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Distribution of Family Spionidae (Annelida: Polychaeta) in the Calamianes Islands, Northern Palawan, Philippines

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Abstract—The distribution of family Spionidae (Annelida: Polychaeta) in the Calamianes group of islands, northern Palawan, Philippines was investigated. Sampling was conducted in a total of 21 stations using a van Veen grab. The depths (m) and sediment regime in these stations were also determined. The spionids were selected for this study because this group was the most abundant polychaete family in the samples. A total of 96 individuals divided into 14 species belonged to the family Spionidae, with *Spiophanes soederstromi*, *Spio filicornis*, and *Prionospio pinnata* as the top three species. Overall mean density of the 14 species was 48.8 ind $\cdot$ m^{-2}. A geographical pattern was observed in the distribution of the specimens wherein specimens were found only in the peripheral stations (i.e. those fringing the islands), while there was an absence of specimens in the 9 centrally-located stations (non-fringing). The Q-mode cluster analysis revealed that the distribution of Spionidae in the 21 stations was divided into 2 major clusters and 3 station groups, namely cluster 1 with the 9 centrally-located stations, and the peripheral stations classified as Clusters 2A & 2B. The absence of the specimens in the centrally-located stations (Cluster 1) was attributed to the high percentage of sand and a very low silt-clay component in these stations. A 2-way ANOVA showed that spionid density significantly affected the observed clustering pattern. The peripheral stations were also shallower in depths and nearer to habitats such as seagrasses and mangroves. Thus, higher spionid abundance was associated not only with finer sediments experiencing low wave action, but also with areas nearer islands, which were ideal sinks for organic matter.

Key words: Spionidae, Annelida, Polychaeta, species composition, distribution, Palawan, Philippines, benthos, macrofauna

Introduction

Polychaetes constitute an important component of benthic communities. They are efficient bioturbators, mixing the substrate that they colonize and modifying the sediment through the formation of tubes, fecal pellets and castings (Sumich 1996). Opportunistic polychaete species are widely used as indicators of anthropogenic or natural disturbance (Simboura and Nicolaidou 2001), and hence are usually used in applied environmental research. Some polychaete species are the main source of food of many commercial fish species and cultured shrimps (Aungtonya 2002).

Though the polychaetes are an ecologically and commercially important group, they are poorly studied in tropical areas (Aungtonya 2002). There is thus a lack of information on species compositions and distributions of this benthic group in the tropics. Much of the knowledge on polychaetes is derived from studies conducted in temperate areas. In the Philippines, the little knowledge we have on them is supplied either by taxonomic studies (e.g. Palpal-latoc 1991, 1999), or studies on benthic community structure that lump the polychaetes with other benthic animals (e.g. Mequila et al. 2004, Narida-Nacionales and Campos 2004, etc.). Therefore, baseline studies focusing on the polychaetes, specifically the dominant polychaete group of family Spionidae and their distribution in relation to environmental factors are needed.

We examined distributions of spionids, which constitute the dominant polychaete group, in the coasts of the Calamianes Islands, Northern Palawan, Philippines and determined the relationship between their distribution and the sediment regime.

Materials and Methods

Study area

The Calamianes group of Islands is located north of Palawan, the westernmost island of the Philippine archipelago (Fig. 1). Palawan is bound by the South China Sea in the northwest and the Sulu Sea in the east. The biggest island of the Calamianes is Busuanga Island. Southeast of Busuanga island is Coron island. It is a protected area whose forest and overlying limestone rock are still 75% intact (Magdaraog 1998).

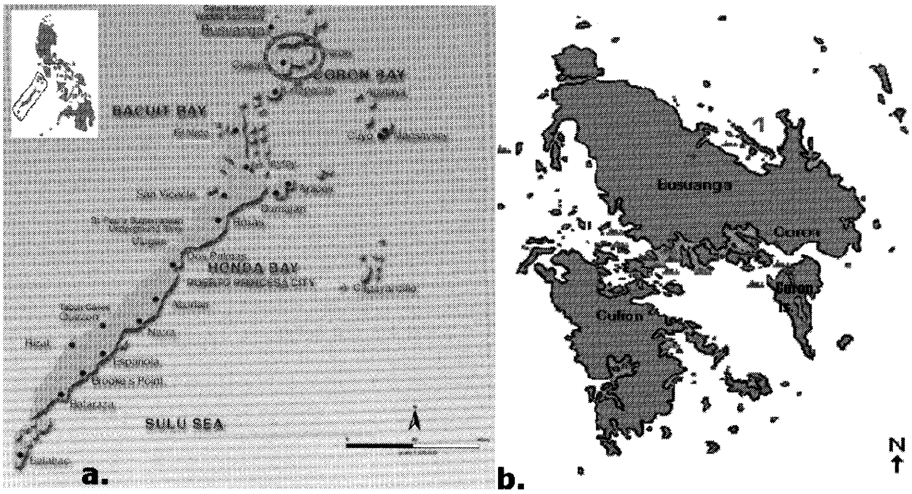

Fig. 1. Map showing the location of study area in the Calamianes Islands, northern Palawan, Philippines.

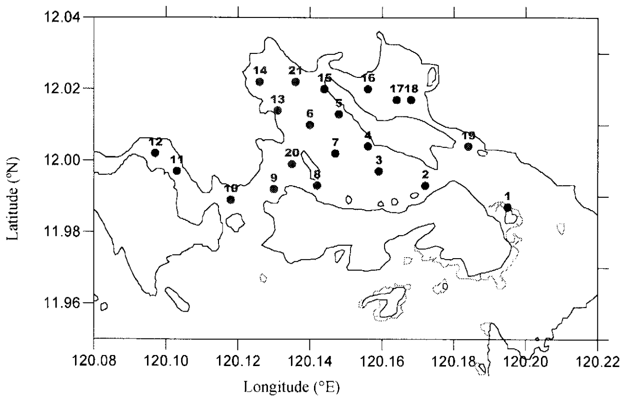

Fig. 2. Map showing the 21 stations sampled in the Calamianes Islands, northern Palawan in May 2004.

Field sampling and laboratory processing of samples

Samples were collected in the waters surrounding the Calamianes group of islands in May 2004. Sampling covered a total of 21 stations (Fig. 2), located either in the center of islands or fringing the islands. At all stations, sediments were sampled using a van Veen grab whose opening is 0.39 m in length and 0.24 m in width. Depths (m) of the stations were determined using either the calibrations on the grab sampler wire or read off from a bathymetry map. Sediment samples were fixed in 10% seawater-formalin solution and stained with Rose Bengal dye. In the laboratory, samples were sieved in a 0.5 mm mesh. The same sediment sample was used for the analysis of sediment characteristics.

Sample fauna were sorted into two groups (polychaetes and non-polychaetes) using a dissecting microscope. Polychaetes were first identified to the family level. The individuals comprising the most dominant family (Spionidae) were further identified to the lowest taxonomic level possible based on Fauvel (1953) and Day (1967a, b).

Sediment samples were sieved through a series of mesh screens with sizes 2, 1.18, 0.5, 0.25, 0.125, and 0.063 mm. The classified particle sizes were oven dried at 110°C for 24 hrs and weighed using an analytical balance. Median particle diameter (Mid ϕ) was estimated by plotting the cumulative % dry weight versus the corresponding phi value of sieve mesh sizes. Values corresponding to a % cumulative weight of 50% correspond to Mid ϕ (Gray 1981). The sorting index was computed according to the formula:

$$(\phi 84-\phi 16)/4+(\phi 95-\phi 5)/6.6$$

also referred to as the Inclusive Graphic Standard Deviation of Gray (1981). This index produces the following sediment sorting classes:

Sorting Index	Sorting Class
Under 0.35ϕ	Very well sorted
0.35–0.50ϕ	Well sorted
0.50–0.71ϕ	Moderately well sorted
0.71–1.00ϕ	Moderately sorted
1.00–2.00ϕ	Poorly sorted
2.00–4.00ϕ	Very poorly sorted
Over 4.00ϕ	Extremely poorly sorted

Data analysis

A raising factor (RF) of 10.68 was computed from the formula $RF=1\,m^2/A_{grab}$, whereby $A_{grab}=L\times W$ using the dimensions given above. Raw counts were multiplied with the calculated RF to obtain density values in $ind\cdot m^{-2}$ for the various stations.

To show large-scale patterns in spatial distributions of the species, cluster analysis was done using the computer program COMM (Piepenburg and Piatkowski 1992). Stations were grouped into station clusters with similar species/taxa composition and abundance. Station groups were formed after transforming (square root) the raw density data. Mean values of the following parameters: station depths, poly-

Table 1. Polychaete and spionid species densities (ind · m^{-2}) of stations sampled in the Calamianes Islands, May 2004.

Species	Stations																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Mean density (ind · m^{-2})	%
Spiophanes soderstroemi	21.4	0	0	0	0	0	0	0	32.0	42.7	0	0	0	21.4	0	0	0	0	139	42.7	0	14.2	29.2
Spio filicornis	21.4	0	0	0	0	0	0	0	42.7	42.7	0	0	0	42.7	0	21.4	0	0	0	74.8	0	11.7	24.0
Prionospio pinnata	10.7	0	0	0	0	0	0	0	0	0	10.7	0	0	0	0	0	0	42.7	96.1	21.4	0	8.65	17.7
Rhyncospio glutea	0	10.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.7	53.4	0	0	3.56	7.30
Prionospio cirrobranchiata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53.4	0	2.54	5.21
Prionospio saldanha	0	0	0	0	0	0	0	0	10.7	0	0	0	0	10.7	0	0	0	0	0	0	0	1.02	2.08
Prionospio steenstrupi	0	0	0	0	0	0	0	0	21.4	0	0	0	0	0	0	0	0	0	0	0	0	1.02	2.08
Prionospio malgreni	0	0	0	0	0	0	0	0	0	10.7	0	0	0	10.7	0	0	0	0	0	0	0	1.02	2.08
Laonice sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	10.7	0	0	0	10.7	0	0	0	1.02	2.08
Laonice cirrata	0	0	0	0	0	0	0	0	0	0	0	10.7	0	0	0	10.7	0	0	0	0	0	1.02	2.08
Spio sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21.4	0	0	0	0	1.02	2.08
Polydora kempi	10.7	0	0	0	0	0	0	0	0	10.7	0	0	0	0	0	0	0	0	0	0	0	1.02	2.08
Prionospio ehlersi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.7	0	0.51	1.04
Spiophanes bombyx	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.7	0	0	0	0	0	0.51	1.04
Density (ind · m^{-2})	246	53.4	21.4	42.7	21.4	0	0	96.1	246	513	10.7	85.4	182	662	972	534	192	107	662	726	790	293	100

chaete densities, spionid densities, sorting index, mid ϕ, and spionid species, were compared among station groups by means of an ANOVA after performing a Levene test of homogeneity of variances. A multiple regression analysis between the spionid, and overall polychaete species and the physical parameters was also further conducted.

Results

Species composition and distribution

A total of 577 polychaete individuals belonging to 35 families were collected from the 21 sampling stations. The mean polychaete density in the Calamianes islands was 293 ind$\cdot$m^{-2} (SD=463, N=34) (Table 1). Of the 577 polychaete individuals, 96 individuals divided into 14 species belonged to the family Spionidae. Family Spionidae was the dominant family comprising 17% of the polychaetes found in the area. Based on densities, the top *three species are Spiophanes soederstromi* (29%), *Spio filicornis* (24%), and *Prionospio pinnata* (18%). Over-all mean density of all spionids was 49 ind$\cdot$m^{-2} (SD=130, N=21).

Spionids were present only in the peripheral stations (1, 2, 9, 10, 11, 12, 14, 16, 17, 18, 19, and 20), whereas there was an absence of specimens in the 9 centrally-located stations (3, 4, 5, 6, 7, 8, 13, 15, and 21) (Fig. 3). Highest densities of Spionidae were found in Station 19 (288 ind$\cdot$m^{-2}) and Station 20 (203 ind$\cdot$m^{-2}).

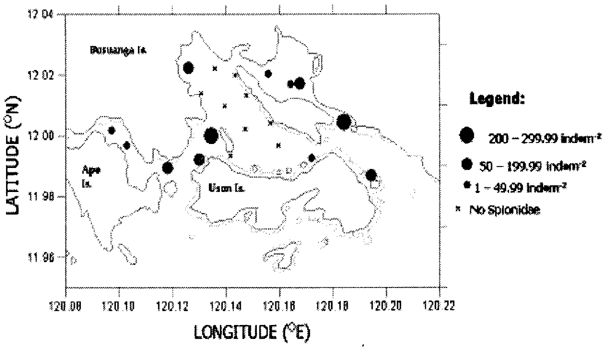

Fig. 3. Density distribution of family Spionidae in the Calamianes Islands, northern Palawan, May. 2004.

Spatial distributions

The Q-mode cluster analysis revealed that the distribution of family Spionidae in the 21 stations is divided into 2 major clusters and 3 station groups (Fig. 4). Station cluster 1 (stations without Spionidae) included the nine centrally-located stations 3, 4, 5, 6, 7, 8, 13, 15, and 21. Station cluster 2 was divided into station groups C2A (Stations 1, 9, 10, 14, and 20, or those primarily near the western entrance to the bay) and C2B (Stations 2, 11, 12, 16, 17, 18, and 19, or those deep inside the inner portions of the bay).

Sediment analysis and station depths

The location, depths (m) and sediment characteristics of all stations were summarized by cluster in Table 2. The sediment grain size (based on the mid ϕ value) ranged from -2.25 corresponding to pebbles in Station 21 to 4.36 corresponding to very fine Sand in Station 2. The Sorting Index ranged from 1.84 in Station 6 to 3.99 in Station 21. The sediments in the 21 sampling stations are thus classified as poorly to very poorly sorted. Stations in Cluster 1 were the deepest having a mean depth of 7.4 m (SD=1.6, N=9), whereas the stations in both Clusters 2A & B were shallower: mean depth$_{2A}$=6.1 m (SD=2.3 N=5) and mean depth$_{2B}$=5.5 m (SD=2.8; N=7).

Biotic and abiotic relationships

Based on the ANOVA, the 3 clusters showed differences

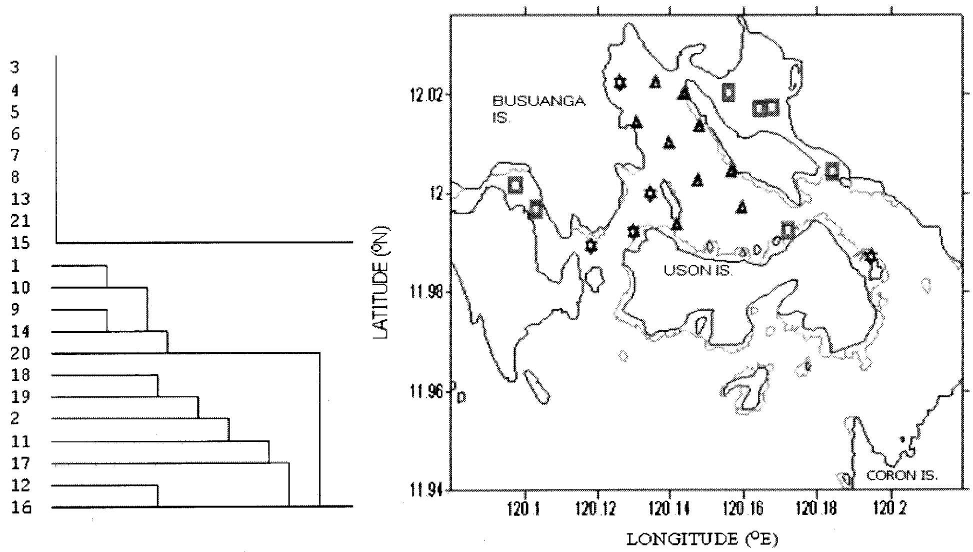

Fig. 4. Station clusters and map of the geographical location of the station clusters (△ cluster 1; ✡ cluster 2a; □ cluster2b).

Table 2. Location (latitude and longitude), depth (m) of stations sampled in the Calamianes Islands, and their corresponding sediment characteristics and cluster groups.

Station Number	Cluster Assign-ment	Latitude	Longitude	Depth (m)	Sorting Index	Sorting Class	Md ϕ	Sediment Size Classes	% Sand	% Mud
1	C2A	11°59.2′N	120°12′E	4.6	2.52	Very poorly sorted	1.88	Coarse sand	64.2	35.8
2	C2B	11°59.6′N	120°10′E	6.1	2.58	Very poorly sorted	4.36	Very fine sand	20.2	79.8
3	C1	11°59.8′N	120°10′E	6.1	2.35	Very poorly sorted	3.95	Fine sand	34.6	65.4
4	C1	12°00.2′N	120°10′E	7.6	1.86	Poorly sorted	3.23	Fine sand	71.2	28.8
5	C1	12°00.8′N	120°09′E	7.6	2.69	Very poorly sorted	0.07	Very coarse sand	95.7	4.3
6	C1	12°00.6′N	120°08′E	6.1	1.84	Poorly sorted	3.22	Fine sand	77.6	22.4
7	C1	12°00.1′N	120°09′E	4.6	1.89	Poorly sorted	1.01	Coarse sand	97.7	2.3
8	C1	11°59.6′N	120°08′E	7.6	1.93	Poorly sorted	1.87	Coarse sand	83.3	16.7
9	C2A	11°59.5′N	120°08′E	9.1	2	Poorly sorted	2.45	Medium sand	76.5	23.5
10	C2A	11°59.3′N	120°07′E	6.1	2.61	Very poorly sorted	1.91	Coarse sand	66.5	33.5
11	C2B	11°59.8′N	120°06′E	3.7	1.87	Poorly sorted	3.15	Fine sand	70.1	29.9
12	C2B	12°00.1′N	120°06′E	1.2	2.14	Very poorly sorted	1.68	Coarse sand	81.3	18.7
13	C1	12°00.8′N	120°08′E	9.1	2.47	Very poorly sorted	3.6	Fine sand	36.8	63.2
14	C2A	12°01.3′N	120°08′E	3.3	2.16	Very poorly sorted	3.42	Fine sand	54.0	46.0
15	C1	12°01.2′N	120°08′E	7.6	2.48	Very poorly sorted	−0.12	Granule	96.6	3.45
16	C2B	12°01.2′N	120°10′E	4.9	2.41	Very poorly sorted	4.14	Pebble	29.6	70.3
17	C2B	12°01.0′N	120°10′E	9	2.31	Very poorly sorted	3.56	Fine sand	38.5	61.5
18	C2B	12°01.0′N	120°10′E	9	2.31	Very poorly sorted	3.92	Fine sand	35.0	65.0
19	C2B	12°00.2′N	120°11′E	4.9	2.04	Very poorly sorted	3.24	Fine sand	55.1	44.9
20	C2A	11°59.9′N	120°08′E	7.6	2.45	Very poorly sorted	3.6	Fine sand	39.9	60.1
21	C1	12°01.3′N	120°08′E	10.1	3.99	Very poorly sorted	−2.25	Pebble	97.9	2.08

Table 3. Multiple regression results for densities of various species of spionidae and other polychaetes in Calamianes, northern Palawan, May 2004. (italicized entries are the only significant results).

Species	R^2	MUD	Depth	Sorting Index
Prionospio pinnata	0.014	0.253		
Rhynchospio glutea	0.055	0.320		
Prionospio steenstrupi	0.062		0.395	−0.321
Prionospio malgreni	0.017		−0.258	
Laonice sp.	0.011	0.246		
Laonice cirrata	0.209		*−0.498*	
Spio sp.	0.015		0.254	
Spiophanes bombyx	0.046	0.307		
Polychaete	0.185			*0.475*

in spionid densities ($F=82.5$, $p=8.6\times10^{-10}$). This was thus the factor that most likely affected the species' spatial distribution. Furthermore, a multi-comparisons test also showed that the differences among the 3 clusters were $1 \ll 2B < 2A$, i.e. Cluster 1 being very different from 2A and 2B. The multiple regressions on the other hand, only showed two significant values: *Laonice cirrata* for depth and polychaetes for the sorting index.

Discussion

Family Spionidae is one of the major contributors of the polychaete component of benthic community studies. The abundance of spionids in other studies is commonly attributed to their opportunistic habits, having the ability to rapidly re-colonize a disturbed area (Clarke & Warwick 1994). Hence, they have been regarded as indicators of pollution or disturbance (e.g. Kastoro et al. 1991, Ong Che and Morton 1995, Ong Che et al. 1998, Mequila et al. 2004). Unlike however these disturbed areas which are either located in urban or trawled areas, the Calamianes islands represent a relatively pristine environment. But if they indeed are indicators of disturbance, the overall lower spionid density observed in this study compared with other areas in the Philippines (Table 4) further shows that the Calamianes islands represent a relatively pristine environment.

Though they may not be as abundant in non-disturbed areas, they however also display localized distribution patterns as observed in the present study. Thus, within the Calamianes, there are parts of the bay with no spionids (the central part or Cluster 1), and parts with spionids (the peripheral stations, or Clusters 2A and Cluster 2B). The absence can be attributed to the high percentage of sand and very low silt-clay component. Aside from sediment size (Dauer et al. 1981), spionid distribution can also be influenced by the amount of food in the form of organic matter content of the sediment. Gray (1981) attributed the higher organic matter

Table 4. Comparisons of spionid densities (ind·m^{-2}) from various Philippine locations.

Study Area	Density (ind·m^{-2})	Sampling Date/Duration	Sampling Gear	Reference
Calamianes Islands, northern Palawan	0–288	May 2004	Grab	This study
Visayan Sea	0–4440	Apr–May 2001	Grab, corer	Genito (2004)
Taklong Island National Marine Reserve (TINMAR), Guimaras Island	0–2590	Mar–Dec 2002	Grab, corer	Narida-Nacionales and Campos (2004)
Balingasay, Bolinao, Pangasinan	57.7–851	Jan 1988	Grab	Yap et al. (1991)
San Teodoro, Oriental Mindoro	563–1410	Mar 1988	Grab	Yap et al. (1991)

content of sediments to finer sediments. Stations with spionids (Clusters 2A & B) do not only have closer proximity to land, but also to mangrove and sea grass bottoms. It must however also be pointed out that, sediment characteristics are not the only important factors that influence distribution, but also other factors, such as salinity, production of the above water column, etc. Although the study is limited by the lack of data on these factors, the latter habitats provide a richer source of nutrients than the centrally-located stations, which are located farther from these richer areas. Although the effect of depth was not significant based on the results of the ANOVA, the stations belonging to Cluster 2B still have the shallowest average depth (5.5 m) compared to those in Cluster 1 (7.4 m) and 2A (6.1 m). These depth differences are consistent with the location of the stations and their bottom type, being that central stations are deepest, with coarser sediments, and peripheral stations are shallower, but with finer, enriched sediments.

In summary, this study showed the dominance of spionids among the polychaete families in the Calamianes islands, although overall density was lower than those in other areas exposed to more disturbances. The spatial distribution pattern showed the absence of spionids in areas which are predominantly sandy and deep, and presence in areas with finer sediments and shallower depths. Spionids are therefore not merely indicators of disturbance as reported in the literature, but rather also show more localized distribution patterns related not just to sediment characteristics, which are in turn, serve as indicators of the degree and extent of organic matter enrichment, but also to other factors beyond the scope of this study.

Acknowledgments

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References

Aungtonya, C. 2002. The need for research on marine forms (Annelida: Polychaeta) in Thailand, including applied aspects. Phuket Biol. Ctr. Spec. Publ. 24: 17–20.

Clarcke, K. R. and Warwicke, R. M. 1994. Change in marine communities: An approach to statistical analysis and interpretation. Natural Environment Research Council. Plymouth Marine Laboratory, Plymouth, UK.

Dauer, D., Maybury, C. and Ewing, R. M. 1981. Feeding behavior and general ecology of several spionid polychaetes from the Chesapeake Bay. J. Exp. Mar. Biol. and Ecol. 54: 21–38.

Day, J. H. 1967a. A monograph on the Polychaeta of southern Africa: Part I. Errantia. Trustees of the British Museum (Natural History), London.

Day, J. H. 1967b. A monograph on the Polychaeta of southern Africa: Part II. Sedentaria. Trustees of the British Museum (Natural History), London.

Fauvel, P. 1953. Annelida: Polychaeta. The Fauna of India including Pakistan, Ceylon, Burma, and Malaya. Allahabad.

Genito, G. E. 2004. Species composition, distribution and biomass of the macrofauna in the Visayan Sea. BS Bio. Undergraduate thesis, UPV, Miagao.

Gray, J.S. 1981. The ecology of marine sediments (An Introduction to the Structure and Function of Benthic communities). Cambridge Univ. Press, NY.

Kastoro, W. W., Soedibjo, B. S., Aziz, A., Aswandy, I. and Hakim, I. A., 1991. Soft-bottom benthic community of a mangrove creek in Grajagan, East Java. *In* Procs. Reg. Sympo. Living Res. Coastal Areas, Alcala, A. C., Chou, L. M., Miclat, R., Fortes, M., Goong, W. K., Sasekumar, A., Biña, R. and Tridech, S. D. (eds.), pp. 207–221, Mar. Sci. Inst. UP Diliman, Quezon City, Philippines.

Magdaraog, G. L. 1998. Environment and natural resource atlas of the Philippines. Envt. Ctr. Phils. Found.

Mequila, A. T., Genito, G. E. and Campos, W. L. 2004. Large scale distribution of macro- and meiofaunal assemblages in the Visayan Sea. UPV J. Nat. Sci. 9(1): 54–69.

Narida-Nacionales, E. B. and Campos, W. L. 2004. Macrobenthic assemblages in Taklong Island National Marine Reserve, Southern Guimaras. UPV J. Nat. Sci. 9(1): 30–44.

Ong Che, R. G. and Morton, B., 1995. Further studies on the subtidal macrobenthic community of Tai Tam Bay, Hongkong. Asian Mar. Biol. 12: 53–68.

Ong Che, R. G., Janwen, Q. and Baoling, W. 1998. Distribution of polychaeta in the southern waters of Hongkong. Asian Mar. Biol. 15: 135–158.

Palpal-latoc, V. S. 1991. New records of polychaetous annelids from Ilocos Sur. Nat'l Mus. Paps. (Phils.). 1(1): 45–69.

Palpal-latoc, V. S. 1999. Techniques in the collection, preservation and identification of polychaete worms. Nat'l. Mus. Paps. (Phils.). 9(2): 19–27.

Piepenburg, D. and Piatkowski, U. 1992. A program for computer-based analyses of ecological field data. CABIOS 8(6): 587–590.

Simboura, N. and Nicolaidou, A. 2001. The Polychaetes (Annelida: Polychaeta) of Greece: Checklist, distribution and ecological characteristics. Mono. Mar. Sci. 4. Athens Nat'l Ctr. Mar. Res.: 11–14.

Sumich, J. 1996. An introduction to the biology of marine life. MC. Brown, Dubuque.

Yap, H. T., Viloria, B. H. R. and Nacorda, H. M. E. 1991. Comparison of soft bottom community profile in two Philippine nearshore sites. *In* Procs. Reg. Sympo. Living Res. Coastal Areas. MSI, UP Diliman, Quezon City. Alcala A. C., Ming, C. L., Miclat, R., Fortes, M., Wooi-Khoon, G., Sasekumar, A., Bina, R. and Tridech, S. D. (eds.), pp. 261–277, Mar. Sci. Inst. UP Diliman, Quezon City, Philippines.