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ANNUAL DYNAMICS OF MEIOBENTHIC COMMUNITIES IN THE LIGURIAN SEA (NORTHWESTERN MEDITERRANEAN): PRELIMINARY RESULTS

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RIASSUNTO

La struttura e la dinamica di comunità meiobentoniche di una area sabbiosa subtidale del Mar Ligure, posta alla profondità di 10 metri, sono state studiate tra il Gennaio 1991 ed il Gennaio 1992. La densità della meiofauna era compresa tra 447 e 3421 ind./lOcm^2 (rispettivamente in Aprile e Luglio). I nematodi costituivano il gruppo dominante (in media il 75 % della comunità). I copepodi arpacticoidi costituivano il secondo gruppo per abbondanza (variando tra l'1.7 ed il 55.3 %) seguiti dai turbellari (in media il 5.5 % della meiofauna totale) e policheti (in media l'1.2 % del totale). Diversi parametri ambientali (contenuto in materiale organico, granulometrìa, profondità dello strato anossico, RPD) sono stati posti in relazione alle caratteristiche strutturali della comunità. Viene discussa l'importanza dei fattori ambientali nello strutturare la comunità.

SUMMARY

The dynamics of meiobenthic community were investigated on sandy sediments of the pilot station of Zoagli (Ligurian Sea) between January 1991 and January 1992. Meiofaunal densities ranged between 447 (April) and 3421 (July) ind./10 cm^2. Nematodes were the dominant group comprising on the average 75 % of the total fauna. Harpacticoid copepods were the second most abundant group (from 1.7 to 55.3 %) followed by Turbellaria (on the average 5.5 % of total fauna) and Polychaeta (on average 1.2 % of total fauna). The importance of several environmental parameters (such as total organic matter, grain size and RPD depth) in structuring the meiobenthic community is discussed.

1. INTRODUCTION

The meiofauna is defined as an assemblage of small benthic metazoans having a coherent set of life-history and feeding characteristics which sets them apart as a separate evolutionary unit from larger macrofauna (Warwick, 1987). Meiofauna is also considered as one of the most important components in marine sediments both in terms of abundance and production (Higgins & Thiel, 1988).

Despite this meiofauna received, untill few years ago, little attention in the Mediterranean Sea and very few studies dealt with the distribution of meiobenthos in the continental shelf (see Soyer, 1985 for a review) or deeper areas (Soetaert et al, 1991).

The mediterranean basin is considered a semienclosed, oligotrophic System. However, meiofaunal densities reported for this area are comparable to those recorded in other ocean which are richer in terms of food availability on the sea floor (Soyer, 1985).

Most of the studies suggest that meiofauna populations are related to sediment properties (Higgins & Thiel, 1988). However, biological interactions and particularly the amount of available food seem to play a significant role in the regulation of meiofaunal dynamics. Nevertheless, at the present moment we still don't know exactly which are the regulation mechanisms, the factors affecting meiofaunal distribution and the importance of meiobenthos in the energetics of benthos in the Mediterranean (Gufile & Soyer, 1978).

In the present study, the observations relative to the annual dynamics of meiobenthic communities in a subtidal sandy station of the Ligurian Sea are reported.

2. MATERIALS AND METHODS

Sediment samples were collected on a monthly basis by SCUBA divers between January 1991 and January 1992 in a subtidal sandy station of the Gulf of Marconi (Ligurian Sea, Northwestern Mediterranean, Fig. 1). Salinity and temperature were recorded using an AANDERAA instrument (mod. 2975). Grain size analysis was carried out using dry sieve technique. The depth of the Redox Potential Discontinuity (RPD) was measured on three replicates as depth on which the colour of the sediment core turns from grey-brown to black.

Total organic matter was reported as the difference between the dry weight (60°C, 24h) of the sediment and weight of the residue left after combustion at 450°C (2 h). Meiofaunal sampling was carried out on two replicate cores (10.7 cm^2) after division in 3 vertical sections (0-4, 4-8, 8-12 cm). Samples were fixed with a hot (60°C), 4 % formaldehyde in prefiltered seawater solution (0.4 *µm,* Nuclepore polycarbonate filters). When sediment was too coarse, a first extraction was based on decantation. The fine material (or for the fine sediments the whole sample) was sieved trough 1000 and 37 μm mesh sizes. The fraction remaining on the 37 μm sieve was centrifugated three times with Ludox TM (density 1.18 g cm^3) in order to separate the organisms from the sediment grains (Heip et al., 1985). All meiobenthic animals (of the complete core) were counted and classified per taxon under a stereo microscope after staining with Rose Bengal.

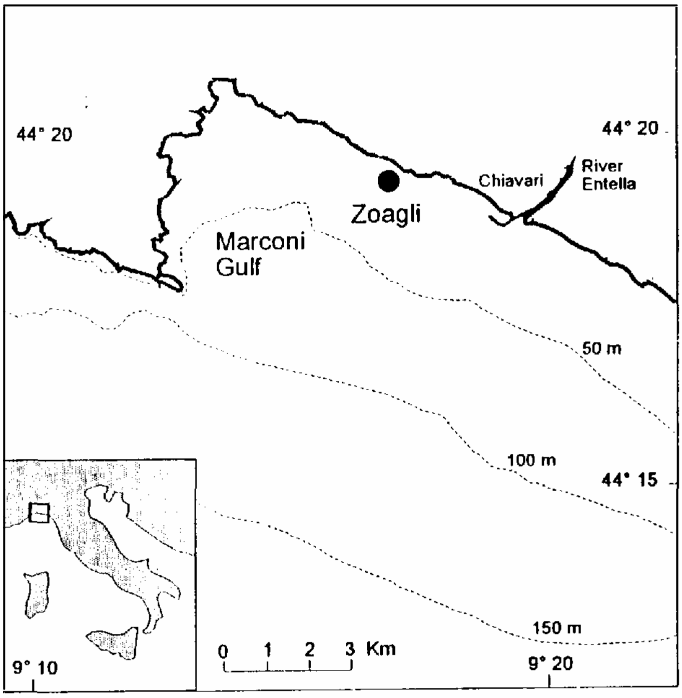

Fig. 1. Sampling area and station location.

3. DATA ANALYSIS

The whole set of data underwent to least-square regression analysis. Bray-Curtis clustering and Two-Ways Indicator Species Analysis (TWINSPAN) was used to classify the meiofaunal taxa with replicates kept separately. Analyses were carried out on transformed and on non transformed data. When not specified, the results of the analyses based on non transformed data are reported. The density values for the 8 cut levels used for the TWINSPAN analysis are 0,3, 7, 15, 45,150, 750,1500.

4. RESULTS AND DISCUSSION

Temperatures recorded during the 13 months investigation showed a typical trend characterized by highest temperatures between July and September in correspondence to water column stratification (Fig. 2). Lowest temperatures were observed in February. As result of the colder air temperature, bottom sediment showed temperature higher than at surface waters in March, November and January.

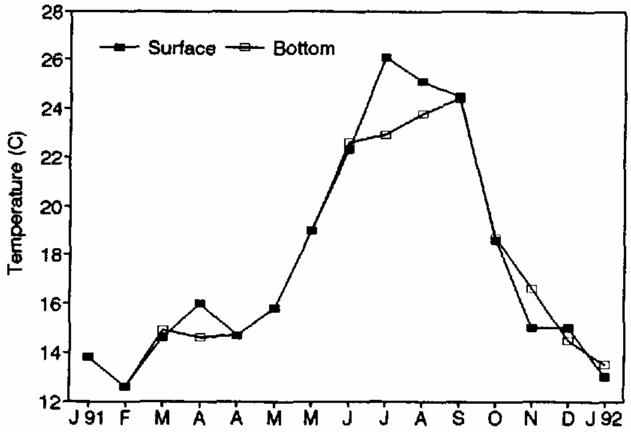

Fig. 2. Seasonal variations of temperature at surface and sediment / water interface.

Large seasonal variations were observed both for rain precipitations and for salinity that showed, as consequence of the heavy rainfall during summer, the lowest values between May and August remaining quite Constant during the rest of the year (Fig. 3).

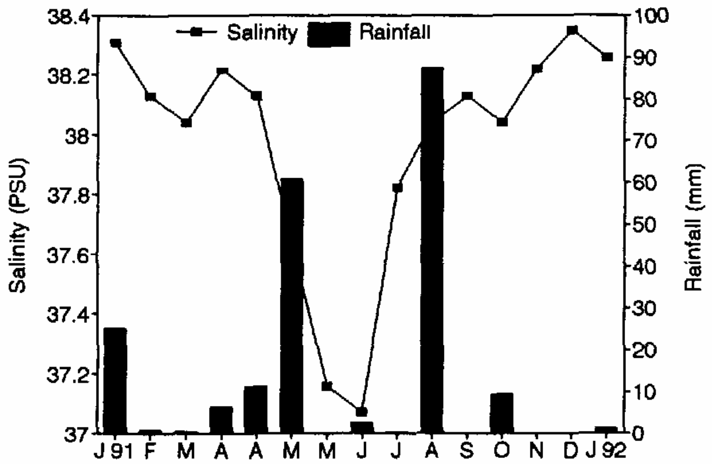

Fig. 3. Seasonal variations of salinity and rain precipitations

During the study period, sediments were always characterized by oxic conditions in the top 12 cm. Anoxic conditions were observed in June (19 cm depth), October (16.0 cm depth) and January (12 cm depth) (Fig. 4).

Granulometric analysis of the sediments in the top 4 cm is shown in Fig. 5. Grain size did not show significant variations during the year with the only exception of May when sediments exibited a coarser composition because sampling was carried out after a sea storm.

Total organic matter content ranged between 0.8 and 2.9 % respectively in June and February 91 and January 92. Generally, lowest concentrations were recorded in summer (Fig. 6).

Seasonal variations of total meiofaunal abundance are shown in Fig. 7 and the relative importance of the different taxa in Fig. 8. The strong seasonality was characterised by highest densities during warmest months (3463 247 ind./10 cm^2, July) while usually lowest densities were recorded in winter.

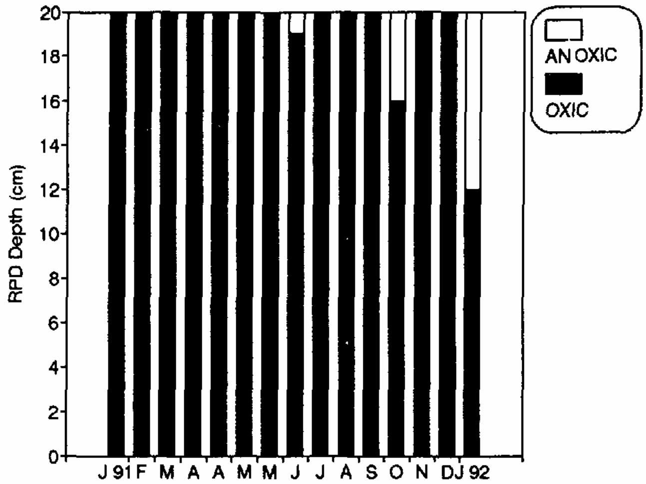

Fig. 4. Seasonal changes of the RPD depth (cm).

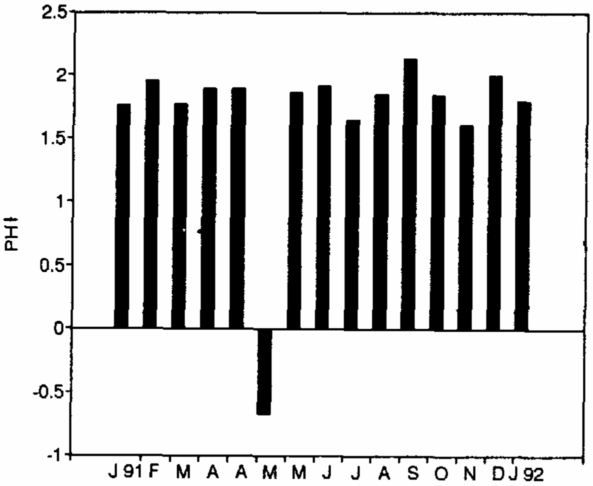

Fig. 5. Seasonal variations of the grain size (Wentworth scale).

The reported densities are in good agreement with those reported for the Mediterranean Sea and with those recorded in adiacent seas (Table 1).

This is surprising since this area is characterized by low macrofaunal density and biomass when compared to other coastal areas (Albertelli et al., 1992).

Being an usual feature of this kind of sediments, Nematoda were the dominant group accounting on average for 75 % of total meiofaunal density (ranging between 30 % in November and 93 % in August, Fig. 9). Copepoda harpacticoida were the second taxa in terms of abundance (ranging between 1.7 % in April and 55.3 % in November, Fig. 9) followed by Turbellaria (ranging between 2 %, in July and 16 %, in November; Fig. 10) and by Polychaeta (on the average 1.2 % of total meiofaunal abundance, Fig. 10).

No clear seasonal dynamics can be detected by the result of the cluster analysis (Fig. 11). However, a particular feature was observed in November and is the result of the temporary copepod recruit. The TWINSPAN analysis allows to identify which taxonomic groups are responsible for the observed dynamics (Fig.12). For instance, the bivalve recruit characterised the spring months: March (cut level 1) and May-June (cut level 2). Generally low densities were typical of cold months and highest nematode densities (cut level 8) characterised the warmest months.

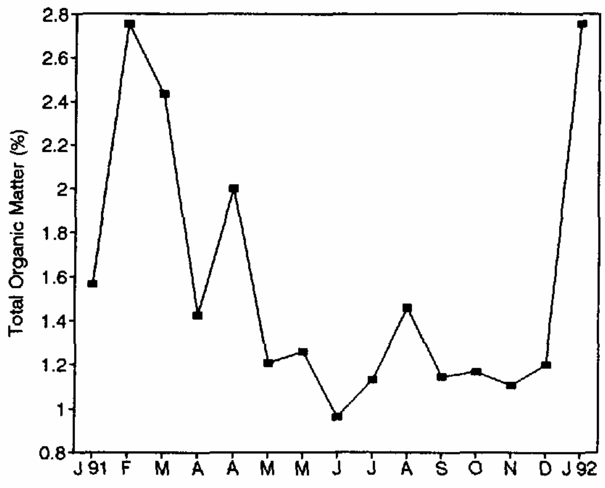

Fig. 6. Seasonal variations of total organic matter (TOM).

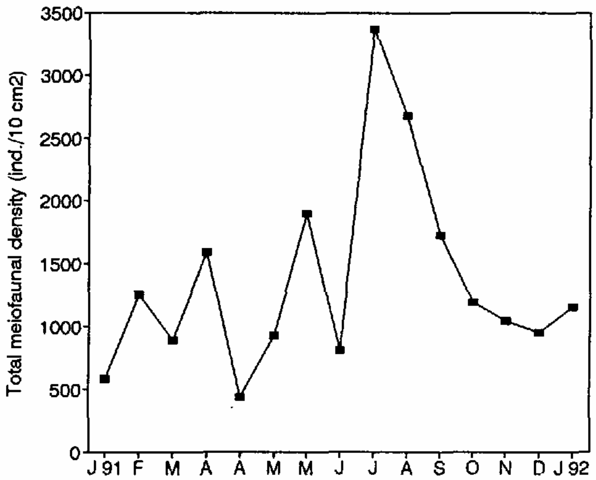

Fig. 7. Seasonal variations of the total abundance of meiofauna in the top 12 cm of the sediments.

Few data are available on the seasonal cycles of abundance of total meiofauna (Soyer, 1971, de Bovée & Soyer, 1974; Hulings, 1974; de Bovée, 1981; Sandulli & De Nicola, 1990). All of them reported strong seasonal fluctuations characterised by low densities in cold months and high peaks in summer. In our study we found a weak relationship between temperature and meiofaunal density. Similar results were observed by Soyer (1971) who found decreasing seasonal variations with increasing depth and consequently reduced temperature variations, and indirectly by Bodiou & Chardy (1973). However, no significant relationships were found when the other environmental factors were considered.

Another factor usually invoked to explain the meiofaunal dynamic is the amount of available food. However, in the present study we did not find any relationship between total organic matter content and meiofaunal densities. Such kind of relationship is usually difficult to establish (Coull, 1970; Tietjen, 1977; de Bovée et al, 1979). Khripounoff et al. (1980) stressed that the quality of sediment organic matter could not be neglected and showed a significant relationship between labile sediment proteins and macrofaunal densities. In the deep-sea sediments of the eastern Mediterranean Sea, Danovaro et al. (1993) found that microbial biomasses were closely related to the amount of labile organic material. In our case, the lack of any relation could be due to the largely refractory composition of the total organic matter.

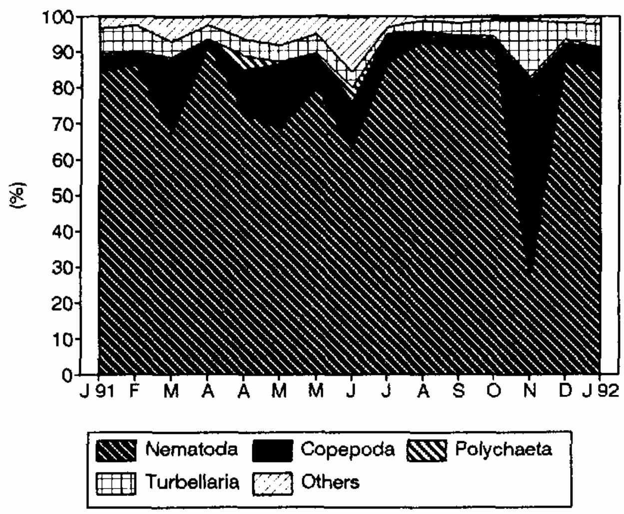

Fig. 8. Seasonal changes in community structure: relative importance of different taxa in terms of abundance.

Area	Depth (m)	Sediment Type	Density (n.x10E5 ind./m2)	Sampling Method	Authors
Banyuls	30	Mud	8.2	Kullemberg	Bougis, 1946
Banyuls	30	Mud	6.7	Kullemberg	Bougis, 1950
Banyuls	15-91	Sand-Mud	0.4-3.5	Kullemberg	Guille & Soyer, 1968
	14-87	Sand-Mud	0.9-6.8	Kullemberg	
Marseille	10	Sand	25	Manual Corer	Vitiello, 1968
Banyuls	10	Sand	5.4	Manual Corer	Soyer, 1971
Banyuls	3-10	Sand	2.5	Manual Corer	
Banyuls	30-70	Mud	2.7-6.1	Kullemberg	
Banyuls	70-130	Mud	0.6-1.3	Kullemberg	
Banyuls	32.5	Mud	29-88	Manual Corer	de Bovée & Soyer, 1974
Banyuls	32.5	Mud	17-88	Manual Corer	de Bovée, 1981
Adriatic Sea	13-17	Sand	2.1-3.6	Kullemberg	Marcotte & Coull, 1974
Adriatic Sea	6-25	Sand	9	Van Veen	Vidakovic, 1983
Tyrrhenian Sea	24	Sand	2-80	Manual Corer	Sandulli & De Nicola, 1980
Ligurian Sea	10	Sand	5-35	Manual Corer	Present Study

Table 1. Total number of meiobenthic organisms (ind./m2) in different shallow subtidal areas of the Mediterranean Sea.

5. CONCLUSIONS

The assessment of the meiofauna's role in the sediments of the Mediterranean Sea is still based on little evidence. These results confirm the quantitative importance of the meiobenthos at shallow depth. Seasonal fluctuations in density were only partially due to changes in temperatures but no relationships were found with other sedimentary parameters such as grain size and the bulk of sediment organic matter. Other factors, such as the amount of labile organic compounds (i.e. organic matter available to benthic consumers) should be probably taken into

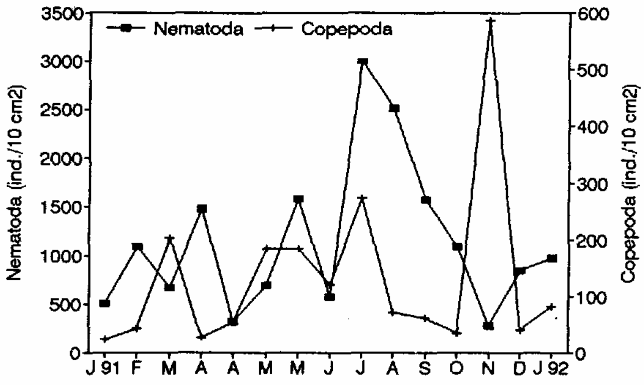

Fig. 9. Seasonal variations of nematoda and copepoda abundance.

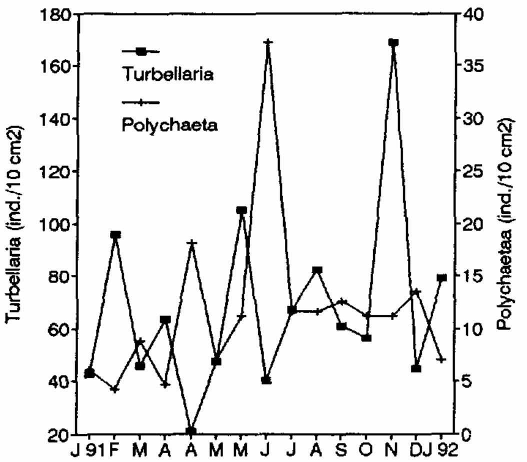

Fig. 10. Seasonal variations of the densities of polychaeta and turbellaria.

consideration for understanding the factors potentially limiting the abundances, trophic strategies and dynamics of meiobenthic communities in the studied area.

Further studies are needed for identifying the factors related to the dynamics of meiofaunal communities.

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Fig. 11. Results of the Bray-Curtis Cluster analysis on meiobenthic taxa (non transformed data).

NR. OF STATIONS = 26
NR. OF SPECIES = 17
SIMILARITY COEFF. = 1 BRAY-CURTIS
CLUSTERING = 3 GROUP AVERAGE

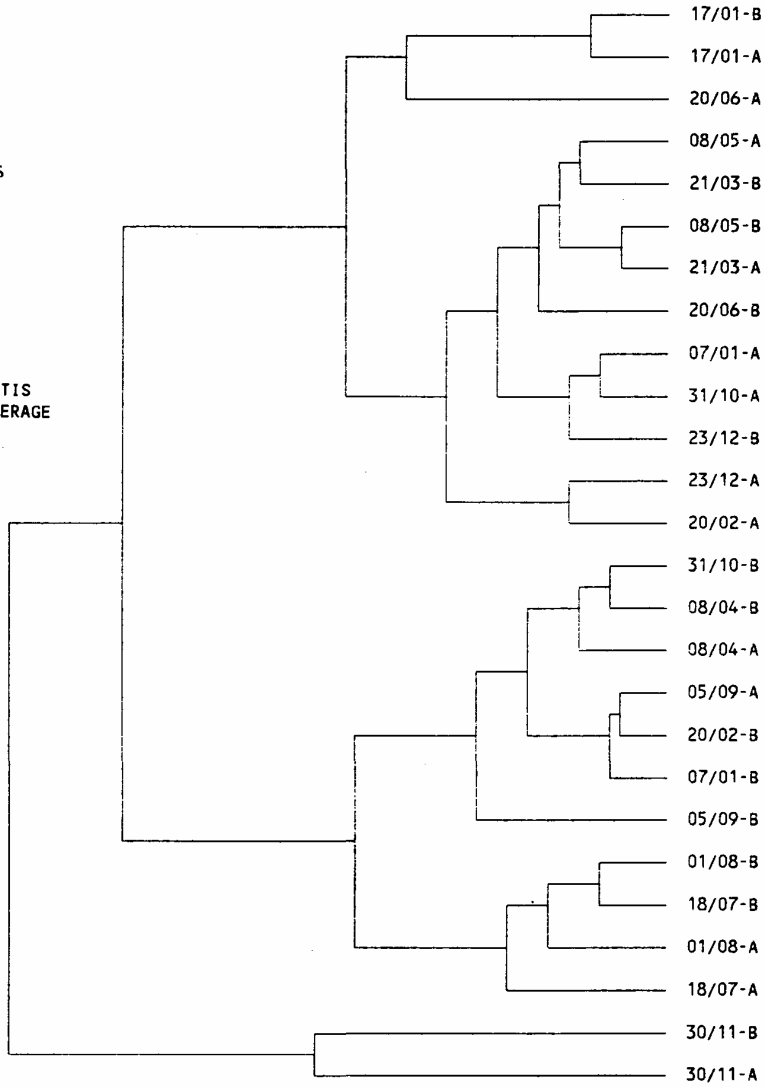
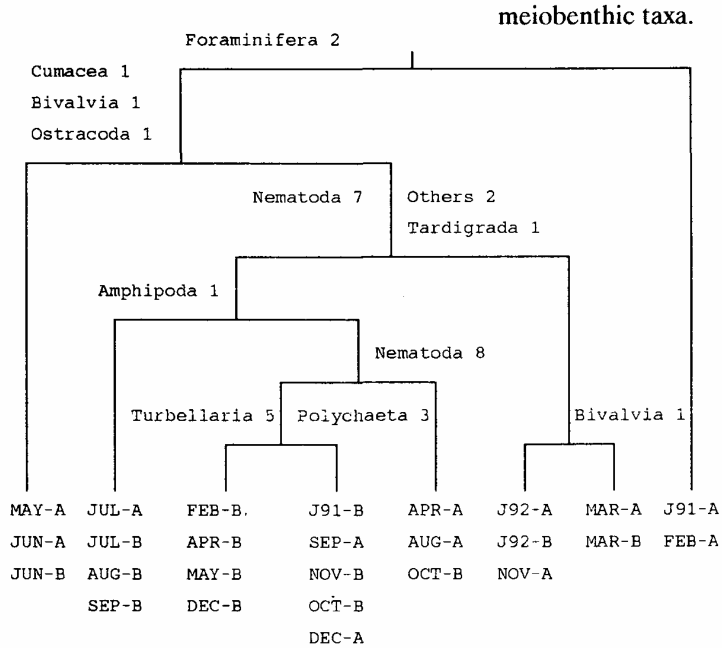


Fig. 12. Results of the TWINSPAN analysis on meiobenthic taxa.



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