



## Teloschistaceae (lichenized Ascomycetes) in Turkey. 1. – Some records from Turkey

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With 1 figure and 1 table

Vondrák, J., M.G. Halıcı, M. Kocakaya & O. Vondrákova (2012): Teloschistaceae (lichenized Ascomycetes) in Turkey. 1. – Some records from Turkey. – Nova Hedwigia 94: 385–396.

**Abstract:** Thirty-seven taxa of Teloschistaceae were identified from samples collected in continental areas of Turkey. Based on previous studies, *Caloplaca cerina*, *C. crenulatella*, *C. ferrarii*, *C. haematites* and *C. variabilis* are considered here as heterogeneous taxa. Some poorly characterised lichens were determined with the support of their ITS nrDNA sequences. According to Blast searches, examined samples resembling *C. albopruinosa* and *C. alociza* do not group with any known taxa of *Caloplaca* with endolithic thallus and without anthraquinones. Phylogenetic analysis was performed to show the identities of some specimens of *Caloplaca ferrarii* and *C. marmorata*. *Caloplaca haematites* and some samples of *C. marmorata* from continental Turkey differ considerably from European populations in their phenotype. *Caloplaca chelyae* and *C. schoeferi* are similar taxa differing mainly in their ecology. *Caloplaca adelphoparasitica*, *C. chelyae*, *C. conversa*, *C. ferrarii* s. lat., *C. ferrugineoides*, *C. interfulgens*, *C. juniperina*, *C. polycarpoides* and *C. sororicida* are new to Turkey. The lichenicolous lichen *Verrucula biatorinaria* hosted by *Caloplaca biatorina* is also new to Turkey.

**Key words:** arid regions, biodiversity, *Caloplaca*, heterogeneous taxa, lichens.

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## Introduction

The scarcity of studies of the lichens of Turkey, a country with unique geographic and climatic characteristics, makes the identification of its lichens often difficult. In our experience, use of general European keys (e.g. Smith et al. 2009, Clauzade & Roux 1985) to identify samples of *Teloschistaceae* from Turkey often yields to incorrect determinations, and some collections clearly fail to key out. This situation encouraged us to study this group in more detail. As a first step, reported here, we evaluated and analyzed critically samples from our field trips to Bakirdag (Develi, Kayseri), Lake Van (East Anatolia, Van) and some other sites in Turkey.

*Teloschistaceae* in the checklist of Turkey (Volker John; in prep.) comprise (1) many species occurring widely in Europe and the Mediterranean, (2) a few species otherwise known only from North America (*Caloplaca floridana* and *C. sideritis*), (3) a few species with a mainly Asian distribution (*Caloplaca persica*, *C. phaeothamos* and *C. transcaspica*), and (4) two almost forgotten species known only from Turkey (*Caloplaca ochronigra* and *C. selinkae*). We provide some evidence that group (3), the Asian group, includes more species than previously thought, many of them probably undescribed. On the other hand, some European and American species listed in the checklist of Turkey are only doubtfully present (e.g. *C. epiphyta*, *C. floridana*, *C. marina*, *C. microthallina*, *C. ruderum* and *C. virescens*).

Recent phylogenetic studies (e.g. Gaya et al. 2008) show that *Teloschistaceae* contains one large paraphyletic genus *Caloplaca* with some internal lineages, which are for various reasons (spore characters, thallus complexity) considered as separate genera; twelve genera are listed in the Myconet classification (Lumbsch & Huhndorf 2007). For this reason, the terms "*Caloplaca*" (genus) and "*Teloschistaceae*" (family) are almost synonyms and we prefer to use "*Teloschistaceae*" throughout the text.

## Materials and methods

Lichen samples collected by the authors have been identified and compared with known species of *Teloschistaceae*. The identification of some samples was supported by ITS nrDNA sequences. 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 followed Ekman (2001). The most similar known sequences were found using the BLAST search in the GenBank (Tab. 1). New sequences from the *C. crenulatella* group were aligned along with similar GenBank sequences in BioEdit; ambiguously aligned regions and sequence ends were manually excluded.

Bayesian phylogenetic estimates of the aligned sequences was performed using MrBayes to find relations of the newly generated sequences to the known taxa in the *Caloplaca crenulatella* group (Fig. 1). For Bayesian inference, the general time reversible model (Rodríguez & al., 1990) assuming a discrete gamma distribution (GTR+G) was selected using the jModelTest software. Two runs with 600 000 generations starting with a random tree and employing 4 simultaneous chains each (one hot, three cold) were made. The temperature of a hot chain was set to 0.2 and every 100th tree was saved. The analysis was terminated when the average standard deviation of split frequencies among the runs dropped below 0.01. The first 25% of trees were discarded as a burn-in phase, and the remaining trees were used for construction of a 50% majority consensus tree.

Selected samples of each listed species and their habitats were photographed and images are available on <http://botanika.bf.jcu.cz/lichenology/index.php?pg=5>.

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

Species	Collection	GenBank accession number	Closest Blast hit (% identity/% coverage)
<i>Caloplaca</i> cf. <i>albopruinosa</i>	MGH 0.4333	JN813384	<i>Caloplaca concreticola</i> EU192151 (96/73)
<i>Caloplaca</i> cf. <i>albciza</i>	MGH 0.5002	JN813386	<i>Caloplaca concreticola</i> EU192151 (95/99)
<i>Caloplaca ferrarii</i> s.lat.	CBFS JV8546	JN813393	<i>Caloplaca lactea</i> HQ234605 (96/96)
<i>Caloplaca haematites</i> s.lat.	MGH 0.4128	JN813387	<i>Caloplaca haematites</i> GU723407 (97/95)
<i>Caloplaca haematites</i> s.lat.	MGH 0.4344	JN813389	<i>Caloplaca aractina</i> GU723409 (97/99)
<i>Caloplaca interfulgens</i>	MGH 0.4346	JN831362	<i>Caloplaca interfulgens</i> HQ699639 (98/99)
<i>Caloplaca juniperina</i>	CBFS JV6507	JN813383	<i>Caloplaca juniperina</i> HQ644199 (99/89)
<i>Caloplaca marmorata</i>	MGH 0.4351	JN813391	<i>Caloplaca marmorata</i> EU639621 (99/98)
<i>Caloplaca marmorata</i>	MGH 0.4350	JN813390	<i>Caloplaca marmorata</i> EU639621 (98/91)
<i>Caloplaca marmorata</i>	CBFS JV9012	JN813394	<i>Caloplaca marmorata</i> HQ699627 (99/91)
<i>Caloplaca pyracea</i>	MGH 0.4157	JN813392	<i>Caloplaca pyracea</i> HM582162 (99/100)
<i>Caloplaca velana</i>	MGH 0.4357)	JN813385	<i>Caloplaca velana</i> var. <i>dolomiticola</i> AF353957 (98/69)

## Results

We obtained three types of results: (1) our sample is conspecific with some known species, (2) our sample is similar to, but probably not conspecific with, a known species, (3) we did not find any known species which is conspecific with our specimen. Most of the records presented here fall into the first category, but we have also included some from the second category. In the latter case we prefix epithets with "cf" or append "s. lat." and we explain the reasons for our doubts. Records from the third category are not presented here.

### Phylogenetic analysis

Sequences from our samples belonging to the difficult *Caloplaca crenulatella* group (sensu Vondrák et al. 2011) were analyzed together with GenBank sequences of the known taxa (Fig. 1) with the following results; (1) One sample was confirmed to be *Caloplaca interfulgens*, (2) three samples with unclear phenotype, intermediate between *C. ferrarii* and *C. marmorata* belong to *C. marmorata*, (3) the sequence of one sample with *C. ferrarii* phenotype falls into the *C. crenulatella* group, but its position within the group is not resolved.

### List of taxa (species marked by asterisks are new to Turkey)

#### \**Caloplaca adelphoparasitica* Nimis & Poelt

SPECIMENS EXAMINED: Turkey, Kayseri, Develi, near Derepimli village, 03 Sep. 2010, M.G.Halıcı & M.Kocakaya (MGH 0.4332); Niğde, Aladağlar Milli Parkı, Cevizlik Mahallesi, Mazmıllı Yayla, 12 Jul. 2007, M.G.Halıcı & A.Aksoy (MGH 0.1622); Tekirdağ, valley of small brook near Gaziköy, 11 Apr. 2007, J.Vondrák (CBFS JV8201).

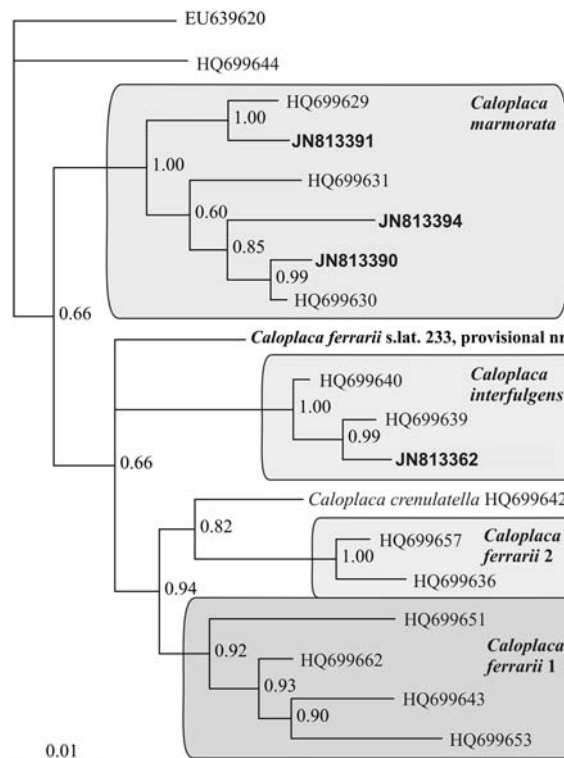


Fig. 1. Bayesian phylogenetic tree based on ITS sequences, showing relationships of the newly generated sequences in this study (in bold) with previously known taxa from the *Caloplaca crenulatella* group.

### ***Caloplaca* cf. *albopruinosa*/C. cf. *alociza***

ITS SEQUENCES: JN813384, JN813386

*Caloplaca albopruinosa* and *C. alociza* lack anthraquinones, have an endolithic thallus and are hardly distinguishable. Muggia et al. (2008:45) showed that the only differences are an inspersed vs. non-inspersed hymenium, well-developed vs. diminishing apothecial margin and the presence/absence of crystals in the epihymenium, but they admit that these characters are not adequate for separating these species. Studies of species without anthraquinones and a having an endolithic thallus (Muggia et al. 2008, Tretiach & Muggia 2006, Tretiach et al. 2003), reported four species from Europe (the two named above, *C. badioreagens* which differs from the others mainly in having a KOH+ brown pigment in the epihymenium, and *C. erodens*, which is sorediate). ITS sequences of our two samples from Turkey (one similar to *C. albopruinosa*, another to *C. alociza*) show their close relationship to *C. concreticola* (closest Blast in Table 1); they may belong to an unnamed cryptic species.

SPECIMENS EXAMINED: Turkey, Kayseri, Develi, near K. Künye village, on calcareous rocks, 38°08.387' N, 35°49.225' E, alt. 1420 m., 03 Sep. 2010, M.G.Halıcı & M.Kocakaya (MGH 0.4333); near Sati

village, on calcareous rocks, 38°12.797'N, 35°47.249'E, alt. 1320 m, 31 Oct. 2010, M.G.Halıcı & M.Kocakaya (MGH 0.5002), Lake Van, limestone coastal rocks 4.5 km SW of Adilcevaz, alt. 1650 m, 38°47'01"N, 42°41'01"E, on limestone, 12 May 2007, J.Vondrák (CBFS JV5318); 3.5 km SW of Adilcevaz, alt. 1650 m, 38°47'14"N, 42°42'03"E, on limestone, 12 May 2007, J.Vondrák (CBFS JV5343, 8574); Yassıca, rocky outcrops near coast, alt. 1690 m, 38°27'59"N, 42°30'08"E, on limestone, 13 May 2007, J.Vondrák (CBFS JV6659); limestone rocky outcrops near coast, SW of Bayramlı, 38°56'38"N, 43°09'05"E, on limestone rock, 11 May 2007, J.Vondrák (CBFS JV8529).

### **Caloplaca biatorina** (A.Massal.) J.Steiner

SPECIMENS EXAMINED: Turkey, Kayseri, Develi, near Satı village, on calcareous rocks, 38°12.797'N, 35°47.249'E, alt. 1320 m, 31 Oct. 2010, M.G.Halıcı & M.Kocakaya (MGH 0.4334); near Yaylacık village, on calcareous rocks, 38°07.077'N, 35°45.788'E, alt. 1620 m, 03 Sep. 2010, M.G.Halıcı & M.Kocakaya (MGH 0.4335); near Sarıkaya village, on calcareous rocks, 38°09.370'N, 35°49.434'E, alt. 1550 m, 31 Oct. 2010, M.G.Halıcı & M.Kocakaya (MGH 0.4336); Lake Van, limestone coastal rocks, 3.5 km SW of Adilcevaz, alt. 1650 m, 38°47'14"N, 42°42'04"E, on limestone, 12 May 2007, J.Vondrák (CBFS JV5344); limestone rocky outcrops near coast, SW of Bayramlı, 38°56'38"N, 43°09'05"E, on limestone rock, infected by *Arthonia molendoi* and *Verrucula biatorinaria*, 11 May 2007, J.Vondrák (CBFS JV6571).

NOTE: At the Lake Van site, *Caloplaca biatorina* was infected by two lichenicolous fungi, (1) non-lichenized *Arthonia molendoi* (Heufl. ex Frauenf.) R.Sant. and (2) lichenized *Verrucula biatorinaria* (Zehetl.) Nav.-Ros. & Cl. Roux. The latter is new to Turkey.

### **Caloplaca cerina** s.lat.

Recently, this taxon has been considered to be paraphyletic and to contain at least four lineages (Šoun et al. 2011). The ecology and geography of our specimen suggest that it belongs to clade A or B of Šoun et al. (2011).

SPECIMEN EXAMINED: Turkey, Lake Van, Yassıca, rocky outcrops near coast, 38°27'59"N, 42°30'08"E, on bark of *Juniperus*, 13 May 2007, J.Vondrák (CBFS JV8515).

### **\*Caloplaca chelyae** I.Pérez-Vargas

Our samples of this muscicolous species were difficult to determine. The basic problem was that several names described from various regions in different periods are poorly understood. Finally, we reduced the choice to one between two very similar species: *Caloplaca chelyae* and *C. schoeferi* Poelt. The phenotype of our samples matches perfectly the description of *C. schoeferi* (Poelt 1955a, b), but that species has a different ecology; it is an alpine species of calcareous substrata. The recent description of *Caloplaca chelyae* from the Canary Isles (Pérez-Vargas & Pérez de Paz 2009) does not fit our specimens perfectly: ascospore septa were 2–3 µm wide in the original description but 2.5–5 µm in our samples, and the apothecial discs were orange in the original description but olive-brownish in old apothecia in our samples. We finally chose the name *C. chelyae* for the following reasons: (1) The figures of the spores in the protologue of *C. chelyae* do not match the text of the protologue; the depicted spore (Fig. 1D) is young with a septum c. 3 µm, but the mature spore in Fig. 1C has the septum thicker than 3 µm. (2) The habit of *C. chelyae* shown in the photograph in the protologue perfectly matches our samples. (3) Substrata and habitats of the Canarian samples cited in the protologue are similar to the Turkish ones – acidic

substrata in dry and insolated stands. The records from the Canary Islands are however from mosses over soil, while Turkish samples are from mosses over acidic stones, but we consider this difference to be very minor. Interestingly, a similar ecology (musci-colous on acidic substrata) and distribution (continental Turkey and Canary Islands) is known for *Caloplaca phaeothamnos*.

SPECIMENS EXAMINED: Turkey, Lake Van, boulder scree in slope at E coast of Lake Nazik, 38°51'41"N, 42°20'20"E, among bryophytes on volcanic boulders, 12 May 2007, J.Vondrák (CBFS JV8544); lava stream 7 km W of Ünseli, 38°59'49"N, 43°30'01"E, among bryophytes on volcanic boulders, 11 May 2007, J.Vondrák (CBFS JV8553).

#### ***Caloplaca cirrochroa* (Ach.) Th.Fr.**

SPECIMEN EXAMINED: Turkey, Lake Van, Yassıca, rocky outcrops near coast, 38°27'59"N, 42°30'08"E, on limestone rock, 13 May 2007, J.Vondrák (CBFS JV8530).

#### **\**Caloplaca conversa* (Kremp.) Jatta**

SPECIMENS EXAMINED: Turkey, Artvin, rocky outcrops near road on side of river opposite town, alt. 550 m, 41°11'24"N, 41°51'28"E, on base-rich siliceous rock, 29 Apr. 2007, J.Vondrák (CBFS JV6461); deep rocky valley of river Okçular below Porta monastery, alt. 560 m, 41°13'49"N, 42°04'08"E, on base-rich siliceous rock, 29 Apr. 2007, J.Vondrák (CBFS JV8522); Lake Van, Yassıca, rocky outcrops near coast, alt. 1690 m, 38°27'59"N, 42°30'08"E, on limestone, 13 May 2007, J.Vondrák (CBFS JV6472).

#### ***Caloplaca coronata* (Körb.) J.Steiner**

SPECIMENS EXAMINED: Turkey, Kayseri, Develi, near Bakırdağ village, parasitic on calcareous rocks, 38°12.583'N, 35°49.117'E, alt. 1350 m, 20 Aug. 2009, M.G.Halıcı & M.Kocakaya (MGH 0.4337); near Satı village, on calcareous rocks, 38°12.797'N, 35°47.249'E, alt. 1320 m, 31 Oct. 2010, M.G.Halıcı & M.Kocakaya (MGH 0.4338); near B. Künye village, on calcareous rocks, 38°08.971'N, 35°48.180'E, alt. 1420 m, 31 Oct. 2010, M.G.Halıcı & M.Kocakaya (MGH 0.4339); Lake Van, limestone rocky outcrops near coast, SW of Bayramlı, 38°56'38"N, 43°09'05"E, on limestone rock, 11 May 2007, J.Vondrák (CBFS JV8550); Lake Van, Yassıca, rocky outcrops near coast, 38°27'59"N, 42°30'08"E, on limestone rock, 13 May 2007, J.Vondrák (CBFS JV8525).

#### ***Caloplaca crenulatella* s.lat.**

Recently, this taxon has been considered to be paraphyletic and to contain at least four lineages (Vondrák et al. 2011). Further molecular and phenotype data should be generated for this heterogeneous taxon to appraise particular clades.

SPECIMENS EXAMINED: Turkey, Kayseri, Develi, near Avla village, steppe area, calcareous rocks, 38°09.026'N, 35°49.761'E, alt. 1600 m, 31 Oct. 2009, M.G.Halıcı & M.Kocakaya (MGH 0.4340); Lake Van, limestone rocky outcrops near coast, SW of Bayramlı, 38°56'38"N, 43°09'05"E, on limestone rock, 11 May 2007, J.Vondrák (CBFS JV8535); Yassıca, rocky outcrops near coast, 38°27'59"N, 42°30'08"E, on sandstone rock, 13 May 2007, J.Vondrák (CBFS JV8549).

#### ***Caloplaca* (= *Fulgensia*) *desertorum* Tomin**

SPECIMEN EXAMINED: Turkey, Iğdır, Tuzluca, hills with salt mines E of town, alt. 1100 m, 40°02'44"N, 43°40'02"E, on gypsum soil, 30 Apr. 2007, J.Vondrák (CBFS JV8572).

#### ***Caloplaca epithallina* Lynge**

SPECIMENS EXAMINED: Turkey, Lake Van, lava stream 7 km W of Ünseli, 38°59'49"N, 43°30'01"E, on volcanic rock, lichenicolous on *Dimelaena oreina* and other lichens, 11 May 2007, J.Vondrák (CBFS

JV8155); boulder scree in slope at E coast of Lake Nazik, 38°51'41"N, 42°20'20"E, on volcanic rock, lichenicolous on *Dimelaena oreina*, 12 May 2007, J.Vondrák (CBFS JV8527); lava stream near NW shore of Lake Sodalı, 38°49'25"N, 42°56'54"E, on volcanic boulder, lichenicolous on *Dimelaena oreina*, 11 May 2007, J.Vondrák (CBFS JV8558).

### **Caloplaca erodens** Tretiach, Pinna & Grube

SPECIMENS EXAMINED: Turkey, Kayseri, Develi, near K.Künye village, on calcareous rocks, 38°08.387'N, 35°49.225'E, alt. 1420 m, 31 Oct. 2009, M.G.Halıcı & M.Kocakaya (MGH 0.4341); near Satı village, on calcareous rocks, 38°12.797'N, 35°47.249'E, alt. 1320 m, 31 Oct. 2009, M.G.Halıcı & M.Kocakaya (MGH 0.4342); Niğde, Aladağlar Milli Parkı, Cevizlik Mahallesi, Mazmılı Yayla, on calcareous rocks, 37°40.882'N, 35°01.466'E, alt. 1310 m, 12 Jul. 2007, M.G.Halıcı & A.Aksoy (MGH 0.4343); Lake Van, limestone coastal rocks 4.5 km SW of Adilcevaz, alt. 1650 m, 38°47'01"N, 42°41'01"E, on limestone, 12 May 2007, J.Vondrák (CBFS JV5362, 5365); limestone rocky outcrops near coast, SW of Bayramlı, alt. 1680 m, 38°56'38"N, 43°09'05"E, 11 May 2007, J.Vondrák (CBFS JV6460, 6482, 6505, 6511); Yassıca, rocky outcrops near coast, alt. 1690 m, 38°27'59"N, 42°30'08"E, on limestone, 13 May 2007, J.Vondrák (CBFS JV6529); Balıkesir, Bandırma, Sea of Marmara coast, 40°22'45"N, 28°04'16"E, on limestone, 13 Apr. 2007, J.Vondrák (CBFS JV6529).

### **\*Caloplaca ferrarii s.lat.**

ITS SEQUENCE: JN813393

Recently, this taxon was shown to be paraphyletic and to contain at least two lineages (Vondrák et al. 2011). Our specimen matches the morphology of *C. ferrarii*, but the molecular analysis places it outside the known clades *Caloplaca ferrarii* 1 & 2 (Fig. 1).

SPECIMEN EXAMINED: Turkey, Lake Van, limestone rocky outcrops near coast, SW of Bayramlı, 38°56'38"N, 43°09'05"E, on soft limestone rock, 11 May 2007, J.Vondrák (CBFS JV8546).

### **\*Caloplaca ferrugineoides** H.Magn.

SPECIMENS EXAMINED: Turkey, Iğdır, shale hills SE of town, 39°51'23"N, 44°05'42"E, on small shrubs in semi-desert, 1 May 2007, J.Vondrák (CBFS JV8563); Tuzluca, hills with salt mines E of town, alt. 1100 m, 40°02'44"N, 43°40'02"E, on dead small shrubs, 30 Apr. 2007, J.Vondrák (CBFS JV8581).

### **Caloplaca grimmiae** (Nyl.) H.Olivier

SPECIMENS EXAMINED: Turkey, Kars, Aygir Lake, alt. 2150 m, 40°46'28"N, 43°01'35"E, on volcanic rock, lichenicolous on *Candelariella vitellina*, 30 Apr. 2007, J.Vondrák (CBFS JV8545); Lake Van, lava stream 7 km W of Ünseli, alt. 1670 m, 38°59'49"N, 43°30'01"E, on pyroclastics, lichenicolous on *Candelariella vitellina*, 11 Apr. 2007, J.Vondrák (CBFS JV8239); boulder scree in slope at E coast of Lake Nazik, 38°51'41"N, 42°20'20"E, on volcanic rock, lichenicolous on *Candelariella vitellina*, 12 May 2007, J.Vondrák (CBFS JV8528).

### **Caloplaca haematites s.lat.**

ITS SEQUENCES: JN813387, JN813389

*Caloplaca haematites* is, as shown recently, a heterogeneous taxon (Vondrák et al., in prep.) that is paraphyletic with lineages of *C. aractina* nested within. Populations from continental Turkey are still little known, but our two collections differ from the Mediterranean populations in having a thicker thallus (c. 100–250 µm) with a ± lobulate margin.

SPECIMENS EXAMINED: Turkey, Kayseri, Develi, near Yaylacık village, under *Pinus nigra* forest, on bark of *Pinus nigra*, 38°07.182'N, 35°44.259' E, alt. 1560 m, 31 Oct. 2009, M.G.Halıcı & M.Kocakaya

(MGH 0.4344); Çataloluk Village, on bark of *Quercus*, 20.8.2009, 38°11'N, 35°50'E, alt. 1400 m, 20 Aug. 2009, M.G.Halıcı & M.Kocakaya (MGH 0.4128).

### **Caloplaca inconnexa** (Nyl.) Zahlbr.

SPECIMENS EXAMINED: Turkey, Kayseri, Develi, near Bakırdağ village, parasitic on *Acarospora cervina* and *Lecanora muralis* on calcareous rocks, 38°12.583'N, 35°49.117'E, alt. 1350 m, 20 Aug. 2009, M.G.Halıcı & M.Kocakaya (MGH 0.4345); near Satu village, parasitic on *crustose lichens* on calcareous rocks, 38°12.797'N, 35°47.249'E, alt. 1320 m, 31 Oct. 2009, M.G.Halıcı & M.Kocakaya (MGH 0.4346); Lake Van, limestone rocky outcrops near coast, SW of Bayramlı, 38°56'38"N, 43°09'05"E, on limestone rock, lichenicolous on *Acarospora cervina*, 11 May 2007, J.Vondrák (CBFS JV8526).

### **\*Caloplaca interfulgens** (Nyl.) J.Steiner

ITS SEQUENCE: JN831362

SPECIMENS EXAMINED: Turkey, Kayseri, Develi, near K.Künye village, on calcareous rocks, 38°08.387'N, 35°49.225'E, alt. 1420 m, 31 Oct. 2009, M.G.Halıcı & M.Kocakaya (MGH 0.4346); near Çataloluk village, on calcareous rocks, 38°11.326'N, 35°50.605' E, alt. 1400 m, 20 Aug. 2009, M.G.Halıcı & M.Kocakaya (MGH 0.4347); near Sarıkaya village, on calcareous rocks, 38°08.557'N, 35°49.789'E, on *Caloplaca transcaspica* on calcareous rocks, alt. 1670 m, 31 Oct. 2010, M.G.Halıcı & M.Kocakaya (MGH 0.4337); Lake Van, limestone rocky outcrops near coast, SW of Bayramlı, 38°56'38"N, 43°09'05"E, on limestone rock, 11 May 2007, J.Vondrák (CBFS JV8539, 8557); lava stream near NW shore of Lake Sodalı, 38°49'25"N, 42°56'54"E, on calcareous stone, 11 May 2007, J.Vondrák (CBFS JV8556).

### **\*Caloplaca juniperina** Tomin

ITS SEQUENCE: JN813383

*Caloplaca juniperina* was described as a corticolous and lignicolous species (Tomin 1953), but our unpublished molecular data of material from the north of Iran show that there are also muscicolous populations. Its occurrence on limestone rock at Lake Van is remarkable.

SPECIMENS EXAMINED: Turkey, Lake Van, Yassıca, rocky outcrops near coast, 38°27'59"N, 42°30'08"E, on bark of *Juglans*, 13 May 2007, J.Vondrák (CBFS JV6507); Ibid.: on calcareous rock (CBFS JV8532); Lake Van, lava stream near NW shore of Lake Sodalı, 38°49'25"N, 42°56'54"E, among bryophytes on volcanic rock, 11 May 2007, J.Vondrák (CBFS JV8518, 8537).

### **Caloplaca lobulata** (Flörke) Hellb.

SPECIMEN EXAMINED: Turkey, Kayseri, Develi, near Yaylacık village, on bark of *Pinus nigra*, 38°07.182'N, 35°44.259'E, alt. 1560 m, 01 Nov. 2009, M.G.Halıcı & M.Kocakaya (MGH 0.4348).

### **Caloplaca marmorata** (Bagl.) Jatta

ITS SEQUENCES: JN813390, JN813391, JN813394

*C. marmorata* is probably phenotypically more variable in continental Turkey than in Europe. Some Turkish samples have paler orange and larger (c. 0.8–2.0 mm diam) apothecia than is usual in Europe (MGH 0.4350, 0.4351, 0.4352, CBFS JV9012). Based on our knowledge of European populations, at first we considered these samples to be *C. ferrarii* (a similar species with paler and larger apothecia in general), but their ITS sequences fell within *C. marmorata* (Fig. 1).

SPECIMENS EXAMINED: Turkey, Kayseri, Develi, near Sarı kaya village, on calcareous rocks, 38°09.370'N, 35°49.434'E, alt. 1550 m, 31 Oct. 2009, M.G.Halıcı & M.Kocakaya (MGH 0.4349); near K.Künye



village, steppe area, calcareous rocks, 38°08.270'N, 35°49.512'E, alt. 1420 m, 31 Oct. 2009, M.G.Halıcı & M.Kocakaya (MGH 0.4350); near Avla village, steppe area, calcareous rocks, 38°09.026'N, 35°49.761'E, alt. 1600 m, 20 Aug. 2009, M.G.Halıcı & M.Kocakaya (MGH 0.4351); near Çataloluk village, on calcareous rocks, 38°11.326'N, 35°50.605'E, alt. 1400 m, 20 Aug. 2009, M.G.Halıcı & M.Kocakaya (MGH 0.4352); Lake Van, limestone coastal rocks 3.5 km SW of Adilcevaz, alt. 1650 m, 38°47'14"N, 42°42'04"E, on limestone, 12 May 2007, J.Vondrák (CBFS JV8580, 9012).

### **Caloplaca pellodella** (Nyl.) Hasse

SPECIMEN EXAMINED: Turkey, Iğdır, lava stream below Mt Ararat, SE of town, alt. 940 m, 39°50'51"N, 44°05'17"E, on volcanic stone, 1 May 2007, J.Vondrák (CBFS JV6315).

### **Caloplaca persica** (J.Steiner) M.Steiner & Poelt

SPECIMEN EXAMINED: Turkey, Lake Van, Yassıca, rocky outcrops near coast, 38°27'59"N, 42°30'08"E, on bark of *Juniperus*, 13 May 2007, J.Vondrák (CBFS JV8515).

### **Caloplaca phaeothamnos** Kalb & Poelt

SPECIMENS EXAMINED: Turkey, Lake Van, lava stream 7 km W of Ünseli, alt. 1670 m, 38°59'49"N, 43°30'01"E, among mosses on volcanic boulders, 11 May 2007, J.Vondrák (CBFS JV7642); lava stream near NW shore of Lake Sodalı, 38°49'25"N, 42°56'54"E, among bryophytes on volcanic boulders, 11 May 2007, J.Vondrák (CBFS JV8511, 8542).

### **\*Caloplaca polycarpoides** (J.Steiner) M.Steiner & Poelt

SPECIMEN EXAMINED: Turkey, Lake Van, limestone coastal rocks 4.5 km SW of Adilcevaz, 38°47'01"N, 42°41'01"E, on shrub twigs, 12 May 2007, J.Vondrák (CBFS JV8524).

### **Caloplaca pyracea** (Ach.) Zwackh

ITS SEQUENCE: JN813392

SPECIMENS EXAMINED: Turkey, Kayseri, Develi, Çataloluk Village, on bark of *Quercus*, 20.8.2009, 38°11'N, 35°50'E, alt. 1400 m, 20 Aug. 2009, M.G.Halıcı & M.Kocakaya (MGH 0.4157).

### **Caloplaca (= Fulgensia) schistidii** (Anzi) Zahlbr.

SPECIMENS EXAMINED: Turkey, Lake Van, Yassıca, rocky outcrops near coast, 38°27'59"N, 42°30'08"E, among bryophytes on calcareous substrate, 13 May 2007, J.Vondrák (CBFS JV8513); limestone coastal rocks 4.5 km SW of Adilcevaz, 38°47'01"N, 42°41'01"E, among bryophytes on calcareous soil, 12 May 2007, J.Vondrák (CBFS JV8523).

### **\*Caloplaca sororicida** M.Steiner & Poelt

According to the protologue (Poelt & Hinteregger 1993), *Caloplaca transcaspica* is the host of this lichenicolous lichen. The host of our specimen is not *C. transcaspica*, but a closely related species, perhaps new, which for the moment we have called "*C. cf. bullata*".

SPECIMENS EXAMINED: Turkey, Kayseri, Develi, near Çataloluk village, parasitic on *Caloplaca* sp. on calcareous rocks, 38°11.326'N, 35°50.605'E, alt. 1400 m, 38°11.326'N, 35°50.605'E, alt. 1400 m, 20 Aug. 2009, M.G.Halıcı & M.Kocakaya (MGH 0.4353); Iğdır, lava stream near shale hills SE of town, 39°50'51"N, 44°05'17"E, on volcanic rock, lichenicolous on *Caloplaca cf. bullata*, 1 May 2007, J.Vondrák (CBFS JV8521, 8568); Lake Van, limestone rocky outcrops near coast, SW of Bayramlı, 38°56'38"N, 43°09'05"E, on limestone rock, lichenicolous on *Caloplaca cf. bullata*, 11 May 2007,

J.Vondrák (CBFS JV8538); lava stream near NW shore of Lake Sodalı, 38°49'25"N, 42°56'54"E, on volcanic rock, lichenicolous on *Caloplaca* cf. *bullata*, 11 May 2007, J.Vondrák (CBFS JV8533).

### ***Caloplaca stillicidiorum* (Vahl) Lyngé**

Although not phenotypically separable from corticolous *Caloplaca cerina* s. lat., this species forms a large monophyletic group containing lichens growing on soil, mosses, plant debris and small shrubs (Šoun et al. 2011).

SPECIMENS EXAMINED: Turkey, Lake Van, Yassıca, rocky outcrops near coast, 38°27'59"N, 42°30'08"E, among bryophytes on calcareous substrate, 13 May 2007, J.Vondrák (CBFS JV8514); boulder scree in slope at E coast of Lake Nazik, 38°51'41"N, 42°20'20"E, among bryophytes on volcanic boulders, 12 May 2007, J.Vondrák (CBFS JV8531); lava stream near NW shore of Lake Sodalı, 38°49'25"N, 42°56'54"E, among bryophytes on volcanic boulders, 11 May 2007, J.Vondrák (CBFS JV8536).

### ***Caloplaca teicholyta* (Ach.) J.Steiner**

SPECIMEN EXAMINED: Turkey, Iğdır, hills SE of town, 39°51'23"N, 44°05'41"E, on calcareous stone, 1 May 2007, J.Vondrák (CBFS JV6456).

### ***Caloplaca tominii* Savicz**

Although originally described as terricolous, *C. tominii* is also common on rocks in arid regions of Eurasia (Vondrák et al. 2011).

SPECIMEN EXAMINED: Turkey, Lake Van, limestone rocky outcrops near coast, SW of Bayramlı, 38°56'38"N, 43°09'05"E, on soft limestone rock, 11 May 2007, J.Vondrák (CBFS JV8554).

### ***Caloplaca trachyphylla* (Tuck) Zahlbr.**

SPECIMENS EXAMINED: Turkey, Kayseri, Develi, near Bakı rdağ village, on calcareous rocks, 38°12.583' N, 35°49.117'E, alt. 1350 m, 20 Aug. 2009, M.G.Halıcı & M.Kocakaya (MGH 0.4354); Iğdır, shale hills SE of town, alt. 1060 m, 39°51'23"N, 44°05'42"E, on calcareous sandstone, 1 May 2007, J.Vondrák (CBFS JV8564).

### ***Caloplaca transcaspica* (Nyl.) Zahlbr.**

SPECIMEN EXAMINED: Turkey, Niğde, Aladağlar Milli Parkı, Cevizlik Mahallesi, Mazmılı Yayla, on calcareous rocks, 37°40.882'N, 35°01.466'E, alt. 1310 m, 12 Jul. 2007, M.G.Halıcı & A.Aksoy (MGH 0.4355).

### ***Caloplaca variabilis* s.lat.**

The whole *C. variabilis* group (subgenus *Pyrenodesmia*) is still very poorly understood, as well as the name "*C. variabilis*" itself. In recent studies, *C. variabilis* has been found to be heterogeneous (e.g. Muggia et al. 2008).

SPECIMENS EXAMINED: Turkey, Kayseri, Develi, near Avla village, steppe area, calcareous rocks, 38°09.026'N, 35°49.761'E, alt. 1600 m, 31 Oct. 2009, M.G.Halıcı & M.Kocakaya (MGH 0.4356); Iğdır, shale hills SE of town, alt. 1060 m, 39°51'23"N, 44°05'42"E, on calcareous sandstone, 1 May 2007, J.Vondrák (CBFS JV6441); Lake Van, Yassıca, rocky outcrops near coast, alt. 1690 m, 38°27'59"N, 42°30'08"E, on calcareous rock, 13 May 2007, J.Vondrák (CBFS JV6454, 6465); limestone coastal rocks 4.5 km SW of Adilcevaz, alt. 1650 m, 38°47'01"N, 42°41'01"E, 12 May 2007, J.Vondrák (CBFS JV5342, 5366, 5437, 5462).

### **Caloplaca cf. velana** (A.Massal.) Du Rietz

ITS SEQUENCE: JN813385

Our samples are related to the species *Caloplaca dolomiticola* (Hue) Zahlbr. and *C. velana*. The differences between these two taxa are not clear, so we prefer to keep our identifications tentative until the taxonomy of the group has been worked out.

SPECIMENS EXAMINED: Turkey, Kayseri, Develi, near B.Künye village, on calcareous rocks, 38°08.971'N, 35°48.180'E, alt. 1420 m, 20 Aug. 2009, M.G.Halıcı & M.Kocakaya (MGH 0.4357); Lake Van, Yassıca, rocky outcrops near coast, alt. 1690 m, 38°27'59"N, 42°30'08"E, on calcareous rock, 13 May 2007, J.Vondrák (CBFS JV6927).

### **Caloplaca xerica** Poelt & Vězda

SPECIMENS EXAMINED: Turkey, Artvin, rocky outcrops near road on side of river opposite town, alt. 550 m, 41°11'24"N, 41°51'28"E, on siliceous rock, 29 Apr. 2007, J.Vondrák (CBFS JV6443); Lake Van, lava stream 7 km W of Ünseli, 1670 m, 38°59'49"N, 43°30'01"E, on volcanic soil, 11 May 2007, J.Vondrák (CBFS JV6521); Zonguldak, coastal rocks 1 km W of Türkali, 41°32'34"N, 31°58'23"E, on base-rich sandstone rock, 16 Apr. 2007, J.Vondrák (CBFS JV6473).

### **Fulgensia bracteata** (Hoffm.) Räsänen

SPECIMENS EXAMINED: Turkey, Lake Van, limestone rocky outcrops near coast, SW of Bayramlı, 38°56'38"N, 43°09'05"E, among bryophytes on calcareous soil, 11 May 2007, J.Vondrák (CBFS JV8541, 8543); Yassıca, rocky outcrops near coast, 38°27'59"N, 42°30'08"E, among bryophytes on calcareous soil, 13 May 2007, J.Vondrák (CBFS JV8512).

### **Acknowledgements**

Our research received support from the Visegrad Fund (grant 51100753) and the project "FBA-09-908; Erciyes Üniversitesi Bilimsel Araştırmalar Projesi", which financially supported the field research in Turkey. Ulf Arup, Linda in Arcadia and an anonymous reviewer made valuable comments on and improvements to the manuscript. Linda in Arcadia also revised the English.

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Manuscript received August 19, 2011; accepted October 19, 2011.