

THE FIRST RECORD OF *RIELLA MACROCARPA* (SPHAEROCARPALES, MARCHANTIOPHYTA) IN ALBANIA

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Abstract: *Riella macrocarpa* was described as *R. helicophylla* var. *macrocarpa* by Allorge in 1929. Later, this variety has not been used further and has not been treated correctly in the checklists. The species was separated and raised to the species rank by Segarra-Moragues et al. in 2022. *Riella macrocarpa* is known mainly in the western part of the Mediterranean Basin. The only record from the eastern part is from Cyprus. In the Balkan Peninsula only *Riella notarisi* has been reported so far from Croatia and Greece. *Riella macrocarpa* was found in Albania (Narta area), which means an extension of the distribution of this species to the eastern Mediterranean region. Its occurrence details in the Narta area and some notes on habitats are presented in this paper.

Key words: Balkan Peninsula, coastal brackish water, liverwort, Narta lagoon

INTRODUCTION

The genus *Riella* Mont. (Riellaceae, Sphaerocarpaceae) includes about 28 species of thalloid aquatic liverworts distributed worldwide (SÖDERSTRÖM *et al.* 2016), mainly in arid or semiarid regions (SEGARRA-MORAGUES *et al.* 2014). The largest diversity is concentrated in countries surrounding the Mediterranean Basin, where 10 species have been reported thus far (SEGARRA-MORAGUES *et al.* 2019).

Riella species are unique among liverworts occurring in seasonal ponds and lagoons, and most of them can colonize brackish water CIRUJANO *et al.* (1993). Due to their ephemeral appearance, temporary habitat, and short lifetime they are likely to be overlooked and under-collected.

According to the checklists of the Albanian bryophyte flora (COLACINO and SABOVLJELIĆ 2006) and recent new records of the country's liverworts

(COLACINO and MARKA 2009, MARKA and SABOVLJEVIĆ 2011, MARKA *et al.* 2013, 2018, PAPP *et al.* 2010, 2018, VAN ZANTEN 2013), no data are available on the occurrence of the genus *Riella* in Albania. This paper reports a *Riella* species, *Riella macrocarpa* (P. Allorge) Puche, Segarra-Moragues, Sabovlj., M. Infante et Heras, from Albania and its habitat details and ecological conditions.

MATERIAL AND METHODS

Field surveys and sampling were carried out several times during the spring season (years: 2012, 2013, 2016, and 2018) in few coastal brackish habitats around the Narta Lagoon, situated in the southern part of the Vjosa river delta (South Albania) (Fig. 1). The northern part of the Narta lagoon has been transformed, in the early 1950s, in operated salt pans, which cover nowadays a surface of 1,500 ha. It is composed of many shallow ponds complemented with islets and dikes that make the area particularly interesting for nesting water birds. The salt pans (saltworks) and the lagoon are divided by a dike of 13.8 km.

The wetland complex of the Vjosa delta-Narta lagoon (19,738 ha) represents a Protected Area (IUCN, category IV); it is also listed as an Important Bird Area (IBA) in Albania and is being considered among potential Natura 2000 sites as

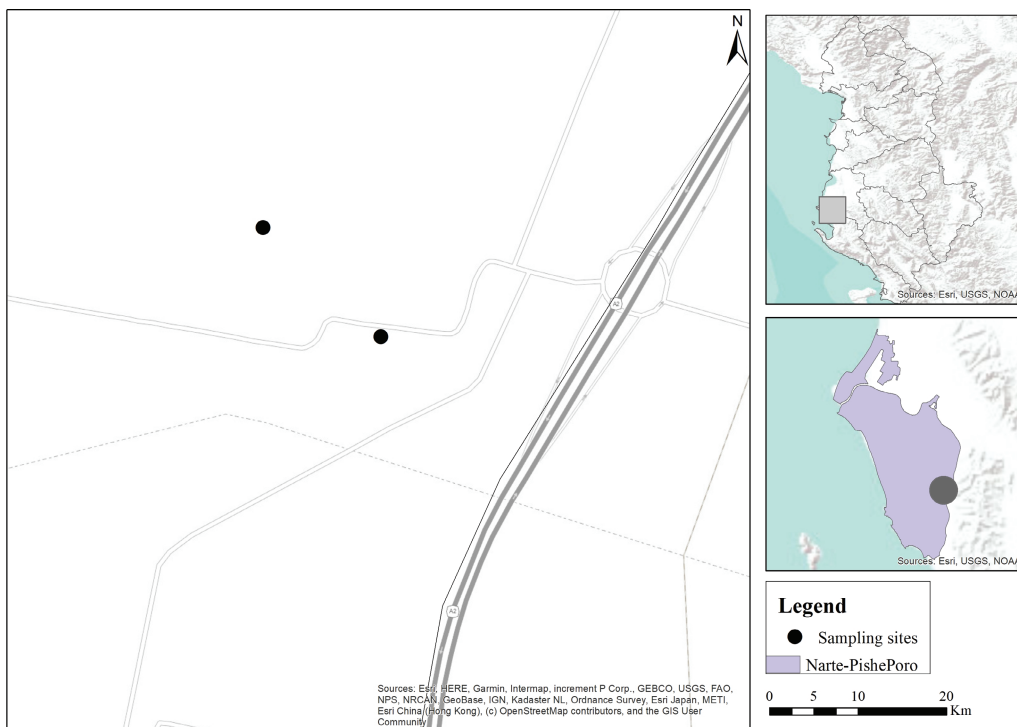


Fig. 1. A map showing the Narta lagoon position in Albania and the collecting sites.

well (SHUMKA *et al.* 2018). The climate in this Albanian coastal area is typically Mediterranean, with an average precipitation of 893 mm. 70 to 75% of the rains occur from October to March (CHAUVELON *et al.* 2006).

Morphological observations and measurements of the *Riella* samples were carried out under a Motic BA310 light microscope and a Motic stereomicroscope, using fresh specimens of male and female fertile individuals. The description of the species and illustrations were based on materials from the Albanian populations. Specimens are kept in the National Herbarium, University of Tirana (TIR).

RESULTS

Riella macrocarpa was collected from two different coastal brackish habitats of the Narta lagoon area:

1) in abandoned ponds of saltworks:

– a scattered population on muddy-clay soil, in one of the abandoned ponds of saltpan, 20 cm deep with moderate plant cover consisting of *Ruppia maritima* L., *Zannichellia pedunculata* Rchb., *Althenia filiformis* Petit, and few individuals of *Lamprothamnium papulosum* (Wallr.) J. Groves.

– a pure population on muddy-clay soil, in another abandoned pond of saltpan, 10 cm deep and characterized by very sparse vegetation composed of *Ruppia maritima* and *Althenia filiformis*. Some parts of this pond were almost dried out in mid-April and the bottom was covered with thousands of fertile individuals (Fig. 2).

2) in a small pool winter-flooded by rainwater, situated between the lagoon and the saltworks, a sparse population on muddy-clay soil, where other plants were growing (*Ruppia maritima*, *Ranunculus peltatus* Schrank subsp. *baudotii* (Godr.) C. D. K. Cook and *Chara galioides* DC.).

Materials examined and preserved as herbarium specimens and/or wet collections

Albania: Municipality Vlorë, close to Narta lagoon, temporary pool between the lagoon and the saltwork, 40° 33' 23.08" N, 19° 27' 30.43" E, 20–30 cm depth under water, 27 April 2013, leg./det.: L. Kashta (TIR: LK Na 13/1); 30 March 2018, leg./det.: L. Kashta (TIR: LK Na 2018/1).

Albania: Municipality Vlorë, close to Narta lagoon, abandoned pond of saltpan, 40° 33' 28.19" N, 19° 27' 23.10" E, 15 cm depth under water and on dried-up bottom, 19 April 2016, leg./det.: L. Kashta (TIR: LK Na 16/2, LK Na 16/2-1 and LK Na 16/2-3).

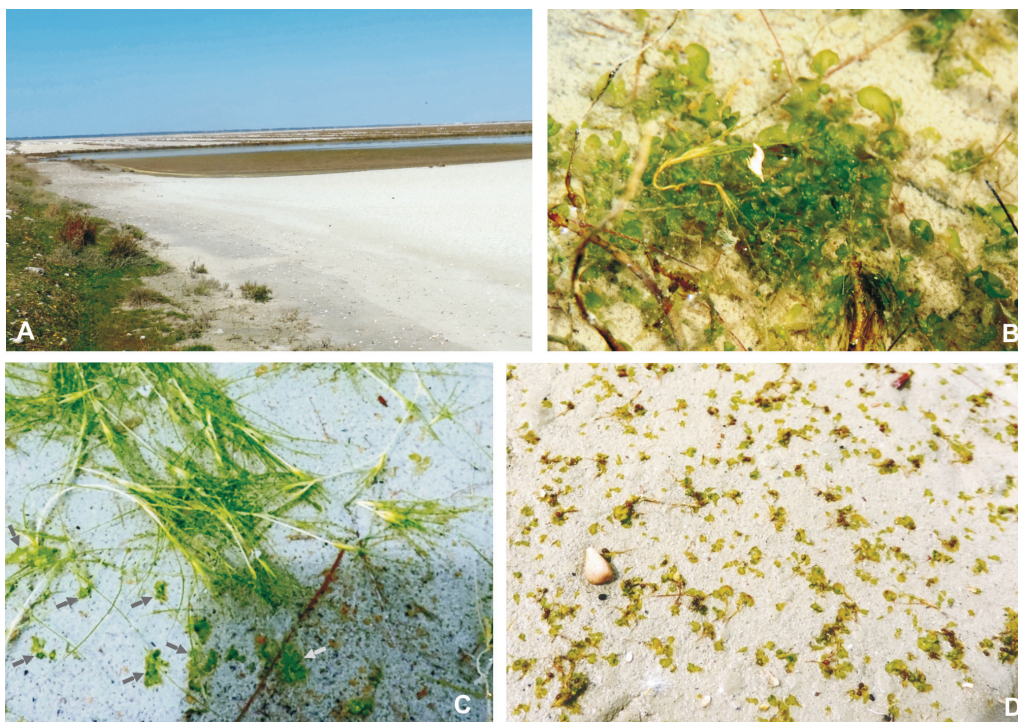


Fig. 2. *Riella macrocarpa* in an abandoned saltworks pond. – A = Overall view of the pond that is drying up. B = Dense stand of *Riella*, a few centimeter underwater. C = *Riella* (arrows) associated with *Althenia filiformis*. D = Fertile individuals remained on the dried-up bottom of the pond.

Description of the Albanian specimens of *Riella macrocarpa*

The thallus is very delicate, 20–30 mm high, composed of a main branch, sometimes bifurcated, with undulate single-layer blade on one side and small lanceolate scales on the other (Fig. 3A–B).

The female plants bear pedicellate sporophytes, surrounded by membranous, ovoid, bottle-shaped involucre without a wing (Fig. 3D), while the male plants have antheridia arranged in a row on the edge of the thallus wing (Fig. 3C). Spores are 80 to 100 μm in diameter, including spines of 8 to 10 μm long, truncated and widened at the apex (Fig. 3E). *R. macrocarpa* is a dioecious species; both male and female plants were found fixed into the substrate by thin rhizoids.

Its close relative is *R. helicophylla*, from which it was separated recently at species level (SEGARRA-MORAGUES *et al.* 2022). The main distinguishing characters are the following. The thallus wing of *R. macrocarpa* is undulate, female involucre is ovoid with shortly acuminate apex with an open mouth, distal spines of the spores are truncate with flat, dilated apex. *R. helicophylla* has helicoid thal-

lus wing, the female involucre are acuminate tapering to an acute apex with an occluded mouth, distal spines of spores have swollen rounded apices (SEGARRA-MORAGUES *et al.* 2022).

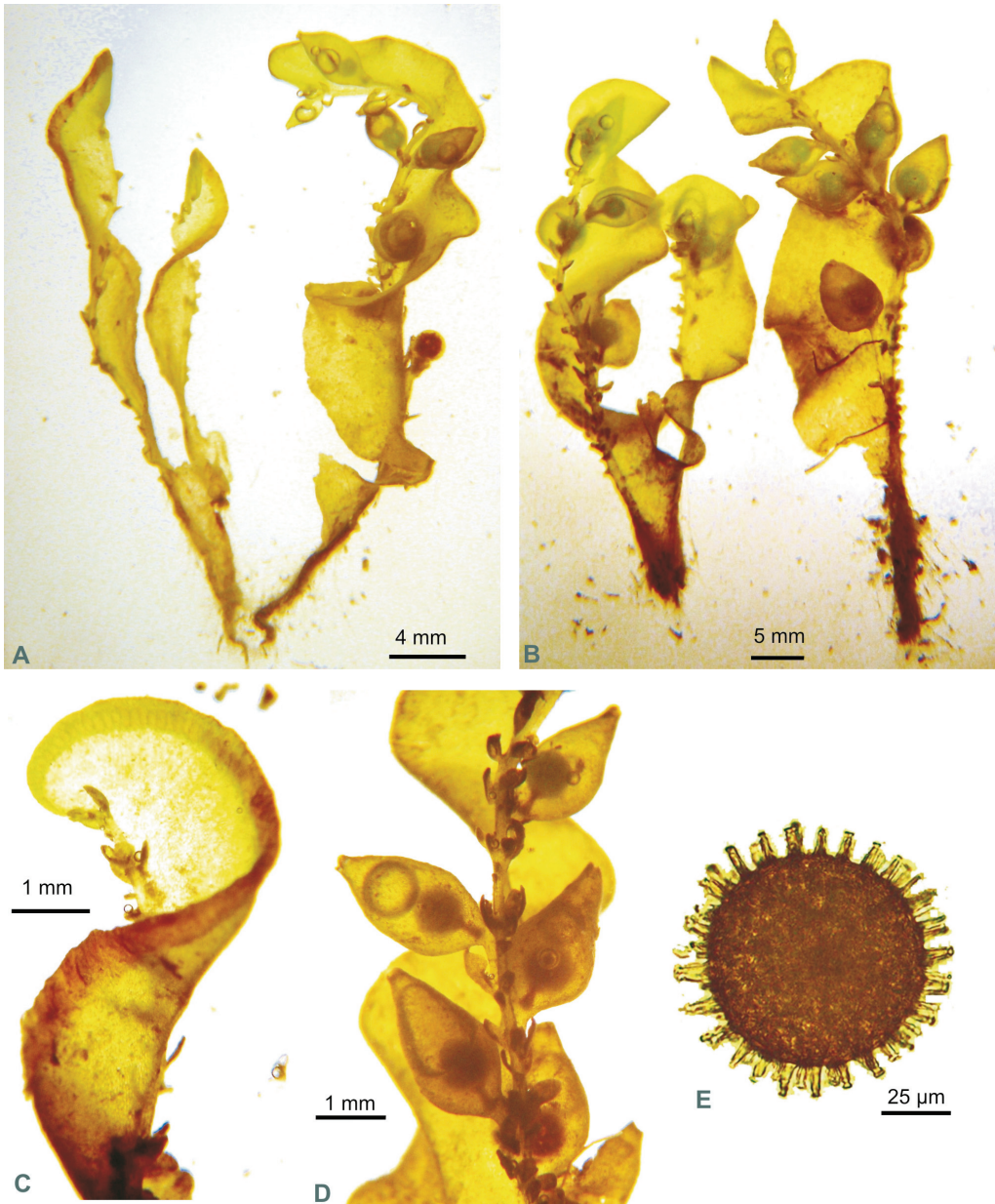


Fig. 3. *Riella macrocarpa*. – A = General view of both male (left) and female (right) plant. B = Female plant bifurcated (left) and simple (right). C = Detail of the upper part of the male thallus. D = Close up of female plant with ovoid, bottle-shaped involucre with sporophytes. E = Optical microscopy image of a spore.

In the Balkan Peninsula in Greece and Croatia *R. notarisii* (Mont.) Mont. occurs (HODGETTS and LOCKHART 2020), which differs in being monoecious and its spores have shorter spines (4 to 5 μm) (HUGONNOT and HÉBRARD 2004).

DISCUSSION

Riella macrocarpa was described by ALLORGE (1929) as *Riella helicophylla* (Bory et Mont.) Mont. var. *macrocarpa* Allorge. This variety differed from the main taxon in having large female involucre and undulate thallus wing. However, this variety has not been used further and for example in the Mediterranean checklist of ROS *et al.* (2007) has not been recognized. Later, this variety appears again in the recent checklists (SÖDERSTRÖM *et al.* 2016, HODGETTS *et al.* 2020).

SEGARRA-MORAGUES *et al.* (2022) dealt with the taxonomy of *Riella helicophylla* and clearly separated morphologically and genetically the variety of *macrocarpa* and they raised it to species level. They proved that the distribution of *R. helicophylla* is much narrower than it was shown earlier in the checklists (ROS *et al.* 2007, SÖDERSTRÖM *et al.* 2016, HODGETTS *et al.* 2019, HODGETTS and LOCKHART 2020). They confirmed the occurrence of this species only from Algeria, Morocco, Tunisia, and mainland Spain. However, *R. macrocarpa* has wider distribution in the Mediterranean Basin (Algeria, Morocco, Tunisia, Portugal, Spain (incl. Minorca), France, Italy (Sardinia), and Cyprus).

Now, it has been found and collected from brackish water at Narta area in Albania. It is a new record for Albania and other occurrences of *R. macrocarpa* are not known in other countries of southeastern Europe. It was known only from the island of Cyprus in the eastern Mediterranean Basin (SEGARRA-MORAGUES *et al.* 2022). This record was reported as *R. helicophylla* by MANOLAKI *et al.* (2012). Only one species of the genus, *Riella notarisii* was known in the Balkan Peninsula, in Croatia, Greece, and Crete (SABOVLJEVIĆ and NATCHEVA 2006, ROS *et al.* 2007, SÖDERSTRÖM *et al.* 2016, HODGETTS and LOCKHART 2020).

The habitats, where *R. macrocarpa* was found in Albania, brackish water temporary pools and abandoned saltpan/saltworks, are probably key habitats, as they provide the most important ecological conditions necessary for the germination and development of populations: temporary water body, relatively shallow and transparent water with salinity drop at winter flooding and high salinity and drought during summer, and soil that is bare or with sparse plant cover. High levels of light and water transparency play an important role in the development of the species in France, where it was also known before as *R. helicophylla* (HUGONNOT and HÉBRARD 2004, GRILLAS *et al.* 2016).

The statements of CIRUJANO *et al.* (1993) and MARTINEZ *et al.* (2014) about the ecology of *R. helicophylla* in Spain and France can be applied to *R.*

macrocarpa. The two species have similar ecological requirements in Spain and only *R. macrocarpa* occurs in France (SEGARRA-MORAGUES *et al.* 2022). As a typical species of temporarily flooded habitats, with a very short reproductive cycle during the vernal period, it depends on fluctuating water levels to avoid the impact of more aggressive hydrophytes that generally favour stable water levels. The plant cover is also very low in the sites found in temporary ponds of the Narta lagoon wetland complex. The aquatic macrophytes associated with *R. macrocarpa*, include typical brackish water or salt-tolerant species like *Ruppia* sp., *Althenia filiformis*, *Zannichellia pedunculata*, *Ranunculus peltatus* subsp. *baudotii*, *Lamprothamnium papulosum*, and *Chara galioides*.

For the nature conservation importance of the species, we can infer using the information on *R. helicophylla*, which is a species of community interest, and it is included in Annex II of the European Union Habitats Directive 92/43/EEC. Recently, it has been assessed as Near Threatened (NT) species in Europe (HODGETTS *et al.* 2019), since it has a restricted geographic range, and there is a continuing decline in the extent and quality of its habitat (SERGIO and PUCHE 2019). SEGARRA-MORAGUES *et al.* (2022) gives an up-to-date global IUCN categorization according to the distribution data (IUCN criterium B). On the basis of this, both species (*R. helicophylla* and *R. macrocarpa*) can be placed in the endangered (EN) category, because their AOO (area of occupancy) is less than 500 km² and a decline in the AOO and population size and a decrease in habitat quality were observed. Besides these, there are high fluctuations in population sizes.

The newly discovered populations of *R. macrocarpa* not only add a new species (and genus) to the list of liverworts of Albania, but also extend the representation of this rare and important species in the Eastern Mediterranean region. Probably, this liverwort species can be more widespread along the Albanian Adriatic Lowland, and new populations may be explored during future field works in other suitable areas.

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Összefoglaló: Allorge 1929-ben írta le a *Riella macrocarpa*-t, mint a *Riella helicophylla* variánsát (var. *macrocarpa*). Később ezt a variánsát általában nem különböztették meg a fő fajtól és így a checklist-ekben sem jelenik meg. Segarra-Moragues és munkatársai különítették el és emelték faji szintre 2022-ben. A *Riella macrocarpa* főleg a Földközi-tenger medencéjének nyugati részén fordul elő. Az egyetlen keleti adata Ciprusról volt ismert. A Balkán-félszigeten korábban csak a *Riella notarisii*-nek voltak előfordulási adatai Horvátországból és Görögországból. A *Riella macrocarpa*-t most sikerült kimutatni Albániából, ami a faj elterjedési területének növekedését jelenti a Földközi-tenger keleti medencéjében. Ebben a cikkben az albániai lelőhelyével kapcsolatos részleteket, megfigyeléseket tesszük közzé, valamint kitérünk a faj ökológiájára és természetvédelmi jelentőségére is.

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