

## ULVA SCANDINAVICA BLIDING, (CHLOROPHYTA): A NEW SPECIES FOR THE ADRIATIC SEA

Claudio BATTELLI

A. Sema Secondary School, SI-6320 Portorož, Med vrtovi 8 and  
Faculty of Education Ljubljana - Department of Koper, SI-6000 Koper, Cankarjeva 5

Ian H. TAN

Royal Botanic Garden Edinburgh, Edinburgh EH3 5LR, Scotland, UK, 20A Inverleith Row

### ABSTRACT

*This article deals with the very first report on the occurrence of *Ulva scandinavica* Bliding, in the Adriatic Sea. A general description of this species is given, as well as its basic morphological and anatomical features its manner of reproduction, its geographical distribution and its habitats in the coastal waters of Slovenia.*

**Key words:** *Ulva scandinavica*, genus *Ulva*, Chlorophyta, occurrence, Adriatic Sea

### INTRODUCTION

In september 1998, the green alga *Ulva scandinavica* Bliding was recorded for the very first time in the coastal waters of Slovenia (Gulf of Trieste).

The genus *Ulva* (Linnaeus) Thuret belongs, together with the genera *Capsosiphon* Gobi and *Enteromorpha* Link, to the family Ulvaceae Lamour. ex Dumort. (Gallardo *et al.*, 1993).

*Ulva* thalli are wide, flat, lobed, of grass green colour, and composed of two adhered layers of parenchymal cells. *Ulva* is also commonly known as "sea lettuce" world wide. They occur, attached to the substratum, mainly in the lower midlittoral and in the upper infralittoral; they may also occur as epiphytes on other algae, or unattached (benthopleustophitically) in the upper infralittoral to a depth of about 3 metres (Rizzi-Longo & Giaccone, 1974; Vuković, 1980, 1984a, b).

In protected areas (particularly bays) and polluted waters (e.g. ports) their thalli can grow up to 1 m in length, while in more exposed and cleaner waters they are usually smaller.

The most characteristic feature of *Ulva* species is that their development begins with a single-serial threadlike thallus. The thallus then becomes multi-serial and eventually grows into hollow cylinder (tubelike). The walls of a young (a few millimetres long thallus) grow

closely together resulting in a flat 2-layered thick thallus. The cells have only one nucleus and one hood-like parietal chloroplast with one or more pyrenoids. In the rhizoidal part of the thallus the cells are multinucleate. Asexually, they reproduce with zoospores; sexually, they reproduce with sexual cells (gametes). Vegetative fragmentation also occurs and results in freeliving individuals. Their life cycle is mostly diplohaplontic (digenetic) and isomorphic. Diploid sporophyte is formed from a zygote, and sporangia are developed from vegetative cells. After reductive division, zoospores with four flagella are produced. From these zoospores, haploid gametophytes develop. On the margins of the gametophytic thallus, gametes are formed. These gametes are smaller than the zoospores, and they are equipped with two flagella. Male gametes are smaller than females ones. Reproduction can be also parthenogenetic, where the gametes can develop directly into haploid thalli. All the vegetative cells, except the basal ones, can transform into reproductive cells. They are attached to the substratum with a small fastening holdfast. This holdfast is perennial and produces a new thallus each spring. *Ulva* is found all over the world from arctic to tropical regions, including the Adriatic, Mediterranean and Black Seas, the Atlantic, Indian and Pacific ocean (Bliding, 1968; Van den Hoek *et al.*, 1995).

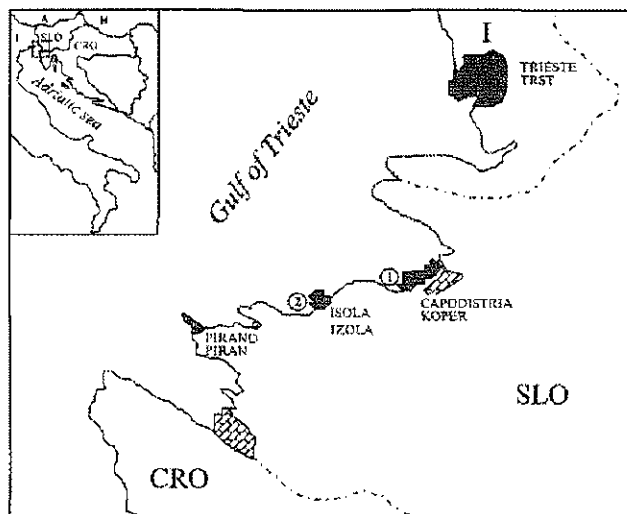


Fig. 1: Study area with sampling stations.

Sl. 1: Obravnavano območje z vzorčevalnimi postajama.

### COLLECTION AND OBSERVATION

Samples were collected from the coastal waters of Slovenia (Semedela and St. Simon Bays) in the lower midlittoral and in the upper infralittoral to a depth of about 3 metres (Fig. 1).

Samples were kept as dry as herbarium specimens and chemically treated as wet preparations in 3-5% methanal (formalin) solution in seawater.

The alga was identified according to the criteria by Bliding (1968) and Rizzi-Longo & Giaccone (1974). These criteria include 1) the thickness of the different parts of the thallus (particularly the margins in the upper part of the thallus and the basal part immediately above the rhizoid), 2) arrangement of the cells on the surface, 3) jagged protuberances on the margins, 4) size and shape of the cells, and 5) number of pyrenoids in the chloroplast. The collected samples were further confirmed as *U. scandinavica* by comparisons of their DNA sequences (nuclear ribosomal internal transcribed spacers) with those of other *Ulva* spp. from all over the world.

### DESCRIPTION OF THE SPECIES

*Ulva scandinavica* (Lat. *Ulva*, sedge; *scandinavica*, Scandinavian) was first described as a new species in 1968 by Bliding. It had been collected already in 1959 in Sweden and in 1962 in Norway. Its thallus is flat and lobed. Its size normally varies from 10 to 30 cm and is either dark or light green. The upper part of the thallus is about 50 µm thick, its middle part is about 70 µm, and its basal part is about 100 µm. Its margin has a number of jagged protuberances which, however, are not branched out as in the related species *U. rigida* (Fig. 2). The cells

are, in most cases, distributed irregularly. It is characteristic for this species that areas with regularly arranged cells alternate with small areas with cells arranged in rows (Fig. 3a). As far as their cell shape is concerned, they are either polygonal or spherical. The cells contain one chloroplast each along the wall. The number of pyrenoids per cell normally varies from 3 to 6 (Fig. 3b). There is no metagenesis in this species. The algae reproduce with biflagellated zoospores (Bliding, 1968).

### DISCUSSION AND CONCLUSIONS

According to Gallardo *et al.* (1993), 10 species of *Ulva* occur in the Mediterranean Sea. Of these, 5 occur in the Adriatic, i.e. *U. curvata* (Kützinger) De Toni; *U. fasciata* Delile; *U. olivascens* Dangeard, 1961; *U. rigida* C. Agardh, 1822, and *U. rotundata* Bliding, 1968 (Giaccone, 1978; Gallardo *et al.*, 1993; Špan & Antolčić, 1994; Špan *et al.*, 1996).

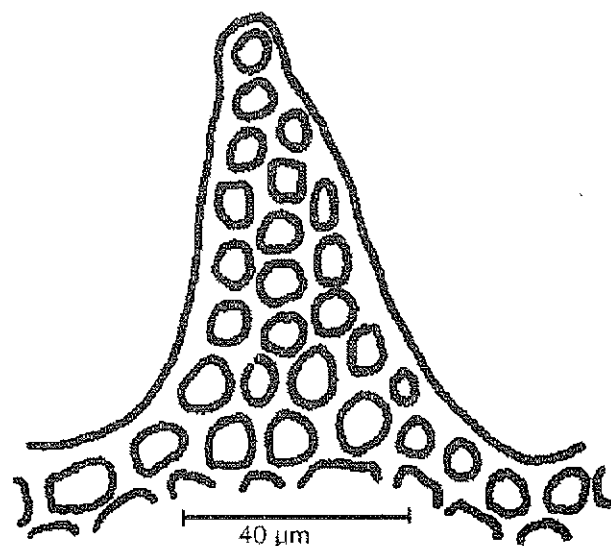
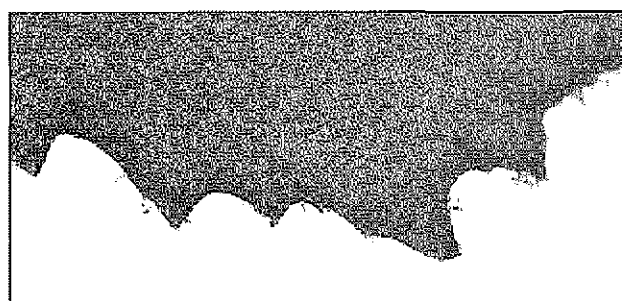


Fig. 2: Toothlike protuberance on the thallus margin (Photo: M. Richter).

Sl. 2: Nazobčan izrastek na robu stielke (Foto: M. Richter).

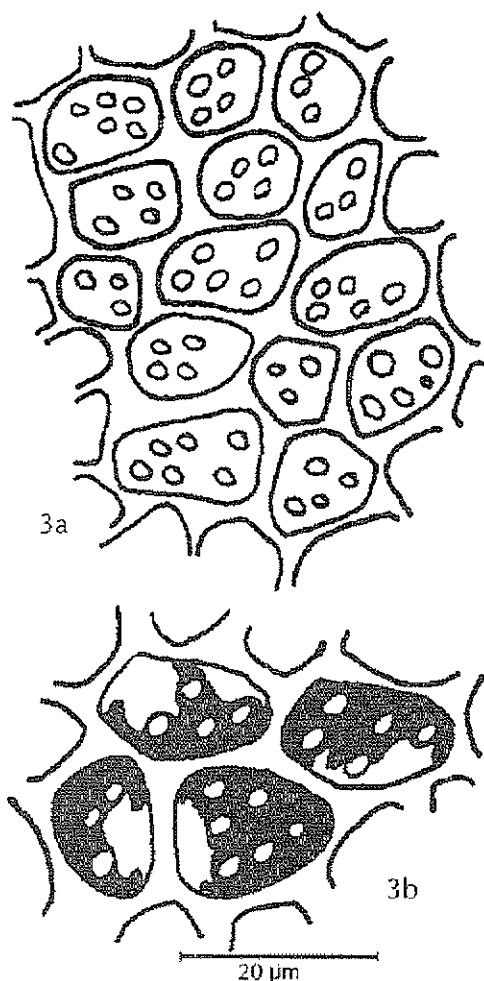


Fig. 3: Cell arrangement (a) and the chloroplast structure with pyrenoids (b).

Sl. 3: Razporeditev celic na površini steljke (a) in struktura kloroplastov s pirenoidi (b).

As far as the Mediterranean Sea is concerned, *U. scandinavica* was recorded only on the west and south coast of Italy (Cormaci *et al.*, 1985; Giaccone *et al.*, 1985; Cecere, 1990; Cecere *et al.*, 1991a, b). Prior to 1998 there have been no data on its occurrence in the Adriatic.

Among the Slovene scientists who have dealt with the algal flora of our coastal waters and prepared its checklist are: Matjašič & Štirn (1975), Vuković (1980, 1981, 1982, 1984a, b), Bussani & Vuković (1987) and Munda (1992, 1993). According to them the species *U. rigida* occurs as the only representative of the genus *Ulva* in the Slovenian coastal sea. Faganeli *et al.* (1986) have on the basis of carbon ( $\delta^{13}\text{C}$ ) and hydrogen ( $\delta\text{D}$ ) isotope measurements in *Ulva rigida* reached a conclusion that two groups exist in our sea, i.e. *Ulva A* and *Ulva B*. However, there is no mention in their work about which particular species from the genus *Ulva* constitute these two groups.

The Italian algologist Giaccone thinks (*pers. comm.*) that the occurrence of *U. scandinavica* in the Adriatic Sea is probably the result of "meridionalisation", i.e. shift of many algal species from the southern part of the Mediterranean Sea towards the north, in this case the Adriatic Sea.

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### *ULVA SCANDINAVICA* BLIDING, (CHLOROPHYTA): NOVA VRSTA V JADRANSKEM MORJU

Claudio BATTELLI

Gimnazija A. Sema, SI-6320 Portorož, Med vrtovi 8 in  
Pedagoška Fakulteta Univerze v Ljubljani, - enota Koper, SI-6000 Koper, Cankarjeva 5

Ian H. TAN

Royal Botanic Garden Edinburgh, Edinburgh EH3 5LR, Scotland, UK, 20A Inverleith Row

#### POVZETEK

V članku obravnavava pojavljanje nove vrste za Jadransko morje iz rodu *Ulva* (Linnaeus) Thuret, to je *Ulva scandinavica* Bliding. Vzorce sva nabrala v spodnjem mediolitoralu in v zgornjem infralitoralu v slovenskem obalnem morju (Semedelski in Simonov zaliv). Shranjeni so kot mokri preparati v 4-5% metanalu (formalinu) in kot suhi

preparati v lastnem algariju. V delu podajava splošne morfološke, razmnoževalne in ekološke značilnosti rodu *Ulva* in podroben opis vrste *U. scandinavica*. Obravnavava predvsem tiste morfološke znake, ki so osnova za določanje. Ti znaki so naslednji: premer bazalnega dela, razporeditev celic na površini steljke, število pirenoidov v kloroplastih ter oblika izrastkov na robu steljke. Opis je obogaten z risbami. Risbe so shematične; njihov namen je predstaviti osnovne posebnosti, s katerimi lažje prepoznamo obravnavano vrsto.

**Ključne besede:** *Ulva scandinavica*, rod *Ulva*, Chlorophyta, pojavljanje, Jadransko morje

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