ความผันแปรตามฤดูกาลของสัตว์หน้าดินขนาดใหญ่ บริเวณท่าเรือน้ำลึกมาบตาพุด จังหวัดระยอง

SEASONAL VARIATION OF MACROBENTHIC FAUNA AT THE MAP-TA-PHUT DEEP SEA PORT, RAYONG PROVINCE

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บทคัดย่อ

ความผันแปรตามฤดูกาลของสัตว์หน้าดินขนาดใหญ่บริเวณท่าเทียบเรือน้ำลึกมาบตาพุด จังหวัดระยอง ได้ถูกศึกษาเปรียบเทียบระหว่างช่วงฤดูฝนคือเดือนมิถุนายนและช่วงฤดูหนาวคือเดือนธันวาคม ของปี 2000 การศึกษาในครั้งนี้ ทำการเก็บตัวอย่างทั้งสิ้นจำนวน 4 ซ้ำ จาก 8 สถานี ด้วยอุปกรณ์ตักดินแบบ Smith-McIntyre (0.0405 ตารางเมตร) จากการศึกษาค่าเฉลี่ยความหนาแน่นและมวลชีวภาพของน้ำหนักเปียกของสัตว์หน้าดินที่ได้จากการร่อนผ่านตะแกรงขนาด 0.5 มิลลิเมตร พบว่าในเดือนมิถุนายน มีค่าเท่ากับ 115 $\pm$ 36 ตัวต่อตารางเมตร โดยมีค่าอยู่ระหว่าง 49 ถึง 196 ตัวต่อตารางเมตร และในเดือนธันวาคม มีค่าเท่ากับ 127 $\pm$ 23 ตัวต่อตารางเมตร โดยมีค่าอยู่ระหว่าง 6 ถึง 240 ตัวต่อตารางเมตร ค่าเฉลี่ยมวลชีวภาพของน้ำหนักเปียกมีค่าเท่ากับ 13.26 $\pm$ 4.2 กรัมต่อตารางเมตร โดยมีค่าอยู่ระหว่าง 2.61 ถึง 31.08 กรัมต่อตารางเมตรในเดือนมิถุนายน และในเดือนธันวาคม มีค่าเท่ากับ 58.35 $\pm$ 11.17 กรัมต่อตารางเมตรโดยมีค่าอยู่ระหว่าง 0.02 ถึง 258.95 กรัมต่อตารางเมตร

สัตว์พื้นทะเลที่พบหนาแน่นมากที่สุดทั้งในเดือนมิถุนายนและธันวาคม ได้แก่ Polychaeta (76.3% และ 52.1% ของทั้งหมด) รองลงมาคือ Echinodermata (9.9% และ 13.3%), Crustaceana (7.8% และ 16.9%) และ Mollusca (5.3% และ 10.8%) สำหรับมวลชีวภาพของสัตว์พื้นทะเลที่พบสูงที่สุดในเดือนมิถุนายนได้แก่ Polychaeta (76.4%) รองลงมาได้แก่ Crustacean(10%), Hemichordata (5.7%), Mollusca (4.8%) และ Echinoderm (3.1%) ตามลำดับ และในเดือนธันวาคม มวลชีวภาพของสัตว์พื้นทะเลที่พบสูงที่สุดได้แก่ Polychaeta (11.63%) รองลงมาได้แก่ Echinoderm และ Mollusca (24.12% และ 24.57% ตามลำดับ)

ผลจากการศึกษาชี้ให้เห็นว่า ค่าเฉลี่ยความหนาแน่นและมวลชีวภาพทั้งหมดของสัตว์หน้าดินที่พบในบริเวณที่ศึกษาในเดือนมิถุนายนมีแนวโน้มต่ำกว่าเดือนธันวาคม อย่างไรก็ตาม ค่าเฉลี่ยความหนาแน่นและมวลชีวภาพทั้งหมดของสัตว์หน้าดินที่พบในทั้งสองเดือนมีค่าต่ำกว่าค่าที่ได้จากการศึกษาสัตว์หน้าดินในบริเวณอื่นๆ สาเหตุของการลดลงของความหนาแน่นและมวลชีวภาพดังกล่าว อาจมีอิทธิพลเนื่องมาจาก การขุดลอกและการก่อสร้างที่เกิดขึ้นอย่างต่อเนื่องในบริเวณท่าเทียบเรือน้ำลึกแห่งนี้ การขุดลอกดังกล่าวมีผลทำให้น้ำบริเวณนั้นขุ่น เกิดสารแขวนลอยและดินตะกอนขึ้น ซึ่งเป็นสาเหตุสำคัญของตายหรือลดปริมาณความหนาแน่นของสัตว์หน้าดินในบริเวณนั้น

ABSTRACT

Seasonal variation of macrobenthic fauna around the Map-Ta-Phut Deep Sea Port, Rayong Province was investigated and compared between the rainy season in June and the cold season in December 2000. Four grab (Smith-McIntyre) samples (0.0405 m^2) were taken at each station of all 8 stations which have been studied. Average abundance of macrofauna obtained with 0.5 mm mesh sieve in June was 115 $\pm$ 36 ind.m^{-2}, with a range from 49 to 196 ind.m^{-2} and in December was 127 $\pm$ 23 ind.m^{-2}, with a range from 6 to 240 ind.m^{-2} The average biomass expressed as wet weight in June was 13.26 $\pm$ 4.2 g.m^{-2} with a range from 2.61 to 31.08 g.m^{-2} and in December was 58.35 $\pm$ 11.17 g.m^{-2} with a range from 0.02 to 258.95 g.m^{-2}

Among the taxa, the Polychaeta was the most abundant group found both in June and December (76.3% and 52.1% of the individuals in June and December respectively) followed by

the Echinodermata (9.9% and 13.3%), Crustaceana (7.8% and 16.9%) and Mollusca (5.3% and 10.8%). In term of biomass, in June, Polychaeta obtained the highest proportion among five taxa (Polychaeta 76.4%, Crustacea 10%, Hemichordata 5.7%, Mollusca 4.8% and Echinoderm 3.1%) and in December, Polychaete, Echinoderm and Mollusca was found to have higher proportion among other taxa (11.63%, 24.12% and 24.57% respectively).

Results of the study revealed that there was a trend of lower abundance and biomass of macrobenthic fauna found in June than those found in December. However, abundance and biomass of macrobenthic fauna found at both periods were lower than those of the previous studies. This probably due to the influence from the continuous dredging of the sediment during the reclamation/construction of the Deep Sea Port. Dreadging is detrimental to benthic fauna by stirring up the bottom sediments and bringing fine particles into suspension and may also be responsible to some extent for the generally low macrobenthic abundance.

INTRODUCTION

Studies on abundance and biomass of macrobenthos fauna can be used as an indicator of the fertility of all aquatic environments since these benthic organisms were the main food of decapod crustaceans, molluscs and fishes of high economic values. Thorson (1975) stated that the size of an economic fish stock is to a large extent determined by the density of the macrobenthic fauna. It has also been suggested that benthic fauna can be used as an indicator of water quality in an area (Wass, 1967; Reish, 1972; Holland *et al.*, 1973)

Numerous benthic studies have been conducted in the Gulf of Thailand, (Piyakarnchana *et al.*, 1978; Charoenrouy, 1979; Katsamut *et al.*, 1980 a, b; Charoenrouy and Piamthipmanus, 1981; Thanapong and Mhordee, 1982; Charoenrouy *et al.*, 1983). Sanguansin (1988) reported the macrobenthic fauna in Rayong Bay including Map-Ta-Phut Deep Sea Port Area. He reported that the macrobenthic fauna at Rayong Bay collected by grab, during February 1986 to April 1987, had average density of 191.99 ind. m^{-2} and average biomass of 85.745 $g.m^{-2}$. Polychaetes were the most abundant, followed by amphioxus and crustaceans. Molluscs,

echinoderms, fishes, nemerteans, echiurans, sipunculids, oligochaetes and coelenterate were also recorded.

The objective of this paper is to report the quantitative distribution and faunal composition of the macrobenthos around the Map-Ta-Phut Deep Sea Port during the moonsoon season in June and the cold season in December. The study will quantify total faunal abundance, biomass and diversity of the major taxonomic groups of macrobenthic fauna.

MATERIALS AND METHODS

The study area

The benthos sampling locations off the Map-Ta-Phut Deep Seaport, is located on latitude between N 1396 000 and N 1400 000, longitude between E 733 500 and E 736 000. Eight sampling stations were assigned within the study sites (Fig.1). The distant between each station was ca. 1.5 km. The survey was carried out in June and December 2000.

Sampling methods

Samples of sediment were collected using grab (Smith-McIntyre). Four replicate grabs sampled were collected at each station, resulting in a total of 32 grabs samples. Each sample was kept in a plastic bag for sieving.

Sieves with three different mesh size; 2, 1 and 0.5 mm. were used for sorting the benthic fauna. The sampling sediment was washed through a set of sieves with seawater. Organisms remaining on the seives were then sorted out and fixed in 10% formalin. In the laboratory, benthic fauna were first classified into eight taxonomic groups namely; Polychaeta, Crustacea, Mollusca, Echinodermmata, Hemichordata, Sipunculida, Amphioxus and Fishes, then, within each group, family classification were carried out. The number of each taxonomic group were counted for estimating the abundance. Biomass of each family was determined as wet weight (including hard part), to the nearest 1 mg. Excess water was blotted off before weighing.

RESULTS

General description of the sampling stations was summarized in Table 1. It was found that there was a variation on the sediment characteristic between the sampling station. Also, there were small variations on depth, transparency and salinity between the two sampling period, June and December. Abundance and biomass of the major macrobenthos taxa found in each station during in June and December were presented in Table 2 and 3 respectively. Community parameters of all macrobenthos in each station were presented in Table 4. Both in June and December, there was a gradient of both abundance and biomass that increase according to the distance from the Deep Sea Port. Station 2,3, 4, 5, 6, 7 and 8 obtained higher total abundance, biomass and diversity than that of station 1. This indicated the influence from dredging of the sediment to some paticular area.

Table 5-7 summarized the abundance and biomass of each taxa found in all stations. It was found that total abundance and biomass of all macrobenthos along the study area in June and December were 115 $\pm$ 36 and 127 $\pm$ 23 individuals. m^{-2} while their biomass were 13.3 $\pm$ 4.2 and 58.35 $\pm$ 11.7 g. m^{-2} respectively. Polychaete was the numerically dominant taxa in these benthic communities, all other taxa being relatively insignificant (Fig. 8). In terms of biomass, polychaetes obtained the highest proportion among all taxa except those biomass of Mollusc and Echinoderm obtained in December (Fig. 9).

Details of benthos found in each station are as follows:

Station 1

At station 1, the collected sediment was in a black colour with fine sand and a high mud content. Polychaetes was found to be the highest abundance taxa of all benthic communities, with the average abundance of 172 and 6 ind.m^{-2} in June and December respectively (Table 2-3, Fig. 2-3). The average abundance of all other taxa was relatively low. In June, the polychaetes, crustaceans and echinoderms had similar biomasses and there was no mollusc and echinoderm

found in this station (Table 2, Fig. 2). In December, there was no other taxa except the polychaete found in this station (Table 3, Fig. 3). The total abundance and biomass of macrobenthic fauna found in June were 196 ind.m^{-2} and 2.61 g.m^{-2} and those found in December were 6 ind.m^{-2} and 0.02 g.m^{-2} respectively (Table 4, Fig. 6-7).

Station 2

At station 2, the collected sediment was yellow sand with shell fractions. Similar to the station 1, polychaetes was found to be the highest abundance taxa of all benthic communities, with the average abundance of 99 ind.m^{-2} both in June and December (Table 2-3, Fig. 2-3). The average abundance of all other taxa was relatively low, except for the echinoderm found in December which is 74 ind.m^{-2}. In June, the polychaetes, crustaceans and echinoderms had similar biomasses and there was no mollusc, hemichordata, sipunculida, amphioxus and fishes found in this station (Table 2, Fig. 2). In December, the biomasses of molluscs and echinoderm were 146.83 and 97.05 g.m^{-2} respectively (Table 3, Fig. 3). The total abundance and biomass of macrobenthic fauna found in June were 123 ind.m^{-2} and 4.47 g.m^{-2} and those found in December were 216 ind.m^{-2} and 258.95 g.m^{-2} respectively (Table 4, Fig. 6-7).

Station 3

At station 3, the collected sediment was in a black colour with fine sand and mud. In this station, polychaetes was found to be the highest abundance taxa following by echinoderms, with the average abundance of 80 and 43 ind.m^{-2} in June and 111 and 12 ind.m^{-2} in December respectively (Table 2-3, Fig. 2-3). There were sipunculida and amphioxus found in this station in December. In terms of biomass, polychaetes dominated both in June and in December (Table 2, Fig. 2). The total abundance and biomass of macrobenthic fauna found in June were 135 ind.m^{-2} and 21.22 g.m^{-2} and those found in December were 168 ind.m^{-2} and 19.10 g.m^{-2} respectively (Table 4, Fig. 6-7).

Station 4

At station 4, the collected sediment was in a black colour with fine sand and mud which is similar to those found in the station 3. In this station, polychaetes was found to be the highest abundance taxa in June, but crustaceans was found to be the highest abundance following by amphioxus in December. (Table 2-3, Fig. 2-3). In terms of biomass, polychaetes dominated in June and echinoderms dominated in December (Table 2-3, Fig. 2-3). The total abundance and biomass of macrobenthic fauna found in June were 123 ind.m^{-2} and 7.60 g.m^{-2} and those found in December were 109 ind.m^{-2} and 109.37 g.m^{-2} respectively (Table 4, Fig. 6-7).

Station 5

At station 5, the collected sediment was in a black colour with fine sand and mud which is similar to those found in the station 3 and 4. In this station, polychaetes was found to be the highest abundance taxa in June, with the average abundance of 136 ind.m^{-2} (Table 2, Fig. 2), whereas crustaceans was found to be the highest abundance taxa in December, with the average abundance of 37 ind.m^{-2} The average abundance of all other taxa being relatively low. In terms of biomass, polychaetes dominated both in June and December (Table 2-3, Fig. 2-3). The total abundance and biomass of macrobenthic fauna found in June were 166 ind.m^{-2} and 61 g.m^{-2} and those found in December were 31.08 ind.m^{-2} and 19.20 g.m^{-2} respectively (Table 4, Fig. 6-7).

Station 6

At station 6, the collected sediment was in a black colour with fine sand and a high content mud which is similar to those in the station 1. In this station, polychaetes was found to be the highest abundance taxa, with the average abundance of 37 ind.m^{-2} both in June and December (Table 2-3, Fig. 2-3). In terms of biomass, however, crustaceans was found to have a higher biomass than polychaetes both in June and December (Table 2-3, Fig. 2-3). The total abundance and biomass of macrobenthic fauna found in June were 49 ind.m^{-2} and 3.75 g.m^{-2} and those found in December were 55 ind.m^{-2} and 7.94 g.m^{-2} respectively (Table 4, Fig. 6-7).

Station 7

At station 7, the collected sediment was in a black colour with fine sand and a high content mud which is similar to those in the station 1 and 6. In this station, polychaetes was found to be the highest abundance taxa both in June and December, with the average abundance of 62 and 93 ind.m^{-2} in June and december respectively(Table 2-3, Fig. 2-3). In terms of biomass, polychaetes dominated in June but molluscs dominated in December (Table 2-3, Fig. 2-3). Similar to the station 3 and 4, there was amphioxus found in this station in December. The total abundance and biomass of macrobenthic fauna found in June were 74 ind.m^{-2} and 30.37 g.m^{-2} and those found in December were 160 ind.m^{-2} and 46.19 g.m^{-2} respectively (Table 4, Fig. 6-7).

Station 8

At station 8, the collected sediment was yellow sand with shell fractions which is similar to those found in the station 2. There is no polychaetes found in this station in June, but in December, polychaete was found to be the highest abundance with the average abundance of 154 ind.m^{-2} (Table 2-3, Fig. 2-3) following by crustaceans and echinoderms. Similar to the station 3, 4 and 7 there was amphioxus found in this station in December. The total abundance and biomass of macrobenthic fauna found in June were 74 ind.m^{-2} and 30.37 g.m^{-2} and those found in December were 160 ind.m^{-2} and 46.19 g.m^{-2} respectively (Table 4, Fig. 6-7).

DISCUSSION

We have investigated the macrobenthic fauna quantitatively in the area of Map-Ta-Phut Deep Sea Port, Rayong Province. This has been done to evaluate these coastal waters on the basis of macrobenthic abundance and biomass as a whole. This study may be used to identified valuable feeding grounds for demersal fish, decapod crustaceans and cephalops of commercial interest. It may also serve as a baseline study for investigations on environmental trends in this coastal ecosystem.

The sampling stations for benthos study is located on latitude between N 1396 000 and N 1400 000, longtitude between E 733 500 and E 736 000. Eight sampling stations were assigned within the study sites and the distant between each station was ca. 1.5 km. From the study, it was found that the depth of water in this area is between 5 to 14 m in June and between 6 to 19 m in December, with the most shallow in the station 2 and the deepest in station 5, 6 and 7. The low and high tide periods of the day may be the main reason for the difference in the depth of water between June and December. The transparency of water is between 1.8 to 4.5 m in June and between 3 to >15 m in December. Such a difference in transparency of water may be due to the moonsoon season in June. This is correlated to the data on the salinity of water which is lower in June than in December (29-32 ppt in June and 32-35 ppt in December). The overall pattern of sediment collected in most sampling stations were found to be black in color with fine sand and high in mud content, except for the station 2 and 8 in which the sediment was yellow sand with shell fractions. This is correlated to the depth of water since the depth of water at station 2 and 8 were 5 and 8 m respectively. In addition, the station 2 and 8 are also located near the seafloor dredging area, deposition of yellow sand with shell fractions in these stations are probably affected by the direction of winds and currents in this area. The current and wave action remove sand and shell fractions from the seafloor dredging to the area of station 2 and 8. .

There were eight groups of macrobenthic fauna found in this study. Polychaetes was found to be dominated in the macrobenthic community. This was not, however, only the case with regards to relative abundance but this taxon also contributed to a large share of the biomass. The percentage abundance and biomass of polychaetes were 76.3% and 76.4% in June and were 52.1% and 11.63% in December respectively (Table 5, Fig. 10). The percentage abundance and biomass of crustaceans, molluscs and echinoderms in June was lower than in December. Sipunculida, amphioxus and fishes was also found only in December. In December, however, the percentage biomass of both molluscs and echinoderms were found to be very high (41.33% and 42.10% respectively). The high biomass was due to a very large size of a bivalve and a sea urchin found in the study area. However, the results of the study showed that the overall abundance and biomass of macrobenthic fauna found in December was higher than those found in June.

Other studies reported that polychaetes was a dominated group of macrofauna in the Gulf of Thailand and Andaman Sea (Seidenfaden *et al.*, 1968; Piyakarnchana *et al.*, 1978; Hylleberg *et al.*, 1985; Podapol and Piamthipmanus, 1981; Sanguansin, 1986, 1988; Chatanantawej and Bussarawit, 1987). Polychaetes are possibly important in the diet of local demersal fish, decapod crustaceans and cephalopods. Crustaceans, molluscs, echinoderms and hemichordata are considerably less abundance which is similar to Piyakarnchana *et al.* (1978) and Saguansin (1988). Small crustaceans, such as amphipods, ostracods, tanaidaceans and cumaceans were not found in the study area. Actually these fauna are importance to carnivorus species which often are of economic interest and they are also very important in the food chain Dredging is probably detrimental to these benthic fauna by stirring up the bottom sediments and bringing fine particles into suspension.

By comparing with other benthos studies, it seems that the composition of macrobenthic fauna in the coastal area of the tropical sea was the same or similarly. However, the abundance and biomass would be different depend on the fertility of the sea. The overall average abundance and biomass of macrobenthic fauna found at all sampling stations around the Map-Ta-Phut Deep Sea Port were 115 ind.m^{-2} and 13.3 g.m^{-2} in June and 127 ind.m^{-2} and 58.35 g.m^{-2} in December respectively which were lower than the range found by Sanguansin (1988) in Rayong Bay and Piyakarnchana *et al* (1978) in the upper Gulf of Thailand (Table 8).

In conclusion, it was found that the overall abundance and biomass of macrobenthic fauna found in December was higher than those found in June. However, a general trend in our surveys was the low abundance and biomass of macrobenthic fauna in all stations both in June and December. We thus conclude that the area of Map-Ta-Phut Deep Sea Port is poor feeding grounds for demersal fishes, decapod crustaceans and cephalopods since its provides low abundance and biomass of the benthic macrofauna. This area is not suitable for development of thriving macrobenthic fauna and provides less food for bottom living fish.

ACKNOWLEDGEMENTS

The authors would like to express their thanks to the BLCP and Mouchel (Thailand) Ltd. for their financial support.

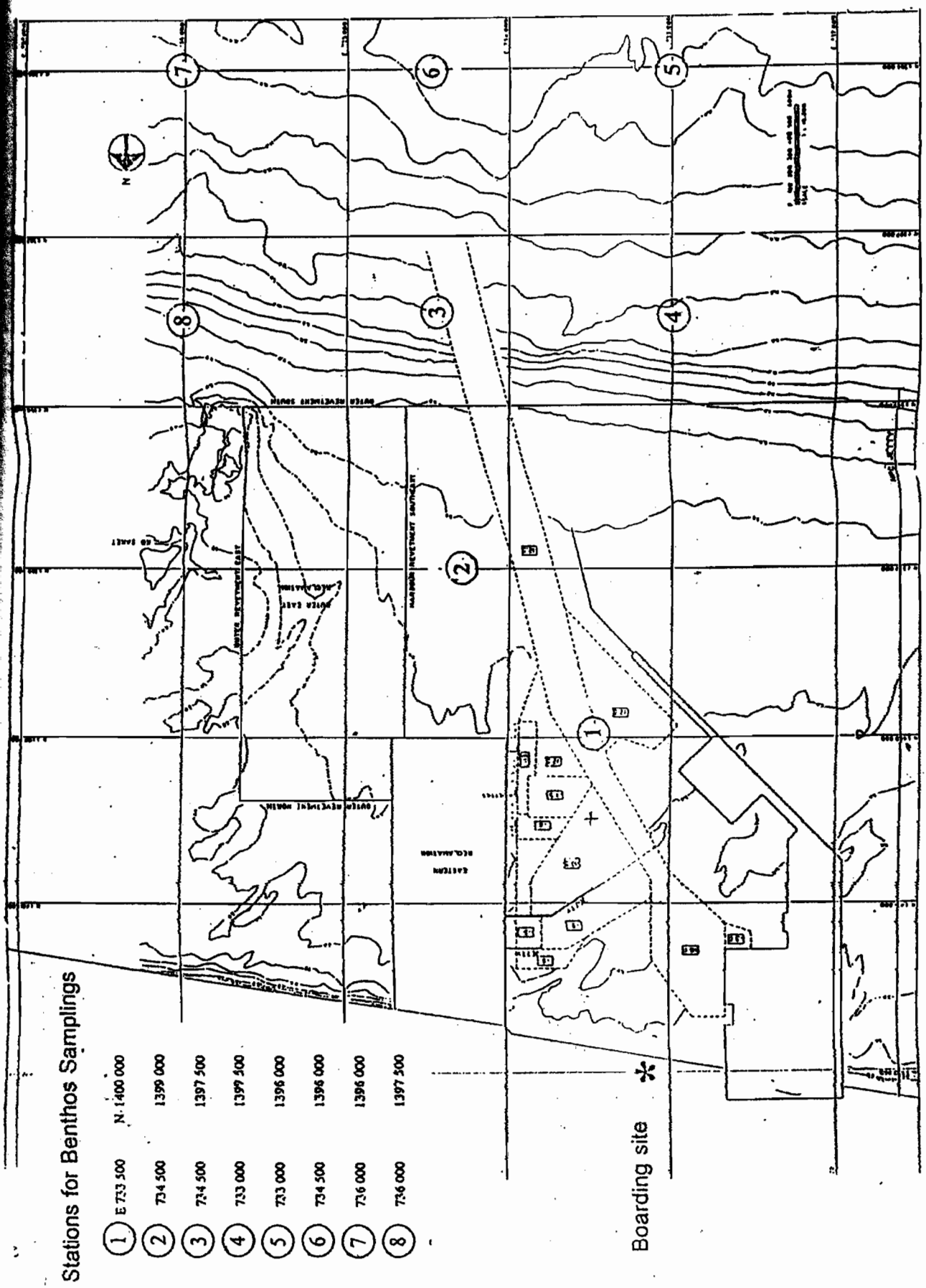

Fig. 1 Map of Map-Ta-Phut Deep Sea Port showing 8 sampling stations for benthos

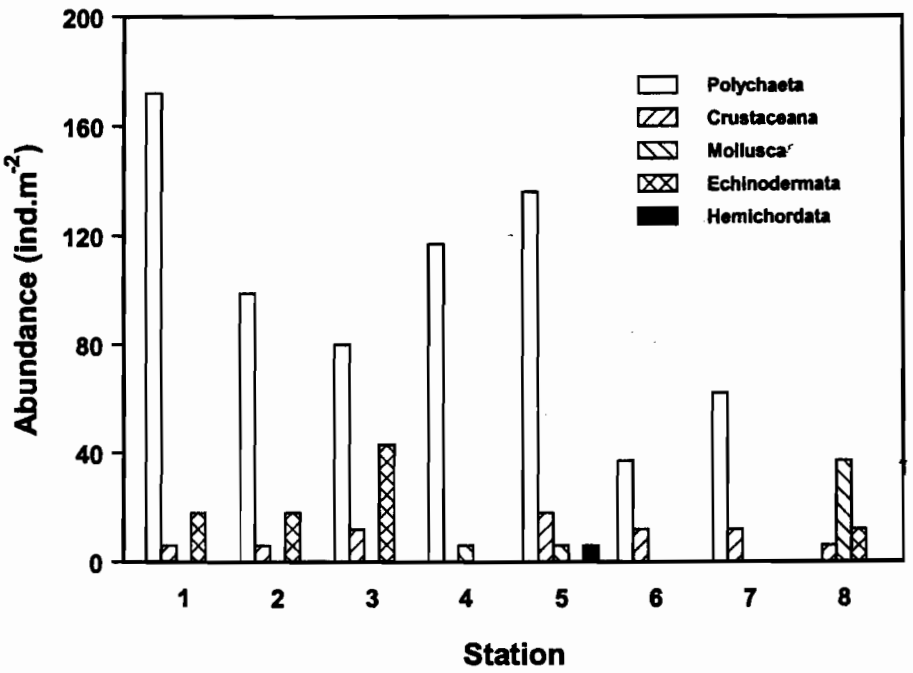

Fig. 2 Abundance of macrobenthic fauna at each sampling station around the Map-Ta-Phut Deep Sea Port in June 2000

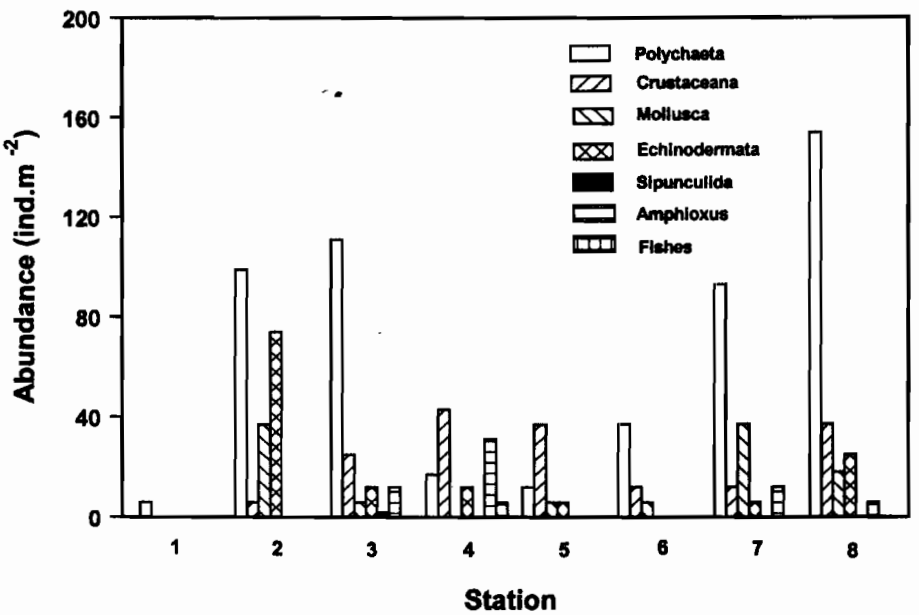

Fig. 3 Abundance of macrobenthic fauna at each sampling station around the Map-Ta-Phut Deep Sea Port in December 2000

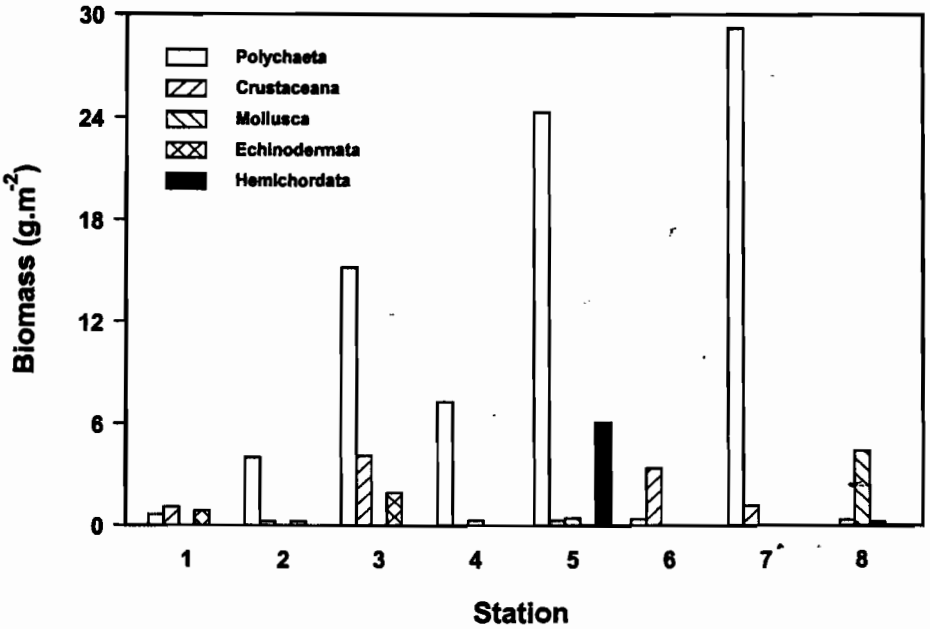

Fig. 4 Biomass of macrobenthic fauna at each sampling station around the Map-Ta-Phut Deep Sea Port in June 2000

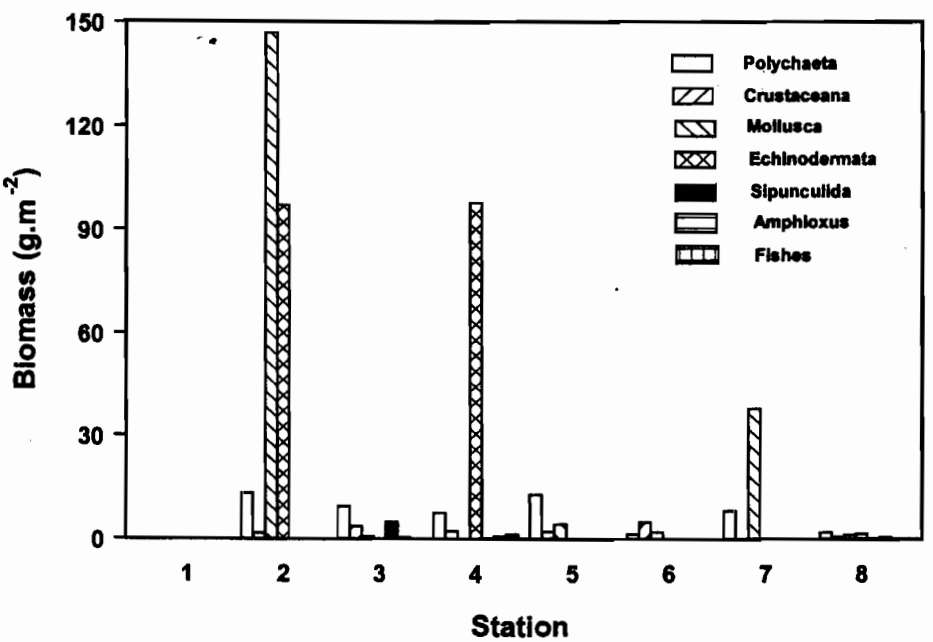

Fig. 5 Biomass of macrobenthic fauna at each sampling station around the Map-Ta-Phut Deep Sea Port in December 2000

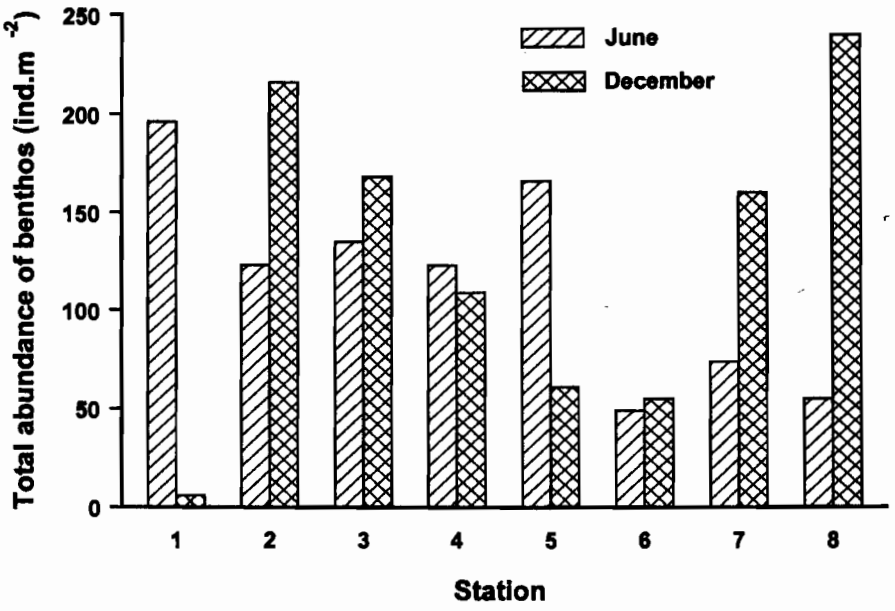

Fig. 6 Total abundance of all macrobenthic fauna at each sampling station around the Map-Ta-Phut Deep Sea Port in June and December 2000

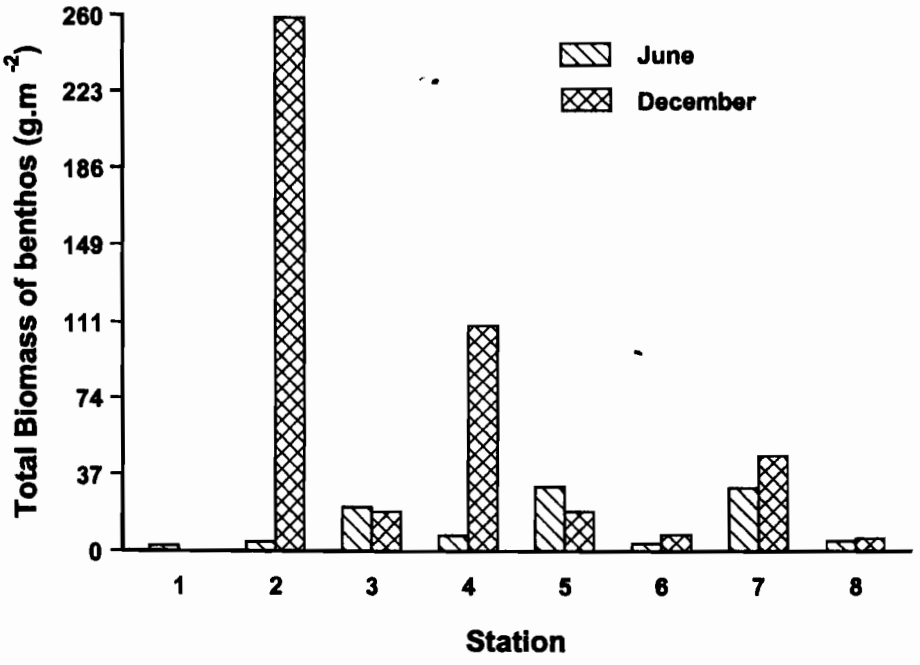

Fig. 7 Total biomass of all macrobenthic fauna at each sampling station around the Map-Ta-Phut Deep Sea Port in June and December 2000

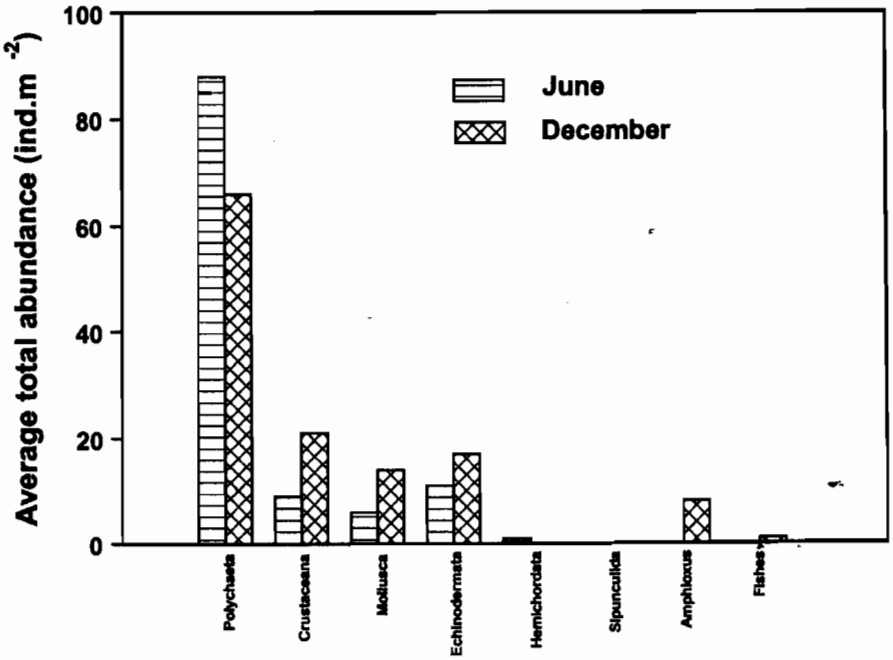

Fig. 8 Average total abundance of macrobenthic fauna found at all sampling stations around the Map-Ta-Phut Deep Sea Port in June and December 2000

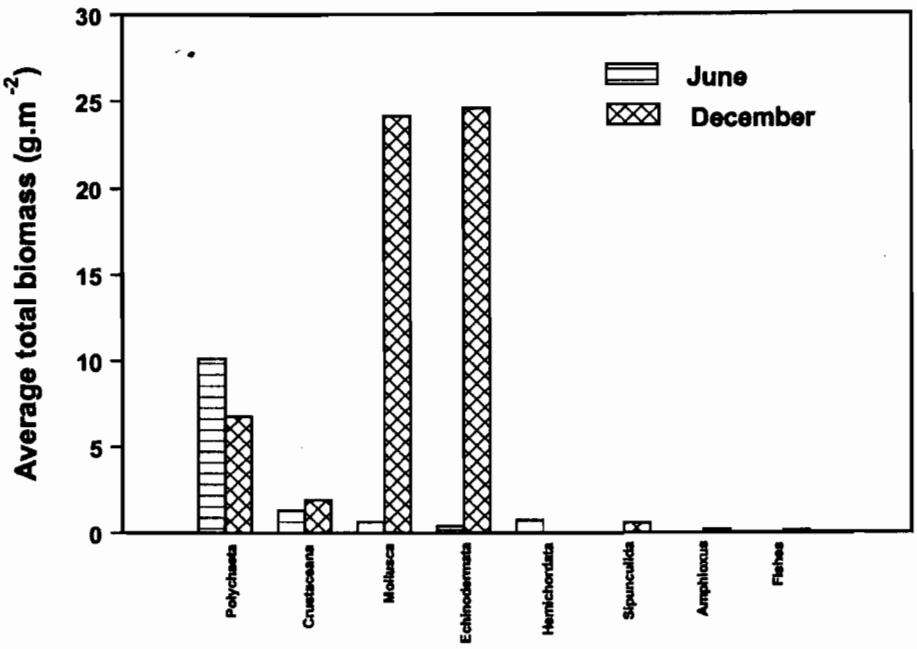

Fig. 9 Average total biomass of macrobenthic fauna found at all sampling stations around the Map-Ta-Phut Deep Sea Port in June and December 2000

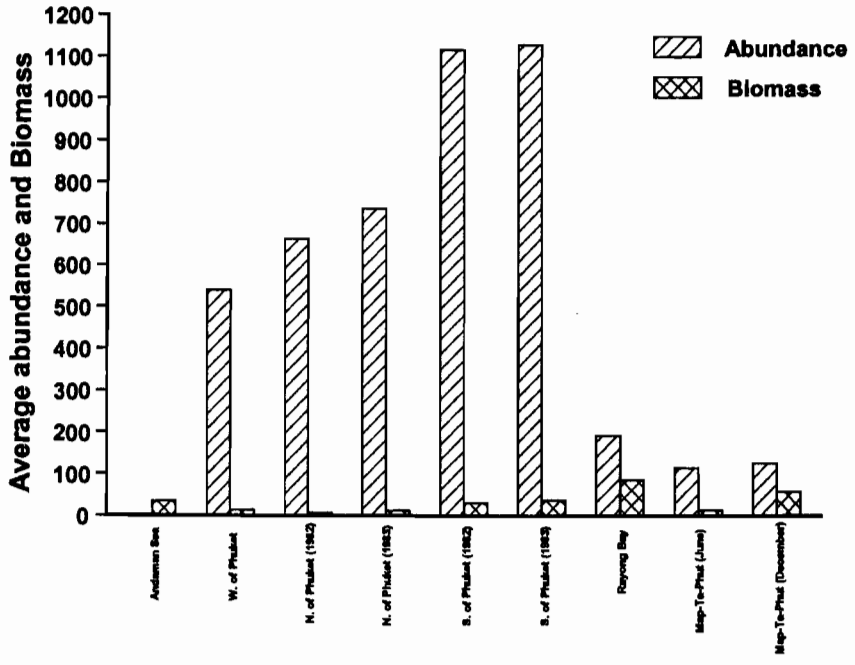

Fig. 10 Average abundance and biomass of macrobenthic fauna from the Andaman Sea, the coast of Phuket, Rayong Bay and around the Map-Ta-Phut Deep Sea Port (in June and December)

Table 1. Descriptions of stations for benthos samplings around the Map-Ta-Phut Deep Sea Port in June and December 2000.

Station	East	North	Depth (m)		Transparency		Salinity (ppt)		Sediment characteristic
			June	December	June	December	June	December	
1	733 500	1400 000	10	12	1.8	4	30	34	Black colour sediment with fine sand and a high mud content
2	734 500	1399 000	5	6	1.8	3	29	34	Yellow sand with shell fractions
3	734 500	1397 000	12	12	4	3	30	33	Black colour sediment with fine sand and mud
4	733 000	1397 000	12	15	4	4	31	35	Black colour sediment with fine sand and mud
5	733 000	1396 000	14	18	4	>15	32	34	Black colour sediment with fine sand and mud
6	734 500	1396 000	14	19	4.5	>15	32	35	Black colour sediment with fine sand and a high mud content
7	736 000	1396 000	14	19	4	15	32	32	Black colour sediment with fine sand and a high mud content
8	736 000	1397 000	8	8	2.5	3	32	33	Yellow sand with shell fractions

Table 2. Abundance (ind.m^{-2}) and biomass (g.m^{-2}) of macrobenthic fauna at each sampling station around the Map-Ta-Phut Deep Sea Port in June 2000

Station	Polychaeta		Crustaceana		Mollusca		Echinodermata		Hemichordata	
	Abundance (ind.m^{-2})	Biomass (g.m^{-2})	Abundance (ind.m^{-2})	Biomass (g.m^{-2})	Abundance (ind.m^{-2})	Biomass (g.m^{-2})	Abundance (ind.m^{-2})	Biomass (g.m^{-2})	Abundance (ind.m^{-2})	Biomass (g.m^{-2})
1	172	0.656	6	1.070	-	-	18	0.889	-	-
2	99	4.012	6	0.230	-	-	18	0.232	-	-
3	80	15.173	12	4.129	-	-	43	1.917	-	-
4	117	7.288	-	-	6	0.313	-	-	-	-
5	136	24.283	18	0.310	6	0.422	-	-	6	6.067
6	37	0.384	12	3.369	-	-	-	-	-	-
7	62	29.206	12	1.168	-	-	-	-	-	-
8	-	-	6	0.336	37	4.409	12	0.206	-	-

Table 3. Abundance (ind.m^{-2}) and biomass (g.m^{-2}) of macrobenthic fauna at each sampling station around the Map-Ta-Phut Deep Sea Port in December 2000

Station	Polychaeta		Crustaceana		Mollusca		Echinodermata		Sipunculida		Amphioxus		Fishes	
	Abundance (ind.m^{-2})	Biomass (g.m^{-2})	Abundance (ind.m^{-2})	Biomass (g.m^{-2})	Abundance (ind.m^{-2})	Biomass (g.m^{-2})	Abundance (ind.m^{-2})	Biomass (g.m^{-2})	Abundance (ind.m^{-2})	Biomass (g.m^{-2})	Abundance (ind.m^{-2})	Biomass (g.m^{-2})	Abundance (ind.m^{-2})	Biomass (g.m^{-2})
1	6	0.020	0	0	0	0	0	0	0	0	0	0	0	0
2	99	13.16	6	1.76	37	146.83	74	97.05	0	0	0	0.15	0	0
3	111	9.41	25	3.61	6	0.76	12	0.13	2	4.81	12	0.38	0	0
4	17	7.54	43	2.27	0	0	12	97.68	0	0	31	0.64	6	1.24
5	12	12.73	37	2.21	6	4.17	6	0.09	0	0	0	0	0	0
6	37	1.36	12	4.71	6	1.89	0	0	0	0	0	0	0	0
7	93	8.07	12	0.06	37	38.01	6	0	0	0	12	0.05	0	0
8	154	2.00	37	0.68	18	1.30	25	1.57	0	0	6	0.50	0	0

Table 4 Total abundance (ind.m^{-2}), biomass (g.m^{-2}), total family, total individual and shannon index of all macrobenthic fauna at each sampling station around the Map-Ta-Phut Deep Sea Port in June and December 2000

Station	Total abundance (ind.m^{-2})		Total biomass (g.m^{-2})		Total family		Total individual		Shannon index	
	June	December	June	December	June	December	June	December	June	December
1	196	6	2.61	0.02	5	1	32	1	0.72	0
2	123	216	4.47	258.95	7	13	20	29	1.73	2.18
3	135	168	21.22	19.10	6	17	19	24	1.62	2.70
4	123	109	7.60	109.37	8	12	19	27	1.88	2.35
5	166	61	31.08	19.20	13	12	27	17	2.24	2.36
6	49	55	3.75	7.94	9	5	9	5	2.20	1.43
7	74	160	30.37	46.19	8	13	11	21	1.97	2.38
8	55	240	4.95	6.05	11	18	17	36	2.23	2.73

Table 5 Average total abundance (ind.m^{-2}) and biomass (gm^{-2}) of macrobenthic fauna found at all sampling stations around the Map-Ta-Phut Deep Sea Port in June and December 2000

Taxon	Abundance				Biomass			
	June		December		June		December	
	Ind.m^{-2}	%	Ind.m^{-2}	%	g.m^{-2}	%	g.m^{-2}	%
Polychaeta	88 ± 55	76.3	66 ± 55	52.1	10.12 ± 11.48	76.4	6.79 ± 5.11	11.63
Crustacea	9 ± 5	7.8	21 ± 16	16.9	1.33 ± 1.56	10.0	1.91 ± 1.67	3.28
Mollusca	6 ± 13	5.3	14 ± 15	10.8	0.64 ± 1.53	4.8	24.12 ± 51.23	41.33
Echinodermata	11 ± 15	9.9	17 ± 24	13.3	0.40 ± 0.68	3.1	24.57 ± 44.94	42.10
Hemichordata	1 ± 2	0.6	0	0	0.76 ± 2.14	5.7	0	0
Sipunculida	0	0	< 1	0.2	0	0	0.60 ± 1.70	1.03
Amphioxus	0	0	8 ± 11	6.0	0	0	0.21 ± 0.26	0.37
Fishes	0	0	1 ± 2	0.6	0	0	0.15 ± 0.44	0.27
Total fauna	**115 ± 36**	**100**	**127 ± 23**	**100**	**13.26 ± 4.19**	**100**	**58.35 ± 11.17**	**100**

Table 6. Family diversity of macrobenthic fauna at each sampling station around the Map-Ta-Phut Deep Sea Port in June 2000

Class	Family	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7	Station 8
Polychaeta	Nereidae	1	5	-	-	-	1	1	1
	Pilargidae	1	-	-	-	-	-	-	-
	Trochochaetidae	26	-	-	-	-	-	1	1
	Glyceridae	-	1	3	3	2	-	-	-
	Maldamidae	-	6	-	3	1	1	-	-
	Onuphidae	-	3	-	1	2	1	-	-
	Spionidae	-	1	-	1		1	1	1
	Capitellidae	-	-	4	4	2	-	1	1
	Orbiniidae	-	-	1	-	9	-	-	-
	Terebellidae	-	-	2	5	2	1	3	3
	Eunicidae	-	-	-	1	3	1	-	-
	Pectinariidae	-	-	-	-	-	1	1	-
	Syllidae	-	-	-	-	-	-	-	-
	Fire worm	-	-	-	-	1	-	-	1
Crustacea	Porcellanidae	1	-	-	-	-	-	-	-
	Grapsidae	-	1	-	-	-	-	-	-
	Porcellanidae	-	-	2	-	-	-	-	-
	Xanthidae	-	-	-	-	1	-	-	-
	Palaemonidae	-	-	-	-	1	-	-	-
	Alphaeidae	-	-	-	-	1	-	-	-
	Squilloidae	-	-	-	-	-	1	-	-
	Xanthidae	-	-	-	-	-	1	-	-
	Isopoda	-	-	-	-	-	-	2	-
	Goneplacidae	-	-	-	-	-	-	-	1
Mollusca	Veneridae	-	-	-	1	-	-	1	1
	Cerithidae	-	-	-	-	1	-	-	1
	Donacidae	-	-	-	-	-	-	-	4
Echinodermata	Brittle star	3	3	7	-	-	-	-	-
	Heart urchin	-	-	-	-	-	-	-	2
Hemichordata	Acorn worm	-	-	-	-	1	-	-	-

Table 7. Family diversity of macrobenthic fauna at each sampling station around the Map-Ta-Phut Deep Sea Port in December 2000

Class	Family	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Station 7	Station 8
Polychaeta	Nereidae	1	1	-	-	1	-	-	4
	Glyceridae	-	5	1	1	2	-	1	4
	Maldanaidae	-	-	1	-	-	-	-	-
	Onuphidae	-	-	-	2	-	-	-	-
	Spionidae	-	-	-	2		1	1	1
	Capitellidae	-	4	2	3	-	-	2	-
	Orbiniidae	-	-	3	3	4	2	1	2
	Terebellidae	-	-	1	2	-	-	-	5
	Eunicidae	-	1	2	-	-	-	5	-
	Pectinariidae	-	1	-	-	-	-	-	-
	Amphinomidae	-	-	-	-	1	-	-	1
	Cirratulidae	-	-	1	-	-	-	-	-
	Aphroditidae	-	1	-	-	-	-	-	-
	Echinoidae	-	-	-	-	-	-	-	1
	Ophiellidae	-	-	-	-	-	-	-	1
	Nephtyidae	-	-	2	-	-	-	2	4
	Fire worm	-	-	-	-	1	-	-	1
Crustacea	Portunidae		-	1	-	2	1	-	-
	Palaemonidae	-	-	-	-	1	-	-	1
	Alphaeidae	-	-	-	5	2	1	2	3
	Penaeidae	-	-	2	-	-	-	-	-
	Amphipods	-	-	-	-	-	-	-	1
	Goneplacidae	-	1	1	2	1	-	-	-
Mollusca	Veneridae	-	2	1	-	-	1	3	1
	Strombacea	-	1	-	-	-	-	-	-
	Marginellidae	-	-	-	-	-	-	1	1
	Mytilacea	-	-	-	-	1	-	-	1
	Malleidae	-	-	-	-	-	-	1	-
	Donacidae	-	3	-	-	-	-	1	1
Echinodermata	Brittle star	-	11	2	1	1	-	1	2
	Sea cucumber	-	-	-	1	-	-	-	-
	Heart urchin	-	1	-	-	-	-	-	2
Sipuncalida	Sipuncalid	-	-	2	-	-	-	-	-
Cephalochordata	Amphioxus	-	-	2	5	-	-	1	2
Fish	Fish larvae	-		1	-		-	-	-

Table 8 The average abundance (ind.m $^{-2}$) and biomass (g. m $^{-2}$) of macrobenthic fauna from the Andaman Sea and upper Gulf of Thailand

Location	Abundance (ind.m $^{-2}$)	Biomass (g. m $^{-2}$)	Sources
Andaman Sea	Not indicated	5.0 – 35.0	Seidenfaden et al, 1968
West Coast of Phuket Island	540	14	Hylleberg et al., 1985
North Coast of Phuket Island (in 1982)	664	7.58	Chatananthawej and Bussarawit, 1987
North Coast of Phuket Island (in 1983)	737	13.01	Chatananthawej and Bussarawit, 1987
South Coast of Phuket Island (in 1982)	1117	30.81	Chatananthawej and Bussarawit, 1987
South Coast of Phuket Island (in 1983)	1129	37.71	Chatananthawej and Bussarawit, 1987
Rayong Bay	191.99	85.75	Saguansin, 1988
Around the Map-Ta-Phut Deep Sea Port (in June)	115	13.3	This study
Around the Map-Ta-Phut Deep Sea Port (in December)	127	58.3	This study

REFERENCES

Charoenrouy, M. (1979) Benthos in the inner Gulf of Thailand. *Thai Fish Gaze*, 32(2): 169-177 (in Thai).

Charoenrouy, M. and N. Piamthipmanus (1981) Benthos in the inner Gulf of Thailand, Surajthani province. *Technical Report, No. 23/6,* Marine Laboratory, Marine Fisheries Division. 13 pp. (in Thai).

Charoenrouy, M.; N. Piamthipmanus and J. Sanguansin (1983) Benthic animals in Chong Angtong, 1981. *Technical Report, No. 25/8*, Marine Laboratory, Marine Fisheries Division. 13 pp. (in Thai).

Holland, J. S.; J. M. Nancy and C. H. Oppenbeimer (1973) Galveston Bay benthic community structure as an indicator of water quality. *Contr. Mar. Sci.,* 17:169-188.

Katsamut, S.; N. Piamthipmanus and N. Charoenrouy (1980a) Benthic animals off the west coast of Gulf of Thailand, 1977. *Technical Report, No. 22/13,* Marine Laboratory, Marine Fisheries Division. 29 pp. (in Thai).

Katsamut, S.; N. Piamthipmanus and N. Charoenrouy (1980b) Benthic animals off the east coast of Gulf of Thailand, 1979. *Technical Report, No. 22/15*, Marine Laboratory, Marine Fisheries Division. 32 pp. (in Thai).

Piyakarnchana, T.; S. Tamiyavanich; N. Jirarochana and N. Setti (1978) On the density and biomass of the marine benthos in the Gulf of Thailand and Andaman Sea. *In*: Proceeding of the symposium on marine pollution research in Thai Water, 20-23 March 1978, National Research council of Thailand, pp. 209-222 (in Thai).

Reish, D. J., (1972) The use of marine invertebrates as indicators of varying degree of marine pollution. *In*: Marine pollution and sea life, pp. 203-207. Ed. By M. Ruivo. London: Fishing News (Books).

Saguansin, J. (1988) The benthic macrofauna in Rayong Bay. *Technical Paper No. 4,* Eastern Marine Fisheries Development Center, Marine Fisheries Division, Department of Fisheries, 45 pp.

Thanapong, C. and R. Mhordee (1982) The benthic fauna and bottom environment in the middle Gulf of Thailand (Area I) *Technical Report*, Marine Exploratory Division, 25 pp.

Thorson, G. (1975) Bottom communities (sublittoral or shallow shelf). *In:* Treatise on marine ecology and palaeoecology, Vol. 1, pp. 461-534. Ed. By J. W. Hedgpeth. Geol. Soc. America, Memoir, 67.

Wass, M. L. (1967) Indicators of pollution. *In:* Pollution and Marine Ecology, pp. 271-284. Ed. By T. A. Olson and F. J. Burgess. New York: Interscience Publisher.