

20-YEARS OCCURRENCE OF THE INVASIVE ALGA *CAULERPA RACEMOSA* VAR. *CYLINDRACEA* IN GREECE

Panayotis Panayotidis ^{1*} and Konstantinos Tsiamis ¹
¹ Hellenic Center for Marine Research - ppanag@hcmr.gr

Abstract

The green seaweed *Caulerpa racemosa* var. *cylindracea* is one of the most aggressive and broadly distributed invasive taxa in the Mediterranean Sea. In the present study, an updated range expansion of the alga is provided for the Greek coasts, based on literature sources and recent personal collections. Moreover, invasive events hitherto reported from the Greek coasts are also cited in detail

Keywords: *Algae, Aegean Sea, Alien species, Ionian Sea*

The green alga *Caulerpa racemosa* var. *cylindracea* (Sonder) Verlaque, Huisman & Boudouresque (Bryopsidales, Caulerpaceae) is one of the most notorious and aggressive invaders in the Mediterranean Sea ([1]). Since the last decade of the 20th century it has exhibited a spectacular expansion in the whole Mediterranean basin ([2]). Its presence has been related with negative impacts to the native benthic communities ([3]). Nevertheless, some positive impacts have been reported from deeper un-vegetated habitats (Relini, personal communication).

In the present study an updated range expansion of *C. racemosa* var. *cylindracea* (hereafter *C. racemosa*) along the Greek coasts is presented, based on both literature records and our recent collections (years 2007-2013), as part of one of the authors (KT) PhD thesis.

After 20 years since its first report from Greece (1993 in Zakynthos Island [4]), today *C. racemosa* var. *cylindracea* can be found in the majority of the Greek seas (Figure 1), presenting an extremely high dispersion rate, possibly related with translocation in short distances through shipping (anchoring and fishing equipment). In fact, an ongoing gradual expansion from the S. Aegean towards the N. Aegean Sea can be observed (Figure 1).

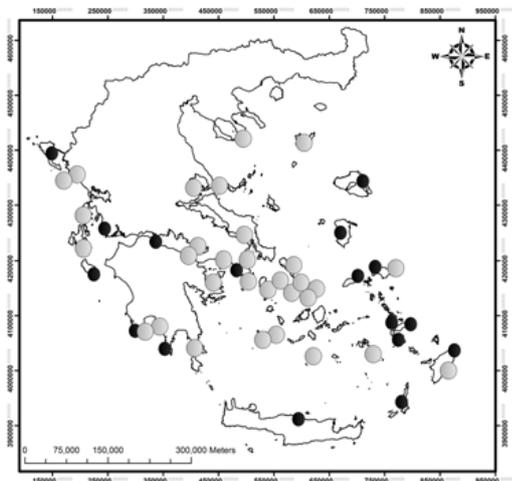


Fig. 1. Distribution records and range expansion of *Caulerpa racemosa* var. *cylindracea* in Greece. Both old (before 2007 - black dots) and new records (after 2007 - grey dots) are also given.

C. racemosa is present through the whole year, but higher abundances have been recorded during summer months. Holocarpic plants have been also recorded during summer. There is an intense polymorphism of the thallus depending on the depth and the hydrodynamism (vesicles distichously to spirally arranged on the erect fronds).

C. racemosa presents a broad ecological niche, since it has been found on both polluted and pristine sites, in hard and soft substrates, from surface level down to 70 m depth. However, more abundant populations have been found on rocky slopes with macroalgae and on dead *Posidonia* mattes ([5],

[6]).

Although *C. racemosa* has been found on numerous Greek coasts, only in 5 cases invasive behavior has been reported (Table 1). During our recent deep-sea exhibition using ROVs down to 120 m depth in the Greek Ionian Sea, vast meadows of *C. racemosa* lying between 40-70 m depth on sandy and muddy bottoms were detected (Table 1). This monopolization of the sea-bottom should be related with the empty ecological niches found on those depths and substrates. On the other hand, in shallower habitats, where competition from the native flora is much higher, *C. racemosa* abundance seems to be restricted in lower values.

Tab. 1. Invasive events of *Caulerpa racemosa* var. *cylindracea* in Greece

Site	Season	Depth	Substrate	Reference
Laganas, Zakynthos Isl.	Spring 2001	2-3 m	rocky / sandy	[7]
Agios Kosmas, Saronikos	June 2007	2 m	rocky	[8]
Chios Isl.	August 2009	0-10 m	rocky	[9]
Kalamaki, Korithiakos	July 2012	30-40 m	sandy	present study
Argostoli, Kephallonia	March 2013	40-80 m	muddy	present study

References

- 1 - Streftaris N. and Zenetos A., 2006. Alien Marine Species in the Mediterranean - the 100 'Worst Invasives' and their Impact. *Medit. Mar. Sci.*, 7(1): 87-118.
- 2 - Klein J. and Verlaque M., 2008. The *Caulerpa racemosa* invasion: A critical review. *Mar. Pollut. Bull.*, 56: 205-225.
- 3 - Vazquez-Luis M., Sanchez-Jerez P. and Bayle-Sempere J.T., 2008. Changes in amphipod (Crustacea) assemblages associated with shallow-water algal habitats invaded by *Caulerpa racemosa* var. *cylindracea* in the western Mediterranean Sea. *Mar. Environ. Res.*, 65: 416-426.
- 4 - Panayotidis P. and Montesanto B., 1994. *Caulerpa racemosa* (Chlorophyta) on the Greek coasts. *Cryptogamie Algol.*, 15: 159-161.
- 5 - Katsanevakis S., Issaris Y., Poursanidis D. and Thessalou-Legaki M., 2010a. Vulnerability of marine habitats to the invasive green alga *Caulerpa racemosa* var. *cylindracea* within a marine protected area. *Mar. Environ. Res.*, 70: 210-218.
- 6 - Katsanevakis S., Salomidi M. and Panou A., 2010b. Modelling distribution patterns and habitat preference of the invasive green alga *Caulerpa racemosa* in the Saronikos Gulf (Eastern Mediterranean). *Aquat. Biol.*, 10: 57-67.
- 7 - Tsirika A. and Haritonidis S., 2005. A survey of the benthic flora in the National Marine Park of Zakynthos (Greece). *Bot. Mar.*, 48: 38-45.
- 8 - Tsiamis K., 2012. Alien macroalgae of the sublittoral zone of the Greek coasts. PhD Thesis. Athens University, Greece, pp. 368.
- 9 - Katsanevakis S. and Tsiamis K., 2009. Records of alien marine species in the shallow coastal waters of Chios Island (2009). *Medit. Mar. Sci.*, 10(2): 99-107.