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HARD SUBSTRATE MACROZOOBENTHOS COMMUNITIES OF THREE ROCKY OUTCROPS IN THE GULF OF VENICE (NORTH ADRIATIC)

Riassunto. *Comunità macrozoobentonica di tre affioramenti rocciosi nel golfo di Venezia (Nord Adriatico).*
La macrofauna di fondo duro del Nord Adriatico è stata studiata in tre affioramenti rocciosi localizzati nel golfo di Venezia denominati D'Ancona, Venezia e Chioggia. Complessivamente sono stati raccolti 185 taxa; le abbondanze medie degli organismi non coloniali sono variate dai 1.680 indd/m² nella tegnùa di Chioggia ai 2.517 indd/m² nell'affioramento chiamato Venezia ai 2.787 indd/m² della tegnùa D'Ancona. La comunità macrobentonica non coloniale è dominata dalla presenza di Annelida, Arthropoda e Mollusca. Il gruppo degli Arthropoda è risultato più abbondante nelle stazioni D'Ancona e Venezia, site a nord del golfo di Venezia, mentre quello dei Mollusca nella stazione localizzata al largo della omonima città di Chioggia. Per quanto concerne gli organismi coloniali, una maggiore biodiversità è stata riscontrata nella tegnùa Venezia, localizzata più al largo della costa, dove sono inoltre presenti colonie di maggiori dimensioni. L'analisi della composizione trofica della macrofauna rileva la grande importanza degli organismi filtratori per questi ambienti, sia in termini di numero di specie che di quantità di biomassa, ed evidenzia una maggior presenza di organismi detritivori negli affioramenti più vicini alla costa (Chioggia e D'Ancona).

Summary. The hard-bottom macrofauna of the North Adriatic Sea was studied in three rocky outcrops located in the gulf of Venice called "D'Ancona", "Venezia" and "Chioggia". On the whole, 185 taxa were collected and the average abundances of non-colonial organisms ranged from 1,680 ind/m² in the Chioggia outcrop to 2,517 ind/m² in the Venezia and 2,787 ind/m² in the D'Ancona outcrops. The macrobenthic community is dominated by Annelida, Mollusca and Arthropoda as non-colonial component. The group of the Arthropoda was more abundant in the D'Ancona and Venezia stations, located north of the gulf of Venice, while Mollusca dominate in the outcrop located off the town of Chioggia. With regard to colonial organisms, the greatest biodiversity was found in the Venezia outcrop, located farther off the coast, where there are also larger colonies. The trophic composition of the macrofauna highlights the importance of filter feeder organisms in these environments, both in terms of number of species and biomass, and shows a greater presence of detritivores in outcrops closer to the coast (Chioggia and D'Ancona).

Keywords: macrobenthos, community, hard-bottom, gulf of Venice, Adriatic Sea.

Introduction

The North Adriatic Sea is a shallow basin characterized mainly by a sandy-muddy bottom with a weak slope and depth up to 70 m (Boldrin et al., 2005); however along the Italian coast, at a distance between 1 and 20 nautical miles off the shore, there are many rocky outcrops locally named "tegnùe", i.e. "hold-back", because professional fishermen often lose their nets on these rocks (Olivi, 1792). These outcrops are thought to have different origins: some had a clastic genesis, while others are of biogenic origin (Stefanon & Mozzi, 1972; Newton & Stefanon, 1975; Boldrin, 1979; Stefanon, 1979). A further theory relates the genesis to sediments cementation due to leaking gases (e.g.: methane) (Colantoni et al., 1997). Though their presence has been well known since the sixties (Stefanon, 1966, 1967), only in the last decades the biological communities of these habitats have been investigated (Mizzan 1992, 1995, 2000; Gabriele et al., 1999; Molin et al., 2003, 2008a; Soresi et al., 2004; Casellato et al., 2005, 2007; Ponti & Mastrototaro, 2006; Ponti et al., 2006, 2011; Casellato & Stefanon, 2008; Fava et al., 2009; AA.VV, 2010).

Several studies have highlighted the rich biodiversity of these outcrops, while the sandy bottom is colonized mainly by typical infaunal macrozoobenthic species (Vatova, 1949; Orel et al., 1990, 1993).

Within the context of the Regione Veneto's project entitled "Progetto Integrato Fusina (PIF)", involving the construction of a new drainpipe from the sewage treatment plant of Fusina (Venice) to the sea, a characterization of the benthic community of the marine area affected by the works was drawn up. Surveys have been conducted on the benthic fauna of sandy bottoms (Molin et al., 2009) and, given the importance of these biological communities, on the macrobenthic community of three rocky outcrops located within the study area.

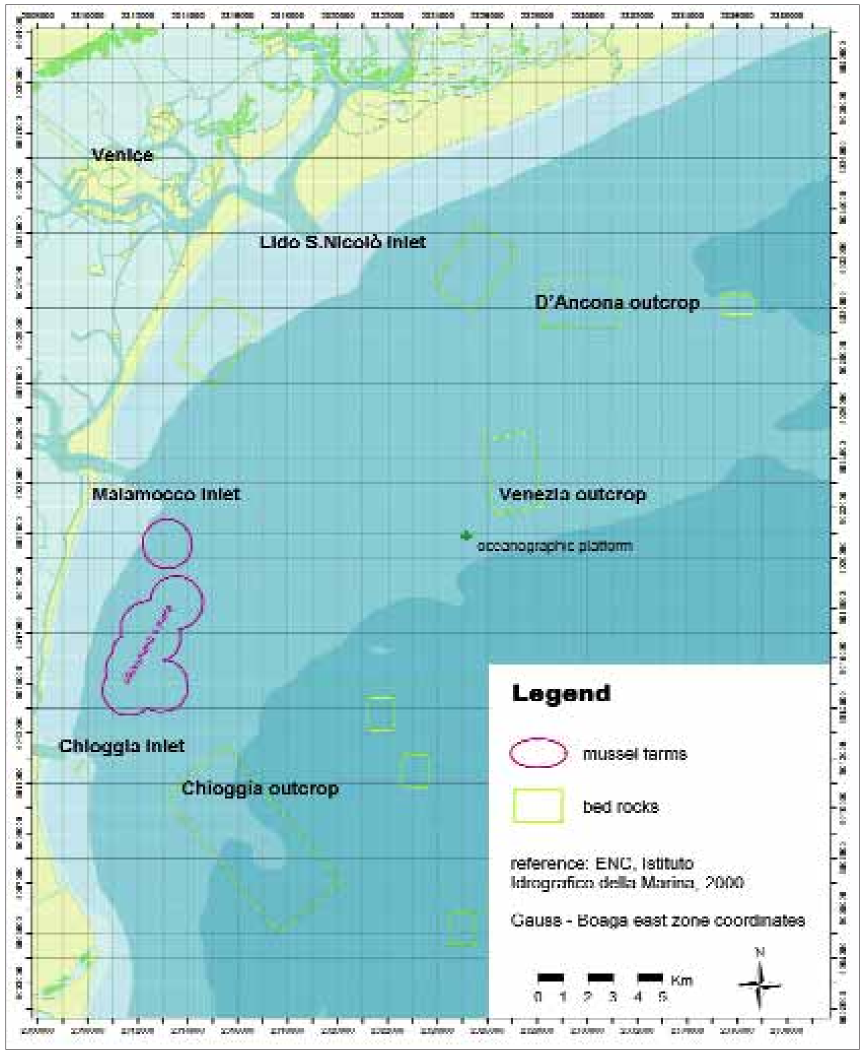


Fig. 1. Location of the study area and of the three outcrops.

Materials and methods

The study area is located in the gulf of Venice, approximately between the cities of Chioggia and Jesolo (fig. 1); the three outcrops investigated are named "D'Ancona", "Venezia" and "Chioggia" and two of them (D'Ancona and Venezia) have already been studied during the Regione Veneto's project "Tegnùe dell'Alto Adriatico. Valorizzazione della risorsa marina attraverso lo studio di aree di pregio ambientale" (AA.VV., 2010). Coordinate position (WGS84) of the sampling stations and the relative bottom depths are reported in table 1, together with average values of the environmental parameters measured at the bottom during four oceanographic surveys conducted in November 2006 and in February, May and July 2007.

The D'Ancona outcrop is located in the northern part of the basin at a distance from the coast of about 4.2 NM. The Chioggia is located in the southern part and its distance from the shore line is about 5.1 NM. The furthest away from the coast is the Venezia outcrop, which is located 8.85 NM from it.

The marine area examined is exposed to winds that blow from NE (bora) and from SE (scirocco) and receives nutrient-rich freshwater from the lagoon of Venice inlets as well as from the Piave, Sile, Adige, Brenta and Po rivers (Socal et al., 2001; Boldrin et al., 2005). The main current runs parallel to the shoreline (from NE to SW) and loads the freshwater coming from lagoon inlets and river mouths to the southern part of the basin; its average daily intensity often exceeds 35 cm/s (Kourafalou, 2001). Due to these reasons, concentrations of nutrients, total solid matter (TSM) and total organic carbon (TOC) in the water column are quite high, although their characteristics vary widely both seasonally and spatially. Seasonal rains regulate the flow from coastal areas, while the main spatial gradients, distance from the coast and from river mouths and lagoon inlets, influence both the quality of the water and the trophic level.

Tab. 1. Main outcrops studied: coordinate position (WGS84), depth and main environmental variables measured at the bottom during four seasonal surveys.

Sampling stations	Latitude	Longitude	Depth (m)	Season	Temperature (°C)	O2 (%)	Chl a (FTU)	Turbidity (NTU)
D'Ancona	N 45° 24.036'	E 12° 34.158'	16.1 – 20.6	Autumn 06	18.09±0.008	84.6±0.24	0.81±0.16	0.62±0.1
				Winter 07	11.18±0.003	87.2±2.2	1.27±0.16	2.4±0.15
				Spring 07	14.5±0.39	100.3±0.8	0.55±0.05	0.49±0.13
				Summer 07	23.7±0.35	100.2±0.3	0.45±0.07	0.01±0.37
Venezia	N 45° 18.654'	E 12° 32.307'	15.5 – 20.5	Autumn 06	18.28±0.06	94.5±0.23	1.09±0.24	1.08±0.32
				Winter 07	11.14±0.006	92.9±1	1.23±0.09	0.9±0.09
				Spring 07	15.19±1.18	90.1±0.26	0.58±0.07	1.02±0.31
				Summer 07	23.9±0.1	100.2±1.1	0.8±0.14	1.24±0.27
Chioggia	N 45° 14.856'	E 12° 25.102'	20.8 – 22.3	Autumn 06	18.37±0.03	112.4±0.3	1.2±0.34	0.8±0.32
				Winter 07	11.3±0.04	99.4±0.3	1.2±0.18	1.8±0.57
				Spring 07	14.85±0.1	118.4±0.8	1±0.2	1.6±0.3
				Summer 07	23.53±0.1	88±2	0.3±0.1	0.7±0.2

The sampling activity was done in August 2007, when a total of 9 macrobenthic samples were carried out by scuba diving; samples were collected from 2,500 cm² squares (50 cm per side) in three replicates for each station through a vacuum sampler after scratching. The samples were immediately fixed with buffered 7% formalin in sea water.

During the sampling activity a photographic survey was carried out at the top of each outcrop, along an horizontal transect following the longitudinal axis of maximum development of the outcrops, at the maximum height from the surrounding sandy bottom. The results of this photographic survey of megabenthos were already discussed in Molin et al. (2008a).

In the laboratory, all samples were sieved by means of a 1 mm-mesh sieve, and organisms were sorted and then classified. All specimens were classified to the lowest possible taxonomic level (always the species), counted, weighted fresh and dry (105°C for 24h). For some colonial organisms such as Ascidiacea and Porifera, the percentage of coverage was also estimated.

The systematic distribution of species, specimens and biomass was analysed; the main systematic groups considered were Porifera, Cnidaria, Mollusca, Annelida Polychaeta, Sipunculida, Arthropoda Crustacea, Echinodermata and Chordata Tunicata.

From an ecological point of view, both the trophic function of the communities and the relationships among different components of the trophic web (primary and secondary consumers) were analyzed. The analysis was conducted in accordance with the approach adopted for hard substrate communities (Jones, 1973; Hiscock & Hoare, 1975; Gabriele et al., 1999). This analysis allows to highlight the different ecological strategies of the species, as well as their adaptation capacity with respect to environmental conditions. The analysis was done calculating the number of taxa and the biomass for each trophic group. The trophic groups considered were: filter feeders, detritivores, omnivores, carnivores (Boaventura et al., 1999); when it was not possible to assign the trophic group, the taxon was included in the indeterminate group. The dataset was also analysed from a morphological point of view, therefore taxa were divided in two main groups: non colonial forms and colonial forms.

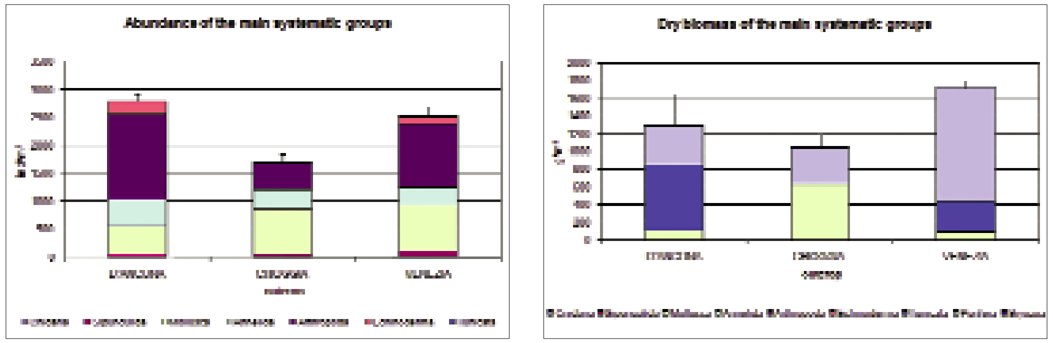
Multivariate analysis - All the macrobenthos data were divided in three main datasets: (a) biomass of all taxa, (b) abundance of non colonial taxa, (c) cover surface of colonial taxa. Bray & Curtis (1957) similarity indices were calculated from the three different sets of data. To test the hypothesis of higher similarity between samples within the same outcrop and to check the presence of significant differences among samples from different outcrops, the ANOSIM test was run from the three similarity matrixes. Then the macrozoobenthos samples were clustered by hierarchical methods (sensu Cormack, 1971) using the average linkage of similarity to group together the most similar samples. The samples were represented graphically by non-metric multi-dimensional scaling (MDS) where the cluster groups were superimposed. SIMPER (Clarke, 1993) was used to determine which species best characterize the communities of the different outcrops.

The main biotic indices were calculated: Richness, Total Abundance, Total Cover Surface, Total Biomass, Pielou dominance (Pielou, 1966) and Shannon-Wiener diversity (Shannon & Weaver, 1949). The average indices of the three stations were compared using the analysis of variance to verify that there were no differences between the average values of the

biotic indices. As for the values of Richness, Total Abundance, Total Cover Surface and Total Biomass, data were previously log-transformed, in order to make the variance more homogeneous and therefore maximize the effectiveness of the tests to highlight any difference.

Results

On the whole, 185 taxa were determined; they belong to 62 Arthropoda, 51 Mollusca, 39 Polychaeta, 15 Porifera, 9 Echinodermata, 7 Tunicata, 1 Cnidaria and 1 Sipunculida. Total abundance ranged between 960 ind/m² and 3,380 ind/m², while the average abundances for each outcrop were respectively: 2,787 ind/m² in D'Ancona, 1,680 ind/m² in Chioggia and 2,517 ind/m² in Venezia. Mollusca and Crustacea are the more abundant non colonial organisms in the outcrops; Crustacea are more abundant in D'Ancona and Venezia where they reach respectively the 55% and the 45% of total individuals, while in Chioggia the percentage is about 25%. On the contrary molluscs are 18% of total in D'Ancona, about 32% in Venezia and 49% in the Chioggia outcrop (fig. 2).



a b

Fig. 2. Distribution of samples average abundances (**a**) and biomass (**b**) in the main systematic groups (Cnidaria; Sipunculida; Mollusca; Annelida; Arthropoda/Crustacea; Echinodermata; Tunicata).

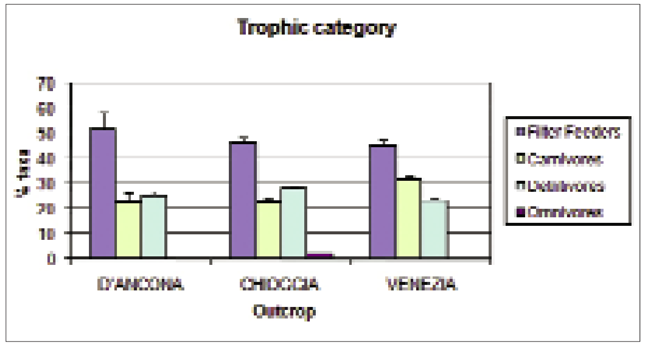


Fig. 3. Main trophic groups (filter feeders, carnivores, detritivores, omnivores): percentage of taxa.

Considering the total biomass of each systematic group, we can observe the relevant role of Porifera, Tunicata and Mollusca; the first two groups are more abundant in D'Ancona and Venezia outcrops while the third in Chioggia. In particular, with respect to the megabenthos component, the Chioggia samples totally lack large colonies of tunicates, as *Polycitor adriaticus* and *Aplidium conicum*, both quite common in the other outcrops considered (Molin et al., 2003, 2008a) (fig. 2).

In all outcrops filter feeder taxa are prevalent, followed by the groups of detritivores in the Chioggia and D'Ancona outcrops and carnivores in Venezia. Biomass distribution in trophic groups highlights the almost absolute dominance of filter feeders, which ranged from 97% of the total biomass in Chioggia and Venezia to 99% in the D'Ancona outcrop (fig. 3).

Multivariate analysis - The ANOSIM test revealed a good representation of the macrozoobenthic samples of different outcrops for every dataset (biomass of all taxa, abundance of non colonial taxa and cover surface of colonial taxa) with R values higher than 0.9. The main results are summarized in table 2. The macrozoobenthos samples are well clustered in three main groups that represent the three outcrops. The cover surface data samples have a similarity level of 12.5%, while the abundance data samples have a level of similarity of 39%. Biomass samples have a similarity level of 30%. The samples of the tegnùe D'Ancona and Venezia are more similar to each other, compared to the samples of the Chioggia outcrop.

The MDS representations of macrozoobenthos samples have low stress (stress = 0.05 ÷ 0.06) for every data set: (a) non colonial taxa abundance, (b) colonial taxa cover surface and (c) biomass of all taxa (fig. 4). The representation of similarity of cover surface samples (colonial taxa) highlights lower similarity between samples belonging to the same outcrop. In fact, only the D'Ancona group have a similarity level of 50% while Venezia and Chioggia are below 40%. The similarity representation of the abundances highlight the grouping of the samples from D'Ancona and Venezia at 40% of similarity, while within each tegnùa the samples have a similarity level higher than 50%. Biomass samples reflect the trend of abundance with a similarity level between the D'Ancona and Venezia samples of 40% and within each outcrop of 50%.

Tab. 2. Results from ANOSIM tests for the macrozoobenthos data.

Group	Original matrix of data	Factor	R	P (%)
Macrozoobenthos	Biomass (all taxa)	outcrop	0.984	0.4
	Abundance (non colonial taxa)	outcrop	0.987	0.4
	Cover surface (colonial taxa)	outcrop	0.867	0.4

The three representations (fig. 4) show some differences: abundances of non colonial taxa and biomasses of all taxa reach the highest level of grouping for outcrop, while the colonial taxa highlight more differences between samples within a single outcrop and also among different outcrops: only the D'Ancona samples are grouped at 40% similarity level.

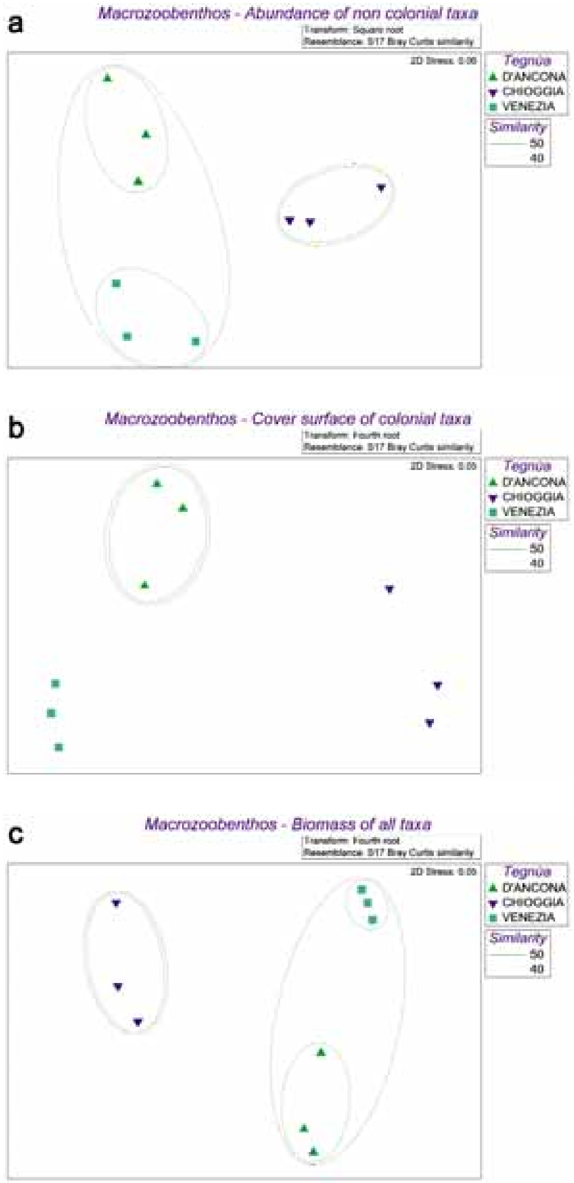


Fig. 4. Non metric Multi Dimensional Scaling (MDS) derived from Bray & Curtis (1957) similarities of abundance (**a**), cover surface (**b**), biomass (**c**) of macrozoobenthos.

Tab. 3. Main results of SIMPER test on the biomass data: species of the three outcrops that better explain the similarity between samples collected in every single area.

	Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
D'ANCONA	*Cliona viridis*	3,14	8,91	17,58	16,56	16,56
Similarity: 53.81	*Gastrochaena dubia*	1,54	4,49	11,41	8,34	24,9
	Lithophaga lithophaga	1,51	3,61	9,89	6,7	31,6
	Sarcotragus spinosulus	1,38	2,97	1,76	5,51	37,11
	Muricopsis cristata	1,08	2,93	22,39	5,45	42,55
	Striarca lactea	0,91	2,41	12,87	4,47	47,02
	Ophiothrix fragilis	0,86	2,29	5,6	4,25	51,28
CHIOGGIA	*Dysidea avara*	1,83	4,24	17,19	7,99	7,99
Similarity: 53.09	*Gastrochaena dubia*	1,66	3,95	5,7	7,44	15,42
	Mimachlamys varia	1,66	3,27	2,1	6,16	21,58
	Clathria sp.	1,86	3,16	1,83	5,95	27,53
	Ostrea edulis	2,14	2,5	0,58	4,72	32,25
	Arca noae	1,78	2,5	1,08	4,71	36,96
	Calliostoma zizyphinum	1,02	2,34	3,06	4,4	41,36
	Hymeniacidon perlevis	1,83	2,31	0,58	4,35	45,71
	Nassarius incrassatus	0,84	2,08	7,36	3,92	49,62
	Hiatella arctica	0,79	1,9	5,07	3,58	53,21
VENEZIA	*Ircinia variabilis*	3,18	7,04	13,58	12,15	12,15
Similarity: 57.91	*Aplysina aerophoba*	2,99	6,61	13,44	11,41	23,56
	Hippospongia communis	2,83	6,27	13,69	10,83	34,38
	Polycitor adriaticus	2,2	2,23	0,58	3,85	38,24
	Aspidosiphon muelleri	1,02	2,22	15,18	3,84	42,07
	Muricopsis cristata	1,13	2,18	6,27	3,76	45,84
	Chondrosia reniformis	2	2,11	0,58	3,64	49,48
	Nassarius incrassatus	0,9	1,95	16,81	3,36	52,84

For each outcrop, the species that contribute together to a samples similarity of about 50% are listed in table 3. In the D'Ancona and Chioggia samples most species are bivalves and few species are sponges while in the Venezia samples most species are sponges (*Ircinia variabilis*, *Aplysina aerophoba*, *Hippospongia communis*, *Chondrosia reniformis*), only two are gastropods (*Muricopsis cristata*, *Nassarius incrassatus*), one is a sipunculid (*Aspidosiphon muelleri*) and one is an ascidian (*Polycitor adriaticus*).

Chioggia and Venezia samples display higher dissimilarity (71%) than Venezia and D'Ancona samples dissimilarity (63%). D'Ancona and Chioggia samples dissimilarity (68%) is closer to the values characterizing Venezia and Chioggia.

Biotic indices - The analysis of the main biotic indices highlights that the higher values of richness (S), total cover surface and biomass, Pielou dominance (J') and Shannon-Wiener diversity (H') (log_2) are reached in the tegnùa Venezia. This trend is not confirmed in the total abundance, which reaches the maximum value in the D'Ancona outcrop, but is quite similar to that of Venezia (tab. 4).

Tab. 4. Average values ± S.D. of main biotic indices calculated from macrozoobenthos samples.

Biotic indices	D'ANCONA	VENEZIA	CHIOGGIA
Richness	61 ± 13.5	67 ± 8	60 ± 12.5
Total abundance	697 ± 135	629 ± 170	420 ± 156
Total cover surface	452 ± 157	1155 ± 363	318 ± 167
Total biomass	321 ± 358.5	431 ± 78	261 ± 137
Pielou	0.77 ± 0.08	0.85 ± 0.03	0.78 ± 0.06
Shannon - Wiener	4.4 ± 0.4	5 ± 0.1	4.5 ± 0.6

Tab. 5. Results of the analysis of variance (ANOVA) between averages of the main biotic indices calculated from the macrozoobenthos data of different outcrops. *All taxa = calculated from dry biomass data. **Non colonial taxa = calculated from abundance data. ***Colonial taxa = calculated from cover surface data.

Data set			**All taxa**			**Non colonial taxa**			**Colonial taxa**		
Biotic indices	*gdl*	F_{critic}	*MS*	*F*	*P*	*MS*	*F*	*P*	*MS*	*F*	*P*
Richness ln(S)											
Between outcrops	2	5,14	0,014	0,361	0,711	0,008	0,171	0,847	0,183	3,886	0,083
Within outcrops	6		0,038			0,046			0,047		
Total biomass, abundance and cover surface											
Between outcrops	2	5,14	0,423	0,837	0,478	0,253	2,477	0,164	1,497	6,677	0,030
Within outcrops	6		0,505			0,102			0,224		
Shannon-Wiener H' (log 2)											
Between outcrops	2	5,14	0,889	12,658	0,007	0,250	1,454	0,306	1,144	14,859	0,005
Within outcrops	6		0,070			0,172			0,077		
Pielou j'											
Between outcrops	2	5,14	0,023	7,910	0,021	0,005	1,383	0,321	0,091	9,832	0,013
Within outcrops	6		0,003			0,003			0,009		

The analysis of variance (ANOVA) highlights more variability in the indices calculated from colonial taxa than others. Significant differences between stations result for many indices calculated on this macrobenthic component. Total cover surface, Shannon-Wiener diversity (H' (log_2)) and Pielou dominance (J') show significant differences between outcrops. The level of biodiversity and equitability measured in the offshore outcrop Venezia are significantly higher (tab. 5). Non colonial taxa do not show significant differences between outcrops, which imply a greater homogeneity of this component of the macrobenthos. The comparison between indices calculated from the biomass of all taxa reflects the important contribution in terms of biomass given by colonial fauna. In fact, also for this parameter the analysis of variance highlights significant differences for Shannon-Wiener diversity (H' (log_2)) and Pielou dominance (J') between outcrops.

Discussion and conclusions

The macrobenthic community of three North Adriatic outcrops was investigated and 185 taxa were observed. High diversity indices and rich communities were observed in the three sampling stations; nevertheless, species distribution in the study area seems to be not homogeneous, as observed before by many authors (Mizzan, 1992; Gabriele et al., 1999; Molin et al., 2008a; AA.VV., 2010; Fava et al., 2009; Ponti et al., 2011), and it seems to be regulated by the different species tolerance to variability in local environmental conditions.

The investigated outcrops are in fact characterized by different distance from the main terrigenous input of the coast; as a result, chemistry and physics of the water column, acting directly and indirectly on the benthonic organism, may be different in different site (Socal et al., 2002, 2008; Boldrin et al., 2005).

The balance among coastal water (rich in nutrients and organic matter), Modified Levantine Intermediate Water (MLIW) (rich in O_2 and poor of nutrients), the Northern Adriatic Dense Water (NADW) generated locally in winter (Theocharis et al., 2002; Socal et al., 2008) and the influence of wave motion significantly affect environmental variables like dissolved oxygen concentration, water turbidity and sedimentation rates at the bottom. All these factors affect directly the mechanisms of breathing and feeding of many filter feeders species (the main trophic group found in these environments) (Airoldi, 2003; Relini & Giaccone, 2009).

The characteristics of the non colonial fauna of the three outcrops investigated are more similar and show lower differences of diversity level and abundance than colonial taxa. In D'Ancona and, secondarily, in Venezia were recorded the highest abundances, with Crustacea being the dominant taxon, while in Chioggia the molluscan gastropods are the most abundant systematic group.

Concerning colonial taxa, the studied communities show higher biodiversity in the Venezia offshore station, where colonial filter feeders reach also the highest level of biomass (tab. 6), with large colonies of Porifera and Ascidiacea both in scraped samples and photographic samples (Molin et al., 2008). These species probably need more favourable and stable conditions for their slow growth and they prefer the clearer and deeper water of offshore marine areas (Carballo et al., 1996; Narajo et al., 1996; Molin et al., 2006, 2008; Molin & Berton, 2007). A decrease in species number, abundance and biomass as well as diversity is observed along a gradient from the Venezia to Chioggia; moreover the D'Ancona and, especially, the Chioggia outcrops are characterized by a greater presence of species related to the detritus chain, a clear sign of higher turbidity levels.

In the northern Adriatic ecosystem, the relationship between the abundance of some species (*P. adriaticus*, *A. conicum*, *Styela plicata, Chondrosia reniformis*) and the distance from the main terriginous imputs from the coast, and therefore water turbidity and sedimentation rates, has been already observed (Gabriele et al., 1999; Ponti & Mastrototaro, 2006; Casellato & Stefanon, 2008; AA.VV., 2010; Ponti et al., 2011).

Some of these observations were confirmed by the results of the Veneto Region's project called "Tegnùe dell'Alto Adriatico. Valorizzazione della risorsa marina attraverso lo studio di aree di pregio ambientale" (AA.VV., 2010). On the other hand, the absence of some species or the lowest abundance of large colonies of some Porifera and Ascidiacea near

Tab. 6. Total dry biomass of tunicates and sponges species collected in the three outcrops.

TAXA	Species	D'ANCONA	CHIOGGIA	VENEZIA
		g/m² d.w.	g/m² d.w.	g/m² d.w.
ASCIDIACEA	*Microcosmus sulcatus*	10.80	7.08	0
	Pyura sp.	1.89	0	6.48
	Didemnidae sp.	1.37	0	2
	Didemnum maculosum	0.43	0.68	0.45
	Polycitor adriaticus	715.84	0	323.25
	Ascidiacea sp.	0	0	0
	Chondrosia reniformis	0	0	217.71
PORIFERA	*Hippospongia communis*	2.65	0	257.46
	Ircinia variabilis	0	0	408.53
	Aplysina aerophoba	0	0	317.95
	Cliona viridis	407.19	0	89.15
	Tethya sp.	0	32.93	1.07
	Chondrilla nucula	0.82	0	0.60
	Sycon raphanus	0.01	0	0.01
	Sarcotragus spinosulus	25.71	49.17	0
	Dysidea avara	5.1	0	0
	Hymeniacidon perlevis	3.01	0	0
	Clathria sp.	0	59.46	0

Fig. 5. Photographic sample of an *A. conicum* colony subject to hypoxia due to a mucilaginous bloom in March 1999.

the coast is reported also in recent studies performed in stations located in front of the Sile river mouth in an artificial reef (Molin et al., 2006, 2008b) and in the artificial barrier installed along the Lido di Venezia coast (Magistrato alle Acque di Venezia & SELC, 2007, 2009).

Some species are more sensitive to sedimentation rates and turbidity of the water column, while others are able to exploit this immense source of energy, making it available to the whole food chain. Figure 5 shows a large colony of *A. conicum*, one of the species which are assumed to suffer high sedimentation rates and therefore often prefer positions faraway, exposed to currents or elevated from the sandy bottom, photographed during the dystrophic crisis with mucilaginous bloom of 1999, in the D'Ancona outcrop. The organic material fallout on the seabed caused the occurrence of degenerative phenomena in some colonies.

Present knowledge suggests that this component of the ecosystem can be used as a bioindicator to check the quality of entire communities and to verify the presence of impacts of natural or anthropic origins, especially in a dynamic framework of observations over time. For example, climate change and the consequent alterations in regional water systems can modify the inputs of continental waters, the characteristics of the water column in the sea and the structure of biological communities. The ability to detect changes in the structure of biological communities by means of key-species especially sensitive to environmental changes, in this case to water turbidity and sedimentation rates at the bottom, as a consequence of terrigenous loads coming from the coast, may be an essential element for the easy and fast monitoring of the entire ecosystem.

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