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## First report of the North Atlantic myrionematoid brown alga *Ulonema rhizophorum* Foslie (Phaeophyceae, Chordariaceae) in the Mediterranean Sea

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### Abstract

The myrionematoid brown alga *Ulonema rhizophorum* Foslie (Phaeophyceae, Chordariaceae) is reported for the first time from the Mediterranean Sea. This species was collected growing as an epiphyte on *Ulva* sp. from the Dardanelles (Sea of Marmara, Turkey) in the midlittoral zone. *Ulonema rhizophorum* is characterized by downwardly produced rhizoids from the basal system. A key to the Mediterranean related genera of *Ulonema* is provided.

**Keywords:** Brown algae, Mediterranean Sea, seaweeds, Turkey, *Ulonema rhizophorum*.

### Introduction

The monospecific genus *Ulonema* was established by Foslie (1894: 131), with the species *Ulonema rhizophorum* Foslie from Norway. Foslie (1894) reported that this species was growing on the red algal host *Dumontia filiformis* (Hornemann) Greville [= *Dumontia contorta* (S.G. Gmelin) Ruprecht]. *Ulonema* closely resembles another myrionematoid genus, namely *Myrionema* Greville, but it differs from that in having rhizoids arising from the basal system (Fletcher, 1987; Taşkın *et al.*, 2006). *U. rhizophorum* has been recorded from the north-eastern Atlantic Ocean [Ireland and Great Britain (Fletcher, 1987), the Faroes (Nielsen & Gunnarsson, 2001), France (Dizerbo & Herpe, 2007), The Netherlands (Stegenga & Mol, 1983), Norway (Jaasund, 1951, 1965), Sweden (Kylin, 1947)], Germany [Schories *et al.*, 1997; as *Ulonema rhizophorum* (Foslie) Sauvageau] and the north-western Atlantic Ocean (Mathieson & Hehre, 1986).

Six species encompassing four genera of the myrionematoids have previously been recorded to occur in Turkey (Taşkın *et al.*, 2008): *Microspongium globosum* Reinke, *Myrionema furcatum* Jaasund, *M. orbiculare* J. Agardh, *M. strangulans* Greville, *Protectocarpus speciosus* (Børgesen) Kornmann and *Compsonea saxicola* (Kuckuck) Kuckuck. This paper reports the first record of a seventh species, namely, *Ulonema rhizophorum*, in Turkey. *U. rhizophorum* was probably introduced into the Sea of Marmara (Turkey) by aquaculture or ballast water. The Dardanelles is a very important strait in the Mediterranean Sea; a transition zone for ships travelling

to the Black Sea. Recently, 33 taxa - at specific and infra-specific level - of alien marine macrophytes were reported to occur on the coasts of Turkey (Taşkın *et al.*, 2011a; Taşkın, 2012). However, the species could be native and have been overlooked in previous studies because of its close resemblance with *Myrionema strangulans*.

### Materials and Methods

*Ulonema rhizophorum* was collected in the midlittoral zone, as an epiphyte on the green alga *Ulva* sp. from the Dardanelles (40°01'03"N; 26°19'17"E), Sea of Marmara, Turkey, and was preserved in 4% formalin in seawater. The identification was made on the basis of Foslie's (1894) and Fletcher's (1987) accounts. The material was studied using light microscopy (Nikon SE), and photographs were taken using a Nikon P5100. Magellan SporTrak Color. A GPS device was used to measure the co-ordinates of the collection site. Voucher material was deposited at the Department of Biology of Celal Bayar University, Manisa, Turkey.

### Results

*Ulonema rhizophorum* Foslie 1894: 132, pl. III, figs 11-17.

Type locality: Lyngøy, Tromsø, Norway (Foslie, 1894).

Thalli were epiphytic on the green alga *Ulva* sp., forming light brown circular spots up to 1mm in diameter (Fig. 1). In a squash preparation, the thallus consists of a monostromatic basal layer of cells, with basal

cells measuring 10-20µm long and 7-8µm wide; erect filaments simple or rarely branched, uniseriate, 60-80µm long (Figs 2 & 3); cells of the erect filaments 15-20µm long, 5-6µm wide, each one contains one or two plate-like chloroplasts; downwardly produced rhizoids from the basal system present, single or multicellular (Fig. 2); phaeophycean hairs present, arising from the basal layer; unilocular sporangia common, spherical to pyriform, measuring 20-25 x 35-45µm, borne directly from the basal cells, sessile or on one-celled stalks at the base of the paraphyses (Figs 2 & 3); plurilocular sporangia were not observed in our plants.

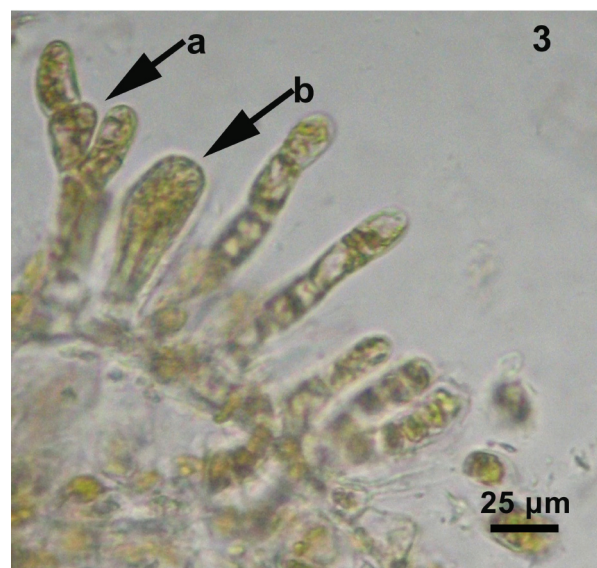
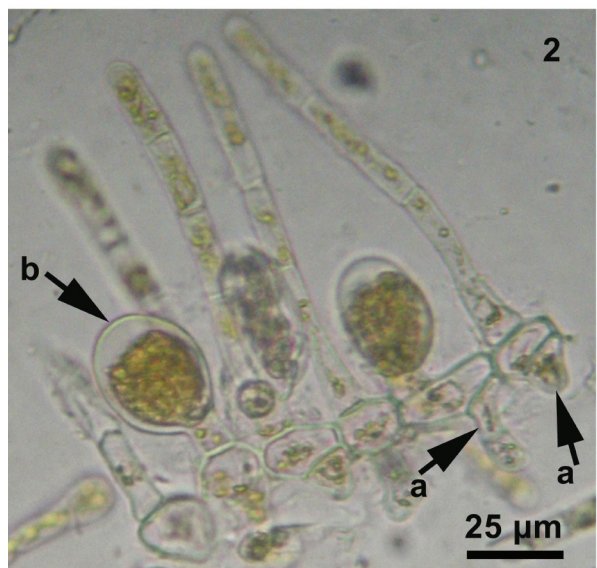
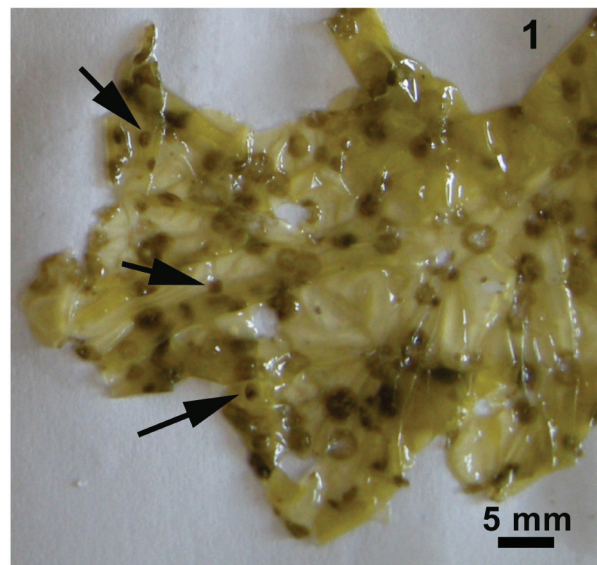
This species was collected from the Dardanelles (40°01'03"N; 26°19'17"E), Sea of Marmara, Turkey in March 2012; water temperature was 13°C and salinity of 25‰. The collection site is characterized partially by both sandy and stony bottoms. Other algal species that were present at the collection site were: *Ceramium ciliatum* (J. Ellis) Ducluzeau, *Cladophora* spp., *Codium fragile* (Suringar) Hariot subsp. *fragile*, *Colpomenia sinuosa* (Mertens ex Roth) Derbès & Solier, *Corallina elongata* J. Ellis & Solander, *Dictyota dichotoma* (Hudson) J.V. Lamouroux, *Ectocarpus siliculosus* (Dillwyn) Lyngbye, *Feldmannia irregularis* (Kützinger) G. Hamel, *Giraudia sphaclarioides* Derbès & Solier, *Gracilaria gracilis* (Stackhouse) Steentoft, Irvine & Farnham, *Halopteris scoparia* (L.) Sauvageau, *Halothrix lumbricalis* (Kützinger) Reinke, *Laurencia obtusa* (Hudson) J.V. Lamouroux, *Myrionema strangulans* Greville, *Padina pavonica* (L.) Thivy, *Punctaria latifolia* Greville, *Scytosiphon lomentaria* (Lyngbye) Link, *Striaria attenuata* (Greville) Greville, and *Ulva* spp., as well as the seagrasses *Posidonia oceanica* (L.) Delile and *Zostera* sp.

## Discussion

Turkish plants identified here as *Ulonema rhizophorum* strongly resemble the figures of the species provided by Foslie (1894, Figs 11-17). Plurilocular sporangia were not observed by Foslie (1894), but later Sauvageau (1897), Hamel (1935) and Fletcher (1987) showed that plurilocular sporangia are present in this species. However, they were absent in our specimens.

*Ulonema rhizophorum* has been assigned to the Myrionemataceae (Sauvageau, 1897; Hamel, 1935; Fletcher, 1987). Recently, this species was assigned to the Chordariaceae with other myrionematoids (*Myrionema* Greville, *Microspongium* Reinke) (Guiry & Guiry, 2012).

The genus *Ulonema* shows similarities to the other myrionematoid genera *Myrionema* and *Microspongium*, but differs from those in having irregularly spreading basal filaments and downwardly produced branched rhizoidal filaments from the basal system (Foslie, 1894; Sauvageau, 1897; Fletcher, 1987; Taşkın *et al.*, 2006). More



**Figs 1-3:** *Ulonema rhizophorum*. Fig. 1. Habit (arrows), on *Ulva* sp. Fig. 2. Monostromatic basal layer, downwardly produced rhizoids (a) and unilocular sporangia (b). Fig. 3. Erect branched filament (a) and unilocular sporangia (b).

specifically, *U. rhizophorum* is similar to *Myrionema strangulans* (Fig. 4) as regards the monostromatic basal layer and shape of unilocular sporangia and erect filaments, but it differs from that species by its downwardly produced rhizoidal filaments from the basal cells, the rarely branched erect filaments (erect filaments are simple in *M. strangulans*) and by the uniseriate plurilocular sporangia (occasionally biseriata in *M. strangulans*).

Some authors have further discussed the possible conspecificity between *Ulonema rhizophorum* and *Myrionema strangulans* (Fletcher, 1987). There is a need for further experimental and culture studies to test this possibility. Loiseaux (1972) showed that both microscopic discoid thalli and macroscopic filamentous thalli occur in the life history of *M. strangulans*. Pedersen (1984) included *Myrionema*-like microthalli in the life history of Giraudiaceae and Chordariaceae. Recently, *Myrionema*-like microthalli of *Cladosiphon* were observed in nature from Turkey by Taşkın *et al.* (2011b).

Jaasund (1951) recognized *Ulonema rhizophorum* from Norway, and he claimed that “it appears desirable to keep it as separate species until it has been cultured”. Jaasund (1951) described two new species, *Myrionema irregulare* Jaasund, which grew on the surface of *Scytosiphon lomentaria* (Lyngbye) Link, and *Myrionema furcatum* Jaasund, which grew on the surface of *Dumontia incrassata* (O.F. Müller) J.V. Lamouroux [= *Dumontia contorta* (S.G. Gmelin) Ruprecht]. *M. irregulare* was considered as a stage of *Myriotrichia filiformis* Harvey (= *Myriotrichia clavaeformis* Harvey) by Athanasiadis (1996). *Myrionema furcatum* differs from *Ulonema rhizophorum* in plurilocular sporangia [on the upper part of the erect filaments, biseriata or uniseriate and furcate in *M. furcatum* (Jaasund, 1951), sessile or shortly stalked on basal layer, uniseriate and simple in *U. rhizophorum* (Fletcher, 1987)], by habit (*M. furcatum* exhibits a papillous under-side of *Dumontia*, while *U. rhizophorum* develops real rhizoids), and by the cell size of the erect filaments [8-12µm wide in *M. furcatum* (Jaasund, 1951), 6-9µm wide in *U. rhizophorum* (Foslie, 1894)]. Jaasund (1951) reported that the shape of the plurilocular sporangia of *M. furcatum* is similar to that of *Streblonema fasciculatum* Thuret. The plurilocular sporangia were abundant and the unilocular sporangia were very rare in *M. furcatum*, while unilocular sporangia were abundant in *U. rhizophorum* (Jaasund, 1965). Taşkın *et al.* (2008) reported that *M. furcatum* should be confirmed in Turkey and the Mediterranean Sea.

Molecular analysis and culture studies comparing the Mediterranean material of *Ulonema* and the Atlantic species should be carried out for progress. *Ulonema rhizophorum* and *Myrionema strangulans* also need experimental and culture studies to investigate the microthalli of *Cladosiphon*.

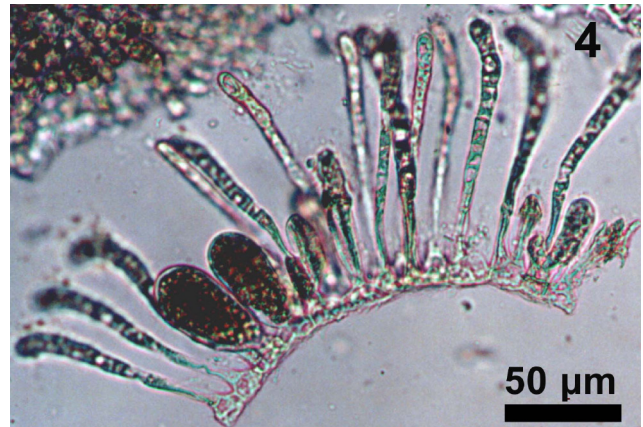


Fig. 4: *Myrionema strangulans*, monostromatic basal layer, simple filaments and unilocular sporangia.

#### Key to the Mediterranean Myrionematoids related with *Ulonema*:

1. Basal layer monostromatic or distromatic ..... *Chilionema*
1. Basal layer monostromatic ..... 2
2. Presence of irregularly spreading basal filaments and downwardly produced branched rhizoidal filaments from the basal system ..... *Ulonema*
2. Lack of irregularly spreading basal filaments and downwardly produced branched rhizoidal filaments from the basal system ..... 3
3. The erect filaments simple or pseudodichotomously branched ..... *Microspongium*
3. The erect filaments simple or secundly branched ..... *Myrionema*

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