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Teloschistaceae (lichenized Ascomycetes) in Turkey II. – Some poorly known taxa. Supported by molecular data

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With 1 figure and 1 table

Abstract: *Calogaya arnoldii*, "*Caloplaca*" *fuscoatroides*, *Caloplaca* aff. *monacensis*, "*Caloplaca*" *xerica*, *Flavoplaca* cf. *havaasii*, *Rufoplaca arenaria* s.lat., *Variospora australis*, *V. glomerata* and *Xanthocarpia lactea* (Teloschistaceae) were identified from the samples collected by the authors in Turkey. Identifications of all the listed lichens are supported by their ITS nrDNA sequences. *Calogaya arnoldii*, *Flavoplaca* cf. *havaasii Variospora australis* and *V. glomerata* are new to Turkey.

Key words: biodiversity, *Caloplaca*, *Flavoplaca*, lichens, Mediterranean basin, *Rufoplaca*, *Variospora*, *Xanthocarpia*

Introduction

The lichen family Teloschistaceae is one of the largest families of lichenized fungi; Arup et al. (2013) estimated the number of species to some thousand or more. They also proposed a new classification within the family, in which they recognized 39 genera. Most of the new genera have been previously included in the genus *Caloplaca*. We are still keeping the generic name *Caloplaca* (written in crevices) for some crustose members of *Teloschistaceae*, because generic names are still missing for many taxa, also for some species included in this paper (*C. fuscoatroides* and *C. xerica*).

Crustose Teloschistaceae (the former genus *Caloplaca*) are species-rich in Turkey and nearly 120 species are listed for the country (V.John, in prep.). Our first publication on

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Telochistaceae in Turkey focused on crustose species of the family and contained 37 taxa (Vondrák et al. 2012a). In the summer of 2012, we made further field excursions to collect more species of the family, especially in the western and northern parts of Turkey. For this publication, we selected nine poorly known taxa, which we consider interesting - in some cases we were not able to identify the samples with known species.

Materials and methods

Lichen samples collected by the authors have been identified on the basis of phenotype comparison with known species of Teloschistaceae. Short diagnostic descriptions based on our observations are presented for each taxon. Ascospore measurements were estimated in water and given as: (min –) X–sd – *X* – X+sd (–max.), where 'min.' and 'max.' are the extreme values, 'X' the arithmetic mean, and 'sd' the corresponding standard deviation. Ten ascospores were measured in each examined specimen.

Genomic DNA of selected samples of each taxon was isolated according to Grube et al. (1995) or Cubero et al. (1999). ITS regions with the 5.8S gene of the nuclear rDNA were amplified. Primers used for amplication were ITS1F (Gardes and Bruns 1993) and ITS4 (White et al. 1990) and PCR cycling parameters followed Samson et al. (2010). The ITS sequences were blasted with GenBank sequences to verify their identity; the closest Blast results are reported for each taxon (Table 1). New sequences from these groups were aligned with similar GenBank sequences using ClustalW in the MEGA5 software (Tamura et al. 2011). Ambiguously aligned regions and unaligned ends were manually excluded resulting in a final alignment with 36 sequences with a total length of 582 BP. The Tajima-Nei model in Neighbor-joining method in MEGA5 was used for analysis of phylogenetic relationship with 1000 bootstrap. *Physcia adscendens* (AF224422) was used as an outgroup (Fig. 1). The estimated value of the shape parameter for the discrete Gamma Distribution is 0.7095. Substitution pattern and rates were estimated under the General Time Reversible (GTR) model (+G) (Nei & Kumar 2000). A discrete Gamma distribution was used to model evolutionary rate differences among sites (5 categories, [+G]). Mean evolutionary rates in these categories were 0.05, 0.26, 0.60, 1.18, 2.91 substitutions per site. Selected samples of each listed species and their habitats were photographed and images are available on web pages https://www.facebook.com/media/set/?set=a.523963277641323.1073741825.418658201505165&type=1 and http://botanika.bf.jcu.cz/lichenology/.

Results

The list of records (species marked by asterisks are new to Turkey)

Calogaya arnoldii (Zahlbr. ex Ginzb.) Arup, Frödén & Søchting

ITS SEQUENCES: KF007910 (CL0.027); KF007909 (CL 0.030).

SPECIMENS EXAMINED: Turkey, Osmaniye, Amanos Mountain Chains, Zorkun Plateau, 14.08.2009 (CL 0.027); Eskişehir, Mihalıççık, N of Sorkun village, 22.07.2012 (CL 0.030); Eskişehir, Mihalıççık, SE of Yunusemre, 22.07.2012 (CL 0.126).

A detailed description of this taxon was provided by Gaya (2009) who recognized several morphologically defined subspecies within *Calogaya arnoldii*. Phylogenetic analysis of the *C. saxicola* group (= *Calogaya*) did not differentiate among the subspecies (Gaya et al. 2011) and we consider particular subspecies only as morphotypes of a single taxon. The samples collected from Turkey represent two morphotypes: (1) *arnoldii*-morphotype (CL 0.030): Thallus forming rosettes well delimited, 5−9 mm

Table 1. Newly generated ITS sequences with their closest GenBank sequences (according to the Blast search).

Species	**Herbarium Number**	**GenBank acc. number**	**Closest Blast hit** (% identity/% coverage)
Calogaya arnoldii ("*arnoldii* morphotype")	CL0.030	KF007909	*Caloplaca arnoldii* subsp. *arnoldii* HM800864 (99/95)
Calogaya arnoldii ("*obliterata* morphotype")	CL0.027	KF007910	*Caloplaca arnoldii* subsp. *obliterata* HM800865 (99/100)
"*Caloplaca*" *fuscoatroides*	CL0.061	KF007915	*Caloplaca fuscoatroides* JN813404 (98/93)
Caloplaca aff. *monacensis*	CL0.001	KF007917	*Caloplaca monacensis* HM538494 (96/97)
"*Caloplaca*" *xerica*	CL0.055	KF007918	*Caloplaca xerica* HQ611275 (96/97)
Flavoplaca cf. *havaasii*	CL0.004	KF007913	*Caloplaca communis* EU563409 (99/99)
Rufoplaca arenaria	CL0.023	KF007908	*Caloplaca arenaria* JN813412 (92/95)
Variospora australis	CL0.104	KF007912	*Caloplaca australis* AY233223 (98/99)
Variospora glomerata	CL0.024	KF007916	*Caloplaca glomerata* JN813412 (99/90)
Xanthocarpia lactea	CL0.014	KF007907	*Caloplaca lactea* HQ699644 (100/93)

in diam., yellowish brown and strongly pruinose; marginal lobes extremely convex, irregular or finger-like, slightly broadening at the tips, branched, 0.8−1.0 mm long and 0.40−0.55 mm wide at tips. Upper cortex is scleroplectenchymatous type A or type B as indicated in Gaya (2009). Apothecia 0.4−0.5 mm in diam.; reddish orange to brown and contrasting against the yellowish pruinose thallus. Ascospores polarilocular, colourless, narrowly ellipsoid, (10.0−)10.5−*11.0*−11.5(−12.0) × 4.5−*5.0*−5.5 µm, septa 2.0−*2.5*−3.0(−3.5) µm. This morphotype is characterized by short and thick lobes, narrowly ellipsoid ascospores and the usual occurrence of pruina giving a characteristic rosy shade to the thallus. It is widely distributed in Europe, especially in the Mediterranean basin (Gaya 2009). (2) *obliterata*-morphotype (CL 0.027; 0.126): This morphotype has an extremely reduced thallus formed by scattered lobes or a prothallus. The colour of the thalli is usually pale yellow to bright yellow, rarely with an orange tinge. Apothecia abundant, orange-red, flat to strongly convex, ± slightly pruinose, 0.20−0.45 mm in diam. Ascospores polarilocular, narrowly ellipsoid, (8.0−)8.5−*10.0*−11.5(−12.5) × 3.5−*4.5*−5.5(−6.0) µm, septa (1.0−)1.5−*2.0*−2.5 (−3.5) µm. According to Gaya (2009), this morphotype is mainly characterized by thallus with strongly reduced or absent marginal lobes. It has a temperate and boreal bias in Europe but it also occurs in southern Europe (Gaya 2009).

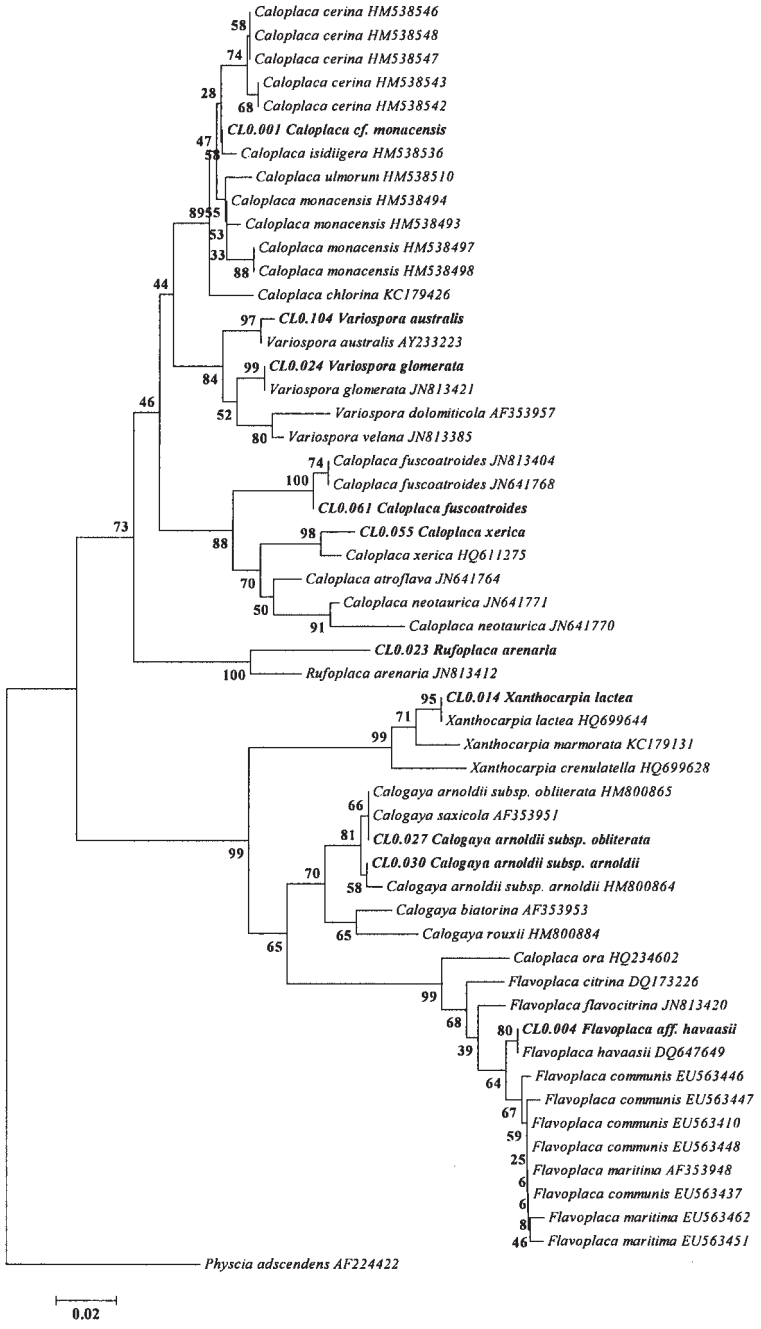

Fig.1. Best-scoring Neighbour-joining ITS phylogeny showing the relationships of the newly generated sequences in this study with previously known taxa in the GenBank. Numbers show bootstrap supports of the nodes. The new sequences from Turkey are in bold.

"Caloplaca" fuscoatroides J.Steiner

ITS SEQUENCE: KF007915 (CL0.061)

SPECIMENS EXAMINED: Turkey, Osmaniye, Amanos Mountain Chains, Zorkun Plateau, old Pinus nigra and Quercus forest, 36°59'04"N, 36°21'44"E, on siliceous rocks, alt. 1400 m, 14/08/2009 [CL 0.027]; Eskişehir, Mihalıççık, north of Sorkun village, Pinus nigra and Juniperus forest, on overhanged calcareous rocks, alt. 1260 m, 22/07/2012 [CL 0.030]; Eskişehir, Mihalıççık, southerneast of Yunusemre Village, Juniperus communities, 39°40'53"N, 31°30'21"E, on siliceous rocks, alt. 940 m, 22/07/2012 [CL 0.126].

Thallus grey to black, areolate, areoles more or less convex, with the pigment Sedifolia-grey in upper layer of thallus (K+ sordid-violet in sections). Apothecia reddish brown, zeorine, C+ purple (with chlorinated anthraquinones); 0.30−0.55 mm in diam. Ascospores polarilocular, 13.5−*14.5*−15.5(−16.0) × (7.0−)7.5−*8.5*−9.5(−10.0) µm, septa (3.0−)3.5−*4.5*−5.5(−6.5) µm.

Caloplaca fuscoatroides is rather common throughout the Mediterranean where it occurs on coastal siliceous (rarely calcareous) cliffs, but also on inland rocks (see http://botanika.bf.jcu.cz/lichenology/data.php). At higher latitudes, such as at the Black Sea and Atlantic coasts, the taxon is restricted to coastal habitats (our unpublished data). *C. fuscoatroides* belongs to the *C. xerica* group (Vondrák et al. 2012b), but it differs from most of the related species by the absence of vegetative diaspores. In Great Britain it is known under the name *C. ceracea* J.R.Laundon, but we consider *C. ceracea* as a synonym to *C. fuscoatroides* (Redchenko et al. 2012). The type of *C. aetnensis* de Lesd. (UPS 62456–lectotypus selected by Loppi et al. 1997) is also regarded as *C. fuscoatroides*. Known taxa of the *C. xerica* group without vegetative diaspores include *C. atroflava* (Turner) Mong. (differs by paler apothecia without chlorinated anthraquinones in apothecia) and *C. neotaurica* Vondrák, Khodosovtsev, Arup & Søchting (with thin thallus without marginal squamules).

Caloplaca* cf. *monacensis (Leder.) Lettau

ITS SEQUENCE: KF007917 (CL0.001)

SPECIMEN EXAMINED: Turkey, İçel, Gülnar, Delikkaya position, 36°17'06"N, 33°28'58"E, alt. 622 m, on siliceous rocks, 14/04/2011 [CL 0.061].

Thallus granular, without distinct areoles; pale or dark grey, containing Sedifolia-grey (K+ sordid-violet in section). Apothecia lecanorine, abundant, 0.3−2.0 mm in diam., sessile, disc yellow-orange to orange, ± white pruinose, true exciple very thin, thalline exciple thick, dark grey, whitish pruinose, raised above the disc. Ascospores polarilocular, (10.5−)11.0−*12.5*−14.0(−14.5) × (5−)5.5−*7.0*−8.5 µm, septa (3.5−)3.5−*4.0*−5.5 µm.

Although the Blast search shows the closest sequence identified as *Caloplaca monacensis* (Table 1), the analysis of ITS sequences did not confirm placement of our specimen into the *C. monacensis* clade; its placement is unresolved within the *C. cerina* group (Šoun et al. 2011). The granulose thallus of the Turkish specimen strongly resembles *C. monacensis* (Šoun et al. 2011), so we prefer to call the specimen "*C.* cf. *monacensis*".

"Caloplaca" xerica Poelt & Vězda

ITS SEQUENCE: KF007918 (CL0.055)

SPECIMENS EXAMINED: Turkey, Adıyaman, Tut, south-western slopes of Göksu River, east of Çiftlik Village, 37°46'47"N, 37°50'31"E, on serpentine, alt. 700 m, 28/07/2004 [CL 0.055]; İçel, Erdemli, Esenpınar Village, 36°35'N, 34°06ßE, alt. 830 m, lichenicolous on Aspicilia sp. on schist, 26/02/2012 [CL 0.062]; Tokat, Niksar, Ormanbeyli Village, 40°29'38"N, 36°47'21"E, alt. 940 m, on nutrient-rich limestone outcrops in village, 29.8.2012 (CBFS JV9775).

Thallus areolate with dark grey granules, pustules or lobules on the surface of the areoles. Sedifolia-grey pigment present in upper layer of thallus (K+ sordid-violet in sections). Apothecia zeorine, with distinct but thin anthraquinone-containing true exciple; thalline exciple rather thick, dark grey, disc dark brownish orange, 0.5−1.3 mm in diam. Ascospores 13.5−*15.5*−17.5(−19.5) × (7.0−)7.5−*8.0*−8.5(−9.0) µm, septa (4.0−)4.5−*5.0*−5.5(−6.0) µm.

Caloplaca xerica is distinguished from other taxa of the *C. xerica* group (Vondrák et al. 2012b) by the presence of large vegetative diaspores. It is often lichenicolous on *Aspicilia* spp. It may strongly resemble the lichenicolous taxon *C. furax* Egea & Llimona, which, however, has no vegetative diaspores and smaller ascospores, 11−15 × 7−10 µm (our observations of the isotype in GZU). *C. xerica* is known from arid territories of eastern Turkey and from the Black Sea coast (Vondrák et al. 2012a), but it seems to be also common in the continental parts of Anatolia on sun-exposed siliceous (rarely calcareous) rocks.

Flavoplaca* cf. *havaasii (H.Magn.) Arup, Frödén & Søchting

ITS SEQUENCE: KF007913 (CL0.004)

SPECIMENS EXAMINED: Turkey, Mediterranean Sea coast, İçel, Silifke, Akkuyu, Beşparmak Island, 36°08'21"N, 33°20'55"E, alt. 30 m, on siliceous rocks, 26/09/2011 [CL 0.004]; Black Sea coast, Giresun, Espiye, North of Espiye, on siliceous rocks, 40°57'04"N, 38°40'18"E, alt. 0 m, 31/08/2009 [CL 0.157].

Thallus yellow-orange, areolate; areoles bullate, sometimes overgrowing each other. Apothecia common, disc in mature apothecia slightly convex, orange; 0.30−0.55 mm in diam. Hymenium 60−70 µm in length; paraphyses 5−6 µm wide at the tips. Ascospores colourless, polarilocular, some mature ascospores somewhat rhomboid, 10.5−*11.5*−12.5(−13.5) × (5.0−)5.5−*6.0*−6.5(−7.5) µm, septa 3.0−*3.5*−4.0(−4.5) µm.

The Blast search shows the closest sequence identified as *Flavoplaca communis* (Vondrák et al.) Arup, Søchting & Frödén (Table 1). However, *F. havaasii* and *F. maritima* (de Lesd.) Arup, Frödén & Søchting, are also closely related (Vondrák et al. 2009). Analysis of ITS grouped the Turkish specimen with the sequence of the type of *F. havaasii* (BS=80), but all the selected sequences of *F. communis*/*C. maritima* formed a poorly resolved sister clade (Fig. 1). *F. havaasii* is described in Arup (2006). We did not find any significant phenotypic differences between the Turkish specimen and the Norwegian *F. havaasii*. As we have only one specimen (with its single ITS sequence) currently at hand, we prefer to present the record as "*F.* cf. *havaasii*".

Rufoplaca arenaria (Pers.) Arup, Søchting & Frödén

ITS sequence: KF007908 (CL 0.023)

Specimen examined: Turkey, İçel, Gülnar-Akkuyu, eastern part of the port, in shrubby vegetation with dead Pinus brutia trees, on lime-enriched siliceous rocks, 36°08'53"N, 33°21'38"E, alt. 3–12 m, 13/04/2012 [CL 0.023].

Thallus indistinct or very thin, when present, pale grayish with Sedifolia-Grey in the upper parts of the thallus (K+ sordid violet in sections). Apothecia abundant, ferruginous red, C-, without chlorinated anthraquinones, becoming darker and brownish with age, 0.3−0.8 mm in diam., convex when old. Ascospores thinly ellipsoid, (13.5−)14.5−*17.5*−20.0 × 5.0−*5.5*−6.0µm, septa 2.0−*2.5*−3.0 µm.

The genus *Rufoplaca* is poorly known; preliminary ITS sequence data show the taxon "*R. arenaria*" heterogeneous (Arup et al., unpublished data) and we consider our sample "*R. arenaria* sensu lato". On the morphological basis, our sample differs from other known *Rufoplaca* taxa: *R. subpallida* (H. Magn.) Arup, Søchting & Frödén (differs by distinct gray thallus and paler apothecia), *R. tristiuscula* (H.Magn.) Arup, Sochting & Frödén, (differs by dark grayish, thick thallus) and "*Caloplaca ligustica* de Lesd." (differs by dark red to black apothecial disc contrasting with orange-red margin).

****Variospora australis*** (Arnold) Arup, Søchting & Frödén

ITS sequence: KF007912 (CL0.104)

Specimens examined: Turkey, İçel, Çamlıyayla, Bolkarlar, Meydan Plateu, 37°24'51"N, 34°33'55"E, alt. 2342 m, on calcareous rock, 23/09/2011 [CL 0.104]; Konya, Taşkent, Gevne Valley, Beyreli Plateu, 36°49'83"N, 32°26'69"E, alt. 1700 m, on calcareous rock, 26/09/2009 [CL 0.109].

Thallus bright orange, consisting of convex areoles in the central part and elongated rather convex lobes at the margins. Apothecia 0.75−1.35 mm in diam., disk deep red, zeorine, true and thalline exciple paler than disk, thalline exciple sometimes crenulate. Ascospores one-septate (not polarilocular), some ascospores slightly curved, 15.0−*17.5*−19.5(−21) × (5.0−)5.5−*6.0*−6.5 µm.

This species was collected from two localities in the alpine zone of the Taurus Mountain Chains on sun-exposed face of hard calcareous rocks. This species is known from the Alps (Poelt, 1974) and the Karakorum Mts in China at an altitude of 4800 m (Xahidin et al. 2009). A similar alpine lichen with one-septate ascospores, *Gyalolechia aurea* (Schaer.) A.Massal., is muscicolous (Vondrák & Wirth 2013).

****Variospora glomerata*** (Arup) Arup, Søchting & Frödén

ITS sequence: KF007916 (CL0.024)

Specimens examined: Turkey, İçel, Akkuyu, Beydilli Village, 36°14'01"N, 33°28'16"E, alt. 700 m, on calcareous rocks in *Pinus brutia* and *Quercus coccifera* forest, 14/04/2012 [CL 0.024]; Eskişehir, Mihalıççık, north of Sorkun Village, Pinus nigra and *Juniperus* sp. communities, 39°57'08"N, 31°23'19"E, on calcareous rocks, alt. 1260 m, 22/07/2012 [CL 0.409]; Uşak, Ulubey, Ulubey Canyon, 38°25'06"N, 29°18'14"E, on calcareous rocks, alt. 745 m, 05/07/2012 [CL 0.430].

Thallus areolate, yellowish-orange; areoles normally flat and polygonal, thick, but in the sample CL 0.430, some areoles are rounded and convex. Apothecia zeorine; immersed in the areoles, disk reddish-orange; 0.35−0.55 mm in diam. Ascospores with apically thickened walls, colourless, (12.0−)14.0−*16.5*−18.5(−20.0) × (6.0−)7.5−*9.5*−11.5(−13.0) µm.

This species is morphologically similar to species in the *Caloplaca dolomiticola* complex (a part of the genus *Variospora*) but clearly differs in having ascospores with apically thickened walls (Arup 1990). Another species with ascospores having apically thickened walls, *C. latzelii* has biatorine apothecia and an endolithic thallus (Navarro-Rosinés & Hladun 1992).

Xanthocarpia lactea (A.Massal.) A.Massal.

ITS SEQUENCE: KF007907 (CL 0.014)

SPECIMEN EXAMINED: Turkey, İçel, Silifke, Ayaş Municipality, Merdivenli Kıyı beach, on hard calcareous coastal rocks, 36°29'08"N, 34°10'40"E, alt. 25 m, 26/2/2012 [CL 0.014].

Thallus reduced, indistinct. Apothecia usually numerous, orange, K+ purple, zeorine, slightly concave in the beginning but in maturity flat or slightly convex; 0.2−0.5 mm in diam. Epihymenium yellowish brown, hymenium colourless, 80−90 µm high, paraphyses 6.5−7.5 µm wide at top. Ascospores colourless, polarilocular, (11.0−)11.5−*13.0*−13.5(−14.0) × (6.5−)6.5−*7.0*−7.5µm, septa (3.0−)3.0−*3.5*−4.0 µm.

Xanthocarpia aquensis (Houmeau & Cl.Roux) Frödén, Arup & Søchting is similar, but differs in having larger apothecia and longer ascospores. Other similar species include *X. ferrarii* (Bagl.) Frödén, Arup & Søchting and *X. marmorata*, are distinguished in having longer ascospores (Navarro-Rosinés & Hladun 1996, Vondrák et al. 2011). This species was recorded from several localities in Turkey but these records mostly belong to other taxa, e.g. *C. crenulatella*, *C. ferrarii*, *C. marmorata* and *C. aquensis*.

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References

ARUP, U. 1990: *Caloplaca glomerata*, a new calcicolous lichen species from Sweden. – Ann. Bot. Fennici **27**: 329–333.

ARUP, U. 2006: The status of *Caloplaca havaasii*. – Graphis Scripta **18**: 33–37.

ARUP, U., U. SØCHTING & P. FRÖDEN 2013: A new taxonomy of the family Teloschistaceae. – Nordic J. Bot. **31**: 16–83.

CUBERO, O.F, A. CRESPO, J. FATEHI & P.D. BRIDGE 1999: DNA extraction and PCR amplification method suitable for fresh, herbarium-stored, lichenized, and other fungi. – Plant Syst. Evol. **216**: 243–249.

GARDES, M. & T.D. BRUNS 1993: ITS primers with enhanced specificity for basidiomycetes. Application for the identification of mycorrhizae and rust. – Mol. Ecol. **2**: 113–118.

GAYA, E. 2009: Taxonomical revision of the *Caloplaca saxicola* group (*Teloschistaceae*, lichen-forming *Ascomycota*). – Biblioth. Lichenol. **101**: 1–191.

GAYA, E., B.D. REDELINGS, P. NAVARRO-ROSINÉS, X. LLIMONA, M. DE CÁCERES et al. 2011: Align or not to align? Resolving species complexes within the *Caloplaca saxicola* group as a case study. – Mycologia **103**: 361–378.

GRUBE, M., P.T. DEPRIEST, A. GARGAS & J. HAFELLNER 1995: DNA isolation from lichen ascomata. – Mycol. Res. **99**: 1321–1324.

LOPPI, S., M.G. MARIOTTI & E. PUTORTI 1997: Typification of some poorly-known *Caloplaca* species (*Teloschistaceae*, lichenes) described by Bouly de Lesdain. – Lagascalia **19**: 491–494.

NAVARRO-ROSINÉS, P. & N.L. HLADUN 1992: *Caloplaca latzelii* y *C. glomerata* (Teloschistaceae, Liquenes), dos especies con esporas atipicas. – Cryptogamie, Bryol. Lichénol. **13**: 227–235.

NEI, M. & S. KUMAR 2000: Molecular Evolution and Phylogenetics. – Oxford Univ. Press, New York.

POELT, J. 1954: Beitrage zur Florengeschichte der Alpen. – Mitt. Bot. Staatssamml. München **11**: 11–31.

POELT, J. 1974: Bestimmungsschlüssel Europäischer Flechten. – Cramer, Vaduz.

REDCHENKO, O., J. VONDRÁK & J. KOŠNAR 2012: The oldest sequenced fungal herbarium sample. – Lichenologist **44**: 715–718.

SAMSON, R.A, J. HOUBRAKEN, U. THRANE, J.C. FRISVAD & B. ANDERSEN 2010: Food and Indoor Fungi. – CBS KNAW Fungal Div. Centre, Utrecht, The Netherlands.

ŠOUN, J., J. VONDRÁK, U. SØCHTING, P. HROUZEK, A. KHODOSOVTSEV et al. 2011: Taxonomy and phylogeny of the *Caloplaca cerina* group in Europe. – Lichenologist **43**: 113–135.

TAMURA K., D. PETERSON, N. PETERSON, G. STECHER, M. NEI et al. 2011: MEGA5: Molecular Evolutionary Genetics Analysis using Maximum Likelihood, Evolutionary Distance, and Maximum Parsimony Methods. – Mol. Biol. Evol. **28**: 2731–2739.

VONDRÁK, J., P. ŘÍHA, U. ARUP & U. SØCHTING 2009: The taxonomy of the *Caloplaca citrina* group (*Teloschistaceae*) in the Black Sea region; with contributions to the cryptic species concept in lichenology. – Lichenologist **41**: 571–604.

VONDRÁK J., P. ŘÍHA, O. REDCHENKO, O. VONDRÁKOVÁ, P. HROUZEK et al. 2011: The *Caloplaca crenulatella* species complex; its intricate taxonomy and description of a new species. – Lichenologist **43**: 467–481.

VONDRÁK, J., M.G. HALICI, M. KOCAKAYA & O. VONDRÁKOVÁ 2012a: Teloschistaceae (lichenized Ascomycetes) in Turkey. 1. – Some records from Turkey. – Nova Hedwigia **94**: 385–396.

VONDRÁK, J., J.ŠOUN, O. VONDRÁKOVÁ, A.M. FRYDAY, A. KHODOSOVTSEV et al. 2012b: Absence of anthraquinone pigments is paraphyletic and a phylogenetically unreliable character in the *Teloschistaceae*. – Lichenologist **44**: 401–418.

VONDRÁK, J. & V. WIRTH 2013: *Caloplaca*. – In: WIRTH, V., M. HAUCK & M. SCHULTZ (eds.): Die Flechten Deutschlands, pp. 262–317. – Ulmer, Stuttgart.

WHITE, T.J., T.D. BRUNS, S. LEE, & J. TAYLOR 1990: Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenies. – In: INNIS, M.A., GELFAND, D.H., SNINSKY, J.J. & T.J. WHITE (eds.): PCR Protocols: a Guide to Methods and Applications, pp. 315–322. – Academic Press, San Diego.

XAHIDIN, H., P. BAHTI, T. TURSUN, R. MAMUT & A. ABBAS. 2009: The lichen genus *Fulgensia* in Xinjiang, China. – Mycosystema **28**: 106–111.

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