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Different structure of assemblages understoried by three *Cystoseira* species occurring on the same upper-infralittoral platforms

Daniela Casu*, Giulia Ceccherelli, Nicola Sechi

Dipartimento di Botanica ed Ecologia vegetale, Università di Sassari, Via F. Muroni 25, Sassari, 07100 Italy

Abstract

Canopy algae of the genus *Cystoseira* are considered important habitat formers providing shade and shelter for a diversified assemblage of animals and plants. Some evidence suggested that these algae are highly sensitive to anthropogenic disturbances and their presence could be used as an 'ecological quality' indicator. In this paper we tested the hypothesis that structure of assemblages understoried by these algae is dependent on *Cystoseira* species. To achieve this aim the composition of benthic assemblages under the canopy of three *Cystoseira* species was estimated at Sinis-Mal di Ventre MPA (western Mediterranean), where at some sites these algae occur on the same upper-infralittoral platforms. At one site 2 areas have been sampled and in each area 5 replicates were taken per *Cystoseira* species. The percent coverage of benthic species was estimating in the field using a 20×20 cm multiple-scale quadrats. A multivariate analysis was performed to highlight differences in *taxa* composition. Results have evidenced significant variations in assemblages depending on *Cystoseira* species (ANOSIM R= 0.585 p=0.1%). These results suggest that the three *Cystoseira* species co-occurring on the same platforms do structure different habitats supporting diversified species assemblages. Hence, given the high variability on small spatial scale of habitats it is necessary to perform well designed experiments to correctly interpret results collected during monitoring program.

Keywords: *Cystoseira*; Marine Protected Area; Diversity; Canopy

1. Introduction

Canopy algae of the genus *Cystoseira* C. Agardh (Fucales: Fucophyceae) has a worldwide distribution. Most of them are keyspecies in a variety of communities which are encountered on upper infralittoral and circalittoral hard bottoms (Giaccone & Bruni 1973). These algae are considered important habitat formers providing shade and shelter for a diversified assemblage of animals and algae. Some evidence suggested that these algae are highly sensitive to both natural and anthropogenic stress (Panayotidis *et al*. 1999) and their presence could be used as an 'ecological quality' indicator. In this paper we tested the hypothesis that structure of assemblages understoried by these algae is dependent on

Corresponding author. Tel.: +39-079228646; fax: +39-079233600; e-mail: danicasu@uniss.it.

Cystoseira species. To achieve this aim the composition of benthic assemblages under the canopy of three *Cystoseira* species was estimated at Sinis-Mal di Ventre Marine Protected Area (western Sardinia), where at some sites these algae occur on the same upper-infralittoral platforms.

2. Materials and methods

Sampling was carried out within rocky platforms between 0.2-0.4 water depth. Low-shore assemblages were dominated by canopy algae such as *C. barbata* (Stackhouse) C. Agardh *v. barbata f. aurantia*, *C. compressa* (Esper) Gerloff *et* Nizamuddin *f. compressa* (Furnari *et al*. 2003) and *Cystoseira.* sp. Last *Cystoseira* was not possible to identify to species level, nevertheless it had following characteristics: thallus with short single axe, covered by oval, smooth, characteristic tophules; cylindrical or flattened branches, covered by spaced thorns; 30 to 50cm in length; brown colour.

At this site 2 areas have been sampled and in each area 5 replicates were taken per *Cystoseira* species. The percent coverage of benthic species was estimating in the field after canopy removal using a 20×20 cm multiple-scale quadrat (Fig.1). Analysis of similarities (Clarke 1993) was performed on overall abundance of taxa to test for differences among the different assemblages of three *Cystoseira* species.

Fig. 1. 20X20 cm quadrats.

The percentage contribution of each taxa to the average dissimilarity was calculated using SIMPER (Clarke 1993). Non-metric multidimensional scaling (nMDS) was used to produce two-dimensional ordination plots to show similarities among taxa assemblages at different *Cystoseira* spp.

3. Results

Results have evidenced significant variations in assemblages depending on Cystoseira species (ANOSIM R= 0.585 p=0.1%). This is also indicated by the spread of the replicate samples for each *Cystoseira* in the nMDS ordination plot (Fig.2). The pairwise comparisons showed significant differences in the structure of assemblages under the canopy of three *Cystoseira* species (*C.* sp. Vs *C. compressa* R=0.468 p=0.1%; *C.* sp. Vs *C. barbata* R=0.532 p=0.1%; *C. compressa* Vs *C. barbata* R=0.743 p=0.1%). Overall 7, 11 and 13 were the taxa identified under *C. compressa*, *C.* sp. and *C. barbata* respectively.

SIMPER analysis identified taxa that mostly contributed to the average dissimilarities (Table1). Among taxa mostly contributing to differences Articulated Corallinaceae, *Halimeda tuna* and Green Filamentous Algae are mostly abundant under *Cystoseira compressa*, Encrusting Calcified Rhodophytes, Dark Filamentous Algae, *Diplosoma listerianum* and *Anadyomene stellata* under *Cystoseira* sp., while Encrusting Calcified Rhodophytes, *Diplosoma listerianum*, *Cliona* spp., *Didemnum* spp. and *Ircinia variabilis* under *Cystoseira barbata*.

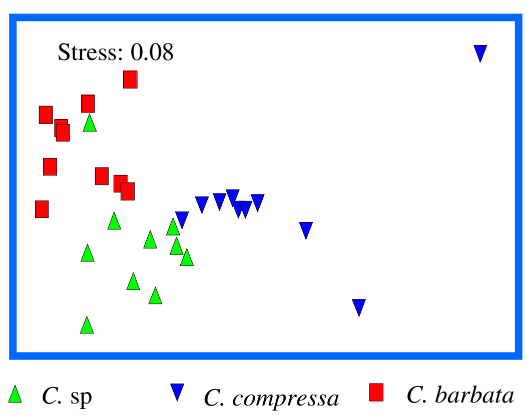

Fig. 2. nMDS ordination plot

Table. 1 Percent contribution of the taxa (cut off 90%) at dissimilarities.

Average dissimilarity = 25.51	*C.* sp	***C. barbata***	
Taxa	Av.Abund		Contrib%
ECR - Encrusting Calcifed Rhodophytes	7.80	25.40	25.93
dead ECR	3.50	12.50	14.49
DFA - Dark Filamentous Algae	7.40	0.80	9.07
AC - Articulated Corallinaceae	4.10	2.40	6.56
Diplosoma listerianum	3.50	5.40	5.99
Halimeda tuna	4.40	2.00	4.87
Anadyomene stellata	3.20	0.00	4.02
Valonia utricolaris	3.10	0.90	3.95
Cliona sp.	0.00	2.60	3.30

Average dissimilarity = 37.99	***C .compressa***	***C. barbata***	
Taxa	Av.Abund		Contrib%
AC – Articulated Corallinaceae	61.40	2.40	37.65
ECR - Encrusting Calcifed Rhodophytes	0.10	25.40	19.26
Halimeda tuna	20.70	2.00	12.99
dead ECR	0.30	12.50	9.29
Diplosoma listerianum	0.00	5.40	4.10
GFA - Green Filamentous Algae	5.00	0.60	3.52
Cliona sp.	0.00	2.60	1.99
Didemnideae	0.00	2.50	1.89

Average dissimilarity = 31.38	*C.* sp	***C. compressa***	
Taxa	Av.Abund		Contrib%
AC – Articulated Corallinaceae	4.10	61.40	45.74
Halimeda tuna	4.40	20.70	15.22
ECR - Encrusting Calcifed Rhodophytes	7.80	0.10	7.48
DFA - Dark Filamentous Algae	7.40	0.30	7.11
GFA - Green Filamentous Algae	2.30	5.00	3.82
Diplosoma listerianum	3.50	0.00	3.47
dead ECR	3.50	0.30	3.40
Anadyomene stellata	3.20	0.00	3.11
Valonia utricolaris	3.10	0.20	2.94

4. Discussion

Canopy algae are important components of assemblages of rocky shores because they provide habitat to several species of animals and algae whilst preventing the colonization of other sessile organisms (Dayton 1985; Schiel & Foster 1986; Johnson & Mann 1988). Drastic decrease of these structurally important species is often associated with changes in the composition of assemblages, as described by experimental manipulations studies of canopy algae (e.g. Dayton *et al*. 1992; Bulleri *et al*. 2002).

Results from the present study suggest that the three *Cystoseira* species co-occurring on the same platforms can play a major rule in structuring different habitats with diversified species assemblages, likely due to the different algal structure in the three species. Hence, given the high variability of *Cystoseira* habitats in diversity and abundance of underlying benthic communities even on a small spatial scale, each *Cystoseira* habitat needs to be considered separately.

Well designed monitoring programs should take carefully into account such differences in *Cystoseira* habitats e.g. when comparing sites with different level of protection and/or exposition on the basis of benthic assemblages under *Cystoseira* canopy.

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