

# THE SPREAD OF THE INVASIVE VARIETY OF *CAULERPA RACEMOSA* IN THE ADRIATIC SEA

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## Abstract

By the end of 2003, *Caulerpa racemosa* had been discovered at 11 locations along the Croatian coast of the Adriatic Sea. Here we discuss the possible mechanisms and vectors of its long distance dispersal.

**Key-words:** *Caulerpa racemosa*, Adriatic Sea, dissemination

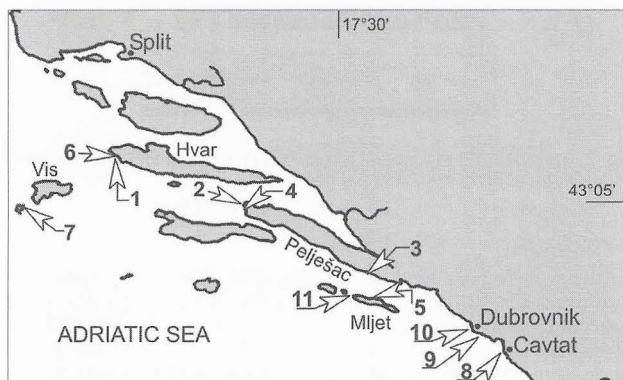
## Introduction

The first record of the invasive variety of *Caulerpa racemosa* (Forsskål) J. Agardh (Caulerpales, Chlorophyta) in the Mediterranean Sea was in 1990 in Tripoli (Libya). In the next 10 years it was found also in Tunis, Egypt, Cyprus, Turkey, Greece, Malta, Italy, France, Spain and Croatia (1). The vector of its introduction to the Mediterranean Sea as well as its phylogenetic relations are still unknown (2). Moreover there is still doubt about the vectors of its long distance dispersal.

The first report in the Adriatic Sea was in 2000 on the Pakleni archipelago (3). Here we present new data about its spread along the Croatian part of the Adriatic Sea, and discuss a possible mechanism of its long distance dispersal.

## Observation and Discussion

By the end of 2003, 11 distant stations of *Caulerpa racemosa* had been discovered (Fig. 1). The algae proliferates on rocky, sandy and muddy bottoms, in photophilic and sciaphilic communities, as well as in meadows of *Posidonia oceanica* (L.) Delile and *Cymodocea nodosa* (Ucria) Ascherson seagrass, and on sessile animals such as sponges. It grows from 0.5 to 50 m deep, with the densest colonies forming between depths of 2 and 30 m. The most dense colony was recorded on Pakleni Island at 7 m deep where the canopy contained 2600 m<sup>-2</sup> of total stolon length and nearly 27 000 fronds m<sup>-2</sup> (3).



**Fig. 1.** Stations of *Caulerpa racemosa* numbered by historical record: 1) Pakleni Islands, 2) Česminova Cove, 3) Marčuleti Bay, 4) Mirca, 5) Cape Pusti, 6) Vela Garaška Cove, 7) Mežuprat Cove, 8) Cavtat, 9) Dubrovnik – Cape Osti, 10) Dubrovnik, 11) Goli Islet.

Several mechanisms could be involved in the long distance dispersal of the algae throughout Adriatic Sea.

**Anchoring.** As is the case with *C. taxifolia*, it is likely that *C. racemosa* could be transported in boat anchor lockers. However, most of the infested stations in the Adriatic Sea are not suitable or common mooring places.

**Fishing nets.** The infestation in Mirca village was probably introduced by fishing nets from the significantly larger colony in Česminova Cove. The algae was observed in a small fishing harbour where fishermen clean their nets.

**Sexual reproduction.** There is no strong evidence that sexual reproduction in the Mediterranean Sea is successful. The only observation of the formation of both types of gametes was in Greece (4), but with a low percentage of gamete conjugation and formation of planozygotes. Moreover, the authors suspect that the observed zygotes

could have been an artefact of incomplete cleavage during gametogenesis, which at the time of observation looked like planozygotes.

**Fragmentation.** As with fragments of *C. taxifolia*, fragments of *C. racemosa* do not float. Due to its spherical ramuli, *C. racemosa* fragments sink relatively slowly, and may be more easily transported by currents. However, thalli of *C. racemosa* consist predominantly of the creeping stolon. In *C. taxifolia* the predominant part are fronds. Because of that, in the colonies of *C. taxifolia* there are usually numerous frond fragments, while in *C. racemosa* colonies fragments are rare.

**Epiphytes.** *Caulerpa racemosa* grows on other macro algae such as *Cystoseira* and *Sargassum* species. Detached *Cystoseira* or *Sargassum* thalli could float for several days and disperse attached *C. racemosa*.

**Propagules.** Spherical ramuli can separate from the fronds and act as propagules (5) that could be carried by currents and waves. It is not known how far the propagule could be carried.

**Ballast water.** In order for ballast water to be a vector of *C. racemosa* spread, there must be a floating phase of its lifecycle (fragments, propagule or zygotes). Although it is unknown if *C. racemosa* has this floating phase, ballast water is usually released offshore far away from the recorded colonies in the Adriatic Sea.

**Currents.** Most of the *C. racemosa* records in the Adriatic Sea correspond with the flow of the cyclonic Adriatic Current. The closest colony from where the algae could have originated and been driven by the cyclonic Adriatic Current was found in the Ionian Sea (Zakynthos Island) in 1993 (6). Unfortunately there is no information about *C. racemosa* along the Albanian coast which could support the theory of dispersal by currents.

## Conclusion

The geographic distribution of most of the *C. racemosa* colonies in the Adriatic Sea suggests that the cyclonic Adriatic Current could be the basic vector of *C. racemosa* long distance dispersal. The portion of the thallus that floats (fragments, propagules, zygotes or epiphytic transportation) remains unknown.

## References

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