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Pseudoderbesia eckloniae, sp. nov. (Bryopsidaceae, Ulvophyceae) from Western Australia

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ABSTRACT
Pseudoderbesia eckloniae Huisman & Verbruggen, sp. nov., is described for specimens collected from Cape Peron, Western Australia, growing epiphytically on the kelp *Ecklonia radiata* (C.Agardh) J.Agardh. The new species forms a velvety turf on the host and is distinguished from related species by a combination of molecular analyses (*rbc*L) and morphological characteristics.

KEY WORDS
Australia, Bryopsidaceae, new species.

RÉSUMÉ
Pseudoderbesia eckloniae*, sp. nov. (Bryopsidaceae, Ulvophyceae) d'Australie occidentale.*
Pseudoderbesia eckloniae Huisman & Verbruggen, sp. nov., est décrit pour des spécimens collectés au cap Péron, en Australie occidentale, poussant de manière épiphytique sur le kelp *Ecklonia radiata* (C.Agardh) J.Agardh. La nouvelle espèce forme un gazon dense sur l'hôte et se distingue des espèces apparentées par une combinaison d'analyses moléculaires (*rbc*L) et de caractéristiques morphologiques.

MOTS CLÉS
Australie, Bryopsidaceae, espèce nouvelle.

INTRODUCTION

The genus *Pseudoderbesia* Calderon & Schnetter (1991) was described for small, siphonous green algae with rhizoidally attached stoloniferous bases that give rise to erect axes with dichotomously branched, tapering siphons. Reproduction is via biflagellate zooids that arise in transformed branches and are released through papillae in the siphon wall. The genus is currently monospecific and was poorly known until the review of Leliaert *et al.* (2014), who described specimens from Greece that conformed to *Pseudoderbesia* but could not be confidently assigned to its only species, *P. arbuscula* Calderon & Schnetter (1991), and were left as *Pseudoderbesia* sp. (Greece).

A recent Western Australian collection of a tufted green alga, growing epiphytically on the kelp *Ecklonia radiata* (C.Agardh) J.Agardh, morphologically agreed with *Pseudoderbesia* but differed in subtle ways from *P. arbuscula* and other taxa described in Leliaert *et al.* (2014), and is described here as a new species.

SYSTEMATICS

Family Bryopsidaceae Bory
Genus *Pseudoderbesia* Calderon & Schnetter

Pseudoderbesia eckloniae
Huisman & Verbruggen, sp. nov.
(Fig. 1)

Holotype. — PERTH 09134638. Collected at Cape Peron, Western Australia (32°16.18'S, 115°41.178'E), epiphytic on *Ecklonia radiata* at 2 m depth, 9.I.2019, *J.M.Huisman 9.1.19.1A-C* (three specimens mounted on sheet) (Fig. 1B).

Paratype. — PERTH 09134646. *Loc. id.*, 30.XII.2018, *J.M.Huisman 30.12.18*.

Etymology. — The epithet "eckloniae" refers to the species' only known host, *Ecklonia radiata*.

Description

Thallus grass green, forming a velvety layer on the surface of degrading branches of *Ecklonia radiata* (Fig. 1A), spreading laterally for up to 10 cm, siphonous, with dichotomously branched upright axes arising from a stoloniferous base (Fig. 1C). Stolons terete, 35-50 µm in diameter, attached by elongate, terete rhizoidal siphons. Upright axes dichotomously (rarely trichotomously) branched 4-7 times when mature, dichotomies mostly at similar levels but occasionally unequal, with slight constrictions commonly present at branch bases (Fig. 1D). Upright axes proximally 50 µm in diameter when young, 120-200 µm in diameter when mature; distal branches markedly narrowing, with ultimate branches 12-25 µm in diameter. Chloroplasts numerous, elongate to ovate, each with a single pyrenoid (Fig. 1E). Reproduction not observed.

Molecular Analysis

The *rbc*L gene of four samples of the new species was sequenced following the procedures of Verbruggen *et al.* (2009) and submitted to GenBank (MT108929). The four sequences of *Pseudoderbesia eckloniae*, sp. nov., were identical and only one was included for further analysis. The sequence was aligned with those of Bryopsidineae used in Leliaert *et al.* (2014) and *Lambia antarctica* (Skottsberg) Delépine (Cremen *et al.* 2019). A maximum likelihood phylogenetic tree was inferred with RAxML 8.2.10, using a GTR+G+I model and 100 standard bootstraps (Stamatakis 2014). The phylogenetic tree (Fig. 2) shows that the genus *Pseudoderbesia* is related to *Lambia* Delépine and *Bryopsis* J.V.Lamouroux, but the exact relationships among these genera is not recovered with sufficient bootstrap support. The divergence between *Pseudoderbesia eckloniae*, sp. nov., and *Pseudoderbesia* sp. from Greece is clear in the tree, and the *rbc*L interspecific divergence between these two *Pseudoderbesia* species is 3.87%.

Affinities

The only currently named species of *Pseudoderbesia* is the generitype, *P. arbuscula* Calderon & Schnetter (1991). Based on the comparative table provided in Leliaert *et al.* (2014), upright axes in *P. eckloniae*, sp. nov., grow to approximately twice the dimensions of *P. arbuscula*, to 8 mm tall (as opposed to 4.3 mm), with lower siphons to 200 µm in diameter (54-84 µm). In addition, rhizoids in *P. arbuscula* are short, distally lobed and surrounded by mucilage, differing from the elongate rhizoids without mucilage of *P. eckloniae*, sp. nov. Two other undescribed entities (potentially species) were described from the Canary Islands and Greece (Calderon & Schnetter 1991; Leliaert *et al.* 2014). In both, the maximum siphon diameter near the base is smaller than that of *P. eckloniae*, sp. nov. The Greek entity also differs in having short rhizoids. While the morphological variation described above could be encompassed in a single, broadly defined species, our molecular analysis indicates species-level variation between *P. eckloniae*, sp. nov., and *Pseudoderbesia* sp. (Greece), the only other taxon currently represented in molecular libraries. Based on this, plus the geographical separation between the Australian and Columbian localities, we prefer to describe our material as a new species.

Leliaert *et al.* (2014) also noted three species currently placed in *Derbesia* Solier that, based on morphology, might be better placed in *Pseudoderbesia*. These species are *D. attenuata* Dawson (1954), *D. padinae* Trono (1972) and *D. fastigiata* Taylor (1928). The dichotomously branched upright axes of *P. eckloniae*, sp. nov., are somewhat similar to those of *D. attenuata*, described originally from Vietnam (Dawson 1954) but also recorded from north-western Australia (Huisman 2015) and elsewhere. As the original material of *D. attenuata* lacked reproductive structures, Dawson expressed some doubt regarding its generic placement, and the subsequent Australian collection added no new information. In contrast to *P. eckloniae*, sp. nov., Dawson's species was described as "usually solitary" with unconstricted upright siphons. Moreover, siphon diameters of *D. attenuata*

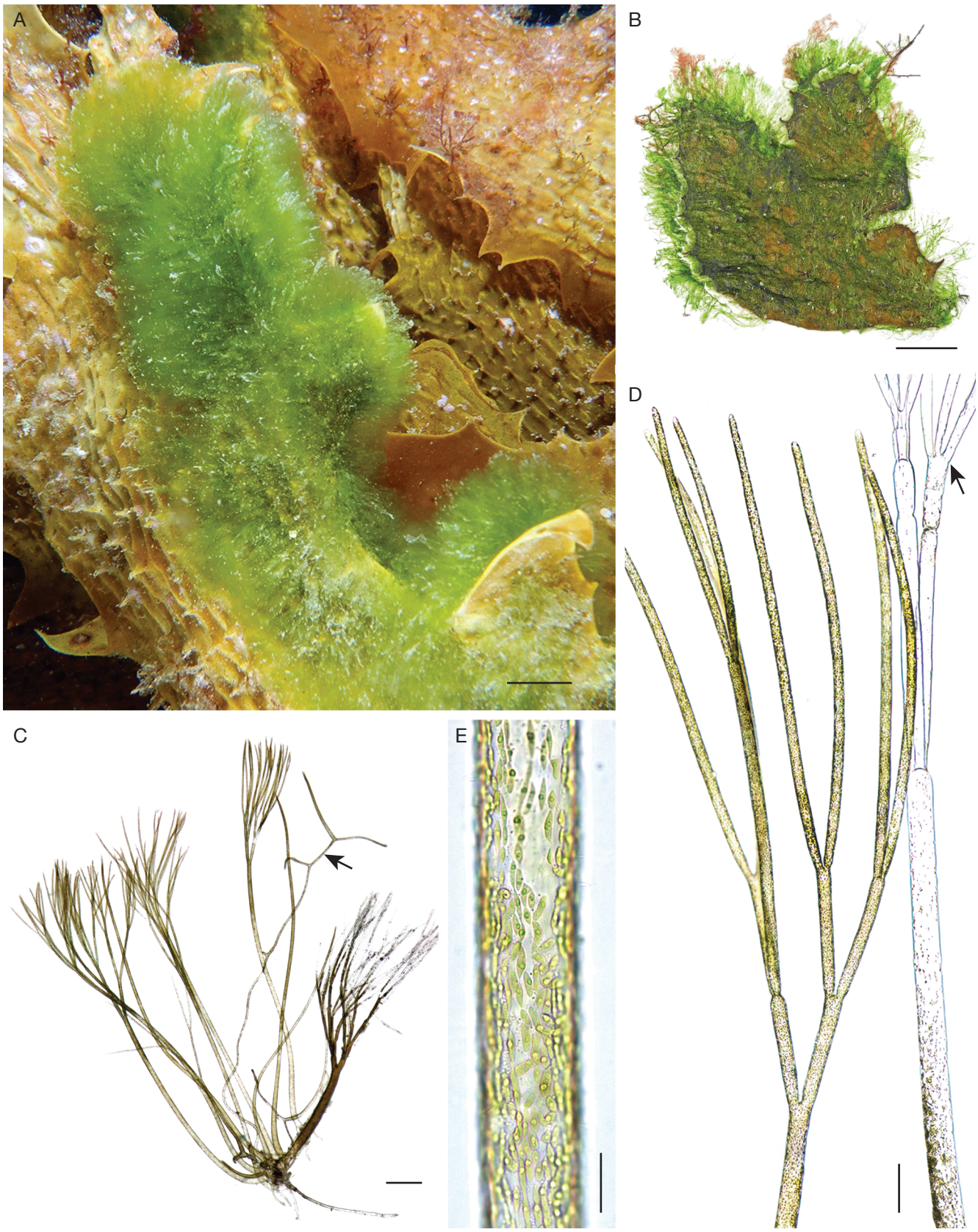

FIG. 1. — *Pseudoderbesia eckloniae* Huisman & Verbruggen, sp. nov.: **A**, specimen from the type collection growing on *Ecklonia radiata* (C.Agardh) J.Agardh at Cape Peron, Western Australia; **B**, one of three specimens from the holotype sheet (PERTH 09134638); **C**, closer view, showing stolons (**arrow**) and dichotomously branched upright axes; **D**, detail of upper branches, with slight constrictions at dichotomies. A trichotomy is also present (**arrow**); **E**, siphon detail showing elongate chloroplasts, each with a single pyrenoid. Scale bars: A, B, 1 cm; C, 500 µm; D, 100 µm; E, 25 µm.

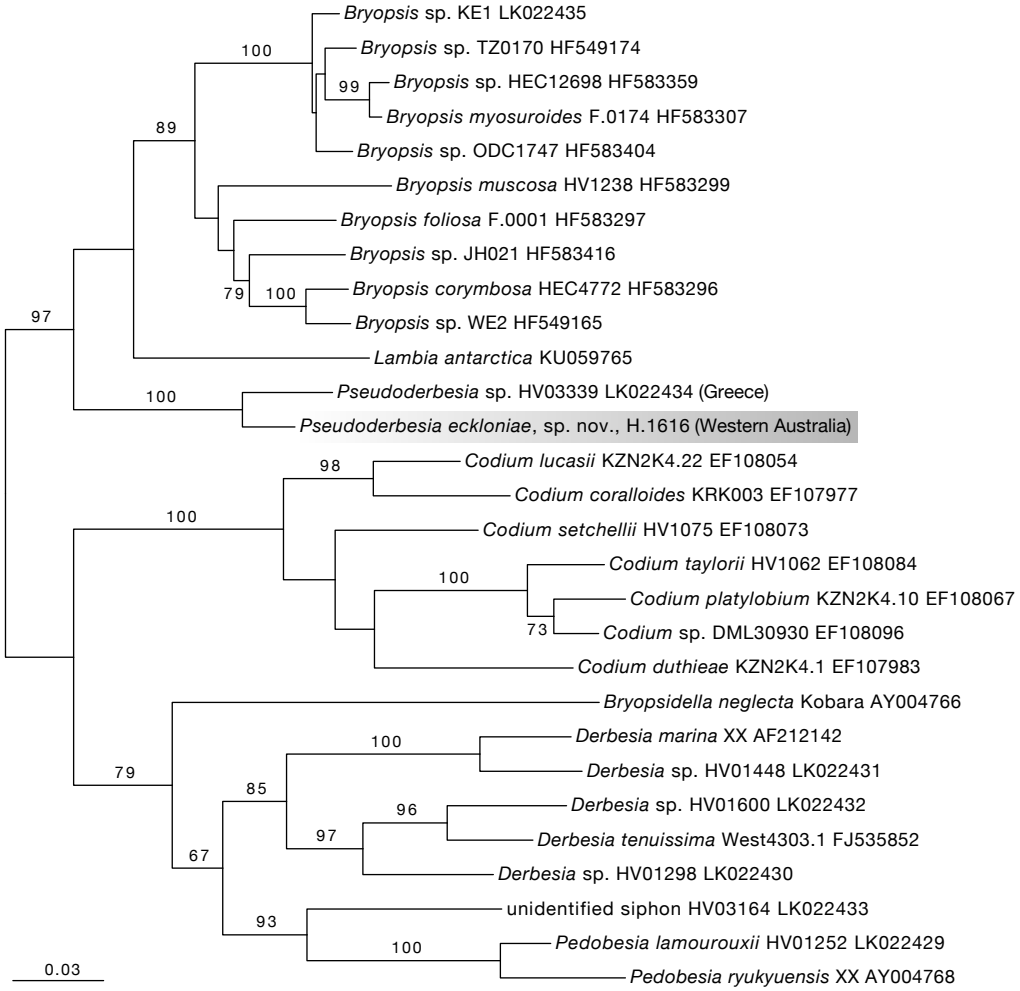

Fig. 2. — Maximum likelihood phylogenetic tree of the *rbc*L gene showing the new species *Pseudoderbesia eckloniae* Huisman & Verbruggen, sp. nov., clustering with the Greek *Pseudoderbesia* strain. The scale bar is in estimated substitutions per site. Branch labels indicate bootstrap support, shown only when >70.

are markedly less than those of *P. eckloniae*, sp. nov., as is also true for *D. padinae*, which grades from lower axes of 50-60 µm diameter to ultimate branches of 6-8 µm diameter. As described by Littler & Littler (2000), the tropical American *D. fastigiata* can grow to a larger size (to 2 cm), but again the siphons do not reach the dimensions of *P. eckloniae*, sp. nov. A further distinguishing feature is the siphons of *D. fastigiata* often being swollen below dichotomies (Littler & Littler 2000).

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