

Short Communication

Ephebe brasiliensis (Ascomycota, Lichinaceae): an overlooked freshwater lichenized fungus

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Abstract

Ephebe brasiliensis is a semi-aquatic fruticose cyanolichen that occurs in freshwater environments from Brazil (Minas Gerais and São Paulo states) and Uruguay. Although this species may be locally abundant and has “wide” distribution, it has been poorly studied and is still misunderstood with respect to their distribution and ecological characteristics. Herein, *E. brasiliensis* is reported for the first time in Southern Brazil.

Key words: Atlantic Forest, biodiversity, cyanobacteria, cyanolichen, *Stigonema*.

Resumo

Ephebe brasiliensis é um cianolíquen fruticoso e semiaquático que ocorre em ambientes de água doce do Brasil e Uruguai. Embora essa espécie possa ser localmente abundante e apresente uma ampla distribuição geográfica, ela ainda é pouco estudada e permanece incompreendida. Nesse artigo, *E. brasiliensis* é registrada pela primeira para o Sul do Brasil.

Palavras-chave: Floresta Atlântica, biodiversidade, cianobactéria, cianolíquen, *Stigonema*.

Lichens with cyanobacteria as the main photobiont are commonly known as cyanolichens and correspond to a small group gathering approximately 12% of lichen-forming fungal species (Rikkinen 2003).

The most well-known genera of cyanolichens in Brazil are *Leptogium* (Ach.) Gray (*e.g.*, Müller Argoviensis 1891; Marcelli 1992; Osorio 1997; Spielmann 2006; Kitaura & Marcelli 2012, 2013; Kitaura *et al.* 2013a,b, 2014; Benatti *et al.* 2013), *Collema* F. H. Wigg., and *Coccocarpia* Pers. (*e.g.*, Müller Argoviensis 1891; Degelius 1974; Osorio 1977; Fleig 1990; Spielmann 2006; Eliasaro *et al.* 2009; Gumboski & Eliasaro 2011), still with unreported/undiscovered species for many localities. In fact, genera with large thalli, which are frequently collected by non-lichenologists, such as *Sticta* (Schreb.) Ach. (p.p.) and *Peltigera* Willd., present many dubious citations and need revision (see Vitikainen 1998; Moncada *et al.* 2014).

Other cyanolichens recorded in Brazil are also still poorly known in relation to their taxonomy, ecology, and mainly their actual distribution within of the country. These include *Peltula* Nyl., *Jenmania* W. Wächt., *Leprocollema* Vain., *Pyrenopsis* (Nyl.) Nyl. and *Ephebe* Fr., whose species are recorded for few localities, most often only in very succinct species list (*e.g.*, Vainio 1890; Osorio & Homrich 1978; Fleig 1995; Spielmann *et al.* 2007). Overall, the actual distribution and ecological features of these taxa are poorly understood.

The knowledge about semi-aquatic lichens (which remain submerged for a substantial amount of time) is even more incipient in Brazil. Even though many crustose lichens from freshwater and marine habitats were reported in Europe and USA (*e.g.*, *Verrucaria* Schrad.; Orange *et al.* 2009; *Peltigera hydrothyria* Miadl. & Lutzoni; Brodo *et al.* 2001), only informal observations indicated

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that this fascinating group of lichens also occurs in freshwater and marine habitats in Brazil (author's personal field experience, unpublished data). This is the first attempt at the semi-aquatic lichens from Brazil. Many questions about these lichens still remain unclear, and we suggest the following references for more information (e.g., Hawksworth 2000; Shearer *et al.* 2007; Nash 2008).

The genus *Ephebe* (Lichinaceae) is widespread, currently with 13 species (Lücking *et al.* 2017) and is characterized by the black to brownish black fruticose thallus with the cyanobacteria *Stigonema* determining the appearance of the whole thallus. This species branches are terete, its hymenium never covered by photobiont filaments, and occurs in semi-aquatic freshwater habitats (Vainio 1890; Henssen 1963; Schultz & Büdel 2002). In South America only two, poorly known species have been recorded: *Ephebe ocellata* Henssen, recorded in Argentina (Calvelo & Liberatore 2002) and Chile (Henssen 1963; Galloway & Quilhot 1998), and *E. brasiliensis* (Vain.) Henssen, reported to Brazil (Vainio 1890; Müller Argoviensis 1895; Henssen 1963; Aptroot 2002) and Uruguay (Osorio 1975).

Ephebe brasiliensis was currently only known for two localities in Brazil, the type locality in the state of Minas Gerais (Vainio 1890; Henssen 1963; Aptroot 2002) and in the state of São Paulo (Henssen 1963), as well as one single locality in Uruguay (Osorio 1975) (Fig. 1). These localities are over 1000 km apart in a North-South line, and the wide range of environments between them demonstrates the lack of information about the species distribution. This report records now *Ephebe brasiliensis* in Southern Brazil and aim to contribute with information about its distribution, taxonomy, and ecological features.

Specimens were collected using a knife, stored in paper bags, and dried at room temperature. They were examined using standard stereoscope (20–40×) and light microscope (100–1000×) techniques. Freehand sections of the thalli were mounted in water. The spot tests (K, C, KC and P), observations under UV light, and thin layer chromatography (TLC) using solvent system C were conducted according to Huneck & Yoshimura (1996) and Orange *et al.* (2001). The distribution map (Fig. 1) was produced in QGIS Software 2.0.1, according to a tutorial developed by Calegari *et al.* (2016).

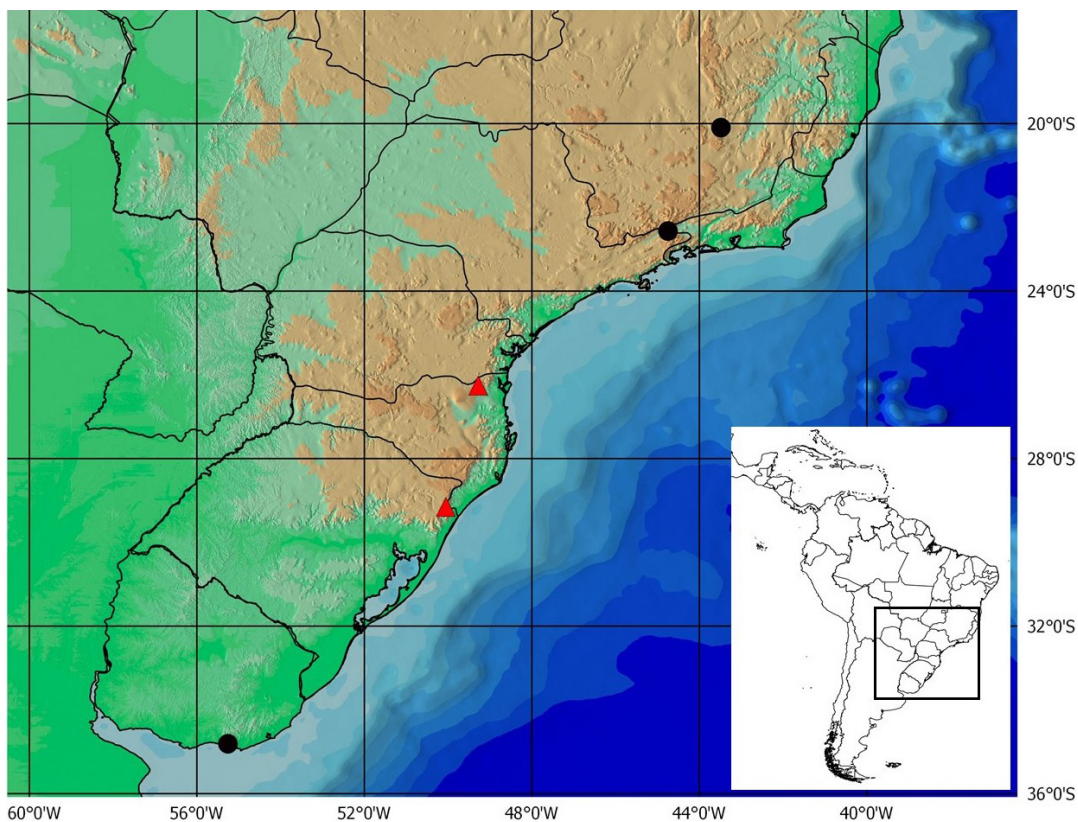


Figure 1 – Distribution of *Ephebe brasiliensis* in Brazil and Uruguay. Already known records are in black circles, the new records are in red triangles.

Ephebe brasiliensis (Vain.) A. Henssen, Symb. Bot. Upsal. 18(1): 56. 1963.

≡ *Ephebeia brasiliensis* Vain., Acta Soc. Fauna Fl. Fenn. 7: 245. 1890. Brazil, Minas Gerais state, Catas Altas, Caraça, 1885, Vainio (Holotype: TUR; Isotype: BM, UPS). fide Henssen (1963). = *Ephebe uleana* Müll. Arg., Hedwigia 34: 27. 1895. Brazil, Minas Gerais state, Catas Altas, Caraça, 1892, Ule (Isotypes: HBG, UPS). fide Henssen (1963). Fig. 2

Description. Thallus fruticose, caespitose, black to bluish black, shiny when wet and somewhat olive opaque when dry, up to 3 cm tall in the field, up to 1.5 cm tall when dry, something gelatinous when wet and brittle when dry, homoiomerous, ecorticate; branches terete, (90–)105–180 µm thick, solid, surface smooth to somewhat rough, branching mainly anisotomic-dicotomic, sometimes trichotomic and rarely tetracotomic, apices usually curved, frequently with up to 6 tiny branches. Photobiont with true branching. Ascomata and pycnidia not found.

Chemistry. Spot tests: K-, C-, KC-, P-, UV-. No substances detected by TLC.

Substrate and ecology. Most specimens were found on rocks in montane water streams, with at least a thin layer of freshwater (Fig. 3). Specimens from the state of Santa Catarina were found in semi-aquatic conditions (Fig. 2a), while some specimens, including those from the state of Rio Grande do Sul, were found submerged up to 0.4 m. Nevertheless, they can survive out of the water during dry periods (Fig. 2b). Locally, this species is abundant, forming a large population that can occupy several square meters.

Specimens examined: BRAZIL. RIO GRANDE DO SUL: Municipality of Cambará do Sul, National Park Serra Geral, Tigre Preto, 14.III.2014, A. Gerlach & M. Akkerman 1484 (ICN); Fortaleza Canyon, on submerge rock on stream, 05.V.2007, L.S. Canêz, A.A. Spielmann, P. Jungbluth & M.J. Kitaura 2488 (CGMS). SANTA CATARINA: Municipality of São Bento do Sul, APA Rio Vermelho/Humboldt, Araucaria forest, rural area, on rocks submerged in the river, 26°15'23.26"S, 49°16'48.84"W, 16.II.2013, E. Gumboski 4240 (JOI); 12.III.2013, E. Gumboski 4282, 4288 (JOI), 31.X.2013, E. Gumboski 4896 (JOI). MINAS GERAIS: Municipality of Catas Altas, Parque Natural do Caraça, 27.VII.2010, A. Gerlach 274 (ICN); 20°05'38.7" S, 43°30'00.3" W, Cascudos Stream, on submerge sedimentary rock, 27.III.2006, L.S. Canêz, A.A. Spielmann & M.P. Marcelli 1477 (CGMS).

In Brazil, *Ephebe brasiliensis* is a freshwater lichen that can be recognized even when it is sterile. It is characterized by the black to bluish black fruticose thallus, containing *Stigonema* species as photobiont, with (90–)105–180 µm thick branches. According to Vainio (1890) and Henssen (1963), the species have lecanorine apothecia, lateral to terminal, up to 0.5 mm diam., with 16-spored asci, ascospores simple, colorless, ellipsoid, 9–16 × 4–7 µm (immature in asci). The conidia are cylindrical, 2.5–3 × 1 µm. This species can be found on rocks, submerged or not, in semi-aquatic or aquatic environments.

As previously known, lichens are excellent environmental bio monitors (e.g., Cislaghi & Nimis 1997; Nash 2008). Therefore, we recommend that *Ephebe brasiliensis* would be included as a key species for future biomonitoring and water quality investigations due to its occurrence in conserved areas (i.e. National Parks).

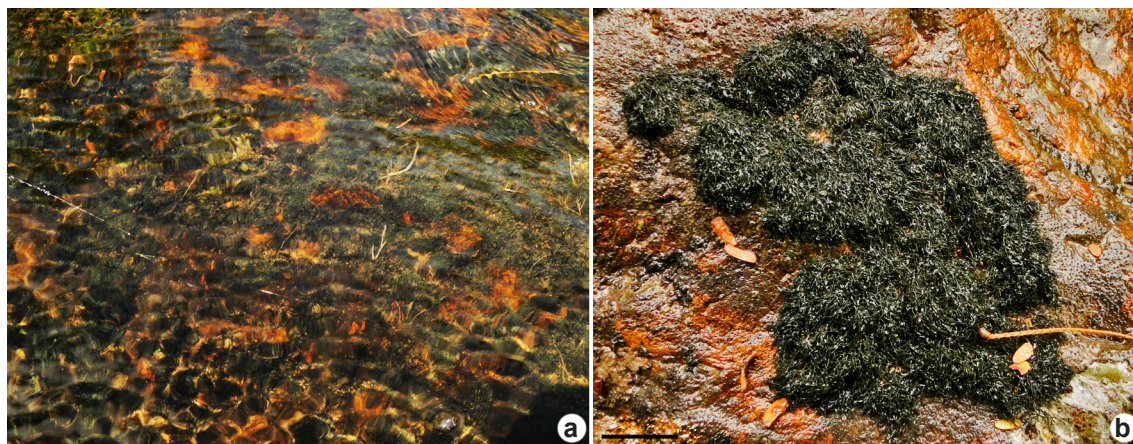


Figure 2 – *Ephebe brasiliensis* – a. habitat with submerged thalli; b. thallus not submerged attached to rock. Scale bar: 1 cm.



Figure 3 – Habitat of *Ephebe brasiliensis* found in Rio Grande do Sul state, Municipality of Cambará do Sul, National Park Serra Geral.

Future studies are important for conservation strategies of the species, and we postulate that *E. brasiliensis* probably presents an even wider distribution in South America.

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