributed in Bulgaria, Croatia, the Czech Republic, Iran, Romania and Turkey and it occurs on a variety of substrata. In addition to occurring on the bark of broad-leaved trees, we know of the species growing on stems of steppe and maritime shrubs (*Limonium*) and on shaded limestone rock.

The distribution of *C. ulcerosa* in Europe, the Near East and North Africa (Fig. 1) shows a strong tendency to occur close to sea coasts. The species is widely distributed; it is known from Spain in

the west to the Caspian Sea coast in the east and from southern Scandinavia and Scotland in the north to northern Africa and Israel in the south. Most of the considered localities (95 % of 90 records) are within 50 km from a sea coast and more than 80 % are within 10 km from seashores. This pattern may represent the first known example of a maritime distribution of a lichen generally growing on tree trunks.

There is, however, an exceptional, peculiar occurrence in the Czech Republic, where the species grows on shaded calcareous rock. It is one of two known saxicolous records; there is also one occurrence on shaded limestone on the island of Gotland, Sweden. Conspecificity of the Czech population with *C. ulcerosa* was supported by molecular data, ITS nrDNA (Fig. 2). An image of the voucher sample is available on our web page <http://botanika.prf.jcu.cz/lichenology>. The extraordinary ecology of the central European specimen may be interpreted as an adaptation of the generally maritime species to inland conditions.

In North America, *C. ulcerosa* is only known from the inland, in contrast to Europe. Nevertheless, ITS sequence of the North American *C. ulcerosa* obtained by Ulf Arup (Ulf Arup1017, Kansas) is somewhat similar to sequences of European specimens, but it represents another species. One unidentified specimen from the Austrian Alps (Austria, Carinthia, Gailtaler Alpen, on *Sambucus*, coll. v.d. Boom 1994; hb. v.d. Boom 15927) surprisingly appears to be conspecific with the North American sample (Fig. 2). The Austrian specimen differs from *C. ulcerosa* s.str. by rather convex, never crater-like soralia.



Fig. 1. The distribution of *Caloplaca ulcerosa* in Europe, northern Africa and the Near East. White dots, literature data; black dots, new data.

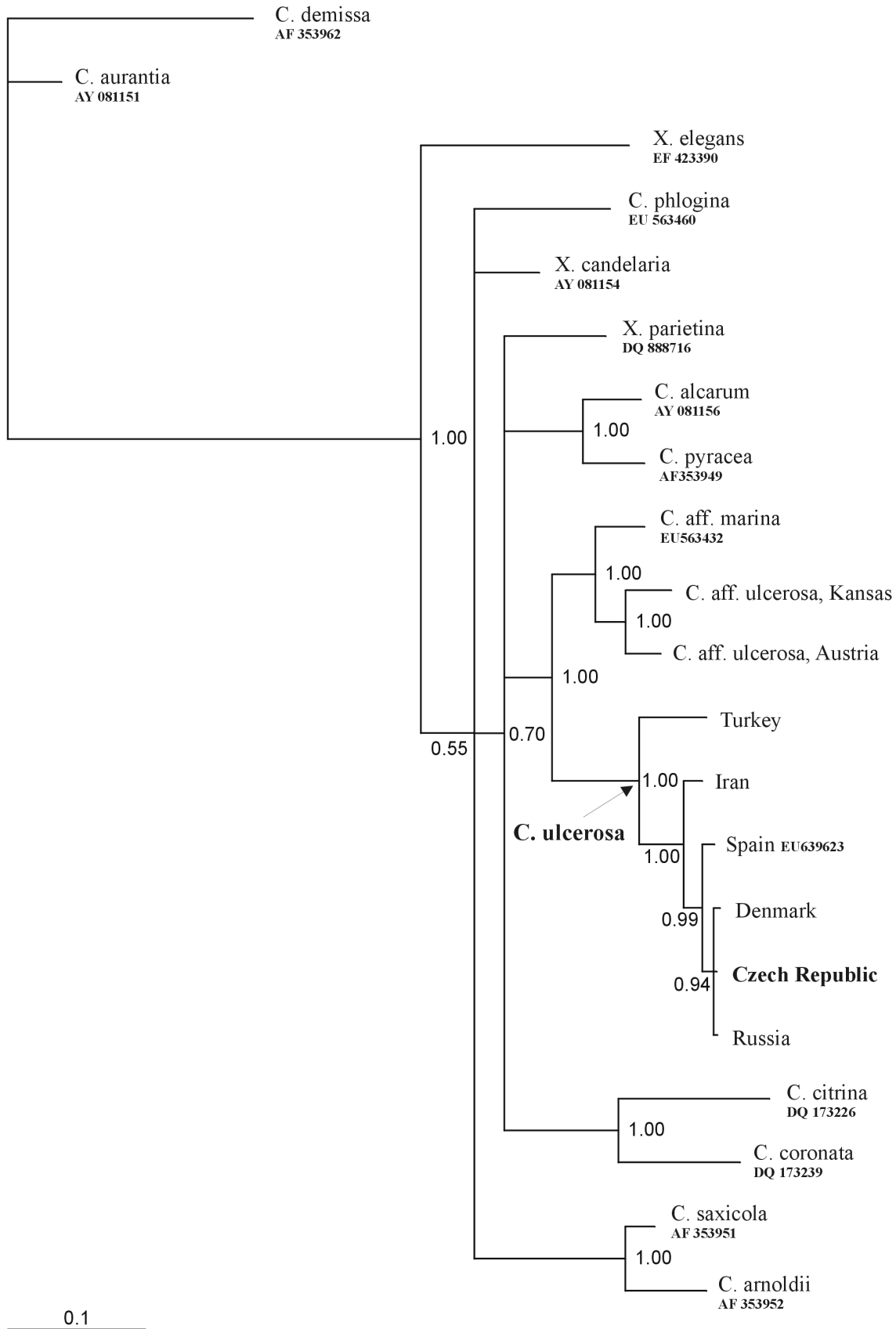


Fig. 2. Bayesian consensus phylogeny of the clade including *Caloplaca ulcerosa*. Node support values are Bayesian posterior probabilities. The saxicolous specimen from the Czech Republic (in bold) is placed within the monophyletic *C. ulcerosa* group.

DNA extraction, amplification, sequencing and phylogenetic analysis

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.

Newly obtained ITS sequences of *Caloplaca ulcerosa* (Tab. 1) were included in the phylogenetic analysis along with selected sequences of *Caloplaca* species downloaded from the GenBank database to estimate phylogenetic position of *C. ulcerosa*. Sequences were aligned using MAFFT 6 (on-line version in the G-INS-i mode; see Katoh et al. 2002) and manually cut to eliminate the unaligned ends; 559 positions were retained. Bayesian phylogenetic analysis was carried out using the program MrBayes 3.1.1 (Ronquist & Huelsenbeck 2003). The General Time Reversible substitution model with estimation of invariant sites and assuming a gamma distribution with four categories (GTR+I+G) was used for likelihood calculations. The MCMC analysis was run for one million generations, with four chains starting from a random tree and using the default temperature of 0.2. Every 100th tree was sampled, and the first 100 000 generations were discarded as burn-in.

Specimen	Collection data	GenBank Accession No.
<i>C. ulcerosa</i> CBFS JV6912	Turkey. Black Sea coast: Kandıra, sand dunes and coastal limestone rocks 6 km E of Cebeci, N41°12'00.35", E30°19'47.18", on bark of <i>Robinia pseudaccacia</i> , 15 Apr. 2007, <i>J. Vondrák</i>	GU080293
<i>C. ulcerosa</i> CBFS JV5699	Iran. Caspian Sea coast: Astara, forested dunes near coast close to Haviq, N38°11'17.28", E48°53'39.02", on bark of <i>Populus</i> , 5 May 2007, <i>J. Vondrák</i>	GU080294
<i>C. ulcerosa</i> CBFS JV4725	Denmark. Bornholm: NW coast of Bornholm, Jons Kapel, on bark of <i>Sambucus nigra</i> close to sea shore, 11. Nov. 2006, <i>R. S. Larsen & J. Vondrák</i>	GU080295
<i>C. ulcerosa</i> CBFS JV4309	Czech Republic. Blanský les Upland: Český Krumlov, Nové Dobrkovice, N-exposed rock S of village, near road between Č. Krumlov and Kájov, alt. 496 m, N48°49'01.2", E14°17'27.0", on limestone under overhang in shaded and humid conditions, 17 Apr. 2006, <i>J. Vondrák</i>	GU080296
<i>C. ulcerosa</i> CBFS JV6913	Russia. Black Sea coast: Novorossiysk, coastal rocks near Dyurso, N44°40'39.73", E37°33'24.68", on bark of <i>Fraxinus</i> , 19 May 2007, <i>J. Vondrák</i>	GU080297
<i>C. aff. ulcerosa</i> LD; UlfArup 1017	USA. Kansas	GU080298
<i>C. aff. ulcerosa</i> hb. v.d. Boom 15927	Austria. Carinthia: Gailtaler Alpen, on <i>Sambucus</i> , 1994, <i>v.d. Boom</i>	GU080299

Tab. 1. Voucher specimens and GenBank accession numbers of the ITS sequences used in the phylogenetic analysis.

Note on the identity of *Caloplaca viperae* (Zahlbr.) H. Olivier

Nimis (2003) considered the name *C. viperae* (holotype: Croatia, Pelješča Peninsula [Dalmatien: Mte. Vipera auf Sabioncello, 25. 5. 1906, lg. J. Baumgartner], W!) to be a possible synonym of *C. ulcerosa*. However, upon appraising the holotype of *C. viperae*, it is a very conspicuous lichen with a pale-grey, blastidiate-isidiate thallus; our appraisal agrees with Wetmore (2004a). The apothecial margins are strongly C+ violet suggesting the presence of chlorinated anthraquinones.

This forgotten species belongs to the *Caloplaca ferruginea* group and is probably conspecific with *C. herbidella* (Hue) H. Magn. (an image of the type is also to be found at <http://botanika.prf.jcu.cz/lichenology>).

- *List of new records (vouchers are deposited in CBFS except for Aptroot 16022 which is in ABL):*
Bulgaria. Black Sea coast: Varna, Shabla, around lighthouse on cape "Nos Shabla", N43°32'22.7", E28°36'26.2", on bark of *Morus*, 24 Nov. 2005, *J. Vondrák 3463*; **Croatia.** Istria: Poreč, Špadići, at sea coast, on bark of *Carpinus betulus*, 11 Sept. 2009, *J. Vondrák 7255*; **Czech Republic.** Blanský les Upland: Český Krumlov, Nové Dobrkovice, N-exposed rock S of village, near road between Č. Krumlov and Kájov, alt. 496 m, N48°49'01.2", E14°17'27.0", on limestone under overhang in shaded and humid conditions, 17 Apr. 2006, *J. Vondrák 4309, 4310*; **Iran.** Caspian Sea coast: Astara, forested dunes near coast close to Haviq, N38°11'17.28", E48°53'39.02", on bark of *Populus*, 5 May 2007, *J. Vondrák 5699*; **Portugal – Azores.** São Miguel: Ponta Delgada, alt. 20 m, on *Ulmus*, July 1986, *Aptroot 16022*; **Romania.** Black Sea coast: Tulcea, Popina Island (Insula Popina) in Razim Lake (Lacul Razim), NW coast, N44°58'25.04", E28°58'35.51", on stems of steppe shrubs, 3 Apr 2007, *J. Vondrák 6627*; **Russia.** Black Sea coast: Gelendzhik, coastal rocks W of Krinita (near Betta), N44°23'34.06", E38°19'22.45", on bark of *Ulmus minor*, 18 May 2007, *J. Vondrák 6419*; Novorossiysk, coastal rocks near Dyurso, N44°40'39.73", E37°33'24.68", on bark of *Fraxinus*, 19 May 2007, *J. Vondrák 6913*; **Spain (territory of UK).** Mediterranean coast: Gibraltar, E coast of peninsula, coastal cliffs, N36°7'2.60", W05°20'31.99", on *Limonium* in maritime vegetation, 28 Feb. 2008, *J. Vondrák 6281*; **Turkey.** Black Sea coast: Kandıra, sand dunes c. 6 km E of Cebeci, N41°12'00.35", E30°19'47.18", on *Robinia pseudaccacia*, 15 Apr. 2007, *J. Vondrák 6172, 6912*; Sea of Marmara coast: Şarköy, olive plantation W of town, at sea coast, alt. 10 m, N40°37'21.84", E27°08'37.67", on *Olea europea*, 11 Apr. 2007, *J. Vondrák 6959*.

Souhrn

Caloplaca ulcerosa je drobný lišejník připomínající stélkou *C. obscurella*; oba druhy jsou ve sterilním stavu v některých případech nerozlišitelné. S jistotou může být *C. ulcerosa* určena za přítomnosti oranžových až červeno-oranžových plodnic. Druh byl dosud znám z kůry listnatých stromů, většinou z kmenů starých jasanů, javorů, jilmů a lip. My jej nově uvádíme z kmínků keříků ve stepní a přímořské vegetaci a z vápencové skály.

Zpracovali jsme rozšíření druhu v Evropě a přilehlých oblastech Asie a Afriky a získali jsme zajímavý obraz; 95 % z osmdesáti sedmi zpracovaných lokalit se nalézají do 50 km od mořských pobřeží. Nelze ale vysledovat jiné geografické trendy, výskyty druhu jsou více méně pravidelně rozptýleny v studovaném území. *Caloplaca ulcerosa* lze tedy považovat za druh s maritimním rozšířením. Není vyloučeno, že takový typ rozšíření zatím nebyl popsán u lišejníků osidlujících převážně kmeny stromů.

Vnitrozemská populace v České republice je výjimečná svou ekologií (výskyt na převislé vápencové skále). Výskyt na zvláštním substrátu a netypická morfologie mohou představovat adaptace pro život ve vnitrozemí. Foto dokladového materiálu je dostupné na našem webu <http://botanika.prf.jcu.cz/lichenology>.

Severoamerické sběry nazývané *C. ulcerosa* pravděpodobně náleží jinému příbuznému druhu, který byl zjištěn i v evropském vnitrozemí (Obr. 2).

Jméno *Caloplaca viperae* Zahlbr. považované Nimisem za možné synonymum k *C. ulcerosa* náleží ve skutečnosti odlišnému druhu s blastidiozní až isidiozní stélkou a s C+ fialově reagujícím okrajem plodnic. Jde pravděpodobně o synonymum ke *Caloplaca herbidella* ze skupiny *C. ferruginea*.

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