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A Benthic Polychaete Assemblage off the Korean South Coast (Gwangyang Bay and Yeosu Sound)

Yong-Hyun Kim[1] and Hyun Chool Shin[2]*

[1] *Tidal Flat Research Institute, Natiolal Fisheries Research & Development Institute, Gunsan 573-882, Korea*

[2] *Faculty of Marine Technology, Chonnam National University, Yeosu 550-749, Korea*

We investigated the benthic polychaete assemblage in Gwangyang Bay and Yeosu Sound in February 1997. The sediment was an almost entirely muddy facies. The benthic macrofauna comprised 295 species occurring at a mean density of 875 indiv./m^2. Polychaetes were the major faunal component; there were 94 species at mean density 765 indiv./ m^2. The highest abundance and species richness occurred in the Myodo south and north channels, in the mouth of Gwangyang Bay, and in the Noryang channel mouth. The most abundant polychaete was *Tharyx* sp. (47.9%), followed in rank order by *Heteromastus filiformis* (9.6%), *Melinna cristata* (9.3%), and *Lumbrineris longifolia* (7.3%). Cluster analysis divided the study area into four station groups based on station similarities in benthic polychaete assemblages: the *Glycinde–Prionospio* cluster in the western inner bay, the *H. filiformis* cluster in the middle inner bay, the *Melinna–Lumbrineris* cluster in the Myodo south-north channel, and the *Tharyx* cluster in the eastern main channel region. The sediment type of Gwangyang Bay has changed gradually from sandy to muddy. Dominant species have also changed from *Chone teres* and *Lagis bocki* to *Tharyx* sp., which is a potential organic pollution indicator.

Key words: Polychaete, Benthic-assemblage, Indicator taxa, Gwangyang Bay, Yeosu Sound

Introduction

Benthic macrofaunal composition on/in soft sediments is sensitive to habitat disturbance, including increased organic contents in sediments or toxic sediment pollution. Most macrofaunal species are non-motile or slow-moving and cannot escape changing conditions in their immediate environment. These organisms form an important element in marine ecosystems. They have significant roles in ecosystem processes such as nutrient cycling, metabolism of pollutants, dispersion, bioturbation, and secondary production (Snelgrove, 1998). Polychaetes are particularly characteristic of soft-bottom benthic communities. The group is highly speciose (Olsgard and Somerfield, 2000; Sparks-McConkey and Watling, 2001; Arvanitidis et al., 2002). The most important physic-chemical factors affecting polychaete distribution are grain structure and organic contents of sediments. Biological interactions among animals also affect ecological structure and function of polychaete assemblages (Gambi and Giangrande, 1986). Changes in habitat factors that affect assemblage structure may occur slowly over time or suddenly, following a physical disturbance. The composition and function of the polychaete component of benthic macrofauna reflects changing conditions in the biotic and physic-chemical environment. For this reason, ecological studies of polychaetes contribute to better understanding of the entire benthic biota.

Studies of macrobenthos distributions off Korean shorelines got underway by the 1980s. By the 1990s, investigations of southern central coasts (especially Jinhae Bay, Gwangyang Bay, and Yoja Bay) were proceeding actively. Gwangyang Bay is located on the central coast of the Korean southern sea. In 1983 and 1984, large-scale reclamation and dredging projects were undertaken for the construction of POSCO, a steel production enterprise, and associated industries. Reclamation and dredging are ongoing in the western inner section of Gwangyang Bay; there is also frequent dredging in the northern and southern sections of the Myodo channels. The western tidal

*Corresponding author: shinhc@chonnam.ac.kr

flat marks the landward edge of the highly diverse and productive marine ecosystem food chain in Gwangyang Bay. Anthropogenic construction in the area threatens the marine benthic biota through massive disturbance of sediment and by changes in tidal flow patterns.

Our aim was to determine polychaete assemblage structure and distribution in impacted areas of Gwangyang Bay and Yeosu Sound. We also made comparisons between modern assemblages and those recorded in historical data sets.

Materials and Methods

Study area

Gwangyang Bay, located in the center of the southern Korean coast, has an east–west orientation. It is semi-enclosed, flanked by the Yeosu Peninsula to the south and Namhaedo to the southeast. The bay is linked to Namhaedo by Yeosu Sound and to Jinju Bay by the Noryang channel (Fig. 1). Freshwater from the Seomjin River and Suo stream flows into Gwangyang Bay on its northern shore; the two flows combine and form part of the bay's estuarine circulation system, which flows outward from the southern coast through Yeosu Sound. Beginning in the 1970s, Gwangyang Bay was targeted for construction of the Yeocheon industrial complex for manufacturing and land development. In the 1980s, the wide delta of the Seomjin River estuary was reclaimed for the construction of POSCO (a steel production enterprise), a harbor system, Yulchon industrial complex and other enterprises. Infilling reduced the submarine area of the bay, into which huge amounts of waste and warm water were discharged. Dredging of a shipping channel added to massive disturbance in the sedimentary environment of the Seomjin River estuary through changes in tidal flow that resulted in sand accumulation. These events had enormous direct and indirect impacts on the benthic system of Gwangyang Bay.

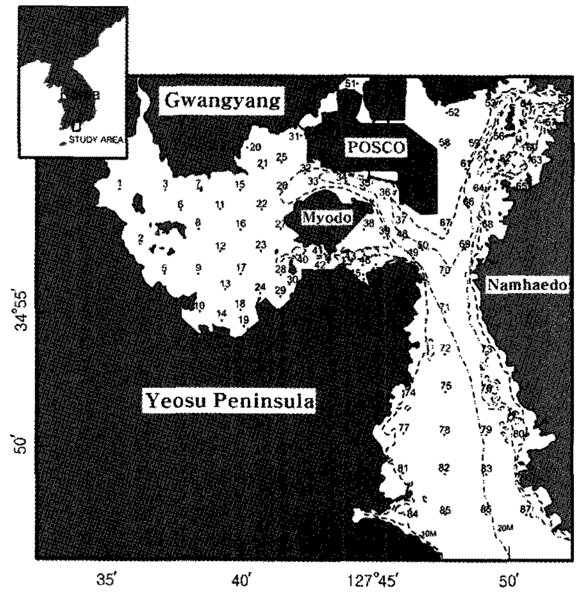


Fig. 1. A map showing the study area, sampling stations and bathymetry in Gwangyang Bay and Yeosu Sound.

Surface sediment collection and analysis

We used an improved van Veen grab sampler (0.1 m^2) to collect a total of 86 surface sediment samples from Gwangyang Bay and Yeosu Sound in February of 1997. For sediment grain-size analysis, organic materials and carbonates were removed with 10% H_2O_2 and 0.1 N HCl, respectively. Subsequently, sediment samples were divided into coarse and fine size fractions using a 63 μm sieve. Fractions >63 μm were analyzed at intervals of 1 Ø by sieving, and fine fractions were analyzed with a Sedigraph-5100 (Micromeritics Instrument Corporation). Mean grain size was calculated by the method of Folk and Ward (1957).

Macrobenthos collection and analysis of data

Benthic macrofauna was sampled with an improved van Veen grab (0.1 m^2) in February 1997. Eighty-seven stations were selected to cover the study area over which we planned to determine distributions of animal taxa, especially polychaetes. Duplicate grab samples were taken at each station. Sediment samples were sieved by onboard seawater flushing through a 1 mm mesh screen. Materials trapped by the screen were preserved in 10% neutralized formalin solution. In the laboratory, samples were sorted into major taxonomic groups under a dissecting microscope, and polychaetes were identified to species level (when possible) and counted. Ecological indices of the benthic polychaete assemblage were calculated using PRIMER (Plymouth Routines in Multivariate Ecological Research: ver. 5.0) software, viz. species diversity index (Shannon and Weaver, 1963), species richness index (Margalef, 1958), evenness index (Pielou, 1966), and dominance (Simpson, 1949).

Cluster analysis was performed to classify the study area into station groups based on polychaete composition. Abundance data were log-transformed due to large deviations among the individual counts. We used chord distance as the similarity index between stations, which were grouped by the weighted pair- group linkage procedure.

Results

Surface sediment structure

We analyzed surface sediment structures in 86 samples from 87 stations in Gwangyang Bay and Yeosu Sound. The mean contents of sand, silt, and clay were 14.1%, 37.5%, and 48.4%, respectively. The mean phi (-$\log_2$ particle size [mm]) in the study area was 7.9, indicating that sediments were silty clay and clayey silt (Table 1). The sedimentary distribution was divisible into seven facies: C, SiC, CSi, SSiC, CS, SiCS, and SiS (Fig. 2). Samples from stations in the western inner bay and Myodo south-north channel in Gwangyang Bay and most areas of Yeosu Sound had an SiC sedimentary facies; the eastern area of delta region in the Seomjin River estuary had an S sedimentary facies.

Table 1. Ecological characteristics of macrobenthic communities collected in Gwangyang Bay and Yeosu Sound. The values in parentheses are the relative percentage of the total number of taxa

Ecological parameters	Mean
Sediment characteristics	
Sand (%)	14.1
Silt (%)	37.5
Clay (%)	48.4
Mz (Ø)	07.9
Main sediment facies	Silty clay /Clayey silt
Benthic macrofauna	
Mean density (indiv./m^2)	875
Taxonomic group (Density)	
Polychaeta	765 (87.5%)
Crustacea	073 (8.3%)
Mollusca	023 (2.6%)
Echinodermata	009 (1.0%)
Others	005 (0.6%)
Benthic Polychaeta	
Total species number	094
Mean number of species per 0.2 m^2	015
Mean density (indiv./m^2)	765
Ecological indices of polychaete community	
Diversity (H')	1.7 ± 0.6
Richness (R)	3.1 ± 1.1
Evenness (J)	0.7 ± 0.2
Dominance (λ)	0.3 ± 0.2

Macrofaunal assemblages

Total number of benthic macrofaunal species in Gwangyang Bay and Yeosu Sound was 295, with a mean number of 23 per station. Of the total species number, 36.9% (109 species) were crustaceans, and 31.9% (94 species) were polychaetes (Fig. 3). The mean macrofaunal density was 875 indiv./m^2. Average polychaete density was 765 indiv./m^2, accounting for 87.5% of total macrofaunal density. In term of individual numbers, polychaetes were the dominant macrofaunal component. Densities of other species were low.

More species occurred in the south-north channel, bay mouth, Myodo main channel, and Noryang channel mouth than in the inner section of Gwangyang

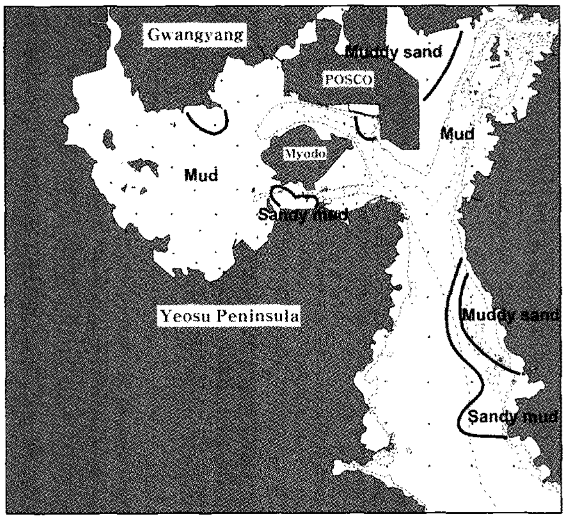
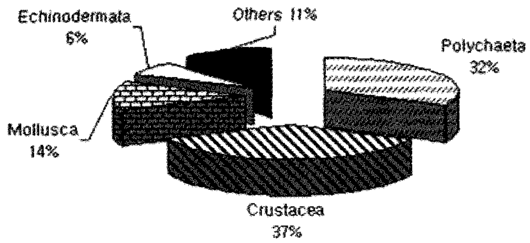
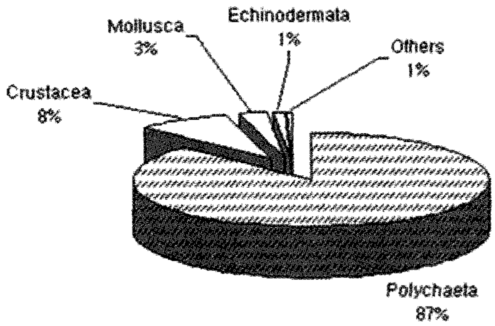


Fig. 2. Distribution of surface sediment facies.



a. Species Number (spp./0.2 m^2)



b. Density (indiv./m^2)

Fig. 3. Dominant rate of species numebr (spp./0.2 m^2) and density (indiv./m^2) of benthic macrofaunal groups in Gwangyang Bay and Yeosu Sound.

Bay (Fig. 4A). At station 34 located in the Myodo north channel, there were 58 species. There were 49, 50, and 52 species at stations 42, 43, and 46 in the south channel. In Noryang channel stations 54 and 55, we collected 42 and 51 species, respectively. There were 45 species at station 69 in the main channel, and 52 at station 73 located in the bay mouth near Namhaedo.

Densities were higher in the Myodo south-north channel, in the bay mouth, and in Noryang main channel than in the inner section of Gwangyang Bay. The Myodo north channel had higher densities than did the south channel (Fig. 4B). The bay mouth station at Yeosu Peninsula had higher density than the station near Namhaedo. The density at station 54 was 7,925 indiv./m^2, the highest in the study area. The most common species of polychaete *Tharyx* sp., which occurred at a density was 6,960 indiv./m^2.

Spatial distribution and ecological descriptors of the polychaete assemblage

Total number of polychaete species was 94; an average of 15 polychaete species occurred at each station (Table 1). More species occurred in the inner bay than i n the Myodo south-north channel, the bay mouth, or the section near Noryang channel. Among bay mouth collections, more species occurred at the station near Nam haedo than at the Yeosu Peninsula (Fig. 5A). The highest species number (34) occurred at station 34 in the Myodo north channel, followed by station 42 in the south channel, which had 30 species. The lowest species number (two) occurred at station 30 located in the southern section of the inner bay.

Densities of polychaetes were higher in the Myodo south-north channel, the bay mouth, and the main section of the Noryang channel than in the inner bay (Fig. 5B). The highest density (7,390 indiv./m^2)

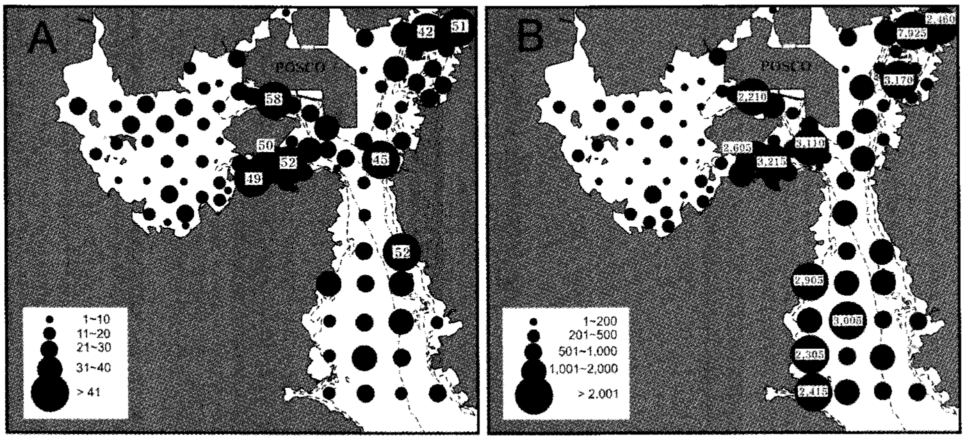


Fig. 4. Distribution of (A) benthic macrofaunal species number (spp./0.2 m^2) and (B) density (indiv./m^2) in Gwangyang Bay and Yeosu Sound.

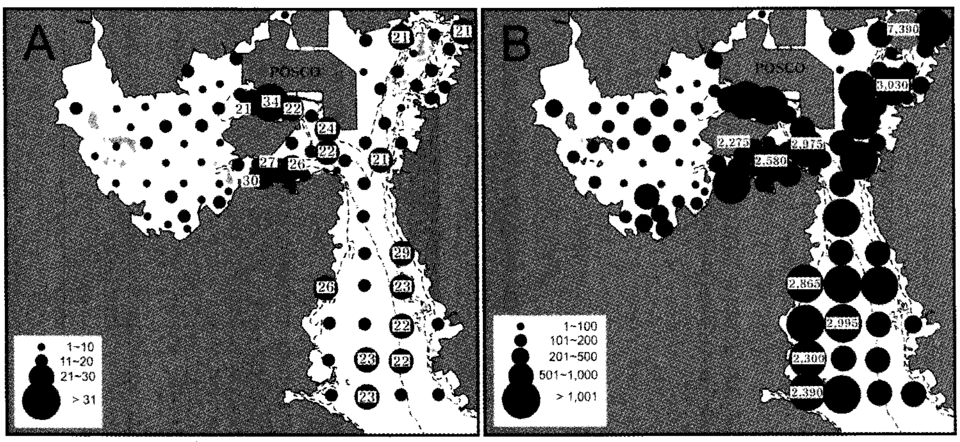


Fig. 5. Distribution of (A) benthic polychaetous species number (spp./0.2 m^2) and (B) density (indiv./m^2) in Gwangyang Bay and Yeosu Sound.

occurred at station 54 near Noryang channel, and the lowest density (15 indiv./m^2) occurred in stations 27 and 30 located in the southern section of the inner bay.

Both species richness and density were higher in the Myodo south-north channel, the bay mouth, and the main channel than in the inner bay. Species richness was higher in the Myodo north channel than in the south channel, but densities were higher in south channel than in the north channel. The station near Noryang channel had the lowest number of species, but the highest densities. At the bay mouth, species richness was higher at the station near Namhaedo than at those off the Yeosu Peninsula; the polychaete density ranking was reversed.

Species diversity indices ranged from 1.0 to 1.9 for most stations; the highest index (3.2) was at station 59, and the lowest (0.7) at stations 48 and 54 (Fig. 6). Nine stations had indices <1.0, and these were located inside Gwangyang Bay, east of Myodo, in the Seomjin River estuary, and in the mouth of Gwangyang Bay near Yeosu Odongdo and Noryang channel. Stations with indices >2.0 were located in the northern section inside Gwangyang Bay, in the eastern Seomjin River delta, east of Myodo, in Noryang channel, and in the mouth of Gwangyang Bay.

Polychaete species richnesses were >3.0 for the most of stations. The highest (9.4) occurred at station 34, and the lowest (1.7) at stations 14 and 30. The other side, four stations had richness values <1.5; these were located in the southern section of the inner bay and in the Seomjin River estuary. Stations with richness values of 1.5-1.9 were located in the inner bay, in Noryang channel, and near shore in the bay mouth area.

Dominance index was <0.5 for the most of stations. It was highest (0.9) at stations 48, 54, 62, and 84, and lowest (0.2) at stations 32, 59, and 65. Stations with indices >0.5 were located in the southern section of the inner bay, in the Myodo north channel, in Noryang channel, and in the bay mouth near Yeosu Odongdo.

In summary, the polychaete species diversity index was higher in the Myodo south-north channel, in the bay mouth, and in Noryang channel; species richness was higher in the channel area than in the inner bay. The spatial patterns of the dominance and species richness indices were similarly distributed, with the highest off the Yeosu Peninsula in the bay mouth area. In some stations, dominance was attributable to rare species.

Spatial distribution of dominant polychaete species

Ten dominant species of polychaetes were identified. Each of these species was within the top 1.0% of total polychaete individual counts. Together, they accounted for 84.8% of polychaete individuals in the study area. The species with the highest dominance value was *Tharyx* sp. (mean density: 366 indiv./m^2;

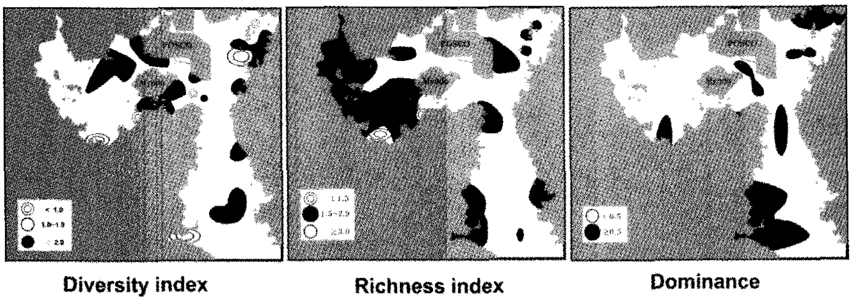


Fig. 6. Distribution of ecological indices in Gwangyang Bay and Yeosu Sound.

Table 2. Dominant polychaetes species collected in Gwangyang Bay and Yeosu Sound

Species	Total Density	Percent of Total Density	Mean density (indiv./m^2) ± SD	Frequency (%)
Tharyx sp.	31,865	47.9	366 ± 949	69.0
Heteromastus filiformis	6,385	9.6	73 ± 120	81.6
Melinna cristata	6,175	9.3	71 ± 226	32.2
Lumbrineris longifolia	4,860	7.3	56 ± 92	64.4
Glycera chirori	1,890	2.8	22 ± 22	83.9
Prionospio sp.	1,250	1.9	14 ± 25	57.5
Glycinde sp.	1,195	1.8	14 ± 21	60.9
Eunice antennata	1,115	1.7	13 ± 119	2.3
Magelona japonica	925	1.4	11 ± 27	34.5
Ampharete arctica	825	1.2	9 ± 31	35.6

dominance index: 47.9%; Table 2). In rank order, the next most dominant species were *H. filiformis*, *M. cristata*, and *L. longifolia* (mean densities: 56-73 indiv./m^2; dominance indices: 5-10%). Mean densities and dominance values of six other species were 9-22 indiv./m^2 and 1-3%, respectively.

Frequency values of *H. filiformis* and *G. chirori* exceeded 80%. The frequency value of *E. antennata* was <30%.

Tharyx sp.

The density of *Tharyx* sp. in the channel region was higher than in the inner section of Gwangyang Bay (Fig. 7), where densities were <100 indiv./m^2, *Tharyx* sp. was not found in some inner bay sections or at station 51 in the Seomjin River estuary. Within the inner bay, density at the station near the Y eosu Peninsula was higher than at the station near Namhaedo. Station 54 near the Noryang channel had the highest density (6,960 indiv./m^2). At station 62, the density was 2,700 indiv./m^2.

Heteromastus filiformis

H. filiformis occurred at similar densities across most stations. In the inner bay, density was high off the southern coast section. Density was higher in the Myodo south channel than in the north channel; it was also higher at the bay mouth than in Noryang channel. Station 76 at the mouth of the bay had the highest density (855 indiv./m^2). At station 13, the density was 500 indiv./m^2.

Melinna cristata

M. cristata was found only in the Myodo south-north channel and in Noryang channel. Density at station 34 located in the Myodo north channel was 805 indiv./m^2. Densities in the Myodo south channel were 555, 1000, and 1475 indiv./m^2 at stations 42, 43, and 46, respectively. The density at station 53 was 710 indiv./m^2.

Lumbrineris longifolia

Densities of this species were low. It was found mostly in the Myodo south-north channel, the mouth of the bay, the main channel, the Seomjin River estuary and Noryang channel. It was difficult to find in the inner bay. The density at station 34 in the Myodo north channel was 385 indiv./m^2, at station 42 (Myodo north channel) it was 310 indiv./m^2, at station 43 (Myodo north channel) it was 380 indiv./m^2, at station 52 (Seomjin River estuary) it was 230 indiv./m^2, at stations 73 and 83 at the mouth of the bay near Namhaedo, densities were 295 indiv./m^2 and 385 indiv./m^2, respectively.

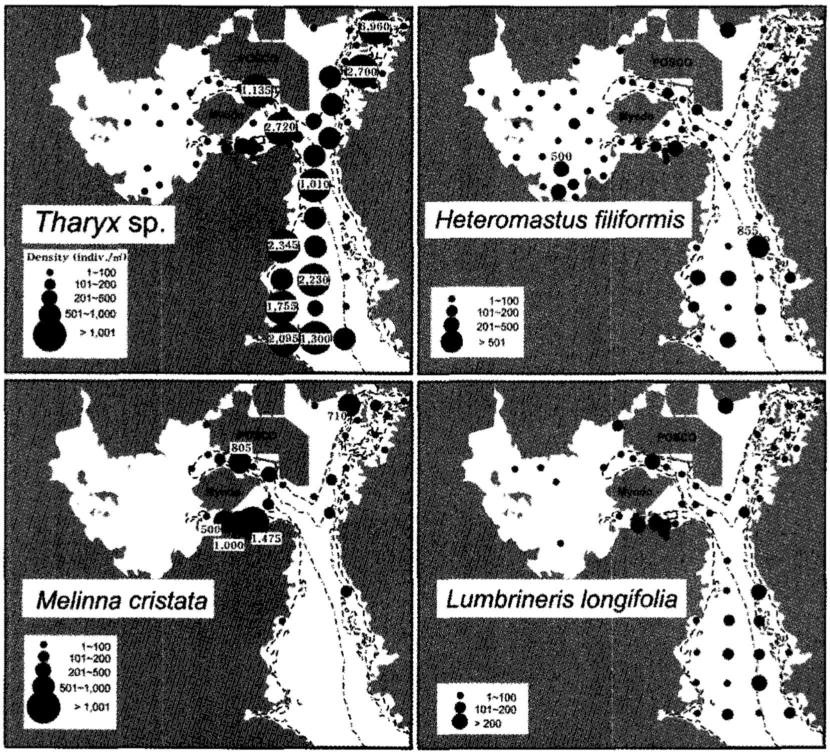


Fig. 7. Spatial distribution of dominant polychaetous species of upper 5% in Gwangyang Bay and Yeosu Sound.

Spatial distribution of the polychaete assem-blage

Stations were divided into two groups by cluster analysis based on a Bray-Curtis similarity matrix (after log-transforming all values). Station group A comprised stations in the western section of the inner bay; station group B included all other stations and was further subdivided into three parts: BI (central section of inner bay), BII (Myodo south-north channel) and BIII (eastern part of main channel) (Fig. 8).

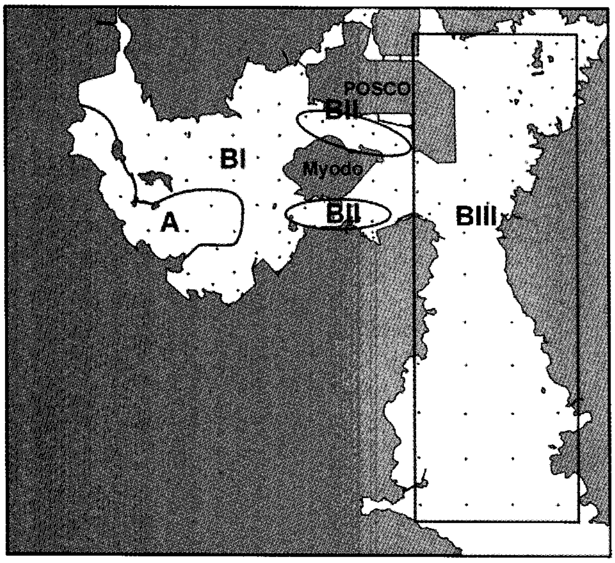


Fig. 8. Spatial distribution of station groups(A, BI, BII, BIII) from cluster analysis based on species composition.

Station group A contained nine stations and the surface sedimentary facies of the area was silty clay (Table 3). The total number of polychaete species was 25. Station group A had the lowest species richness values and lowest densities (mean=96 indiv./m^2). Species diversity indices were low, but the species evenness index was highest among station groups. The dominance index was relatively low in this area. Hence, the polychaete assemblage in station group A was species poor, but an even distribution of taxa was observed across the area. The dominant species was *G. gurjanovae* (28 indiv./m^2); *Prionospio* sp. ranked in the upper 5% of dominant species.

Station group BI comprised 29 stations at which the surface sedimentary facies was silty clay. The total number of polychaete species in group BI was 55. The mean density was 209 indiv./m^2. The species diversity index was low, but species evenness was high, indicating an even spread of species across the group. The dominance index was relatively low. The dominant species were *H. filiformis* (42 indiv./m^2); *G. gurjanovae* ranked in the upper 5% of dominant species.

Station group BII comprised 21 stations with surface sedimentary facies that were silty clay and silty clayey sand. The total number of polychaete species was 77. This was the highest species richness among station groups. The mean density in BII was 798 indiv./m^2, the highest among groups. Species diversity and species richness indices were higher than those of other station groups. The species evenness index was high, whereas the dominance index was relatively low in this group. High densities of individuals were distributed evenly across stations. The dominant species was *M. cristata* (33 indiv./m^2); *L. longifolia* ranked in the top 5% of dominant species.

Station group BIII comprised 28 stations with surface sedimentary facies of silty clay. Total polychaete species was 77. The mean density in the group was 1,532 indiv./m^2, the highest among groups. The species diversity index was low, and the species evenness index was lower than those of other station groups. The dominance index of this station group was much higher than that of other groups, indicating that dominance was attributable to only a limited suite of species. The most dominant species was *Tharyx* sp. (71 indiv./m^2), with *H. filiformis* ranking in the top 5% of dominant species (but at low density [7 indiv./m^2]).

Discussion

Two-thirds of the delta region of the Seomjin River estuary was reclaimed to build POSCO in 1984. Before this massive development, the sedimentary environment comprised the delta, intertidal flats, subtidal zones, and the channels. A sand facies containing gravel and sand was found in the delta region; a mud facies (develops in low-energy environments) was found in the western section of the bay, and a mixed facies occurred in sections between the sand and mud facies. A gravel facies occurred continuously along the main channel connecting Yeosu Sound and Noryang channel.

The discharge volume of the Seomjin River decreased rapidly after development around Gwangyang Bay, and the flow of seawater in the western region of the bay has weakened. Tidal energy has also decreased. These changes are reflected in the sandy sedimentary facies in the Myodo south-north channel; in general, though, the whole area has become muddier.

Table 3. Comparison of ecological parameters between station groups. The individual numbers of dominant species are expressed as mean density (indiv./m^2) at each station group. Values in parentheses are the relative percentages of the faunal groups

Station groups	Inner bay (West)	Inner bay (middle)	Myodo south-north channel	Eastern part of main channel
Parameters	A	BI	BII	BIII
Number of station	090.	0290.	210.	280.
Sediment				
Sand (%)	09.2	07.6	28.0	11.1
Silt (%)	37.0	41.2	31.7	38.8
Clay (%)	53.8	51.2	40.3	50.1
Mz (Ø)	08.4	08.4	06.7	08.1
Surface sediment facies	Silty clay	Silty clay	Silty clay / Silty clayey sand	Silty clay
Characteristices of polychaeta community				
Total number of species	25	055	077	00,77
Mean number of species per 0.2 m^2	06	011	020	00,17
Mean density (indiv./m^2)	96	209	798	1,532
Ecological indices				
Diversity (H')	1.4 ± 0.3	1.8 ± 0.5	2.0 ± 0.5	1.4 ± 0.6
Richness (R)	2.1 ± 0.5	2.8 ± 1.0	3.9 ± 0.9	3.1 ± 0.9
Evenness (J)	0.9 ± 0.1	0.8 ± 0.1	0.7 ± 0.2	0.5 ± 0.2
Dominance (λ)	0.2 ± 0.1	0.2 ± 0.2	0.2 ± 0.1	0.5 ± 0.2
Dominant species (indiv./m^2) over 5%				
Glycinde gurjanovae	28	10		
Prionospio sp.	19			
Haploscoloplos elongatus	09			
Pseudopolydora kempi	07			
Glycera chirori	06	06		
Sigambra tentaculata	06			
Tharyx sp.		06	06	71
Heteromastus filiformis		42	05	07
Melinna cristata			33	
Lumbrineris longifolia			16	
Eunice antennata			07	

Average macrofaunal density in Gwangyang Bay and Yeosu Sound was 875 indiv./m^2 (Table 1). This value may be compared with other low density areas such as Yoja Bay (388 indiv./m^2; Lim et al., 1991), Gamak Bay (340 indiv./m^2; Shin, 1995), and Samcheonpo (182 indiv./m^2; Shin and Koh, 1993), and with high density areas such as Deukryang Bay (1,432 indiv./m^2; Ma et al., 1995) and Jinhae Bay (1,045 indiv./m^2; Lim and Hong, 1997) (Table 4). Polychaete density in Gwangyang Bay and Yeosu Sound was 765 indiv./m^2. Densities were lower in Gamak Bay (253 indiv./m^2), Yoja Bay (189 indiv./m^2), Samcheonpo (112 indiv./m^2), and Deukryang Bay (276 indiv./m^2), but higher in Jinhae Bay (825 indiv./m^2). Density of the benthic polychaete assem-blage in Gwangyang Bay before industrial develop-ment was 490 indiv./m^2 (Choi and Koh, 1984); during the development work, density dropped to 342-437 indiv./m^2 (Jung et al., 1997). After development, the density of benthic polychaete assemblage increased to 520 indiv./m^2 (Shin and Koh, 1990) and to 765 indiv./m^2 at the time of our recent survey.

Number of polychaete species in Gwangyang Bay and Yeosu Sound was 94, higher than in Yoja Bay, Gamak Bay, and Deukryang Bay; the richness in Jinhae Bay was similar to that in Gwangyang Bay. Species composition in Gwangyang Bay changed little before, during, and after development, although at the time of this study, it had increased slightly, which may reflect a broader sampling effort. Because most of the macrofaunal species encountered are long-lived, sampling by season is probably unnecessary. However, annual monitoring should continue because reclamation and dredging have not stopped in Gwangyang Bay.

Station groups in Gwangyang Bay and Yeosu Sound were divided into four groups by species composition (Table 3). There were two groups in the inner bay, one in the Myodo south–north channel, and one in the main channel including Yeosu Sound. *G. gurjanovae* and *Prionospio* sp. were the dominant species in the western inner bay, and *H. filiformis* was the dominant species in the central inner bay. In the Myodo south-north channel, *M. cristata* and *L. longifolia*

Table 4. Comparison of benthic community of the major bays in southern part of Korea

Locality	Sampling time	Benthic macrofauna	Polychaete		References
		Mean density (indiv./m^2)	Mean density (indiv./m^2)	Species number (spp.)	
Yoja Bay	1989	0,388	189	72	Lim et al. (1991)
Samchunpo	1989	0,180	112	50	Shin and Koh (1993)
Kamak Bay	1993	0,340	253	84	Shin (1995)
Deukryang Bay	1991-92	1,432	276	52	Ma et al. (1995)
Chinhae Bay	1989-1990	1,045	825	88	Lim and Hong (1997)
	1982		490	70	Choi and Koh (1984)
Gwangyang Bay	1983-1984		342-437	76-77	Jung et al. (1997)
	1987-1988		520	79	Shin and Koh (1990)
	1997	0,875	765	94	The Present study

were dominant species. In the main channel, *Tharyx* sp. was the dominant species.

In previous studies before the development of the area, three station groups were identified in Gwangyang Bay: the delta area of the Seomjin River estuary, the inner bay, and the channel area. During development of POSCO, the stations fell into three somewhat different groups: the Seomjin River estuary, the inner bay, and the main channel. After development, the stations fell into four groups: the Seomjin River estuary, the inner bay, the Myodo south-north channel, and the main channel. Hence, continuing industrial development along the shoreline is reflected in shifting multivariate structure in the marine benthic assemblages.

Changes have also occurred in the identity of dominant species. In this study, *Tharyx* sp was the dominant species. Other dominants were *H. filiformis*, *M. cristata*, and *L. longifolia.* The dominant species during industrial development were *L. bocki*, *L. longifolia*, *C. teres*, and *S. scutata*. During development, the dominant species were *L. bocki*, *C. teres*, *G. gurjanovae*, and *H. filiformis*, indicating little change. However, after development, dominant species shifted to *L. longifolia*, *N. polybranchia*, *T. horikoshii*, and *S. scutata*. Before and during development, the most dominant species was *L. bocki*, and it was found mainly in the Myodo channels. There is very little information on this species in Korea. Pectinariids live in sandy sediment using organic particles or microbes on the sand grains as food and constructing a tube from sand granules. The construction of POSCO, sea floor reclamation, and dredging in the Seomjin River estuary delta area have caused destruction of *L. bocki* habitat, and at the time of this study, it was difficult to find the species. The distribution pattern of *C. teres* closely matched that of *L. bocki*, and it also disappeared after the development. Following development, species such as *Tharyx* sp., *L. longifolia*, and *H. filiformis* became dominant. These species are potential organic pollution indicators that preferentially inhabit muddy sediment. Larger numbers of these species occurred in the Myodo channels and in the main channel (where muddy sediments occur) than in the inner bay.

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