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Polychaete distribution, diversity and seasonality related to seagrass cover in shallow soft bottoms of the Tyrrhenian Sea (Italy)*

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SUMMARY: Polychaete distribution, diversity and seasonality were studied in relation to covering of the small phanerogams *Cymodocea nodosa* and *Zostera noltii* in shallow soft-bottoms off the island of Ischia (Tyrrhenian Sea, Italy). Samples were collected bimonthly from July 1988 to May 1989 from four stations, selected for seagrass meadows of different physiognomy and shoot density, and in a bare sandy bottom nearby, selected as a non-vegetated reference habitat. Two meadow compartments were considered: the leaf stratum and the sediment. A hand-towed net was used to sample vagile organisms living in the leaf stratum, while PVC corers were utilized for the sediment fauna. Stratification within the sediment was studied considering three layers (0-5 cm, 5-10 cm and > 10 cm deep). On the whole a total of 4640 individuals of polychaetes, belonging to 119 species, were collected; 4061 individuals and 115 taxa were found in the core-samples, and 579 individuals and 35 taxa in the net-samples. Polychaete diversity and abundance was higher in both meadow compartments and in all seasons in the station located in the meadow where more sheltered conditions occurred, high silt-clay and organic matter content in the sediment were observed. In addition, this is where higher shoot density, plant Leaf Area Index (LAI) and Leaf Standing Crop (LSC) were recorded. Whereas, lower diversity and higher patchiness (differences among core replicates) were always recorded in the less vegetated stations, and on the bare sandy bottom. The polychaete populations of the sediment layers showed their lowest diversity and abundances in summer. Whereas, the populations associated with the leaf stratum showed an opposite trend with higher development (number of species and individuals) in summer (July-September), consistent with the higher values of all the plant phenological parameters recorded (shoot density, LAI and LSC). In all stations and seasons, the polychaetes were concentrated (84% of the whole abundance) in the upper sediment layer (0-5 cm) and decreased strongly in the deeper sediment layers. Faunistic differences were recorded mainly between the leaf stratum and the sediment populations. The interstitial Syllidae *Exogone naidina*, *Parapionosyllis elegans, Sphaerosyllis thomasi,* dominated in the leaf stratum; while endofaunal forms, such as *Neanthes caudata, Peresiella clymenoides, Heteromastus filiformis, Notomastus latericeus* and *Euclymene collaris,* dominated at the sediment level. The differences in polychaete community structure observed between the sites studied can be explained by the coupling of abiotic conditions (in particular the reduced hydrodynamics and sediment features) and meadow structure and habitat complexity characterized by plant phenological features (e.g., shoot density, LAI, LSC). The seasonal and microdistributional (sediment and leaf stratum) patterns within each of the meadow stations are influenced by ecology and life history of single species, and probably by the higher predation pressure occurring in some seasons. These results suggest that at least for small-sized and less mobile organisms, like polychaetes generally, meadow structure, shoot density and other phenological plant features influence species composition and abundances both at large (between-meadows) and smaller (within-meadow) spatial scale.

Key words: Polychaeta, seagrass, soft bottoms, *Cymodocea nodosa, Zostera noltii,* distribution, diversity, seasonality, Mediterranean Sea.

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RESUMEN: DISTRIBUCIÓN, DIVERSIDAD Y ESTACIONALIDAD DE LOS POLIQUETOS EN RELACIÓN AL RECUBRIMIENTO DE FANERÓGAMAS EN FONDOS BLANDOS LITORALES DEL MAR TIRRENO (ITALIA). – Se ha estudiado la distribución, diversidad y estacionalidad de poliquetos en la isla de Ischia (Mar Tirreno, Italia), en relación al recubrimiento de pequeñas matas de *Cymodocea nodosa* y *Zostera noltii*. Las muestras se recogieron cada dos meses desde julio de 1988 a mayo de 1989, en praderas con distinta distribución y densidad de matas y en otra estación sin matas como lugar de referencia. Se consideró tanto la fauna de las hojas de las fanerógamas como los sedimentos. La fauna vagil se recolectó mediante una red manejada a mano y el sedimento mediante cores de PVC de los que se consideraron tres estratos (0-5 cm, 5-10 cm, > 10 cm de profundidad). Se recolectaron 4640 individuos pertenecientes a 119 especies (4061 ind. de 115 taxa en los cores y 579 ind. de 35 taxa en las muestras de red). Las mayores densidades y mayor diversidad (tanto en el sedimento como en las hojas como estacionalmente) se observó en las praderas en zonas protegidas de las corrientes, con una mayor relación finos/arenas, contenido de materia orgánica, densidad de plantas, índice de cobertura de hojas (LAI) como el de biomasa de las mismas (LSC). La menor densidad y diversidad de poliquetos se observó en praderas con una menor densidad de matas y zonas más expuestas a las corrientes. La menor densidad de poliquetos en el sustrato arenoso se observó en verano mientras que en las hojas, el verano fué la mejor época. En todas las épocas del año y en todas las zonas prospectadas la densidad de poliquetos fué mayor (84 %) en los primeros 5 cm para decrecer fuertemente hacia los estratos inferiores. Las mayores diferencias faunísticas se observaron entre sedimento y hojas. Los Sílidos intersticiales *Exogone naidina, Parapionosyllis elegans, Sphaerosyllis thomasi* fueron dominantes en las hojas, mientras que en el sedimento dominaron, *Neanthes caudata, Peresiella clymenoides, Heteromastus filiformis, Notomastus latericeus* y *Euclymene collaris*. Las diferencias observadas entre la estructura de las comunidades de poliquetos estudiadas se pueden explicar por factores abióticos (hidrodinamismo y tipo de sedimento) conjuntamente con factores ligados a la heterogeneidad del hábitat debida a la morfología de las praderas. Las variaciones estacionales y las observadas en la microdistribución (entre sedimento y hojas) se explican por los propios ciclos de vida de las especies y por la depredación que reciben en algunas épocas del año. Los resultados obtenidos sugieren que para organismos como los poliquetos, la densidad de las matas de la pradera y sus características morfológicas determinan la densidad y diversidad de especies tanto, a gran escala (entre praderas) como, a pequeña escala (entre matas).

Palabras clave: Poliquetos, praderas de fanerógamas, fondos blandos, *Cymodocea nodosa, Zostera noltii,* distribución, diversidad, estacionalidad, Mar Mediterráneo.

INTRODUCTION

Several studies on seagrass-associated benthic communities have demonstrated the richness, both in species and individuals, of these systems (Young and (Young, 1977; Kikuchi, 1980; Howard *et al.*, 1989), especially when compared with bare soft-bottoms (Stoner, 1980; Young and Young, 1982; Hicks, 1986). This pattern has been mainly attributed to the effect of the "structural complexity" of the seagrass canopy, often expressed as plant density and/or standing crop, and plant "architecture" or configuration (Orth *et al.*, 1984; Virnestein and Howard, 1987; Stoner and Lewis, 1985). Shoot density, or leaf surface and biomass, strongly affects the composition and abundance of the fauna associated with seagrasses, as plants provide additional microhabitats, increase substratum and food resources, and shelter from physical factors and from predation (Stoner, 1980; Heck and Orth, 1980; Lewis and Stoner, 1983; Bell and Westoby, 1986 a, 1986 b; Hall and Bell, 1988). Seagrass shoots represent also a kind of "structure of retention" that may increase larval settlement and/or reduce larval emigration to other sites (Eckmann, 1987). However, studies on relatively large and highly mobile organisms (e.g., fishes and decapod crustaceans), that include experimental manipulation of shoot-density, demonstrated that density had an effect mainly at small scale and within-bed level and not at larger scale or between-bed level (Bell and Westoby, 1986 a, 1986 b). Moreover, individual faunistic groups or single species may show different patterns of distribution and abundance at increasing spatial complexity of the habitat (Edgar, 1990). Furthermore, the relationships with meadow structure may be more evident for epifaunal organisms associated with the leaf stratum, than for the infaunal organisms which are more or less buried in the sediment (Howard *et al.*, 1989). Thus, various patterns can be recognized depending on both the type of seagrass and taxa analyzed.

In the Mediterranean Sea, studies on seagrass associated animals have been carried out mainly on *Posidonia oceanica* (L.) Delile, the endemic species building up a complex and unique ecosystem (Mazzella *et al.*, 1992). The fauna associated with small phanerogams, such as *Cymodocea nodosa* (Ucria) Ascherson and *Zostera noltii* Hornemann, has been relatively less studied (Lanera and Gambi, 1993) despite the fact that these plants, after *P. oceanica,* are the most common and widespread seagrass systems of the Mediterranean Sea (Mazzella *et al.*, 1993).

Cymodocea nodosa and *Z. noltii* form more depth-limited and less extended meadows than *P. oceanica*. They colonize various types of shallow sediments, often in front of river mouths. Both species show the prevalence of "r strategy" traits in their life-history (Buia and Mazzella, 1991), and marked spatial and seasonal fluctuations in plant density, standing crop and production (Buia and Mazzella, 1991; Mazzella *et al.*, 1993). Similar to *P. oceanica* beds, it is possible in *C. nodosa* and *Z. noltii* meadows, to recognize meadow compartments characterized by different microclimatic conditions: the leaf-stratum and the rhizome-sediment layer (which in these species develops below-ground). These systems show an intermediate degree of complexity compared to both soft bottoms (lower structural complexity) and *P. oceanica* beds (higher complexity), and therefore seem particularly suitable to study the relationships between habitat structural complexity and the patterns of distribution, abundance and diversity of the associated fauna (Gambi *et al.*, 1996). Most of the investigations on faunal distribution in these systems deal mainly with faunistic analysis (Ledoyer, 1966, 1968; Harmelin and True-Schlenz, 1963), while the potential role of meadow structure and plant phenology in structuring the associated benthic communities has been hypothesized only in a few studies (True-Schlenz, 1965; Lanera and Gambi, 1993). Recently, Connolly and Butler (1996) have experimentally tested that in some Mediterranean meadows, reduction (leaf height) or removal of the *C. nodosa* canopy caused a dramatic decline in the abundance of the main taxonomic groups of motile epifaunal species and a change of their size range towards larger dimensions. The study of the relationships between vagile fauna and plant phenology has also been approached by Scipione *et al.* (1996) by analyzing distribution and community structure of invertebrates associated with the leaf strata of both shallow *P. oceanica* and *C. nodosa-Z. noltii* meadows in relation to the seasonal changes in their canopy structure and phenology. In that study, the two *Cymodocea-Zostera* meadows studied were characterized by different exposure to water movements, sediment features, and structure and physiognomy (e.g. shoot density). A positive correlation (linear regression) was found in the more dense *Cymodocea* meadows studied, between the total number of vagile species and the Leaf Area Index (LAI), and between number of mollusc species and plant density, LAI and Leaf Standing Crop (LSC). In the other, less dense *Cymodocea* stand, LAI and LSC were positively correlated only with the whole number of individuals and with individuals of crustacean decapods (Scipione *et al.*, 1996).

The aim of this paper is to discuss in more detail the data on polychaetes collected in the leaf stratum, during the above mentioned study, and to compare them with the assemblages sampled in the sediment layers of the same *Cymodocea-Zostera* meadows, characterized by different exposure to water movement and physiognomy, and of a bare soft bottom considered as a reference non-vegetated habitat (Gambi *et al.*, 1996). Spatial and seasonal changes in species composition, abundance and other structural parameters (e.g., diversity), as well as the small-scale distribution between the seagrass compartments (leaf stratum and sediment layers) were analyzed in relation also to shoot density of the meadow and other plant phenological parameters. Polychaetes are particularly suitable for this study since they show a very high diversification in species compostion and life habits in seagrass systems (Hutchings *et al.*, 1992; Somaschini *et al.*, 1994), including small-phanerogam meadows (Lanera and Gambi, 1993).

STUDY AREA AND METHODS

The study site was located in front of a sandy beach (San Pietro beach) on the northern side off the Island of Ischia (Gulf of Naples, Italy) (Fig. 1). Surface-water temperature during the study period ranged between 27 ºC in July and 13 ºC in February. Part of this area is protected from wind-driven wave action by artificial rocky barriers perpendicular and parallel to the coast. In this zone, bare sandy bottoms as well as *C. nodosa-Z. noltii* meadows occurred (Buia *et al.*, 1985). Four sampling sites were established in the area: Station 1 was at 3 m depth, located near the eastern side of the perpendicular barrier where more sheltered conditions occur. In this zone, *C. nodosa* formed a mixed meadow with *Z. noltii*. The two species developed a "turf" (about 20 cm thick) characterized by a dense interlacing of their rhizomes and roots (Buia *et al.*, 1985). Station 2 was located at 3 m depth, on the western side of the barrier. This area was more exposed to wave action and only *C. nodosa* occurred in large patches settled on a sandy bottom. No "turf" was present. Stations 3 and 4 were both at 4.5 m depth, located at the end of the barrier. Station 3 was on bare sand not colonized by the seagrass, while station 4 was in the vegetated area at the lower limit of a meadow characterized only by *C. nodosa,* not forming the 'turf'.

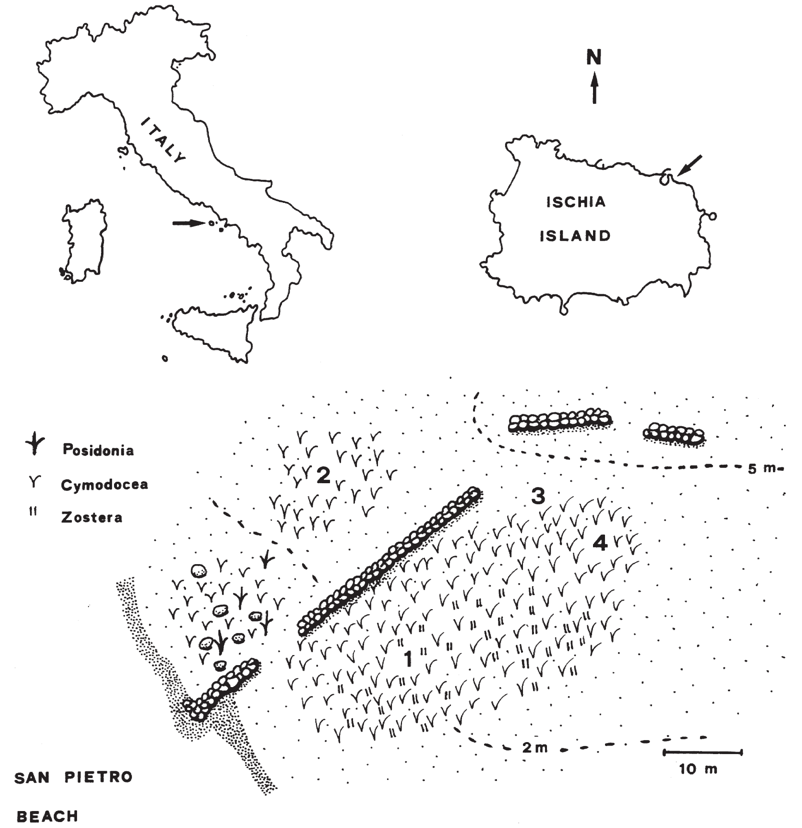

FIG. 1. – Map of the investigated area with the location of the sampling Stations (1, 2, 3 and 4).

Plant density and some plant phenological features were measured each month from July 1988 to May 1989 at Stations 1 and 2, and only in July and February at Station 4, in the framework of a study on plant dynamics (Cancemi, 1991; Di Leva, 1994). At Station 1, both *C. nodosa* e *Z. noltii* together, reached densities up to 1725 shoots m^{-2} in September and 975 shoots m^{-2} in November (Cancemi, 1991), while, at Station 2, *C. nodosa* alone ranged from 942 shoots m^{-2} in September to 555 shoots m^{-2} in May (Cancemi, 1991). At Station 4 (lower depth limit of the bed), the lowest densities were recorded, from about 500 shoots m^{-2} in July to 375 shoots m^{-2} in February. The Leaf Area Index (LAI, m^2/m^2), which represents the leaf surface in 1 square meter of substratum, was maximum between July and September, and decreased sharply from November through April-May, at Stations 1 and 2. However, LAI was almost twice at Station 1 (between 3.5 and 0.3 m^2/m^2) than at Station 2 (between 1.6 and 0.1 m^2/m^2) in all months. The Leaf Standing Crop (LSC, g m^{-2} dry weight), which represents leaf biomass in 1 square meter of substratum, showed a seasonal trend similar to that of the LAI at both stations. Also the LSC was almost twice that at Station 1 (between 138 and 30 g m^{-2} d.w.; Cancemi, 1991) than at Station 2 (between 68 and 12 g m^{-2} d. w.; Di Leva, 1994).

Exposure to water movement at the four studied stations was estimated using the “plaster dissolution” method which measures losses in weight by plaster balls during fixed periods of field exposure (Gambi *et al.*, 1989 a). Measurements were made, in each sampling month, by placing plaster balls at each station at two different levels: about 5 cm above the bottom (bottom level, 16 balls), and above the plant canopy at about 80 cm above the bottom (canopy level, 16 balls). The plaster balls were recollected after 48 hours and weighed (dry weight). The parametric Student t-test was performed to assess differences among the means of plaster consumption between stations and levels, regardless of the sampling season.

Sediments were collected and analyzed only in July at each station using small corers for granulometric, structural and chemical measurements.

Pelites (silt and clay) and other granulometric fractions were measured using conventional methods (Buchanan, 1984). Carbonate content was measured after digestion of a sediment subsample with HCl 1N; Organic matter content was measured after combustion at 450 ºC for 5 h.

Faunal samples were collected bimonthly from July 1988 to May 1989 at Stations 1 and 2, while for Stations 3 and 4 samples were collected only in July and January. The fauna on the leaves was sampled only in the vegetated stations 1, 2 and 4. Samples (herein referred to as "net-samples") were collected by means of a hand-net (0.4 mm mesh size) that was towed over the seagrass canopy, according to a standardized technique with a series of strokes (60) to shake the leaves (Russo *et al.*, 1985). One net-sample was taken for each station and sampling month, and was considered to be representative of the assemblage according to a previous study (Lanera and Gambi, 1993). The fauna living in the sediment (herein referred to as "core-samples") was collected by means of corers. Each corer consisted of a PVC tube 10 cm in diameter and 25 cm in height (surface = 78.5 cm^2), with a 0.4 mm mesh net on top, that was inserted about 20 cm into the sediment. To study the stratification of the animals within the sediment, each core sample was separated in three layers 0-5 cm, 5-10 cm and > 10 cm (generally 10-20 cm). Material of each level was sieved at 0.4 mm mesh net, the shoots sampled at the sediment surface were washed and the associated fauna was considered as belonging to the first layer (0-5 cm). At each site, during each sampling period, five core replicates were collected. Due to the fact that the corer technique collects quantitative samples, while the hand-towed technique collects semi-quantitative samples, the number of individuals found using the two methods cannot be compared. However, differences among stations can be evaluated comparing data from the same method. The samples here considered are those collected in the leaf stratum (Scipione *et al.*, 1996), and for those of the sediment layers during the months of July, November, January and May. The index of species diversity (H; Shannon and Weaver, 1949) and evenness (J) (Pielou, 1969) were calculated for each hand-net sample and core replicate. Statistical correlation (non parametric Spearman rank pairwise test) between structural parameters of both core and hand-net populations (no. of species and individuals, H' and J) and shoot density, LAI and LSC recorded at the same meadow stations and sampling months, were calculated. Only for quantitative core-samples an Analysis of Correspondences (AC; Benzecri, 1973) was performed on a matrix based on actual species abundances. Significance of the factors was tested according to Frontier (1974). A cluster analysis was finally performed on the core samples, based on the Bray-Curtis similarity and utilizing the technique of the 'average linkage clustering' (Bray and Curtis, 1957).

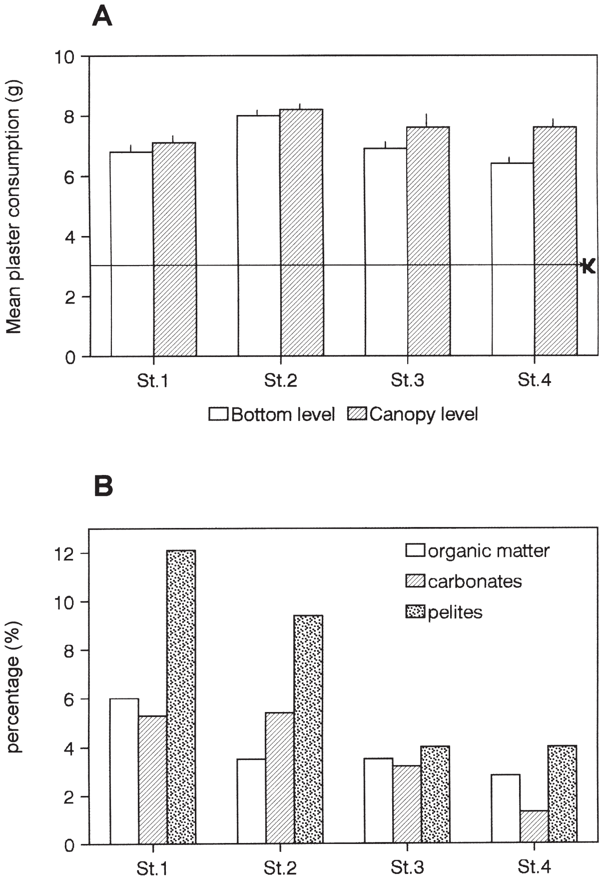

FIG. 2. – (A) Trend of the mean consumption of plaster at bottom and canopy level in the studied stations. K= constant of plaster consumption in still water (Gambi *et al.*, 1989 a). Values are means of five seasonal measurements; bars represent standard deviations. (B) Trend of the percentage of organic matter, carbonate and pelite contents in the sediment of the studied stations (data of July).

RESULTS

Water movement and sediment analysis

In all studied months mean plaster consumption recorded at Station 2, and at the "canopy" levels of all stations, was slightly greater (Fig. 2a) but not significantly different (parametric t-test), in each sampling month, between stations or between levels of the same station. The sediment granulometry was very similar at all stations, and was mainly characterized (over 55%) by well sorted fine sands (0.125 mm mean grain size). The highest value of the pelites (silt and clay) was recorded in Station 1 (Fig. 2b). The organic matter content was higher in Station 1, while the carbonate contents were higher both at Stations 1 and 2.

Faunistic analysis

Polychaetes represented 27% of the whole abundance of the benthic taxa collected, and were only exceeded by molluscs (38%). Other abundant macrobenthic groups were crustacean amphipods, tanaids, cumaceans and decapods (Scipione *et al.*, 1996). A total of 4640 individuals of polychaetes belonging to 119 taxa (classified at species and genus levels) were collected, 4061 individuals and 115 taxa were found in the core-samples (Table 1), and 579 individuals and 35 taxa in the net-samples (Table 2). Twenty-nine species were present both in net- and core-samples, 86 and 6 taxa were exclusive from core-samples and net-samples, respectively. Forty-five taxa occurred only in a single sample with one or a few individuals. On the whole, the Syllidae were the most common family, both as number of species (33) and individuals (2103). They were mainly represented by interstitial forms of the sub-family Exogoninae *(Exogone* spp., *Sphaerosyllis* spp., *Parapionosyllis* spp.). Other abundant families were Capitellidae, Spionidae and Nereididae, this latter represented mainly by *Neanthes caudata.*

Comparison between stations

A total of 91 taxa and 2288 individuals were found at Station 1. Thirty-two taxa were collected exclusively at this site, among them the most abundant were *P. ilvana, E. collaris, E. verugera, L. gracilis* and *C. duneri*. Other abundant, but not exclusive species were *N. caudata, S. thomasi, E. naidina* and *S. garciai*. A total of 48 taxa and 2071 individuals were collected at Station 2. Eight taxa were exclusively found at this station but were represented by a few individuals. The most abundant species were *C. minimus, P. elegans* and *P. clavata*. A total of 11 taxa and 22 individuals were collected at Station 3 where, both in July and January, only one of

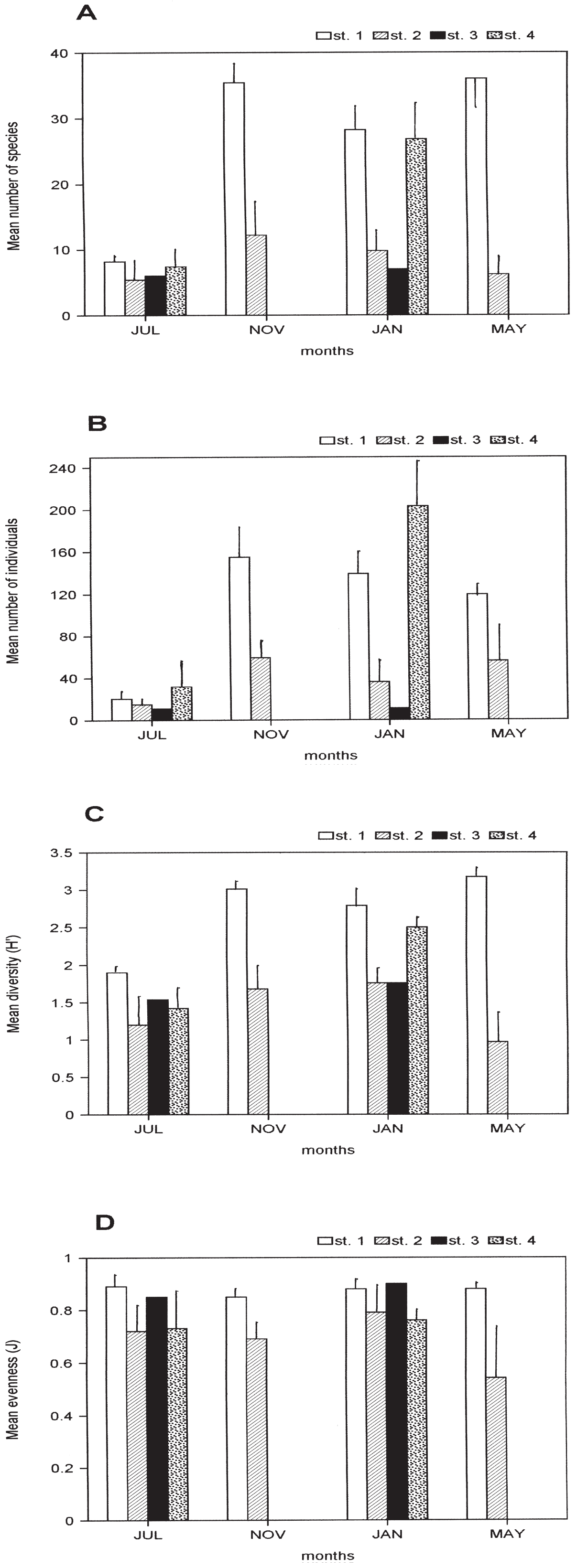

FIG. 3. – Trend of the mean number of species (A), individuals (B), diversity (C) and evenness (D) of the polychaete populations of the core samples of the studied stations and months. Bars represent standard deviations.

TABLE 1. – List of taxa found and actual number of individuals in the core samples. Values of the five core replicates of each stations have been pooled. (To report the data to square meter multiply each value by 25.5).

Stations and month of sampling	1 Ju	2 Ju	3 Ju	4 Ju	1 No	2 No	1 Ja	2 Ja	3 Ja	4 Ja	1 Ma	2 Ma
ORBINIIDAE												
Scolaricia typica Eisig			1	1		3	1	7	2	1	2	9
Scoloplos armiger (O.F. Muller)	1	6	2	3							1	
Phylo foetida ligustica Orlandi		2										
Orbinidae juv.						3						
PARAONIDAE												
Paradoneis ilvana Castelli	5				5		3			17	2	
Paradoneis lyra (Southern)					17		2			1	35	
Aricidea (Acmira) catherinae Laubier					9	3		3	1	9	3	1
Paraonides neapolitana (Cerruti)								1			1	
Cirrophorus furcatus (Hartman)											1	
Paraonidae n.d.										1	2	
SPIONIDAE												
Malacoceros fuliginosus (Claparède)										1		
Prionospio cirrifera Wiren					16		2			5	12	
Prionospio malmgreni Claparede					33	14	31	2	4	108	50	
Prionospio n.d.										1		
Pseudopolydora antennata (Claparède)		2			1		2			1	1	
Spio decoratus Bobretzki								8	1	2		
Spio filicornis (O.F. Muller)											2	
Microspio mecznikovianus (Claparède)					30	10	19	1		12	24	
Aonides oxycephala (Sars)					9		3				14	
Aonides paucibranchiata Southern											1	
Polydora quadrilobata Jacobi											1	
Scolelepis tridentata (Southern)					1							
MAGELONIDAE												
Magelona alleni Wilson										1		
CHAETOPTERIDAE												
Spiochaetopterus costarum (Claparède)											3	
CIRRATULIDAE												
Caulleriella alata (Southern)					3	1	1		9		1	
Chaetozone setosa Malmgren						3			3	16		
Tharyx marioni (Saint-Joseph)	2			7	2					1		
Capitomastus minimus (Langerhans)					3	92	13	60	1	55	4	211
Notomastus latericeus Sars					30		24				20	
Mediomastus capensis Day					6	1	2			3	5	
Mediomastus fragilis Rasmussen					4	1	1	1		1		2
Leiochrides sp.							1					
Pseudoleiocapitella fauveli Harmelin					1						1	
MALDANIDAE												
Clymenella sp.										1		
Euclymene collaris Claparède					68		27				27	
Euclymene oerstedi Claparède	13			1	8		2			3	11	
Euclymene palermitana Grube	9				1		8			4	1	
Euclymene sp.					2		2			4	5	
Praxillella lophoseta (Orlandi)					3		2				3	
Praxillella praetermissa (Malmgren)											1	
Clymenura clypeata (Saint-Joseph)					2						2	
Axiothella constricta (Claparède)					1		1				5	
OPHELIIDAE												
Armandia sp.							3			2	1	
PHYLLODOCIDAE												
Phyllodoce sp.					1							

Stations and month of sampling	1 Ju	2 Ju	3 Ju	4 Ju	1 No	2 No	1 Ja	2 Ja	3 Ja	4 Ja	1 Ma	2 Ma
Pirakia punctifera Grube											2	
Phyllodoce laminosa Savigny		1										
SIGALIONIDAE												
Sthenelais boa (Johnston)				2								
Psammolyce arenosa Delle Chiaje										1		
SYLLIDAE												
Exogone dispar Webster	4	2		1	2		48			5	12	
Exogone naidina Oersted					43	3	57	1		31	56	7
Exogone verugera Claparède					80	2				2	6	
Exogone rostrata Naville					1	1						
Parapionosyllis elegans (Pierantoni)	1	48	5	35	27	106	51	53		244	9	35
Parapionosyllis minuta (Pierantoni)					5		4	16		24	4	
Parapionosyllis labronica Cognetti					2		2	5		2		1
Parapionosyllis brevicirra Day					1							
Pionosyllis serrata Southern					4		24			3	3	
Pionosyllis monroe San Martin										2		
Pionosyllis lamelligera Saint-Joseph					13							
Grubeosyllis clavata (Claparède)					2	1					3	
Grubeosyllis limbata (Claparède)					5	6					1	
Sphaerosyllis adelae San Martin					2		1				3	1
Sphaerosyllis austriaca Banse		1										
Sphaerosyllis campoyi San Martin					7					1	3	
Sphaerosyllis claparedii Ehlers					1						1	
Sphaerosyllis pirifera Claparède										1		
Sphaerosyllis sublevis Ehlers					4							
Sphaerosyllis taylori Perkins	1											
Sphaerosyllis thomasi San Martin					10	4	17			64	21	
Sphaerosyllis tetralix Eliason										2	1	
Sphaerosyllis xarifae Hartmann-Schroeder					1		2			2	8	
Streptosyllis websteri Southern							3					2
Syllides edentatus Westheide							1					
Syllides fulvus Marion et Bobretzy					1					1	1	
Syllis garciai (Capoy)	17	2		20	20	6	33	1		111	11	
Syllis prolifera Khron		1										
Syllis rosea Langerhans										1		
NEREIDIDAE												
Neanthes caudata (Delle Chiaje)	22	4	1	55	118	7	54	2	1	88	43	
Platynereis dumerilii (Audouin & M. Edwards)					2	2	1				2	
Nereididae n.d.		2										
GLYCERIDAE												
Glycera cf. *rouxi* Audouin & M. Edwards				1						1		
Glycera tesselata Grube							1					
NEPHTYIDAE												
Micronephtys mariae San Martin					23	1	17	4		55	21	5
Nephtys hombergi (Savigny)								1				
ONUPHIDAE												
Aponuphis bilineata (Baird)		1								2		
Onuphis eremita Audouin & M. Edwards						1						
Diopatra neapolitana Delle Chiaje	5	1		1			2			1	9	
EUNICIDAE												
Eunice vittata (Delle Chiaje)					8					1	4	
Nematonereis unicornis (Grube)		2		2						2	3	
Eunicidae nd	1											
LUMBRINERIDAE												
Lumbrineris tetraura (Claparède)		3					3		1			
Lumbrineris latreilli Audouin & M. Edwards	11				10		7			2	9	
Lumbrineris coccinea (Reiner)											5	
Lumbrineris funchalensis (Kinberg)					4							1

Stations and month of sampling	1 Ju	2 Ju	3 Ju	4 Ju	1 No	2 No	1 Ja	2 Ja	3 Ja	4 Ja	1 Ma	2 Ma
ARABELLIDAE												
Drilonereis filum (Claparède)	3			2	2	1	1			2	1	
DORVILLEIDAE												
Protodorvillea kefersteini (Mc Intosh)	2				39		8	5		4	27	
Dorvillea rudolphi (Delle Chiaje)					9		5			1	7	
Schistomeringos caeca (Webster et Benedict)						2		1		1		
Dorvilleidae gen. sp												
PECTINARIIDAE												
Pectinaria belgica (Pallas)				1								
OWENIIDAE												
Owenia fusiformis Delle Chiaje			1	1			1					
TEREBELLIDAE												
Pista cristata Muller					1						1	
Lanice conchylega (Pallas)					1						1	
Thelepus sp										1		
TRICHOBRANCHIDAE												
Trichobranchus sp					2						1	
SABELLIDAE												
Chone collaris Langerhans					2	5	4	1		1	2	
Chone sp					3		4				1	
Chone duneri Malmgren					3					2		
Chone n.d.												
Amphiglena mediterranea Leydig						2						
Branchiomma luctuosum Grube					2							

the five core replicates sampled contained polychaetes. No exclusive species were found at this site and the only representative species was *P. elegans*. A total of 57 taxa and 1004 individuals were found at Station 4. Nine taxa were exclusively found at this site but were represented by a few individuals. The most abundant species were *N. caudata, P. elegans* and *S. garciai*.

In the core-samples, the highest mean number of species and individuals were recorded at Station 1 in all studied months, and at Station 4 in January (Fig. 3a and 3b). Whereas, both Stations 2 and 3 showed remarkable lower values, especially in some months. The mean diversity index (H') was also higher at Station 1 for all considered months (range between 3.17 and 1.90). The mean equitability index (J) showed a trend similar to that of diversity, even though Stations 3 and 4 showed also quite high values in some months (Fig. 3c and 3d). A certain degree of variability in abundance occurred among the core replicates (as shown by values of standard deviations, Table 3). This variability was higher for both Stations 2 and 4 compared to Station 1, suggesting a higher patchiness in the polychaete distribution in these former stations.

On the whole, the total number of species collected on the leaf stratum (net-samples) was lower than those recorded in the core-samples. Also in these samples, the highest species richness and number of individuals were recorded at Station 1 (Fig. 4a and 4b). Diversity and evenness values showed quite irregular trends, probably due to the scarce number of species and individuals recorded in some months (Fig. 4c and 4d).

The correlation analysis (Spearman rank test) between population structural parameters and plant phenological features, such as shoot density, LAI and LSC recorded in the same stations, showed for the core samples a positive and significant correlation only between evenness values (J) and shoot density ($r= 0.81$, $P<0.01$). When analyzing the hand-net samples, positive and significant correlations were observed between the number of species and individuals, and LAI and LSC values (species vs LAI $r= 0.79$, $P< 0.01$; species vs LSC $r= 0.71$ $P< 0.01$; individuals vs LAI $r= 0.72$, $P< 0.01$; individuals vs LSC $r= 0.65$, $P<0.05$).

TABLE 2. – List of taxa found and their actual number of individuals in the hand-net samples.

Station and month of sampling	1 Ju	1 Se	1 No	1 Ja	1 Mr	1 Ma	2 Ju	2 Se	2 No	2 Ja	2 Mr	2 Ma	4 Ju	4 Ja
Taxa														
SPIONIDAE														
Malacoceros fuliginosus (Claparède)							1							
Prionospio cirrifera Wiren		6		2	1									
Prionospio malmgreni Claparède					1									
Pseudopolydora antennata (Claparède)	1		1											
Spio decoratus Bobretzky					3									
OPHELIDAE														
Tachytrypane jeffreysii McIntosh														1
PHYLLODOCIDAE														
Phyllodocidae n.d.						1								
SYLLIDAE														
Brania oculata (Hartmann-Schroeder)												1		
Eurysyllis tuberculata Ehlers												1		
Exogone dispar Webster	2	4		1			1							
Exogone naidina Oersted	21	53	7	7	63	7	65	14	9	3	4	22	25	
Exogone parahomoseta mediterranea San Martin	1			2										
Exogone verugera Claparède	1	2		2										
Parapionosyllis elegans (Pierantoni)														2
Pionosyllis serrata Southern													1	
Grubeosyllis clavata (Claparède)	3	8	5		3		34	15	2	1		7		2
Sphaerosyllis campoyi San Martin et. al.	1	1			7			1				1		3
Sphaerosyllis austriaca Banse	1											3		
Sphaerosyllis cryptica Ben Eliahu								1		1		4		
Sphaerosyllis taylori Perkins							1	1	1			9		
Sphaerosyllis thomasi San Martin	11	16	2	1	5		2	2			2	3		3
Syllides edentatus Westheide							1							
Syllis garciai (Campoy)	1	2		1										
Syllis prolifera Khron						1								
NEREIDIDAE														
Neanthes caudata (Delle Chiaje)		14	1				1	13						
*Platynereis dumerilii (*Audouin & Milne Edwards)	2	1		1				7		1			1	
Nereididae n.d.														1
NEPHTYIDAE														
Micronephtys mariae San Martin			1											
ONUPHIDAE														
Diopatra neapolitana Delle Chiaje		2												
LUMBRINERIDAE														
Lumbrineris tetraura (Claparède)	7													
Lumbrineris latreilli Audouin & Milne Edwards				1										
SABELLIDAE														
Amphiglena mediterranea Leydig		2						2						
Chone collaris Langerhans		5						1						
Chone duneri Malmgren		4												
Oriopsis armandi (Claparède)								4						
Total number of individuals	52	120	17	18	83	9	106	61	12	6	6	51	2	37
Total number of species	12	14	6	9	7	3	8	11	3	4	2	9	2	7
diversity (H')	1.94	1.92	1.47	1.90	0.93	0.68	0.95	1.93	0.72	1.24	0.63	1.70	-	1.18
evenness (J)	0.70	0.76	0.67	0.58	0.37	0.10	0.52	0.85	0.29	0.10	0.75	0.76	-	0.60

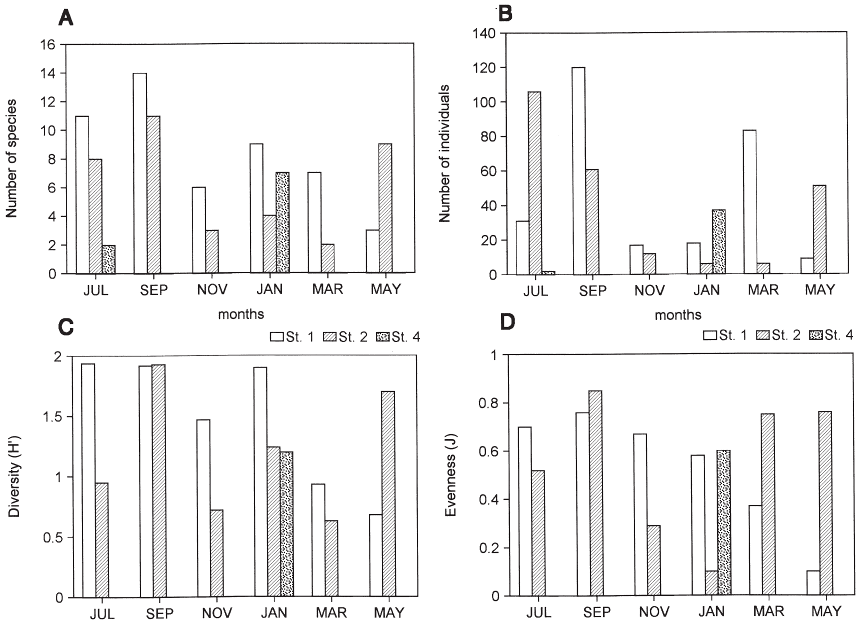

FIG. 4. – Trend of the number of species (A), individuals (B), diversity (C) and evenness (D) of the polychaete populations of the hand-net samples. Values are those of a single net sample.

Comparisons between methods and small-scale distribution

Differences in species composition and abundance were observed according to the sampling method employed, regardless of the station. Eighty-six species were exclusively found in the core-samples, while only six species occurred only in the net-samples and with a few individuals. When comparing the two methods of sampling it was possible to recognize the most characteristic species of each compartment, even though in the core samples epiphytic species, living in the shoots collected with the corer, were mixed with species of the sediment. However, many species even when collected with both sampling methods, were more abundant with one of them, indicating a differential distribution between meadow compartments. *P. clavata, E. naidina* and *S. thomasi,* accounting for 99%, 98% and 57% of the individuals of the net-samples respectively, demonstrated a clear preference for the leaf stratum. *N. caudata, S. garciai* and *P. elegans* were more abundant in the core samples, indicating a stronger affinity for the sediment.

As regards the stratification of the species within the sediment, at each station and sampling month, polychaetes were found in all three sediment layers considered (Table 3), except Station 3. On the whole, 84% of the individuals were collected on the surface layer (0-5 cm), and the mean number of species and individuals was always higher in this layer at all stations and

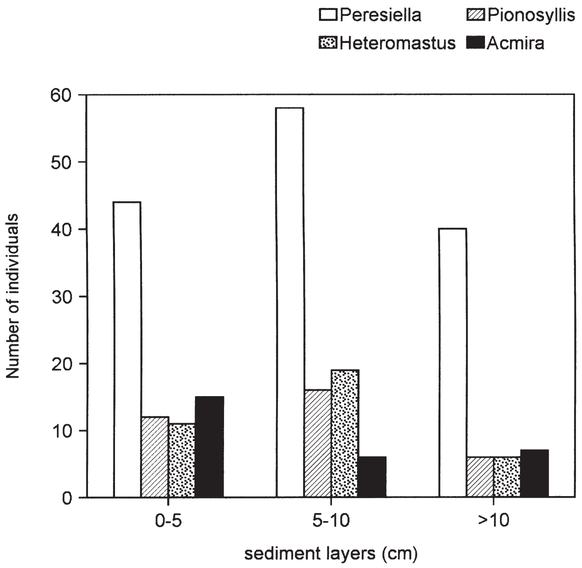

FIG. 5. – Distribution and abundance of some species of polychaetes in the studied sediment layers: *Peresiella clymeoides, Heteromastus filiformis, Acmira catherinae* and *Pionosyllis serrata.* The species abundances represent pooled data of all stations and sampling months considered.

TABLE 3. – Abundance, number of species, diversity and evenness of polychaete populations found in whole cores and number of individuals and species found in each sediment layer at the cores. Values are means (av) of five core replicates at each station; standard deviations (SD) are in parentheses. Station 3*= values are those of the single core replicate where worms were found. Sediment levels= 0-5 cm deep; 5-10 cm deep, > 10 cm deep.

	whole cores individuals av (SD)	species av (SD)	H' av (SD)	J av (SD)	level 0-5 individuals av (SD)	species av (SD)	level 5-10 individuals av (SD)	species av (SD)	level >10 individuals av (SD)	species av (SD)
Station 1										
July	20.4 (7.4)	8.2 (0.7)	1.90 (0.08)	0.89 (0.04)	17.8 (17.6)	7.4 (0.8)	1.8 (0.4)	1.2 (0.4)	0.8 (0.7)	0.8 (0.7)
November	156 (31.1)	35.4 (3.0)	3.01 (0.10)	0.85 (0.02)	137.4 (23.1)	31.2 (2.2)	16.6 (9.0)	7.6 (3.7)	0.8 (0.7)	0.8 (0.7)
January	139 (20.2)	28.2 (3.5)	2.79 (0.21)	0.88 (0.03)	114.2 (16.6)	25 (2.9)	17 (3.8)	9.4 (1.6)	5.4 (5.8)	3.0 (2.9)
May	119 (8.9)	36 (4.3)	3.17 (0.11)	0.88 (0.02)	109.4 (9.5)	33.4 (3.9)	8.8 (1.6)	5.4 (1.2)	0.8 (0.4)	0.8 (0.7)
Station 2										
July	15 (4.0)	7.2 (2.7)	1.20 (0.35)	0.72 (0.09)	10.2 (3.4)	4 (1.7)	4 (2.4)	2.4 (1.3)	0.8 (0.7)	0.8 (0.7)
November	59 (15.1)	12.2 (4.6)	1.68 (0.34)	0.69 (0.05)	48.8 (17.7)	11.4 (4.0)	8.4 (4.6)	2.8 (0.7)	1.8 (1.1)	1.2 (0.7)
January	36 (21.4)	9.8 (2.9)	1.76 (0.19)	0.79 (0.10)	26.6 (14.7)	7.6 (2.8)	8.4 (6.0)	3.6 (1.7)	0.8 (0.7)	0.8 (0.7)
May	55.6 (37.6)	6.2 (2.4)	0.97 (0.44)	0.54 (0.19)	46.2 (32.5)	5.8 (2.4)	7.8 (8.3)	1.4 (1.2)	2.0 (1.6)	1.0 (0.6)
Station 3*										
July	11	6	1.54	0.85	11	6	0	0	0	0
January	11	8	1.76	0.90	11	8	0	0	0	0
Statio 4										
July	31.8 (25.2)	7.4 (2.3)	1.42 (0.28)	0.73 (0.14)	20 (10.3)	6 (2.3)	2.8 (2.6)	2 (1.6)	5.2 (8.4)	1.6 (1.7)
January	203 (44.7)	26.8 (5.1)	2.50 (0.13)	0.76 (0.03)	175.8 (43.1)	22.8 (4.6)	20.6 (9.8)	7.8 (2.6)	7 (3.0)	3.6 (0.4)

months (Table 3). In the intermediate sediment layer (5-10 cm deep) there is a strong reduction, both in the number of species and individuals. Further below (>10 cm deep) polychaetes were collected (Table 3) except for a small number of species which showed a more uniform distribution within the sediment, particularly evident when data of all stations and seasons were pooled: *P. clymenoides, A. catherinae, P. serrata* and *H. filiformis* (Fig. 5).

Seasonal and structural analyses

In the core-samples of all stations the lowest species richness and diversity were recorded in July (H' between 1.20 and 1.90; Table 3) when abundances were quite low and their differences among the stations were less pronounced. The net-samples of the vegetated Stations 1, 2 and 4 showed a different trend from that observed in the core-samples, with more diversified and abundant populations in summer (July-September) (see Fig. 3 and Fig. 4). The species that in the overall samples accounted for the wider seasonal fluctuations were *E. naidina, P. elegans, S. garciai, C. minimus, P. malmgreni, E. collaris, N. latericeus* and *N. caudata*.

The ordination model obtained from the AC analysis of the core-samples is represented in Fig. 6. The first two factorial axes (F1, F2), which are both significant ($P< 0.05$), accounted for 33.4% and 17.5% of the total variance respectively. In the ordination model only the species with relative contribution of F1 or F2 higher than 1% were indicated with their initials (see legend of Fig. 6). All seasonal samples at Station 1 are well separated on the negative pole of the F1 axis from seasonal samples of Stations 2 and 3. The samples of Station 4 are located in an intermediate position. According to F2, samples are ordinated according to season, with July samples quite isolated (especially Stations 2, 3 and 4) on the negative part the axis, and strongly separated from May samples. January and November samples are in an intermediate position. The distances between seasonal samples were small for Station 1 (forming an almost closed line) and relatively large (forming an open line, Fig. 6) for both Stations 2 and 3, indicating that seasonal differences are more pronounced in these latter stations. The species with a relative contribution to F1 higher than 1% were: *C. minimus* (Cmi in Fig. 6) and *S. typica* (Sty) associated with Station 2, and *E. collaris* (Eco), *E. verugera* (Eve), *N. latericeus* (Nla), *E. naidina* (Ena) associated with Station 1. The species

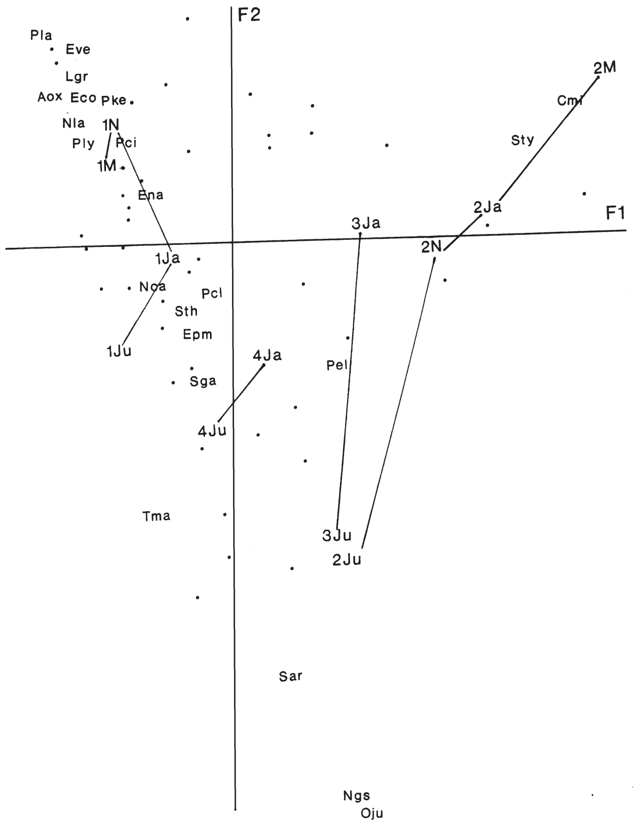

FIG. 6. – AC ordination model of samples and species in the plane of the first two axes (F1= 33.4%, F2= 17.5%). Large numbers and letters, represent seasonal points of the studied stations (Ju= July, N= November, Ja= January, M= May). Seasonal points of the same stations have been united with a solid line to show scattering among samples. Lower letters represent species-points, only the species with relative contribution to one of the two axes higher than 1% are considered: Sty= *Scolaricia typica,* Sar= *Scoloplos armiger,* Oju= Orbiniidae juv., Ply= *Paradoneis lyra,* Pci= *Prionospio cirrifera,* Aox= *Aonides oxycephala,* Tma= *Tharyx marioni,* Cmi= *Capitomastus minimus,* Pcl= *Peresiella clymenoides,* Nla= *Notomastus latericeus,* Eco= *Euclymene collaris,* Ena= *Exogone naidina,* Epm= *E. parahomoseta mediterranea,* Eve= *E. verugera,* Pel= *Parapionosyllis elegans,* Pla= *Pionosyllis lamelligera,* Sth= *Sphaerosyllis thomasi,* Sga= *Syllis garciai,* Nca= *Neanthes caudata,* Ngs= *Nereididae* gen. sp., Lgr= *Lumbrineris gracilis,* Pke= *Protodorvillea kefersteini.*

with a relative contribution of F2 higher than 1% were: *S. armiger* (Sar), *P. elegans* (Pel), *T. marioni* (Tma), *S. garciai* (Sga), and *E. parahomoseta mediterranea* (Epm), associated mainly with July and January samples; while *C. minimus, E. collaris, N. latericeus, E. verugera, L. gracilis* (Lgr) and *P. kefersteini* (Pke) are mainly associated with the November and May samples (Fig. 6).

The Bray-Curtis similarity analysis is shown in Fig. 7. Four main clusters have been identified: the group formed by seasonal samples of Station 2 (except that of July) (51% average similarity), the group of July samples (except Station 3) (23% average similarity); the group of seasonal samples of Station 1 joined with the January sample of Station 4 (50% average similarity), and finally the two seasonal samples of Station 3 (20% average similarity). This pattern is consistent with the AC ordination model.

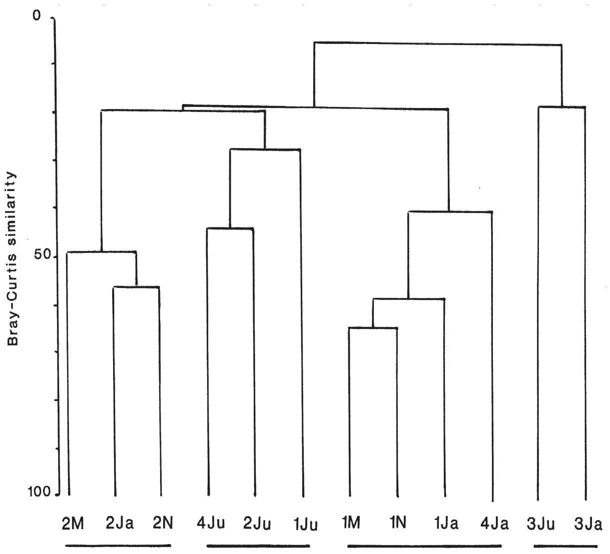

FIG. 7. – Dendogram of the Bray-Curtis similarity analysis. The main clusters of samples identified have been underlined.

DISCUSSION

The differences in polychaete community structure observed between the studied stations, and synthesized by the ordination of samples in the AC and in the Bray-Curtis analyses, are due to a complex environmental gradient that includes both abiotic (e.g., hydrodynamics, sediment features) and biotic (e.g., shoot density and other plant features) factors, characterizing seasonally the different sites. The relatively high silt-clay and organic matter content in sediment, as well as the development of the "turf" at Station 1 reflects the more sheltered hydrodynamic conditions of this site. The hydrodynamic regime plays an important indirect role for the associated fauna by greatly influencing sediment properties and distribution and physiognomy of seagrass meadows (Fonseca *et al*., 1983; Gambi *et al*., 1990). This environmental situation, coupled with high values of shoot densities, LAI and LSC throughout the year (Cancemi, 1991), may account for the overall higher biodiversity of polychaetes recorded at Station 1 in all sampling months. Station 2, with higher exposure to wave action and much lower values of all plant phenological parameters, showed reduced species diversity and abundances. Station 4, with a shoot density comparable to Station 2 but with more sheltered conditions due to its deeper location (4.5 m), represented an intermediate situation as regards to community structure. Finally, Station 3 in bare sandy bottom was characterized by the poorest polychaete populations.

This pattern was clear for both the assemblage inhabiting the sediment (core-samples), and for that associated with the leaf stratum (hand-net samples). However, while for the sediment assemblages unclear relationships were recorded between structural parameters of the populations, and shoot density and plant phenology, for the polychaetes of the leaf stratum positive correlations were observed between number of species and individuals and LAI and LSC. Similar results have been obtained for the whole vagile fauna of the leaf stratum, when comparing Station 1 and Station 2 (Scipione *et al*., 1996). Previous studies on polychaete distribution in *C. nodosa* meadows of different geographic areas (True-Schlenz, 1965; Giangrande and Gambi, 1986; Lanera and Gambi, 1993), showed between-bed differences that, even though possibly overridden by different environmental factors, have be partially determined by meadow structure and shoot density. Experimental work on the effects of *Cymodocea* canopy reduction in height, or total canopy removal, for the small motile invertebrates (Connolly and Butler, 1996), are highly consistent with our results. In particular polychaetes (considered as a single taxonomic group) with their decrease both in abundance and biomass in the conditions of canopy reduction or removal contributed largely to the statistical differences between the experimental treatments. Relationships between polychaete biodiversity and shoot density have been found also by Somaschini *et al*. (1994) for *Posidonia oceanica* meadows, when considering the rhizome-matte populations of different beds.

The studied *Cymodocea-Zostera* meadows were characterized by some faunistic differences between stations that were were mainly due to the relative abundance of the most common species (present at all sites), or to the occurrence of less abundant taxa. More pronounced differences in species composition and distribution have been recognized between leaf stratum and sediment.

In the sediment the polychaete fauna was mainly composed by typical infaunal and also interstitial forms. The community was richer and more diversified than on the leaf stratum, due also to the fact that with the corers some epiphytic species were also sampled (see Methods). A certain degree of patchiness in the distribution and abundance of some species has been recognized within each meadow station, when comparing data of the various core replicates. This patchiness was higher in the less vegetated Stations 2 and 4 (see values of SD in Table 3), indicating that in the less vegetated sites, within-bed variability, due to the occurrence of more or less dense shoot patches, was higher.

Most polychaetes (up to 84%) were distributed in the upper superficial layer (0-5 cm). These results agree with those observed in *P. oceanica* beds where the fauna, mainly composed of polychaetes, was concentrated in the first 4 cm depth layer (Willsie, 1983; Somaschini *et al*., 1994). The rarefaction of fauna in the deeper sediment layers is a trend generally observed in soft bottoms, and reflects a more or less gradual decrease in oxygen concentration and an increase in sediment compaction with depth. In our samples, a decrease in oxygen concentration, as indicated by the negative values of the Redox potential (Eh), was observed below the first few centimeters of the sediment in July, especially at Station 1 (M.C. Gambi, pers. observ.). The few species occurring with relatively high number of individuals also in the deeper sediment layers are, in fact, mainly infaunal forms known to be deep burrowers (e.g., *H. filiformis* and *P. clymenoides,* Fig. 5). However, neither these forms nor any other species was sampled in the deeper sediment layers at Station 3, and this does not seem to be related to unfavorable sediment conditions. This trend could likely be related to the extreme faunal rarefaction observed in the bare sandy bottom (only one of the five core replicates sampled contained worms) that is further enhanced in its deeper sediment layers. We are aware that probably both the small core dimension and the limited replicates are unsufficient to correctly evaluate the higher dispersion of benthic organisms in this kind of habitat. Anyway, these results point out the strong differences in distribution of benthos between non-vegetated and vegetated systems of shallow soft-bottoms.

The species found on the leaf stratum were mainly interstitial micrograzers (e.g. *E. naidina, S. thomasi, P. clavata*) often reported from Mediterranean shallow seaweed biotopes (Giangrande, 1988; Sarda, 1991), sediments (San Martin, 1984) as well as *Posidonia* beds (Gambi *et al*., 1995). This polychaete assemblage was poorer and less structured than that of the sediment level. This pattern, observed also in other seagrass meadows (Hutchings, 1982; Gambi *et al*., 1995) may result from the conditions within the leaf stratum that offers very specialized microhabitats in which the organisms experience higher water movement (Gambi *et al*., 1990) and light intensity than on the bottom. For the Mediterranean seagrass systems Ledoyer (1966) first stated that the zoobenthic populations associated with *C. nodosa* leaves represent an impoverished facies of the *P. oceanica* leaf-stratum community. A comparison between our net-samples (35 taxa and 560 individuals) and those collected in a shallow *P. oceanica* bed at the same geographic area (Island of Ischia) revealed that during a year round investigation, a total of 45 species and 321 individuals and 54 species and 296 individuals of polychaetes were found at 1 m and 3 m depth respectively (Gambi and Lanera, 1992; Scipione *et al*., 1996). Thus the leaf stratum of *Cymodocea-Zostera* meadows was poorer in polychaete species richness than the corresponding compartment in *Posidonia* but showed higher abundances. This pattern may be explained by the fact that, although the *Posidonia* canopy shows a spatial complexity higher than that of *Cymodocea-Zostera,* probably both predation pressure and competition among the different taxa are higher.

Species occurrence and abundance showed clear seasonal trends that were well evidenced by the separation of seasonal samples in the AC ordination, as well as in the Bray-Curtis similarity. These trends were quite different in the two meadow compartments considered. In the leaf stratum, polychaete diversity and abundance were higher in July and September, when the leaf canopy was more developed (higher habitat complexity), and coherently with the trend observed for the other groups of vagile fauna (Scipione *et al*., 1996). At the sediment level, the minima of all the structural parameters of the populations were observed in the same months. The numerical fluctuations of the species responsible for such seasonal differences (*P. elegans, E. naidina, N. caudata, N. latericeus, E. collaris*) are probably related to their life histories. *N. caudata,* as an example, showed an abundance peak in July and September mainly composed of juveniles (M.C. Gambi, pers. observ). Many brooding specimens of some interstitial species of Exogoninae were observed mainly in winter (M.C. Gambi, pers. observ.), in agreement with previous studies of other biotopes (Giangrande, 1989-90). In this respect, an analysis at population level of the most abundant species is in progress. However, numerical fluctuations can also be due to seasonal changes in predation pressure, that is an important structuring factor in seagrass (Young *et al*., 1976; Heck and Thomas, 1981; Summerson and Peterson, 1984; Edgar, 1990). Predation may be higher in vegetated systems than in bare soft-bottoms (Young and Young, 1977, 1982), and in *Posidonia oceanica* it has been hypothesized to be higher in summer (Mazzella *et al*., 1989; Gambi *et al*., 1992) than in other seasons. The different seasonal abundance pattern observed between leaf and sediment compartments of the meadows can be due to more unfavorable environmental conditions at the sediment level in summer (e.g., oxygen concentration) coupled with higher predation pressure exerted at the bottom level. Whereas in the leaf stratum the higher structural complexity in summer increase the potential of the canopy for the crypsis and shelter for the associated fauna. The wider seasonal differences, both in species composition and abundance, recorded at Station 2 with respect to Station 1 (Fig. 6) indicate a less stable polychaete community at this Station. This can be related to both the more stressfull environmental conditions and the higher patchiness occurring at this site.

From a biocenotic and ecological point of view only a few of the polychaete taxa found (e.g., *P. foetida ligustica, H. filiformis, C. collaris*) may be considered as typical of *Cymodocea-Zostera* meadows (Harmelin and True-Schlenz, 1963). Comparisons of polychaete populations from other seagrass systems with our data are difficult due to different geographic location, sampling methods and sieve mesh used by various authors which can strongly influence both species composition and abundances (see Gambi *et al*., 1995 for a discussion). The conspicuous occurrence of interstitial Syllidae Exogoninae has also been reported for other temperate seagrass systems (Young and Young, 1982; Lewis and Hollingworth, 1982), including the Mediterranean *P. oceanica* (Gambi *et al*., 1995; Somaschini *et al*., 1994). The occurrence and abundance of the nereidids *P. dumerilii* and *N. caudata* agree with the observation of Hutchings (1982) who recorded at least one dominant species of nereidid in the polychaete assemblages associated with each of the different seagrass systems in Australian waters.

In the Mediterranean bionomic studies, the meadows formed by the small phanerogams are defined as 'epifloral facies' of different shallow soft bottom biocoenoses (Peres and Picard, 1964). While, as stated before, the fauna living on the leaves is considered a simplified community with respect to that inhabiting the canopy of *Posidonia* beds (Ledoyer, 1966). Many studies, however, considered separately the different meadow compartments (leaf-stratum or sediment). Thus, the overall biodiversity and complexity of these systems have been probably underestimated. When the whole complex of microenvironments and of associated organisms of the meadows are considered, these systems may show both a relatively high biodiversity and a characteristic coenotic configuration strongly influenced by meadow structure and physiognomy (Scipione *et al*., 1996). Our results, compared with the studies previously mentioned, suggest that at least for small-sized and moderately mobile organisms meadow structure, shoot density and other phenological plant features influence species composition and abundances both at large (between-meadows) and small (within-meadow) spatial scale. More experimental work, involving 'in situ' manipulation, is necessary to evaluate the response of the individual species to the high variability in space and time displayed by these seagrass systems.

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