

## Five new records and an identification key of the lichen genus *Leptogium* from Santa Catarina state, Brazil

Marcos Junji Kitaura<sup>1,4</sup>, Emerson Luiz Gumboski<sup>2</sup> & Ricardo Koroiva<sup>3</sup>

### Abstract

*Leptogium* is a cosmopolitan genus with currently 180 accepted species, of which 46 are reported from Brazil. *Leptogium atlanticum*, *L. azureum*, *L. cyanescens*, *L. sessile* and *L. subjuressianum* are recorded from the Brazilian state of Santa Catarina for the first time. *Leptogium chloromelum* var. *crassius* is synonymized with *L. sessile*. *Leptogium atlanticum* is recorded for the first time outside the type locality. We also provide comments and the first identification key for *Leptogium* species found in Santa Catarina state.

**Key words:** *Ascomycota*, *Collembataceae*, diversity, jelly lichen, taxonomy.

### Resumo

*Leptogium* é um gênero cosmopolita com atualmente 180 espécies aceitas, das quais 46 são citadas para o Brasil. *Leptogium atlanticum*, *L. azureum*, *L. cyanescens*, *L. sessile* e *L. subjuressianum* são registradas aqui pela primeira vez para o estado de Santa Catarina. *Leptogium chloromelum* var. *crassius* é sinonimizado com *L. sessile*. *Leptogium atlanticum* é registrada pela primeira vez fora da localidade tipo. Nós também fornecemos comentários e a primeira chave de identificação para espécies de *Leptogium* encontradas no estado de Santa Catarina.

**Palavras-chave:** *Ascomycota*, *Collembataceae*, diversidade, líquens gelatinosos, taxonomia.

### Introduction

*Leptogium* (Ach.) Gray is a jelly lichen genus with about 180 accepted species, though the monophyly remains questioned (Otálora *et al.* 2014). The species are cosmopolitan, occurring particularly in tropical regions, growing on various substrates and in several environments (Sierk 1964). *Leptogium* is characterized by its large, homoiomerous, foliose thallus, by distinct cortices with at least one well-defined cortical layer (eucortex), and its mainly epiphytic habit (Otálora *et al.* 2014). Recent studies suggest that the number of species ranges between 150 to 400 (Jayalal *et al.* 2014).

Forty-six *Leptogium* species are actually accept to Brazil: *L. adpressum* Nyl., *L. atlanticum* Marcelli & Kitaura, *L. austroamericanum* (Malme) C.W. Dodge, *L. azureum* (Sw.) Mont., *L. brebissonii* Mont., *L. burgessii* (L.) Mont., *L. caespitosum* (Taylor) Swinscow & Krog, *L. chloromelum*

(Ach.) Nyl., *L. cochleatum* (Dicks.) P.M. Jørg. & James, *L. coralloideum* (Meyen & Flot.) Vain., *L. corticola* (Taylor) Tuck., *L. cyanescens* (Rabenh.) Kōrb., *L. decipiens* P.M. Jørg., *L. denticulatum* Nyl., *L. diaphanum* Mont., *L. dimorphum* Müll. Arg., *L. foveolatum* Nyl., *L. fusisporum* (Tuck.) C.W. Dodge, *L. hibernicum* M.E. Mitch. ex P.M. Jørg., *L. involutum* Kitaura, Käffer & Martins, *L. isidiosellum* (Riddle) Sierk, *L. javanicum* Mont., *L. kalbii* Marcelli & Cunha, *L. laceroides* Degel., *L. lafayetteanum* Vain., *L. longisporum* Kitaura & Marcelli, *L. mantiqueirense* Kitaura & Marcelli, *L. marginellum* (Sw.) Gray, *L. mattogrossense* Malme, *L. megapoticum* Malme, *L. moluccanum* (Pers.) Vain., *L. pachycheilum* Malme, *L. phyllocarpum* Mont., *L. pichneum* (Ach.) Nyl., *L. puiggarii* Müll. Arg., *L. punctulatum* Nyl., *L. reticulatum* Mont., *L. schiffneri* Zahlbr., *L. sessile* Vain., *L. sphinctrinum* Nyl., *L. stipitatum* Vain., *L. subbullatum* Kremp., *L. subjuressianum* Marcelli & Kitaura, *L. tuckermanii*

<sup>1</sup> Universidade Federal de Mato Grosso do Sul, PPG em Biologia Vegetal, Cidade Universitária s/n, 79070-900, Campo Grande, MS, Brazil. junjimjk@gmail.com

<sup>2</sup> Universidade da Região de Joinville, Depto. Ciências Biológicas, R. Paulo Malschitzki 10, Zona Industrial Norte, 89219-710, Joinville, SC, Brazil. emersongumboski@gmail.com

<sup>3</sup> Universidade Federal de São Carlos, PPG em Ecologia e Recursos Naturais, Rod. Washington Luís km 235, SP-310, 13565-905, São Carlos, SP, Brazil. ricardo.koroiva@gmail.com

<sup>4</sup> Author for correspondence: junjimjk@gmail.com

C.W. Dodge, *L. ulvaceum* Vain. and *L. vesiculosum* (Sw.) Malme (Krempelhuber 1876; Vainio 1890; Malme 1924; Osorio 1977a; Osorio 1977b; Aptroot 2002; Spielmann 2006; Cunha 2007; Käffer *et al.* 2007; Gumboski & Eliasaro 2011; Kitaura 2012; Kitaura & Marcelli 2012; Kitaura & Marcelli 2013; Benatti *et al.* 2013; Kitaura *et al.* 2013a; Kitaura *et al.* 2013b; Aptroot & Cáceres 2014; Kitaura *et al.* 2014; Cáceres *et al.* 2014; Kitaura *et al.* 2015).

In the Southern Brazil, nine species were recorded for the Paraná state (Eliasaro & Gumboski, pers. comm.), and 19 species for the Rio Grande do Sul state (Spielmann 2006), but the vast majority of these were recorded only from a few localities.

For the Santa Catarina state, Gumboski & Eliasaro (2011) reported 11 *Leptogium* species. Despite this number, during recent field campaigns specimens representing five new records were sampled: *L. atlanticum*, *L. azureum*, *L. cyanescens*,

*L. sessile* and *L. subjussiaianum*, increasing the number of *Leptogium* species known in the state with 45%. We hereby present these new records with comments and include *L. chloromelum* var. *crassius* in the synonymy of *L. sessile*. In addition, we provide the first identification key for *Leptogium* species found in Santa Catarina.

We collected samples during lichenological field work on several sites in eastern Santa Catarina state (municipalities of São Francisco do Sul and São Bento do Sul). They were deposited in the Universidade Federal de Mato Grosso do Sul Herbarium (CGMS). Moreover, we analyzed all specimens according to the protocol of Kitaura (2012) and Kitaura & Marcelli (2012; 2013).

Lichen photographs were taken with a Scanjet 5590 and by the Canon RebelT3i coupled on Olympus Sz stereomicroscopy and Olympus CX22LED microscopy.

#### Identification key to *Leptogium* in Santa Catarina state, Brazil

1. Thallus with hairs ..... 2
  2. Hairs constituted by spherical cells ..... *Leptogium burgessii*
  - 2'. Hairs constituted by cylindrical cells ..... *Leptogium subjussiaianum*
- 1'. Thallus without hairs ..... 3
  3. Thallus with smooth to slightly rugose upper surface ..... 4
    4. Thallus with ornaments on the lamina and margin ..... 5
      5. Ornaments usually cylindrical (isidia) ..... *Leptogium cyanescens*
      - 5'. Ornaments usually flattened and rotund (lobules) ..... *Leptogium atlanticum*
    - 4'. Thallus without ornaments on the lamina and margin ..... 6
      6. Thallus with apothecia subpedicellate or adnate ..... *Leptogium moluccanum*
      - 6'. Thallus with apothecia pedicellate (ascending by the thallus) ..... 7
        7. Pedicel long (more than 0.5 mm), inflated ..... *Leptogium javanicum*
        - 7'. Pedicel short (to 0.5 mm long), not inflated ..... 8
          8. Thallus is colored bluish and 70–100  $\mu\text{m}$  ..... *Leptogium azureum*
          - 8'. Thallus is colored greyish and 100–150  $\mu\text{m}$  ..... *Leptogium cochleatum*
  - 3'. Thallus with upper surface with ridges, wrinkles or foveolate ..... 9
    9. Thallus with foveolate surface ..... *Leptogium foveolatum*
    - 9'. Thallus with upper surface ridged or wrinkled ..... 10
      10. Ornaments present on the thallus and/or apothecia ..... 11
        11. Ornaments on the thallus and apothecia ..... 12
          12. Upper surface has wrinkles ..... *Leptogium isidiosellum*
          - 12'. Upper surface has ridges ..... *Leptogium austroamericanum*
        - 11'. Ornaments only on the apothecia ..... 13
          13. Thallus with marginal apothecia ..... *Leptogium marginellum*
          - 13'. Thallus with submarginal or laminal apothecia ..... *Leptogium phyllocarpum*
      - 10'. Ornaments absent ..... 14
        14. Apothecia pedicellate (more than 0.5 mm) ..... *Leptogium vesiculosum*
        - 14'. Apothecia sessile, immerse and adnate ..... 15
          15. Apothecia immerse, ascospores muriform to submuriform ... *Leptogium sessile*
          - 15'. Apothecia adnate, ascospores transversally septate ..... *Leptogium adpressum*

***Leptogium atlanticum*** Marcelli & Kitaura, The Bryologist, 118(1): 12. 2015.

Type: BRAZIL. SÃO PAULO: Municipality of Peruibe, Reserva Ecológica Juréia-Itatins. Núcleo Guarauzinho, Sopé da Serra, Arpoador Beach, on rock, 27.VII.1993, *M.P. Marcelli & O. Yano 23710* (holotype: SP!; isotypes: COLO!, H!).

Description and illustrations of the holotype: Kitaura *et al.* (2015).

*Leptogium atlanticum* is characterized by lobulated thallus, the smooth to rugulose upper surface, the elongated or rotund lobules on the lamina and margin, and the medulla is constituted of helicoidal columnar hyphae. Initially, we identified *L. atlanticum* as *L. denticulatum*, but that species differs from the first one by the presence of irregular lobules on the thallus (Kitaura *et al.* 2015).

We collected our specimens on trunks of restinga shrubs.

Distribution: This species had been reported only for São Paulo state, Brazil, where it was sampled on different substrata, from the beach to mangroves and rainforest on the coastal slopes (Kitaura *et al.* 2015).

**Material examined:** São Francisco do Sul, Parque Estadual do Acaraí, 26°17'28.6"S, 48°32'15.8"W, alt. 6 m, on trunk, 6.X.2015, *M.J. Kitaura 2619 & 2637* (CGMS).

***Leptogium azureum*** (Sw.) Mont. Hist. Nat. Iles Canar. 3: 129. 1840.

Type: JAMAICA: on the Mountains, *O. Swartz s/n.* (lectotype: UPS; isolectotype: BM000963630!, designed by Jørgensen & James 1983).

≡ *Lichen azureus* Sw. ap. Ach., Lichenog. Suec. Prodr.: 137. 1798.

≡ *Parmelia azurea* Ach., Meth. Lich.: 223. 1803.

≡ *Collema azureum* Ach., Lich. Univ.: 654. 1810.

= *Collema tremelloides* var. *azureum* Eschw. in Mart., *Fl. bras.* 1: 237. 1833.

= *Leptogium tremelloides* var. *azureum* (Sw.) Nyl., Syn. Lich. 1: 125. 1858.

Description and illustrations of the holotype: Aragón *et al.* (2004) and Kitaura (2012).

*Leptogium azureum* is characterized by its bluish color, smooth upper surface and pedicellated apothecia. This species is complex and necessitates further taxonomical studies.

The species occurs on trunks of restinga shrubs, and on trunks of Araucaria forest.

Distribution: *Leptogium azureum* is a species occurring across the globe (Aragón *et al.* 2004).

In Brazil, there are records for the states of Mato Grosso, Minas Gerais, Pará, Paraná, Rio de Janeiro, Rio Grande do Sul and São Paulo (Krempelhuber 1876; Brako *et al.* 1985; Aptroot 2002; Carbonero *et al.* 2003; Aragón *et al.* 2004; Spielmann 2006 Cunha 2007).

**Material examined:** São Bento do Sul, APA do Rio Vermelho-Humboldt, Araucaria Forest, corticolous, 6.IX.2012, *E. Gumboski 3909 & 3910*; 31.X.2013, *E. Gumboski 4959*. São Francisco do Sul, Parque Estadual do Acaraí, 26°17'28.6"S, 48°32'15.8"W, alt. 6 m., on trunk, 6.X. 2015, *M.J. Kitaura 2578, 2585, 2601, 2604 & 2614*.

***Leptogium cyanescens*** (Rabenh.) Korb, Syst. Lich.: 420. 1855.

Type: SWITZERLAND. HELVETIA: *no.* 757. (lectotype: H-ACH 1913!, designated by Galloway & Jørgensen 1995).

≡ *Collema cyanescens* Rabenh., Deutsch. Krypt. Fl.: 50. 1845.

= *Collema tremelloides* var. *cyanescens* Ach., Syn. Meth. Lich.: 326. 1814. nom. illeg.

= *Leptogium caesium* (Ach.) Vain., Acta Soc. Fauna & Flora Fenn. 7A: 225. 1890.

= *Collema tremelloides* var. *caesium* Ach., Lich. Univ.: 656. 1810.

Description and illustrations of the holotype: Goward *et al.* (1994), McCune & Geiser (1997), Brodo *et al.* (2001), Stone & Ruchty (2007) and Kitaura (2012).

*Leptogium cyanescens* differs from other *Leptogium* species through its blue-grey color, smooth upper surface, thin and rounded lobes, and its cylindrical and delicate isidia emerging as small whitish papillae on the upper surface and along the margins.

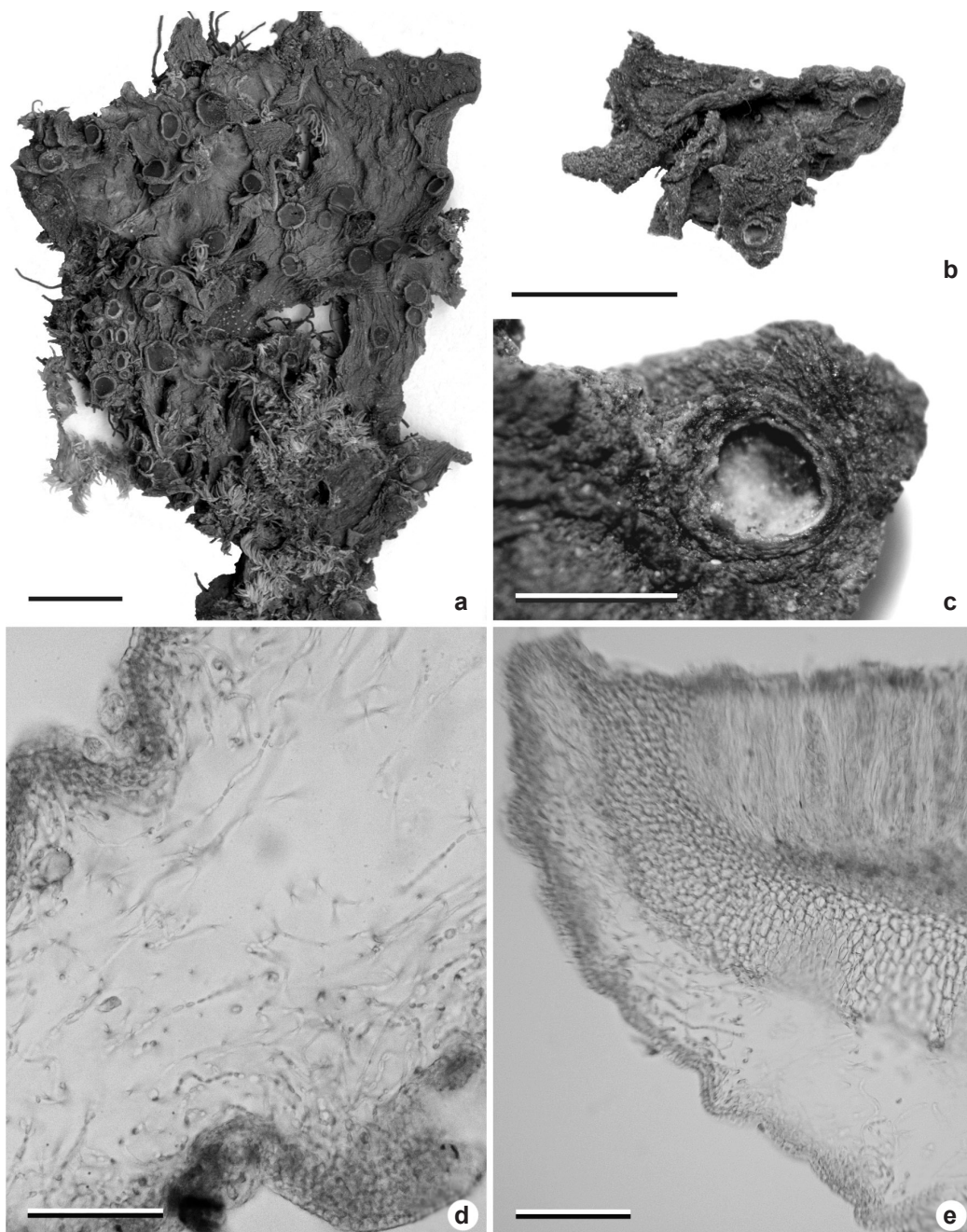
Our specimens were collected off the trunks of mangroves and shrubs of restinga.

Distribution: *Leptogium cyanescens* is a species with a global distribution. In Brazil, there are records for the states of Sergipe, Minas Gerais, Paraná, Rio de Janeiro, Rio Grande do Sul and São Paulo (Krempelhuber 1876; Osorio 1977a; Osorio 1977b; Aptroot 2002; Spielmann 2006; Cunha 2007; Cáceres *et al.* 2014).

**Material examined:** São Francisco do Sul, Campus of Universidade da Região de Joinville (Univille), 26°12'53.2"S, 48°34'27.7"W, alt. 2 m, on trunk, 5.X.2015, *M.J. Kitaura 2561, 2568, 2570 & 2571*; Parque Estadual do Acaraí, 26°17'28.6"S, 48°32'15.8"W, alt. 6 m, on trunk, restinga, 6.X.2015, *M.J. Kitaura 2583, 2609, 2610, 2612 & 2621*; 26°22'04.2"S, 48°34'13"W, 29.III.2009, *E. Gumboski & S. Eliasaro 1418b*.

*Leptogium sessile* Vain., Ann. Acad. Sci. Fenn. ser. A IV Biologica 6(7): 108. 1915. Fig. 1a-e  
 Type: DOMINICA (WEST INDIA). SHAWFORD STATE: ad corticem arboris, 1896, *W.R. Elliott 1594p.p.* (holotype: TUR-V 10791!; isotype: TUR-V 10792!). Fig. 1a,d,e

= *Leptogium chloromelum* var. *crassius* Nyl., Bull. Soc. Linn. Norm. 3(2): 5. 1869. Type: SOUTH AFRICA. DURBAN: Port-Natal, *Miss Armstrong s/n.* (holotype: H-NYL 41253!). Fig. 1b,c  
 Description and illustrations of the holotype: Vainio (1915), Sierk (1964) and Kitaura (2012).



**Figure 1** – a-e. *Leptogium* species – a. *L. sessile* holotype (TUR-V 10791); b. *L. chloromelum* var. *crassius* holotype (holotype: H-NYL 41253); c. Apothecia detail of *L. chloromelum* var. *crassius*; d. Transversal section of *L. sessile* thallus; e. Transversal section of *L. sessile* apothecia. Scale bars: a,b = 5 mm; c = 1 mm; d = 50 µm; e = 100 µm.

*Leptogium sessile* is characterized by its thickened thallus (115–190 µm thick), rugulose and wrinkled longitudinal lobes, as well as its immersed to sessile apothecia and amphithecium with circular ridges (Fig. 1c).

*Leptogium chloromelum* var. *crassius* was included in the list of synonyms of *L. sessile* after studying the type. The type *L. chloromelum* var. *crassius* (H-NYL 41253) is identical to the distal parts of the holotype of *L. sessile* (TUR-V 10791).

Vainio (1915) studied the material collected by W.R. Elliott and described *L. sessile* without mentioning the collector number. Later, Sierk (1964) reviewed the material studied by Vainio and considered W.R. Elliott's material (now TUR-V 10791) as lectotype during a study of *Leptogium* species from USA and Mexico.

Even so, Jørgensen found other material in the same herbarium: W.R. Elliott 1594 p.p. (TUR-V 11792), which had been identified as *L. phyllocarpum*. Jørgensen concluded that the TUR-V 11792 material is an isotype of the *L. sessile* and reported this fact on an annotation label, but he did not publish his discovery. During a visit to the Turku herbarium, this TUR-V 11792 material was analyzed and we found these comments on the labels with the material.

We collected these specimens on trunk of restinga shrubs.

Distribution: *Leptogium sessile* is a species with global distribution. In Brazil, there are state records for Rio Grande do Sul (Spielmann 2006) and São Paulo (Aptroot 2002).

**Material examined:** São Francisco do Sul, Parque Estadual do Acaraí, 26°17'28.6"S, 48°32'15.8"W, alt. 6 m, on trunk, restinga, 6.X.2016, *M.J. Kitaura 2590*; 7.X.2016, *M.J. Kitaura 2640*.

***Leptogium subjuressianum*** Marcelli & Kitaura, Mycotaxon 120: 218. 2012.

Type: BRAZIL. RIO GRANDE DO SUL: Municipality of Tapes, on trunk of a tree, 5 m alt., 29.I.1994, *M.P. Marcelli 26459* (holotype: SP!).

Description and illustrations of the holotype: Kitaura & Marcelli (2012).

*Leptogium subjuressianum* is distinguishable according to its spongioid hairs on upper surface and rounded lobules on the margin of the thallus.

This specimen was collected on trunk of Araucaria forest.

Distribution: *Leptogium subjuressianum* is common in Brazil and usually collected from surfaces of tree trunks. The species has been collected from Tapes Municipality, Rio Grande do

Sul state, to Alto Caparaó Municipality in Minas Gerais state (Kitaura & Marcelli 2012).

**Material examined:** São Bento do Sul, APA do Rio Vermelho-Humboldt, Araucaria Forest, corticolous, 16.II.2013, *E. Gumboski 4239b*.

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