

Caloplaca himalayana, a new epiphytic lichen from the Indian subcontinent

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Abstract: Twenty-three species of epiphytic *Caloplaca* are recognized in India, of which *Caloplaca himalayana* Joshi, Y. & Upreti, characterized by thin, continuous, yellowish thallus, numerous ferruginous-red to brownish red, flat to subconvex apothecia with a persistent proper margin and lignicolous habitat, is described here as a new species. Because of the ferruginous coloured apothecial disc, the new species is provisionally placed in the *ferruginea* group until a taxonomic treatment of the whole group has been carried out. The *ferruginea* group is characterized by a whitish to grey (rarely yellowish) crustose thallus, a ferruginous to rarely blackish apothecial disc, biatorine to lecanorine exciple, thick-walled spore septa and the chemosyndrome C. The taxonomic affinities of the new taxa with several other taxa, including species of *ferruginea* group, are discussed. Two new records for India are also recorded: *Caloplaca alnetorum* Giralt, Nimis & Poelt and *C. crocea* (Kremp.) Hafellner & Poelt. A key to all the corticolous *Caloplaca* species occurring in the Indian subcontinent is also provided.

Key words: *Caloplaca ferruginea* group, India, *Teloschistaceae*, new species, new records

Introduction

Corticolous and/or lignicolous species of the lichen genus *Caloplaca* have been taxonomically well-treated by various workers across the world (e.g. Arup 2006; Giralt *et al.* 1992; Hafellner & Poelt 1979; Hansen *et al.* 1987; Khodosovtsev *et al.* 2004; Laundon 1992; Magnusson 1944; Poelt & Hinteregger 1993; Søchting 1989; Wade 1965; Wetmore 1994, 2001, 2004 *a, b*, 2007). For the Indian subcontinent, Awasthi (1991), Poelt & Hinteregger (1993) and Joshi & Upreti (2007, 2008 *a, b*) reported 11, 24 and 11 corticolous species of *Caloplaca*, respectively. While revising *Teloschistacean* taxa from India, one of the authors (YJ) reported 23 corticolous species of this genus from India (Joshi 2008c), one of which was collected 3 to 6 years ago in temperate regions of the Western Himalayas growing over dead wood. It is described here as new to science

along with two new records to the Indian lichen flora. A revised and updated key of all the corticolous Indian epiphytic *Caloplaca* species is also provided.

Materials and Methods

The present study is based on collections in LWG (including LWU–AWAS). The morphological characters were examined on dry material under a dissecting microscope (×40). The thallus and ascomata were examined with a compound microscope (×100, oil immersion). The sections cut for studying anatomical details were mounted in water. For characters such as size of thallus, apothecium and thickness of the hymenium, 5 measurements were recorded from each specimen; 10 measurements per specimen were recorded for ascospore dimensions. The dimensions of epihymenium, hymenium and ascospores are generally presented as (minimum value recorded–) lowest specimen arithmetic mean observed–highest specimen arithmetic mean observed (–maximum value recorded). All measurements were made on material mounted in water, but the paraphyses were studied after replacing water with 25% KOH (Wetmore 1994). Chemicals used in identification were 10% KOH (K), calcium hypochlorite (C), and *para*-phenylenediamine (PD). Secondary metabolites were identified by TLC as described by Walker & James (1980). The chromatograms were developed in solvent systems A (toluene: 1, 4-dioxane: acetic acid) and C (toluene: acetic acid). Terminology for tissues

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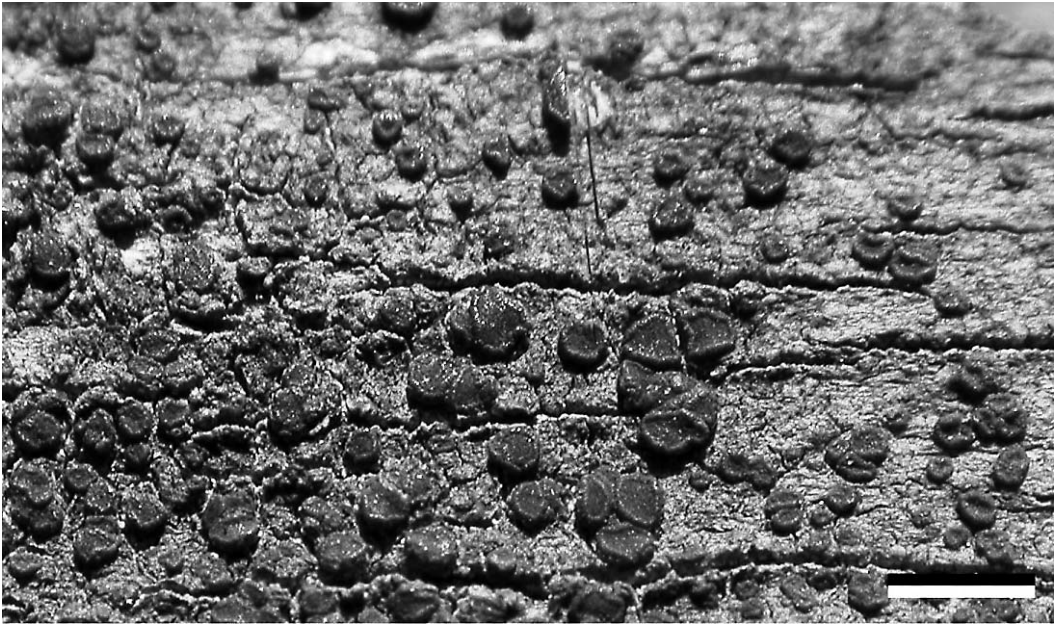


FIG. 1. *Caloplaca himalayana*, habitus (holotype in LWG). Scale = 3 mm.

generally follows that of Nash & Gries (2002) and Wetmore (1994).

The New Species

Caloplaca himalayana Y. Joshi & Upreti sp. nov.

Caloplaca flavorubescens similis sed margine thalino deficienti, amphithecio sine algis, sporis parvis differt.

Typus: India, Himachal Pradesh, Shimla district, Rohru, Sungri, alt. 2600 m, on dead wood, 22 May 2002, S. Nayaka & R. Srivastava 02-219451 (LWG—holotypus; CAL— isotypus).

(Fig. 1)

Thallus crustose, lignicolous, thin, continuous, determinate, irregular, 0.4–2(–3) cm diam., 25–30 µm thick, yellowish. *Cortex* thin, 8–13 µm thick, paraplectenchymatous, of thin-walled cells, algal layer even and continuous. *Medulla* macroscopically white, of loose hyaline hyphae, prosoplectenchymatous. *Prothallus* absent.

Apothecia biatorine, numerous, scattered to ± aggregated (1–4), sessile, round to ± angular owing to pressure, 0.2–1(–1.2) mm

diam.; *disc* ferruginous red to reddish brown, plane to subconvex, glossy; *proper margin* smooth, entire, persistent, thin, 0.2–0.5 mm, flush, concolorous or paler than disc, glossy; *thalline margin* absent. *Epihymenium* golden brown, 15–30 µm thick; *hymenium* hyaline, 50–80 µm high; *hypothecium* hyaline, of isodiametric cells, with numerous oil-droplets; *parathecium* cupular, of thin walled elongated hyphal cells; *amphithecium* of thin-walled elongated hyphal cells, without algae or algae ± restricted to the base of parathecium. *Paraphyses* thin, simple, ± furcated at the tips, sometimes with ± inflated apices. *Ascus* 8-spored, *ascospores* polaribilocular, ellipsoid to broadly ellipsoid to ovoid, 9–11 × (4–)5–6(–7) µm, isthmus 2–4 µm.

Pycnidia not seen.

Chemistry. Thallus, apothecial disc and epihymenium K+ purple, C–, Pd–. Medulla K–, C–, Pd–. TLC: 7-chloroemodin (major) and parietinic acid (traces).

Ecology and distribution. Currently *C. himalayana* is known from two localities in Himachal Pradesh and one locality in Jammu

& Kashmir. The species was found growing over dead wood between elevations of 2150–2800 m in temperate regions of the Western Himalayas. The three known communities in which the new taxon has been encountered, have a similar lichen composition (*Lecanora* and *Rinodina* spp.), along with a dense mat of cyanophycean species.

Remarks. The new taxon can be recognized by a thin, continuous yellowish thallus with ferruginous apothecia, absence of both a thalline margin and algae in the amphithecium, and lignicolous habitat. It is often confused with the citrine or orange-grey coloured species of *C. herbidella* (= *C. herbidella* f. *citrescens* H. Magn.) which differs from the new taxa in being isidiate. Sometimes *C. flavorubescens* (Huds.) J. R. Laundon with deep reddish brown to brown apothecia is difficult to separate from the new taxon, but the former differs in the presence of a thalline margin, algae in the amphithecium and larger spores [$12\text{--}20(-25) \times 5\text{--}10(-13.6) \mu\text{m}$]. *Caloplaca ammiospila* (Wahlenb.) H. Olivier, *C. caesiorufella* (Nyl.) Zahlbr., *C. ferruginea* (Huds.) Th. Fr., *C. ferrugineofusca* (Vain.) H. Magn., *C. jenisejensis* H. Magn., *C. spitsbergensis* H. Magn. and *C. subathallina* H. Magn., are other lignicolous or corticolous species having ferruginous or reddish brown coloured apothecial discs, but differ from the new taxon in having endoxylic, poorly to well-developed grey thalli and larger spores ($12\text{--}17 \mu\text{m}$). On the other hand, *C. asserigena* (J. Lahm) Della Torre & Sarnth., having a ferruginous coloured apothecial disc and similar sized spores to that of the new taxon ($9\text{--}12 \times 5\text{--}6.5 \mu\text{m}$), differs in its grey thallus and lecanorine to zeorine small apothecia ($0.2\text{--}0.4 \text{ mm}$ broad). *Caloplaca juniperi* Poelt & Hint., another related species having a yellowish thallus and ferruginous coloured apothecial disc, differs from the new taxon in having squamulose thalli and pale yellow margined concave apothecia.

Additional specimens examined. **India:** Himachal Pradesh: Shimla district, Narkanda, 3–4 km towards Hatu Peak, alt. 2800 m, on dead wood, 2002, S. Nayaka & R. Srivastava 02-81522 (LWG). Jammu & Kashmir: Udhampur district, Patnitop, Tourist area, alt. 2150 m, on dead wood, 9 xii 2005, M. Sheikh s.n. (LWG).

New Records

Caloplaca alnetorum Giralt, Nimis & Poelt

Cryptog. Bryol. Lichénol. 13: 269 (1992).

This species is characterized by: irregular to \pm orbicular, very thin (almost confused with the substratum) continuous to \pm areolate, golden yellow thallus; orange apothecial discs; persistent proper margin; parathecium of \pm elongated cells or paraplectenchymatous; amphithecium with algae; and spores with thickened end walls, $11\text{--}12 \times 5\text{--}7 \mu\text{m}$, with isthmus $4\text{--}6 \mu\text{m}$. In external appearance the species is close to *Caloplaca cerinelloides* (Erichs.) Poelt, but differs in having a yellowish thallus and spores of variable shapes with thickened end-walls. *Caloplaca cerinelloides* has a greyish K– thallus. *Caloplaca flavorubescens* another related species, differs in having a greenish yellow thallus with a prominent thalline margin and larger broadly ellipsoid spores [$12\text{--}20(-25) \times 5\text{--}10(-13.6) \mu\text{m}$].

Poelt (1969, as “*C. alnetorum* ad int.”) and Giralt, Nimis & Poelt (1992) reported this species from Europe and Nordic countries. Alon & Galun (1971) reported this species growing over bark of *Quercus calliprinos* and *Pistacia palestina* from Israel. It is a new record for India and is found growing on bark of *Cedrus* and *Abies* between elevations of 2000–2800 m in the Central Himalayas.

Additional specimens examined. **India:** Himachal Pradesh: Chamba district, Chamba, around Joth, alt. 2000–2350 m, on *Cedrus* bark, 2001, D. K. Upreti & S. Nayaka 01-75556 (LWG); Shimla district, Narkanda, 3–4 km towards Hatu Peak, alt. 2800 m, on *Abies* bark, 2002, S. Nayaka & R. Srivastava 02-67177 (LWG).

Caloplaca crocea (Kremp.) Hafellner & Poelt

J. Hattori Bot. Lab. 46: 19–24 (1979). – *Lecidea crocea* Kremp., *Flora* 59: 317 (1876).

The species is characterized by: a thin continuous to subareolate, smooth, whitish-grey, UV+ cream-yellow, K– thallus; yellow to yellowish orange apothecial disc; proper margin pale orange-brown; thalline margin persistent, smooth, thick, raised above the

level of disc, concolorous with thallus; hypothecium paraplectenchymatous, with oil droplets; parathecium of radiating elongated hyphal cells, amphithecium with algae, outer surface with hyaline crystals, paraphyses simple to \pm branched at the tips, spores trilocular, $16\text{--}18 \times 8\text{--}10 \mu\text{m}$, middle locule of similar size to the polar locules. In external morphology, the species is similar to *C. aff. cerina* (Ehrh. ex Hedw.) Th. Fr., a corticolous species, growing in temperate regions of India. However, the trilocular spores of *C. crocea* separate it from species of *C. cerina* group.

Hafellner & Poelt (1979) reported *C. crocea* growing on bark and wood in Africa, Madagascar, Argentina, Brazil, Paraguay and Uruguay, while Wetmore (2007) reported it from North and Central America. It is a new record for India and is reported from the tropical regions of southern India, where it was found growing on trees at an altitude of 1100 m with *C. bassiae* (Willd. ex Ach.) Zahlbr.

Specimen examined. India: Tamil Nadu: Chennai, Pulmedu, Siruvani Hills, alt. 1100 m, on bark, 1996, G. N. Hariharan & Balaji CC9 (MSSRF).

Key to the epiphytic species of *Caloplaca* from the Indian subcontinent

A total of 32 species of epiphytic *Caloplaca* from the Indian subcontinent are keyed out, of which 23 occur in India (**bold in key**) and the remaining 9 are reported from other parts of the Indian subcontinent. Figures for spore measurements include (minimum value recorded–) lowest specimen arithmetic mean observed—highest specimen arithmetic mean observed (–maximum value recorded); dimensions given for apothecia all refer to their diameter. Vegetative propagules play an important role in demarcating the species, hence their presence or absence is an important distinguishing character. The number of locules within the spores varies between the species, but one type, polaribilocular is more common than than any other; the type of spore is only given when deviating from the normal type or where it is important for identification. The key in this paper will certainly not solve all problems, but should be consulted together with previous publications (cited above).

- | | | |
|------|---|--|
| 1 | Thallus sorediate, isidiate or blastidiate | 2 |
| | Thallus without soredia, isidia or blastidia | 12 |
| 2(1) | Thallus isidiate | 3 |
| | Thallus sorediate or blastidiate | 5 |
| 3(2) | Thallus grey; apothecial disc ferruginous red | |
| | C. herbidella (Nyl. ex Hue) H. Magn. | |
| | Thallus yellow; apothecial disc orange-brown to brownish red | 4 |
| 4(3) | Apothecia biatorine; cosmopolitan | C. bassiae (Willd. ex Ach.) Zahlbr. |
| | Apothecia lecanorine; restricted to temperate regions | |
| | C. kashmirensis Joshi, Y. & Upreti | |
| 5(2) | Thallus blastidiate | C. farinosa Poelt & Hinter. |
| | Thallus sorediate. | 6 |
| 6(5) | Thallus leprose, completely sorediate or nearly so | 7 |
| | Thallus only partly dissolved into soredia. | 9 |
| 7(6) | Thallus completely leprose, golden to brownish yellow, consorediate | |
| | C. chrysodeta (Vain. ex Räsänen) Domb. | |
| | Thallus usually completely dissolved into soredia but not leprose | 8 |
| 8(7) | Soredia arising marginally | C. phlogina (Ach.) Flagey |
| | Soredia of medullary origin | C. phloginopsis Poelt & Hinter. |

- 9(6) Thallus grey 10
 Thallus yellow-orange 11
- 10(9) Thallus distinctly grey, rarely sorediate, with numerous brown to blackish apothecia; tropical distribution **C. atrosanguinea (G. Merr.) I. M. Lamb**
 Thallus grey, sometimes yellow tinged, distinctly sorediate, rarely apotheciata; temperate distribution. **C. granularis (Müll. Arg.) Zahlbr.**
- 11(9) Soralia mainly marginal, disc yellowish orange . **C. flavocitrina (Nyl.) H. Olivier**
 Soralia of medullary origin, almost crater-like, disc ferruginous red
 **C. chrysophthalma Degel.**
- 12(1) Spores trilocular 13
 Spores polaribilocular 17
- 13(12) Apothecial disc different shades of brown, K–; differs entirely from *C. cerina*. . 14
 Apothecial disc yellow to orange to rust brown, K+ purple; often confused with
C. cerina **C. crocea (Kremp.) Hafellner & Poelt**
- 14(13) Middle locule rhomboidal in shape *C. brebissonii* (Fée) Zahlbr.
 Middle locule not rhomboidal. 15
- 15(14) Anthraquinone and/or hyaline crystals absent in amphithecium and parathecium
 *C. homologa* Nyl.
 Anthraquinone and/or hyaline crystals present in amphithecium and parathecium
 16
- 16(15) Anthraquinone crystals present in epihymenium; hypothecium with oil droplets;
 middle locule of spores not elongated; thallus UV+ cream-yellow
 **C. jatolensis Joshi, Y. & Upreti**
 Anthraquinone crystals absent in epihymenium; hypothecium without oil droplets;
 middle locule of spores elongated; thallus UV+ orange . . **C. triloculans Zahlbr.**
- 17(12) Thallus different shades of yellow to orange 18
 Thallus different shades of grey 22
- 18(17) Apothecia ± stipitate; ascus 12–16 spored; thallus *Xanthoriella*-type (i.e. lobate
 species of *Caloplaca* resembling *Xanthoria* but devoid of lower cortex and rhizines)
 *C. persica* (Stein.) M. Stein. & Poelt
 Apothecia sessile; ascus 8 spored; thallus not of *Xanthoriella* type 19
- 19(18) Thallus obligate on *Juniperus* bark or on dead wood; apothecial disc ferruginous red
 but never with orange tinge 20
 Thallus not obligate over *Juniperus* bark or on dead wood; apothecial disc orange-
 yellow to brownish orange, rarely ferruginous red 21
- 20(19) Mature thalli squamulose; apothecia deeply concave in the beginning; spores 10–14
 × 4.5–8 µm; obligate on *Juniperus*. *C. juniperi* Poelt & Hint.
 Mature thalli continuous; apothecia plane from the beginning; spores 9–11 × 5–6
 µm; obligate on dead wood **C. himalayana Joshi, Y. & Upreti**
- 21(19) Thallus greenish yellow to dull greyish, continuous to cracked areolate, prothallus
 black; hypothecium with oil droplets; spores ellipsoid with thin end walls
 **C. flavorubescens (Huds.) J. R. Laundon**
 Thallus golden yellow, continuous to areolate, prothallus absent; hypothecium
 without oil droplets; spores ellipsoid with thickened end walls
 **C. alnetorum Giralt, Nimis & Poelt**

- 22(17) Apothecial disc different shades of brown to blackish 23
 Apothecial disc yellow to orange or red 27
- 23(22) Spores > 20 μm long. *C. yuennana* (Zahlbr.) Poelt & Hinter.
 Spores shorter 24
- 24(23) Disc dark brown to black 25
 Disc pale brown with some reddish or orange tinge 26
- 25(24) Epiphytenium first K+ strong reddish purple then turning blue, thallus \pm sorediate
 ***C. atosanguinea* (G. Merr.) I. M. Lamb**
 Epiphytenium K+ purple not turning blue, thallus esorediate
 ***C. rinodinopsis* Poelt & Hinter.**
- 26(24) Thallus granular to verruculose, prothallus present (bluish grey); spores with thin
 end-walls. *C. haematites* (Chaub.) Zwack
 Thallus continuous to areolate, prothallus absent; spores with thick end-walls . . .
 ***C. pollinii* (A. Massal.) Jatta**
- 27(22) Asci usually 12–16 spored; thallus indistinct ***C. cerinella* (Nyl.) Flagey**
 Asci usually with 8 or fewer spores; thallus distinct. 28
- 28(27) Margins whitish to dark bluish-grey, never yellow . . ***C. cerina* (Hedw.) Th. Fr.**
 Margins usually yellow to orange at least in the upper part and around the disc, the
 flanks often discolouring, whitish or greyish 29
- 29(28) Spores with thick end-walls (hour glass type); parathecium distinctly paraplecten-
 chymatous and cupulate *C. cupulata* Poelt & Hinter.
 Spores not with thick end-walls; parathecium neither paraplectenchymatous nor
 cupulate 30
- 30(29) Thallus granulose 31
 Thallus smooth or crustose-membranaceous 32
- 31(30) Prothallus absent, cortex of the amphithecium very thick; from Karakorum Range in
 Pakistan *C. baltistanica* Poelt & Hinter.
 Prothallus distinct, pale grey with bluish tinge; from Europe & Israel
 *C. haematites* (Chaub. ex St.-Amans) Zwackh
- 32(30) Apothecia uniformly ferrugineous ***C. ferruginea* (Huds.) Th. Fr.**
 Apothecia yellow to orange 33
- 33(32) Apothecia uniformly ceraceous yellow, but the thin, sharp margin often discoloured,
 becoming olivaceous or greyish black. *C. borealis* (Vain.) Poelt
 Apothecia yellow to orange, but margins usually not discoloured 34
- 34(33) Apothecia up to 1.5 mm in diam., distinctly zeorine, spores 14–22 \times 7–11 μm . . .
 *C. satparae* Poelt & Hinter.
 Apothecia mostly 0.2–0.7(–1) mm in diam., \pm indistinctly zeorine, spores smaller
 35
- 35(34) Apothecia yellow to orange-yellow, margins somewhat brighter than discs; spores
 9–13 \times 5–7 μm ***C. cerinelloides* (Erichsen) Poelt**
 Apothecia yellowish orange to orange or brownish orange, but flanks of the margins
 often becoming greyish; spores usually 11–14 \times 5–7 μm
 ***C. pyracea* (Ach.) Th. Fr.**

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