

Calopadia saxicola (*Pilocarpaceae*, *Ascomycota*), a new saxicolous species growing on rocky seashores in southern Brazil

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Abstract: *Calopadia saxicola* is described as new to science. The species grows on rocky shores in southern Brazil and is characterized by the corticate thallus, pruinose apothecia with brownish to reddish brown disc, mainly 2–3-spored asci with muriform ascospores, and the absence of secondary metabolites. A description with ecological data, figures, comments and a key to all species in the genus known from Brazil are given.

Key words: coastal vegetation, fungi, lichen, Santa Catarina, taxonomy

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Introduction

Calopadia Vězda, a genus with a pantropical distribution, comprises more than 25 species that grow on leaves, bark and rocks (Vězda 1986; Kalb & Vězda 1987; Lücking 2008; Lücking *et al.* 2011; Lumbsch *et al.* 2011; Seavey & Seavey 2011; Farkas *et al.* 2012). The genus is characterized by biatorine apothecia with brownish (rarely black) discs, amyloid hymenia, transversely septate to muriform ascospores, campylidia with well-developed lobes, and filiform, multiseptate conidia (Vězda 1986; Lücking 2008).

Fourteen species are recorded for Brazil (Müller 1891; Malme 1937; Santesson 1952; Kalb & Vězda 1987; Fleig 1990, 1995; Marcelli 1992; Cáceres 2007; Lücking 2008; Farkas *et al.* 2012), most of which are foliicolous taxa occurring in a variety of vegetation types, such as the Atlantic rainforest, the ‘Cerrado’, open dry forest, and ‘brejos de altitude’ (high altitude rainforest), from sea level to an altitude of 900 m.

From a lichenological point of view, rocky seashores are among the least studied habitats in Brazil. According to estimates by Marcelli (1998), at least 200 species are expected in these habitats, but only 25 species have been

recorded previously. However, recent studies have revealed several new records and undescribed species, suggesting that the diversity of species that inhabit the rocky seashores may be greater than previously estimated (e.g. Benatti & Marcelli 2008, 2009; Benatti *et al.* 2008; Marcelli *et al.* 2008; Eliasaro *et al.* 2012; Gerlach & Eliasaro 2012; Gumboski & Eliasaro 2011, 2012*a, b, c*).

The new species of *Calopadia* described here was found during intensive fieldwork conducted by the author along rocky seashores in southern Brazil. To date, this is the only species of campylidia-forming lichenized fungi found in this habitat.

Material and Methods

Fragments of rocks containing the specimens were collected using a chisel and hammer. Specimens were examined using standard techniques with stereoscopic ($\times 20$ –40; Zeiss Stemi DV4) and light microscopes ($\times 400$ –1000; Olympus CX 31). Hand-cut sections of the thalli, apothecia and campylidia were mounted in water. Spot tests were conducted according to Huneck & Yoshimura (1996) and Orange *et al.* (2001) and included observation under UV light, microcrystalization, and thin-layer chromatography (TLC) using solvent C.

The Species

Calopadia saxicola Gumboski sp. nov.

Mycobank No.: MB 810698

Differing from *Calopadia chacoensis* by the clearly defined thallus, brownish to reddish brown disc, thicker hymenium, and smaller conidia.

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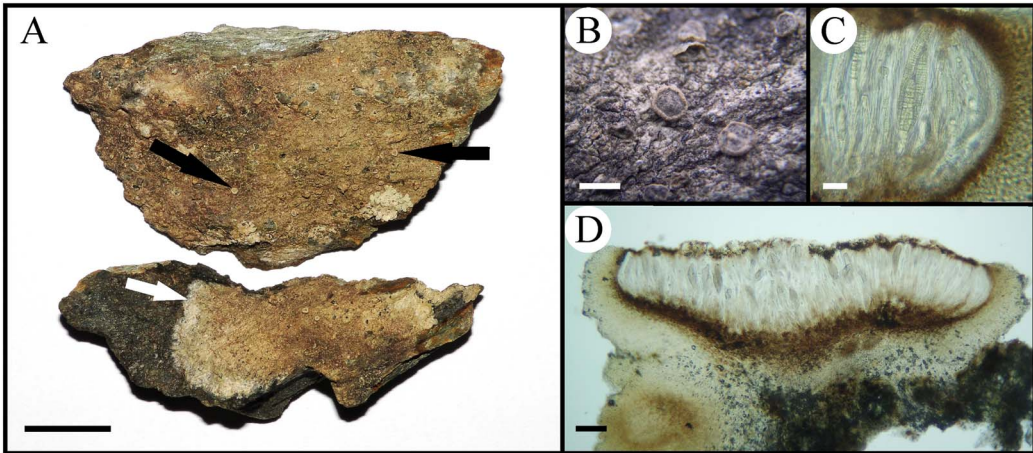


FIG. 1. A, *Calopadia saxicola*, holotype (black arrows pointing to the apothecia, white arrow pointing to the prothallus); B, details of apothecia; C, details of 3-spored asci and muriform ascospores; D, anatomical section of apothecium. Scales: A=1 cm; B=1 mm; C=20 μm ; D=100 μm . In colour online.

Type: Brazil, Santa Catarina State, Municipality of Penha, north of Praia Vermelha, on rocky seashore, 26°48'09"S, 48°35'47"W, 25 October 2011, E. Gumboski & F. Beilke 2963 (ICN—holotype; JOI, UPCB—isotypes).

(Fig. 1)

Thallus saxicolous, continuous, clearly defined, whitish to pale brown, dirty brown on older parts, surface smooth to rugose, weakly shiny, without vegetative propagules, corticate, up to 0.3 mm thick, and 10 cm diam.; *cortex* paraplectenchymatous, 6–10 μm thick, algal layer 7–18 μm thick, medulla white, 150–280 μm thick; *prothallus* smooth, whitish, 1.2–2.0 mm wide.

Apothecia biatorine, sessile, rounded, up to 1.2 mm diam.; *disc* plane to slightly convex, brownish to reddish brown with whitish pruina (K–, C–, KC–, UV–), margin distinct, thin, whitish to pale grey. *Excipulum* colourless, paraplectenchymatous, 90–155 μm thick; *epithecium* brownish, 10–20 μm thick; *hymenium* colourless, 120–230 μm thick, I+ dark blue; *hypothecium* prosoplectenchymatous, brownish to dark brown, 35–70 μm thick, K–; *paraphyses* sparsely branched, c. 1 μm thick. *Asci* 95–165 \times 25–40 μm , (1–)2–3(–4)-spored; *ascospores* muriform, hyaline, with

halo in fresh specimens (up to 3 μm thick), (63–)72–112(–128) \times 10–18 μm , I–.

Campylidia sessile, hood-shaped, pale to dark grey, up to 1.0 mm high, up to 0.8 mm wide, pruinose on back side when young, discrete base; *conidia* filiform, curved with a single smooth clavate apex, 4–7 septate, hyaline, (35–)45–55(–60) \times 2.0–3.5 μm .

Chemistry. [Cortex and medulla] K–, C–, KC–, UV–. No substances detected by microcrystalization and TLC.

Distribution and habitat. The new species is known only from rocky seashores in southern Brazil (Fig. 2), growing directly on shaded rocks near vegetated zones and protected from direct wave splash. Most specimens occur in isolation, away from other crustose lichens.

Discussion. *Calopadia saxicola* is characterized by the saxicolous, clearly delimited and corticate thallus, pruinose apothecia with brownish to reddish brown disc, mainly 2–3-spored asci, muriform ascospores, and the absence of secondary metabolites.

It is similar to *C. chacoensis* (Malme) Kalb & Vězda in general apothecium and campylidium features. However, *C. saxicola*

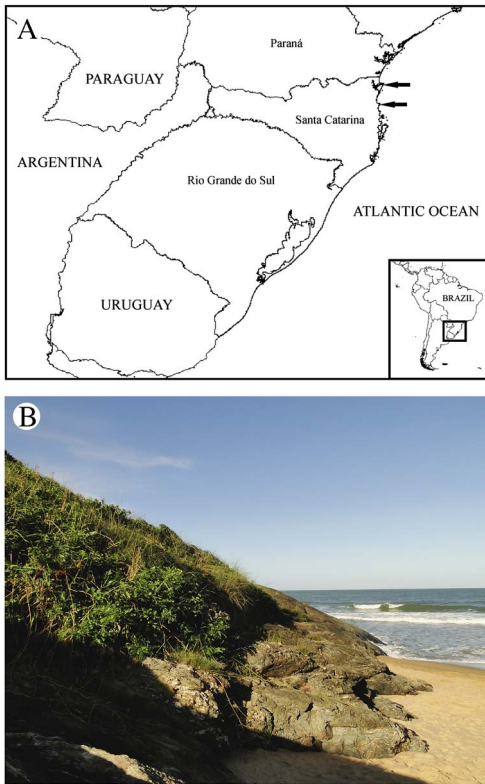


FIG. 2. A, southern Brazil, black arrows point to the area of rocky seashores where specimens of *Calopadia saxicola* were found; B, northern rocky seashore at Praia Vermelha, Municipality of Penha, Santa Catarina State, southern Brazil. In colour online.

has a clearly defined thallus, up to 0.3 mm thick, the disc is brownish to reddish brown with a thicker hymenium (120–230 μm), and it has shorter and broader conidia [(35–)45–55(–60) \times 2.0–3.5 μm] with 4–7 septa. In *C. chacoensis*, the thallus is not sharply defined and is very thin, the disc is dark brown to black, and it has longer and narrower conidia (60–80 \times 1.8 μm) with 5–12 septa (Malme 1937; Kalb & Vězda 1987).

Other species with more than one ascospore per ascus, such as *C. foliicola* (Fée) Vězda and *C. phyllogena* (Müll. Arg.) Vězda, have ecorticate and thin thalli (20–30 μm thick) (Kalb & Vězda 1987; Lücking 2008), while *C. saxicola* has a corticate thallus up to 0.3 mm thick. They also differ in apothecium

morphology. For example, *C. foliicola* has a convex disc with pale yellow pruina, and *C. phyllogena* has a flat disc lacking pruina (Lücking 2008).

Calopadia schomerae F. Seavey & J. Seavey (2011) also has a corticate thallus, pruinose apothecia and muriform ascospores, but the asci are single spored, the conidia are smaller (25–31 μm) and the thallus contains two xanthonenes (Seavey & Seavey 2011), while *C. saxicola* lacks such substances.

The species *Calopadia cinereopruinosa* Bungartz & Lücking and *C. editae* Vězda ex Chaves & Lücking, both described in Lumbsch *et al.* (2011), have pruinose apothecia and muriform ascospores, as does *C. saxicola*. However, *C. cinereopruinosa* has an ecorticate (or with indistinct cortical layer) thallus with a grey-black apothecial disc and an aeruginous hypothecium. *Calopadia editae* also has an ecorticate thallus, but its apothecia have pale yellowish to cream-coloured pruina. In addition, both species have single-spored asci and shorter ascospores.

Calopadia saxicola is also similar to *C. puiggarii* (Müll. Arg.) Vězda (1986) and *C. fusca* (Müll. Arg.) Vězda (1986) in hypothecium colour and the muriform ascospore size, but both have an ecorticate thallus, epruinose apothecium, and a single-spored ascus with shorter ascospores (Lücking 2008).

Interestingly, the halonate ascospores of *C. saxicola* could only be observed in fresh specimens. Upon re-examination of the material, approximately six months later, the halo had disappeared. Another notable observation was that, when returning to the field *c.* 30 months after the material was first collected, the specimens of *C. saxicola* that originally had fertile apothecia, only featured an old campylidium and no apothecia.

Additional specimens examined. Brazil: Santa Catarina State: Municipality of Penha, north of Praia Vermelha, on rocky seashore [metamorphic rock, mylonite, of dynamic-thermal origin from shear zone], 26°48'09"S, 48°35'47"W, 2011, E. Gumboski & F. Beilke 2947 (UPCB), 2961, 2964 (JOI); Municipality of São Francisco do Sul, Morro da Enseada, on rocky seashore [ortho-metamorphic rock, granite-gneiss, cataclastic structure], 26°13'44"S, 48°29'54"W, 2009, E. Gumboski 1685, 1691 (JOI).

Key to the species of *Calopadia* in Brazil

- 1 Thallus squamulose **C. psoromoides**
 Thallus crustose 2
- 2(1) Asci with 2–4(–8) ascospores 3
 Asci with a single ascospore 7
- 3(2) Ascospores submuriform, 30–35 µm long **C. isidiosa**
 Ascospores muriform, 55–120 µm long 4
- 4(3) Conidia 5–12 septate, 60–80 µm long **C. chacoensis**
 Conidia 3–7 septate, 35–60 µm long 5
- 5(4) Thallus corticate, up to 300 µm thick; on rock **C. saxicola**
 Thallus ecorticate, up to 30 µm thick; on leaves and bark. 6
- 6(5) Apothecial disc convex, pruinose (pale yellow to grey) **C. foliicola**
 Apothecial disc flat, epruinose **C. phyllogena**
- 7(2) Campylidia bright red **C. erythrocephala**
 Campylidia grey to blackish 8
- 8(7) Ascospores 80–110 µm long 9
 Ascospores 55–85 µm long 11
- 9(8) Apothecial disc pale brown, thickly white-pruinose **C. perpallida**
 Apothecial disc brown to dark brown, epruinose or thinly pruinose 10
- 10(9) Apothecial disc pruinose, at least when young **C. bonitensis**
 Apothecial disc epruinose **C. subfusca**
- 11(8) Conidia 13–15 septate, 90–120 µm long; apothecial disc black, with brown
 hypothecium **C. lecanorella**
 Conidia 3–7 septate, 30–50 µm long; apothecial disc variously coloured, if black
 then with aeruginous hypothecium 12
- 12(11) Apothecial disc thickly pruinose **C. editae***
 Apothecial disc epruinose 13
- 13(12) Apothecial disc greyish black to black; hypothecium aeruginous
 **C. subcoerulescens**
 Apothecial disc pale to dark brown; hypothecium pale to dark brown 14
- 14(13) Apothecial disc orange-brown to reddish brown; hypothecium pale brown
 **C. fusca**
 Apothecial disc pale to dark greyish brown; hypothecium dark brown
 **C. puiggarii**

*Recorded by Cáceres (2007) as *Calopadia pruinosa* Chaves & Lücking *nom. nud.*

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