

## *Caloplaca cinnabarina* – a new candidate for Missouri’s most colorful lichen

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ABSTRACT. — The colorful crustose lichen *Caloplaca cinnabarina* is reported new to Missouri and Kentucky, with a discussion of its Midwestern distribution, historical problems surrounding the application of the name in North America, and several new reports for the Great Plains and Midwest. The species typically occurs on massive siliceous rock exposures and is characterized by striking orange-red areolate thalli with immersed apothecia.

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Although most lichens typically range from black and brown to various shades of grays, blue-grays, and greens, some lichens are far more spectacularly hued in yellows, oranges, and reds. One of the larger groups of brightly colored lichens occurs within the genus *Caloplaca* s.l. (Teloschistaceae) — a famously difficult and poorly understood genus with more than 500 known species (Kirk et al. 2008).

Many *Caloplaca* species have prominent yellow, orange, or reddish coloration. In Missouri, where at least 24 species have been documented (Ladd, unpublished data), 17 have some features with prominent yellow or orange coloration. These colors are largely due to the presence of various polycyclic aromatic hydrocarbons called anthraquinones, notably parietin (C<sub>16</sub>H<sub>12</sub>O<sub>5</sub>), which occurs in lichens, non-lichenized fungi, and some vascular plants including species of *Rhamnus*, *Rheum*, and *Rumex* (Fernández-Marín et al. 2018). In laboratory studies, the pigment protects against damaging effects of UV-B radiation (Solhaug & Gauslaa 1996) and blue light (Gauslaa & Ustvedt 2003); it also has antibacterial and antifungal properties (Basile et al. 2015).

A visually spectacular species of *Caloplaca* in North America is *Caloplaca cinnabarina* (Ach.) Zahlbr. This striking crustose lichen occurs on massive siliceous rock exposures, usually in well-drained microhabitats, such as on vertical faces of bluffs, outcrops, and large boulders. The thallus is a vivid reddish orange and the immersed, disk-like apothecia are similarly colored but slightly redder. This species often occurs in populations with multiple adjacent thalli merging to create patches of bright orange-red several centimeters across which are visible from

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considerable distances (Fig. 1). *Caloplaca* is in the process of being divided into numerous smaller genera based on recent molecular data (Arup et al. 2013), but the status of *C. cinnabarina* remains uncertain. *Caloplaca subsoluta* and related taxa have been segregated into the newly described genus *Squamulea* Arup, while some other species closely resembling *C. cinnabarina* have been placed in the genus *Polycaulonia*.

*Caloplaca cinnabarina* has been erroneously attributed to Missouri by several sources (including reports summarized in Ladd [1996], most of which are referable to *C. subsoluta* [= *Squamulea subsoluta*]). This is part of a long historical pattern throughout North America of misidentifying saxicolous species of *Caloplaca* with orange thalli (particularly those now segregated into the genus *Squamulea*) as *C. cinnabarina*, as discussed by Wetmore and Kärnefelt (1999). They restrict the North American range of *C. cinnabarina* to the southern United States, Mexico, and the Caribbean; within the United States they report it from 14 states including four counties in the Ouachita region of Arkansas and three poorly documented 19<sup>th</sup> century collections from Illinois, Pennsylvania, and Tennessee without further locality data (Wetmore & Kärnefelt 1999). Subsequent field work in the Ozark region has resulted in three new Arkansas localities (cited below) but despite intensive lichen field work in suitable Missouri habitats, particularly in the St. Francois mountains region of the Ozarks, the species was not known from Missouri.

In July 2015, the senior author discovered a small population of *C. cinnabarina* (Fig. 1 A & 1 B) in an extensive and remote igneous glade system on Proffit Mountain in Reynolds County, Missouri. Here, despite abundant available substrate, it was restricted to several small patches (10-15 total) in one area of the glade at an approximate elevation of 1310 feet on a steep west-facing slope. Individuals grew primarily on the south and west sides of large, rhyolitic boulders and outcrops. Associates growing in the same habitat included *Acarospora fuscata*, *Dimelaena oreina*, *Lecanora oreinoides*, *Rhizoplaca subdiscrepans*, and *Xanthoparmelia viriduloumbrina* (nomenclature and authorities for lichen names follow Esslinger 2019). Interestingly, Paul McKenzie later independently found and photographed this population in 2016.

Subsequent field work by Braun in September 2018 revealed another Missouri population (Fig. 1 C) about 7.8 air miles northwest of the Reynolds County location, on Bell Mountain in neighboring Iron County. This population appears to be limited to a few rhyolitic boulders on a west-southwest facing igneous glade at an approximate elevation of 1200 feet. Both Missouri populations occur on boulders and outcrops in igneous glades in the St. Francois Knobs and Basins region of Missouri. While many igneous glades exhibit impacts of past grazing activities (Nelson 2010), both of these glades seem less affected and retain deep, intact soils and rich vascular vegetation exhibiting strong floristic affinities with tallgrass prairies.

*Caloplaca cinnabarina* is readily distinguished in the field by its thin, continuous, bright orange-red areolate thallus that is closely adnate to the underlying rock substrate. The marginal

areoles are often elongate and appear sub-effigurate, with sharply defined margins and no marginal thinning or evident prothallus (Fig. 1B & 1C). Older portions of the thalli in the Missouri populations have abundant, mostly immersed, apothecia to 0.5 mm broad; these are darker orange-red than the thallus, with an evident thalline margin.

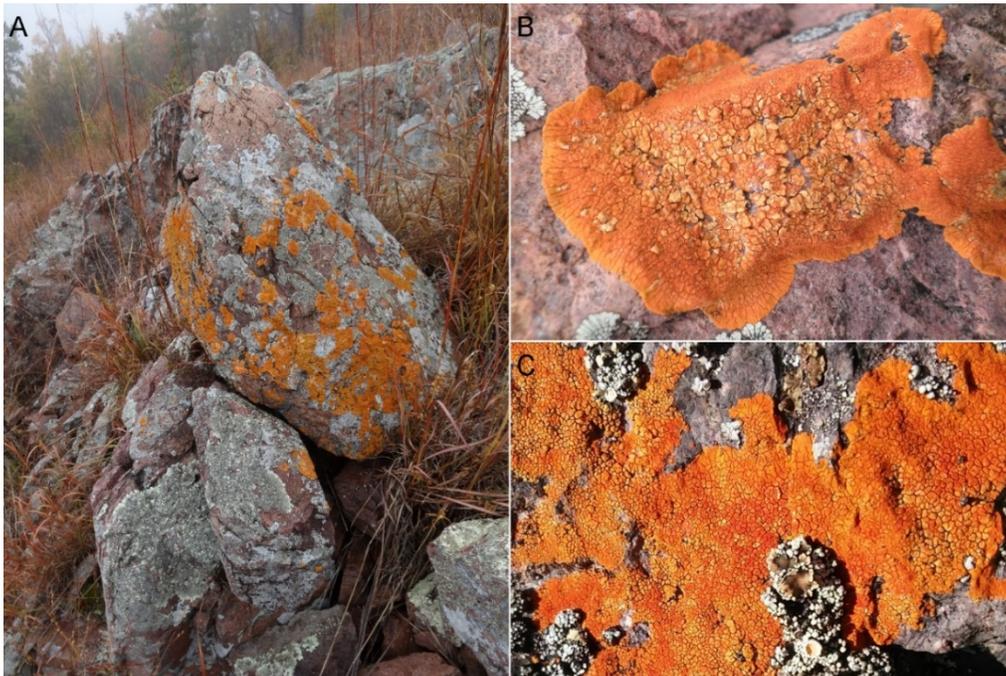
Locally, *C. cinnabarina* is most likely to be confused with *C. subsoluta*, which is common throughout Missouri, occurring on all types of rocks. The thallus of *C. subsoluta* is more yellowish orange and dispersed-areolate, and the margins of the areoles are often not tightly attached to the underlying rock and are often undulate or irregularly indented (Fig. 2). The apothecia of *C. subsoluta* are sessile but not immersed in the thallus as in *C. cinnabarina*. Another lichen of uncertain identity with which *C. cinnabarina* can be confused occurs on siliceous and calcareous rocks in Ozark glades and has been reported erroneously as *C. squamosa* (e.g. Ladd 1996). This taxon has well-developed, deep orange, thicker, squamulose thallus that can be pried from the substrate<sup>4</sup>.

When the University of Missouri divested its herbarium in 2016, we identified a Kentucky specimen of *C. cinnabarina* while reviewing undetermined specimens during transfer of the university's lichens to the University of Kansas (KANU). This specimen, collected from Natural Bridge State Resort Park in Powell County, Kentucky, presumably occurred on Rockcastle Sandstone, a Pennsylvanian age conglomerate sandstone which forms the cliffs in the area (McFarlan 1954). It is unknown whether other populations occur in the state, although sandstone cliffs are abundant in southeastern Kentucky, particularly on the Cumberland Plateau and its escarpments.

It is possible that further exploration in Missouri will find more locations for *C. cinnabarina*, but given its charismatic appearance and the intensity of lichen survey in the Missouri Ozarks, this showy lichen is likely rare in Missouri. Despite abundant occurrences of apparently suitable habitat, the limited extent of known populations suggests some type of ecological constraint. This may result from climate factors near the northern edge of the known range for the species, or the extreme environmental conditions that characterize igneous glades. This species appears to be more common at southern latitudes in North America as well as in Africa, Asia, and Australia (Wetmore & Kärnefelt 1999). There may be few suitable habitats available locally for *C. cinnabarina*, minimizing the probability of successful colonization even at sites with apparently abundant available substrate. This species shows a strong preference for being elevated above the ground on well-drained, often vertical surfaces, such as boulders or faces of bluffs and outcrops rather than on bedrock flats. This preference is likely to limit the potential for many of Missouri's abundant sandstone glades to harbor this species, although it occurs on massive sandstone bluffs in the southern Ozarks.

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<sup>4</sup> McCune (2017) mentions Missouri material of this taxon was "tentatively" identified as *C. inconnexa* by W.A. Weber.



**Figure 1.** *Caloplaca cinnabarina* **A:** original discovery on rhyolitic boulders in a glade on Proffit Mountain, Reynolds Co.; **B:** close-up of thallus showing contiguous areoles and elongated, sub-effigurate marginal areoles; **C:** thalli from Bell Mountain population, Iron Co. Photos A & B: Claire Ciafré; photo C: Andrew Braun.



**Figure 2.** *Caloplaca (=Squamulea) subsoluta* from exposed sandstone; scale intervals are 1 mm. (Ladd 18506). Photo: Douglas Ladd.

Many potential habitats are relatively inaccessible due to difficult terrain, limited roads, and lack of access to private land. Igneous glades are locally abundant within an approximately 5,000 square mile region of the southeastern Missouri Ozarks (Nelson 2010). In conjunction with extensive sandstone exposures, and more limited but similar chert systems present in the state, there are opportunities for more populations to occur. Given the remote location of existing populations on protected public lands, additional information is required before assessments of rarity and need for state level protected status can be completed.

*Missouri specimens examined:* **U.S.A. MISSOURI:** IRON CO.: Bell Mountain Wilderness Area, on southern face of large rhyolitic boulder in open, degraded glade, 2018, *Braun 20180909.01* (hb. Ladd; photo voucher). REYNOLDS CO.: Proffit Mountain, Ketcherside Conservation Area, on exposed well-drained rhyolitic edges and face in extensive igneous glade on south-facing slope, 2017, 37.563689, -90.787471, *Ladd 34025 with C. Ciafré & A. Braun* (hb. Ladd);

*Other previously unreported specimens examined:* **U.S.A. ARKANSAS:** CONWAY CO.: on sandstone; 1954, *Hale 3364* (US); NEWTON CO.: exposed summit of sandstone bluff; 2005, *Ladd 27119* (hb. Ladd). POPE CO.: Ozark National Forest, exposed summit of sandstone bluff; 2002, *Ladd 24306* (hb. Ladd). STONE CO.: Ozark National Forest, on exposed edge of massive sandstone bluff; 2005, *Ladd 27206* (hb. Ladd). **KENTUCKY:** POWELL CO.: Natural Bridge State Park; 1967, *Cameron s.n.* (KANU). **OKLAHOMA:** LE FLORE CO.: Heavener Runestone State Park, on vertical sandstone face; 1996, *Ladd 19827 with M. Ladd* (hb. Ladd). Wister State Park, on exposed face of south-facing sandstone bluff; 1996, *Ladd 19861 with M. Ladd* (hb. Ladd).

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