ISSN: 0001-5113
AADRAY

ACTA ADRIAT.,
45 (2): 121-130, 2004

UDC: 582.273 (497.4)(262.3-17)
Original scientific paper

# Phytocoenological study of the *Catenella caespitosa* (Withering) L.M. Irvine (Gigartinales, Rhodophyceae) community from the Slovenian coast, northern Adriatic Sea

Claudio BATTELLI

***University of Primorska, Faculty of Education of Koper, Cankarjeva 5, 6000 Koper, Slovenia***
***E-mail: claudio.battelli@guest.arnes.si***

*The* Catenella caespitosa *(Withering) L.M. Irvine community at two stations on the Slovenian coast of the northern Adriatic Sea was sampled monthly during 2002. The flora consisted of 18 species: seven Chlorophyceae, five Rhodophyceae, two Fucophyceae, and four Cyanobacteria. The diversity index indicated low community complexity at both stations (0.8 at station A and 0.5 at station B). The study also confirms the identification of the zonation of this community. A new sub-association of the upper mid-littoral zone* Catenelletosum caespitosae*, included in the* Fucetum virsoidis *Pignatti 1962 association, is described by the synecological method.*

**Key words:** *Catenella caespitosa* community, seasonal variation, floral composition, bionomical and phytocoenological position, northern Adriatic Sea

## INTRODUCTION

The Slovenian coast on the southern part of the Gulf of Trieste is mainly composed of Eocene flysch layers (Fig. 1) (OGORELEC *et al*., 1997). In Izola, it is formed of limestone with alveolines and nummulites (PAVLOVEC, 1985). The red algae *Catenella caespitos* (Withering) L. M. Irvine is a sub-cosmopolitan species (FURNARI *et al.*, 1999). In the Gulf of Trieste and along the Slovenian coast, *C. caespitosa* is commonly found in the middle to upper levels of the mid-littoral zone, but is restricted to moist, sheltered, and shaded cracks and crevices. It is diffused in patches on the limestone substrate and absent on the flysch substrata (GIACCONE & PIGNATTI, 1967; MATJAŠIČ & ŠTIRN, 1975; VUKOVIČ, 1980, 1984; MUNDA, 1991, 1993a, 1993b; BATTELLI, 2000, 2002).

LORENZ (1863) and ZALOKAR (1942) studied the *C. caespitosa* community of the Adriatic Sea and considered this community an association of the supra-littoral zone (*Catenelletum* Lorenz, *Catenella opuntia* Zalokar). ZEI (1955) considered it a characteristic facies of mid-littoral biocoenosis with *Chthamalus*. PÉRÈS & PICARD (1964) associated it (as *C. opuntia*) with the characteristic species *Hildebrandia prototypus*. ZAVODNIK (1967) studied the community near Rovinj (Croatia, North Adriatic) and confirmed the bionomic and sintaxonomic position of the community previously defined by PÉRÈS & PICARD (1964). Recent studies considered *C. caespitosa* a differential species of the *Fucetum virsoidis* Pignatti 1962 association that developed on the mid-littoral rocky shores from Albania to the northern Adriatic and is probably a relict of the Paratethys basin. From the phytocoenological point of view, *F. virsoidis* is included in the alliance *Ralfsion verrucosae* Giaccone

1993, order *Ralfsietalia verrucosae* Giaccone 1993, class *Entophysalidetea* Giaccone 1993 (GIACCONE *et al.*, 1993).

The purpose of this study was to investigate the floral composition and seasonal variations of the *C. caespitosa* community at two stations on the Slovenian coast: Station A – the coastal zone extending from Koper to Izola, and Station B – the Simon Bay near Izola. The study also assessed the bionomical and phytocoenological position of this community.

## MATERIAL AND METHODS

The study was carried out on the hard substrata in the upper mid-littoral zone at two stations on the Slovenian coast. The first sampling station (station A) is situated in the Koper Bay along a 3-km coastal zone between Koper and Izola. The shore is formed of limestone breakwater rocks. It is exposed to wave action and winds that blow from southwest to northeast. The second sampling station (station B) is situated in the Simon Bay, near Izola. It is a rocky shore with a 250-m horizontal scarp. The area is exposed to wave action and winds that blow from the southwest to the northeast. The substratum is formed of limestone with alveolines and nummulites. Both stations are mainly influenced by the wind that blows from the north-northeast, the "burja" in Slovenian, "bora" in Italian and "bura" in Croatian. During the investigation, the tidal range was about 150 cm and the sea surface temperature ranged from 7.1°C in January to 26.0°C in August, with an average of 9.6°C in winter, 18.9°C in spring, 24.9°C in summer, and 17.2°C in autumn.

Twenty-four samplings were made (one sampling per month for each station). During each season, three samples were randomly collected. All algae were removed from 100-cm$^2$ (10 x 10 cm) squares of coast. The samples were preserved in a 4% seawater-formaldehyde solution. Specimens were made and kept in an herbarium at the Faculty of Education of Koper,

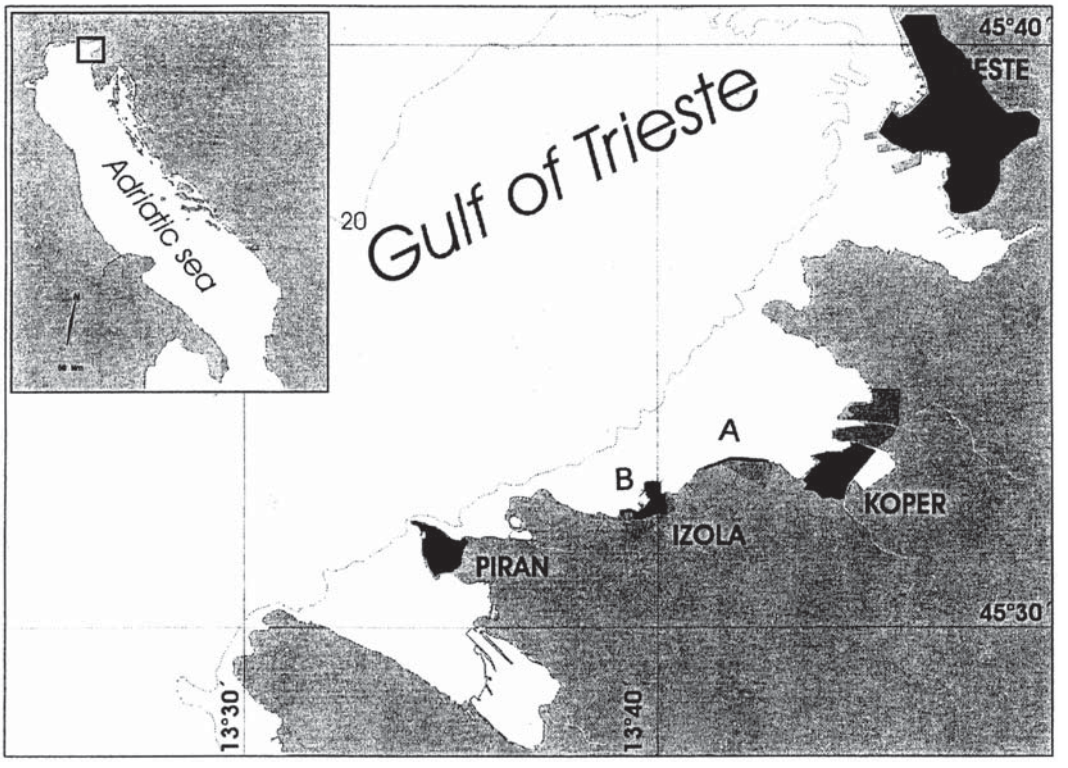


*Fig. 1. Study area with sampling stations A and B*

University of Primorska. For each sample, the algal species were sorted in the laboratory and the abundance of species was expressed as a 'percentage cover'. The 100-cm$^2$ quadrates were divided into 100 sub-quadrates and the area of the sub-quadrates covered by a single species was considered the percentage cover for that species. The classic BRAUN-BLANQUET method (BRAUN-BLANQUET, 1964), modified by BOUDOURESQUE (1971), was used to assess the phytocoenological position of this community. The number of species (no.), percentage cover (Rt), species evenness (J), and SHANNON-WEAVER diversity index (H') were calculated for each sampling following BOUDOURESQUE (1971). The SØRENSEN's similarity index (SQ) was calculated to evaluate the similarity between the flora of the two stations.

The Code of Phytosociological Nomenclature (BARKMAN *et al.*, 1986) was used to describe the new sub-association, *Catenelletosum caespitosae*. The bionomic position of the investigated community was defined according to terminology proposed by BELLAN-SANTINI *et al.* (1994) and the algal nomenclature according to RIBERA *et al.* (1992), GALLARDO *et al.* (1993), SILVA *et al.* (1996), and DROUET (1981).

## RESULTS

The floral composition at both stations was the same. Eighteen taxa was identified (Table 1). Chlorophyceae dominated with seven species (38.9%), Rhodophyceae were represented by five species (27.8%), Fucophyceae had two species (11.1%), and Cyanobacteria were present with four (22.2%). The average number of species at a single time was slightly higher at station A (9.4) than at station B (8.9; Fig. 2). The average percentage cover at station A (21.88%) was significantly lower than at station B (45.71%; Fig. 3).

*Table 1. Species found in the investigated areas*

| | Species | Phytogeographic region* |
|---|---|---|
| Cyanobacteria | *Calothrix crustacea* Thuret | Cosmopolite |
| | *Entophysalis conferta* (Kützing) F.E. Drouet et W.A. Daily | Cosmopolite |
| | *Entophysalis deusta* (Meneghini) F.E. Drouet et W.A. Daily | Cosmopolite |
| | *Microcoleus lyngbyaceus* (Kützing) P. et H. Crouan | Cosmopolite |
| Rhodophyceae | *Catenella caespitosa* (Withering) L.M. Irvine | Subcosmopolitan |
| | *Gelidium pusillum* (Stackhouse) Le Jolis | Cosmopolite |
| | *Nemalion helminthoides* (Velley) Batters | Subcosmopolitan |
| | *Porphyra leucosticta* Thuret in Le Jolis | Subcosmopolitan |
| | *Stylonema alsidii* (Zanardini) Drew | Cosmopolite |
| Fucophyceae | *Ectocarpus siliculosus* (Dillwyn) Lyngbye | Cosmopolite |
| | *Fucus virsoides* J. Agardh | Mediterranean |
| Chlorophyceae | *Blidingia minima* (Nägeli ex Kützing) Kylin | Subcosmopolitan |
| | *Chaetomorpha linum* (O. F. Müller) Kützing | Cosmopolite |
| | *Cladophora albida* (Nees) Kützing | Subcosmopolitan |
| | *Cladophora laetevirens* (Dillwyn) Kützing | Subcosmopolitan |
| | *Ulva compressa* Linnaeus | Cosmopolite |
| | *Ulva clathrata* (Roth) C. Agardh | Cosmopolite |
| | *Rhizoclonium tortuosum* (Dillwyn) Kützing | Subcosmopolitan |

* According to FURNARI *et. al.* (1999)

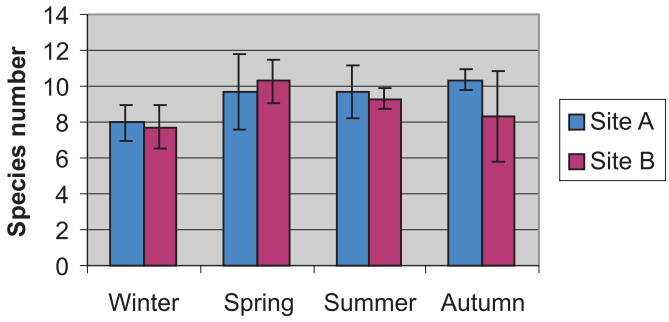


*Fig. 2. Seasonal variations in number of algae species (means± SD, n = 3)*

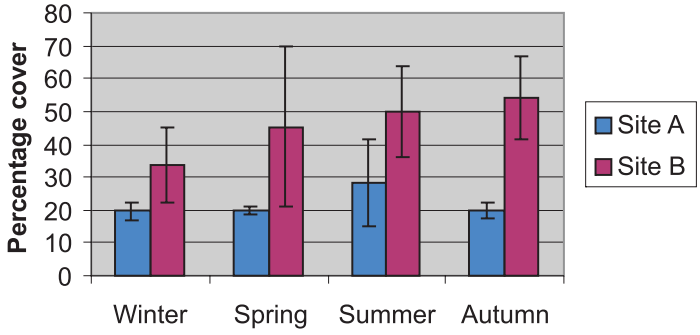


*Fig. 3. Seasonal variations of average percentage cover (means± SD, n = 3)*

The average SHANNON-WEAVER diversity index at station A (0.8) was slightly higher than at station B (0.5; Fig. 4). The most frequent species in all months at both stations were the red algae *C. caespitosa* and the Cyanobacteria *E. conferta*, *E. deusta*, and *M. lyngbyaceus* (Tables 2,3). *U. compressa* was also frequent at station B. The majority of species (11 species for station A, 61.1%; 12 species for station B, 66.6%) were small epiphytes, living on the *C. caespitosa*. Large non-epiphytic species such as *G. pusillum*, *F. virsoides*, and *N. helminthoides* were extremely rare. The SQ values were uniformly high throughout the year, ranging from 0.7 in summer and autumn to 0.8 in winter and spring (Fig. 5), indicating a great similarity in the flora at both stations.

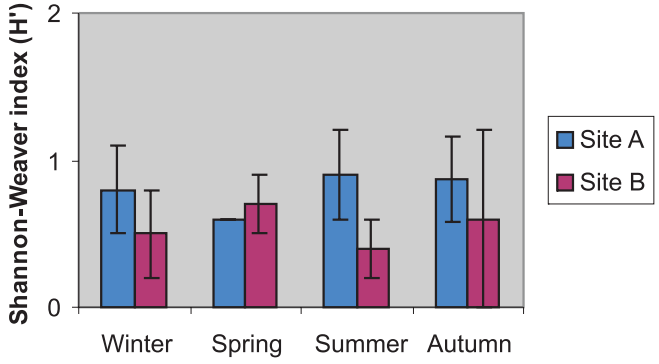


*Fig. 4. Seasonal variations in the SHANNON-WEAVER diversity index (means± SD; n = 3)*

*Table 2. Monthly characteristic flora at station A*

| Month | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth (cm) | 15 | 25 | 20 | 15 | 20 | 15 | 25 | 10 | 10 | 25 | 10 | 15 | |
| Exposure | NW | W | SW | W | N | W | N | NE | W | NW | NE | SW | |
| Total cover (%) | 18.0 | 22.9 | 18.2 | 18.5 | 20.6 | 20.5 | 43.2 | 18.1 | 23.2 | 22.6 | 18.3 | 18.4 | 21.88 |
| No. species | 7 | 8 | 9 | 12 | 9 | 8 | 10 | 8 | 11 | 10 | 10 | 11 | 9.4 |
| Evenness (J) | 0.3 | 0.5 | 0.3 | 0.2 | 0.3 | 0.3 | 0.4 | 0.3 | 0.5 | 0.5 | 0.3 | 0.3 | 0.3 |
| Diversity (H') | 0.6 | 1.1 | 0.6 | 0.6 | 0.6 | 0.6 | 0.9 | 0.6 | 1.1 | 1.2 | 0.7 | 0.7 | 0.8 |
| Characteristic species | | | | | | | | | | | | | P |
| *G. pusillum* | - | - | - | - | - | - | - | - | 1 | 1 | - | - | 1 |
| *F. virsoides* | - | - | - | - | - | - | - | - | 1 | - | - | - | 0.5 |
| *C. caespitosa* | 2 | 2 | 2 | 2t | 2t | 2t | 3t | 2t | 2t | 2t | 2 | 2 | 5 |
| Characteristic species of superior units | | | | | | | | | | | | | |
| *E. deusta* | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 5 |
| *M. lyngbyaceus* | +e | +e | +e | +e | +e | +e | +e | +e | +e | +e | +e | +e | 5 |
| *U. compressa* | +e | - | - | +e | - | - | +e | - | +e | - | +e | - | 3 |
| *C. crustacea* | - | 1 | - | - | 1 | 1 | 1 | - | - | 1 | - | - | 3 |
| *P. leucosticta* | - | + | - | +e | +e | +e | - | - | - | - | +e | +e | 3 |
| *B. minima* | - | - | +e | +e | - | +e | +e | - | - | - | - | - | 2 |
| *N. helminthoides* | - | 1 | - | - | - | - | - | - | - | - | - | - | 0.5 |
| Other species | | | | | | | | | | | | | |
| *E. conferta* | +e | +e | +e | +e | +e | +e | +e | +e | +e | +e | +e | +e | 5 |
| *C. linum* | - | - | +e | +e | +e | - | +e | - | +e | +e | +e | +e | 4 |
| *C. albida* | - | +e | +e | +e | +e | - | +e | +e | +e | - | +e | +e | 4 |
| *C. laetevirens* | +e | - | +e | +e | - | - | - | +e | +e | +e | +e | +e | 4 |
| *U. clathrata* | - | - | +e | +e | - | +e | +e | +e | - | +e | +e | +e | 4 |
| *R. tortuosum* | - | - | - | - | +e | - | - | +e | +e | - | - | +e | 2 |
| *E. siliculosus* | +e | - | - | +e | - | - | - | - | - | - | - | - | 1 |
| *S. alsidii* | - | - | - | - | - | - | - | - | - | +e | +e | + | 1 |

t = tetrasporophyte. e = epiphyte

Cover abundance values are:

| Class | % cover | Average values |
|---|---|---|
| + | <1% | 0.1% |
| 1 | 1.1 – 5.0% | 2.5% |
| 2 | 5.1 –25.0% | 15.0% |
| 3 | 25.1 – 50.0% | 37.5% |
| 4 | 50.1- 75.0% | 62.5% |
| 5 | 75.1- 100% | 87.5% |

*Table 3. Monthly characteristic flora at station B*

| Month | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth in cm | 15 | 25 | 20 | 15 | 20 | 15 | 25 | 10 | 10 | 25 | 10 | 15 | |
| Exposure | NW | W | SW | W | N | W | N | NE | W | NW | NE | SW | |
| Total cover (%) | 40.5 | 20.6 | 40.5 | 69.2 | 45.7 | 20.6 | 65.7 | 43.1 | 40.8 | 40.4 | 55.8 | 65.6 | 45.71 |
| No. species | 7 | 9 | 7 | 11 | 11 | 9 | 9 | 9 | 10 | 6 | 11 | 8 | 8.9 |
| Evenness (J) | 0.2 | 0.4 | 0.2 | 0.2 | 0.3 | 0.4 | 0.1 | 0.2 | 0.2 | 0.2 | 0.5 | 0.1 | 0.2 |
| Diversity (H') | 0.3 | 0.9 | 0.3 | 0.5 | 0.7 | 0.9 | 0.2 | 0.5 | 0.4 | 0.3 | 1.3 | 0.2 | 0.5 |
| Characteristic species | | | | | | | | | | | | | P |
| *G. pusillum* | - | - | - | - | 1 | - | - | - | - | - | - | - | 0.5 |
| *F. virsoides* | - | - | - | - | - | - | - | - | - | - | 2 | - | 0.5 |
| *C. caespitosa* | 3 | 2 | 3 | 4t | 3t | 2t | 4t | 3t | 3t | 3 | 3 | 4 | 5 |
| Characteristic species of superior units | | | | | | | | | | | | | |
| *E. deusta* | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 5 |
| *M. lyngbyaceus* | +e | +e | +e | +e | +e | +e | +e | +e | +e | +e | +e | +e | 5 |
| *U. compressa* | +e | +e | - | +e | +e | +e | +e | +e | +e | +e | +e | +e | 5 |
| *C. crustacea* | - | - | - | 1 | 1 | 1 | - | 1 | - | 1 | - | - | 2 |
| *P. leucosticta* | - | + | + | + | - | - | - | - | - | - | +e | - | 2 |
| *B. minima* | - | - | +e | +e | - | +e | +e | +e | +e | - | +e | - | 3 |
| *N. helminthoides* | - | 1 | - | - | - | - | - | - | - | - | - | - | 0.5 |
| Other species | | | | | | | | | | | | | |
| *E. conferta* | +e | +e | +e | +e | +e | +e | +e | +e | +e | +e | +e | +e | 5 |
| *C. linum* | - | - | - | +e | +e | - | +e | +e | +e | +e | +e | +e | 4 |
| *C. albida* | +e | - | +e | +e | +e | +e | - | +e | +e | - | +e | - | 4 |
| *C. laetevirens* | - | +e | - | +e | +e | +e | +e | - | +e | - | - | +e | 3 |
| *U. clathrata* | +e | - | - | - | - | - | - | - | - | - | - | +e | 1 |
| *R. tortuosum* | - | - | - | - | - | - | +e | - | +e | - | - | - | 1 |
| *S. alsidii* | - | - | - | - | +e | - | - | - | - | - | +e | - | 1 |
| *E. siliculosus* | - | +e | - | - | - | - | - | - | - | - | - | - | 0.5 |

t = tetrasporophyte. e = epiphyte

Cover abundance values as in Table 1

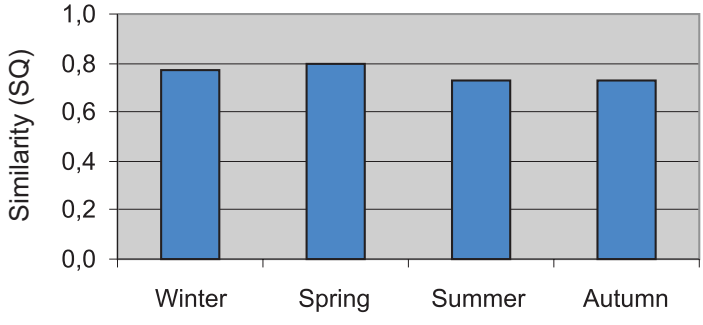


*Fig. 5. Seasonal variations of the SØRENSEN's index of flora*

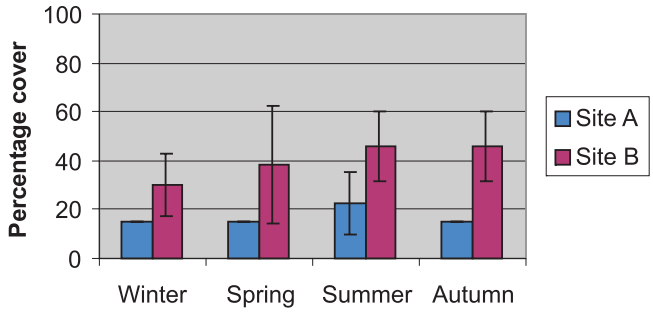


*Fig. 6. Seasonal variations of the average percentage cover (means± SD, n = 3) of* Catenella caespitosa

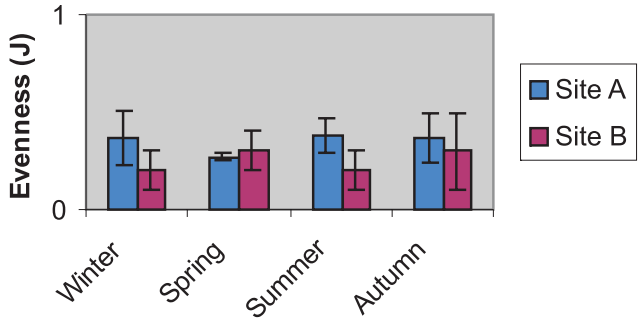


*Fig. 7. Average seasonal variations of flora evenness (means± SD, n = 3)*

The red algae *C. caespitosa* was well developed in shaded fissures and roofed rocks in the upper mid-littoral zone, forming a belt of dense turf that was 0.5 to 1.5 cm thick with a very patchy and irregular distribution. The average percentage cover of *C. caespitosa* at station B (39.98%) was significantly higher than at station A (16.88%) throughout the year (Fig. 6). The more sheltered shore and many crevices and fissures at station B seem to be important factors influencing the abundance of the *C. caespitosa* community. Mean evenness was slightly higher at station A than at station B. The low evenness values indicate that there was a limited number of species at both stations (Fig. 7).

## DISCUSSION

The study showed that *C. caespitosa* assemblages are better structured and more extensive in the shallowest parts of the upper mid-littoral, especially shady crevices and wet fissures, and less frequent and less extensive on better lit surfaces. Light seems to be the most important factor influencing the abundance and spatial distribution of *C. caespitosa*, whereas no significant effects of the sampling date were observed.

Seasonal patterns were manifested when the reproductive phenology of *C. caespitosa* was considered. Tetrasporangia were the only reproductive structures recorded for this species at both stations. In autumn and winter, only non-reproductive thalli were found. Tetrasporangial thalli emerged from late spring to early autumn when the sea surface temperature was higher.

Although the average number of species and percentage cover varied slightly during the study period, the *C. caespitosa* communities of both stations were quite similar. This is supported by the high average SQ. The low diversity indices at both stations indicate low community complexity. Although it was slightly higher at station A, the mean evenness was low at both stations. Temporal variations of these values were basically constant, denoting the dominance of a small number of species in both stations. In both, cosmopolitan (10) and sub-cosmopolitan (7) species dominated, while

only one Mediterranean species, *F. virsoides*, was found.

*C. caespitosa* was considered a differential species of the *F. virsoidis* association (GIACCONE, pers. comm.). This study revealed that it is a schiaphilic community, restricted to shaded, moist, and sheltered cracks and crevices of the upper part of the mid-littoral zone, while *F. virsoidis* is preferentially a photophilic community, developing in better lit and moderately exposed shores from the lower to the upper part of the mid-littoral zone. The vertical slope of the belt of *C. caespitosa* at the two stations was about 15 cm. The *F. virsoidis* association is included in the Reference List of Habitat Types for the Selection of Stations in the National Inventories of Natural Stations of Conservation Interest (document UNEP-OCA-MED WG. 167/ 2000).

## ACKNOWLEDGEMENTS

I am grateful to Professor Giuseppe GIACCONE from the University of Catania, Italy, for his advice and help with the revision of the text. I would also like to thank Professor Lia Angela GHIRARDELLI for help in determining the Cyanobacteria species.

## REFERENCES

BARKMAN, J.J., J. MOREVEC & S. RAUSCHERT. 1986. Code of phytosociological nomenclature. Vegetatio, 67: 145-195.

BATTELLI, C. 2000. Makrobentoške alge pršnega in bibavičnega nadstropja. Proteus, 62(9-10): 442-449.

BATTELLI, C. 2002. The macrophytobenthos on the hard upper medio-littoral from two stations of Slovenian coast (northern Adriatic Sea). Hacquetia, 1/2: 193-203.

BELLAN-SANTINI, D., LACAZE, J.C. & C. POIZAT. 1994. Les Biocénoses marines et littorales de Méditerranée. Synthèse, menaces et perspectives. Museum National d'Histoire Naturelle, Paris.

BOUDOURESQUE, C.F. 1971. Méthodes d'étude qualitative du benthos (en particulier du phytobenthos). Téthys, 3(1): 79-104.

BRAUN-BLANQUET J. 1964. Planzesoziologie. Grundzüge der Vegetationskunde. (Editor). Springer-Verlag, Wien, 865 pp.

DROUET, F. 1981. Revision of the Stigonemataceae with a summary of the classification of the blue-green algae. Nova Hedwigia, Cramer, 213 pp.

FURNARI, G., M. CORMACI & D. SERIO. 1999. Catalogue of the benthic marine macroalgae of the Italian coast of the Adriatic Sea. Herbarium Mediterraneum Panormitanum (Editors). Palermo, Bocconea 12: 5-214.

GALLARDO, T., A. GÓMEZ GARRETA, M. RIBERA, M. CORMACI, G. FURNARI, G. GIACCONE & C.F. BOUDOURESQUE. 1993. Check-list of Mediterranean seaweeds. II. Chlorophyceae Wille s.l. Botanica Marina, 36(5): 399-421.

GIACCONE, G. & S. PIGNATTI. 1967. Studi sulla produttività primaria del fitobentos nel Golfo di Trieste. - II. La vegetazione del Golfo di Trieste. Nova Thalassia, 3(2): 1-28.

GIACCONE, G., G. ALONGI, A. COSSU, R. DI GERONIMO & D. SERIO. 1993. La vegetazione marina bentonica del Mediterraneo: I. Sopralitorale e mesolitorale. Proposte di aggiornamento. Boll. Acc. Gioenia Sci. Nat., Catania, 26 (341): 145-172.

LORENZ, J.R. 1863. Physicalische Verhältnisse und Verteilung der Organismen im Quarnerishen Golfe. Wien, 379 pp.

MATJAŠIČ, J. & J. ŠTIRN. 1975. Flora in favna severnega Jadrana. Pris. 1., SAZU, Ljubljana, Raz.4: 19-23.

MUNDA, I.M. 1991. Algal resources in polluted stations of the northern Adriatic (vicinity of Piran). Acta Adriat., 32(2): 683-704.

MUNDA, I.M. 1993a. Changes and degradation of seaweeds stands in the northern Adriatic. Hidrobiologia, 260/261: 239-253.

MUNDA, M.I. 1993b. Impact of pollution on benthic marine algae in the northern Adriatic. Int. J. Environ. Stud., 43: 185-199.

OGORELEC, B., J. FAGANELI, M. MIŠIČ & B. ČERMELJ. 1997. Reconstruction of paleoenvironment in the Bay of Koper (Gulf of Trieste, northern Adriatic). Annales, 11: 187-200.

PAVLOVEC, R. 1985. Numulitine iz apnencev pri Izoli (SW Slovenija). Razprave 4. Razred SAZU, 26: 219-230.

PÉRÈS, J.M. & J. PICARD. 1964. Nouveau manuel de bionomie benthique de mer Méditerranée. Rec. Trav. Stat. Mar. Endoume, 31: 5-137.

RIBERA, M.A., A. GOMEZ GARRETA, T. GALLARDO, M. CORMACI, G. FURNARI & G. GIACCONE. 1992. Check-list of Mediterranean seaweeds. I. Fucophyceae (Warming, 1884). Botanica Marina, 35: 109-130.

SILVA, P.C., P.W. BASSON & R.L. MOE. 1996. Catalogue of the benthic marine algae of the Indian Ocean. Univ. Calif. Publ. Bot., 79: XVI + 1259 pp.

VUKOVIČ, A. 1980. Asociacije morskih bentoških alg v Piranskem zalivu. Biol. Vestn., 28(2): 103-124.

VUKOVIČ, A. 1984. Prispevek k poznavanju flore morskih alg Slovenije. Slov. Mor. in Zal., 7(6-7): 187-193.

ZALOKAR, M. 1942. Les associations sousmarines de la côte Adriatique au dessous de Velebit. Bull. Soc. Bot. Genève, 33: 172-195.

ZAVODNIK, D. 1967. Bilješka o naselju *Catenella opuntia* (Good. et Woodw.) Grev. Kamnite obale kod Rovinja. Thalassia Jugoslavica, III(1-6): 89-90.

ZEI, M. 1955. Doprinos k ekologiji morskega litorala (s. lat). Supralitoral, litoral in zgornji infralitoral na kamniti zahodnoistrski obali. Razprave 4. Razred SAZU, 3: 255-300.

Received: 24 March 2003
Accepted: 22 September 2004

# Ficenološka studija naselja alge *Catenella caespitosa* (Withering) I. M. Irvine (Gigartinales, Rhodophyceae) na slovenskoj obali (sjeverni Jadran)

Claudio BATTELLI

*Sveučilište na Primorskem, Pedagoški Fakultet Koper, Cankarjeva 5, 6000 Koper, Slovenija*
*E-mail: claudio.battelli@guest.arnes.si*

**SAŽETAK**

U radu su prikazani rezultati fitocenološkog istraživanja naselja crvene alge *Catenella caespitosa* (Withering) L. M. Irvine na mediolitoralnoj bionomskoj stepenici slovenske obale. Uzorkovanja su obavljena mjesečno na dvije postaje tijekom 2002 godine. Opisana je nova sub-asociacija mediolitoralne bionomske stepenice: *Catenelletosum caespitosae sub-ass. nova,* uključena u asociaciji *Fucetum virsoidis* Pignatti 1962. Flora je prikazana brojčanom i postotnom zastupljenošću sistematskih razreda Cyanobacteria, Rhodophyceae, Fucophyceae i Chlorophyceae. Fitogeografska pripadnost je prikazana pomoću skupina flornih elemenata. Ukupno je na cijelom istraživanom području određeno 14 vrsta bentoskih algi (u razredu Chlorophyceae 7 vrsta ili 38,9%, u razredu Rhodophyceae 5 vrsta ili 27,8%, u razredu Fucophyceae 2 vrste ili 11,1%) i 4 vrste ili 22,2% iz razreda Cyanobacteria. Od flornih elemenata najbolje su zastupljeni kozmopolitski elementi s 11 vrsta, a slijede ih subkozmopolitski sa 6 vrsta, te s jednom vrstom koja je jadranski florni element. Indeks različitosti (H') je mali (0,8 za postaju A i 0,6 za postaju B), a indeks sličnosti (SQ) je velik (0,8) što ukazuje na međusobno veliku sličnost sastava bentoske flore na istraživanim postajama. Tetrasporociste alge *Catenella caespitosa* su razvijene od travnja do listopada.

**Ključne riječi:** *Catenella caespitosa,* sezonska kolebanja, sastav flore, bionomski i fitocenološki položaj, sjeverni Jadran