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Short communication

Rediscovery of *Riella alatospora* (Riellaceae, Sphaerocarpales), an aquatic, South African endemic liverwort previously known from a now largely transformed type locality

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Abstract

Riella alatospora is reported from cultured sediments from a salt pan near Springfield (Western Cape), South Africa. This species was previously known only from the type locality near Cape Town, and has not been collected since 1932. Because the original locality has been severely affected by urbanization in the past decades, the species is unlikely to survive there. The identity of the specimens obtained from the cultured sediments were confirmed by comparison with the type material of *R. alatospora*. A detailed description of *R. alatospora* including lectotypification, illustrations, light and scanning electron microscopy micrographs of spores, and an updated distribution map is presented. Our finding suggests that the genus *Riella* is likely to be more widespread in South Africa than previously thought and that extensive sampling is required before an accurate distribution of the species can be ascertained. This study also highlights the value of culture sediments in revealing the presence of *Riella*.

Keywords: Aquatic liverworts; Bryophytes; South Africa; Southern Hemisphere; Spore morphology

1. Introduction

The genus *Riella* Mont. (Riellaceae, Sphaerocarpales) includes some 22 species of aquatic thallose liverworts and is distributed in areas of Mediterranean or subdesertic climate types on all continents except Antarctica. Their small size, ephemeral aquatic habitat, and dependence on the nature of the flooding season makes finding populations somewhat difficult. Populations are generally demographically fluctuant, with some years experiencing sudden demographic blooms and other of complete absence, as population growth may be inhibited both by too high or too low water levels. Furthermore, their specialised aquatic habitat offers very little of interest to bryologists, apart from *Riella*, and so they are often overlooked. It is not surprising then that some populations and even species have been discovered from cultures aimed at sampling ponds and lagoons for other organisms like crustacean (Cavers, 1903; Hässel de Menéndez, 1979; Perold, 2000; Porsild, 1902). Five species of *Riella* (*R. affinis* M. Howe & Underw., *R. alatospora* Wigglesworth, *R. capensis* Cavers, *R. echinospora* Wigglesworth and *R. purpureospora* Wigglesworth) are present in southern Africa (Perold, 2000; Wigginton and Grolle, 1996; Wigginton, 2009). Of these five species, *R. affinis* a monoecious species of subgenus *Trabutiella* has the widest distribution range, and is the only species reported outside southern Africa (Howe and Underwood, 1903; Patel, 1977; Puche and Boisset, 2009; Thompson, 1940). However, within South Africa this species is still known only from a single reported locality (Proskauer,

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1955). The remaining four species belong to subgenus *Riella*, sharing the smooth female involucres. *Riella echinospora* is known from only two isolated localities, the one in South Africa (Wigglesworth, 1937) and the other in Namibia (Arnell, 1957); *R. purpureospora* is endemic to South Africa and is the only species reported in recent times (Harding et al., 2000; Perold, 2000) around the Cape Town area. The two remaining species *R. capensis* Cavers and *R. alatospora* Wigglesworth were both known only from one locality (Cavers, 1903; Wigglesworth, 1937). Some other existing reports of *Riella* from South Africa (Perold, 2000; Wigglesworth, 1937) and Namibia (Arnell, 1957) have not been assigned to any of these species because of the absence of mature spores which are essential for species identification whereas others have been tentatively assigned to *R. capensis* (Coetzer, 1987), but have not been verified in recent revisions of the genus (Perold, 2000).

Riella alatospora was originally collected by Dr. E.L. Stephens from a vlei (pond) in Salt River, Cape Town in 1932 and sent to Manchester where it was studied by Dr. G. Wigglesworth who described it after the presence of a wing along the equatorial plane of the spores. This original locality has been severely altered by urbanizing activities, as have many parts of the city area (Rebelo et al., 2011), to the point that it is unlikely that populations of this species are currently developing there. As a result, *R. alatospora* has not been collected or reported for more than 80 years (Perold, 2000).

As part of a world-wide study of the genus *Riella*, sediments from a salt pan at Springfield, near Cape Agulhas were collected by the first author during February 2010. Cultures of those sediments rendered plants of *Riella* in an area not previously included in the known distribution ranges for any of the South African species.

2. Materials and methods

About 0.5 kg of dried sediments were collected from several points in one side of the salt pan and included the first 5 cm depth of soil. Collection points were located just a few meters from the shore line and where visible dried debris of plants and algae had accumulated. Sediments were kept on a zip plastic bag in the laboratory at room temperature. One year after collection of soil samples the sediments were flooded with distilled water in the laboratory. The cultures were turbid after this initial flooding and two subsequent water changes were required until they were transparent. These changes were conducted without disturbing the sediments and any visible germination that could have occurred.

Measurements of vegetative and spore characters were taken using the interactive measurement module of Leica Application Suite (LAS) v. 3.8 (Leica microsystems, Barcelona, Spain) calibrated to the nearest 0.01 μm on digital images. All measurements were taken under a Leica DMLB 100S light microscope, except for the size of gametophytes and width of wing from the thallus that were taken under a Leica M76 stereomicroscope. A Leica DFC425 digital camera was used for producing high resolution images. Mature spores were mounted directly on stubs using double-sided adhesive tape and coated with gold/palladium in a BIORAD SC-500 ion sputtering coater. Morphological observations were carried out in a Hitachi S-4100 field emission scanning electron microscope (SEM) at the University of Valencia (SCSIE-UV). Terminology for spore characters follows Perold (2000).

3. Results

In May 2011 the first germlings of *Riella* appeared in the cultures, just two months after the flooding of the sediments with distilled water. Gametophyte development continued during the two following months until the first reproductive organs were visible. The individuals corresponded to a dioecious species and males were the first to reach maturity. Two weeks later female individuals began to develop involucres after the fertilization of the archegonia and sporophytes contained ripe spores by the end of August 2011. The spores of these individuals were compared to those present in the original cultured material used for the description of *R. alatospora* (Wigglesworth, 1937). Both samples showed spores triangular in outline and with a conspicuous wing around the equatorial plane, short truncate spines on the distal face and short acute spines over a flattened central dome on the proximal face. These distinctive spore characters allowed for the unambiguous placement of the cultured specimens with that of *R. alatospora* (Fig. 1).

A detailed description of *R. alatospora* was provided by Wigglesworth (1937) including developmental stages observed in the laboratory and later by Perold (2000) from herbarium material. Here we supplement those descriptions with individual characters from this new collection.

3.1. Riella alatospora

Wigglesworth in J. Linn. Soc., Bot., 5: 317 (1937). Type: South Africa. Western Cape, Cape Town (3318), 'vlei at Salt River between main road and railway line' (−CD), 1932, *E. L. Stephens s.n.* (CC 1627 MANCH! lecto.; BOL, iso.). [Note: Grace Wigglesworth received a specimen of *R. alatospora* from E. L. Stephens and then cultured the plant further from spores. Apparently, both wild and cultivated materials were used in the original description of this species with no explicit designation of a holotype in Wigglesworth (1937). Contrary to other South African specimens of *Riella* reared in the laboratory by Wigglesworth, the material of *R. alatospora* (CC 1627) was not labelled as having been derived from cultures and rather represents the duplicate of the original Stephens' collection in BOL (not located). As such the specimen in MANCH is here designated as the lectotype.]

Plants 11–18 (20) mm tall, erect, caespitose, usually bifurcate from the base and 2 to 3 branched above, becoming shrubby, rarely unbranched (Figs. 2, 3B, C). Thallus apex falciform. Axis slightly flattened, 0.15–0.22 mm wide. Dorsal wing 0.8–2.1 mm wide, undulate, margin entire, marginal cells quadrate or oblate, the first 5 to 7 rows of cells hyaline (Figs. 2D, 3F), 15–41 × 14–34 μm; cells from middle part of wing polygonal 38–70 × 30–55 μm; cells from wing near axis rectangular or hexagonal 58–123 × 28–75 μm; oil cells 14–26 × 17–28 μm, oil bodies 12–20 × 14–22 μm spherical or ovoid, opaque, smooth. Vegetative scales lanceolate-triangular 313–1015 × 185–805 μm, arranged in two lateral rows, opposite (Figs. 2C, 3E). Propaguliferous scales not