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Suprabenthic community of the Cananeia lagoon estuarine region, Southeastern Brazil

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Abstract : The temporal and spatial distribution of the suprabenthos in the marine sector of the Cananeia estuarine lagoon in the State of São Paulo, Brazil, is described. The studied area is a lower intertidal mud-flat with a scattered *Spartina alterniflora* cover. In relation to the total density, *Metamysidopsis elongata atlantica* dominated the suprabenthos. In relation to the total biomass, fish was the dominant group, followed by *M. elongata atlantica* and juveniles of *Penaeus schimitti.* In this suprabenthic community there was a sequential appearance, with high abundance, then disappearance of temporary suprabenthic species, besides strong temporal fluctuations of permanent species. Temporal variations of community diversity were greatly influenced by the local population dynamics, showing a clear seasonal pattern, negatively linked to peaks of density of dominant species and positively with evenness values. The density displayed a distinct pattern of seasonal changes, with high values in spring months, due to the abundance peak of *M. elongata atlantica*, followed by a marked decline in summer. In short, the suprabenthic community analysed is characterized by a low species richness, low diversity values, and strong temporal fluctuations in species density.

Résumé : *La communauté suprabenthique de la région estuarienne de Cananeia, sud-est du Brésil.* La région étudiée, couverte par la phanérogame *Spartina alterniflora*, montre une dominance de sédiments sableux assez fins. L'espèce numériquement dominante est *Metamysidopsis elongata atlantica.* Pondéralement, le groupe dominant est celui des poissons, suivi par *M. elongata atlantica* et les juvéniles de *Penaeus schimitti.* La communauté suprabenthique est affectée par de fortes variations saisonnières avec des valeurs maximales au printemps, du fait de l'abondance du mysidacé *M. elongata atlantica*, et d'une décroissance de la densité en été. En résumé, la communauté suprabenthique étudiée est caractérisée par une pauvreté en espèces et en diversité, et par de fortes variations temporelles de densité.

Keywords : Suprabenthos, temporal variation, estuarine region, southeastern Brazil.

Introduction

The suprabenthos is also called hyperbenthos, demersal zooplankton, nectobenthos and benthopelagic plankton (Brunel *et al.*, 1978; Sibert, 1981; Sorbe, 1981, 1989; Saint-Marie & Brunel, 1985; Dauvin *et al.*, 1994). Suprabenthic communities contain elements suggesting two distinct origins: benthic species with upward movements and planktonic species with downward movements (Sibert, 1981). The suprabenthal constitutes a transitional zone between the benthal and the pelagial, containing organisms living in the water column but dependent on the proximity of the bottom (Mees *et al.*, 1993a). These organisms belong to a variety of taxa; some are permanent suprabenthic

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animals (e.g. mysids, amphipods and isopods) and others temporary (e.g. larvae of decapods and fishes).

Studies on suprabenthos are of great interest since crustaceans, the main suprabenthos component, are a valuable food source for many demersal fishes feeding in different levels of the water column contiguous to the bottom. They stress the importance of this community for the general economy of the sea by contributing substantially to its trophodynamics (Sibert, 1981; Sorbe, 1981, 1989; Mees & Hamerlynck, 1992). In the present study most of the organisms comprising the suprabenthos have been found in the stomachs of fishes inhabiting the Cananeia lagoon estuarine region (Wakabara *et al.*, 1993).

This paper focuses on the identification of suprabenthos community components of the marine sector of the Cananeia lagoon estuarine region. The description of their distribution along the lower intertidal mud-flat of the studied shore and the pattern of species temporal changes were investigated. Environmental variables such as grain size, sediment organic contents, water salinity, temperature and dissolved oxygen were examined as factors likely to influence the distribution of species. Such a descriptive baseline study is necessary to unravel the functioning of the estuarine ecosystem.

Material and Methods

Situated in the state of São Paulo, southeastern Brazil, the Cananeia lagoon estuarine region is a system bounded by mangroves and salt-marshes. The studied area is a mud-flat in the marine sector, composed mainly of fine sand and silt and covered with disperse stands of *Spartina alterniflora*. Along this mud-flat, eight stations were sampled at the low intertidal zone in order to cover the total extention of the shore (Fig. 1).

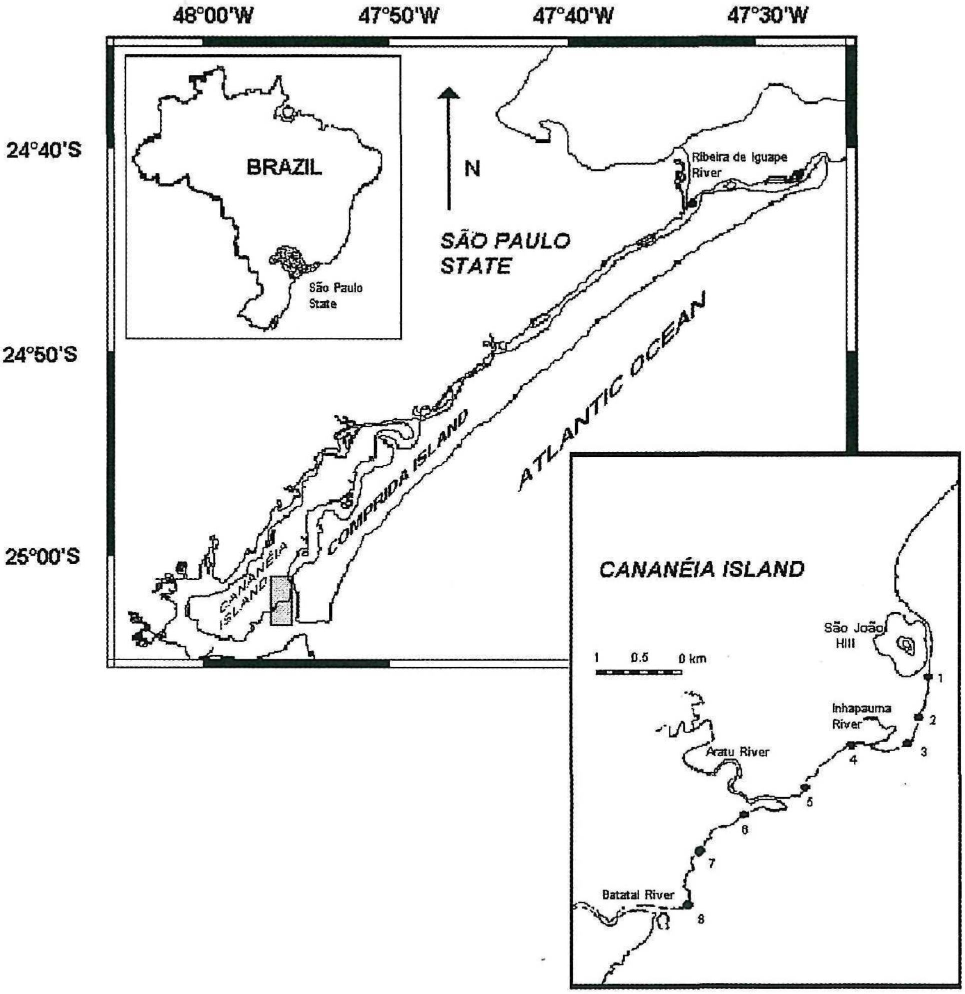


Figure 1. Location of the sampling sites (stations 1-8) in the Cananeia lagoon estuarine region, São Paulo State, southeastern Brazil.

Figure 1. Localisation géographique des stations d'échantillonnages (stations 1-8) dans la région de l'estuaire de Cananeia, Etat de São Paulo, sud-est du Brésil.

Suprabenthic faunal samples were taken monthly from September 1984 to October 1985, with a "Renfro Beam - Trawl" modified by Iwai (1978) consisting of two mounted nets, one external, 6 mm mesh size and one internal at the back of the trawl, 0.5 mm mesh size (Fig. 2). Trawling was done on the sea bottom, once at each station, for five minutes at a boat speed of 2 knots. All samples were taken during the day at high tide; sampling depth was 1-3 metres. The sampled area of each station was calculated using the formula: A = V x T x W, where V (m/min) is the boat velocity, T (min) is the towing time and W (m) is the width of the sampling gear, totalizing 618 m^2. Samples were rinsed over a 0.5 mm mesh sieve and preserved in a buffered formaldehyde solution (6% final concentration).

Salinity (PSU = practical salinity units), water temperature (°C) and dissolved oxygen ($ml.l^{-1}$) were measured at each site; the organic content and particle grain size of sediment were analysed. Such measures were used in the PCA analysis.

All the collected animals were identified in the laboratory to species level, if possible, and counted. The suprabenthic faunal groups were weighed (wet weight) with an analytical Mettler scale (capacity 160 g; accuracy 10^{-4} g). All density and biomass data are expressed as numbers of individuals and mg wet weight per 100 m^2, excepting data grouped by season, when the sampling area corresponds to 300 m^2 (100 m^2 x 3).

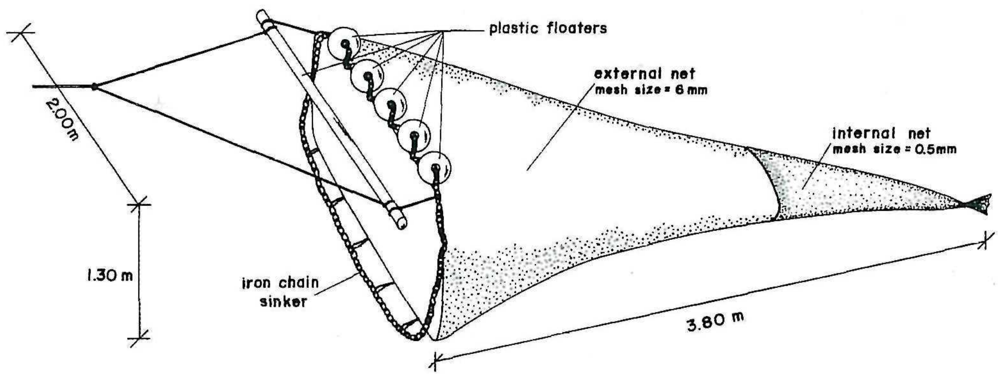


Figure 2. Renfro beam trawl used for suprabenthos sampling.
Figure 2. Chalut "Renfro beam" utilisé pour l'échantillonnage suprabenthique.

From the total of 135 species identified, accidentally caught epibenthic (eg. demersal fish, adult crabs, adult shrimps, gastropods) and endobenthic (eg. adult polychaetes, foraminifera and bivalves) organisms were discarded from the quantitative analyses. The demersal zooplankton was also discarded due to the inefficiency of the net size for this group. Postlarval fishes were considered as well as the free living stage of ectoparasites. Rare species were selected by the index of Jackson (1972), excluding species if less than an average of 2 individuals per sampled period were collected. After these reductions from data matrices, the suprabenthic fauna amounted to 23 species.

Community parameters such as species richness (S), abundance per haul (N), diversity (Shannon index H') and evenness (Pielou's index J') were computed for each sample in order to identify the individual components of the suprabenthic community, describe their spatial distribution and define a seasonal pattern for the community. The formulae used were:

$$H' = -\sum_{i=1}^{S} \frac{n_i}{N} \cdot \log \frac{n_i}{N} \text{ and } J' = \frac{H'}{\log S}$$

where n_i is the number of individuals of the i th species, N the total number of individuals and S the number of species.

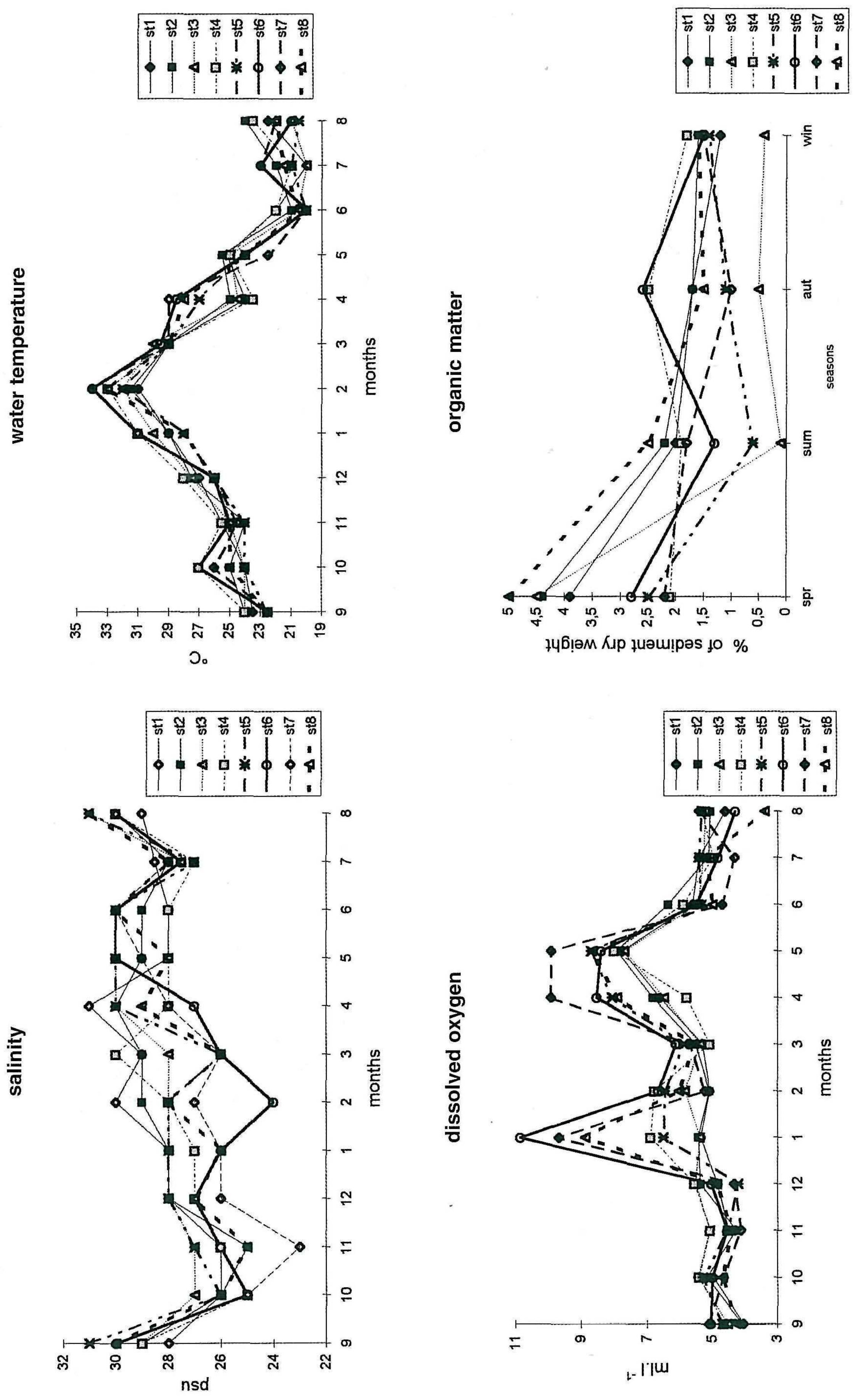
The abundance of selected species was plotted against time in order to describe typical temporal fluctuations of abundance of the suprabenthic species.

A multivariate analysis of the community structure was performed after a log (x + 1) transformation of the density data of each sample. The transformed data were then subjected to an ordination technique, Principal Component Analysis (PCA), combining the biotic data with environmental variables.

For the presentation of part of the data, monthly samples were grouped as follows: spring (October-December); summer (January-March); autumn (April-June) and winter (July-September).

Results

Figure 3 shows the range of the recorded environmental variables. Values of salinity varied from 23.0 to 31.0, water


water temperature
°C
months
st1
st2
st3
st4
st5
st6
st7
st8
salinity
psu
months
organic matter
% of sediment dry weight
seasons
spr
sum
aut
win
dissolved oxygen
ml.l-1
months

temperature ranged from a minimum of 20°C in winter to 34°C in summer. Dissolved oxygen showed two peaks: one in January (10.86 $ml.l^{-1}$) and one in April/May (9.92 $ml.l^{-1}$); a minimal value occurred in August (3.39 $ml.l^{-1}$). Sediment organic matter showed higher values in spring (maximum = 5.0%) and lower values in summer and winter (minimum = 0.4%). Although there were some marked aperiodical changes in the environmental variables, no conspicuous differences were observed among stations.

A total of 23 suprabenthic taxa was considered for the quantitative analyses, totalizing 1199407 individuals and corresponding to a total biomass of 25435.9 mg (Tabs. 1 and 2). A total of 37 suprabenthic taxa was recorded (Tab. 1).

Metamysidopsis elongata atlantica dominated the suprabenthos in number, totalizing 1195712 individuals, (99.7% of all individuals sampled), followed by juveniles of *Penaeus schimitti* with 2220 individuals (0.19%) (Tab. 1). In relation to the total biomass (Tab. 2), fish was the dominant group with 11797 mg/1200 m^2, (46.4% of the total) followed by *M. elongata atlantica* with 9501.7 mg/1200 m^2 (37.3%) and juveniles of *P. schimitti* with 4029.6 mg/1200 m^2 (15.8%).

Changes of populations were evident, as shown by variations in the monthly abundance of the 23 most common species. Some fluctuations displayed a strong seasonal component, with species more abundant in winter (*Mysidopsis coelhoi, Mysidopsis tortonesi, Zeuxo coralensis, Cassidinidea tuberculata, Dies fluminensis, Sphaeromopsis mourei* and Amphipoda), in spring (*Edotea triloba, Parhyalella welpleyi*, Gobiidae, *Micropogonias furnieri, Metamysidopsis elongata atlantica*, Engraulididae), in autumn (*Munna cananeia*) or in summer (*Aega* sp.). Examples of each type of distribution are given in Fig. 4. Other species did not show a clear seasonal pattern in spite of apparently aperiodical fluctuations (Bodotridae, *Kalliapseudes schubarti, Grandidierella bonnieroides, Microgobius meeki*, Gerreidae, *Anchoa januaria* and *Penaeus schimitti*).

The variations of Schannon diversity, Pielou evenness, species richness and density values are shown in Figs. 5 and 6. The diversity and evenness indices of the stations sampled had minimal values during the spring, when maximal values of density were recorded. Low values of species richness presented apparently irregular fluctuations throughout the studied period.

In the plane formed by the first (eigenvalue 0.22) and second (eigenvalue 0.15) PCA axes (Fig. 7) the sample scores clearly separate the four seasons. All spring samples are located in the upper right quadrant which, in the corresponding species plot, contains *Penaeus schimitti, Edotea triloba*, Engraulididae and *Microgobius meeki*. These species are highly abundant in spring (those with higher values in axis II) or spring and summer (those closer to axis I). All summer samples are located in the lower right quadrant which, in the corresponding species plot, contains *Aega* sp. and *Anchoa januaria*, species with a higher abundance in the summer. Winter and, to a lesser extent, autumn samples are located on the left side of the ordination plane, corresponding to isopod and amphipod species with a higher abundance in those periods. From the environmental plot it is evident that the first axis correlates strongly with temperature. This result suggests that temperature (seasonal) effects are most decisive in structuring the suprabenthos in the marine sector of the estuary, separating mainly the summer samples from the autumn and winter ones. The second axis correlates with sediment organic contents. Along the second axis the spring samples are located in the higher half of the diagram, forming a tight cluster corresponding to samples with high sediment organic contents. Summer, autumn and, to a lesser extent, winter are segregated at the lower half of the diagram, corresponding to lower values of sediment organic contents.

The mean seasonal abundance of the different temporal communities as identified by ordination analysis are shown in Fig. 8. In these graphs, the faunistic composition is presented considering only species that made up 5% or more of the total suprabenthic community. Summer is the season with lower values of density and biomass (Tabs. 1 and 2). On the other hand, high values of diversity and evenness were generally recorded (Fig. 5). In terms of density, the dominant species were *Penaeus schimitti* and fishes (Fig. 8). The suprabenthic fauna reached highest values in abundance and biomass in spring, when the community is dominated in density as well as in biomass by *Metamysidopsis elongata atlantica* (Fig. 8; Tabs. 1 and 2). Due to the extreme dominance of the mysid *M. elongata atlantica*, values of diversity and evenness are low (Fig. 5). Throughout the studied period monthly values of diversity appear to reflect the numerical densities of dominant species rather than species richness at each station. In autumn, total density and biomass were higher than in summer but lower

Figure 3. Environmental variables measured at each station during the studied period. spr: spring (10-12), sum: summer (1-3), aut: autumn (4-6), win: winter (7-9).

Figure 3. Variables de l'environnement mesurées à chaque station pendant la période d'étude. Spr = printemps (10-12), sum = été (1-3), aut = automne (4-6), win = hiver (7-9).

Table 1. Seasonal density variation (n° ind/300 m^2) of suprabenthic species. () = relative abundance. (*) = values lower than 0.01%.

Tableau 1. Variation saisonnière de la densité (n° ind/300 m^2) des espèces suprabenthiques. () = abondance relative. (*) = valeurs inférieures à 0,01 %.

TAXA	spring	summer	autumn	winter	total
DENDROBRANCHIATA					
Penaeus schimitti Burkenroad, 1934	491 (0.28)	409 (48.12)	814 (24.70)	506 (4.37)	2220 (0.19)
Penaeus brasiliensis Latreille, 1817	-	-	-	-	
Penaeus paulensis Pérez Farfante, 1967	-	-	-	-	
MYSIDACEA					
Metamysidopsis elongata atlantica Bacescu, 1968	182718 (99.48)	30 (3.53)	2187 (66.35)	10777 (92.98)	1195712 (99.69)
Mysidopsis coelhoi Bacescu, 1968	2 (*)	-	13 (0.39)	35 (0.30)	50 (0.01)
Mysidopsis tortonesi Bascescu, 1968	-	-	-	21 (0.18)	21 (*)
Bowmaniella brasiliensis Bacescu, 1968	-	-	-	-	
Brasilomysis castroi Bacescu, 1968	-	-	-	-	
CUMACEA					
Bodotridae	5 (*)	-	2 (0.06)	6 (0.05)	13 (*)
TANAIDACEA					
Kalliapseudes schubarti (Mañe-Garzon, 1944)	-	16 (1.88)	10 (0.30)	8 (0.07)	34 (*)
Zeuxo coralensis Sieg, 1980	-	-	-	22 (0.19)	22 (*)
ISOPODA					
Aega sp.	7 (*)	24 (2.82)	10 (0.30)	9 (0.08)	50 (0.01)
Cassidinidea tuberculata Richardson, 1912	31 (0.02)	22 (2.59)	19 (0.60)	78 (0.67)	150 (0.01)
Dies fluminensis (Mañe-Garzon, 1944)	10 (0.01)	2 (0.24)	4 (0.12)	20 (0.17)	36 (*)
Edotea triloba Say	7 (*)	-	-	-	7 (*)
Munna cananeia Pires, 1985	5 (*)	-	45 (1.37)	7 (0.06)	57 (0.01)
Sphaeromopsis mourei (Loyola & Silva, 1960)	5 (*)	-	5 (0.15)	17 (0.15)	27 (*)
GAMMARIDEA					
Grandidierella bonnieroides Stephensen, 1947	7 (*)	-	10 (0.30)	19 (0.16)	36 (*)
Parhyalella welpleyi (Shoemaker, 1933)	21 (0.01)	-	-	9 (0.08)	30 (*)
Amphipoda (young)	2 (*)	-	2 (0.06)	28 (0.24)	32 (*)
Ampithoe ramondi Audouin, 1826	-	-	-	-	
Atylus minikoi (Walker, 1905)	-	-	-	-	
Batea catharinensis F. Müller, 1865	-	-	-	-	
Chelorchestia sp.	-	-	-	-	
Corophium acherusicum (Costa, 1851)	-	-	-	-	
Cymadusa filosa Savigny, 1816	-	-	-	-	
Erichthonius brasiliensis (Dana, 1853)	-	-	-	-	
Resupinus coloni Thomas & J.L. Barnard, 1986)	-	-	-	-	
Stenothoe valida Dana, 1853	-	-	-	-	
Tiburonella viscana (J.L. Barnard, 1964)	-	-	-	-	
FISHES					
Gobiidae	34 (0.02)	4 (0.47)	5 (0.15)	4 (0.03)	47 (0.01)
Microgobius meeki Evermann & Marsh, 1900	60 (0.03)	27 (3.18)	38 (1.15)	6 (0.05)	131 (0.01)
Gerreidae	56 (0.03)	29 (3.40)	32 (0.97)	-	117 (0.01)
Engraulididae	58 (0.03)	52 (6.12)	11 (0.33)	2 (0.02)	123 (0.01)
Anchoa januaria (Steindachner, 1879)	64 (0.04)	169 (19.88)	68 (2.06)	5 (0.04)	306 (0.03)
Micropogonias furnieri (Desmarest, 1823)	38 (0.02)	-	-	8 (0.07)	46 (*)
Fish (small sized)	48 (0.03)	65 (7.65)	18 (0.55)	4 (0.04)	135 (0.01)

Note: - indicates that only one or a few specimen were found in all samples.

than in spring, while values of diversity and evenness were lower than in summer but higher than in spring (Fig. 5). In terms of density, the most well represented species is again *M. elongata atlantica* (Fig. 8). This species, however, did not contribute greatly to the overall biomass, since fishes correspond to 87.1% of the total biomass (Tab. 2). In winter, total densities continued to increase (Fig. 6). Values of diversity and evenness decreased again with the return of mysid dominance in terms of density (Fig. 5). In terms of biomass, fishes remained dominant (Tab. 2).

All the year round, all the sampling stations were quite similar in species composition (Fig. 9), stressing the absence of a spatial pattern as already pointed out by the PCA analysis, although aperiodical fluctuations of environmental variables did occur.

Table 2. Seasonal biomass variation (mg wet weight/300 m^2) of suprabenthic main taxa. ( ) = relative biomass. (*) = values lower than 0.01%.

Tableau 2. Variation saisonnière de la biomasse (mg poids humide/300 m^2) des principaux taxa suprabenthiques. ( ) = biomasse relative. (*) = valeurs inférieures à 0,01 %.

TAXA	spring	summer	autumn	winter	Total
Penaeus schimitti	1418.5 (13.08)	1177.0 (33.12)	674.0 (11.81)	760.1 (14.24)	4029.6 (15,84)
Metamysidopsis elongata atlantica	8801.6 (81.20)	0.7 (0.01)	39.0 (0.68)	660.4 (12.37)	9501.7 (37.35)
Tanaidacea	0 (*)	0.3 (*)	0.1 (*)	0.4 (*)	0.8 (*)
Isopoda	19.8 (0.18)	26.4 (0.74)	17.1 (0.29)	37.5 (0.70)	100.8 (0.39)
Amphipoda	1.4 (0.01)	0 (*)	0.3 (*)	4.2 (0.07)	5.9 (0.02)
Fishes	598.0 (5.51)	2348.7 (66.10)	4975.7 (87.19)	3874.7 (72.59)	11797.1 (46.38)

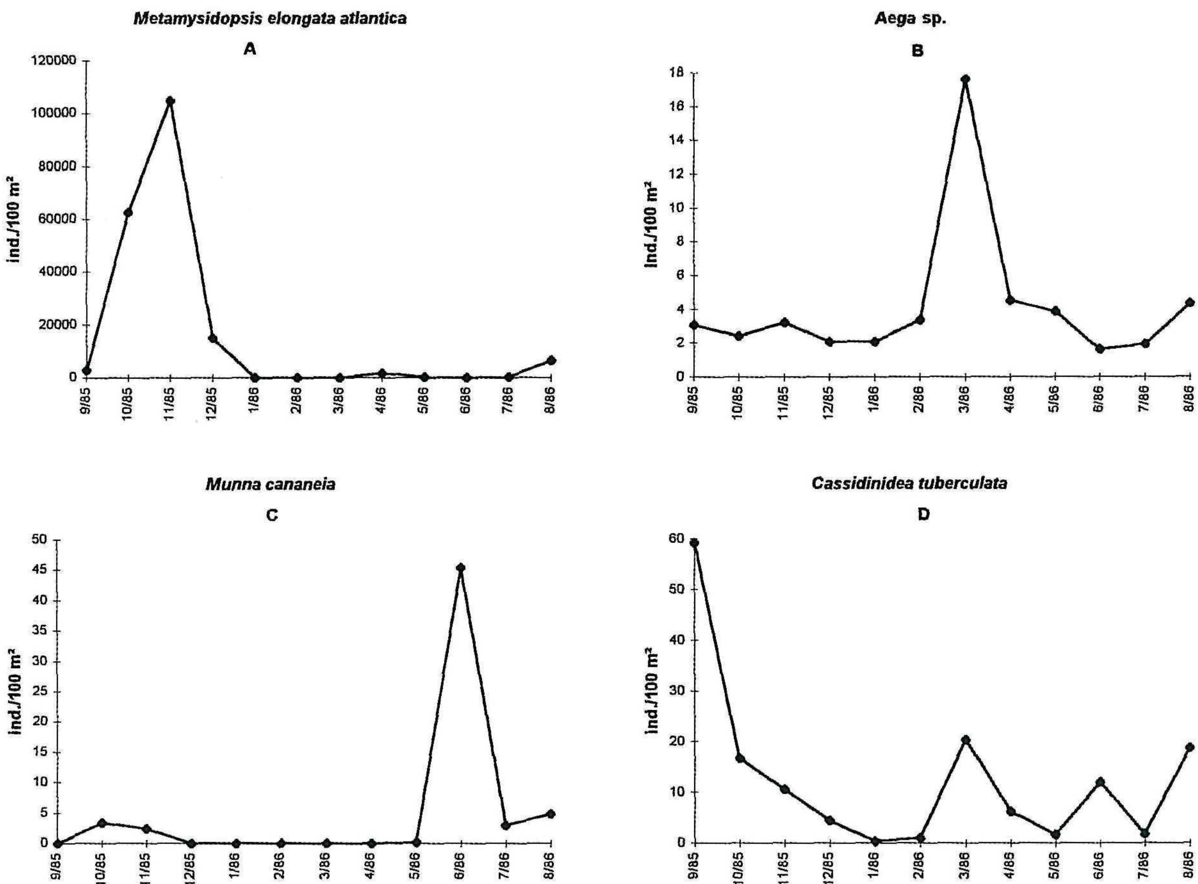


Figure 4. Monthly abundance of selected suprabenthic species, representing dominant species: A) spring, B) summer, C) autumn, D) winter.

Figure 4. Evolution mensuelle de la densité des espèces suprabenthiques dominantes : A) printemps, B) été, C) automne, D) hiver.

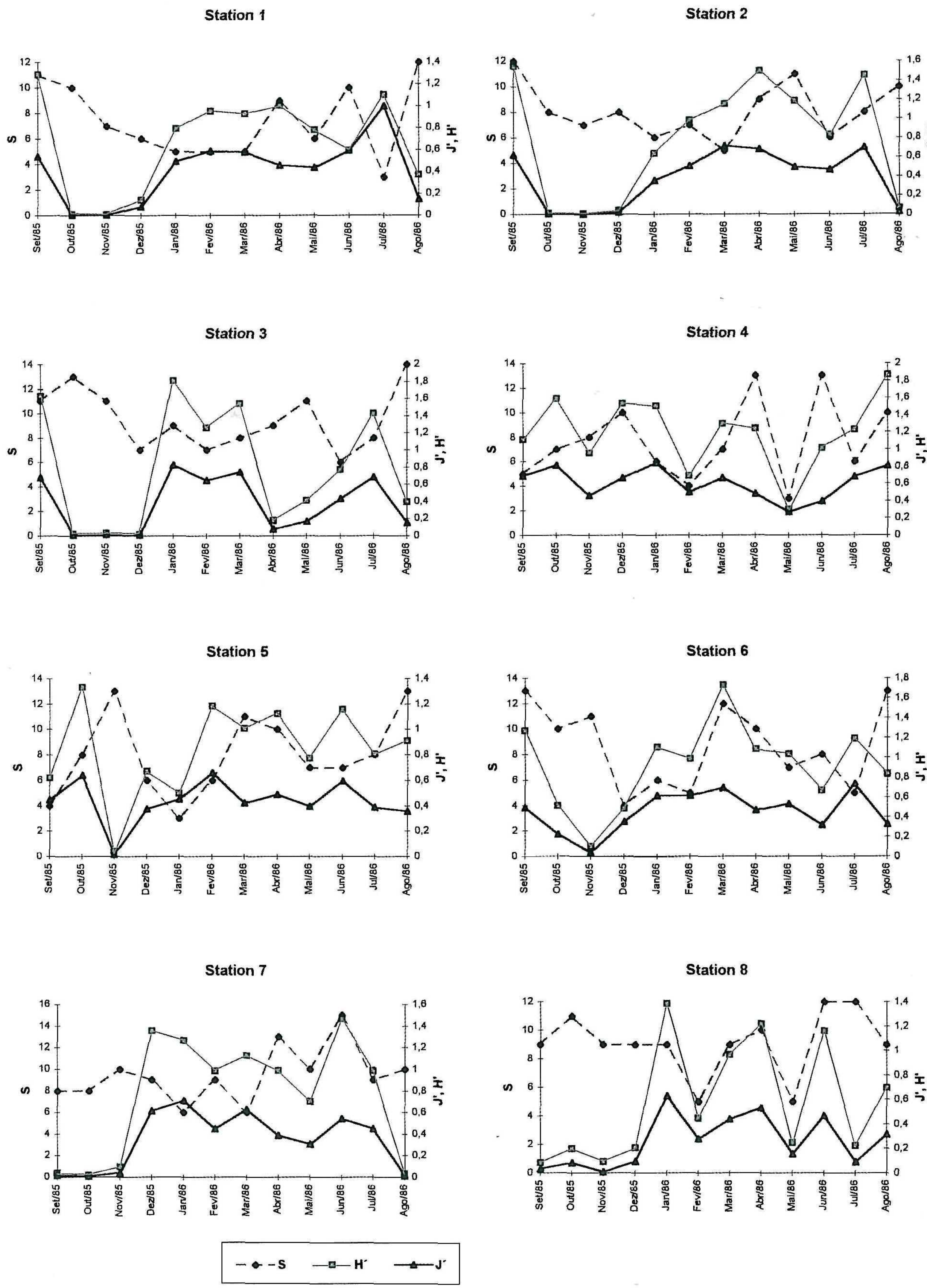

Station 1
Station 2
Station 3
Station 4
Station 5
Station 6
Station 7
Station 8
S
J', H'
Set/85
Out/85
Nov/85
Dez/85
Jan/86
Fev/86
Mar/86
Abr/86
Mai/86
Jun/86
Jul/86
Ago/86
S
H´
J´

Figure 5. Monthly variation of diversity (H'), evenness (J') and species richness (S) at stations 1 - 8.
Figure 5. Variation mensuelle de la diversité (H'), de la régularité (J') et de la richesse spécifiques aux stations 1-8.

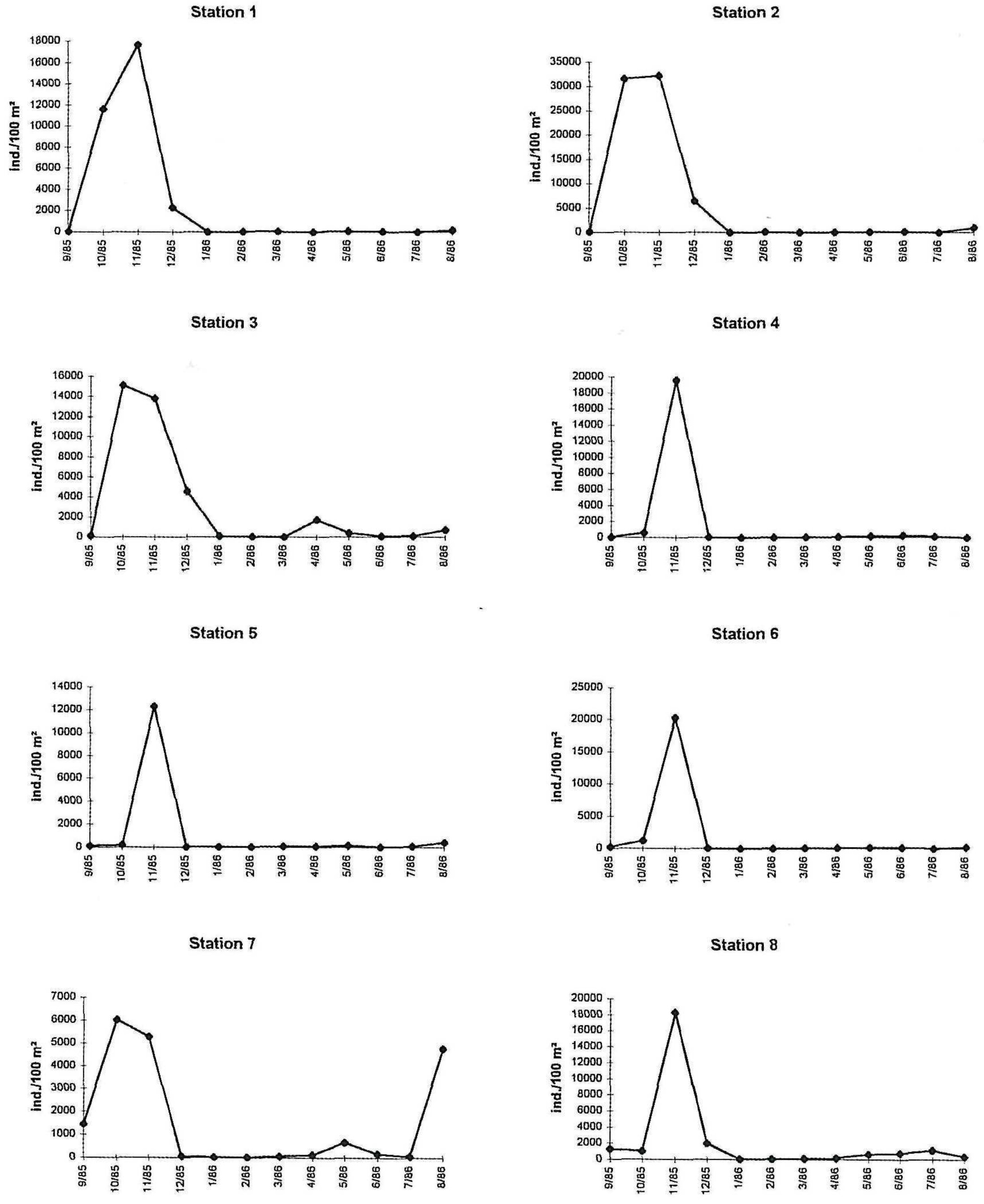
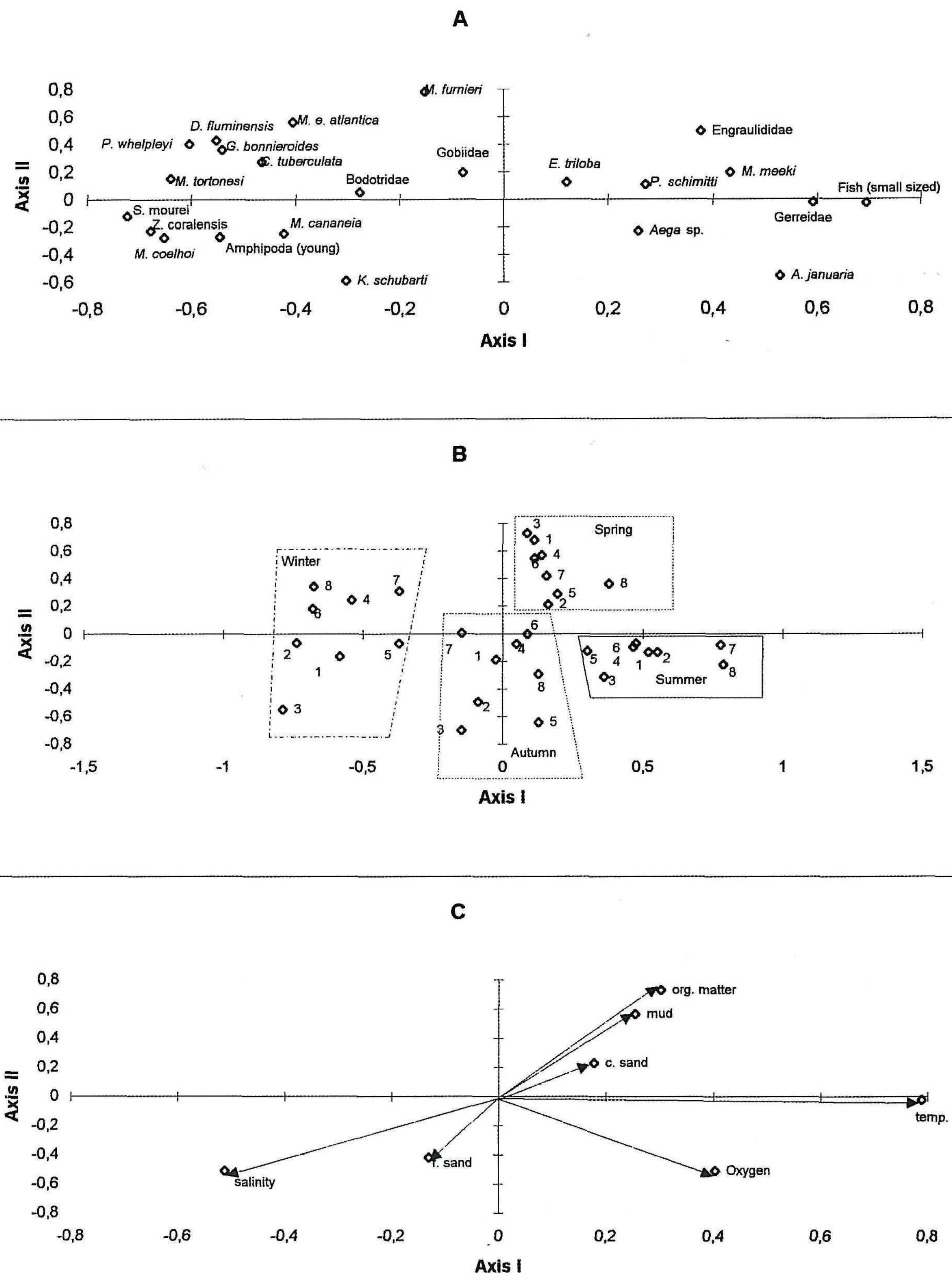


Figure 6. Monthly total density of the suprabenthic fauna at stations 1 - 8.
Figure 6. Densité mensuelle totale de la faune suprabenthique aux stations 1-8.


A
Axis II
Axis I
M. furnieri
M. e. atlantica
D. fluminensis
P. whelpleyi
G. bonnieroides
C. tuberculata
M. tortonesi
Bodotridae
Gobiidae
E. triloba
Engraulididae
M. meeki
P. schimitti
Fish (small sized)
Gerreidae
S. mourei
Z. coralensis
M. coelhoi
M. cananeia
Amphipoda (young)
K. schubarti
Aega sp.
A. januaria
B
Winter
Spring
Summer
Autumn
C
org. matter
mud
c. sand
temp.
f. sand
salinity
Oxygen

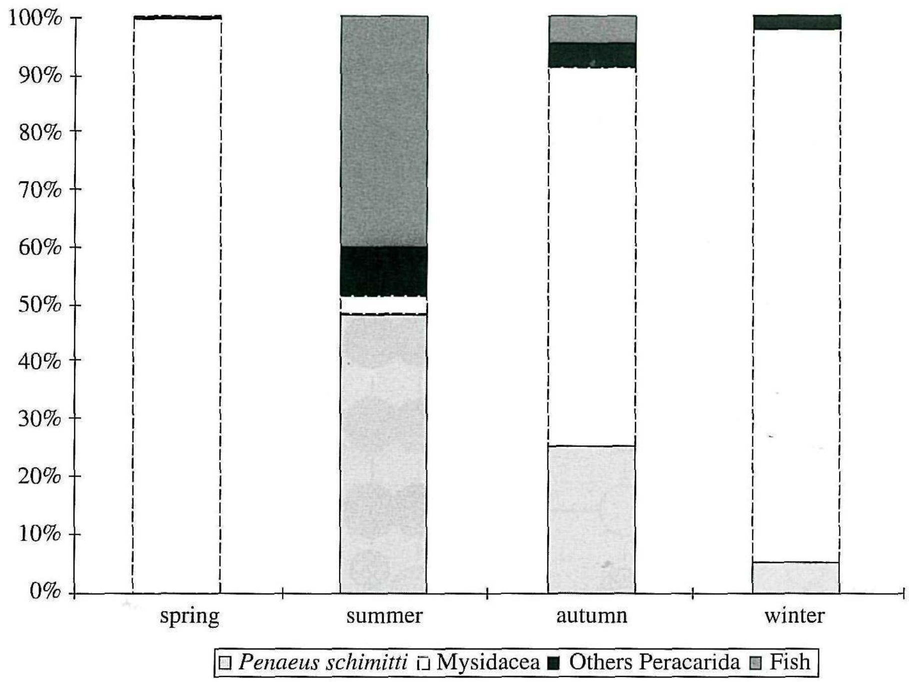


Figure 8. Seasonal composition of the suprabenthic community identified by the Principal Component Analysis.
Figure 8. Composition saisonnière de la communauté suprabenthique identifiée par les analyses d'ordination.

Discussion

In the suprabenthic community of the shallow marine area of the Cananeia lagoon estuarine region the seasonal pattern was more important than the spatial structure. This was mainly due to the sequential appearance, high abundance and disappearance of temporary suprabenthic species such as larvae of *Penaeus* and postlarval fish, besides strong temporal fluctuations of populations of permanent suprabenthic organisms like *Metamysidopsis elongata atlantica*. This fact has already been observed by Buhl-Jensen & Fossa (1991) for coastal areas of the Western Sweden. For Westerschelde Estuary, in the Southweast Netherlands, Mees *et al.* (1993 a) found the reverse, i.e. the spatial patterns being more important than the temporal ones. The main reason for this was that the suprabenthos of the marine and brackish parts was composed mostly by different species. Diverse species composition along with the salinity gradient were also found in the Schelde, Eems and Gironde Estuaries (Mees *et al.*, 1995). Although the Cananeia Estuary presented a salinity gradient from the inner parts of the estuary towards the sea (Teixeira *et al.*, 1965), the studied site is restricted to the marine sector of the estuary, and did not reveal differences in spatial species composition.

Patterns of community diversity were greatly influenced by local population dynamics, showing a clear seasonal pattern related negatively to density peaks of dominant species and positively to evenness values. The abundance of species displayed a distinct pattern of seasonal changes, with higher densities in spring months, followed by a marked decline of most populations during the summer.

Metamysidopsis elongata atlantica dominated the area, presenting maximal density and biomass in spring, and minimal values in summer. Mees *et al.* (1993b) also observed the same fluctuation, linking the maximal abundance to breeding, young production and migration activities and the minimal abundance to predation by ctenophores, chaetognaths and demersal fishes, besides natural mortality and migrations. There is an obvious

Figure 7. Results of the Principal Component Analysis (first two axes). A: species scores, B) samples scores and C) environmental biplot (Spr = spring, Sum = summer, Aut = autumn, Win = winter).

Figure 7. Représentation graphique de l'Analyse en Composantes Principales pour les deux premiers axes. A : groupes d'espèces, B : groupes des stations, C : données de l'environnement (Spr = printemps, Sum = été, Aut = automne, Win =hiver).

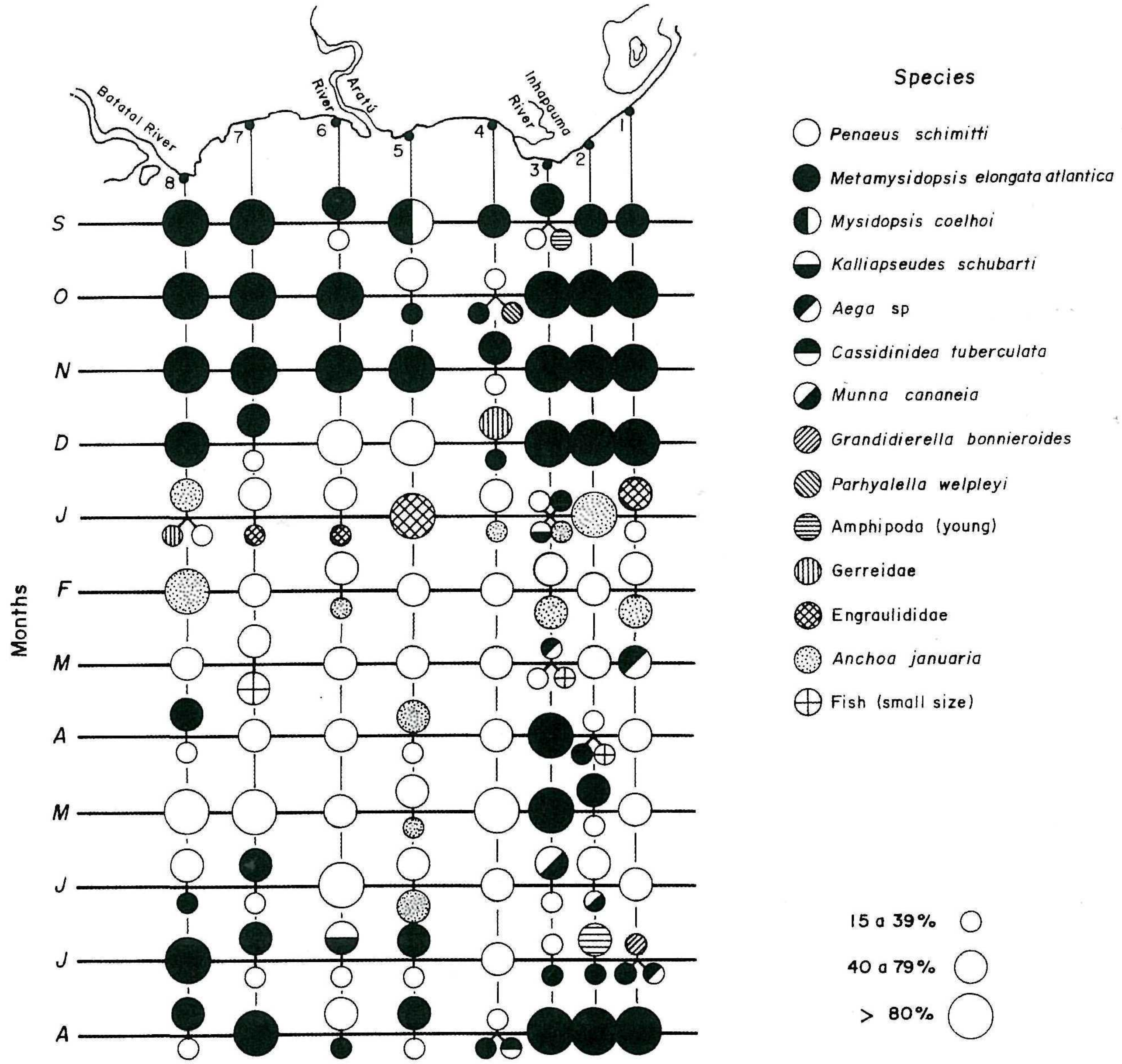


Figure 9. Monthly dominance of the suprabenthic species at each sampling station (O, N, D = spring; J, F, M = summer; A, M, J = autumn; J, A, S = winter).

Figure 9. Dominance mensuelle des espèces du suprabenthos à chaque station d'échantillonnage (O, N, D = printemps ; J, F, M = été ; A, M, J = automne ; J, A, S = hiver).

correlation between high mysid abundance and maximal concentration of organic matter in spring. This fact has been documented by several authors (Almeida Prado, 1973; Fossa, 1985; Mees & Hamerlynck, 1992). This mysid is also an important food source for local young fishes such as *Micropogonias furnieri*, *Symphurus jenynsii* and *Stellifer stellifer* (Wakabara *et al.*, 1993).

In summer, there was a predominance of *Penaeus schimitti* at all sampling stations, due to the absence of *Metamysidopsis elongata atlantica*. Rulifson (1983) described the migration of this decapod to estuarine areas at the beginning of larval and postlarval phases. It is a temporary estuarine suprabenthic species since the individuals return to the open sea (Iwai, 1978). When they invade the estuary, they select grassy bottoms (Kneib, 1987; Zimmerman *et al.*, 1984; Wenner & Beaty, 1993). Some studies show a strong correlation between the densities of young *Penaeus schimitti* and the presence of *Spartina alterniflora* because detritus and the plants associated to the *S. alterniflora* such as green algae, blue-green algae and colonial diatoms are an important nutritious source for the species (Gleason & Zimmerman, 1984; Zimmerman *et al.*, 1984). In the Cananeia region, predation on penaeids occurs mainly by the fishes *Cathorops spixii, Eucinostomus* sp. and *Symphurus jenynsii* (see Wakabara *et al.*, 1993).

At the beginning of autumn, and throughout the winter period, *Metamysidopsis elongata atlantica* reappeared in high densities. Thus *M. elongata atlantica*, a permanent suprabenthic species dominates the community all the year round, except in summer, when a temporary species, *Penaeus schimitti*, predominates.

In terms of biomass, fishes dominated in all seasons, except in spring. The most important species were *Anchoa januaria, Micropogonias furnieri, Microgobius meeki* and species of Gobiidae, Gerreidae and Engraulididae. The abundance of fish associated with estuarine areas and macrophytes is a well documented fact, and this is possibly due to the high supply of small crustacean food items, mainly suprabenthic components (Burchmore *et al.*, 1984; Wakabara *et al.*, 1993; Cattrijsse *et al.*, 1994; Motta *et al.*, 1995).

Results from the multivariate analysis performed on density data confirmed the stability of the seasonal pattern described for the suprabenthic community of this shallow marine area, which means that samples taken at one season were more similar to one another than to samples from the same site but taken at different seasons. Temperature, strongly correlated to first PCA axis, was an important environmental variable because it clearly defined seasonal assemblages.

In short, the intertidal suprabenthic community analysed was characterized by low species richness and diversity values and strong temporal fluctuation of species density. There was always a strong dominance of one species, *Penaeus schimitti* in summer and *Metamysidopsis elongata atlantica* in all other seasons.

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