

THE DISTRIBUTION PLAN OF MACROALGAE DURING THE SUMMER OF 2009 ON THE ROMANIAN BLACK SEA SHORE

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ABSTRACT

This paper presents the state of the macroalgae from the Romanian Black Sea shore during the summer 2009. The collected macroalgae samples were analysed from the qualitative and quantitative point of view. As result of the qualitative analysis the marine eelgrass *Zostera nana* has been identified, a species that decreased its habitat in the past few years and is now considered a rare presence along the Romanian sea side.

KEY WORDS: Black Sea, Romanian seashore, macroalgae, habitat, *Cystoseira barbata*.

INTRODUCTION

Macrophytes play an important ecological role in shallow marine waters. They are cleaning factors for nutrients and heavy metals, substrate and shelter for epiphytic flora and associated fauna, nutrition source for various invertebrates and fish (ABAZA *et al.*, 2006). The development of the marine flora is influenced by a series of factors: the existence of a hard rocky bottom, a favorable water transparency degree, the luminosity gradient, hidrodinamism, temperature, salinity, and water chemistry.

On the Romanian Black Sea shore, the benthic algal flora has endured a gradual decline, due to natural and anthropomorphic factors that have disturbed the quality of the marine environment (hard frost, silting of the rocky bottom by suspended matter, lowering of light energy penetration through the water column due to the mentioned material, increase of eutrophication) (BOLOGA, 1989). Nowadays, this qualitative impoverishment of the

macroalgal flora is balanced by the ability of a small number of opportunistic species to develop noticeable biomasses.

MATERIALS AND METHOD

The macroalgae sampling took place between July and September 2009, from natural rocky bottom (Fig. 1). The studied area of the Romanian Black Sea coast followed following stations and profiles between Năvodari and Vama Veche: Năvodari/0.5m, Cazino Constantza (0.2m, 2m, 3m, 4m and 5m), Eforie Nord (1m and 3m), Eforie Sud (0.3m, 1m, 3m, 5m), Tuzla (1m, 1.5m, 3m, 5m), Costinesti (from rocks on the shore, 0.3m, 1m, 3m and 5m), Mangalia (0.3m, 1m, 3m and 5m), 2 Mai (0.2m, 0.3m, 0.5m, 1m, 3m, 5m) and Vama Veche (1m, 3m and 5m).

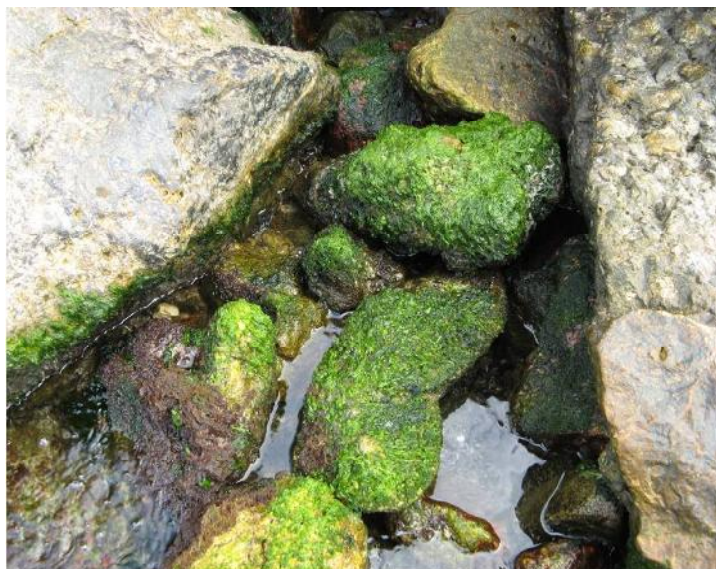


Fig. 1 - Rocky bottom covered with algae at Eforie Sud

Macroalgae samples have been collected from various depths between 0 and 5 meters, using a scraper and a frame of 20 cm each side. All samples have been brought fresh into the laboratory, in refrigeration box, in order to avoid their alteration caused by high temperatures, during the warm season, in plastic bags, labeled, mentioning place and time of collection. The fresh macroalgae samples were washed for sediments and associated fauna and identified to species level, macroscopically where possible and by means of algological handbooks, scientific literature and microscope for more difficult genera such as *Enteromorpha*, *Cladophora* and *Ceramium*. Representative

individuals were kept for herbarium collection. These analyses provide a macroalgae species list identified along the Romanian seashore during the summer 2009.

The fresh macroalgae samples were also analysed from the quantitative point of view, wet biomass was determined by weighing the fresh material, after algae were previously rested on filter paper to reduce humidity. Fresh biomass results were expressed in g/m².

RESULTS AND DISCUSSION

As result of the qualitative analysis, 12 macroalgae species have been identified during the summer 2009: 6 species belonging to phylum Chlorophyta, one species (*Cystoseira barbata*) to phylum Phaeophyta, 4 species to phylum Rhodophyta, and one marine eelgrass (*Zostera nana*) (Table 1).

Table 1 - Macroalgae species list identified during the summer 2009

Phyllum	Species
CHLOROPHYTA	<i>Ulva lactuca</i> <i>Enteromorpha intestinalis</i> <i>Enteromorpha flexuosa</i> <i>Enteromorpha compressa</i> <i>Cladophora vagabunda</i> <i>Cladophora sericea</i>
PHAEOPHYTA	<i>Cystoseira barbata</i>
RHODOPHYTA	<i>Ceramium elegans</i> <i>Ceramium rubrum</i> <i>Callithamnion corymbosum</i> <i>Polysiphonia denudata</i>
PHANEROGAMA	<i>Zostera nana</i>

During the summer 2009, both qualitative (Fig. 2) and quantitative (Fig. 3) dominance of green algae has been noticed, followed by the red algae, by some opportunistic species able to develop noticeable wet biomasses at depths between 0 and 5 meters.

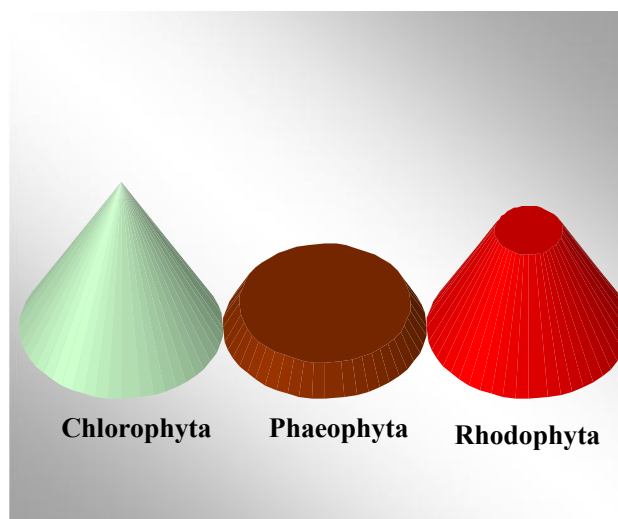


Fig. 2 - Variation of macroalgae diversity along the Romanian seaside during the summer 2009

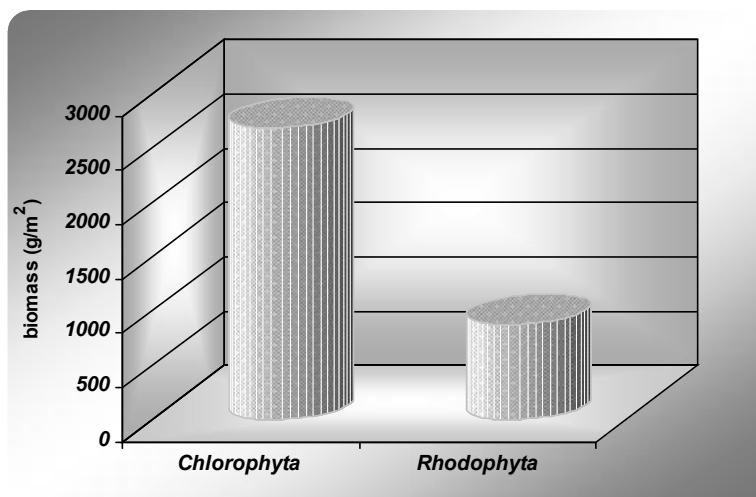


Fig. 3 – The variation of the mean wet biomass for the quantitatively dominant phyla along the Romanian seashore between July and September 2009

The fact that most species belong to the green algae is possible because of eutrophication which generally harms marine life, but also favours a reduced number of resistant genera which do proliferate at present. The red algae are the most sensitive to pollution: as a matter of fact about 30 species are missing nowadays compared to 1977; they are also the most numerous on the list of disappeared, extinct or rare species (BOLOGA and SAVA, 2006).

Among the red algae, *Ceramium* genera (*C. elegans* and *C. rubrum*), together with *Callithamnion corymbosum* and *Polysiphonia denudata* (identified near Constantza city, on Pescarie beach) had a continuous presence and developed noticeable biomasses during the summer 2009. The biomasses of *Callithamnion corymbosum* and *Polysiphonia denudata* were much lower compared with those developed by *Ceramium*. High biomasses of red algae are almost entirely owed to species of *Ceramium*, found on rocky bottom. This can be explained by the fact that *Ceramium* species have a high capacity of both asexual and sexual reproduction, so they can easily and quickly populate the rocky bottoms, sometimes even completely (SAVA and BOLOGA, 2008).

During the summer 2009, *Enteromorpha* and *Cladophora* genera thrived, together with *Ceramium* sp., from the Rhodophyceae, and these genera create the present physiognomy of the benthic vegetation from the Romanian coast.

At the beginning of July the dominant species were *Ulva lactuca* and *Ceramium elegans* (Fig. 5), opportunistic species able to develop important fresh biomasses, over 1,000 g/m²: *U. lactuca* – 1,537.5 g/m² at Cazino/3m, *C. elegans* – 1,320 g/m² at Costinesti/5m, a maximum of 2,027.5 g/m², at Mangalia/3m. Also, at Mangalia at a depth of 5 meters, *C. elegans* had a high wet biomass of approximate 1,000 grams (970 g/m²).

At the end of July, the benthic algal flora is dominated by the following species: *Ulva lactuca* (Fig. 4), *Enteromorpha flexuosa*, *E. intestinalis*. In future, *E. flexuosa* could have economic importance, recent research showing that this species presents antibacterial activity against *Mycobacterium tuberculosis* (the agent of tuberculosis) (SAVA, 2006). High biomasses were developed by the species belonging to phylum Chlorophyta, approaching and exceeding 1,000 grams: *Ulva lactuca* - 945 g/m², at Eforie Sud/5m; *Enteromorpha flexuosa* – 1,425 g/m², at Costinesti; *Enteromorpha* sp. (*E. intestinalis* and *E. compressa*) developed a wet biomass of 1,280 g/m², at Mangalia/0.3m; *U. lactuca* – 1,347.5 g/m², at Vama Veche/1m. At the end of July, among the red algae, *Ceramium rubrum* had a fresh biomass of 500 g/m² at 2 Mai/0.3m, with closer values in the northern part of the Romanian seashore, at Năvodari (305 g/m²) and Cazino (352.5 g/m²).

In August, the species with the highest biomasses also belonged to phylum Chlorophyta, respectively *Ulva lactuca* (932.5 g/m² - Vama Veche/1m, 1,180 g/m² - Vama Veche/3m, 1,377.5 g/m² - Vama Veche/5m), *Enteromorpha intestinalis* (1,040 g/m² - Costinesti/3m), *Cladophora vagabunda*, with a biomass of approximate 500 g/m² (492.5 g/m²) at Vama Veche, at a depth of one meter. Among the red algae, at the end of August, a

notable fresh biomass was the one developed by *Ceramium* genera - 360 g/m², at Vama Veche/1m.



Fig. 4 – Green algae (*Ulva lactuca*) at Eforie Sud in July, 2009

Also in August, at Mangalia/3m, the marine eelgrass *Zostera nana* was identified. Considerable diminution of phanerogames *Z. marina* and *Z. nana* was also observed in former decades. In the last 30 years the standing stock of eelgrass has decreased tenfold in shallow waters. Eelgrass served as a favourable biotope for many species of invertebrates and fish. The main reason for the degradation of *Zostera* communities was the mobilizing of silt when dredging in the coastal zone (BOLOGA and SAVA, 2006).

In September, a noticeable decrease of the wet biomass value was observed, the highest values being also those developed by the green algae: *Enteromorpha intestinalis* - 425 g/m² at Eforie Nord/3m; other species of *Enteromorpha* genera - aproximative 410 g/m² at Eforie Nord/1m; *Ulva lactuca* - 240 g/m² at Eforie Sud/1m. *Ceramium rubrum* developed a maximum of 287.5 g/m² at Tuzla/3m.

Cladophora sericea and *C. vagabunda* are species with a high ecological amplitude, euriterme and eurihaline, which belong among the opportunistic algae from the Romanian seashore, able to thrive in eutrophic waters. *Enteromorpha intestinalis*, *E. flexuosa*, *E. compressa* are also considered opportunistic species, common, with a high capacity to develop successive generations over a year, able to support contaminated and polluted water areas (SAVA, 2006).

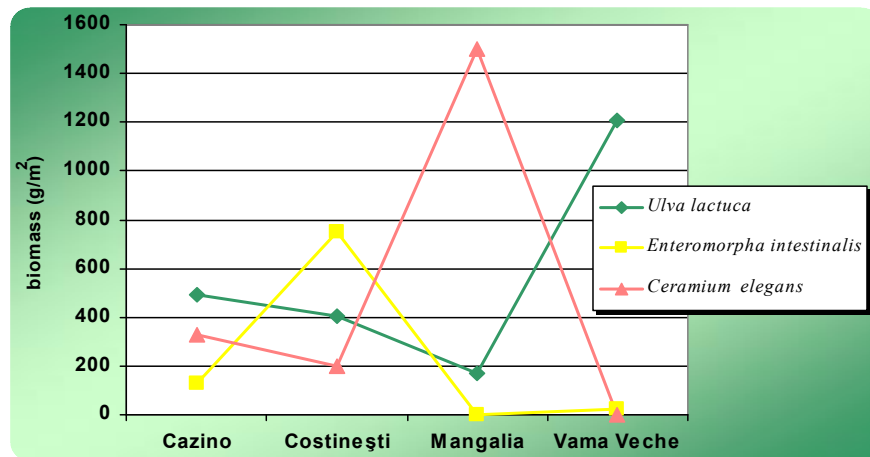


Fig. 5 - The variation of the mean wet biomass for the quantitatively dominant species at the Romanian seashore between July and September 2009

The only representative belonging to phylum Phaeophyta found in the summer 2009 was the perennial species *Cystoseira barbata* (Fig. 6).



Fig. 6 - *Cystoseira barbata* at Mangalia/1m in July, 2009

Cystoseira is ranked as key species for the Romanian Black Sea shore, serving as substrate for flora and fauna, shelter, feeding and reproductive site for fish, thus considerably influencing benthic communities (SBURLEA and BOLOGA, 2006). The joint action of the two factors – that are the ice packs and the extremely low temperature of the sea prevailing in the winter of 1972,

had a damaging effect on *Cystoseira* populations, whose stock was reduced by some 80%. Moreover, it can be assumed that the same actors had strong negative consequences on the associated fauna and flora from *Cystoseira* – *Mytilus* subcoenosis (VASILIU and MÜLLER, 1973).

The firm and elastic thallus of *Cystoseira* and its complicated branched structure represents an ideal place for the epiphytic algae, both the photophyle species (bringing them closer to the water surface) as well as sciaphyle ones, that develop in the shadow of *Cystoseira* thalli (MÜLLER *et al.*, 1969).

The drastical decline of the *Cystoseira* community led to the disappearance of some species that in the past used to form the epiphytic associated flora, very important for the macroalgal flora along the Romanian seashore: *Kylinia* genera, *Cruoriella dubyi*, *Dermatolithon cystoseirae* – from the Rhodophyceae, *Feldmannia irregularis*, *Sphacellaria cirrhosa* f. *irregularis*, *Cladostephus verticillatus*, *Corynophlaea umbellata*, *Desmotrichum undulatum*, *Stilophora rhizoides* – from the Phaeophyceae (BAVARU, 1972). The epiphytes play an important role, their presence creates a higher complexity to the algal substrate. This is an essential condition for the attaching of the diatoms epybiosis and for the refuge of the vagile, tendril or fix fauna (MÜLLER *et al.*, 1969).

During the summer 2009, *Cystoseira barbata* was observed and collected in the southern part of the Romanian seashore. *C. barbata* was encountered as thick bunches from Mangalia to Vama Veche (Fig. 7), able to develop high and strongly epiphyted wet biomasses. *C. barbata* maintains its regeneration trend also noticed in the last five years.



Fig. 7 - *Cystoseira barbata* bunches at Mangalia/0.3 m in August, 2009

At the end of July, the perennial species *C. barbata* was collected at Mangalia/0.3 m. At this station, this species presented a high wet biomass of 3,877.5 g/m² and was strongly epiphyted by the species *Enteromorpha intestinalis*, *Cladophora sericea*, *Ceramium elegans*, *C. rubrum*. In August, at the same station, Mangalia, but at a depth of one meter, *Cystoseira barbata* developed a higher fresh biomass (5,865 g/m²) and presented the following epiphytes: *Enteromorpha intestinalis*, *E. flexuosa*, *E. compressa*, *Cladophora vagabunda*, *Ceramium elegans*, *C. rubrum* at Costinesti, *Cystoseira barbata* was also noticed, but with a lower biomass value.

Cystoseira is a perennial alga with constant yield to marine ecosystem biological productivity. The decline of the *Cystoseira* community causes a loss of associated flora and fauna, reproduction, feeding and sheltering sites of various fish species, considerably affecting the marine biodiversity on the whole (SBURLEA and BOLOGA, 2006).

The summer season represents the peak period of macroalgae development and because of the storms, strong winds and waves, along the Romanian seashore important macroalgal deposits were during the summer 2009 (Fig. 8), fact also noticed in the last few years. As a result of field observations, the following species were identified in macroalgae stocks: *Ulva lactuca*, *Enteromorpha* sp. *Cladophora* sp. (Chlorophyta), *Ceramium rubrum*, *C. elegans*, *Callithamnion corymbosum* (Rhodophyta). In macroalgal deposits, *Ulva lactuca* was the dominant species, followed by genera *Ceramium* and *Enteromorpha*.



Fig. 8 - Macroalgal deposits at Eforie Sud in July, 2009

CONCLUSIONS

The macroalgal vegetation in the summer 2009 is characterized by an appearance of uniformity. The dominant species belonged to phylum Chlorophyta, being opportunistic species, with short life cycle, able to develop noticeable biomasses, easily adaptable to present environmental conditions characterized by eutrophic waters.

A positive sign is the regeneration trend of the perennial alga *Cystoseira barbata*, encountered as thick bunches at Mangalia with a high epiphyte degree.

At Mangalia, in August, the presence of the marine eelgrass *Zostera nana* has been noticed.

During the summer 2009, three perennial species have been identified: *Cystoseira barbata* (Phaeophyta), *Polysiphonia denudata* (Rhodophyta) and *Zostera nana* (Phanerogama).

The southern part of the Romanian seashore was characterized in the summer 2009 by a higher specific biodiversity, compared with the rest of the seashore.

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