Community Structure of Polychaete Families in Mangroves of Guang-Guang Point and Nearby Shores of Pujada Bay, Mati, Davao Oriental

Lea Angsinco-JIMENEZ[1]
[1]Assistant Professor, Natural Sciences Department, Davao Oriental State College of Science and Technology, Mati, Davao Oriental

Abstract

The community structure and function of Polychaete families in mangroves of Guang-guang Point and nearby shores of Pujada Bay, Matis Davao Oriental were examined. A total of fifteen stations were sampled and sampling sites varied according to environmental characteristics which differed in type of sediment, vegetation and zonation. The spatial structures of these infauna were analyzed using multivariate statistical techniques such as TWINSPAN (Two Way Indicator Species Analysis) and CANOCO (Canonical Community Ordination) programs. Eighteen families of Polychaete were identified and densities ranged from 802 to 27,200 inds. m-2 with four dominant families namely: Nereidae represented by two species of Nereis, Syllidae by five genera of *Brania, Oxegone, Pionosyllis,Sphaerosyllis* and *Typosyllis, Spionidae* with *Scolelepis* and *Ophelidae* by Armandia lanceolata. The classification and ordination analyses based on the strong granulometry gradient and other environmental factors yielded the following three spatial communities: G-I, comprising of stations PI to P7, which were generally of sandy sediments at the outer zone (seaward), G-II, with muddy sediments (P8 to P12) at the inner zone (landward) and G-III, the riverine mangrove community with sampling sites (P 13 to PI 5) located separately. The community structure of G-I was observed to be most diverse for the Polychaete families compared with G-II and G-III communities.

Keywords: community ecology, benthic communities, diversity index, zonation

Introduction

Polychaetes are segmented worms that live in marine waters and are known to exist in all oceans. There are two basic groups of polychaetes, the benthic and pelagic forms: the benthic group constitute the majority of polychaetes with 8,000 to 10,000 species and only sixty species are pelagic forms (Day, 1967). They are among the most species-rich marine invertebrates which have a vital role in the community trophic structure (Fauchald and Jumars, 1979; Rosito, 1980)- These benthic communities delineate an important relationship between the primary producers, fish and other higher predators (Robertson, 1986). Moreover, they are recognized to play a vital role in biodegradation processing and nutrient recycling in mangrove ecosystems (McIntyre, 1968). Alongi (1989) reported that few polychaetes are found in mangrove areas of Indo-West Pacific in general, but in Southeast Asia, these organisms are commonly found with the families of Aphroditidae, Capitallidae, Eunicidae, Maldanidae and Nereidae as most abundant-To date very meager data have been documented on mangrove Polychaete communities. Studies were done mostly on taxonomy and identification (Rosito, 1980). This paper would be considered a baseline information in revealing the vital role of these benthic infauna in mangrove areas of the province. This study aimed to: (1) determine the Polychaete family composition, distribution and abundance within the mangrove ecosystem of Guang-guang Point and nearby shores of Pujada Bay, Mati, Davao Oriental; (2) obtain various physico-chemical measurements of the environment; and (3) determine if any correlations exist between the spatial patterns of Polychaete communities and the abiotic environment.

Materials and Methods

Study area. Guang-guang Point is located at the northeastern coast of Pujada Bay. The site lies between 6 ^{0} 55' and 6 ^{0} 56' north latitude and 126 ^{0} 15' and 126 ^{0} 17' east longitude (Figure l). It has extensive mangroves approximately 39,000 m^2 in area and tidal ranges from 0.5 to 1.0 m in water depth. Fifteen stations with a variety of environmental characteristics were sampled. Sampling sites differed in type of sediment , varying vegetation and zonation. The sites were categorized into basin forests and riverine forests according to Twilley et al., (1996), Twelve sites were established in Guang-guang Point and three sampling sites along the banks of Cuabo River.

Field data collection. At each sampling site, a homogenous area of 10m x 10m was established and three replicate cores of samples were taken at an interval of 1m from each other. Sampling was done for only one month (mid-July to August 1996).

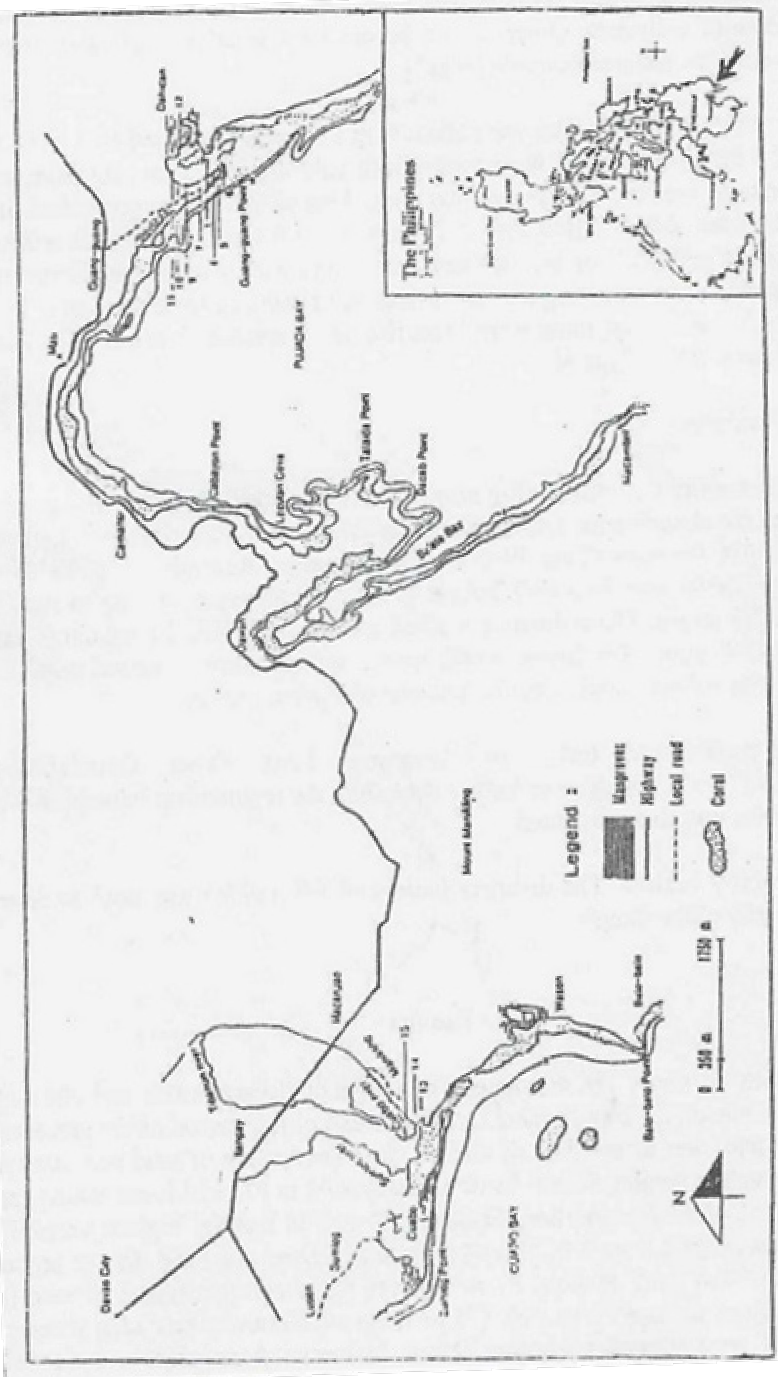

Fig. 1. Location sites of fifteen sampling stations in Guang-guang Point and nearby shores of Pujada Bay, Mati, Davao Oriental

Abiotic factors. Collection of sediment samples was done with a hand core (3.5 cm diameter, 30cm length) and was taken to a depth of about 20 cm. A coulter counter LS was used for grain size analysis. The particulate organic matter was also measured by combustion of sediments- Other abiotic factors such as salinity, pH and temperature were taken from the sediment sample holes.

Biotic factors. Samples were taken with a 6.5 diameter hand core and a sample area of 33.18 cm^2. The samples were treated with cold 8% neutralized formalin solution. In the laboratory, washing and decantation were done to extract the organisms from the sediment and other debris. Three sieves of sizes 0.5, 1.0 and 2.0mm mesh widths were used to improve collection of benthos and density estimate (mesofauna intermediary or temporary meiofauna). Counting and identification of samples were done only in higher taxa (i.e., family level) but some were identified up to species or genus level using the stereomicroscope (Wild Type M3).

Statistical Analyses

Community structure using multivariate statistics. The structural trends were defined using the classification and ordination techniques. The classification method used the TWINSPAN Program (Two-way Indicator Species Analysis; Hill, 1979) which classifies community data into well-defined groups or clusters according to sample and species (family) scores. The ordination method used the CANOCO Program (Canonical Community Ordination, Ter Braak, 1988) which defines more structural trends of the community with ordinates and identifies patterns of the community.

Non-parametric test. The Spearman Rank Order Correlation Test (STATISTICA, 1995) was done to further determine the relationship between biotic and abiotic variables was also conducted.
Diversity indices. The diversity indices of Hill (1973) were used to determine the heterogeneity of the sample.

Results

Abiotic factors. The distribution of sediment characteristics and other abiotic factors are presented in Figures 2 and 3- A clear trend of fluctuation of the percentage of mud (4 to 63 mm) was detected in all stations- Low percentage of mud was observed in PI to P7 with values ranging from 8 to 10%. Stations P8 to P 12 had lower values ranging from 16 to 22% of mud proportion. Stations P13 to P 15 had the highest variability of mud proportion ranging from 0 to 49%. A reverse trend was observed for the proportion of sand (63 to <800 mm). Stations PI to P7 were highest in percentage of sand (85 to 92%) compared to stations P8 to P 12 (75 to 78%) which have lower sand percentages.

Volume 1 Issue No. 1 December 1998
P-ISSN: 2244-4432 • E-ISSN: 2984-7125
National Peer Reviewed Journal
DOI: https://doi.org/10.59120/drj.v1i1.76

Similarly, a-ends were observed in other abiotic factors such as coarse sand, median, skewness, kurtosis and organic material.

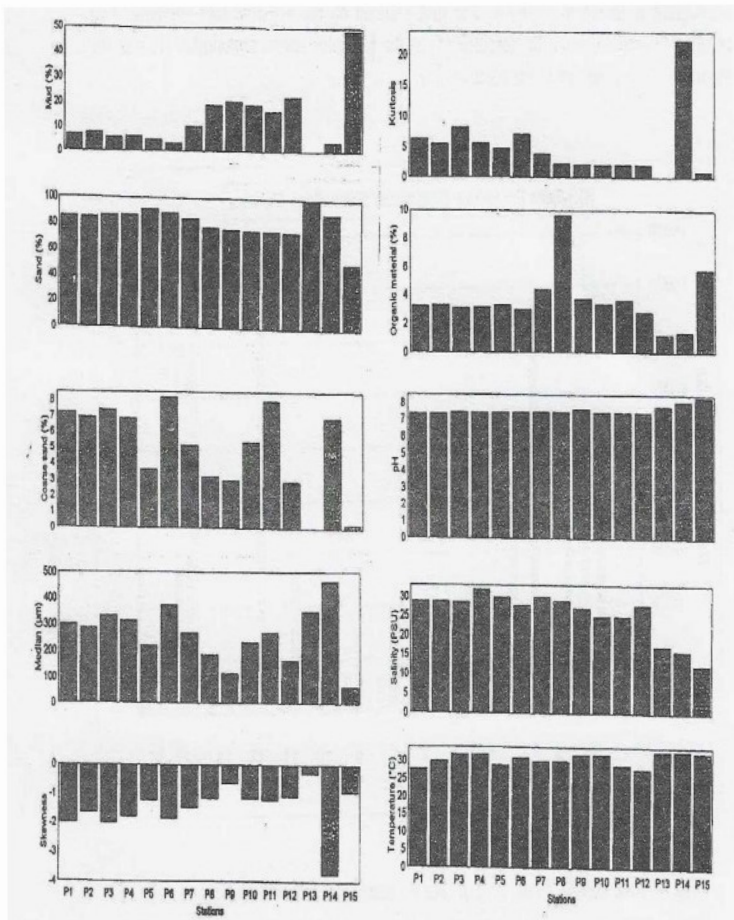

Fig. 2: Sediment patterns of mud, sand coarse sand. median and skewness

Fig. 3: Trends of kurtosis organic matter, pH, salinity and temperature

Biotic factors. A total of eighteen (18) families were identified with four dominant families namely: Syllidae, Nereidae, Spionidae and Ophelidae (Figures 4 and 5). Mean densities of polychaete families ranged from 802 to 27,190 individuals. m [2].

Multivariate community analysis: Classification- The TWINSPAN dendogram is shown in Figure 6. The first division on the negative side contained two groups of communities with Nereidae (5) as the indicator taxon.

Ophellidae (I) was the indicator taxon observed in the positive side.

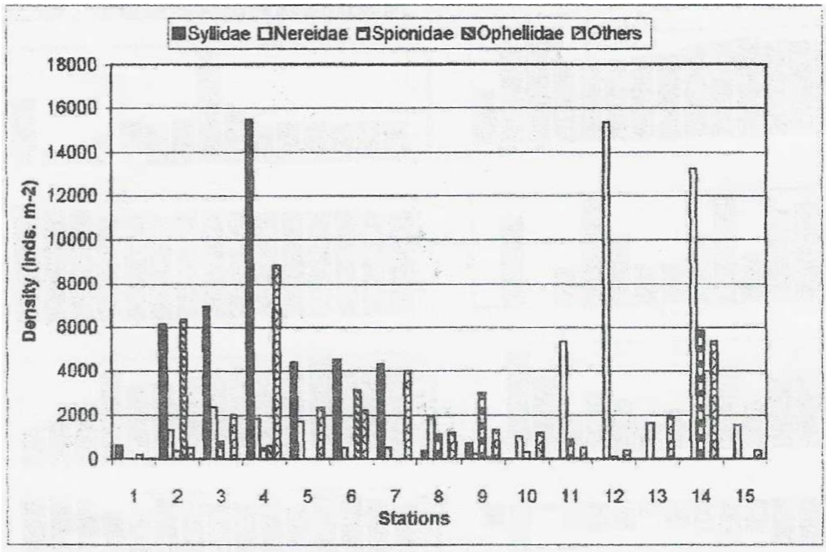

Fig- 4. Total density (inds. m^{-2}) of four dominant Polychaete families

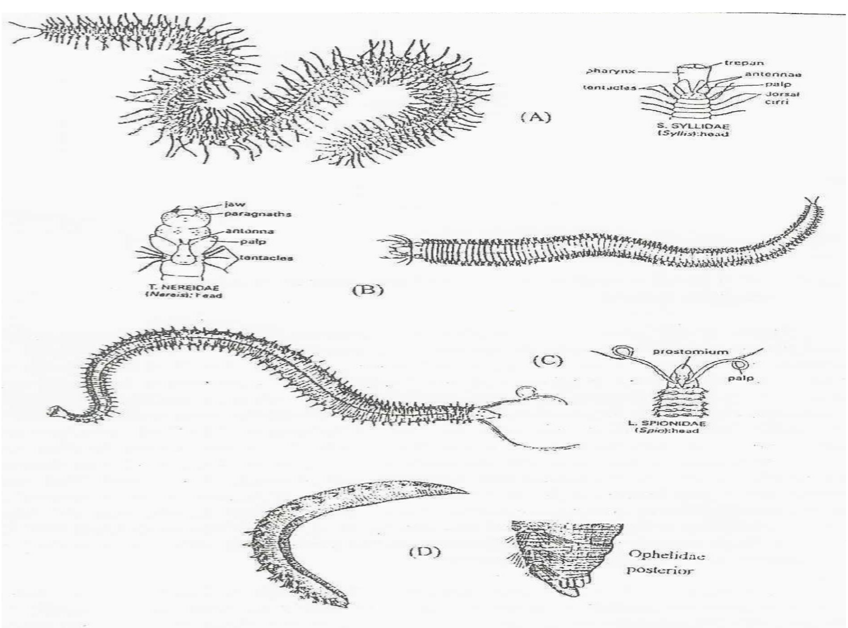

Fig. 5. Key to dominant families of Polychaete in all stations: (A) Syllidae (B) Nereidae (C) Spionidae and (D) Ophelhdae (Knight-Jones et al., 1995)

National Peer Reviewed Journal
DOI: https://doi.org/10.59120/drj.v1i1.76

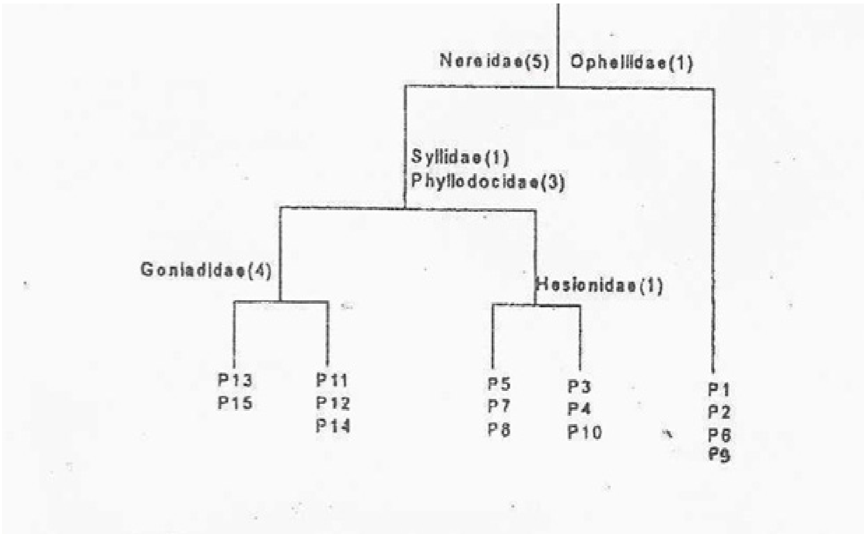

Fig. 6. TWINSPAN — dendrogram of Polychaete families in fifteen sampling stations

Multivariate community analysis: Ordination. The sample scores, species (family) scores and bi-plot scores are shown in Figures 7, 8 and 9- In the sample plot, G-I community was located at the left upper and lower quadrant. The G-II community was located in the right lower quadrant and G-III was clearly separated at the right upper quadrant. In the species(family) plot, the families of Amphinomidae, Flaberridae, Magelonidae, Ophelidae, Phyllodocidae, Pilargidae and Syllidae were associated with GI community. G-II community was associated with Maldanidaes Sabellidae and Spionidae families- The G-III community was closely linked with Pisionidae. Other families were more closely located at the origin and no other trend can be distinguished. The first axis of the bi-plot scores of environmental variables was strongly linked with high mud. Skewness which was located at the lower right quadrant and organic matter located at the lower left quadrant were also associated to G-II community. The second axis was linked to kurtosis, median, temperature, sand and coarse sand which was associated with G-I community. High salinity was clearly linked with G-I community which is a reverse trend in G-III community especially in station P 15.

Spearman rank order correlation. The family Cirratulidae was related positively with coarse sand (r_s = +0.68; p=0.005); Dinophillidae with organic matter (r_s = +0.59; p=0.02); Pilargidae with salinity (r_s +0.57; p=0.03); Phyllodocidae with salinity (r_s +0.71; p=0.003); Pisionidae with median (r_s +0.53; p=0.04). Sabellidae was negatively correlated with sand (r_s = -0.52; p=0.44); Syllidae highly related positively with salinity (r_s = +0.73; p=0.002); and with kurtosis (r_s +0.62; p=0.01) (Table 1.)

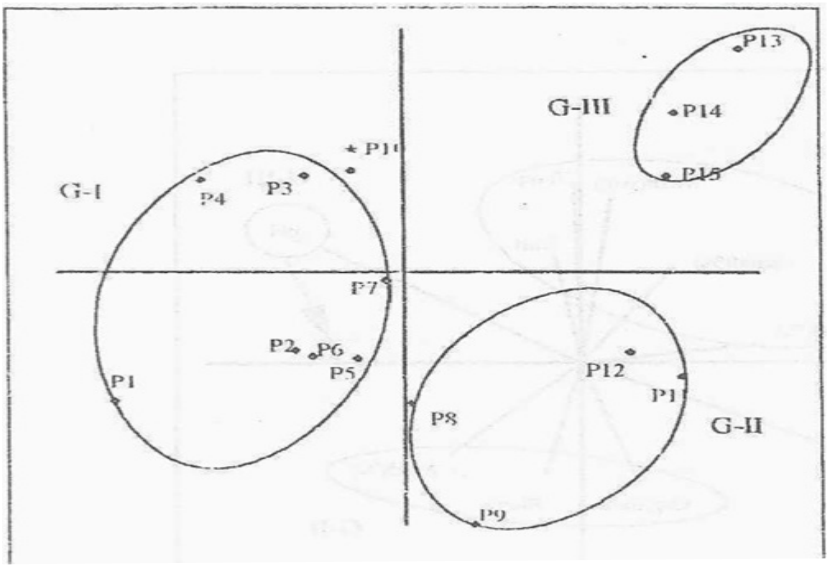

Fig. 7. Sample plot using CANOCO of three groups of communities namely G-I, G-II and G-III

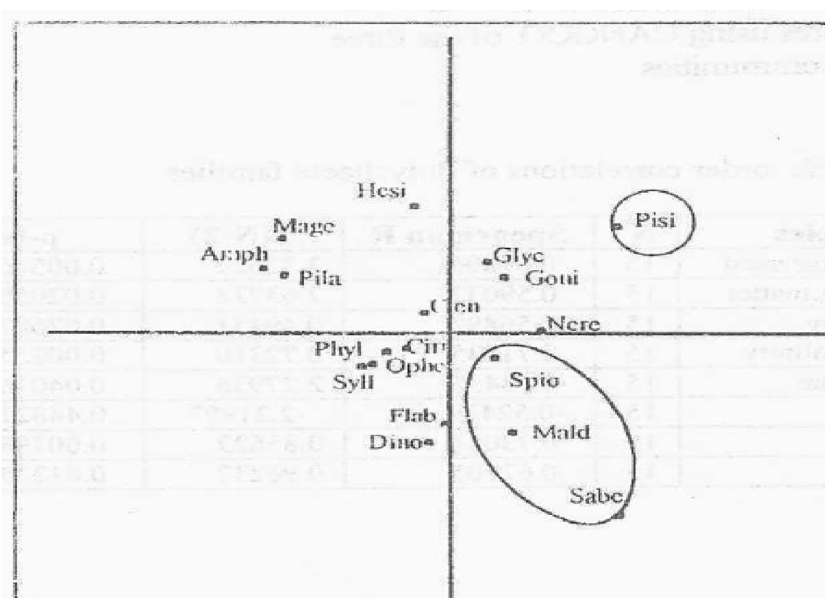

Fig. 8. Species plot using CANOCO of three groups of communities namely: G-I, G-II and G-III

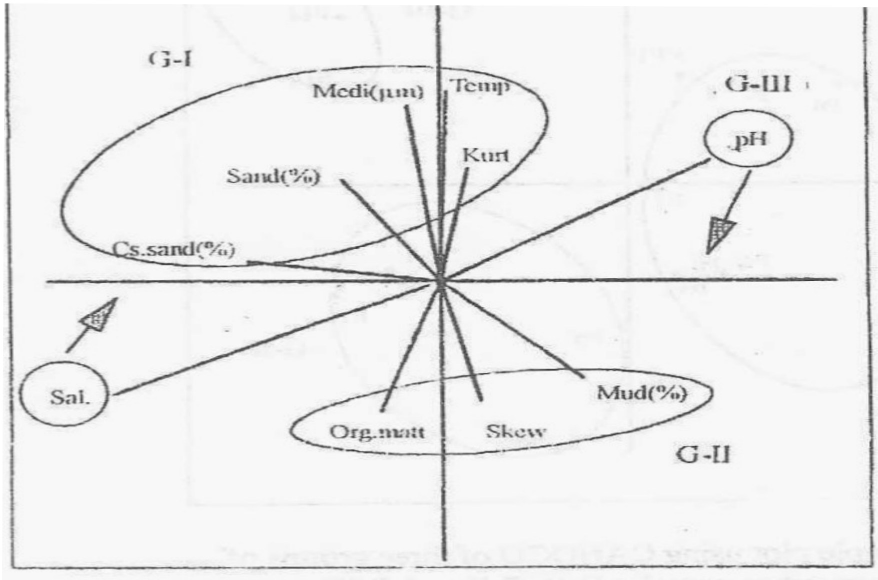

Fig. 9. Bi-plot scores using CANOCO of the three groups of communities

Table I - Spearman rank order correlations of Polychaete families

Pair of variables	N	Spearman R	T(N-2)	p-level
Cirratulidae and Coarse sand	15	0.67806	3.32622	0.00546**
Dinophilidae and Org.matter	15	0.59037	2.63728	0.02050*
Pilargidae and Salinity	15	0.56892	0.49431	0.02687*
Phyllodocidae and Salinity	15	0.71835	0.72310	0.00255**
Pisionidae and Median	15	0.53435	2.27936	0.04016*
Sabellidae and Sand	15	-0.52429	-2.21997	0.44821^{ns}
Syllidae and Salinity	15	0.73044	0.85622	0.00198**
Syllidae andKurtosis	15	0.62705	0.90237	0.01235*

Diversity of Polychaete families. Figure 10 shows the Hill's diversity number N_o and N_1 indicating a decreasing diversity with different group communities (G-I, G-II and G-III communities). G-I was the most diverse group (N_o=7.57; N_1=3.75); the second most diverse group was G-II (N_0 =5.60; N_1=3.15). G-III had the lowest diversity (N_o=3.33; N_1=2.55).

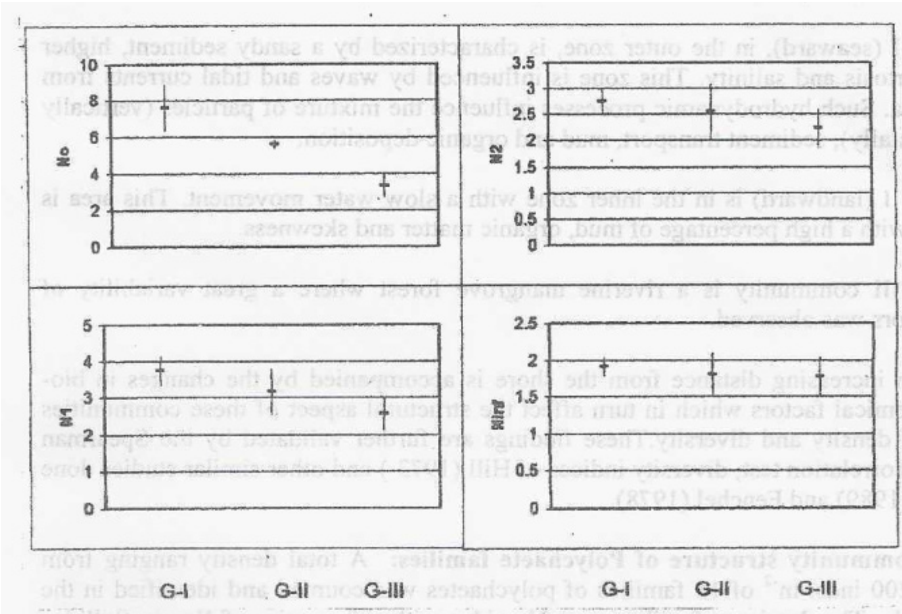

Fig. 10. Diversity indices (Hfl12 1973) in three groups of communities of Polychaete families

Discussion

Environmental influence on community zonation. The influence of environmental variables like salinity, organic matter, temperature, pH and specific sediment types on the different Polychaete families was positively shown by the results of multivariate analysis that distinctly categorized the sub- communities (stations PI to P 15) into three group of communities namely G-I, G-II and G-III.

G-I (seaward), in the outer zone, is characterized by a sandy sediment, higher median, kurtosis and salinity. This zone is influenced by waves and tidal currents from the open sea. Such hydrodynamic processes influence the mixture of particles (vertically and horizontally), sediment transport, mud and organic deposition.

G-II (landward) is in the inner zone with a slow water movement. This area is associated with a high percentage of mud, organic matter and skewness.

G-III community is a riverine mangrove forest where a great variability of abiotic factors was observed.

An increasing distance from the shore is accompanied by the changes in bio-physico-chemical factors which in turn affect the structural aspect of these communities in terms of density and diversity. These findings are further validated by the Spearman rank order correlation test, diversity indices of Hill (1973) and other similar studies done by Alongi (1989) and Fenchel (1978).

Community structure of Polychaete families: A total density ranging from 802 to 30,200 inds. m^{-2} of 18 families of polychaetes was counted and identified in the present study. The dominant families were Nereidae with two species of *Nereis*; Syllidae with five genera represented by *Brania, Oxegoney Pionosyllis, Sphaerosyllis and Typosyllis, Spionidae* with *Scolelepis* and *Ophelidae* by Armandia lanceolata (Willey, 1905). These polychaete families were observed to be abundant in G-I community of sandy and coarse sand sediments which is also similar to Alvarez *et al*., (1995) findings in two embayments in the Eastern Philippines. Trends of its spatial patterns was ftrther verified through the tests of Spearman rank order correlation. Families of *Cirratulidae, Syllidae, Pilargidae and Phyllodocidae* were related positively with coarse sand, kurtosis and salinity. These families were associated with sandy type of sediment (G-I). For muddy sediments (G-II), the families of Dinophillidae were positively correlated with organic matter and Sabellidae was negatively correlated with sand.

Diversity of Polychaete families. Generally, diversity of fauna is higher in sandy than on silty or muddy type of sediment (Fenchel, 1978). G-I exhibits the highest diversity of Polychaete families. A decrease in diversity in G-II and G-III communities is shown in the Hill's diversity numbers N_0, N_1, N_2 and Ninf (Figure 6).

This profile is usually associated with habitat complexity on its bio-physicochemical qualities within or the adjacent communities. G-I is located at the outer zone (seaward) and its location is directly influenced by exposure to water turbulence that may lead to variation of sediment transport, increase in mixing of dissolved oxygen and nutrients yielding to a richer community. This dynamic environment attracts diverse organisms. On the contrary, muddy sediments in G-II and G-III, a sheltered zone, is interrelated with high organic matter and bacterial population which serves as rich sources of food. This also yields to a rich community where meio- and macro-infauna are usually more abundant but generally characterized by low diversity (Commito, 1982).

Conclusions

The distribution pattern of mangrove polychaetes in Guang-guang Point and nearby shores of Pujada Bay is shown to be primarily a function of sediment variability along a landward-to-seaward gradient.

A total of eighteen families were identified with four dominant families namely Syllidae, Nereidae, Spionidae and Ophelidae- Mean densities ranged from 802 to 27,190 inds. m^{-2}.

A higher diversity of the Polychaete community composition was observed in G-I which is sandy compared to G-II and G-III showing rather muddy sediments.

Acknowledgments

The author wishes to thank Prof. Dr. Magda Vincx, head of Marine Biology Section (University of Gent-Belgium) for her valuable constructive suggestions as well as the staff and personnel of Vrije University of Brussels and University of Gent for their technical assistance. The author is grateful to the Belgian Administration for Development and Cooperation and DOSCST for the scholarship grant. Sincerest thanks to James Gutib, Trex Olandria and Rey Yparraguirre for their computer assistance.

Literature Cited

Alongi, D.M. 1989. The Role of Soft-Bottom Benthic Communities in Tropical Mangrove Coral Reef Ecosystems. Rev. in Aquatic Sci. 1:243-280.

Alvarez, R.M., H.T. Yap and H.M. Nacorda, 1995. Comparison of Two Macrofaunal Communities from Two Embayments in the Eastern Philippines. The Phil. Scientist 32:229-266.

Commito, J.A. 1982. Importance of Predation by Infaunal Polychaeta in Controlling the Structure of a Soft-bottom Community in Maine, USA. Mar. Biol. 68:77-81.

Day, J.H. 1967. A Monograph on the Polychaeta of Southern Africa, pts-I and 2. Brit. Museum Natur. Hist.), London. pp.842.

Fauchald, K. and P.A. Jumars. 1979. The Diet of Worms: A Study of Polychaeta Feeding Guilds. Oceanogr. Mar. Biol. Ann- Rev. 17:193-284.

Fenchel, T. 1978. The Ecology of Micro- and Meiobenthos. Ann. Rev. EcolSys. 9:99-121,

Hill, M.O. 1973. Diversity and Evenness: A Unifying Notation and its Consequences. Ecology-54: 427-432.

Hill, M.O. 1979m TWINSPAN - FORTRAN Program for Arranging Multivariate Data in an Ordered Two-Way Table by Classification of the Individuals and Attributes. Ecology and Systematics- Cornwell University, Ithaca, New York. pp.90.

Knight-Jones, E.W., P.Knight-Jones and A. Nelson-Smith. 1995- Annelids (Phylum Annelida). In: Handbook of the Marine Fauna of North-west Europe. (P.J. Hayward and J.S. Ryland). Oxford University Press. pp. 165-270.

McIntyre, A.D. 1968. The Meiofauna and Macrofauna of some Tropical Beaches. J.of zool. 156:377-392.

Rosito, R.M. 1980- Polychaeta from the Shallow Waters Off Mactan, Cebu. Part Il. The Phil. Scientist 17:1-35.

National Peer Reviewed Journal
DOI: https://doi.org/10.59120/drj.v1i1.76

Robertson, A.I. 1986. Food Chains in Tropical Australian Mangrove Habitats: A Review of Recent Research Report of the Proc. of the Symp. on New Perspectives in Research and Management of Mangrove Ecosystems. In: UNDP/UNESCO Research Training Pilot Program on Mangrove Ecosystems in Asia and the Pacific. (C.D. Fields and M. Vanucci, Eds.) Colombo, Sri Lanka. pp. 200-215.

STATISTICA Program. 1995. General conversions and statistics. Volume I. Statsoft. Inc. Tulsa Okla. 350 pp.

Ter Braak, C.J.F. 1998. CANOCO — A FORTRAN Program for Canonical Community Ordination by (Partial) (Detrended) (Canonical) Correspondence Analyses (Version 2.0) Manual, TNO, Wageningen. p. 95.

Twilley, R.R., S.C. Snedaker, A.Y. Arancibia and E. Medina. 1996. Biodiversity and Ecosystem Processes in Tropical Estuaries: Perspectives of mangrove ecosystems. In: (H.A. Mooney, J.H. Cushman, E. Medina, O.E. Sala and E.D. Schulze, Eds.)