

THE SPREAD OF TWO ALLOCHTHONOUS CAULERPA ALONG THE LIGURIAN COAST

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Abstract

Studies carried out on the presence of *Caulerpa taxifolia* and *C. racemosa* along the Ligurian coast since 1992 are summarized. Increase of species richness of benthos and fishes on soft bottoms colonized by *C. taxifolia* and interactions with fishing gear are discussed.

Key words: *allochthonous species, invasion, benthos, fishes, Mediterranean.*

Introduction

The present paper summarizes and updates information obtained on invasion of *Caulerpa taxifolia* (Vahl) C. Agardh and *Caulerpa racemosa* (Forsk.) J. Agardh, that are two new species in respect to the indigenous *Caulerpa prolifera* (Forsk.) Lamouroux, in the neritic water of Gulf of Genoa. *C. taxifolia*, recorded for the first time in Italian water in 1992 (1) is spreading eastward from the French boundary. *C. racemosa*, recorded for the first time in Liguria, at Genova Quinto in 1995 (2), seems to come from south-east (Tuscany) and recent settlements in the Ligurian Sea have been reported by Modena *et al.* (3). Investigations have been carried out since 1992 also with the support of Regione Liguria (4) and in cooperation with E.U. Life Program - DG XI "Control of the spread of *Caulerpa taxifolia* in the Mediterranean Sea" (5).

Materials and methods

1) Two main methods were used to monitor distribution and spreading of *Caulerpa* algae. The first was to control sites where people told the algae were present and thanks to kind cooperation of the Genoa Coast Guard a register for the records was organized. The second way was direct, monitoring by scuba-divers, video-recordings and sometimes by fishing gear. All harbours and marinas from French border to Arenzano (20 km west from Genoa) were checked for the presence of *Caulerpa*. During summer 1998 five harbours (Imperia Porto Maurizio, Imperia Oneglia, the old harbour of San Remo, Alassio and Varazze) and an area of about 25.8 Km² off Imperia were mapped to 50 m depth. In the Genoa Quinto area, *C. racemosa*, was mapped in 1998 and 1999 while in area around Tino island (La Spezia) was mapped in autumn 2000.

2) To study changes in biodiversity, zones colonized by *C. taxifolia* were compared with non-colonized ones. A first set of data was collected from October 1994 to October 1995 (6). From October 1997 to October 1998 four stations were selected for the study of benthos associated with *C. taxifolia* (see 7, 8): A) Imperia San Lazzaro, 4-5 m depth, *C. taxifolia* coverage 90-100% (CSL); B) Imperia, open sea, 9-10 m depth, 25% total cover of both *C. taxifolia* and *Cymodocea nodosa* (CMA); C) Imperia, open sea west of Porto Maurizio, 9 - 10 m depth, covered by *C. nodosa* (CY); D) Alassio, entrance to the harbour, *C. taxifolia* coverage 80-100% (AL).

3) To study fish assemblages visual censuses (50 or 100 m long and 4 m wide) and trammel nets (200 m long and 3 m length) catches were used. Three sets of data were collected between 1994 and 1999. Three stations (CSL, CMA, CY) were the same as those used for benthos; the fourth one was selected on a *Posidonia oceanica* meadow (P) (6, 8, 9, 10, 11).

4) Interaction between fishing gear and spread of *Caulerpa* were observed inside and outside the ports. A particular attention was paid to the harbour areas where fishing boats are moored or trammel nets are cleaned, by means of scuba-divers and videocamera observations and recordings.

Results

1) The presence of *C. taxifolia* was recorded in September 1998 in twelve harbours (Varazze, Alassio, Andora, S. Bartolomeo al Mare, Diano Marina, Imperia San Lazzaro, Imperia Porto Maurizio, Imperia Oneglia, S. Stefano al Mare, San Remo Porto Commerciale, Bordighera) among the twenty ports and landing places along the western Ligurian Riviera; at eight of them the alga was not found (Arenzano, Savona, Finale Ligure, Loano, Marina degli Aregai, Arma di Taggia, Ospedaletti, Marina di San Giuseppe di Ventimiglia (except at "Calandre") (4, 12, 13). The bottom of Imperia Porto Maurizio harbour was colonized by *C. taxifolia* showing a cover of more than 75%. In front of Imperia a map of the principal biocenosis and distribution of *C. taxifolia* with different coverage indices was prepared (12, 13).

2) Dealing with research carried out between 1994 and 1995, there are clear qualitative and quantitative differences between the epiphytic fauna found on *C. taxifolia* and *C. nodosa* (5). From a quantitative point of view fauna is greater on *C. taxifolia* if data are taken as referring to the sampling surface (n°/dm²), on *C. nodosa* if in terms of plant biomass (n°/g). At all four stations in the period 1997-1998 a total of 122 benthos taxa were identified (CSL: 68 taxa, CMA: 61, AL: 48 and CY: 38 taxa), confirming previous data (7, 8). A further confirmation comes from data collected between 1999 and 2000: among 142 taxa, 95 were found at CSL, 65 at CMA and 15 at CY.

3) Detailed results about fish studies are described in the papers listed in bibliography (6, 8, 9, 10, 11, 14). During 1998 at the four stations (CSL, CMA, CY, P) where trammel net and visual censuses were used, 55 fish species were listed. The highest species richness was observed in CSL (34

species) followed by 26 species on P and CMA and only 14 species on CY. If the comparison is made only at CSL and CY from October 1994 to November 1999, a total of 50 different species of fishes were caught in the two stations, 41 at CSL and 31 at CY. Thirty-five species were observed by visual census, 32 at CSL and 8 at CY.

4) Along the Ligurian coast the spread of *Caulerpa* species, in particular *C. taxifolia*, is clearly linked to fishery activities in particular to trammel net and illegal otter trawling inside 50 m depth. The first colonization of the bottom in some harbours correspond exactly to sites where trammel net boats are moored or where nets are commonly cleaned (10, 11).

Conclusions

The two allochthonous algae are currently spreading in the Ligurian Sea and new areas are colonized, though in some shallow mobile and unprotected sites *C. taxifolia* has disappeared due to the strong wave action. This alga seems less adapted than *C. nodosa* to surf and bottom currents. On soft bottoms of Liguria the presence of *C. taxifolia* can considerably increase the number of benthic and fish species differently from what assessed on hard substrata by Harmelin-Vivien (15). Fishing activity seems to be the main cause of the rapid spread of the two *Caulerpa*, but in the meantime fishermen suffer the main damage because fish community has changed and because algae fronds interfere with the performance of gear and much time is required to clean the gear.

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