REPORT
OF
THE THAI-JAPANESE-SEAFDEC JOINT OCEANOGRAPHIC AND TRAWLING SURVEY IN THE GULF OF THAILAND ON BOARD NAGASAKI-MARU

15-28 MAY 1980

Prepared by
the National Research Council of Thailand

Edited and printed by
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Samutprakarn, Thailand
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FOREWORD

In 1979, the National Research Council of Thailand (NRCT), acting upon the advice of its Marine Science Committee, initiated a cooperative project on research and training in marine science with the Nagasaki University and the Southeast Asian Fisheries Development Center (SEAFDEC). Later-in May 1980-the project was named "Thai-Japanese-SEAFDEC Cooperative Survey of the Gulf of Thailand".

Two surveys have been carried out using the training ship Nagasaki-Maru. The first one took place in September 1979. Its report entitled "Preliminary Results of the Thai-Japanese-SEAFDEC Joint survey on Trawling and Oceanography in the Gulf of Thailand, September to October 1979" was prepared and made available by the University.

The report of the second survey, which is reproduced in this volume, is in the form of collected papers prepared by the research/training participants, twenty in number, from the Fisheries Department, Mineral Resources Department, Hydrographic Department of the Royal Thai Navy, Kasetsart University, Chulalongkorn University and SEAFDEC, with Mr. Virat Charusombat, Director of Exploratory Fishing Division, as the team leader.

NRCT wishes to express its appreciation to the Nagasaki University, particularly Dr. Masato Yasuda, Dean of the Fisheries Faculty, and Mr. Shigeaki Yada, Captain of the Nagasaki-Maru, for making available to the participants the research/training facilities on board the vessel, and to SEAFDEC for printing and distributing the collected papers.

Professor Dr. Sanga Sabhasri
Secretary-General, NRCT

INTRODUCTORY COMMENT

1. Introduction

The Gulf of Thailand is very important to the sea fisheries of Thailand. It is one of the bountiful aquatic resources of the world. Thai fishermen have depended on the Gulf as their source of livelihood since ancient times. Therefore it is very appropriate that Thai researchers should look for occasions to participate in surveys relating to the study of environmental parameters of the Gulf of Thailand. Recently two surveys were carried out in the Gulf of Thailand by foreign vessels: in 1957-1960 by the oceanographic vessel the Stranger, of the Scripps Institute of Oceanography under the well-known NAGA EXPEDITION; and in 1970 by the oceanographic and fisheries vessel, the KAIYO MARU. The reports of these two surveys have been very useful to Thai researchers. Both reports concluded that the upwelling phenomenon, which is generally considered as the natural cause of fishery productivity, occurred off the west coast of the Gulf in the waters of Nakhonsritamarat Province. One of the aims of the present survey was to conduct an in-depth study of this phenomenon.

Besides, the information relevant to the nature of currents, related to other environmental parameters, are far from complete. In the field of marine geology, the amount of information available at present is negligible.

The present joint survey is the result of the visit of the Nagasaki-Maru in the latter part of September 1979. On that occasion Thai researchers participated in a survey for 6 days and had the opportunity of learning from and exchanging knowledge and experiences with the Japanese researchers. Another survey in the Gulf of Thailand was planned by Nagasaki University, to be carried out in 1980. The Japanese authorities offerred assistance to the National Research Council of Thailand (NRCT); facilities relating to research and training in the oceanography and the use of special fishing gears were to be provided for the benefit of Thai researchers on board Nagasaki-Maru, for the period of two weeks.

The NRCT Marine Science Committee considered that the occasion was favourable for a joint survey. It appointed Prof. Boon Indrambarya as its coordinator to work with Dr. Keishi Shibata, then a staff member of the Training Department, SEAFDEC and the coordinator of Nagasaki University. Mr. Virat Charusombat, Director of Exploratory Fishing Division, Department of Fisheries, was appointed the Leader of the Thai research team.

An ad-hoc committee was set up with Mr. Virat as its chairman, to work with Nagasaki University personnel in the survey of the Gulf of Thailand. The Nagasaki-Maru was to be equipped with oceanographic instruments and fishing gear for the purpose of the survey. The ad-hoc committee drew up a work-plan of research and training which was reviewed and discussed with the Nagasaki University staff prior to the start of the operation in May 1980.

2. Objectives

2.1 To carry out investigation and study in the fields of oceanography and fishing in the Gulf of Thailand.

2.2 To train Thai researchers in the use of scientific instruments and fishing gears, provided on board the vessel.

3. Report

The main objective of the cruise was to carry out investigation and study in the field of marine science in the Gulf of Thailand. The cruise programme included an oceanographic survey relating to the study of environmental parameters combined with exploratory fishing for identification purposes and hydrographic observation. There were 18 survey stations, all of which were concentrated in the deeper central Gulf. The survey started in the north and progressed southwards from station to station in a zig-zag fashion. Because of prevailing strong wind (southwest monsoon) during the first week of the cruise the operations were slowed down; however, the work went on well.

At each station, the following oceanographic observations were carried out:

a) Water samples were collected by Bandon Bottle;

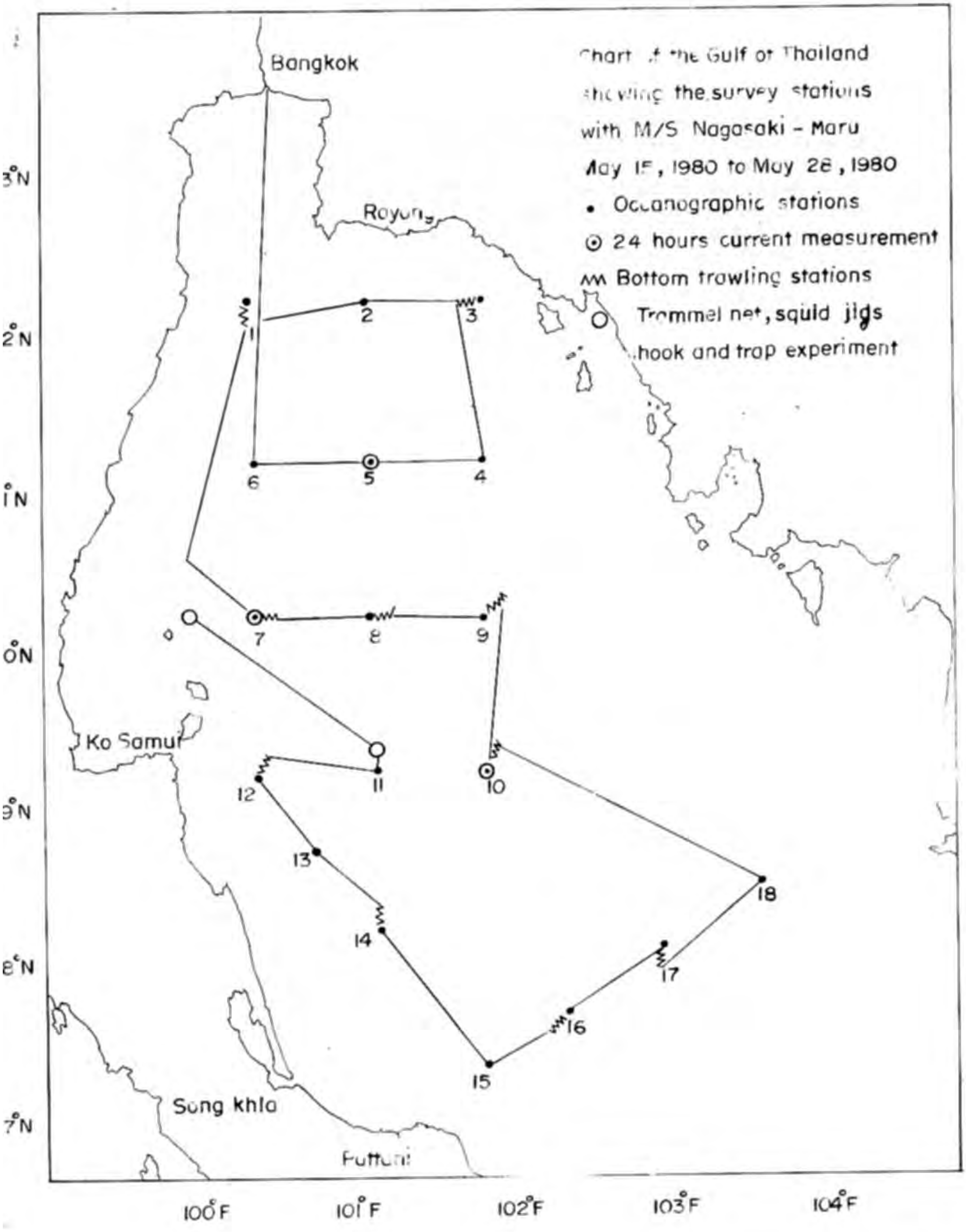
b) Salinity, temperature and depth measurement by S.T.D. meter and salinometer;

c) Determining amounts of dissolved oxygen by D.O. meter;

d) Chemical oxygen demand (C.O.D) determination of mud by reduction of permanganate method;

e) Sediment samples by Smith-MacIntyre sampler and piston corer;

f) Plankton and larvae collection by horizontal and vertical towing;



Gulf of Thailand
the survey stations
with M/S Nagasaki - Maru
May 1?, 1980 to May 28, 1980
Oceanographic stations
24 hours current measurement
Bottom trawling stations
Trommel net, squid jigs
hook and trap experiment
Bangkok
Rayong
Ko Samui
Song khla
Puttani
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
13°N
12°N
11°N
10°N
9°N
8°N
7°N
100°E
101°E
102°E
103°E
104°E

g) Current measurement by current meter (conducted at three stations);

h) Registering/observing bottom topography by echo-sounding.

Catch data were obtained from experimental trawl fishing, with the use of six-seamed net having a head rope and ground rope length of 23.5 to 67 meters. The net was towed at a speed of 3 - 3.5 knots for an average of one hour per haul. Some parts of the northern area were untrawlable because of rough bottom and the operation had to be suspended until the next station was reached. At every anchorage station squid fishing was attempted at night, using squid jigs of different colors.

On the return journey from south to north, the investigation was carried out near the coast along Pattani to Surathani.

At the end of the survey a stop was made for two days near Tao Island for the purpose of fishing gear demonstration and training.

4. Acknowledgements

We wish to express our heartfelt gratitude to Dr. Sanga Sabhasri, Secretary-General of the National Research Council of Thailand, Dr. Deb Menasveta, Secretary-General, and Dr. Shigeaki Shindo, Deputy Secretary-General, SEAFDEC, for their painstaking effort to materialize this joint survey. Thanks are also due to Prof. Boon Indrambarya and Prof. Keishi Shibata who coordinated the joint survey. Last but not least, our sincere thanks are due to the crew of Nagasaki-Maru for their cooperation.

5. Names of Participants

Staff of Nagasaki-Maru

Shigeaki Yada	Captain
Yasuaki Takaki	Chief Officer
Hisao Kanchara	Second Officer
Toshiyuki Kuno	Third Officer
Mitsuyoshi Yamaji	Chief Engineer
Shojiro Miyahara	Investigator
Tetsushi Senta	Investigator

Yasuyuki Tamamoto	Investigator
Kiyoshi Terao	Investigator
Satoshi Yamamoto	Investigator

<u>Researchers of Thailand</u>

Mr. Virat Charusombat	Department of Fisheries
Mr. Dhummasakdi Poreeyanond	"
Miss Chamchoi Tanapong	"
Mr. Weera Pokapunt	"
Mr. Dheerasak Wasuthapitak	"
Mr. Lertchai Podapol	"
Mr. Taweesak Charnprasertporn	"
Mr. Saramit Uraiwan	"
Dr. Takahashi Kozo	SEAFDEC-TD
Mr. Prasert Masthawee	"
LT. Phon Parn-in R.T.N.	Department of Hydrography
Junior LT. Charnchana Buathep R.T.N.	"
Mr. Chorraman Wongwit	Chulalongkorn University
Miss La-orsri Teeratecha	"
Miss Chutima Tantikitti	"
Mr. Teera Lekcholaryut	Kasetsart University
Mr. Taweesak Sangsirikul	"
Mr. Preecha Laochu	Department of Mineral Resources
Mr. Sunoj Kengkoom	"

V. Charusombat

Mr. Virat Charusombat
Leader of Thai Research Team
Director, Exploratory Fishing Division,
Department of Fisheries

ABSTRACT

Three stations of 24-hour current measurements were taken: station number 5 (11° 10.6 N, 101° 10.9 E) on May 16-17, 1980, station number 7 (10° 10.0 N, 100° 24.5 E) on May 19-20, 1980 and station number 10 (09° 10.1 N, 101° 54.8 E) on May 21-22, 1980. The direction of constant currents at the depth of 10 meters were found to be 124°, 344° and 106° (SE, NNW, ESE) orderly. At each station, the flood water flowed to the north-western direction and south-eastern for the ebb but because of the structure control (shore-line), the patterns of tidal currents were not found to be ellipses as they should. The longer period of ebb tide at station number 5 may have been caused by discharges from the 4 main rivers in the upper part of the Gulf. These measurements were not taken in the period of spring water so the highest velocities of current were not found.

INTRODUCTION

In the present paper, the flow in the Gulf of Thailand related to tidal current and southwest monsoon wind was studied. Ordinarily in 24-hour measurement, we use Ekman current meters which have the advantage that measurements can be taken at various layers with minimal time shift (about 5 minutes per layer), but 2-3 operators are required for one measurement and they have to stand by throughout 24 hours. In addition to Ekman current meter, two more types of current meters were developed. The self-recording type seems to give the best results; continuous record of data can be obtained for up to 3 or 7 days and with a series of current meters, data on various layers of current can be collected. By using stationary buoys, many stations can be collected at nearly the same time without any standby. The latest type of current meter is the direct-reading type which was also used on this cruise. Thus besides collecting data on currents, the comparisons among these current meters were also made.

ANALYSES AND RESULTS

It had been planned that at each station 24-hour current measurements would be made in two layers; at 10 m depth and at 10-15 m above bottom, by using 2 direct-reading current meters. However, the current meter on Nagasaki-Maru was out of order, so only data at 10 m depth was obtained by using the meter belonging to Marine Sciences Department, Chulalongkorn University. Hourly basic meteorological data and 4-hourly sea temperature, salinity and dissolved oxygen using STD and DO meter were also collected, as shown in Table 1. Patterns of observed current are shown in Figure 1. From Table 1, the constant currents at stations 5, 7 and 10 were calculated to be .0391 m/s 124°, .0734 m/s 334° and .0744 m/s 106° in order shown in Fig. 2. This indicates that in May the constant current flows into the Gulf of Thailand at station 7 and flows out at stations 5 and 10. By using N and E tidal currents (Tables 2, 3, 4), the tidal currents at stations 5, 7 and 10 can be obtained (Fig. 3, 4 and 5). It can be said by comparing these data with the data from the tide-gauge station on shore that the flood tide has NW direction with maximum speed of .1681 m/s at 1600 (local time) at station 5, but the flood period is shorter than the ebb because of the opposed constant current. The ebb tide has SE direction with maximum speed of .12 m/s. By compensation of constant current and by discharging from the 4 rivers, the ebb period at station 5 is longer (Fig. 2 and 3).

At station 7, maximum speed of observed current with compensated constant current is .224 m/s. The actual flood of tidal current is found to be .189 m/s NW at 2100 and the ebb is .1908 m/s SE at 1000 with rather confused tidal pattern caused by the shoreline beyond (Fig. 2 and 4).

At station 10, the flood of tidal current flows to NW with maximum speed of .2052 m/s at 1200 but with 106° constant current, the observed current is only found to be .15 m/s. The ebb has SE direction with .1592 m/s speed at 0800. With compensated constant current, the observed current is .23 m/s. The pattern of tidal current at this station is much less confused, as the location is approaching the open sea (Fig. 2 and 5). From Figures 6, 7 and 8, showing the current speed, sea temperature, salinity and oxygen of stations 5, 7 and 10, measured simultaneously, the water temperature is minimum in the morning and maximum in the afternoon and no other relations can be clearly observed.

CONCLUSIONS

Three layers of current are normally measured; surface, middle and near the bottom of the sea. The surface current is significant for navigation and land erosion while the current in the middle layer and bottom current are significant for water mass circulation, erosion of the bottom and also deposition of sediments. On this cruise, measurement of the surface current was omitted because this is easily and widely observed by many agencies and also much data were already collected. The bottom current data was missed in this cruise because one of the two current meters was out of order, so only the 10 m layer of current was obtained.

Data obtained from the direct-reading current meter was found not to be entirely satisfactory:

a) The meter scale type: mean current speed and direction can not be so easily and precisely read up to the second decimal point. (1 : 0.5 m/s and 1 : 10 degree).

b) The digital type: only 0.1 knot can be read but the depth and temperature can be read to the second decimal point.

For these reasons and as already explained in introduction, the self-recording current meter seems to be most suitable for 24-hour current measurement. The Ekman current meter is satisfactory and the direct-reading type is only suitable for rough current measurement.

ACKNOWLEDGEMENT

We wish to express our sincere gratitude to the Marine Sciences Department, Faculty of Sciences, Chulalongkorn University, for providing us with the current meter used in this current measurement.

Table 1. Record of Current (10 m)

No.	Station 5, Depth 61 m, Date 16-17/5/80						Station 7, Depth 60 m, Date 19-20/5/80						Station 10, Depth 72 m, Date 21-22/5/80					
	Time	Wind Dir	Wind Vel	Current Dir**	Current Vel	Temp. C Sal, D.O	Time	Wind Dir	Wind Vel	Current Dir**	Current Vel	Temp. C Sal, D.O	Time	Wind Dir	Wind Vel	Current Dir**	Current Vel	Temp. C* Sal, D.O
1	15h00	237°	16	325	12	30.975	13h00	240	17	250	8		16h20	230	20	330	10	
2	16 00	237	10	323	13	32.98	14 00	235	17	020	13		17 00	220	21	330	12	
3	17 00	240	12	340	12	-	15 00	205	20	350	20	30.575	18 00	215	20	005	6	
4	18 00	245	18	340	4		16 00	245	19	350	20	32.76	19 00	205	19	320	11	30.415
5	19 00	250	15	325	5	30.940	17 00	230	18	355	17	4.4	20 00	215	20	350	9	32.26
6	20 00	255	18	120	10	32.94	18 00	220	20	350	18		21 00	220	20	340	15	4.8
7	21 00	265	17	200	6	6.2	19 00	215	18	335	10	30.510	22 00	225	18	030	7	
8	22 00	270	18	160	10		20 00	210	20	330	14	32.69	23 00	225	20	350	11	30.375
9	23 00	275	20	70	7	30.910	21 00	295	22	310	24	5.4	00 00	225	21	320	10	32.77
10	00 00	290	20	130	5	32.96	22 00	290	17	315	15		01 00	225	22	070	10	4.2
11	01 00	285	17	140	15	5.9	23 00	260	10	295	13	30.495	02 00	235	18	100	12	
12	02 00	265	18	95	15		00 00	240	10	315	10	32.74	03 00	225	18	150	13	30.340
13	03 00	270	19	110	13	30.840	01 00	220	15	320	12	4.6	04 00	240	17	125	17	32.77
14	04 00	265	18	155	11	32.96	02 00	245	15	320	10		05 00	230	18	125	15	3.4
15	05 00	265	17	130	12	6.3	03 00	235	15	325	7	30.470	06 00	230	18	120	18	
16	06 00	270	14	160	15		04 00	225	14	310	10	32.74	07 00	235	19	125	20	30.290
17	07 00	268	15	150	8	30.825	05 00	225	13	080	5	4.4	08 00	210	12	125	23	32.79
18	08 00	280	16	160	10	32.93	06 00	275	19	025	5		09 00	225	16	150	20	3.7
19	09 00	270	14	160	15	6.3	07 00	230	17	090	7	30.445	10 00	235	13	135	20	
20	10 00	270	15	160	10		08 00	250	20	020	18	32.74	11 00	220	16	130	20	30.370
21	11 00	270	15	150	8	30.900	09 00	230	11	120	9	4.2	12 00	220	17	132	18	32.79
22	12 00	280	12	130	6	32.97	10 00	240	16	125	13		13 00	220	19	120	16	3.8
23	13 00	270	13	350	5	3.2	11 00	250	19	120	10	30.455	14 00	210	15	145	17	
24	14 00	255	14	335	4		12 00	245	8	125	12	32.74	15 00	210	14	110	12	30.470
25	15 00	265	14	20	10		13 00	265	19	355	11	3.7	16 00	210	16	080	8	32.77
																		4.4

* at 10 m layer.

** Correction is needed as below:

direction reading	0°	40°	90°	140°	180°	220°	270°	320°	360°
true direction	0°	45°	90°	135°	180°	225°	270°	315°	360°

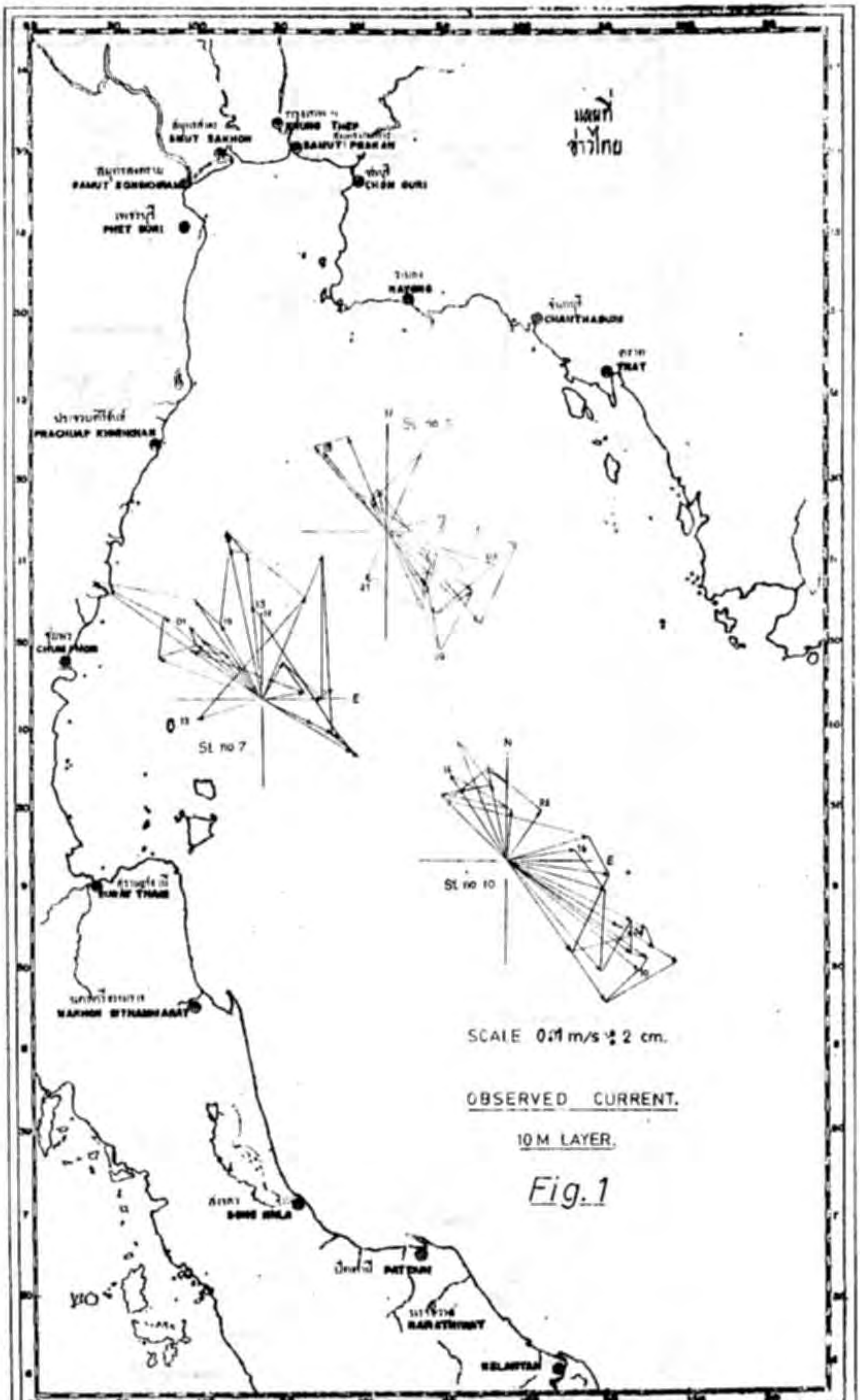
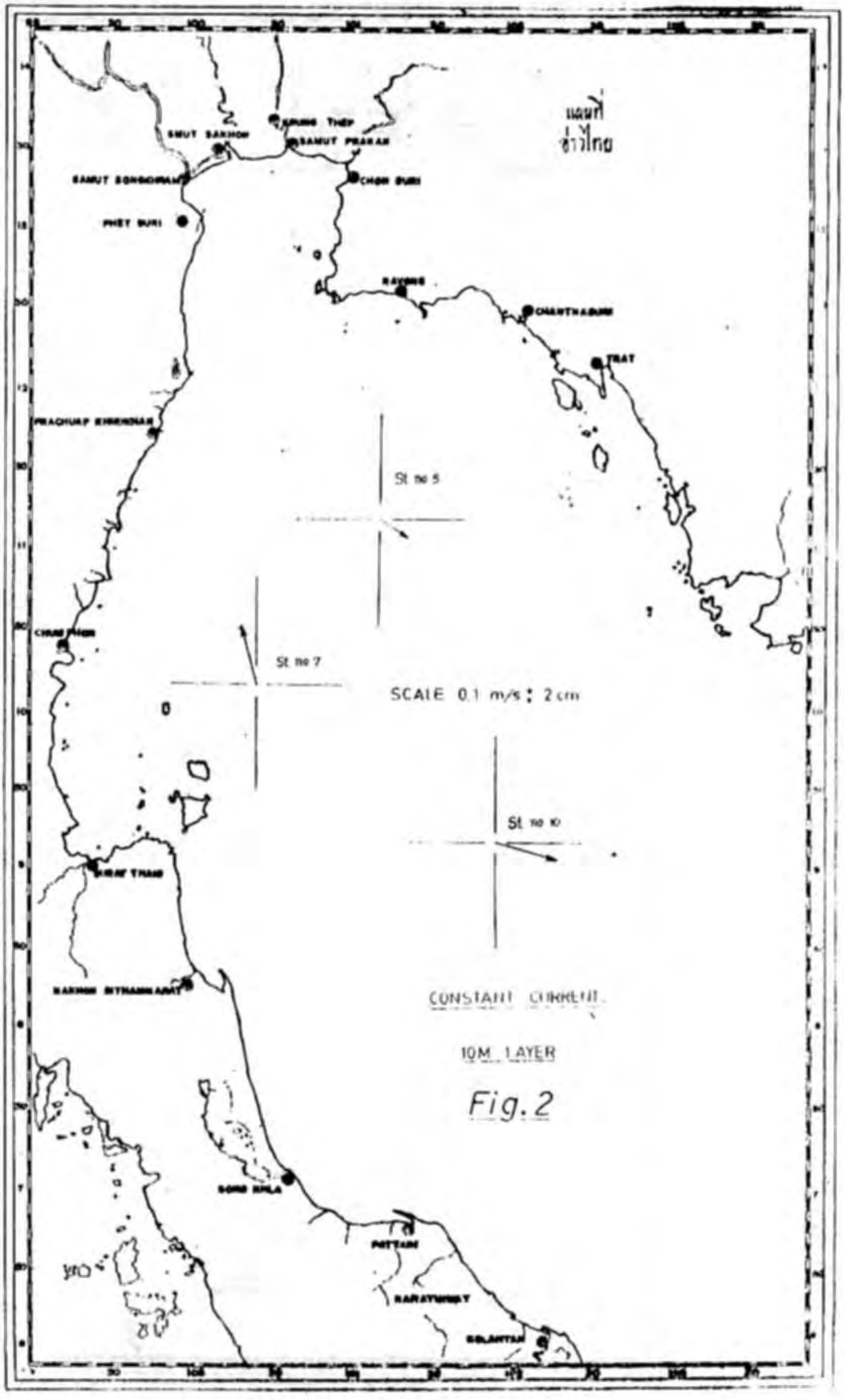

แผนที่
อ่าวไทย
St no 7
St no 10
E
N
SCALE 0.1 m/s : 2 cm.
OBSERVED CURRENT.
10 M LAYER.

Fig. 1



CONSTANT CURRENT

10M LAYER

Fig.2

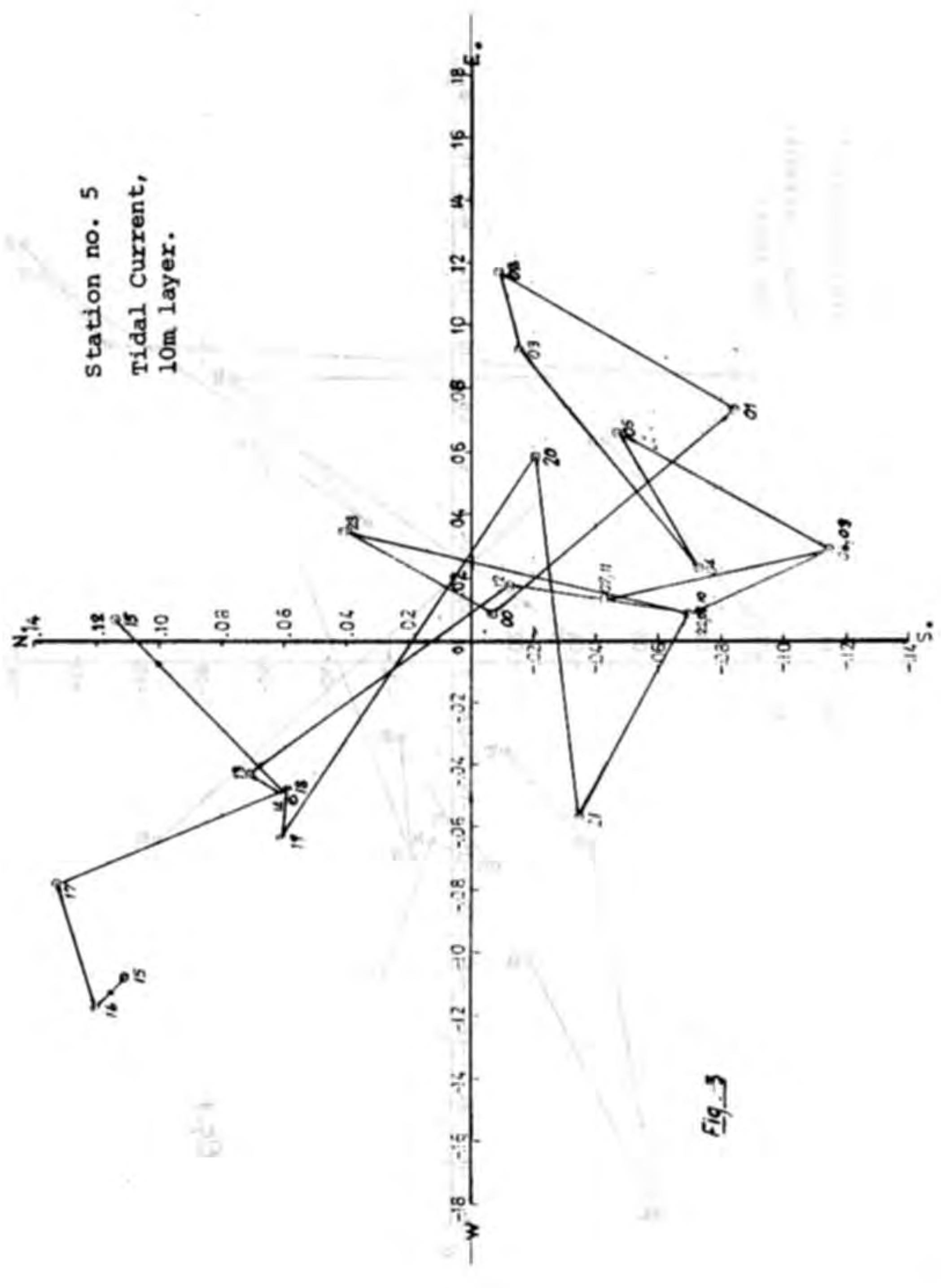


Fig. 3

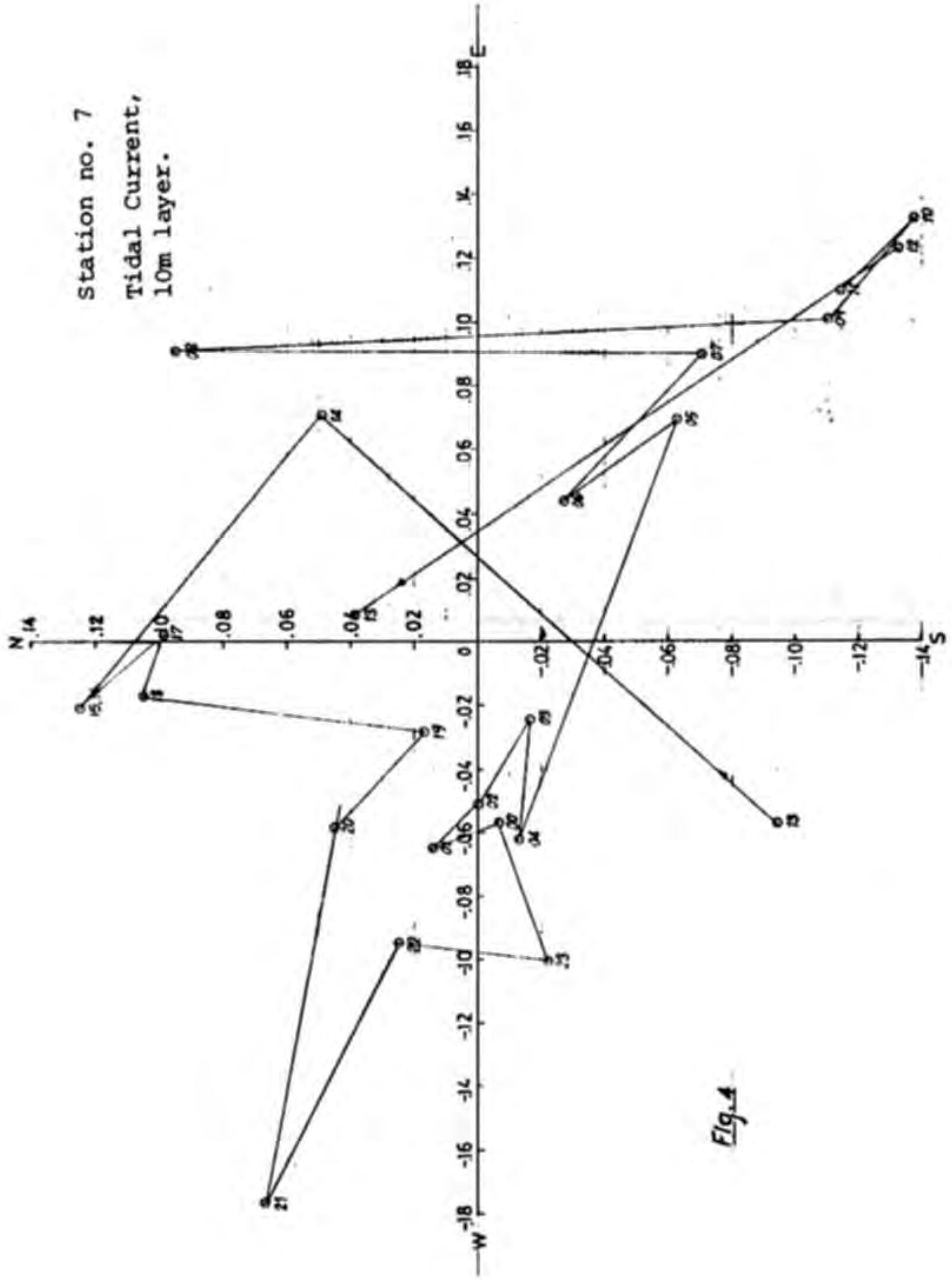


Fig. 4

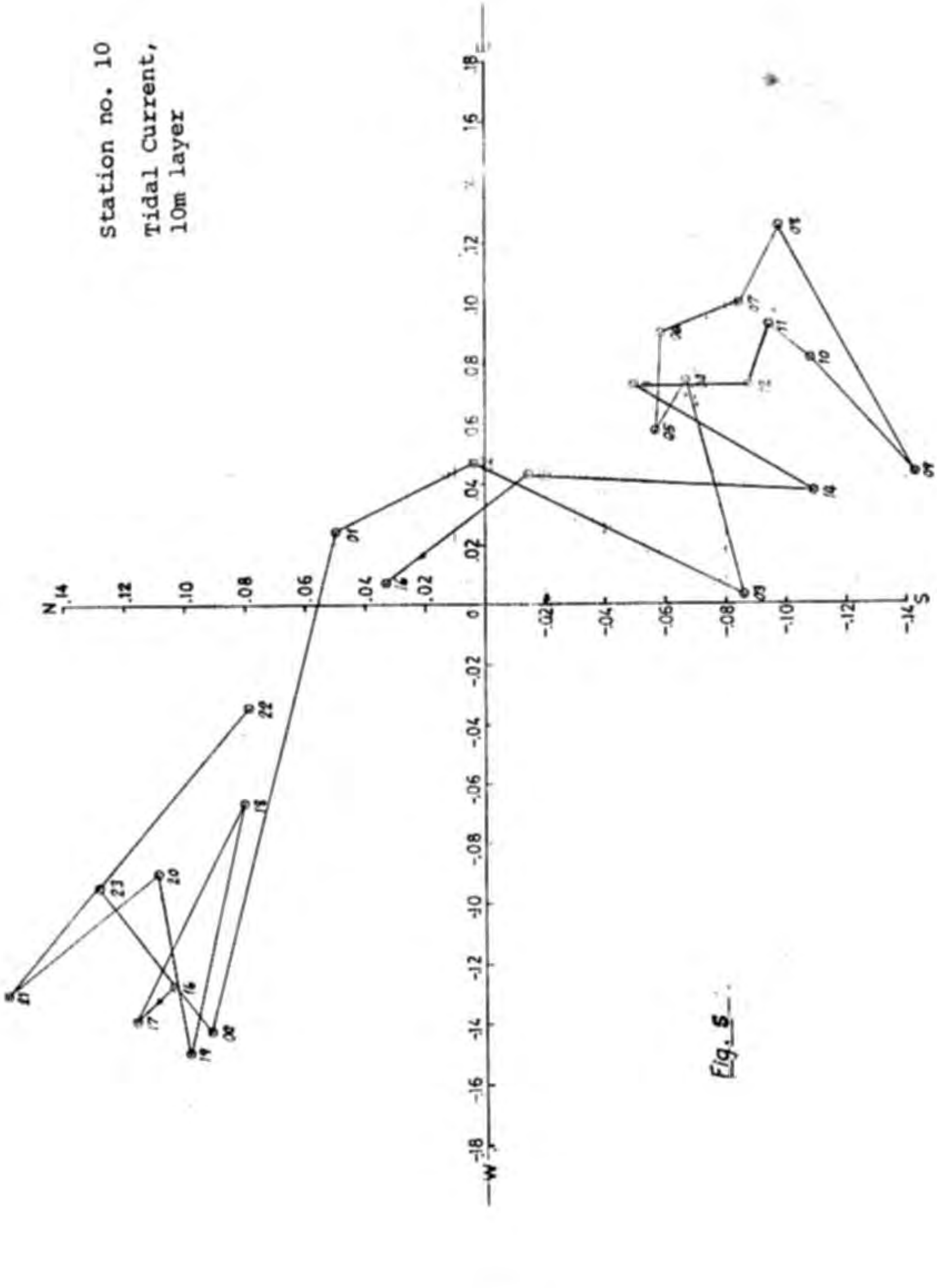


Fig. 5

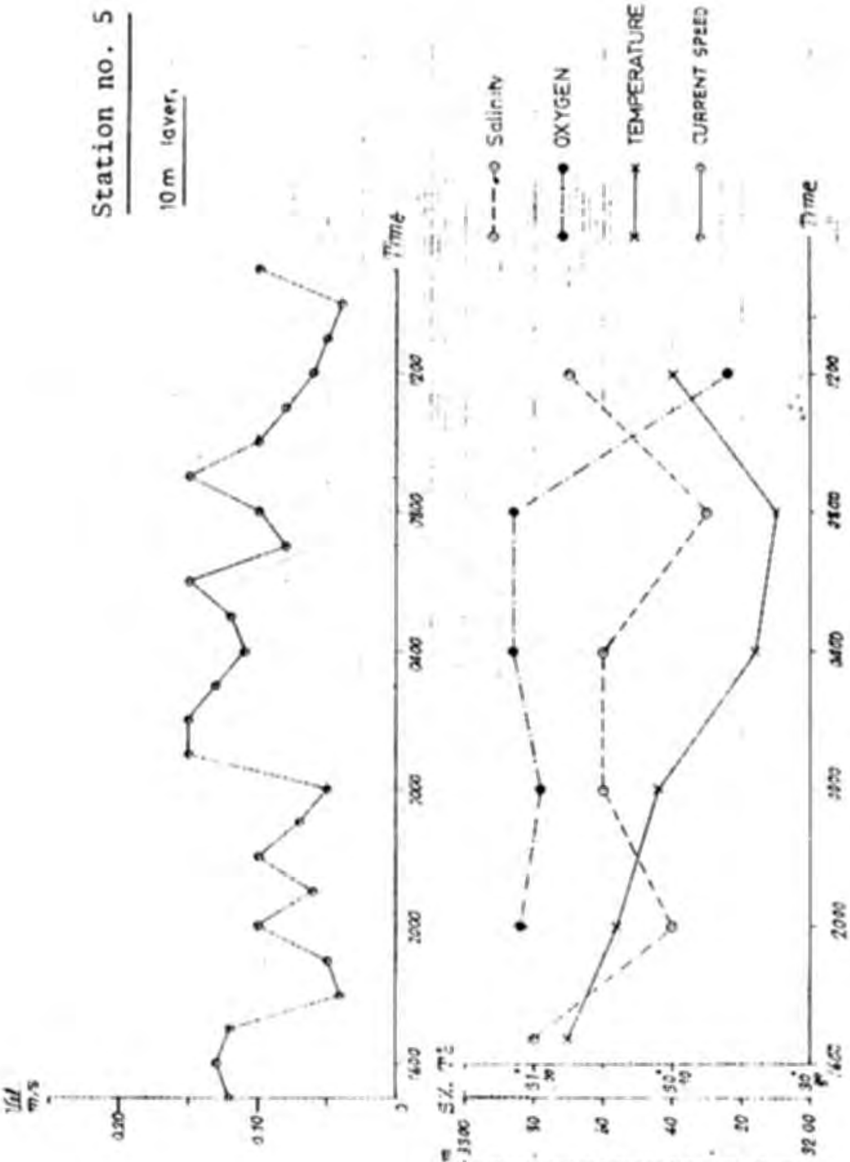

Station no. 5
10 m layer,
Salinity
OXYGEN
TEMPERATURE
CURRENT SPEED
Time
Time
Vel m/s
DO ppm
S‰
T°C

Fig. 6

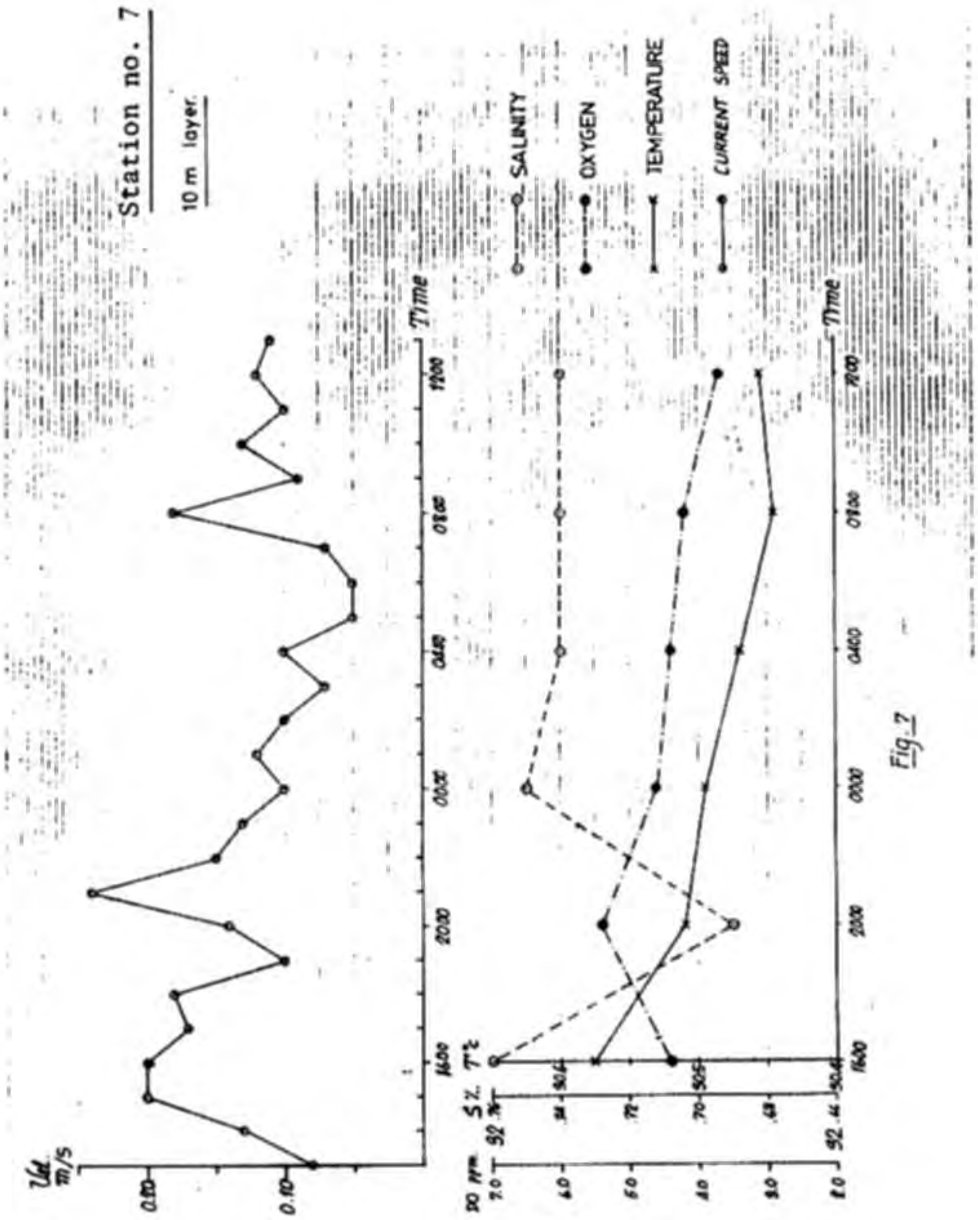

Station no. 7
10 m layer
SALINITY
OXYGEN
TEMPERATURE
CURRENT SPEED
Vel. m/s
0.20
0.10
Time
1600
2000
0000
0400
0800
1200
T°C
S‰
O2 PPM

Fig. 7

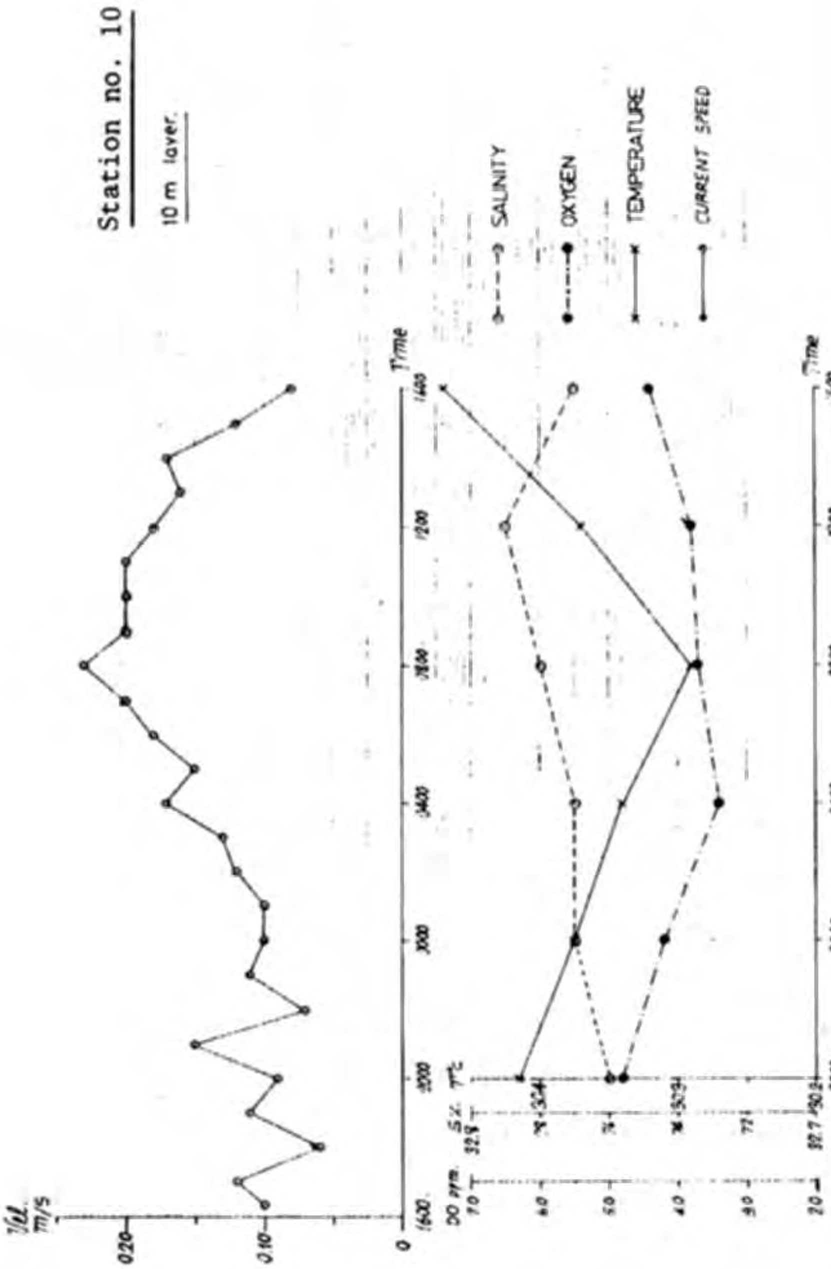

Station no. 10
10 m layer
SALINITY
OXYGEN
TEMPERATURE
CURRENT SPEED
Vel. m/s
Time

Fig. 8

GEOLOGICAL INVESTIGATION IN THE GULF OF THAILAND

Sunoj Kengkoom

Economic Geology Division
Department of Mineral Resources
Ministry of Industry
Bangkok

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ABSTRACT

From the survey on board Nagasaki-Maru in the Gulf of Thailand during 15-28 May 1980, 18 piston-corer sediment-samples were studied sedimentologically, analysed geochemically for 15 trace elements and studied for microfossils identification. (Fig. 1 and Table 1).

Sedimentologically, the 18 piston-corer samples proved to be 2 samples of sand, 3 of mud, 6 of muddy sand and 7 of sandy mud. The calcareous skeleton, quartz and feldspar grains were the main constituents of most samples. (Table 2)

Geochemically, all of the samples were analysed for trace elements at sieved size (-80) mesh except for tin, for which they were analysed at both (-80) mesh and (-20+80) mesh. The concentration of Ni was 5-35 ppm., Co 4-17 ppm., Cr 5-21 ppm., As nil-30 ppm., Cu 4-15 ppm., Pb 10-35 ppm., Zn 4-45 ppm., Mn 24-162 ppm., Cd 1-2 ppm., V nil, P 250-1,000 ppm., Fe 4,920-43,080 ppm., Sn (-80 mesh) 5-13 ppm. and Sn (-20+80 mesh) 5-50 ppm., Sb nil and W nil (Table 3).

Microfossil Identification which was performed on all 18 piston-corer samples revealed Ostracod and Smaller Foraminifera. There were 2,672 specimens of Smaller Foraminifera which were identified to 46 genera; planktonic 3 genera, arenaceous benthonic 8 genera and calcareous benthonic 35 genera. Calcareous benthonic were found the most, both in genera and quantity. (Table 4)

GENERAL

The Gulf of Thailand, formerly known as the Gulf of Siam, is a shallow, flat basin with maximum depth of 86 meters. The Gulf extends from the Chao Phraya deltatic plain near Bangkok southestward about 800 km. Its mouth is defined as a line between the southwestern tip of the Mekong delta and the small island off the east coast of the Thai-Malay Peninsula. Along this line it connects with the North Sunda Shelf and the South China Sea (Fig. 2). In general, the Gulf is floored by modern detrital silts and clays. Along the sides of the Gulf, the sea floor is interrupted by hills, many of which rise above sea level as islands. These islands are composed mainly of granite and/or meta-sediments of Mesozoic-Upper Paleozoic age which locally supply sand and rock fragments to the sea bottom. Some islands lie on the trend of onshore ridges such as the Satun ridge and the Ko Kra ridge (Fig. 3). (C. Achalabhuti, 1975)

SURFACE SEDIMENTS

Of 18 piston-core samples collected from the seafloor of the survey area, 2 samples proved to be sand, 3 samples mud, 6 samples muddy sand and 7 samples sandy mud. (Table 2). The distribution of sediments in the survey area were shown by P. Dheeradilok (1977) as in Fig. 4.

Shell fragments, foraminifera and coccoliths were commonly found in most samples. However, the highest amount of non-calcareous grains such as quartz, feldspar grains and lateritic gravels were found at stations 11, 12, 13 and 14, along the eastern coast of Surattani and Nakhon Srithammarat Province (Fig. 1).

Color of the surface sediments from 18 piston-corer samples was mostly dusky yellowish green to dusky yellow green. However, some samples were greyish olive green, greyish olive, brown and green in color.

GEOCHEMICAL STUDY OF THE SURFACE SEDIMENTS

The 18 piston-corer samples collected between 16-28 May, 1980, in the survey area of the Gulf of Thailand, were geochemically analysed for 15 trace elements; Sn, Sb, Cr, Co, Ni, Cu, Pb, Zn, Cd, P, W, V, Mn, As and Fe. The geochemical analysis was carried out by the Geochemical Laboratory Section of the Economic Geology Division of the Thai Department of Mineral Resources. Summary of the results of the geochemical analysis is shown in Table 3.

MICROFOSSIL ANALYSIS OF THE SURFACE SEDIMENTS

Method

Each of the 18 piston-corer samples was sieved by 250 mesh (Tyler Equivalent = 0.0025 inch), washed and dried at 250^{o} C. Between 100-300 specimens of microfossils were identified in each sample.

Results

Microfossils found in all 18 samples were identified as Ostracod and Smaller Foraminifera.

The Ostracod were not identified but 2672 specimens of Smaller

Foraminifera were identified to 46 genera as below;

3 genera of planktonic,
8 genera of arenaceous benthonic,
and 35 genera of calcareous benthonic.

In every sample, there were more calcareous benthonic than the others Smaller Foraminifera, both genera and quantity.

Arenaceous benthonic were seen in small amounts in every sample.

Planktonic were seen only in the sample number 10, 11, 16, and 17; Globigerina, Globigerinoides trilobus (Reuss), Gümbelina ? and the planktonic genera were common in deep water.

Ostracod were also seen in every station and were found to be very common at the depth of water between 29-30 meters; however, in deeper water there were less Ostracod.

The Cretaceous-Eocene fossil, Gümbelina ? were found in recent sediment. This evidence may be referred to the reworking of these microfossils.

Table 4 gives the lists of Smaller Foraminifera found in 18 samples.

DISCUSSION

The present survey of the Gulf of Thailand on board Nagasaki-Maru was envisaged as a part of the training programme and a preliminary to further exploration.

The geochemical study revealed that the quantity of Sn (-20+80 mesh) of sample No.7 was very high, 50 ppm., which should be the guidance for further exploration of economic tin deposits.

The results of analysis of other trace elements, such as Pb and As were found important for study of effects of industrial pollution.

ACKNOWLEDGEMENTS

The author wishes to express his gratitude to all crew of Nagasaki-Maru and Thai and Japanese Scientists who worked on board

Nagasaki-Maru together.

Special thanks are due to Mr. Suravich Cheingpaisal and his colleagues from the Geochemical Laboratory Section of Economic Geology Division, Department of Mineral Resources, for their help in geochemical analysis of sea-floor sediment samples.

Special thanks are also expressed to Mrs. Junya Jumnongthai of Geological Survey Division, Department of Mineral Resources, for preparing the samples and identifying microfossils.

A deep feeling of appreciation is due to Mr. Suvit Sumpattavanija, Mr. Sermsakdi Kulvanich, Mr. Werapun Jantaranipa and our colleagues in Offshore Prospecting Section of Economic Geology Division, Department of Mineral Resources for their help and valuable suggestions.

REFERENCES

Achalabhuti, C, 1975, Petroleum Geology of the Gulf of Thailand; Dept. of Mineral Resources, Economic Geology Bull. No.7, 53 p.

Achalabhuti, C, 1978, Natural Gas Deposits of the Gulf of Thailand; Natural Gas Organization of Thailand (NGOT), August 4, 1978, 23 p.

Emery, K.O. and Niino, H., 1963, Sediments of the Gulf of Thailand and Adjacent Continental Shelf; Bull. Geol. Soc. Amer. V 74, p. 541-544

ศสิทธิ์ ธีระศิลก, ๒๕๒๓, ความสัมพันธ์ของการเปลี่ยนแปลงชายฝั่งอ่าวไทยกับทรัพยากรแร่, เอกสารประกอบคำบรรยายในการสัมนางานวิจัยทางภูมิศาสตร์ประเทศไทย, ๖-๘ พฤษภาคม ๒๕๒๓, ๒๘ หน้า.

Table 1. Description of piston-corer samples

Station No.	Date	Time	Lat-º.-' N Long-º.-'E	Water Depth (M.)	Wire out (M.)	Approximate core recovery(%)	General description of samples
1	18/5/80	21:55	12-11.0 100-28.2	36	20-32	15	Light grey sand and silt (sandy-silty).
2	18/5/80	14:10	12-10.0 101-09.1	35	20-33	20	Light grey fine sand and hard lateritic clay at the bottom.
3	18/5/80	08:20	12-10.0 101-09.1	30	18-29	100	Greenish grey calcareous sandy silt.
4	17/5/80	20:00	11-10.0 101-54.0	60	50-66	30	Grey silt and consolidated dark grey clay in the core catcher.
5	16/5/80	14:50	11-10.3 101-11.1	64	50-67	100	Greenish grey calcareous mud and consolidated dark clay in core catcher.
6	16/5/80	07:05	11-08.2 100-24.2	51-55	40-55	30	Light grey silty sand with dark consolidated clay in the core catcher.
7	19/5/80	12:38	10-10.0 100-24.5	60	51-59	100	Light grey calcareous mud.
8	20/5/80	20:47	10-09.9 101-09.0	62-69	55-57	50	Brownish grey calcareous mud.
9	21/5/80	06:30	10-10.2 101-55.4	74	65-77	30	Light grey calcareous mud with semiconsolidated clay in the core catcher.

Table 1. Description of piston-corer samples (cont'd)

Station No.	Date	Time	Lat-º.-' N Long-º.-'E	Water Depth (M.)	Wire out (M.)	Approximate core recovery(%)	General description of samples
10	22/5/80	14:10	9-10.1 101-54.8	72	65-73	15	Brownish grey calcareous mud with shell fragments, semiconsolidated clay in the core catcher.
11	25/5/80	13:22	9-10.0 101-10.0	60	50-59	100	Light grey calcareous mud.
12	25/5/80	06:02	9-10.8 100-25.0	30	25-34	50	Light grey calcareous mud with some shell fragments.
13	24/5/80	19:00	8-43.2 100-41.4	32	25-32	80	Light grey calcareous mud with shell fragments.
14	24/5/80	13:15	8-10.1 101-10.1	53	45-53	100	Light grey calcareous mud.
15	24/5/80	06:25	7-15.0 101-50.0	48	40-50	10	Light grey silt sand with consolidated lateritic clay in the core catcher.
16	23/5/80	18:41	7-34.7 102-20.0	73	60-71	100	Light grey calcareous mud.
17	23/5/80	13:28	7-59.3 103-01.5	69	60-71	100	Very soft, light grey calcareous mud.
18	23/5/80	06:13	8-22.7 103-39.6	29	20-29	50	Light grey calcareous mud with some shell fragments.

Table 2. Sedimentological Summary of Piston-corer Samples

Station No.	Color	Grain Size (%)				Microscopic Remark	Name of Sediment (According to Emery & Niino)
		Gravel	Sand	Mud	Total		
1	Dusky yellowish green. (10GY3/2)	27.7	61.1	11.1	99.9	Shell fragments, foraminifera and coccoliths rich	Dusky yellowish green calcareous medium sand.
2	Greyish olive green. (5GY3/2)	40.0	53.3	6.7	100.0	" " "	Greyish olive green calcareous coarse sand.
3	Dusky yellowish green (10GY3/2)	20.0	40.0	40.0	100.0	" " "	Dusky yellowish green calcareous muddy sand.
4	Dusky yellow green (5GY5/2)	0	70.0	30.0	100.0	" " "	Dusky yellow green calcareous muddy sand.
5	Greyish olive (10Y4/2)	0	33.3	66.7	100.0	" " "	Greyish olive calcareous sandy mud.
6	Dusky yellow green (5GY5/2)	7.7	46.1	46.1	99.9	" " "	Dusky yellow green calcareous muddy sand.
7	Dusky yellow green (5GY5/2)	0	8.3	91.7	100.0	" " "	Dusky yellow green calcareous mud.
8	(Surface) Moderately olive brown (5Y4/4) (Below) Dusky yellow green (5GY5/2)	23.1	38.5	38.5	100.1	Brown mud contain more quartz than grey mud	Brown calcareous mud and dusky yellowish green calcareous muddy sand.

Table 2. Sedimentological Summary of Piston-corer Samples (cont'd)

Station No.	Color	Grain Size (%)				Microscopic Remark	Name of Sediment (According to Emery & Niino)
		Gravel	Sand	Mud	Total		
9	(Surface) Moderately olive brown (5Y4/4) (Below) Greyish olive (10Y4/2)	15.0	35.0	50.0	100.0	Brown mud contain more quartz than grey mud	Brown calcareous mud and Greyish olive calcareous sandy mud.
10	(Surface) Moderately yellowish brown (10YR5/4) (Below) Dusky yellow green (5GY5/2)	20.6	44.1	35.2	99.9	Shell fragments foraminifera and coccoliths rich. Brown mud contain more quartz than grey mud. (?)	Brown calcareous mud and dusky yellow green calcareous muddy sand.
11	(Surface) Moderate olive brown (5Y4/4) (Below) Greyish olive (10Y4/2)	12.0	28.0	60.0	100.0	Shell fragments, foraminifera and coccoliths rich. Brown mud contain more quartz than grey mud. (?)	Brown calcareous mud and dusky yellow green calcareous muddy sand.
12	Dusky yellow green (5GY3/2)	25.0	17.9	57.1	100.0	Quartz and feldspar > calcareous grains. Black rock fragments and lateritic gravel	Dusky yellow green (non-calcareous) sandy mud.

Table 2. Sedimentological Summary of Piston-corer Samples (cont'd)

Station No.	Color	Grain Size (%)				Microscopic Remark	Name of Sediment (According to Emery & Niino)
		Gravel	Sand	Mud	Total		
13	Dusky yellow green (5GY5/2)	11.5	34.6	53.8	99.9	Quartz and feldspar > calcareous grains	Dusky yellow green (non-calcareous) sandy mud.
14	Dusky yellow green (5GY5/2)	0.0	20.0	80.0	100.0	Quartz and feldspar > calcareous grains	Dusky yellow green (non-calcareous) sandy mud.
15	Greyish olive (10Y4/2)	18.2	36.4	45.4	100.0	Calcareous grains, quartz, feldspar and black rock fragments	Greyish olive (non-calcareous) muddy sand.
16	Dusky yellow green (5GY5/2)	0.0	6.3	93.7	100.0	Shell fragments, foraminifera and coccoliths rich	Dusky yellow green calcareous mud.
17	Dusky yellow green (5GY5/2)	3.3	3.3	93.3	99.9	" " "	Dusky yellow green, calcareous mud.
18	Greyish olive (10Y4/2)	16.7	33.3	50.0	100.0	" " ", quartz and feldspar	Greyish olive, calcareous sandy mud.

Table 3. Trace elements values in Geochemical sea-floor sediment samples

Samples	Ni ppm -80 mesh	Co ppm -80 mesh	Cr ppm -80 mesh	Sb ppm -80 mesh	W ppm -80 mesh	As ppm -80 mesh	Cu ppm -80 mesh	Pb ppm -80 mesh
ST - 1	13	15	9	nil	nil	nil	4	22
ST - 2	17	17	12	nil	nil	10	5	20
ST - 3	35	17	21	nil	nil	nil	12	30
ST - 4	22	15	5	nil	nil	30	9	25
ST - 5	28	13	14	nil	nil	20	12	30
ST - 6	20	13	11	nil	nil	nil	6	22
ST - 7	30	13	16	nil	nil	20	10	25
ST - 8	5	4	5	nil	nil	nil	15	10
ST - 9	20	17	6	nil	nil	20	5	22
ST - 10	25	17	11	nil	nil	nil	7	25
ST - 11	27	11	11	nil	nil	nil	8	20
ST - 12	17	15	6	nil	nil	nil	8	35
ST - 13	12	9	7	nil	nil	30	9	15
ST - 14	22	13	10	nil	nil	nil	7	12
ST - 15	18	7	11	nil	nil	20	7	20
ST - 16	22	17	7	nil	nil	10	7	20
ST - 17	27	9	14	nil	nil	nil	10	22
ST - 18	22	7	8	nil	nil	20	8	17

Table 3. Trace elements values in Geochemical sea-floor sediment samples (cont'd)

Samples	Zn ppm -80 mesh	Mn ppm -80 mesh	Sn ppm -80 mesh	Sn ppm (-20+80) mesh	Cd ppm -80 mesh	V ppm -80 mesh	Fe ppm -80 mesh	P ppm -80 mesh
ST - 1	11	56	10	5	1	nil	15,840	250
ST - 2	7	162	10	5	1	nil	32,160	250
ST - 3	17	93	5	5	2	nil	17,040	1,000
ST - 4	15	64	10	5	1	nil	13,920	250
ST - 5	26	125	10	5	1	nil	16,080	250
ST - 6	17	85	10	5	2	nil	17,280	250
ST - 7	34	94	10	50	1	nil	21,600	250
ST - 8	4	24	13	5	1	nil	4,920	250
ST - 9	15	92	10	10	1	nil	13,680	250
ST - 10	26	120	10	13	2	nil	14,040	250
ST - 11	30	82	10	5	2	nil	20,040	250
ST - 12	22	120	13	10	2	nil	24,480	250
ST - 13	22	122	10	5	1	nil	15,240	250
ST - 14	24	70	10	5	1	nil	14,520	250
ST - 15	35	122	5	5	1	nil	43,080	250
ST - 16	28	102	10	10	1	nil	16,800	250
ST - 17	45	94	5	5	1	nil	26,400	250
ST - 18	39	70	10	13	1	nil	19,080	250

Table 4. List of microfossils found in sea-floor sediment samples

Station 1

Operculina ammonoides (Geronovius)
Miliammina sp.
Ostracod
Asterorotalia pulchella (d'Orbigny)
Cellanthus craticulatus (Fichtel & Moll)
Quinqueloculina sp.
Cibicides wuellerstorfi (Schwager)
Amphistegina sp.
Elphidium spp.
Reophax sp.
Rotalia spp.
Florilus sp.
Textularia sp.
Reusella sp.
Ammonia sp.
Eponides sp.
Cibicides sp.

Station 2

O. Ammonoides (Geronovius)
Quinqueloculina spp.
Pseudorotalia spp.
C. craticulatus (Fichtel & Moll)
Cibicides spp.
Asterorotalia pulchella (d'Orbigny)
Reophax spp.
Elphidium spp.
Ostracod
Rotalia spp.
Triloculina sp.
T. tricarinata (d'Orbigny)
Spiroloculina spp.
Glandulina sp.
Miliammina sp.

Station 3

Florilus spp.
Quinqueloculina cultrata (Brady)
Quinqueloculina spp.
Elphidium spp.
Reusella sp.
Rotalia spp.
C. craticulatus (Fichtel & Moll)
Ploymorphina ?

Station 4

Pseudorotalia spp.
Textularia spp.
Bigenerina spp.
Quinqueloculina spp.
Ostracod
Cibicides refulgens (Montfort)

Rotalia spp.
A. pulchella (d'Orbigny)
Reophax spp.
Eponides berthelotianus (d'Orbigny)
Elphidium spp.
C. wuellerstorfi (Schwager)

Station 5

Rotalia spp.
Ostracod
Textularia spp.
Triloculina tricarinata (d'Orbigny)
Triloculina spp.
Pseudorotalia spp.
C. craticulatus (Fichtel & Moll)
A. pulchella (d'Orbigny)
Elphidium spp.
Cancris sp.
Bigenerina ?
Bolivina spp.
Quinqueloculina longirostra (d'Orbigny)
Quinqueloculina spp.
Q. cultrata (Brady)
Lagena spp.
Florilus sp.
Spiroloculina spp.
Discorbis ?

Station 6

Spiroloculina spp.
Ostracod
Triloculina tricarinata (d'Orbigny)
C. refulgens (Montfort)
Cibicides spp.
Rotalia spp.
Bolivina spp.
Elphidium spp.
Textularia spp.
C. craticulatus (Fichtel & Moll)
O. ammonoides (Geronovius)
Reusella sp.
Lagena sp.
Quinqueloculina spp.
Florilus sp.
Bigenerina ?
Miliammina sp.
Virgulina sp.
Discorbis ?
Nodosaria sp.

Station 7

Scutuloris hornibrooki (Vella)
Textularia spp.
Miliolinella sp.
Rotalia spp.
Triloculina sp.
Elphidium spp.
Cancris sp.
C. wuellerstorfi (Schwager)

Quinqueloculina longirostra (d'Orbigny)
Quinqueloculina spp.
Spiroloculina spp.
Ostracod
Pseudorotalia spp.
C. refulgens (Montfort)
Eponides berthelstianus (d'Orbigny)
Lagena spp.
Triloculina tricarinata (d'Orbigny)
Cibicides spp.
A. pulchella (d'Orbigny)
Bolivina spp.
Lenticulina sp.
Reophax ?
Discorbis spp.
Textulariella sp.
Glandulina sp.
Pyrgoella ?

Station 8

Pseudorotalia spp.
A. pulchella (d'Orbigny)
Textularia spp.
Cibicides refulgens (Montfort)
Cibicides spp.
Rotalia spp.
Spiroloculina sp.
Quinqueloculina spp.
Massilina ?
Ostracod
Discorbis ?
Bigenerina ?
E. berthelotianus (d'Orbigny)
Pyrgoella ?
Bolivina spp.
Glandulina sp.
Ammobaculites ?
Miliammina sp.
Elphidium spp.
Melonis ?

Station 9

Bigenerina ?
Textularia spp.
C. refulgens (Montfort)
Cibicides spp.
Ostracod
Elphidium spp.
Massilina ?
Rotalia spp.
Bolivina spp.
Miliolinella spp.
A. pulchella (d'Orbigny)
Miliammina spp.
Quinqueloculina spp.
Pseudorotalia spp.
Nonion ?
Lagena ?
Spiroloculina spp.
Triloculina tricarinata (d'Orbigny)
Discorbis ?
Eponides ?

Station 10

Miliammina spp.
Pseudorotalia spp.
Bigenerina ?
C. refulgens (Montfort)
C. wuellerstorfi (Schwager)
Cibicides spp.
Textularia spp.
Spiroloculina spp.
Ostracod
Elphidium spp.
Quinqueloculina spp.
Q. cultrata (Brady)
Massilina ?
Eponides berthelotianus (d'Orbigny)
Rotalia spp.
Gümbelina ?
Nodosaria sp.
Biloculina sp.
Triloculina tricarinata (d'Orbigny)
Lagena spp.
Bolivina spp.
Globigerinoides trilobus (Reuss)
Cancris sp.
Eponides sp.
Reophax ?
Alabamina ?
Textulariella sp.
A. pulchella (d'Orbigny)

Station 11

Rotalia spp.
Ostracod
Quinqueloculina longirostra (d'Orbigny)
Quinqueloculina spp.
Bolivina spp.
Textularia spp.
Cibicides spp.
C. refulgens (Montfort)
Cornuspiroides foliaceus (Philippi)
Eponides spp.
Spiroloculina spp.
Cancris sp.
Triloculina sp.
Gümbelina ?
Pseudorotalia spp.
Elphidium spp.
Miliolinella sp.
A. pulchella (d'Orbigny)
Glandulina sp.
Pyrgoella ?
Bigenerina ?

Station 12

Pseudorotalia spp.
A. pulchella (d'Orbigny)
Quinqueloculina spp.
Rotalia spp.
Cibicides spp.
Bolivina spp.

C. craticulatus (Fichtel & Moll)
Elphidium spp.
Ostracod
O. ammonoides (Geronovius)
Bigenerina ?
Textularia spp.
Miliammina spp.
Triloculina sp.
Florilus sp.
Eponides repandus (Fichtel & Moll)
Spiroloculina sp.

Station 13

A. pulchella (d'Orbigny)
Rotalia spp.
Ostracod
Textularia spp.
Quinqueloculina spp.
Pseudorotalia spp.
Elphidium spp.
C. craticulatus (Fichtel & Moll)
Bigenerina ?
Cibicides spp.
Eponides spp.
Bolivina sp.
Florilus sp.
Miliammina sp.
Lagena spp.
Triloculina tricarinata (d'Orbigny)

Station 14

Bolivina spp.
Ostracod
Quinqueloculina spp.
Rotalia spp.
Pseudorotalia spp.
Cibicides spp.
C. refulgens (Montfort)
A. pulchella (d'Orbigny)
Textularia spp.
Bigenerina ?
Cancris sp.
Eponides sp.
Nodosaria sp.
Lagena sp.
Triloculina tricarinata (d'Orbigny)

Station 15

C. craticulatus (Fichtel & Moll)
Rotalia spp.
Cibicides spp.
C. refulgens (Montfort)
Eponides berthelotianus (d'Orbigny)
O. ammonoides (Geronovius)
Triloculina tricarinata (d'Orbigny)
Textulariella sp.
Bolivina spp.
A. pulchella (d'Orbigny)

Quinqueloculina spp.
Ostracod
Elphidium spp.
Spiroloculina spp.
Scutuloris hornibrooki (Vella)
Textularia spp.
Pseudorotalia spp.
Eponides spp.
Florilus sp.
Cancris sp.
Alabamina ?

Station 16

Pseudorotalia spp.
A. pulchella (d'Orbigny)
Spiroloculina spp.
Textularia spp.
Quinqueloculina spp.
Q. longirostra (d'Orbigny)
Rotalia spp.
Bigenerina ?
Elphidium spp.
Globigerinoides sp.
Sigmoilopsis ?
Ostracod
Cibicides spp.
C. refulgens (Montfort)
Massilina ?
Reophax ?
Glovigerinoides trilobus (Reuss)
Cancris sp.
Lagena sp.
Triloculina tricarinata (d'Orbigny)

Station 17

Spiroloculina spp.
Cibicides spp.
C. wuellerstorfi (Schwager)
C. refulgens (Montfort)
Quinqueloculina spp.
Q. longirostra (d'Orbigny)
Ostracod
Textularia sp.
Globigerina spp.
Florilus sp.
Lenticulina sp.
A. pulchella (d'Orbigny)
Rotalia spp.
Elphidium spp.
Triloculina tricarinata (d'Orbigny)
Nodosaria sp.
Cancris sp.
Massilina ?
Ammonia sp.
Bolivina sp.
Globigerinoides sp.
Lagena spp.
Fissurina sp.
Calcarina ?
Bigenerina ?
Pseudorotalia sp.

Station 18

Textularia spp.
A. pulchella (d'Orbigny)
Quinqueloculina spp.
Ostracod
Bigenerina ?
Rotalia spp.
Cibicides spp.
C. wuéllerstorfi (Schwager)
Pseudorotalia spp.
Lagena ?
Miliammina spp.
Elphidium spp.
Turrilina ?
Florilus sp.

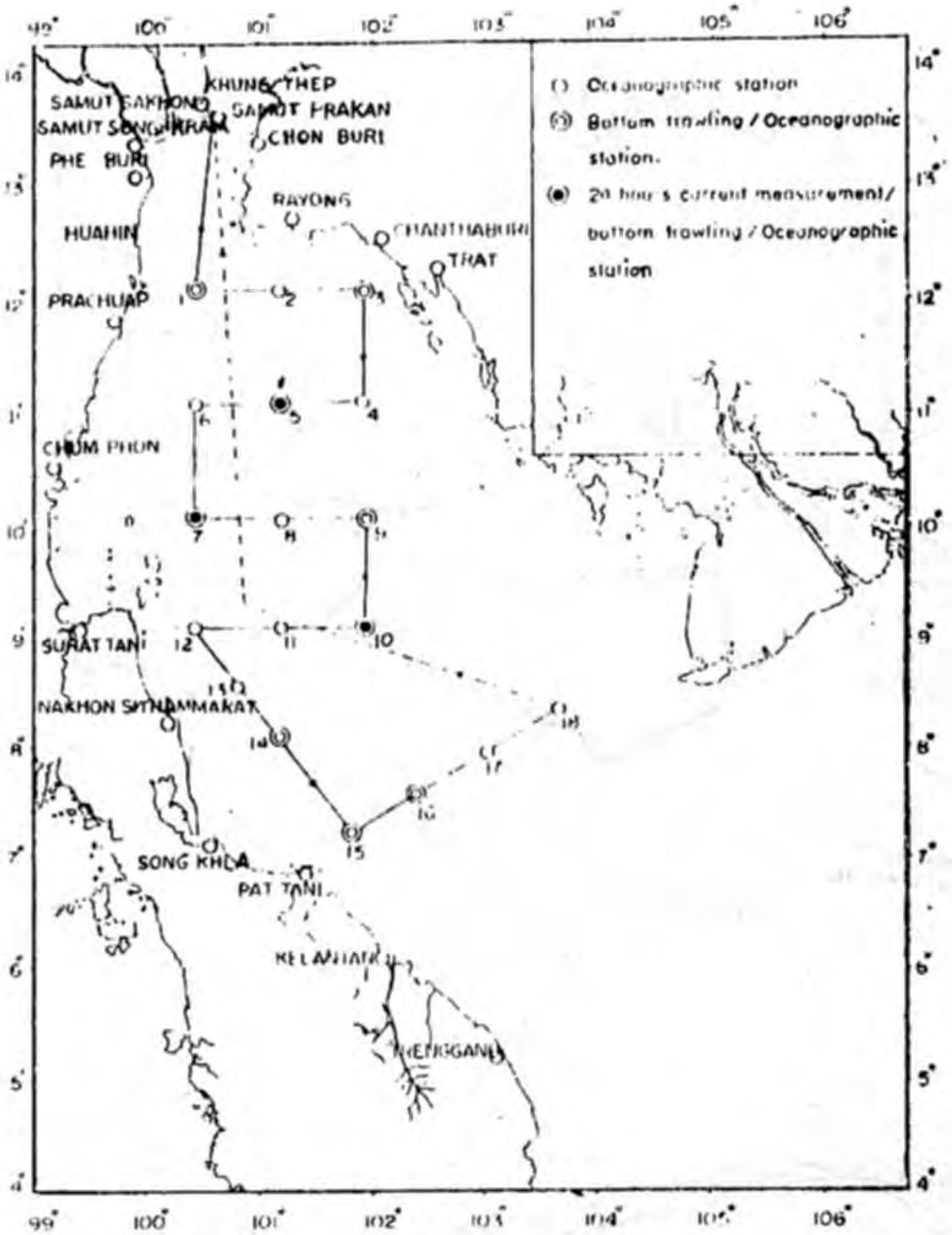

Fig. 1 Plan of Survey Stations

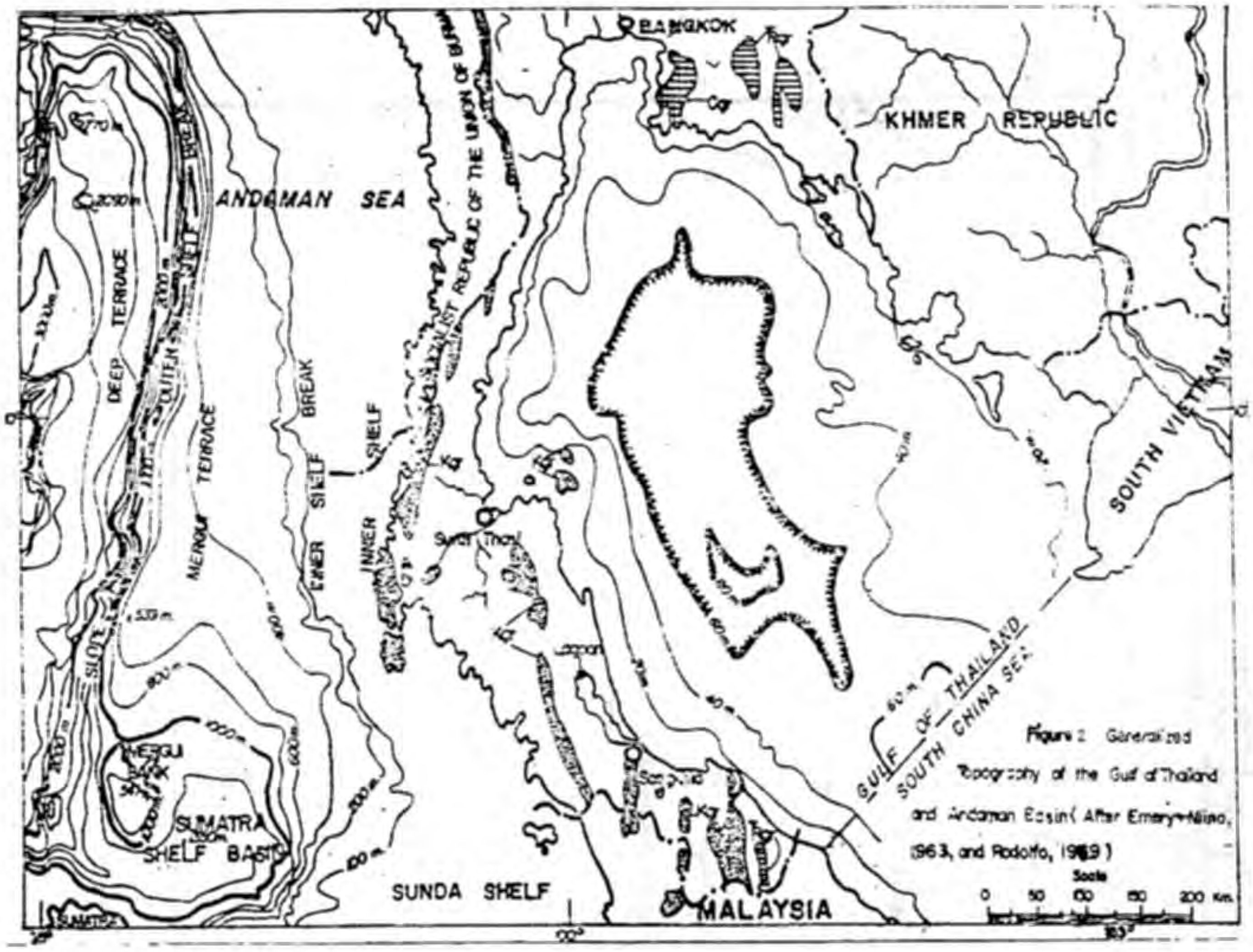

Fig. 2 Generalized Topography of the Gulf of Thailand

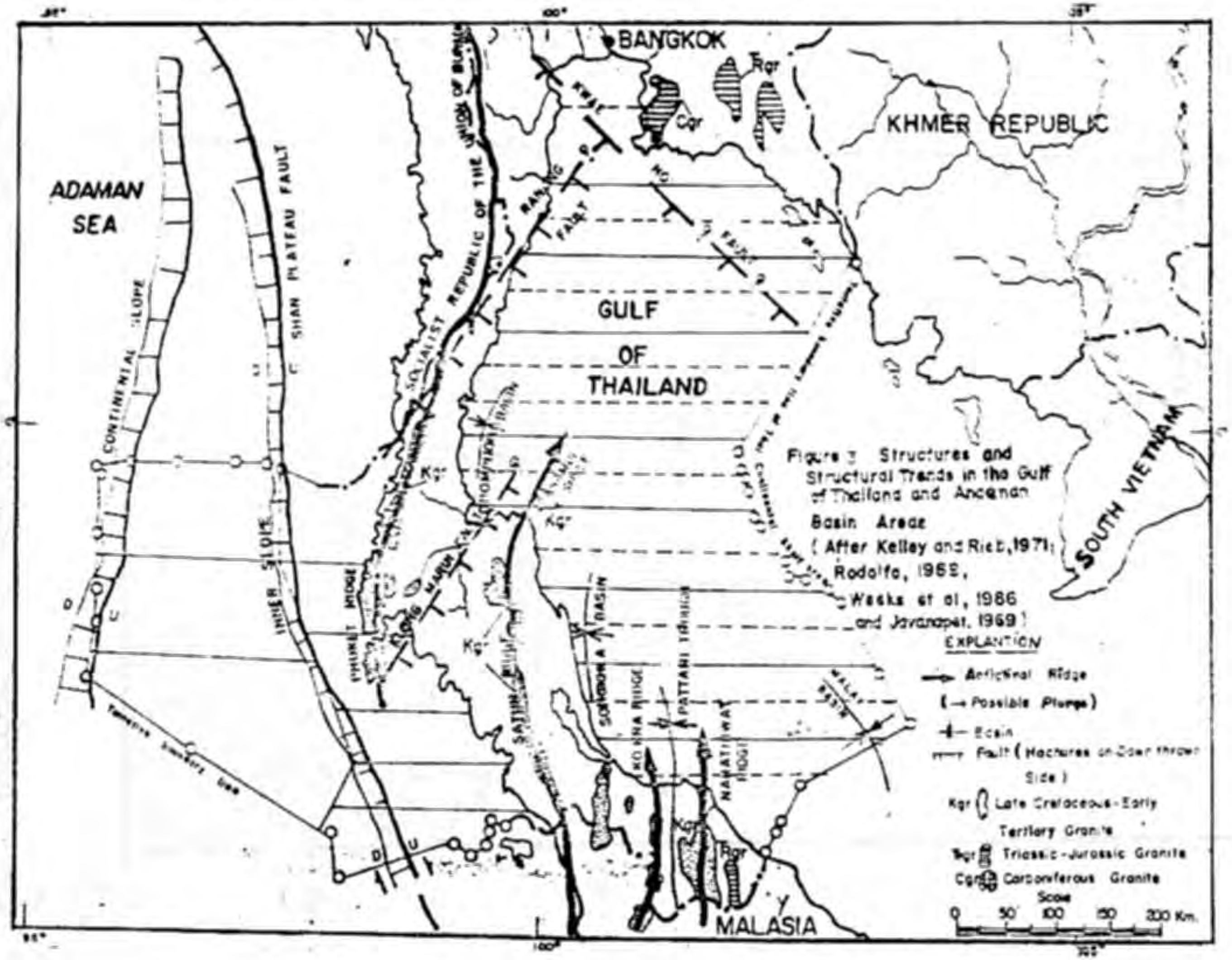

Fig. 3 ...ctures and Structural Trends in the Gulf of Thailand

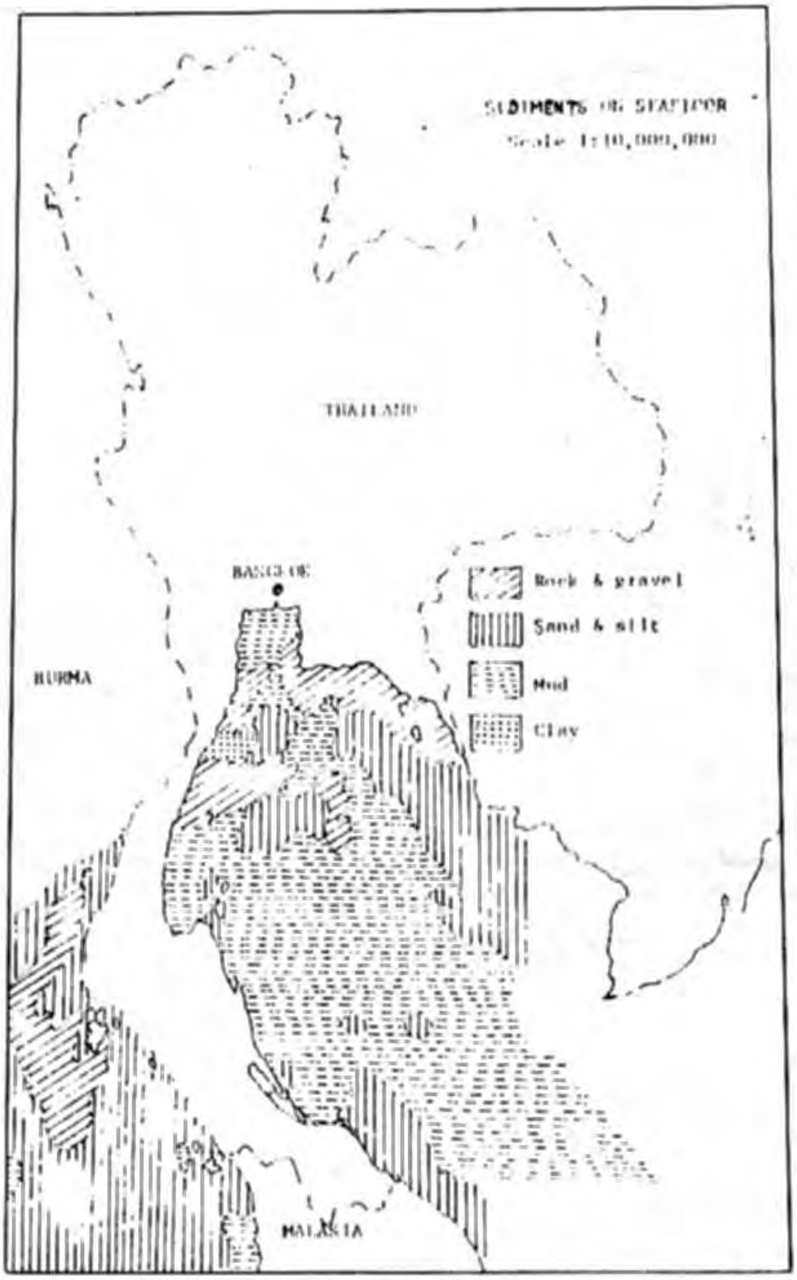

Fig. 4 Distribution of sediments in the Gulf of Thailand
(After P. Dheeradilok, 1980)

THE TRAWL SURVEY IN THE GULF OF THAILAND
BY M/V NAGASAKI-MARU

Dhummasakdi Poreeyanond

and

Weera Pokapunt

The Exploratory Fishing Division

Department of Fisheries

Ministry of Agriculture and Cooperatives

ABSTRACT

The trawl survey in the Gulf of Thailand by Nagasaki-Maru was conducted during 18-25 May 1980. 10 hauls were operated with the highest catch of 113.90 kg/hr. All the catches were classified into good fish, juvenile economic fish, true trash fish and invertebrates.

The average catch per hour was 77.62 kg with good fish 67.33%, juvenile economic fish 8.26%, true trash fish 11.60% and invertebrates 12.81%.

TRAWLING OPERATION

Ten bottom trawl operations were conducted in the Gulf of Thailand during 15-25 of May ranging from 32 to 74 meters in depth. One haul at station no.7 resulted in no catch and the haul at station no.8 was incompletely operated because of the rough bottom topography. These two operations were not included in calculating average catch per hour. All the catches were classified into good fish, juvenile economic fish, true trash fish and invertebrates. They were also classified by species whenever it was possible.

The maximum catch of the bottom trawl was obtained at station no.14 about 60 miles in the north-east of Songkhla, 52 meters in depth, with the catch of 113.90 kilograms per hour. It consisted of good fish 67.69%, juvenile economic fish 7.83%, true trash fish 21.26% and invertebrates 3.22%. Most of the catch consisted of the families Nemipteridae, Synodontidae, Tachysuridae, Lutianidae, Carangidae and Mullidae. The minimum catch was obtained at station 12, about 30 miles southwest of Samui-Island, 33 meters in depth, with the catch of 22.68 kilograms per hour, consisting of good fish 41.31%, juvenile economic fish 8.55%, true trash fish 22.80% and invertebrates 27.34%. The average catch per hour for 8 haul operations was 77.62 kilograms with good fish 67.33%, juvenile economic fish 8.26%, true trash fish 11.60% and invertebrates 12.81%.

The species occurence in the trawl catch was as follows:

Orectolobidae

Chiloscyllium sp.

Trygonidae

Dasyatis imbricatus

Dasyatis sp.

Himantura uarnak

Torpedinidae

Nacine timlei

Clupeidae

Sardinella jussieu

Engraulidae

Stolephorus indicus

Chirocentridae

Chirocentrus dorab

Synodontidae

Saurida elongata

S. micropectoralis

S. tumbil

S. undosquamis

Tachysuridae

Tachysurus thalassinus

Muraenesocidae

Muraenesox talabonoides

Fistulariidae

Fistularia villosa

Holocentridae

Holocentrus rubrum

Sphyraenidae

Sphyraena forsteri

S. obtusata

Serranidae

Epinephelus areolatus

D. sexfasciatus

E. tauvina

Epinephelus sp.

Theraponidae

Therapon jarbue

Priacanthidae

Priacanthus macracanthus

P. tayenus

Apogonidae

Apogon spp.

Carangidae

Alectis ciliaris

Atropus atropus

Caranx crumenophthalmus

C. leptolepis

C. malam

C. mate

Caranx sp.

Decapterus maruadsi

Seriola nigrofasciata

Rachycentridae

Rachycentron canadus

Lutianidae

Lutianus lineolatus

L. lutianus

L. malabaricus

L. russelli

L. sanguineus

L. sebae

L. vitta

Pristipomoides multidens

Caesiodidae

Caesio sp.

Nemipteridae

Nemipterus bleekeri

N. hexodon

N. japonicus

N. marginatus

N. mesoprion

N. nemotophorus

N. nemurus

N. peronii

N. tambuloides

N. tolu

Gerridae

Pentaprion longimanus

Leiognathidae

Leiognathus spp.

Scolopsidae

Scolopsis taeniopterus

Scolopsis sp.

Plectorhychidae

Plectorhynchus pictus

Lethrinidae

Lethrinus lentjan

Pentapodidae

Gymnocranius griseus

Mullidae

Parupeneus fraterculus

Upeneus sulphureus

Upeneus spp.

Scaridae

Callyodon sp.

Uranoscopidae

Uranoscopus oligolepis

Siganidae

Siganus javus

S. oramin

Trichiuridae

Trichiurus haumela

Scombridae

Rastrelliger kanagurta

Scomberomoridae

Scomberomorus commersoni

S. guttatus

Stromateidae

Parastromateus niger

Scorpaenidae

Pterois volitans

Platycephalidae

Platycephalus sp.

Dactylopteridae

Dactyloptena orientalis

Psettodidae

Psettodes erumei

Bothidae

Pseudorhombus spp.

Cynoglossidae

Cynoglossus sp.

Echeneidae

Echeneis naucrates

Balistidae

Abalistes stellaris

Triacanthidae

Pseudotriacanthus strigilifer

Aluteridae

Alutera monoceros

Anacanthidae

Anacanthus barbatus

Diodontidae

Diodon maculifer

Lagocephalidae

Gastrophysus lunaris

Loliginidae

Loligo duvaucellii

L. formosana

L. tagoi

Penaeidae

Penaeus Semisulcatus

Miscellaneous.

Sepiidae

Sepia aculeata

S. brevimana

S. pharaonis

S. recurvirostra

Sepioteuthis lessoniana

Octopodidae

Octopus sp.

Portunidae

Portunus pelagicus

Charybdis cruciata

Charybdis sp.

SPECIES COMPOSITION

55 species of good fish representing 29 families were identified and 5 species could not be unidentified. The occurence of the abundant families in terms of percentage of weight of the total good fish catch was:

Carangidae	18.53%,		Nemipteridae	13.68%,
Lutianidae	13.55%,		Sphyraenidae	8.23%,
Synodontidae	7.57%,		Mullidae	5.22%,
Serranidae	2.81%,	and	Priacanthidae	2.90%.

In the catches of Carangidae, *Caranx crumenophthalmus* was the most dominant species followed by *C. leptolepis*, *C. mate*, *C. malam*, *Seriola nigrofasciata* and *Decapterus maruadsi*. Nemipteridae constituted an important part of the trawl catch in the Gulf of Thailand, with the following species: *Nemipterus nematophorus*, *N. bleekeri*, *N. tambuloides*, *N. peronii*, *N. hexodon*, *N. japonicus*, *N. musoprion*, *N. tolu*, *N. nemurus and N. marginatus*. The another important family was Lutianidae, which was composed of 2 genera and 7 species, *Lutianus sanguineus*, *L. sebae*, *L. lutianus*, *L. vitta*, *L. lineolatus*, *L. russelli* and *Pristipomoides multidens*.

TRASH FISH CATCHES

The species composition of trash fish in the catch falls into two groups; juvenile economic fish and true trash fish. 34 species of 25 families of juvenile economic fish were identified and more than 8 species unidentified. Carangidae, which made up about 27.60% of the total juvenile economic fish catch suitable for human consumption, consisted of *Caranx leptolepis*, *C. mate*, *C. malam*, *C. crumenophthalmus*, *Alectis ciliaris*, *Atropus atropus* and *Seriola nigrofasciata*. Nemipteridae 7.42%, consisted of *Nemipterus peronii*, *N. mesoprion*, *N. nematophorus*, *N. hexodon* and *N. japonicus*. Other common families which occurred in juvenile economic fish groups were Lutianidae 0.74%, Synodontidae 17.51%, Gerridae 20.92% and Mullidae 5.79%. The second group which was true trash fish or a small non-edible fish group and which comprised low grade fish, consisted of 18 families. 12 species were identified and more than 6 species were not identified. The common species which always appeared in the true trash fish group were *Leiognathus* spp. 37.08%, *Gastrophysus lunaris* 12.51%, *Apogon* spp. 8.96%, *Fistularia villosa* 7.00%, *Dactyloptena orientalis* 4.36%, *Uranoscopus oligolepis* 3.21%, *Echeneis naucrates* 2.64%, *Pseudotriacanthus strigilifer* 1.95% and *Alutera monoceros* 1.48%.

INVERTEBRATE CATCHES

The catch of invertebrates was devided into two groups. First group was Cephalopoda with 93.45% of the total invertebrate catch and the second group was Crustacea with 6.55%. From the survey the species composition of invertebrate comprised of 5 families or 14 species. First group, Cephalopoda, consisted of 3 families. 8 species were identified and 1 species was not identified. The second group, Crustacea, comprised of 2 families; 4 species were identified and miscellaneous unidentified.

Table 1. Good fish catch record in kg/hr

Group/Family	Species	Haul No. 01, Station No. 3, Date 18/5	02, 1, 18/5	03, 7, 20/5	04, 8, 20/5	05, 9, 21/5	06, 10, 22/5	07, 17, 23/5	08, 16, 23/5	09, 14, 24/5	10, 12, 25/5
Shark	*Chiloscyllium* sp.	-	12.0		-	-	-	-	-	-	-
Ray	*Dasyaltis imbricatus*	1.45	6.6		-	0.5	-	-	-	-	0.64
	Himantura uarnak	-	-		-	10.0	-	-	-	-	-
Engraulidae	*Stolephorus indicus*	-	-		0.15	-	-	-	-	-	-
Chirocentridae	*Chirocentrus dorab*	-	-		-	0.38	-	0.27	-	0.28	-
Synodontidae	*Saurida undosquamis*	0.06	2.75		-	-	0.77	0.20	1.0	-	0.13
	S. elongata	1.37	0.06		-	9.55	10.34	3.45	2.5	-	1.02
Tachysuridae	*Tachysurus thalassinus*	-	-		-	9.63	1.4	-	-	0.15	-
Muraenesocidae	*Muraenesox talabonoides*	-	-		-	-	-	-	12.0	3.14	-
Sphyraenidae	*Sphyraena forsteri*	0.05	-		0.13	-	3.4	0.6	-	0.5	-
	S. obtusata	-	-		-	0.25	-	-	-	31.0	-
Scombridae	*Rastrelliger kanagurta*	3.95	-		-	0.65	-	-	-	-	0.10
Scomberomoridae	*Scomberomorous commersoni*	4.0	-		-	1.47	-	-	-	0.71	0.99
	S. guttatus	-	-		-	-	0.4	1.7	-	-	1.15
Trichiuridae	*Trichiurus haumela*	-	-		-	0.59	1.0	-	-	-	0.23
Carangidae	*Caranx crumenophthalmus*	0.57	-		0.47	5.0	-	3.45	-	35.5	-
	C. mate	2.62	0.26		-	0.22	0.2	0.95	-	-	1.55
	C. malam	0.66	0.39		-	-	-	-	-	0.13	0.25

Table 1. Good fish catch record in kg/hr (cont'd)

Group/Family	Haul No. / Station No. / Date — Species	01 / 3 / 18/5	02 / 1 / 18/5	03 / 7 / 20/5	04 / 8 / 20/5	05 / 9 / 21/5	06 / 10 / 22/5	07 / 17 / 23/5	08 / 16 / 23/5	09 / 14 / 24/5	10 / 12 / 25/5
	C. leptolepis	6.75	9.0		0.02	-	-	-	-	-	0.61
	Caranx sp.	-	-		-	2.5	1.12	-	-	-	-
	Decapterus maruadsi	-	-		0.38	-	-	-	-	-	-
	Seriola nigrofasciata	0.15	0.15		-	3.2	1.62	1.66	1.63	-	0.49
Stromateidae	*Parastromateus niger*	1.48	-		-	-	0.25	-	-	0.41	-
Rachycentridae	*Rachycentron canadus*	0.4	-		-	-	-	-	-	-	-
Mullidae	*Upeneus sulphureus*	-	-		-	4.6	-	2.59	13.0	-	-
	Parupeneus fraterculus	-	-		-	0.82	1.76	-	-	-	-
Priacanthidae	*Priacanthus tayenus*	0.72	0.8		0.10	1.3	-	-	1.54	0.38	0.52
	P. macracanthus	-	-		-	-	6.96	-	0.42	-	-
Serranidae	*Epinephelus sexfasciatus*	0.74	-		-	0.09	0.5	0.17	-	0.24	-
	E. areolatus	-	-		-	0.86	4.8	-	-	0.57	-
	E. tauvina	-	-		-	-	-	-	-	1.03	-
	Epinephelus sp.	-	0.27		-	0.70	-	0.3	1.9	-	-
Lethrinidae	*Lethrinus lentjan*	0.26	-		-	0.15	1.16	-	-	-	-
Lutianidae	*Lutianus sebae*	-	-		-	6.20	3.69	-	-	-	-
	L. sanguineus	-	-		-	3.45	-	31.60	-	-	-
	L. vitta	0.10	0.08		-	0.70	1.00	-	-	-	-
	L. lutianus	0.38	1.62		-	-	1.5	-	-	-	-

Table 1. Good fish catch record in kg/hr (cont'd)

Group/Family	Haul No. / Station No. / Date / Species	01 / 3 / 18/5	02 / 1 / 18/5	03 / 7 / 20/5	04 / 8 / 20/5	05 / 9 / 21/5	06 / 10 / 22/5	07 / 17 / 23/5	08 / 16 / 23/5	09 / 14 / 24/5	10 / 12 / 25/5
	L. lineolatus	-	-		0.04	0.05	-	-	0.77	-	-
	L. russelli	-	-		-	0.34	-	-	-	-	-
	Pristipomoides multidens	-	-		-	3.50	1.70	2.3	-	-	-
Nemipteridae	*Nemipterus japonicus*	-	-		-	-	-	0.14	1.40	0.65	-
	N. peronii	0.22	9.29		-	-	-	-	-	-	0.25
	N. hexodon	2.00	0.21		-	-	-	-	-	0.51	0.64
	N. marginatus	-	-		-	-	-	0.12	-	-	-
	N. bleekeri	-	-		-	10.50	3.7	0.15	1.50	-	-
	N. tolu	-	-		-	-	-	0.3	-	-	0.11
	N. nematophorus	-	-		-	3.5	-	6.16	5.0	0.93	-
	N. memurus	-	-		-	-	-	0.15	-	-	-
	N. mesoprion	0.15	0.27		-	-	-	0.08	-	0.12	0.36
	N. tambuloides	-	-		-	4.0	3.5	0.3	3.0	0.38	-
Plectorhynchidae	*Plectorhynchus pictus*	-	-		-	2.23	4.14	0.64	-	-	-
Pentapodidae	*Gymnocranius griseus*	-	-		-	1.1	6.0	0.86	-	-	-
Scolopsidae	*Scolopsis taeniopterus*	0.14	1.04		-	-	-	-	-	0.46	-
Siganidae	*Siganus javas*	-	-		-	-	-	-	-	-	0.28
	S. oramin	-	0.36		-	0.40	-	-	-	-	0.05

Table 1. Good fish catch record in kg/hr (cont'd)

Group/Family	Haul No. / Station No. / Date \ Species	01 / 3 / 18/5	02 / 1 / 18/5	03 / 7 / 20/5	04 / 8 / 20/5	05 / 9 / 21/5	06 / 10 / 22/5	07 / 17 / 23/5	08 / 16 / 23/5	09 / 14 / 24/5	10 / 12 / 25/5
Balistidae	*Abalistes stellaris*	-	-		-	4.69	4.0	7.4	3.0	-	-
Aluteridae	*Alutera monoceros*	1.08	-		-	-	-	-	-	-	-
Platycephalidae	*Platycephalus* sp.	-	-		-	-	-	-	0.7	-	-
Psettodidae	*Psettodes erumei*	0.15	-		-	-	-	-	0.47	-	-
Cynoglossidae	*Cynoglossus* sp.	0.75	-		-	-	-	-	-	-	-
Total		30.2	45.15	-	1.29	93.12	64.91	65.54	49.83	77.09	9.37

Table 2. Juvenile of economical species in trash fish (kg/hr.)

Group/Family	Species \ Haul No. / Station No. / Date	01 / 3 / 18/5	02 / 1 / 18/5	03 / 7 / 20/5	04 / 8 / 20/5	05 / 9 / 21/5	06 / 10 / 22/5	07 / 17 / 23/5	08 / 16 / 23/5	09 / 14 / 24/5	10 / 12 / 25/5
Ray	*Dasyatis* sp.	-	-		-	-	0.97	-	-	-	-
Clupeidae	*Sardinella jussieu*	0.13	0.14		-	-	-	-	-	-	-
Engraulidae	*Stolephorus indicus*	0.02	-		-	-	-	-	-	-	-
Synodontidae	*Saurida tumbil*	-	-		-	0.23	-	1.54	-	0.03	-
	S. elongata	0.48	-		-	-	0.34	-	-	-	0.02
	S. undosquamis	0.10	6.02		-	0.11	0.05	0.29	-	-	0.03
	S. micropectoralis	-	-		-	-	-	0.06	-	-	-
Sphyraenidae	*Sphyraena obtusata*	0.02	-		-	-	-	0.31	0.03	-	-
Serranidae	*Epinephelus sexfasciatus*	-	-		-	-	0.02	0.38	-	-	-
	E. areolatus	-	-		-	0.03	-	-	-	-	-
Theraponidae	*Therapon jarbua*	0.30	-		-	-	-	-	-	-	-
Priacanthidae	*Priacanthus tayenus*	0.40	2.08		-	-	-	-	0.11	-	-
	P. macracanthus	-	-		-	-	-	0.05	-	-	-
Carangidae	*Alectis ciliaris*	0.02	-		-	-	-	-	-	-	0.03
	Atropus atropus	0.18	-		-	-	-	-	-	-	-
	Caranx leptolepis	0.15	6.88		-	-	-	0.42	-	-	0.25
	C. mate	0.07	0.14		0.10	0.03	-	0.03	0.01	5.00	0.70
	C. malam	0.07	-		0.02	-	-	-	-	-	-
	C. crumenophthalmus	-	-		-	-	-	0.33	-	-	0.02
	Caranx sp.	-	-		0.04	0.03	0.05	0.03	-	0.07	0.06
	Seriola nigrofasciata	0.16	-		-	0.15	-	-	-	-	-

Table 2. Juvenile of economical species in trash fish (kg/hr.) (cont'd)

Group/Family	Species	01	02	03	04	05	06	07	08	09	10
	Station No.	3	1	7	8	9	10	17	16	14	12
	Date	18/5	18/5	20/5	20/5	21/5	22/5	23/5	23/5	24/5	25/5
Rachycentridae	*Rachycentron canadus*	0.03	-		-	-	-	-	-	-	0.18
Lutianidae	*Lutianus malabaricus*	0.02	-		-	-	-	-	-	-	0.21
	L. lineolatus	-	-		0.04	-	-	-	0.06	0.11	-
	L. vitta	-	-		-	-	-	-	-	0.03	-
Caesiodidae	*Caesio* sp.	-	0.09		0.01	-	-	-	-	-	-
Nemipteridae	*Nemipterus hexodon*	-	-		-	-	-	-	-	-	0.06
	N. peronii	0.12	0.09		-	-	-	-	0.43	-	-
	N. japonicus	-	-		-	-	-	-	-	-	0.03
	N. mesoprion	-	0.90		-	-	0.44	-	-	-	-
	Nemipterus nematophorus	-	-		-	0.25	0.74	-	-	0.14	-
Gerridae	*Pentaprion longimanus*	-	-		0.05	2.65	1.10	7.2	-	0.35	-
Plectorhynchidae	*Plectorhynchus pictus*	0.05	-		-	-	-	-	-	-	0.08
Mullidae	*Upeneus* spp.	0.01	0.72		0.11	0.39	0.07	0.31	-	1.53	-
Siganidae	*Siganus oramin*	0.07	-		-	-	-	-	-	-	-
Trichiuridae	*Trichiurus haumela*	-	-		-	-	-	0.35	0.18	1.66	-
Scombridae	*Rastrelliger kanagurta*	-	0.18		-	-	-	-	-	-	-
Stromateidae	*Parastromateus niger*	0.38	-		-	0.32	-	-	-	-	-
Bothidae	*Pseudorhyombus* spp.	0.30	-		-	-	-	-	-	-	0.05
Cynogloseidae	*Cynoglossus* sp.	-	-		-	-	0.04	-	-	-	-
Loliginidae	*Loligo* spp.	-	-		-	0.07	0.09	1.09	0.08	-	0.22
Sepiidae	*Sepia* spp.	-	-		-	-	0.13	0.12	0.04	-	-
Octopodidae	*Octopus* sp.	-	-		-	-	-	-	0.04	-	-
Total		3.17	1[illegible].05		0.37	4.26	4.04	12.41	0.98	8.92	1.94

Table 3. True trash fish (kg/hr)

Group/Family	Species	Haul No. 01 Station No. 3 Date 18/5	02 1 18/5	03 7 20/5	04 8 20/5	05 9 21/5	06 10 22/5	07 17 23/5	08 16 23/5	09 14 24/5	10 12 25/5
Ray	*Narcine timlei*	-	6.06		-	-	-	0.65	-	-	-
Fistulariidae	*Fistularia villosa*	0.65	-		-	3.54	0.24	-	0.22	0.18	0.05
Holocentridae	*Holocentrus rubrum*	-	-		-	-	0.06	-	-	-	-
Apogonidae	*Apogon* spp.	0.42	4.89		-	0.05	0.07	-	0.48	0.31	0.02
Leiognathidae	*Leiognathus* spp.	0.37	0.13		0.24	0.45	-	-	4.14	18.00	2.78
Scolopsidae	*Scolopsis* spp.	0.27	0.09		-	-	0.10	-	-	-	-
Scaridae	*Callyodon* sp.	-	-		-	-	0.02	-	-	-	-
Uranoscopidae	*Uranoscopus oligolepis*	0.17	1.58		-	-	-	-	0.45	0.03	-
Scorpaenidae	*Pterois volitans*	0.04	-		-	-	0.40	-	0.12	-	-
Platycephalidae	*Platycephalus* spp.	0.17	0.63		-	-	-	-	0.09	-	-
Dactylopteridae	*Dactyloptena orientalis*	-	-		-	0.56	2.50	-	-	-	-
Echeneidae	*Echeneis naucrates*	-	-		-	0.90	0.91	-	-	-	-
Triacanthidae	*Pseudotriacanthus strigilifer*	-	-		-	0.42	0.31	-	0.62	-	-
Aluteridae	*Alutera monoceros*	0.11	0.68		-	0.04	-	-	-	-	-
Diodontidae	*Diodonmaculifer*	-	-		-	-	0.99	-	0.47	-	-
Lagocephalidae	*Gastrophysus lunaris*	0.45	-		-	0.05	0.07	-	0.16	5.70	2.26
Anacanthidae	*Anacanthus barbatus*	0.09	-		-	-	-	-	-	-	-
Portunidae	*Charybdis* sp.	-	4.16		-	0.09	0.06	-	0.08	-	0.06
Total		2.74	18.22		0.24	6.10	5.73	0.65	6.83	24.22	5.17

Table 4. Trawl Catch Record (Invertebrates) (kg/hr)

Group	Species \ Haul No.	1	2	3	4	5	6	7	8	9	10
Loliginidae	*Loligo formosana*	17.5	7.57		-	0.53	1.00	3.1	1.21	2.33	5.30
	L. duvaucellii	2.0	1.17		-	2.55	0.3	0.4	-	1.34	0.51
	L. tagoi	-	-		0.044	-	-	0.06	-	-	-
Sepiidae	*Sepia pharaonis*	-	2.13		-	-	-	0.41	-	-	0.24
	S. aculeata	0.12	0.15		-	-	-	-	-	-	-
	S. recurvirostra	-	1.10		-	-	0.30	0.9	0.11	-	-
	S. brevimana	-	-		-	0.15	0.02	0.1	0.28	-	-
	Sepioteutbis lessoniana	3.3	0.27		-	0.05	-	-	-	-	0.09
Octoponidae	*Octopus* sp.	0.04	0.73		-	-	-	-	0.90	-	-
Portunidae	Portunus pelagicus	0.82	-		-	-	-	-	-	-	-
	Charybdis cruciata	1.05	1.73		-	-	-	-	-	-	-
	Charybdis sp.	0.07	-		-	0.09	0.06	-	-	-	0.06
Penaeidae	*Penaeus semisulcatus*	0.03	-		-	-	-	-	-	-	-
	Miscellaneous	-	-		-	-	-	-	0.12	-	-

Haul No.	01	02	03	04	05	06	07	08	09	10	Average
Total trawl catch (kg)	61.04	96.27	-	1.94	106.85	76.36	83.57	60.26	113.90	22.68	77.62
Good fish catch (%)	49.48	46.90	-	66.50	87.15	85.01	78.42	82.69	67.69	41.31	67.33
Juvenile economic fish (%)	5.19	18.75	-	19.07	3.99	5.29	14.85	1.63	7.83	8.55	8.26
True trash fish (%)	4.49	18.93	-	12.37	5.71	7.50	0.78	11.33	21.26	22.80	11.60
Invertebrates (%)	40.84	15.42	-	2.06	3.15	2.20	5.95	4.35	3.22	27.34	12.81

PRELIMINARY STUDY ON THE OCEANOGRAPHIC CONDITIONS OF TRAWL FISHING GROUNDS IN THE GULF OF THAILAND

Kozo TAKAHASHI, Prasert MASTHAWEE
and
Narong RUANGSIVAKUL

Training Department
Southeast Asian Fisheries Development Center

Samutprakarn, Thailand

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INTRODUCTION

This paper discusses the relationship between oceanographic conditions and the trawl fishing grounds in the Gulf of Thailand based on the oceanographic and trawling data which were collected by the Thai-Japanese-SEAFDEC joint survey conducted from 15-28 May 1980. The locations of the survey stations are shown in Fig. 1.

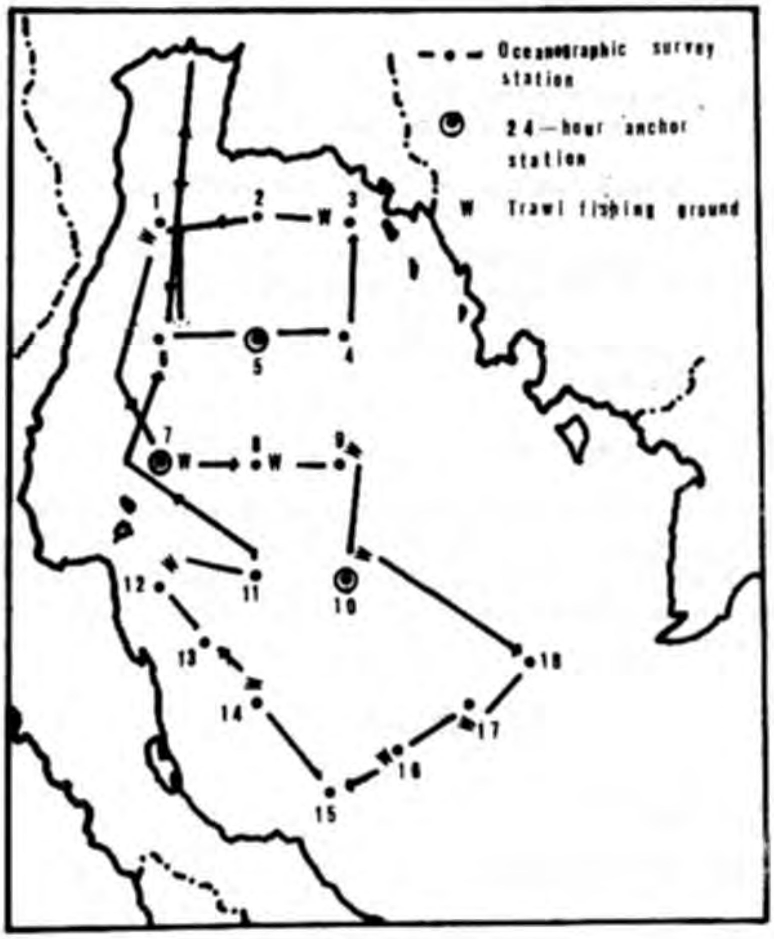

Fig. 1 Location chart of oceanographic survey stations and fishing grounds

MATERIALS AND METHODS

As regards data collection the S-T-D meter provided a detailed determination of the salinity-temperature-depth relationship from the surface to the bottom at each station.

Water samples were collected by Van Dorn Bottle and sediment samples by Smith-MacIntyre sampler and piston corer.

Detailed oceanographic observations were carried out on the following compositions:

a) Salinity, temperature, and depth measurement by S-T-D meter, and salinometer (Table 3);

b) Determination of dissolved oxygen by D.O. meter;

c) Chemical oxygen demand (C.O.D.) determination of mud by reduction of premanganate method;

d) Sediment classification by the Emery and Niino method (Table 4);

e) Bottom topography by echo-sounding.

Catch data were obtained from experimental trawl fishing by M.V. Nagasaki-Maru, with the use of a six-seamed net having a head rope length of 23.5 to 67 m. The net was towed at a speed of 2.9 to 3.6 knots for an average of 63 minutes per haul, except at stations 7 and 8 (Table 7).

RESULTS AND DISCUSSION

1. Bottom Character

(1) Bottom topography

The Gulf of Thailand is a shallow arm of the South China Sea. The greatest depth, in the center, is slightly more than 80 m, and a 50 m depth contour enters near the Bight of Bangkok, the deeper central Gulf is separated from the South China Sea by a sill, with a tip in the area of the Thai-Malaysian border and, on the last coast, a tip off Cape Ca Mau (Fig. 2), (2).

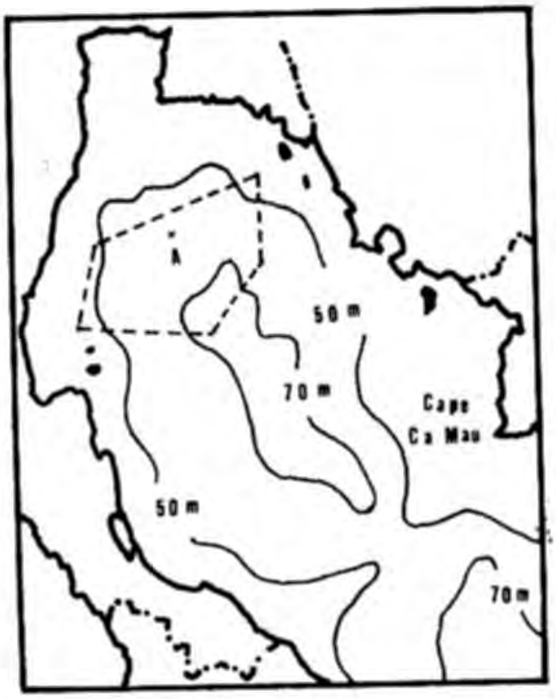

Fig. 2. Bottom topography of the Gulf of Thailand (Source: Naga Report, 1961)

Broken lines: boundary of ragged bottom area.

xA : Position of echograms, shown in Fig. 3.

Fig. 3. Echo profiles across special structures on the bottom of A shown in Fig. 2

The bottom topography of the Gulf is very irregular and shows some interesting features, that is to say, there are a large number of particularly special ragged structures on the bottom in the northeastern part. Echo profiles across the ragged structures on the bottom are shown in Fig. 3, and their positions are given in Fig. 2. Their height is between 4 and 5 m only, while their width varies greatly from 30 to more than 2,000 m. These structures are often serious obstacles to trawl fishing.

(2) Bottom sediment

The bottom sediment distribution in the Gulf can be divided into two typical areas, one is the sandy sedimental area from the mouth to the innermost part of the Gulf along the east coast, and the other is the muddy sedimental area along the west coast towards the inner part (Fig. 4).

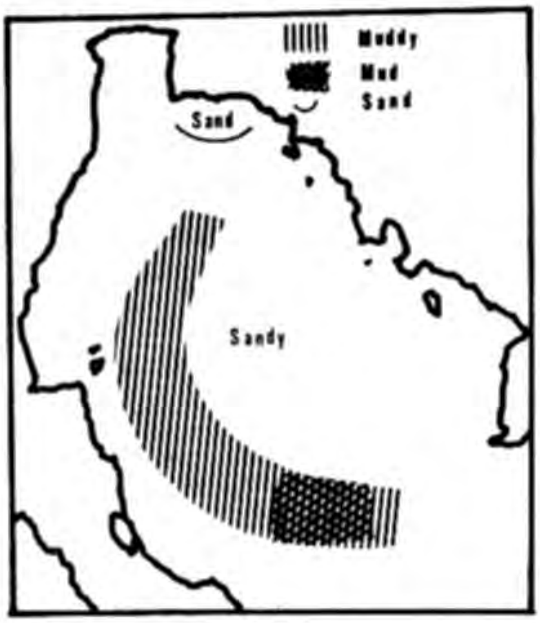

Fig. 4. Bottom feature of the Gulf of Thailand

Each type was characterized by its environment of deposition, which in turn was dependent upon the distribution of different water masses and currents. Finally, the muddy area indicates stagnant waters.

(3) C.O.D.

The content of organic matter is shown in the reduction of permanganate when the organic matter has been completely oxidized by means of potassium permanganate. This method is called C.O.D. (chemical oxygen demand) and expressed as mg/g.

By use of this method, we have tried to carry out the quantitative analysis of organic compounds in the bottom of the Gulf. The results are shown in Fig. 5. It was proved that the level of C.O.D. was less than 8 mg/g at all survey stations.

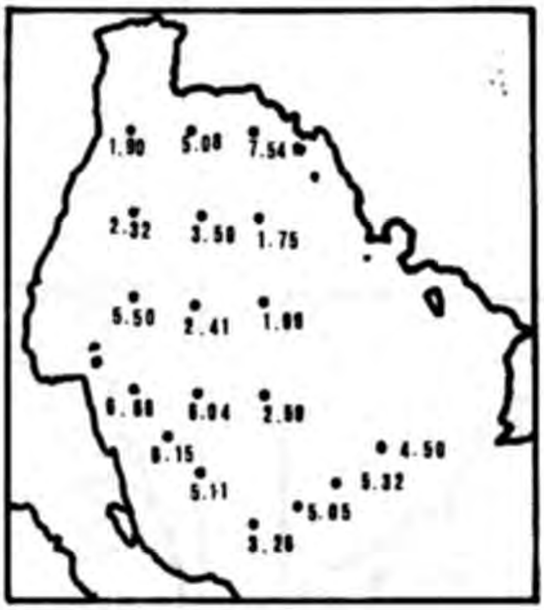

Fig. 5. C.O.D. (mg/g) in the bottom of the Gulf of Thailand

According to the Japanese regulations, the standard amount of C.O.D. for a good fishing ground is set at less than 20 mg/g. Consequently, these survey results suggest that there was an adequate amount of organic matter in the bottom of the Gulf.

(4) Benthos

In the southwestern part, there were large number of sponges in the bottom. Many scientists have proved that mice may be killed by injection of extracts of some sponges, which probably produce some defensive agents against predators. B.W. Halstred (1965) has described that fish, molluscs, or crabs were killed within an hour when placed in a bucket containing the sponge, *Tedania toxicalis*, (3).

It seems therefore that sponges are harmful to fishes. At the experimental trawl fishing stations 14, 16 and 17, many sponges were caught in the trawling net and caused trouble in managing the catch.

Benthos such as polychaetes, crab, shrimp, shell, etc. were found in comparatively small numbers in the bottom of the Gulf, as shown in Table 5.

The distribution of demersal fisheries resources largely depends on the amount of those benthos, excluding sponges, on the sea bed.

2. Water Property

(1) Horizontal distribution of temperature and salinity

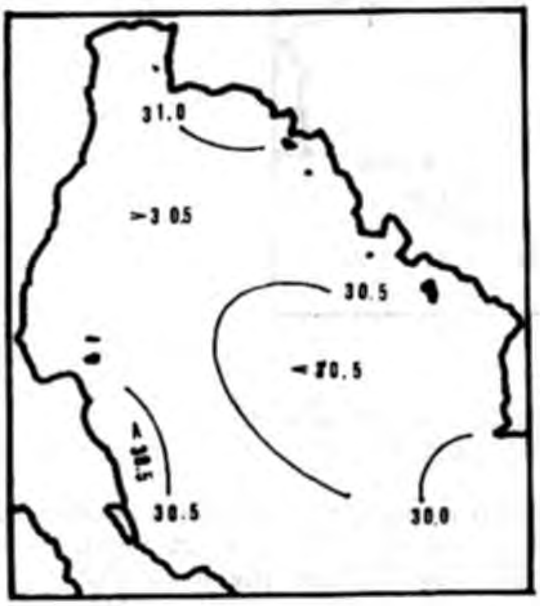

Fig. 6. Distribution of surface temperature (°C)

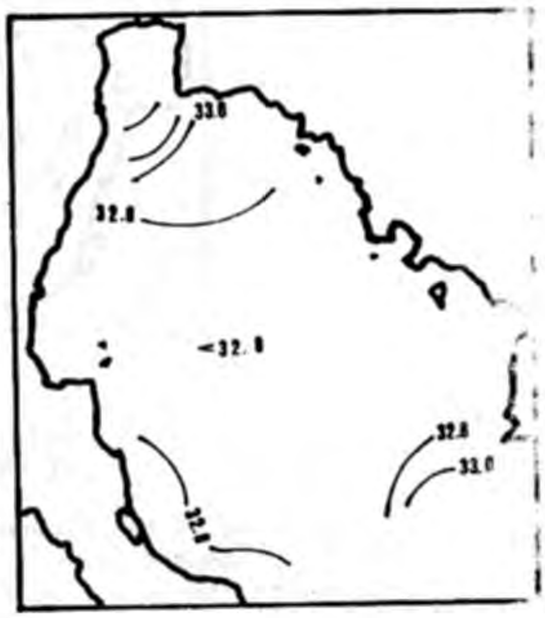

Fig. 7. Distribution of surface salinity (‰)

Horizontal distribution of temperature and salinity at the surface is shown in Figs. 6 and 7. These charts suggest the following phenomena:

(a) there was inflow of relatively cool and high salinity water from the South China Sea into the Gulf along the east coast, and it appeared that there was a weak counterclockwise eddy at the surface in the inner Gulf (Table 6);

(b) an isolated and relatively cold and high salinity water mass at the surface was found off Songkhla, where the phenomenon may be caused by weak upwelling, of which the mechanism is not known;

(c) the highest salinity was observed at station 1 off the bight of Bangkok, indicating that the Chao Phya River was not at that time carrying fresh water to the Gulf.

(2) Diurnal and vertical variations in temperature and salinity

During the cruise, 24-hour anchor stations were taken up at stations 5, 7 and 10. S-T-D observations were made at 4-hour intervals. The vertical curves of temperature, salinity and the diurnal variations were as follows:

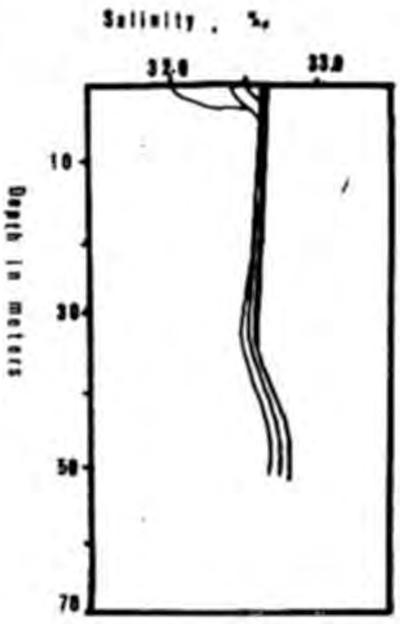

Fig. 8. Vertical distribution of salinity at anchor station 7

Fig. 9. Vertical distribution of temperature at anchor station 7

At station 7, in the upper 10m, when the temperature was constant, there was considerable salinity variability. However, between 30 and 40m a sharp decrease in temperature occurred. The diurnal variation range of salinity was largest at the surface and the temperature was highest at 40m. Both varied approximately 10m in depth (Figs. 8 and 9).

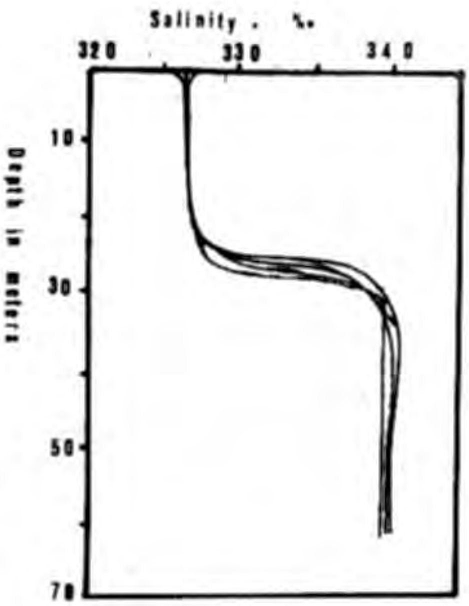

Fig. 10. Vertical distribution of salinity at anchor station 10

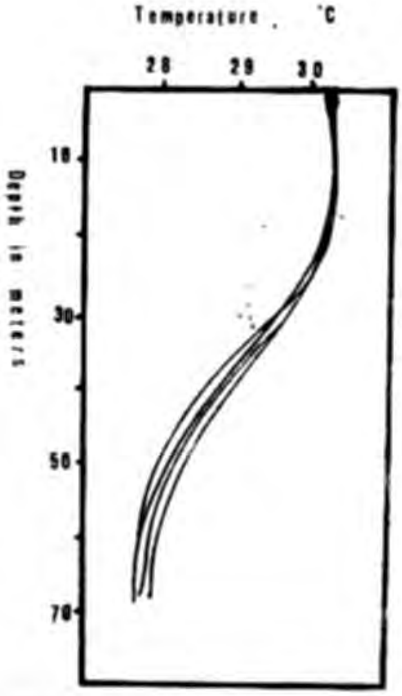

Fig. 11. Vertical distribution of temperature at anchor station 10

Conditions at station 10 were different. The vertical curves were dominated by an extreme halocline between 20 and 30m with an increase from 32.7 to 34.8 ‰ at 27m, and by extreme thermocline between 30 and 50m with a decrease from 29.7 to 28.0°C at 50m. However, between 30 and 50m a thermocline occurred corresponding to the bottom of the halocline.

Finally, beneath 50m homogeneous low temperature and high salinity water was found (Figs. 10 and 11).

At station 5, diurnal variation in temperature and salinity was at a minimum. Above 30m the temperature was isothermal, but below 30m the temperature decreased sharply with depth (Figs. 12 and 13).

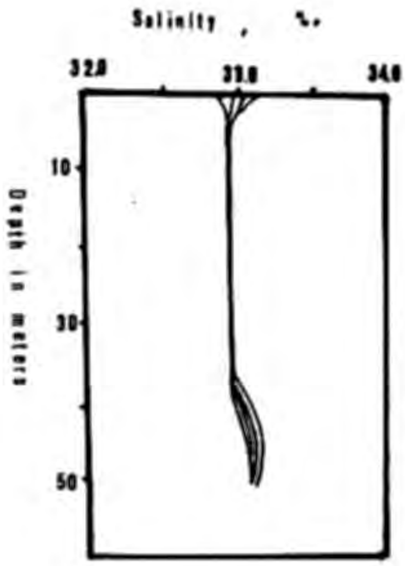

Fig. 12. Vertical distribution of salinity at anchor station 5

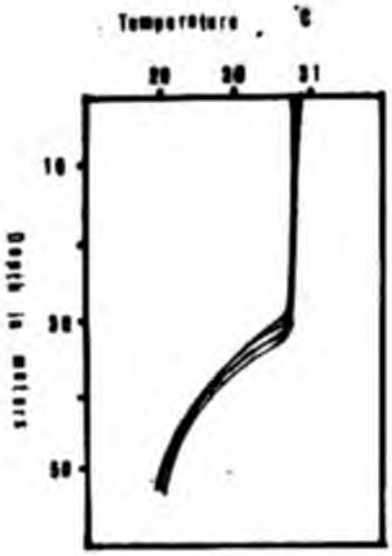

Fig. 13. Vertical distribution of temperature at anchor station 5

At all stations other than those mentioned above, vertical observation by S-T-D meter was carried out. A mixed layer overlay a well developed layer at almost all observation stations.

Taking these facts into consideration we may conclude that, at the time of this survey, the water of the Gulf was composed of two layers, one being a mixed layer and the other a stratum.

3. Trawling Catch

Hauls were made at ten stations (Fig. 1), but at stations 7 and 8, trawling operations could not be carried out effectively owing to the ragged structures on the bottom. Consequently, the present paper summarizes the results of hauls carried out at the remaining eight stations. Species of the catch were identified by Dr. T. Senta, and Thai scientists (Tables 8, 9, and 10).

(1) Catch per hour

Table 1. Composition of catch (kg) and mean catch per hour (c/h) by station

Station / Item	1	3	9	10	12	14	16	17	Total
Fish	50·91	41·16	103·48	74·68	16·48	110·23	57·64	71·29	525·87
(good)	(45·15)	(35·15)	(93·12)	(64·19)	(9·37)	(77·09)	(49·83)	(58·88)	(433·5)
(trash)	(5·76)	(6·01)	(10·36)	(9·77)	(7·11)	(33·14)	(7·81)	(12·41)	(92·37)
Inverte-brates	14·85	24·93	3·07	2·18	6·20	3·67	2·62	4·91	62·43
Total	65·76	66·09	106·55	76·86	22·68	113·90	60·26	27·20	588·30
C/h	46·42	66·09	104·80	73·20	24·46	117·86	61·28	76·26	70·03

The mean catch per hour for each station during the cruise is shown in Table 1. Stations 14 and 9 gave the best mean catch values of more than 100 kg per hour, while station 12 gave a value of less than 30 kg per hour. The remaining five stations may be considered to give intermediate values of mean catch per hour.

Based on the above trawl catches, these stations can be categorized into three types of fishing grounds. First, stations 14 and 9 are considered as good fishing grounds with high catches. Second, stations 1, 3, 10, 16 and 17 are intermediate. Third, station 12 is regarded as a poor fishing ground.

(2) Species composition in catch by station

Table 2. Percentage in weight of major species in catch by station

Station / *Species	1	3	9	10	12	14	16	17	Total
1. Bigeye scad	0.0	0.9	4.7	0.0	0.0	31.7	0.0	4.5	7.7
2. Squid	11.5	26.5	0.5	1.3	23.4	2.0	2.0	4.1	6.6
3. Blood snapper	0.0	0.0	3.2	0.0	0.0	0.0	0.0	41.5	6.0
4. Obtuse barracuda	0.0	0.0	0.2	0.0	0.0	27.2	0.0	0.0	5.3
5. Slender lizardfish	0.1	2.1	9.0	13.5	4.5	0.0	24.1	4.5	4.8
6. Yellow goatfish	0.0	0.0	4.3	0.0	0.0	0.0	26.1	3.4	3.4
7. Starry triggerfish	0.0	0.0	4.4	5.2	0.0	0.0	5.0	9.7	3.2
8. Yellowstripe trevally	13.7	10.2	0.0	0.0	2.7	0.0	0.0	0.0	2.8
9. Threadfin bream	0.0	0.0	9.9	4.8	0.0	0.0	2.5	0.2	2.7
10. Others	74.7	60.3	63.8	75.2	69.4	38.9	40.3	32.1	42.6

* 1. *Selar crumenophthalmus*; 2. *Loligo formosana*; 3. *Lutjanus sanguineus*; 4. *Sphyraena obtusata*; 5. *Saurida elongata*; 6. *Upeneus sulphureus*; 7. *Abalistes stellaris*; 8. *Selaroides leptolepis*; 9. *Nemipterus bleekeri*.

Table 2 illustrates the percentages in weight of total catch for each of the major species in the respective stations. It can be seen that bigeye scads, *Selar crumenophthalmus*, were the most abundant fish in all stations, and constituted more than 30% of the total catch in station 14.

Squid, comprising mainly *Loligo formosana*, was the next most abundant fish and accounted for more than 20% of the total catch in station 3.

Percentages in weight of the catch for all other species varied considerably from station to station. Examples are: blood snapper, *Lutjanus sanguineus*, accounted for 41.5% in station 17, but only 3.2% in station 9; obtuse barracuda, *Sphytaena obtusata*, constituted 27.2% in station 14, followed by 0.2% in station 9.

In addition, trash fish constituted about 16% of the total catch at all trawling stations. Pony fish, *Leiognathus spp.*, was the most abundant trash fish species of the catch.

With regard to mean catch per hour by station, and species composition in catch by station in the Gulf, it is still too early to draw any conclusion as the available data is far from sufficient. However, it can be said that a relatively good fishing ground is generally found in station 14. The catch at this station is not only reasonable, but also of market value.

SUMMARY

This paper discusses the relationship between oceanographic conditions and the trawl fishing grounds in the Gulf of Thailand based on the data collected by the Thai-Japanese-SEAFDEC joint survey from 15 to 28 May 1980. The details of the discussion can be summed up as follows;

(1) There were large numbers of particular structures on the bottom in the northeastern part;

(2) The level of C.O.D. was less than 8 mg/g at all survey stations;

(3) There were great numbers of sea sponges in the bottom of the southwestern part;

(4) The water of the Gulf was composed of two layers: the mixed layer and the stratum;

(5) The best mean catch value was more than 100 kg per hour, while the lowest value was less than 30 kg per hour in the trawling stations;

(6) Bigeye scads were the most abundant fish in the survey stations;

(7) Station 14 off Songkhla was a relatively good fishing area, the best among the experimental trawl fishing grounds.

ACKNOWLEDGEMENT

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Our thanks are due to Dr. S. Shindo, the Deputy Secretary-General of SEAFDEC as well as the editor of technical papers of the Training Department for his critical reading of the manuscript and kind advice.

REFERENCES

1) WYRTKI, K.: Physical Oceanography of Southeast Asian Waters. Naga Report, Vol. 2 Scripps Institution of Oceanography (1961).

2) ROBINSON, M.K.: The Physical Oceanography of the Gulf of Thailand, Naga Expedition. Naga Report, Vol. 3 Part 1. Scripps Institution of Oceanography (1961).

3) HALSTEAD, B.W.: "Poisonous and Venomous Marine Animals of the World", Vol. 1, U.S. Government Printing Office Washington, D.C., (1965).

4) FISHERIES AGENCY: Gov't of Japan. Preliminary Report on the Oceanographic survey by KAIYO-MARU in the Gulf of Thailand (1970).

5) SENTA, T., S.M. TAN and P.Y. LIM: Results of the experimental trawl fisheries in the South China Sea by R/V Changi, in the years 1970 to 1972. Paper submitted to SEAFDEC seminar, (1973).

6) SHIROTA, A.: Some Consideration on the Relationship between Environmental Factors and Distribution of Fisheries Resources in the South China Sea and Andaman Sea. Paper submitted to SEAFDEC seminar, (1973).

7) HASHIMOTO, Y.: Marine Toxins and Other Bioactive Marine Metabolites. Japan Scientific Societies Press, (1979).

TABLES

Table 3. Data on Meteorological, Physical, Geological Oceanography

	Sta.	No.	1	2	3	4	5	6	6	7	8	9
	Lat.	N	12°11.0'	12°10.0'	11°10.0'	11°10.0'	11°10.3'	11°08.2'	11°10.1'	10°10.0'	10°09.9'	10°10.2'
	Long.	E	100°28.2'	101°09.1'	101°55.5'	101°54.0'	101°11.1'	100°24.2'	100°24.9'	100°24.5'	101°09.9'	101°55.4'
	Depth	m	36	35	30	60	64	51 55	51	60	62 69	74
	Date (d. mn.)		18/5	18/5	18/5	17/5	16/5	16/5	27/5	19/5	20/5	21/5
	Time, Start		2100	1355	0800	1940	1415	0600	1435	1230	2040	0618
	" , End		2200	1420	0850	2036	1510	0934	1440	1310	2115	0655
	Weather		bc	bc	bc	c	c	c	bc	bc	o	o
	Wind	dir.	sw	sw	wsw	w	wsw	w	ssw	sw	wsw	sw
	"	force	4	3	4	4	5	5	1	4	4	3
	Wave	dir.	sw	sw	wsw	w	wsw	w	ssw	sw	wsw	sw
		class	4	3	3	4	4	3	1	4	4	3
	Transparency	m	-	10	9	-	15	20		11	-	22
	Water Color		-	3	3	-	2	2		13	-	2
S T D Record	Temp (°C)	0 m	30.880	31.060	31.115	30.815	30.955	30.5	30.925	30.655	30.440	30.475
		10	30.925	30.990	31.140	30.835	30.975	30.4	29.895	30.580	30.460	30.495
		20	30.925	30.975	31.140	30.805	30.975	30.4	29.835	30.585	30.460	30.500
		30	30.915	30.970		30.765	30.925	30.3	29.715	30.550	30.450	30.500
		50				28.710		29.5		28.955	29.705	28.610
		Bot.	30.915	31.055	31.145	30.810	29.910	28.3	29.220	30.315	28.740	28.145
	Sal (‰)	0 m	33.49	33.04	32.92	32.86	33.02		32.87	32.63	32.69	32.78
		10	33.44	33.08	32.93	32.85	32.98		32.84	32.79	32.68	32.79
		20	33.44	33.08	32.93	32.84	32.98		32.85	32.79	32.68	32.79
		30	33.45	33.08		32.85	32.96		32.86	32.78	32.69	32.79
		50				33.18				32.91	33.69	32.79
		Bot.	33.45	33.09	32.93	32.85	32.28		33.13	32.35	35.07	32.17
Salino-meter	Sal (‰)	0 m	33.34	33.28	33.03	32.91	32.91	32.97		32.74	32.76	32.88
		30				32.85	32.83	32.83		32.80	32.62	32.80
		Bot.	33.37	32.99	32.78	33.21	33.21	33.10		32.99	32.95	33.18
Do-meter	Oxygen (ppm)	0 m	6.0	4.2	5.0	5.8	5.4	2.7		3.9	4.6	6.4
		10								5.2		
		30	5.4	4.4	5.8	6.2	5.4	2.6		4.2	6.0	6.6
		Bot.				4.4	3.1	2.7		3.2	5.0	2.2

Table 3. Data on Meteorological, Physical, Geological Oceanography (Cont'd)

Sta.	No.	10	11	12	13	14	15	16	17	18
Lat.	N	9°10.1'	9°10.0'	9°10.8'	8°43.2'	8°10.1'	7°15.0'	7°34.7'	7°59.3'	8°22.7'
Long.	E	101°54.8'	101°10.0'	100°25.0'	100°41.4'	101°10.1'	101°50.0'	102°20.0'	103°01.5'	103°39.5'
Depth	m	72	60	30	32	53	48	73	69	29
Date (d. mn.)		21/5	25/5	25/5	14/5	24/5	24/5	23/5	23/5	23/5
Time, Start		1410	1304	0600	1857	1310	0615	1825	1315	0605
" , End		1450	1340	0620	1925	1338	0652	1905	1358	0629
Weather		c	c	c	o	c	c	o	c	r
Wind	dir.	sw	sw	s	s	w	sse	se	s	s
"	force	5	2	2	2	2	3	3	3	4
Wave	dir.	sw	sw	s	s	w	sse	se	s	s
	class	4	2	2	2	2	3	2	2	3
Transparency	m	12	25	12	-	16	23	-	20	5
Water Color		2	2	3	-	2	2	-	2	3
S T D Record: Temp (°C)	0 m	30.440	30.660	30.330	30.510	30.605	30.820	30.640	30.500	30.015
	10	30.425	30.465	30.350	30.335	30.475	30.855	30.645	30.435	30.095
	20	30.395	30.425	30.220	30.245	30.440	30.860	30.590	30.475	30.335
	30	29.625	30.415			30.375	30.865	30.600	30.220	
	50	28.400	27.425					28.585	28.795	
	Bot.	29.195	27.425	29.765	29.655	29.260	29.750	28.105	30.060	30.085
S T D Record: Sal (‰)	0 m	32.71	32.68	32.78	32.82	32.74	32.85	32.73	32.91	33.02
	10	32.77	32.69	32.71	32.76	32.74	32.84	32.62	32.91	33.15
	20	32.76	32.70	32.72	32.78	32.74	32.85	32.62	32.99	33.45
	30	32.88	32.73			32.82	32.86	33.08	33.27	
	50	33.87	33.79					33.78	33.87	
	Bot.	32.30	33.80	32.90	32.28	33.64	33.58	32.28	33.30	33.20
Salino-meter: Sal (‰)	0 m	32.83	32.76	32.77	32.80	32.84	32.88	32.66	33.03	33.46
	30	34.00	32.80			32.77	32.94	32.96	33.13	
	Bot.	33.86	33.76	32.99	33.21	32.91	33.64	33.96	33.98	33.16
Do-meter: Oxygen (ppm)	0 m	4.0	5.5	6.8	7.0	5.4	5.6	6.2	5.1	3.8
	10				7.1				4.9	
	30	3.9	5.6	6.8	5.6	4.8	5.6	6.0		6.6
	Bot.	2.6	4.2			3.6	5.2	2.8	4.4	

Table 4. Lithologic Summary of Bottom Sediment

Sta. No.	Color	Grain Size (%)				Microscopic Observation	Name of Sediment according to Emery & Niino
		Gravel	Sand	Mud	Total		
1	Dusky yellowish green (10 GY 3/2)	27.7	61.1	11.1	99.9	Shell fragments, foraminifera and Coccoliths rich	Dusky yellowish green calcareous medium sands
2	Grayish olive green (5 GY 3/2)	40.0	53.3	6.7	100.0	" "	Grayish olive green calcareous coarse sand
3	Dusky yellowish green (10 GY 3/2)	20.0	40.0	40.0	100.0	" "	Dusky yellowish green calcareous muddy sand
4	Dusky yellow green (5 GY 5/2)	0	70.0	30.0	100.0	" "	Dusky yellow green calcareous muddy sand
5	Grayish olive (10 Y 4/2)	0	33.3	66.7	100.0	" "	Grayish olive calcareous sandy mud
6	Dusky yellow green (5 GY 5/2)	7.7	46.1	46.1	99.9	" "	Dusky yellow green calcareous muddy sand
7	Dusky yellow green (5 GY 5/2)	0	8.3	91.7	100.0	" "	Dusky yellow green calcareous mud
8	(Surface) Moderately olive brown (5 Y 4/4) (Below) Dusky yellow green (5 GY 5/2)	23.1	38.5	38.5	100.1	" " Brown mud contains more guartz than gray mud (?)	Brown calcareous mud & dusky yellow green calcareous muddy sand
9	(Surface) moderately olive brown (5 Y 4/4) (Below) grayish olive (10 Y 4/2)	15.0	35.0	50.0	100.0	" "	Brown calcareous mud & grayish olive calcareous sandy mud

Sta. No.	Color	Grain Size (%) Gravel	Sand	Mud	Total	Microscopic Observation	Name of Sediment according to Emery & Niino
10	(Surface) Moderate yellowish brown (10 YR 5/4) (Below) Dusky yellow green (5 GY 5/2)	20.6	44.1	35.2	99.9	Brown mud contains more quartz than gray mud (?)	Brown calcareous mud & Dusky yellow green calcareous muddy sand
11	(Surface) Moderate olive brown (5 Y 4/4) (Below) Grayish olive (10 Y 4/2)	12.0	28.0	60.0	100.0	" "	Brown calcareous mud & Grayish olive calcareous Sandy mud
12	Dusky yellow green (5 GY 3/2)	25.0	17.9	57.1	100.0	Quartz and Feld-spars > calcareous grains, Black rock fragments Lateritic gravel	Dusky, yellow green (non-calcareous) sandy mud
13	Dusky yellow green (5 GY 3/2)	11.5	34.6	53.8	99.9	Quartz and feld-spars > calcareous grains	Dusky yellow green (non-calcareous) sandy mud
14	" "	0	20.0	80.0	100.0	" "	" "
15	Grayish olive (10 Y 4/2)	18.2	36.4	45.4	100.0	Calcareous grains Quartz and feld-spars Black rock fragments	Grayish olive (non-calcareous) muddy sand
16	Dusky yellow green (5 GY 5/2)	0	6.3	93.7	100.0	Shell fragments, foraminifera and Coccoliths rich	Dusky yellow green calcareous mud
17	Dusky yellow green (10 Y 4/2)	16.7	33.3	50.0	100.0	" "	" "
18	Grayish olive (10 Y 4/2)	16.7	33.3	50.0	100.0	" " Quartz and feld-spars	Grayish olive calcareous sandy mud

Table 4. Lithologic Summary of Bottom Sediment (Cont'd)

Emery & Niio's classification of sediment

Name of Sediment	Percent (%) of grains coarser than 63
Sand	> 90 %
Muddy sand	50 ~ 90 %
Sandy mud	10 ~ 50 %
Mud	< 10 %

"Calcareous" implies that more than 30 % calcareous particles are contained in the sediment.

Table 5. Smith-MacIntyre Sampling Record

Station No.	Position	Water Depth	Date	Time	Wire out	Remark on Sediment	Benthos Record
1	12°- 10'.56 N 100°- 28'.62 E	30 m	5/18	21:25 21:36	20 → 32 m 20 → 28 m	Sands, shell fragments (bivalves), no smell	3 Polychaetes, 1 shrimp, 2 stomatopod larvae, 1 crab
2	12°- 10'.03 N 101°- 09'.10 E	32	5/18	14:00 14:14	20 → 31 m 20 → 31.5 m	Grayish fine sand and red consolidated clay, shell fragments, no smell	7 Polychaetes, 8 stomatoped larvae, 3 shrimps, 1 crab
3	12°- 09'.64 N 101°- 55'.22 E	29	5/18	08:15 08:26	20 → 27 m 20 → 26.5 m	Greenish gray silt and fine sand, bottom sandy layer, coarse shell fragments, some smell	2 Polychaetes, 1 stomatopod larvae, 1 shrimps, 1 crab
4	11°- 09'.98 N 101°- 53'.96 E	65	5/17	19:52 20:29	50 → 72 m 50 → 66 m	Gray silty mud, shell fragments, no smell	2 Polychaetes, 2 stomatopod larvae, 1 eel
5	11°- 10'.3 N 101°- 11'.1 E	65	5/16	14:40 14:55	55 → 64 m 50 → 67 m	Greenish gray mud, shell fragments, no smell	No benthos
6	11°- 06' N 100°- 27'.5 E	50	5/16	07:52 08:48	48 m 54 m	Greenish gray calcareous silt and fine sand with shell fragments (bivalves)	6 Polychaetes
7	10°- 11'.49 N 100°- 23'.20 E	60	5/19	12:50 13:00	50 → 57 m 52 → 57 m	Grayish calcareous mud	3 Polychaetes, 1 stomatopod larva, 2 Brittle stars
8	10°- 09'.80 N 101°- 09'.50 E	68	5/20	21:00 21:10	55 → 74 m 55 → 73 m	Brownish gray calcareous mud, shell fragments, no smell	1 eel

Table 5. Smith-MacIntyre Sampling Record (Cont'd)

Station No.	Position	Water Depth	Date	Time	Wire out	Remark on Sediment	Benthos Record
9	10°- 10'.15 N 101°- 55'.60 E	74 m	5/21	06:37 06:49	65 → 75 m 65 → 74 m	Surface 2 cm brownish silt, below grayish silty calcareous mud, some shell fragments, no smell	2 stomatopod larvae, 1 Brittle star
10	09°- 15'.91 N 101°- 35'.05 E	72	5/22	14:22 14:36	60 → 72 m 60 → 74 m	Surface 2 cm brownish calcareous mud, below grayish calcareous sandy silt, shell fragments, no smell	1 Polychaete, 1 Squid
11	09°- 10'.17 N 101°- 09'.02 E	60	5/25	13:27 13:37	50 → 61 m 50 → 60 m	Surface 1 cm brownish mud, below grayish calcareous mud shell fragments (bivalves, gastropods), no smell	7 Polychaetes, 1 crab
12	09°- 11'.05 N 100°- 24'.49 E	31	5/25	06:10 06:19	25 → 31 m 25 → 31 m	Grayish calcareous silty mud with some brownish silt and sandy layers, lateritic gravel, shell fragments, no smell	3 Polychaetes
13	08°- 43'.25 N 100°- 41'.42 E	32	5/24	19:06 19:20	25 → 32 m 25 → 31.5 m	Grayish calcareous mud, no fragment, no gravel, no smell, worms and crab	4 Polychaetes, 1 stomatopods larvae, 2 crabs, 1 fish (Gobiidae)
14	08°- 10'.13 N 101°- 10'.16 E	52	5/24	13:24 13:32	45 → 54 m 45 → 54 m	Grayish calcareous mud with some brownish silt on surface, no gravel, no smell	20 Polychaetes, 1 Brittle star, 1 shrimp, 1 crab

Table 5. Smith-MacIntyre Sampling Record (Cont'd)

Station No.	Position	Water Depth	Date	Time	Wire out	Remark on Sediment	Benthos Record
15	07°- 15.12' N 101°- 49.92' E	49 m	5/24	06:40 06:48	35 → 55 m 35 → 44 m	Brown silt and grayish sandy silt with shell fragments, lateritic gravel, sandy patch swimming baby fish, no smell	5 Polychaetes
16	07°- 34.7' N 101°- 20.2' E	65	5/23	18:46 18:57	60 → 71 m 63 → 71 m	Yellowish gray calcareous mud with abundant sponge spicules, no smell	No benthos
17	07°- 50.32' N 102°- 58.92' E	69	5/23	13:37 13:43	60 → 72 m 60 → 71 m	Grayish calcareous mud with some brownish mud on surface, no gravel, no smell	3 Polychaetes, 1 crab
18	08°- 35.65' N 103°- 18.78' E	29	5/23	06:16 06:27	20 → 30 m 20 → 27 m	Grayish calcareous mud with shell fragments, patchy sandy layers, no smell	No benthos

Table 6. Record of Current (10 m)

No.	Station 5, Depth 61 m, Date 16-17/5/80: Time	Wind Dir	Wind Vel	Current Dir**	Current Vel	Temp. C Sal,D.O	Station 7, Depth 60 m, Date 19-20/5/80: Time	Wind Dir	Wind Vel	Current Dir**	Current Vel	Temp. C Sal, D.O	Station 10, Depth 72 m, Date 21-22/5/80: Time	Wind Dir	Wind Vel	Current Dir**	Current Vel	Temp.C* Sal, D.O
1	15^h00	237°	16	325	12	30.975	13^h00	240	17	250	8		16^h20	230	20	330	10	
2	16 00	237	10	323	13	32.98	14 00	235	17	020	13		17 00	220	21	330	12	
3	17 00	240	12	340	12	-	15 00	205	20	350	20	30.575	18 00	215	20	005	6	
4	18 00	245	18	340	4		16 00	245	19	350	20	32.76	19 00	205	19	320	11	30.415
5	19 00	250	15	325	5	30.940	17 00	230	18	355	17	4.4	20 00	215	20	350	9	32.26
6	20 00	255	18	120	10	32.94	18 00	220	20	350	18		21 00	220	20	340	15	4.8
7	21 00	265	17	200	6	6.2	19 00	215	18	335	10	30.510	22 00	225	18	030	7	
8	22 00	270	18	160	10		20 00	210	20	330	14	32.69	23 00	225	20	350	11	30.375
9	23 00	275	20	70	7	30.910	21 00	295	22	310	24	5.4	00 00	225	21	320	10	32.77
10	00 00	290	20	130	5	32.96	22 00	290	17	315	15		01 00	225	22	070	10	4.2
11	01 00	285	17	140	15	5.9	23 00	260	10	295	13	30.495	02 00	235	18	100	12	
12	02 00	265	18	95	15		00 00	240	10	315	10	32.74	03 00	225	18	150	13	30.340
13	03 00	270	19	110	13	30.840	01 00	220	15	320	12	4.6	04 00	240	17	125	17	32.77
14	04 00	265	18	155	11	32.96	02 00	245	15	320	10		05 00	230	18	125	15	3.4
15	05 00	265	17	130	12	6.3	03 00	235	15	325	7	30.470	06 00	230	18	120	18	
16	06 00	270	14	160	15		04 00	225	14	310	10	32.74	07 00	235	19	125	20	30.290
17	07 00	268	15	150	8	30.825	05 00	225	13	080	5	4.4	08 00	210	12	125	23	32.79
18	08 00	280	16	160	10	32.93	06 00	275	19	025	5		09 00	225	16	150	20	3.7
19	09 00	270	14	160	15	6.3	07 00	230	17	090	7	30.445	10 00	235	13	135	20	
20	10 00	270	15	160	10		08 00	250	20	020	18	32.74	11 00	220	16	130	20	30.370
21	11 00	270	15	150	8	30.900	09 00	230	11	120	9	4.2	12 00	220	17	132	18	32.79
22	12 00	280	12	130	6	32.97	10 00	240	16	125	13		13 00	220	19	120	16	3.8
23	13 00	270	13	350	5	3.2	11 00	250	19	120	10	30.455	14 00	210	15	145	17	
24	14 00	255	14	335	4		12 00	245	8	125	12	32.74	15 00	210	14	110	12	30.470
25	15 00	265	14	20	10		13 00	265	19	355	11	3.7	16 00	210	16	080	8	32.77
																		4.4

* at 10 m layer.

** Correction is needed as below:

direction reading	0°	40°	90°	140°	180°	220°	.270°	320°	360°
true direction	0°	45°	90°	135°	180°	225°	270°	315°	360°

Table 7. Operation records of trawl

Haul No. (Station No.)	Date	Time of start	Location		Time of end	Course (°)	Speed (kt)	Wind		Warp Length (m)
			Lat. (N)	Long. (E)				Direction	Force	
1 (3)	May 18	05:50	12°- 10.3 12°- 10.5	101 - 48.9 101 - 52.9	06:50	080	3.3	WSW	4	120
2 (1)	May 18	19:04	12°- 06.2 12°- 09.3	100 - 23.1 100 - 26.6	20:29	050	3.2	West	6	140
3 (7)	May 20	13:30	10°- 10.5 10°- 11.7	100 - 25.3 100 - 31.1	15:13	080	3.5	West	6	130
4 (8)	May 20	19:12	10°- 07.8 10°- 08.8	101 - 05.8 101 - 08.4	20:09	080	3.3	WSW	5	140
5 (9)	May 21	07:19	10°- 10.1 10°- 12.1	101 - 56.1 101 - 58.5	08:20	030	3.6	SW	4	250 270
6 (10)	May 22	16:48	9°- 09.7 9°- 12.5	101 - 54.4 101 - 56.0	17:51	020	3.1	SW	4	260
7 (17)	May 23	11.49	7°- 56.1 7°- 58.6	102 - 58.5 102 - 59.8	12:49	020	3.3	South	4	250
8 (16)	May 23	19:20	7°- 34.7 7°- 33.1	102 - 19.6 102 - 16.0	20:19	220	3.3	SE	3	160
9 (14)	May 24	14:20	8°- 12.3 8°- 15.4	101 - 09.5 101 - 09.8	14:58	000	2.9	Calm		130
10 (12)	May 25	07:05	9°- 12.7 9°- 14.6	100 - 26.0 100 - 27.0	08:03	030 010	3.2	SE	2	120

Table 7. Operation records of trawl (Cont'd)

Haul No. (Station No.)	Date	Time of start	Location Lat. (N)	Location Long. (E)	Horizontal Angle Star-board (°)	Horizontal Angle Port (°)	Vertical Angle Star-board (°)	Vertical Angle Port (°)	Warp Tension Star-board (ton)	Warp Tension Port (ton)	Depth (m)	Net Height (m)	Head Line Depth (m)
1 (3)	May 18	05:50	12°- 10.3 12°- 10.5	101 - 48.9 101 - 52.9	5	6	19	17	3.3	3.6	32	7.0	25
2 (1)	May 18	19:04	12°- 06.2 12°- 09.3	100 - 23.1 100 - 26.6	10	5	15	16	3.0	3.3	36	7.0	29
3 (7)	May 20	13:30	10°- 10.5 10°- 11.7	100 - 25.3 100 - 31.1	3	8	23	23	4.2	4.2	54~62	9.0	44
4 (8)	May 20	19:12	10°- 07.8 10°- 08.8	101 - 05.8 101 - 08.4	6	5	22	22	3.8	3.6	62~66	8.5	48
5 (9)	May 21	07:19	10 - 10.1 10 - 12.1	101 - 56.1 101 - 58.5	0 - 5	2 10	20 20	21 20	3.4	3.2	74	6.3	65
6 (10)	May 22	16:48	9°- 09.7 9°- 12.5	101 - 54.4 101 - 56.0	- 2	12	12	20	3.4	3.2	71	6.0	67
7 (17)	May 23	11:49	7°- 56.1 7°- 58.6	102 - 58.5 102 - 59.8	0	4	20	21	3.4	3.2	69	6.5	63
8 (16)	May 23	19:20	7°- 34.7 7°- 33.1	102 - 19.6 102 - 16.0	2	3	28	28	3.4	3.2	68	8.0	60
9 (14)	May 24	14:20	8°- 12.3 8°- 15.4	101 - 09.5 101 - 09.8	0	8	24	24	3.6	3.4	52	8.0	44
10 (12)	May 25	07:05	9 - 12.7 9 - 14.6	100 - 26.0 100 - 27.0	2	7	18	18	3.4	3.2	33	8.2	23.5

Table 8. Trawl Catch Record kg (Good fish)

Family / Group	Species	Haul No. 1 Sta. No. 3 Date 18/5	2 1 18/5	3 7 20/5	4 8 20/5	5 9 21/5	6 10 22/5	7 17 23/5	8 16 23/5	9 4 24/5	10 12 25/5
Shark	Chiloscyllium sp.	–	12.0	–	–	–	–	–	–	–	–
Ray	Dasyatis imbricatus	1.45	6.6	–	–	0.5	–	–	–	–	0.64
	Narcine timlei	–	–	–	–	–	–	–	–	–	–
	Himantura uarnak	–	–	–	–	10.0	–	–	–	–	–
Engraulidae	Stolephorus	–	–	–	0.15	–	–	–	–	–	–
Chirocentridae	Chirocentrus dorab	–	–	–	–	0.38	–	0.27	–	0.28	–
Synodontidae	Saurida undosquamis	0.06	2.75	–	–	–	0.77	0.20	1.0	–	0.13
	S. elongata	1.37	0.06	–	–	9.55	10.34	3.45	2.5	–	1.02
Ariidae	Arius thalassinus	–	–	–	–	9.63	1.4	–	–	0.15	–
Muraenesocidae	Congresox talabonoides	–	–	–	–	–	–	–	12.0	3.14	–
Sphyraenidae	Sphyraena forsteri	0.05	–	–	0.13	–	3.4	0.6	–	0.5	–
	S. obtusata	–	–	–	–	0.25	–	–	–	31.0	–
Scombridae	Rastrelligen kanagurta	3.95	–	–	–	0.65	–	–	–	–	0.10
	Scamberonorus commerson	4.0	–	–	–	1.47	–	–	–	0.71	0.99
	S. guttatus	–	–	–	–	–	0.4	1.7	–	–	1.15
Trichiuridae	Trichiurus lepturus	–	–	–	–	0.59	1.0	–	–	–	0.23
Carangidae	Selar crumenophthalmus	0.57	–	–	0.47	5.0	–	3.45	–	35.5	–
	Atule mate	2.62	0.26	–	–	0.22	0.2	0.95	–	–	1.55
	Alepes melanoptera	0.66	0.39	–	–	–	–	–	–	0.13	0.25
	Selariodes leptolepis	6.75	9.0	–	0.02	–	–	–	–	–	0.61
	Carangoides sp.	–	–	–	–	2.5	0.02	–	–	–	–
	Uraspis sp.	–	–	–	–	–	1.1	–	–	–	–
	Decapterus maruadsi	–	–	–	0.38	–	–	–	–	–	–
	Formio niger	1.48	–	–	–	–	0.25	–	–	0.41	–
	Seriolina nigrofasciata	0.15	0.15	–	–	3.2	1.62	1.66	1.63	–	0.49
Rachycentridae	Rachycentron canadum	0.4	–	–	–	–	–	–	–	–	–
Mullidae	Upeneus sulphurens	–	–	–	–	4.6	–	2.59	13.0	–	–
	Parupeneus fraterculus	–	–	–	–	0.82	1.76	–	–	–	–
Priacanthidae	Priacanthus tayenus	0.72	0.8	–	0.10	1.3	–	–	1.54	0.38	0.52

Table 9. Trawl Catch Record kg (Trash fish)

Family/Group	Species	Haul No. 1 Station No. 3 Date 18/5	2 1 18/5	3 7 20/5	4 8 20/5	5 9 21/5	6 10 22/5	7 17 23/5	8 16 23/5	9 14 24/5	10 12 25/5
Ray	Dasyatis sp.	-	-		-	-	0.97	-	-	-	-
	Narcine timlei	-	-		-	-	-	-	-	-	-
Clupeidae	Sardinella jussieu	0.13	0.03		-	-	-	-	-	-	-
Engraulidae	Stolephorus indicus	0.02	-		-	-	-	-	-	-	-
Synodontidae	Saurida tumbil	-	-		-	0.23	-	1.54	-	0.03	-
	S. elongata	0.48	-		-	-	0.34	-	-	-	0.02
	S. undosquamis	0.10	1.35		-	0.11	0.05	0.29	-	-	0.03
	S. micropectoralis	-	-		-	-	-	0.06	-	-	-
Fistulariidae	Fistularia villosa	0.65	-		-	3.54	0.24	-	0.22	0.18	0.05
Holocentridae	Holocentrus rubrum	-	-		-	-	0.06	-	-	-	-
Sphyraenidae	Sphyraena obtusata	0.02	-		-	-	-	0.31	0.03	-	-
Serranidae	Epinephelus sexfasciatus	-	-		-	-	0.02	0.28	-	-	-
	E. areolatus	-	-		-	0.03	-	-	-	-	-
Theraponidae	Therapon jarbua	0.30	-		-	-	-	-	-	-	-
Priacanthidae	Priacanthus tayenus	0.40	0.46	None	-	-	-	-	0.11	-	-
	P. macracanthus	-	-		-	-	-	0.05	-	-	-
Apogonidae	Apogon spp.	0.42	1.08		-	0.05	0.07	-	0.48	0.31	0.02
Carangidae	Alectis ciliaris	0.02	-		-	-	-	-	-	-	0.03
	Atropus atropus	0.18	-		-	-	-	-	-	-	-
	Caranx leptolepis	0.15	1.52		-	-	-	0.42	-	-	0.25
	C. mate	0.07	0.03		0.10	0.03	-	0.03	0.01	5.00	0.70
	C. malum	0.07	-		0.02	-	-	-	-	-	-
	C. crumenophthalmus	-	-		-	-	-	0.33	-	-	0.02
	Caranx sp.	-	-		0.04	0.03	0.05	0.03	-	0.07	0.06
	Seriola nigrofasciata	0.16	-		-	0.15	-	-	-	-	-
Rachycentridae	Rachycentron canadus	0.03	-		-	-	-	-	-	-	0.18
Lutianidae	Lutianus malabaricus	0.02	-		-	-	-	-	-	-	0.21
	L. sanguineus	-	-		-	-	-	-	-	-	-
	L. lineolatus	-	-		0.04	-	-	-	0.06	0.11	-
	L. vitta	-	-		-	-	-	-	-	0.03	-

Table 9. Trawl Catch Record kg (Trash fish) (Cont'd)

Family/Group	Species	1	2	3	4	5	6	7	8	9	10
Caesiodidae	Caesio sp.	-	0.02		0.01	-	-	-	-	-	-
Nemipteridae	Nemipterus hexodon	-	-		-	-	-	-	-	-	0.06
	N. petonii	0.12	0.20		-	-	-	-	0.43	-	-
	N. Japonicus	-	-		-	-	-	-	-	-	0.03
	N. mesopilon	-	0.20		-	-	0.44	-	-	-	-
	N. nematophorus	-	-		-	0.25	0.74	-	-	0.14	-
Gerridae	Pentaprion longimanus	-	-		0.05	2.65	1.10	7.20	-	0.35	-
Leiognathidae	Leiognathus spp.	0.37	0.03		0.24	0.45	-	-	4.14	18.00	2.78
Scolapsidae	Scolopsis spp.	0.27	0.02		-	-	0.10	-	-	-	-
Plectornynehidae	Plectorhynchus pictus	0.05	-		-	-	-	-	-	-	0.08
Mutlidae	Upeneus spp.	0.10	0.16		0.11	0.39	0.07	0.31	-	1.53	-
Scaridae	Callyodon sp.	-	-		-	-	0.02	-	-	-	-
Uranoseopidae	Uranoscopus oligatepis	0.17	0.35		-	-	-	-	0.45	0.03	-
Siganidae	Siganus oramin	0.07	-		-	-	-	-	-	-	-
Trichiuridae	Trichiurus haumela	-	-		-	-	-	0.35	0.12	1.66	-
Scombridae	Rastrelliger kanagurta	-	0.04		-	-	-	-	-	-	-
Stromateidae	Parastromateus niger	0.38	-	None	-	0.32	-	-	-	-	-
Scorpaenidae	Pterois volitans	0.04	-		-	-	0.40	-	0.12	-	-
Platyoephalidae	Platyoephalus spp.	0.17	0.14		-	-	-	-	0.09	-	-
Dactylopteridae	Dactyloptena orientalis	-	-		-	0.56	2.50	-	-	-	-
Bathidae	Pseudorhombus spp.	0.30	-		-	-	-	-	-	-	0.05
Cynoglossidae	Cynoglossue sp.	-	-		-	-	0.04	-	-	-	-
Echeneidae	Echeneis naucrates	-	-		-	0.90	0.91	-	-	-	-
Batistidae	Abalistes stellaris	-	-		-	-	-	-	-	-	-
Triaeanthidae	Pseudotriaeanthus-strigilifer	-	-		-	0.42	0.31	-	0.62	-	-
Aluteridae	Alutera monoceros	0.11	0.15		-	0.04	-	-	-	-	-
Diodontidae	Diodon macalifer	-	-		-	-	0.99	-	0.47	-	-
Lagocephalidae	Gasterophysus lunaris	0.45	-		-	0.05	0.07	-	0.16	5.70	2.26
Anacanthidae	Anacanthus barbatus	0.09	-		-	-	-	-	-	-	-
Loliginidae	Laligo spp.	-	-		-	0.07	0.09	1.09	0.08	-	0.22
Sepiidae	Sepia spp.	-	-		-	-	0.13	0.12	0.04	-	-
Octopodidae	Octopus spp.	-	-		-	-	-	-	0.04	-	-
Portunidae	Charhybdis sp.	0.01	0.92		-	0.09	0.96	-	0.08	-	0.06
	Total	5.92	5.80		0.61	10.36	9.77	12.41	7.75	33.14	7.11

Table 10. Trawl Catch Record (Invertebrates)

Group	Species	Haul No. 1	2	3	4	5	6	7	8	9	10
Squid	Loligo formosana	17.5	7.57	None		0.53	1.00	3.1	1.21	2.33	5.30
	L. duraucellii	2.0	1.17			2.25	0.8	0.4	-	1.34	0.51
	L. tagoi	-	-		0.044	-	-	0.06	-	-	-
Cuttle fish	Sepia pharaonis	-	2.13					0.41	-	-	0.24
	S. aculeata	0.12	0.15		-	-	-	-	-	-	-
	S. recurvirostra	-	1.10		-	-	0.30	0.9	0.11	-	-
	S. brevimana	-	-		-	0.15	0.02	0.1	0.28	-	-
	Sepioteuthis lessoniana	3.3	0.27			0.05	-	-	-	-	0.09
Octopus	Octopus sp.	0.04	0.73		-	-	-	-	0.90	-	-
Total Cephalopoda		22.96	13.12		0.044	2.98	2.12	4.97	2.50	3.67	6.14
Crab	Portunus pelagicus	0.82	-		-	-	-	-	-	-	-
	Charybdis cruciata	1.05	1.73		-	-	-	-	-	-	-
	Charybdis sp.	0.07	-		-	0.09	0.06	-	-	-	0.06
Shrimp	Penaeus semisulcatus	0.03	-		-	-	-	-	-	-	-
	Miscellaneous	-	-		-	-	-	-	0.12	-	-
Total, Crustacea		1.97	1.73		-	0.09	0.06	-	0.12	-	0.06

STUDY ON SPECIES, SIZE COMPOSITION AND DISTRIBUTION OF INVERTEBRATES IN THE GULF OF THAILAND

Saramit Uraiwan

Marine Fisheries Division
Department of Fisheries
Thailand

STUDY ON SPECIES, SIZE COMPOSITION AND DISTRIBUTION OF INVERTEBRATES IN THE GULF OF THAILAND

Introduction

A study on species, size composition and distribution of invertebrates was carried out during the Thai-Japanese-SEAFDEC joint survey from 15-28 May 1980 in the Gulf of Thailand. The objective of the study was to detect invertebrates that have high commercial value and which can be caught by means of bottom trawl.

The present paper deals with five main groups of invertebrates; squids, cuttlefish, octopus, crabs and shrimps.

In the course of this survey, bottom trawling was carried out at only nine stations as shown in Fig. 1. It was not possible to observe general aspects of invertebrate distribution in the Gulf of Thailand.

Method

The route of the cruise and work stations are shown in Fig. 1. The bottom trawling stations were 1,3,7,9,10,12,14,16 and 17. Bottom trawling took about 1 hr. at every station. Aquatic animals caught by trawls were sorted and identified. Samples of squids were collected; each sample was measured for mantle length by punching on punching cards and total weight was taken.

Results

Species composition:

To study the species composition of invertebrates, the invertebrates caught by trawling were sorted into five main groups. The five main groups were squids, cuttlefish, octopus, crabs and shrimps. The list of these invertebrates is given below:

Group	Class	Family	Species & Scientific name
Squid	Cephalopoda	Loliginidae	*Loligo formosana* Sasaki *Loligo duvaucelii* d'Orbigny *Loligo tagoi* Sasaki *Sepioteuthis lessoniana* Lesson
Cuttlefish	Cephalopoda	Sepiidae	*Sepia pharaonis* Ehrenberg *Sepia aculeata* Ferussac & d'Orbigny *Sepia recurvirostra*. Steenstrup *Sepia brevimana*. Steenstrup
Octopus	Cephalopoda	Octopodidae	*Octopus* sp.
Crab	Crustacea	Portunidae	*Portunus pelagicus* (Linnaeus) *Charybdis cruciata* (Herbst) *Charybdis* sp.
Shrimp	Crustacea	Penaeidae	*Penaeus semisulcatus* de Hann.

Size composition:

To study the size composition of invertebrates, we collected squids for sample. The samples were measured in mantle length (ML) by punching. Table 1 shows the size distribution of the squid catch by 1 cm. step of mantle length. The size of squids caught ranged from 6 to 25 cm.

Fig. 2, 3 and 4 show the size distribution of squids in the grand total throughout the survey. The upper line of digits is taken as the squid catches by size class and the next line shows the frequency in percentages from the upper data.

Fig. 2 shows the size distribution of squid, *Sepioteuthis lessoniana*, by 1 cm. step of mantle length. The sizes of squids caught ranged from 7 to 21 cm. The dominant mode is shown at 11 cm. class.

Fig. 3 shows the size distribution of squid, *Loligo formosana*, by 1 cm. step of mantle length. The sizes of squids caught ranged from 7 to 21 cm. The dominant mode is shown at 11 cm. class and another small mode is also at 15 cm. long.

Fig. 4 shows the size distribution of squid, *Loligo duvaucelii* by 1 cm. step of mantle length. The sizes of squids caught ranged from 6 to 12 cm. The dominant mode is shown at 7 cm. class.

Other subspecies of squid could not be analysed.

Distribution:

During this survey only nine hauls were carried out. The trawling stations are shown in Fig. 1. It was not possible to observe general aspects of invertebrate distribution in the Gulf of Thailand.

Summary

A study on species, size composition and distribution of invertebrate was carried out during the Thai-Japanese-SEAFDEC joint survey from 15-28 May 1980 in the Gulf of Thailand. The objective of the study was to detect invertebrates which have high commercial value and which could be caught by means of bottom trawl. The invertebrates were sorted into five main groups, two classes and five families. The five main groups were squids, cuttlefish, octopus, crabs and shrimps. The two classes were Cephalopoda and Crustacea. The five families were Loliginidae, Sepiidae, Octopodidae, Portunidae and Penaeidae. To study the size composition, we used squids for samples. The size of squids caught ranged from 6 to 25 cm. Because trawling was carried out at only nine stations it was not possible to observe general aspects of invertebrate distribution.

Reference

1. Adam, W. and W.J. Rees. 1966 : A Review of Cephalopod Family Sci. Rep. John Murray Exped. 1933-34, 11(1) : 165

2. Keishi Shibata, Prasert Masthawee and Yasutami Kitagawa. 1980 : A Preliminary Study on Squid Fishing Around the Phuket Waters Employing Squid Handline, A New Fishing Technique in Thai Waters. SEAFDEC Training Department, Current Technical Paper No. 8

3. Paisarn Sithigorngul. 1974 : Taxonomic survey of Cephalopods in the Gulf of Thailand.

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science. Department of Biology, Graduate School, Chulalongkorn University.

4. Suvatti, C. 1950 : Fauna of Thailand. Department of Fisheries, 32-33

5. Voss, G.L. 1963 : Cephalopods of the Phillipine Island. Smithsonian Institution, Washington, 1-243

6. Voss, G.L. and G.R. Williamson. 1971 : Cephalopods of Hong Kong, Hong Kong Government Press, 1-138

Table 1. Size distribution of squids and cuttlefish catch throughout the trawling.

	Mantle Length (CM.)																				Parameters		
Species	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	N	$\overline{X}$	S.D.
L. formosana	1	11	33	44	46	32	27	28	29	35	23	19	12	8	2	1		2	2	2	357	12.42	3.619
L. duvaucelii	71	135	45	20	14	4	3	1													288	7.32	1.273
Sepio. lessoniana	4	4	3	3	3	7	5	3	3	2	2		2			1					42	11.20	3.547
Sepia pharaonis			1		1		2	1	1	1		1					1				9	13.67	3.858
Sepia recurvirostra		1		4		6	2	1													14	9.79	1.145
Sepia brevimana	4	2																			6	6.33	0.471
Sepia aculeata	1						1	1													3	9.67	2.625

N = Number of individuals

$\overline{X}$ = Average mantle length in CM.

S.D.= Standard deviation

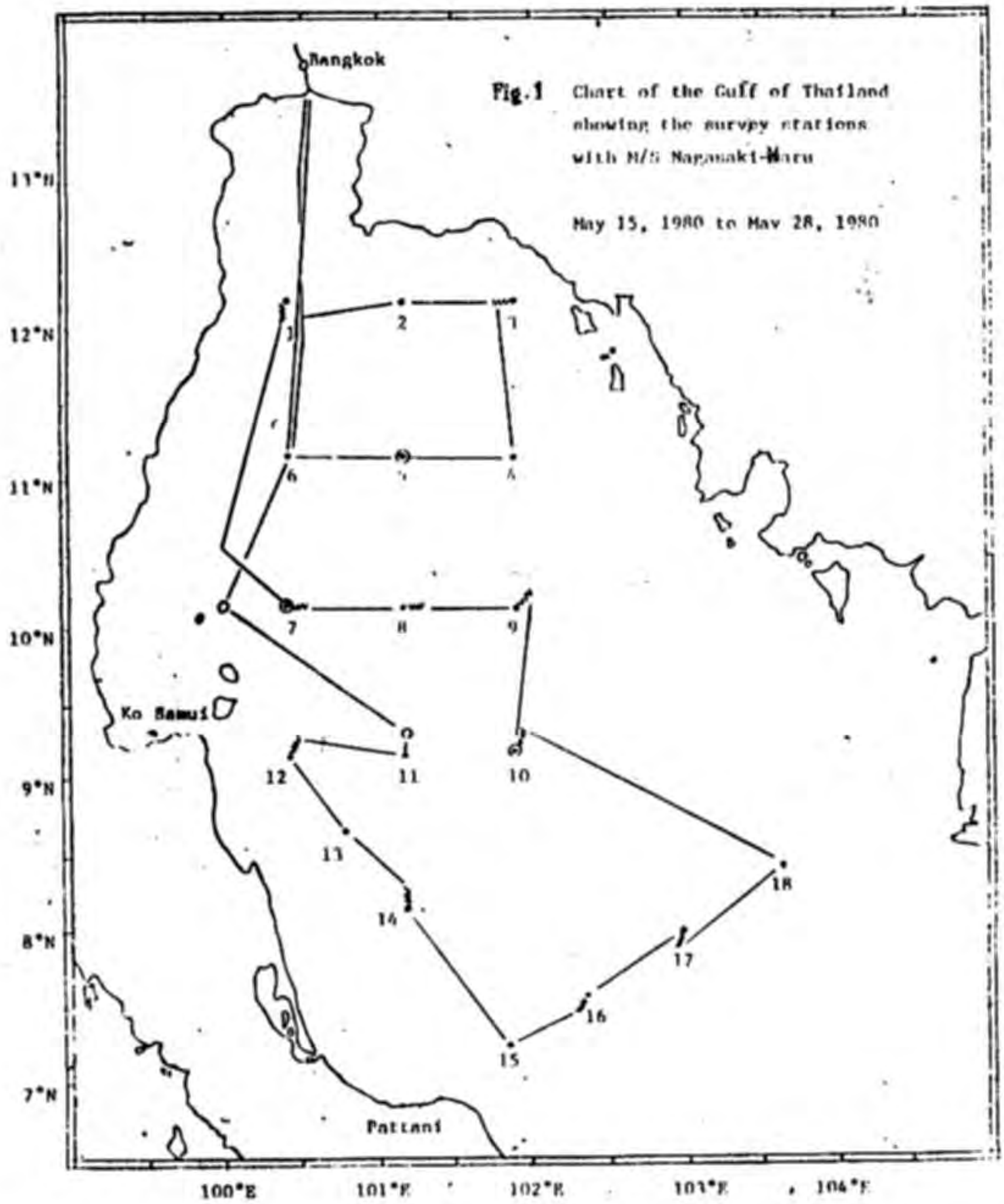

Fig.1 Chart of the Gulf of Thailand showing the survey stations with M/S Nagasaki-Maru

May 15, 1980 to May 28, 1980

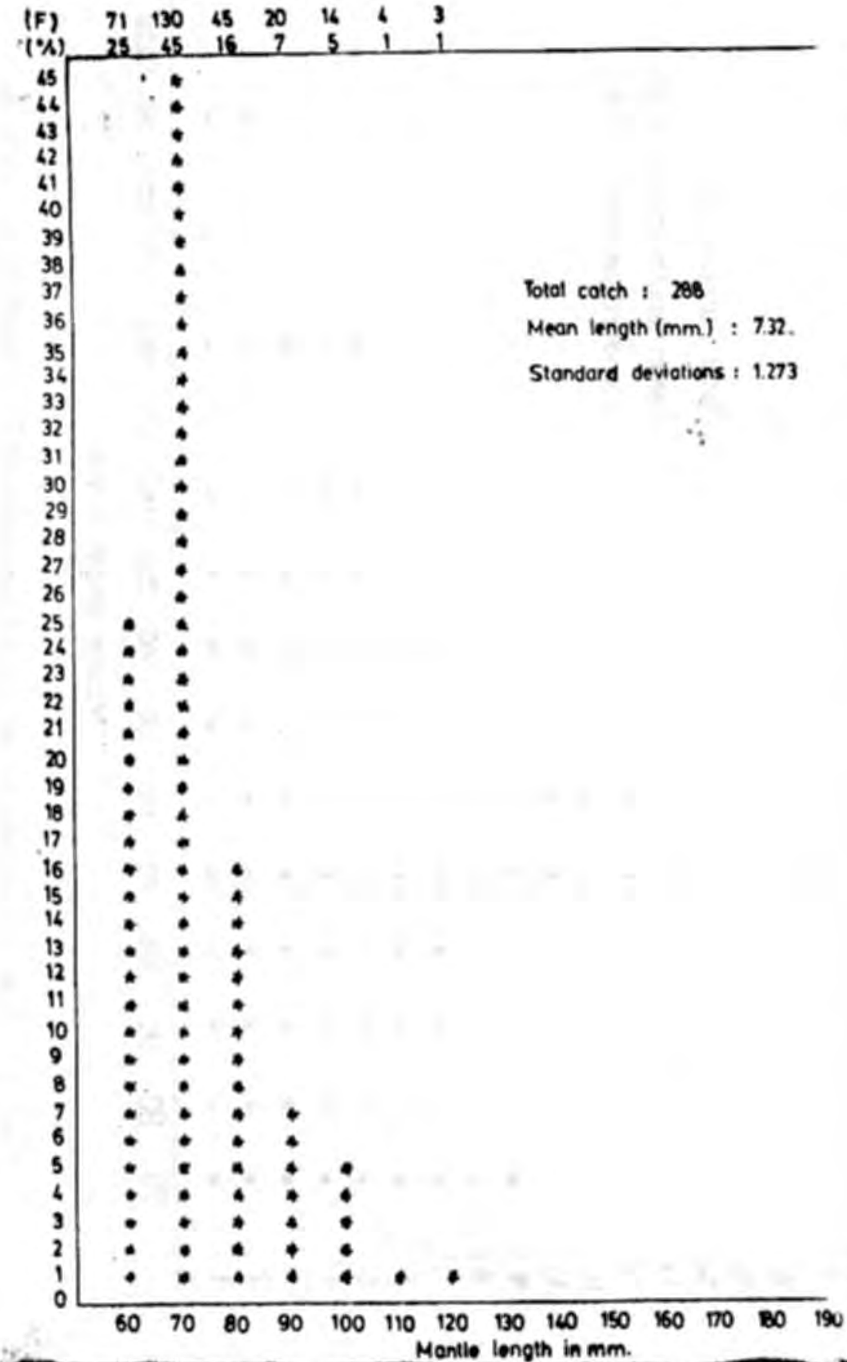

Fig. 4 Size distribution of squid *Loligo duvaucelii* d'Orbigny

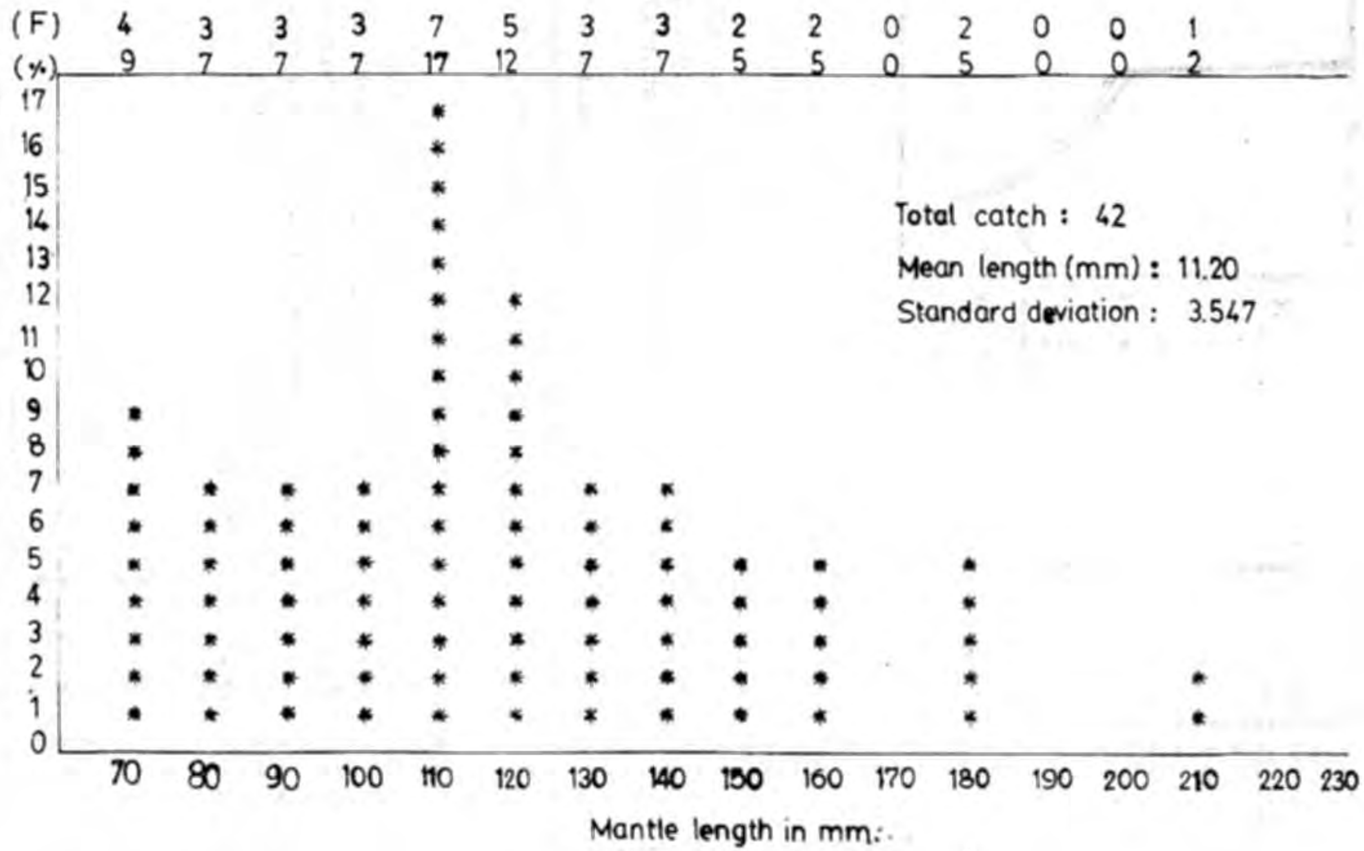

Fig. 2 Size distribution of squid *Sepioteuthis lessoniana.* Lesson

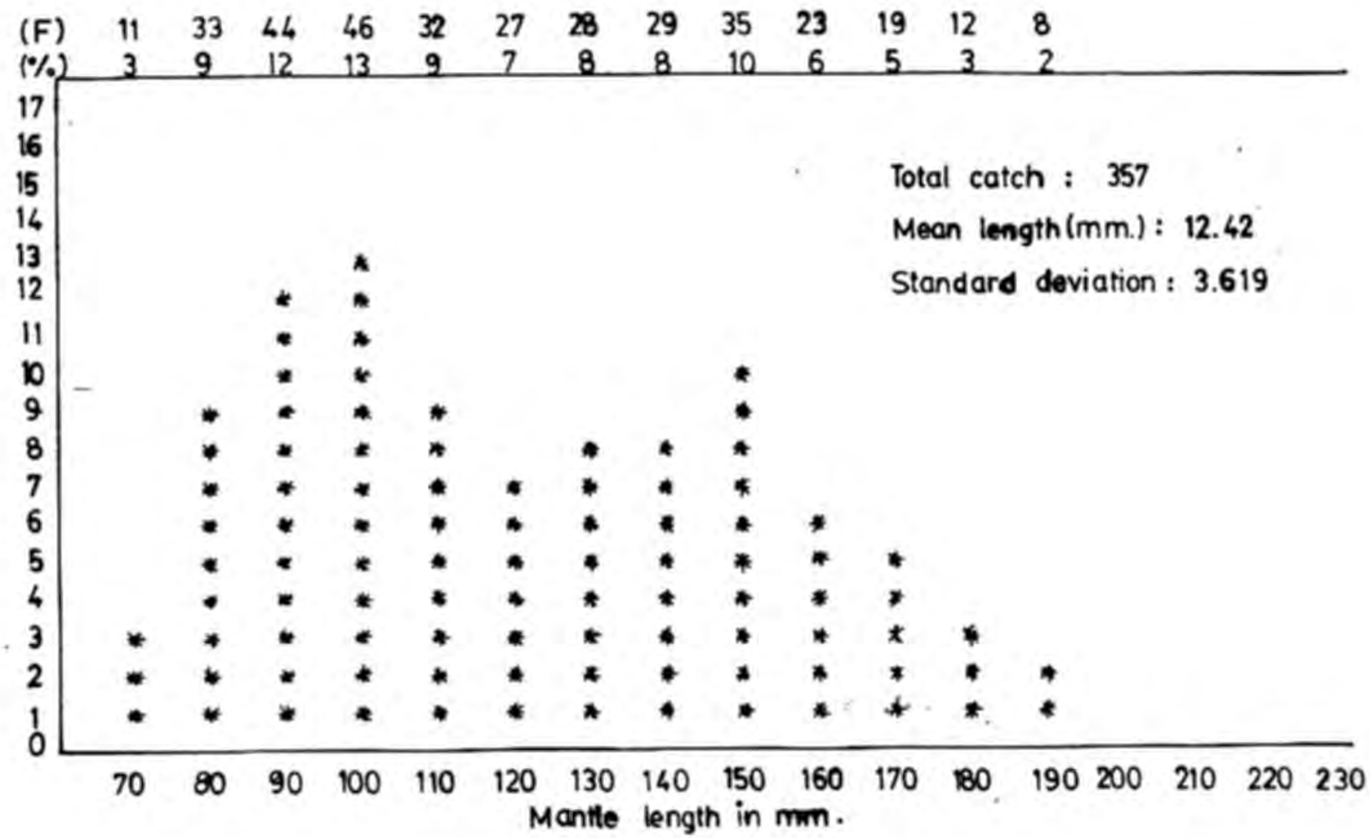

Fig. 3 Size distribution of squid *Loligo formosana*. Sasaki

SEAWATER PROPERTIES IN THE GULF OF THAILAND IN MAY 1980

Chamchoi Tanapong
and
Dheerasak Wasuthapitak

Exploratory Fishing Division
Department of Fisheries
Thailand

SEAWATER PROPERTIES IN THE GULF OF THAILAND, IN MAY 1980

Chamchoi Tanapong & Dheerasak Wasuthapitak

Abstract

In the observation on the physical and chemical properties of seawater in the Gulf of Thailand, the data observed are temperature, salinity, dissolved oxygen, hydrogen-ion concentration, alkalinity and inorganic nutrients (nitrate, nitrite, phosphate, silicate).

1. Introduction

This report is a part of the results of the trawling and oceanographic survey in the Gulf of Thailand which was carried out by the cooperation between Thai scientists and Japanese scientists from Nagasaki University. This joint survey was operated on board the training ship Nagasaki-Maru, from 15 to 28 May 1980. The area of investigation covered the latitudes between 6°45', and longtitudes between 100°15' and 104°E. The navigation route and the location of 18 survey stations are shown in Figure 1. Within this report the characteristics of some physical and chemical properties of seawater (temperature, salinity, dissolved oxygen, hydrogen-ion concentration, alkalinity and dissolved inorganic nutrients) are illustrated and brief discussion is presented.

2. Materials and Methods

In this oceanographic survey the water temperature was measured by S.T.D. (Salinity, temperature, depth sensor), salinity was measured by S.T.D. and inductive salinometer, dissolved oxygen and hydrogen-ion concentration analyses were carried out by the oxymeter and pH-meter, respectively. The instruments were provided by the training ship Nagasaki-Maru. Other chemical data were analysed by chemical methods. In each station the water samples at three depth levels, 0.30 metres and 3-5 metres above the bottom depth, were collected with the 10-litre Bandon type water sampler

4.3 Dissolved oxygen: The concentration of dissolved oxygen in the surface layer ranged from 1.89 ml/l to 4.90 ml/l and the average was 3.60 ml/l. Below the surface level the dissolved oxygen concentration generally decreased with depth, but in some stations it was maximum at the depth of about 30 metres. In the course of the present oceanographic survey it was interesting to note that the maximum concentration of dissolved oxygen occurred at station no. 13 which is in the waters of Nakhonsritamarat Province. According to the reports of investigations by two foreign vessels, the Stranger in 1957-1960 and the Kaiyo-Maru in 1970, it had been concluded that upwelling phenomenon occurred in this area. Nevertheless, the data on dissolved oxygen concentration do not clearly support this conclusion because in this station the other nutrients do not exhibit a distinctly high concentration.

4.4 Hydrogen-ion concentration (pH): In the surface layer the pH range was between 8.10 and 8.26. The data observed showed that the surface pH in the eastern area was higher than that in the western area (Fig. 5), but of the vertical pH a trend of variation was inconstant.

4.5 Alkalinity: The surface alkalinity ranged from 2.00 meg/l to 2.53 meg/l and the average was 2.20 meg/l. From the surface level down to the bottom, the alkalinity was inconstant but in some stations it did not vary.

4.6 Nitrate (NO_3-N): In the surface layer the average concentration of dissolved nitrate was 0.01 Mg-at/l. The relatively high concentration of the surface nitrate originated from two water masses. One is the water mass of the upper western coast of the Gulf and other is the coastal water mass of the Malay Penisula (Fig. 7). Below the surface layer the concentration of nitrate apparently increased with depth.

4.7 Nitrite (NO_2-N): In the surface layer the concentration of dissolved nitrite ranged from 0 to 0.08 Mg-at/l and the average was 0.02 Mg-at/l. Below the surface level down to the depth of about 30 metres the concentration of nitrite was rather constant, but in the bottom layer it was comparatively high.

4.8 Phosphate (PO_4-P): The concentration of dissolved phosphate in the surface layer ranged from 0.58 Mg-at/l to 1.90 Mg-at/l and the average was 1.22 Mg-at/l. The surface distribution of phosphate revealed that the high concentration originated from the coastal areas and then gradually decreased outward to the middle Gulf. Below the surface layer the phosphate concentration was inconstant.

4.9 Silicate ($Si(OH)_4$-Si): The concentration of dissolved silicate in the surface layer ranged from 16 Mg-at/l to 37 Mg-at/l and the average was 29 Mg-at/l. The surface distribution of silicate, contrary to phosphate, showed the relatively high concentration in the middle Gulf. Below the surface level down to the bottom the concentration of silicate varied greatly but in some stations there was little difference.

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We wish to express our sincere thanks to the captain and the crew of the training ship Nagasaki-Maru for their assistance and co-operation in providing the oceanographic equipment and facilities during the field observation.

Reference

J.D. Strickland and T.R. Parsons. 1968:

A Practical Handbook of Seawater Analysis. Fisheries Research Board of Canada. Ottawa.

Table 1 Data of the physical and chemical properties of seawater in the Gulf of Thailand observed in May 1980

Station No.	Total depth m	Depth of sampling m	Temp. C	Salinity ‰		O_2 ml/1	pH	Alk. meq/1	NO_3-N Mg-at/1	NO_2-N Mg-at/1	PO_4-P Mg-at/1	$Si(OH)_4$-Si Mg-at/1
1	36	0	30.880	33.49*	33.34**	4.20	8.10	2.05	0.03	0	1.19	16
		10	30.925	33.44								
		20	30.925	33.44								
		30	30.915	33.45								
		bottom	30.915	33.45	33.37	3.78	8.12	2.05	0.17	0	2.13	37
2	35	0	31.060	33.04	33.28	2.94	8.12	2.22	0.01	0.02	1.55	29
		10	30.990	33.08								
		20	30.975	33.08								
		30	30.970	33.08								
		bottom	31.055	33.09	32.99	3.08	8.15	2.16	0.12	0.02	1.19	-
3	30	0	31.115	32.92	33.03	3.50	8.16	2.31	0.01	0.02	0.93	35
		10	31.140	32.93								
		20	31.140	32.93								
		bottom	31.145	32.93	32.78	4.06	8.10	2.31	0.10	0.02	0.93	35
4	60	0	30.815	32.86	32.91	4.06	8.26	2.05	0	0.05	1.29	20
		10	30.835	32.85								
		20	30.805	32.84								
		30	30.765	32.85	32.85	4.34	8.08	2.10	0.06	0.05	0.58	-
		50	28.710	33.18								
		bottom	30.810	32.85	33.21	3.08	8.13	2.05	0.17	0.70	0.58	35

Table 1 (continued)

Station No.	Total depth m	Depth of sampling m	Temp. C	Salinity ‰		O_2 ml/l	pH	Alk. meq/l	NO_3-N Mg-at/l	NO_2-N Mg-at/l	PO_4-P Mg-at/l	$Si(OH)_4$-Si Mg-at/l
5	64	0	30.955	33.02	32.91	3.78	8.10	2.35	0.03	0.08	0.84	34
		10	30.975	32.98								
		20	30.975	32.98								
		30	30.925	32.83	32.83	3.78	8.12	2.26	0.17	0.08	1.06	37
		bottom	29.910	32.28	32.21	2.17	8.00	2.26	0.34	1.33	0.48	44
6	51	0	30.925	32.87	32.97	1.89	8.18	-	0.06	0.50	1.42	30
		10	29.895	32.84								
		20	29.835	32.85								
		30	29.715	32.86	32.83	1.82	8.06	-	0.09	0.05	1.42	31
		bottom	29.220	33.13	33.10	1.89	8.08	-	0.19	0.55	1.19	44
7	60	0	30.655	32.63	32.74	2.73	8.15	-	0	0.02	1.90	29
		10	30.580	32.79								
		20	30.585	32.79								
		30	30.550	32.78	32.80	2.94	8.12	-	0.28	0.02	1.68	41
		50	28.955	32.91								
		bottom	30.315	32.35	32.99	2.24	8.05	-	0.34	0.50	0.93	31
8	62-69	0	30.440	32.69	32.76	3.22	8.15	2.05	0	0	0.58	35
		10	30.460	32.86								
		20	30.460	32.68								
		30	30.450	32.69	32.62	4.20	8.10	2.16	0	0	0.58	35
		50	29.705	32.69								
		bottom	28.740	33.07	32.95	3.50	8.05	2.16	0.98	0.30	0.48	37

Table 1 (continued)

Station No.	Total depth m	Depth of sampling m	Temp. C^o	Salinity ‰		O_2 ml/l	pH	Alk. $meq/_1$	NO_3-N $Mg\text{-}at/_1$	NO_2-N $Mg\text{-}at/_1$	PO_4-P $Mg\text{-}at/_1$	$Si(OH)_4$-Si Mg-at/l
9	74	0	30.475	32.78	32.88	4.48	8.12	2.00	0	0	1.42	37
		10	30.495	32.79	32.79							
		20	30.500	32.79								
		30	30.500	32.79	32.80	4.62	8.20	2.05	0.12	0	0.93	24
		50	28.610	33.26								
		bottom	28.145	32.17	33.18	1.54	7.80	2.10	2.76	0.12	1.06	39
10	72	0	30.440	32.71	32.83	2.80	8.20	2.10	0	0.05	1.19	26
		10	30.425	32.77								
		20	30.395	32.76								
		30	29.625	33.88	34.00	2.73	8.15	2.16	0.13	0.05	1.19	33
		50	28.400	33.87								
		bottom	29.195	32.30	33.86	1.82	8.06	2.31	1.94	0.33	1.90	41
11	60	0	30.660	32.68	32.76	3.85	8.15	2.26	0.01	0	0.84	30
		10	30.465	32.69								
		20	30.425	32.70								
		30	30.415	32.73	32.80	3.92	8.18	2.35	0.01	0	0.58	41
		50	27.425	23.79								
		bottom	27.425	30.80	33.76	2.94	8.02	2.39	1.50	0.27	0.58	31
12	30	0	30.330	32.78	32.77	4.76	8.12	2.31	0	0	1.19	27
		10	30.350	32.71								
		20	30.220	32.72								
		bottom	29.765	32.90	32.99	4.76	8.00	2.42	0.29	0	1.77	29

Table 1 (continued)

Station No.	Total depth m	Depth of sampling m	Temp. °C	Salinity ‰		O_2 ml/l	pH	Alk. meq/l	NO_3-N Mg-at/l	NO_2-N Mg-at/l	PO_4-P Mg-at/l	$Si(OH)_4$-Si Mg-at/l
13	32	0	30.510	32.82	32.80	4.90	8.12	2.26	0	0.03	1.42	23
		10	30.335	32.76								
		20	30.245	32.78								
		bottom	29.655	32.28	32.21	3.92	8.08	2.31	0.31	0.03	1.68	38
14	53	0	30.605	32.74	32.84	3.78	8.12	2.53	0	0.03	0.93	25
		10	30.475	32.74								
		20	30.440	32.74								
		30	30.375	32.82	32.77	3.36	8.20	2.31	0	0.03	1.90	46
		bottom	29.260	33.64	32.91	2.52	8.10	2.39	0.25	0.40	1.06	39
15	48	0	30.820	32.85	32.88	3.92	8.15	2.26	0.04	0.02	1.06	28
		10	30.855	32.84								
		20	30.860	32.85								
		30	30.865	32.86	32.94	3.92	8.20	2.26	0.04	0.02	0.93	25
		bottom	29.750	33.58	33.64	3.64	8.12	2.66	0.04	0.05	2.03	24
16	73	0	30.640	32.73	32.66	4.34	8.17	2.10	0.04	0	-	33
		10	30.645	32.62								
		20	30.590	32.62								
		30	30.600	33.08	32.96	4.20	8.10	2.10	0.15	0	0.84	27
		50	28.585	33.78								
		bottom	28.105	32.28	33.96	1.96	8.02	2.22	2.94	0.23	1.42	35

Table 1 (continued)

Station No.	Total depth m	Depth of sampling m	Temp. °C	Salinity ‰		O_2 ml/l	pH	Alk. meq/l	NO_3-N Mg-at/l	NO_2-N Mg-at/l	PO_4-P Mg-at/l	$Si(OH)_4$-Si Mg-at/l
17	69	0	30.500	32.91	33.03	3.57	8.20	2.05	0.01	0.07	1.55	35
		10	30.435	32.91								
		20	30.475	32.99								
		30	30.220	33.27	33.13	3.43	8.20	2.10	0.19	0.07	0.93	21
		50	28.795	33.87								
		bottom	30.060	32.30	33.98	3.08	8.13	2.16	0.17	0.52	1.19	20
18	29	0	30.015	33.02	33.46	2.66	8.22	2.26	0	0	1.42	34
		10	30.095	33.15								
		20	30.335	33.45								
		bottom	30.085	33.20	33.16	4.62	8.22	2.35	0.34	0	1.68	33

Remarks

Temp. : Temperature
Alk. : Alkalinity
* : recorded by S.T.D
** : recorded by Salinometer

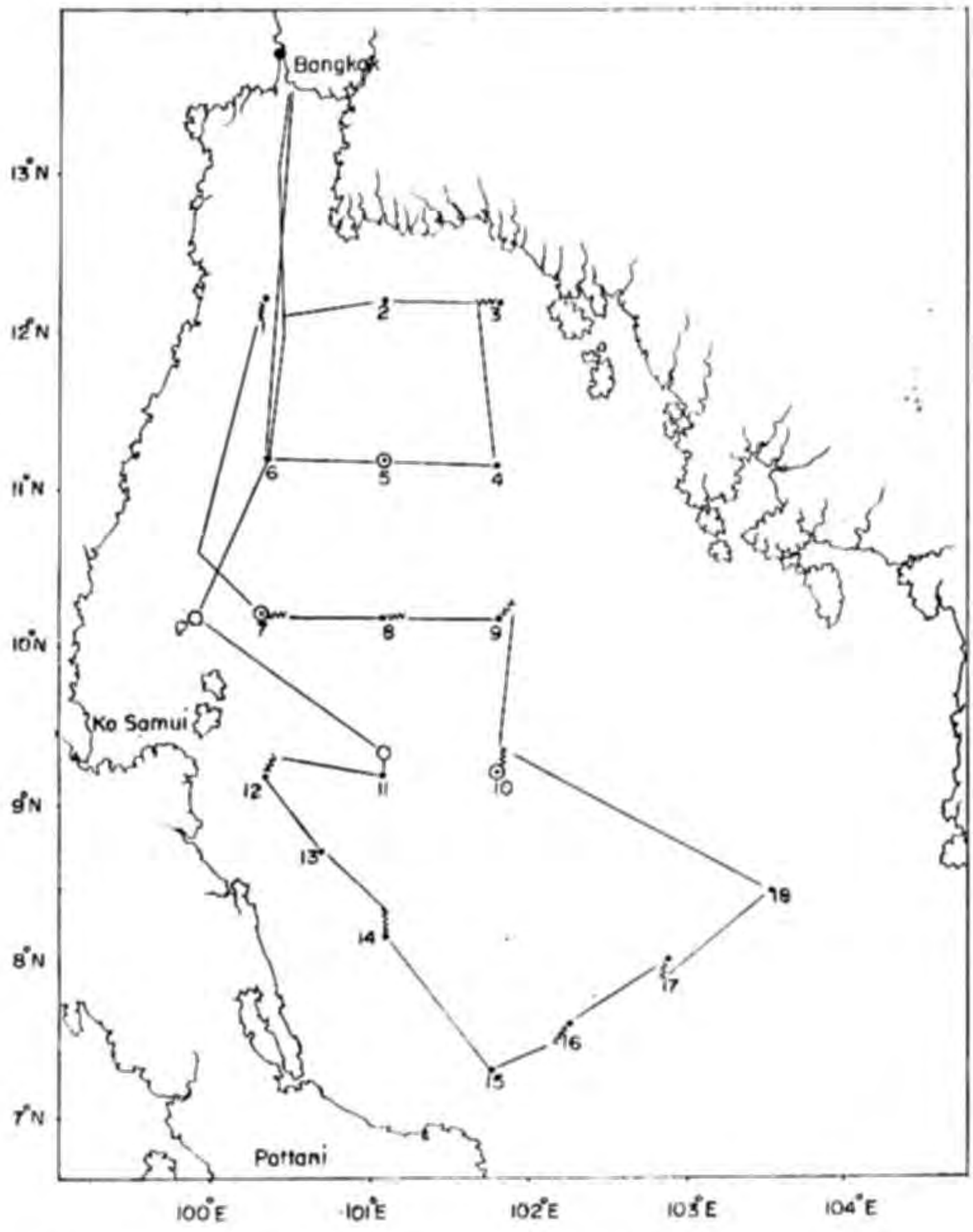

Figure 1. Chart of the Gulf of Thailand showing the survey stations with M/S Nagasaki-Maru

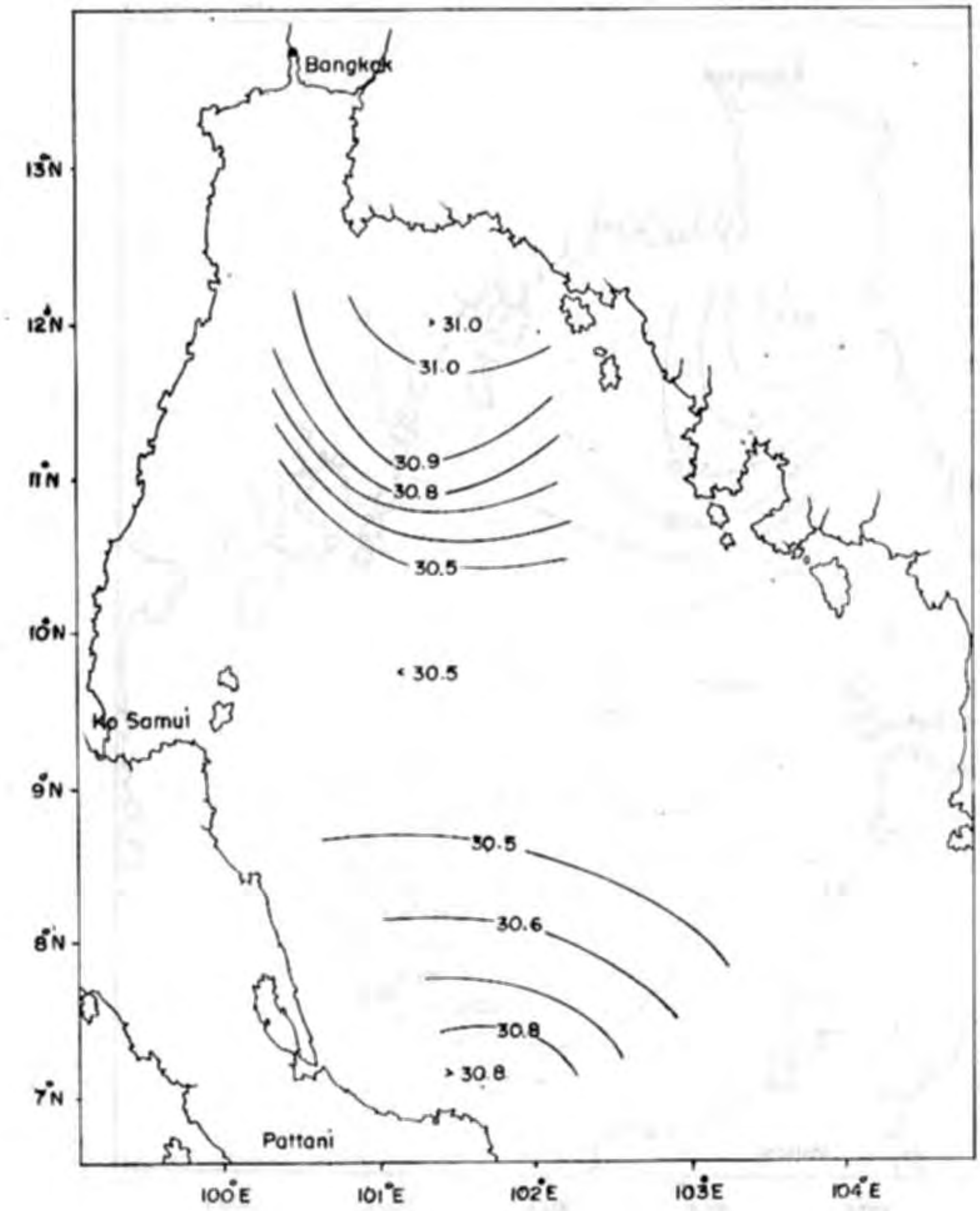

Figure 2. Horizontal distribution of temperature at the surface

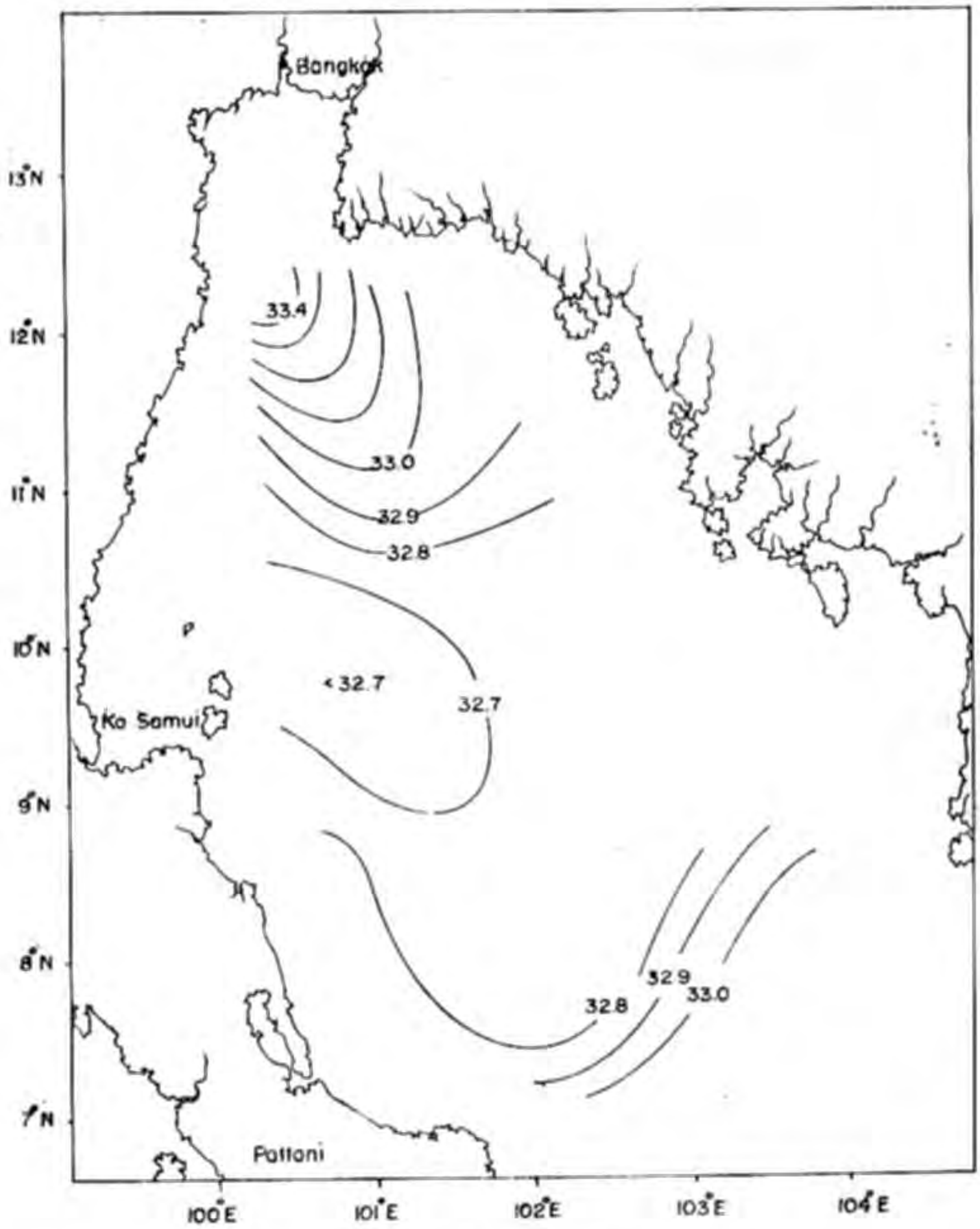

Figure 3. Horizontal distribution of salinity at the surface

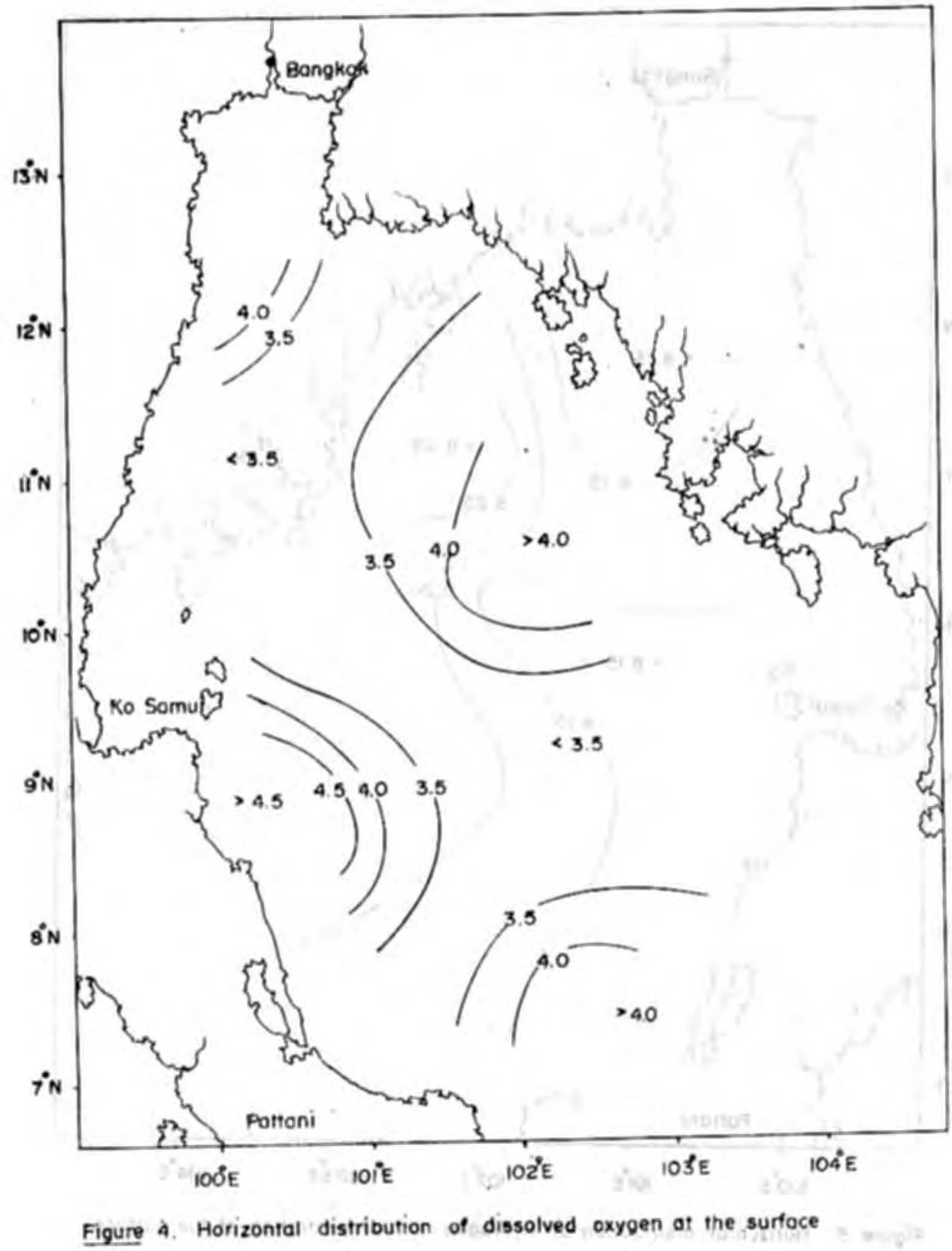

Figure 4. Horizontal distribution of dissolved oxygen at the surface

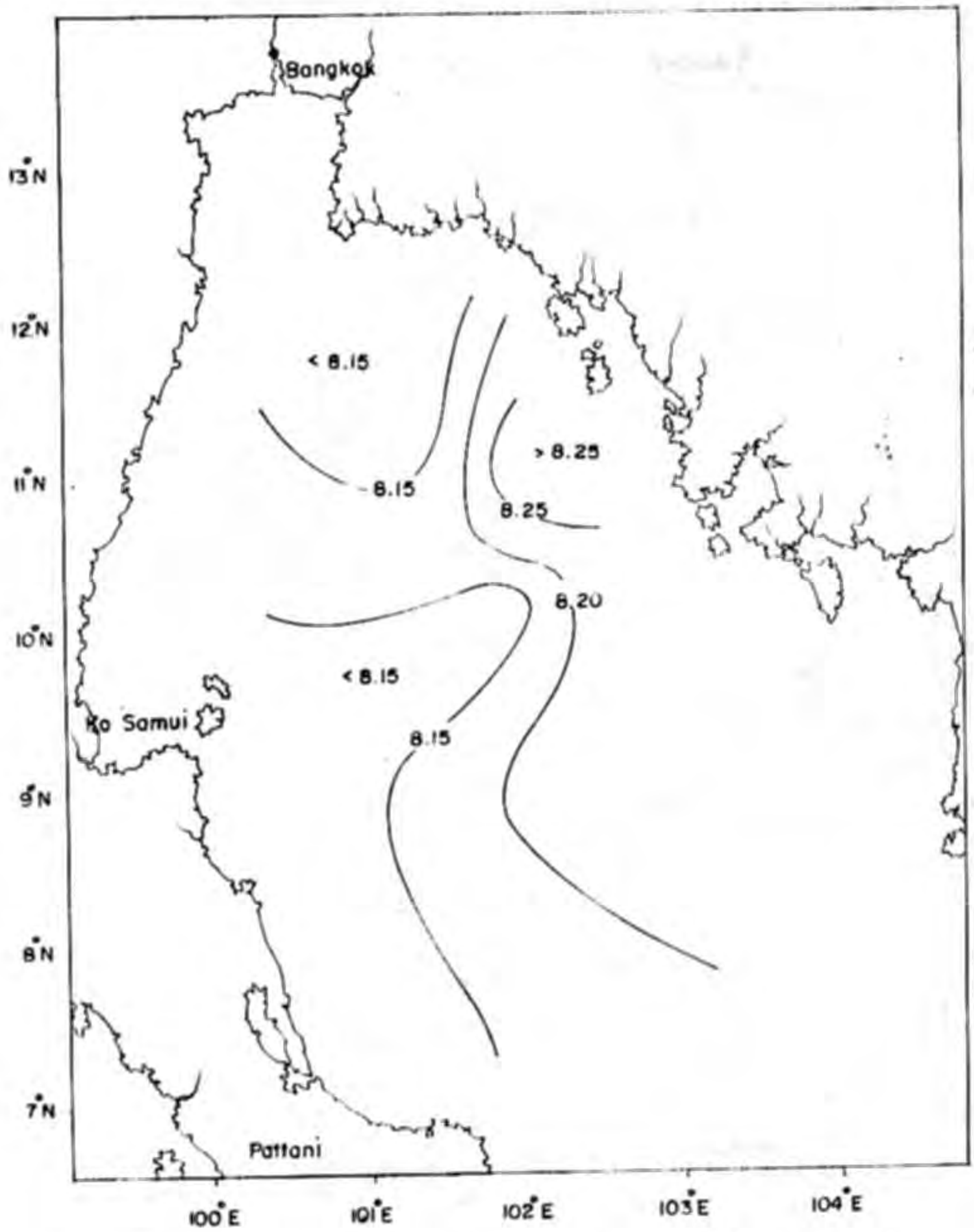

Figure 5. Horizontal distribution of hydrogen-ion concentration at the surface

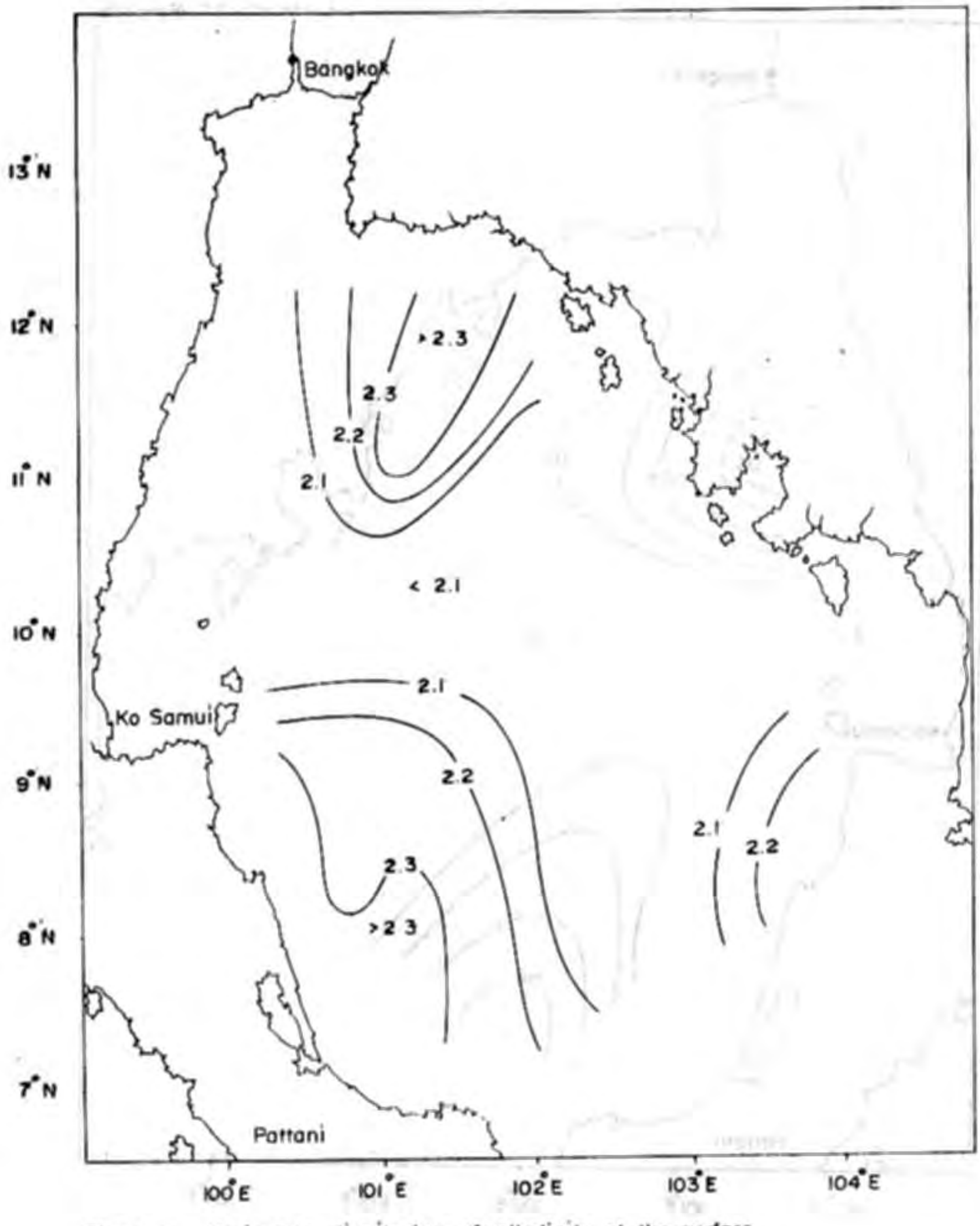

Figure 6. Horizontal distribution of alkalinity at the surface

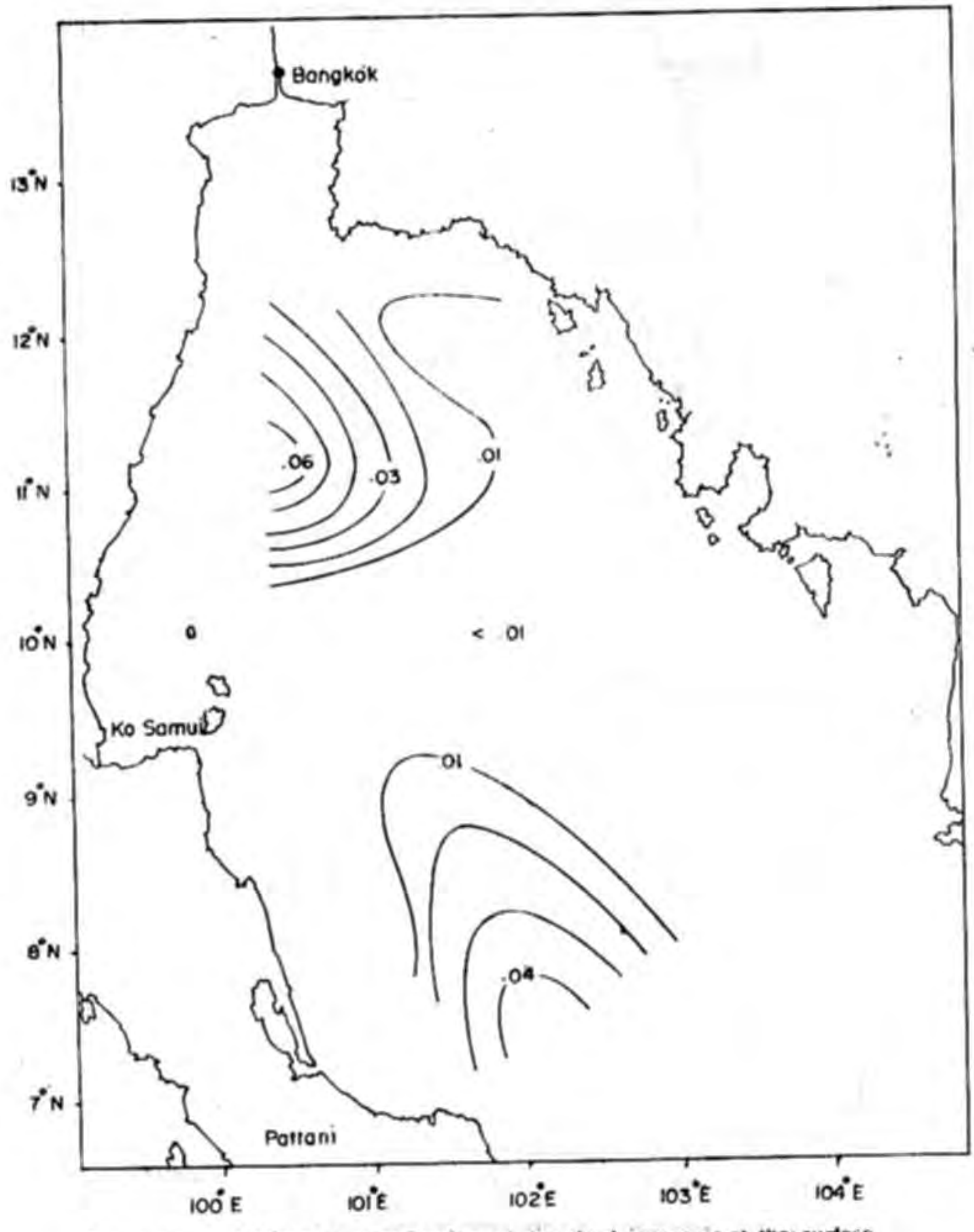

Figure 7. Horizontal distribution of dissolved inorganic nitrate at the surface

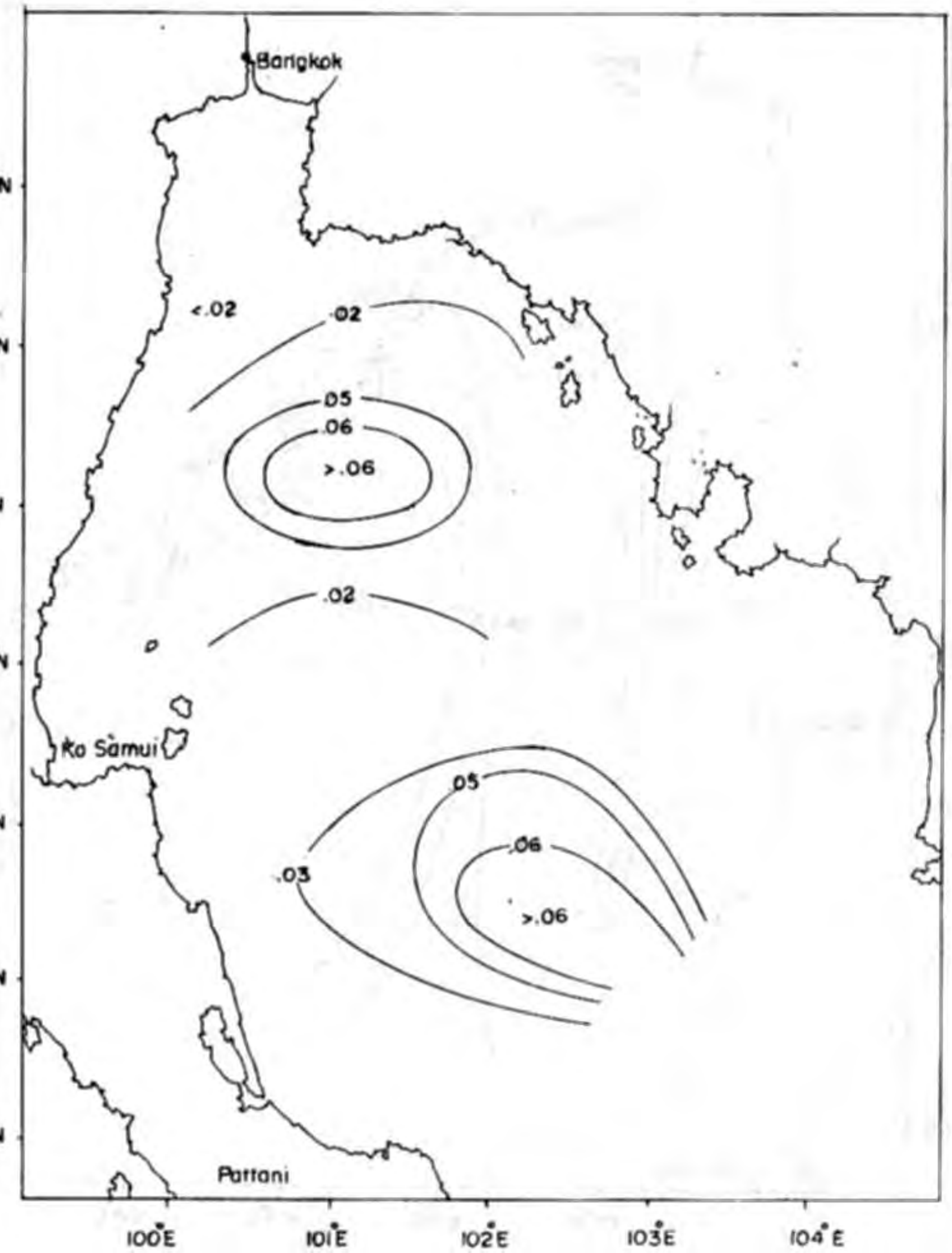

Figure 8. Horizontal distribution of dissolved inorganic at the surface
nitrite

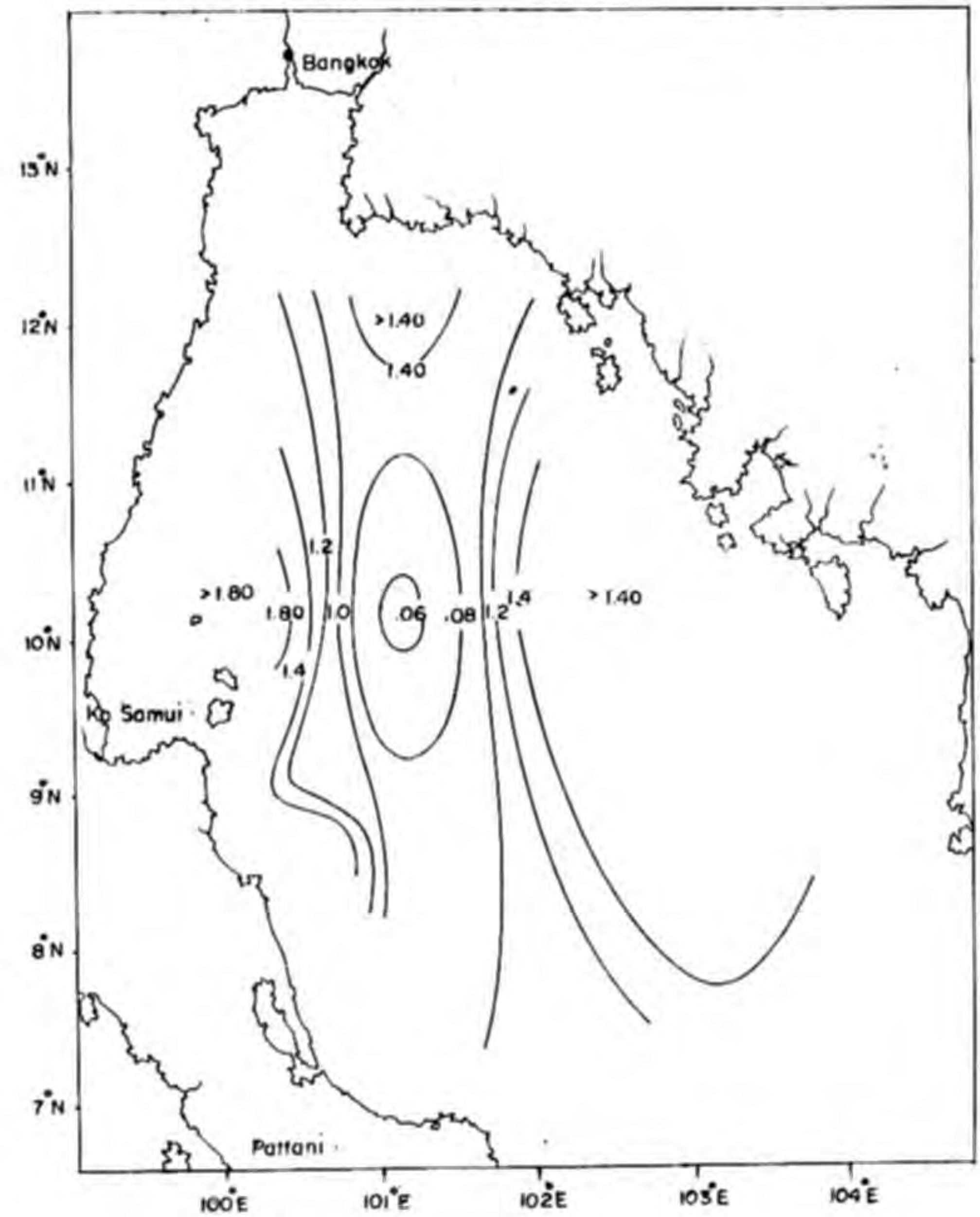

Figure 9. Horizontal distribution of dissolved inorganic phosphate at the surface

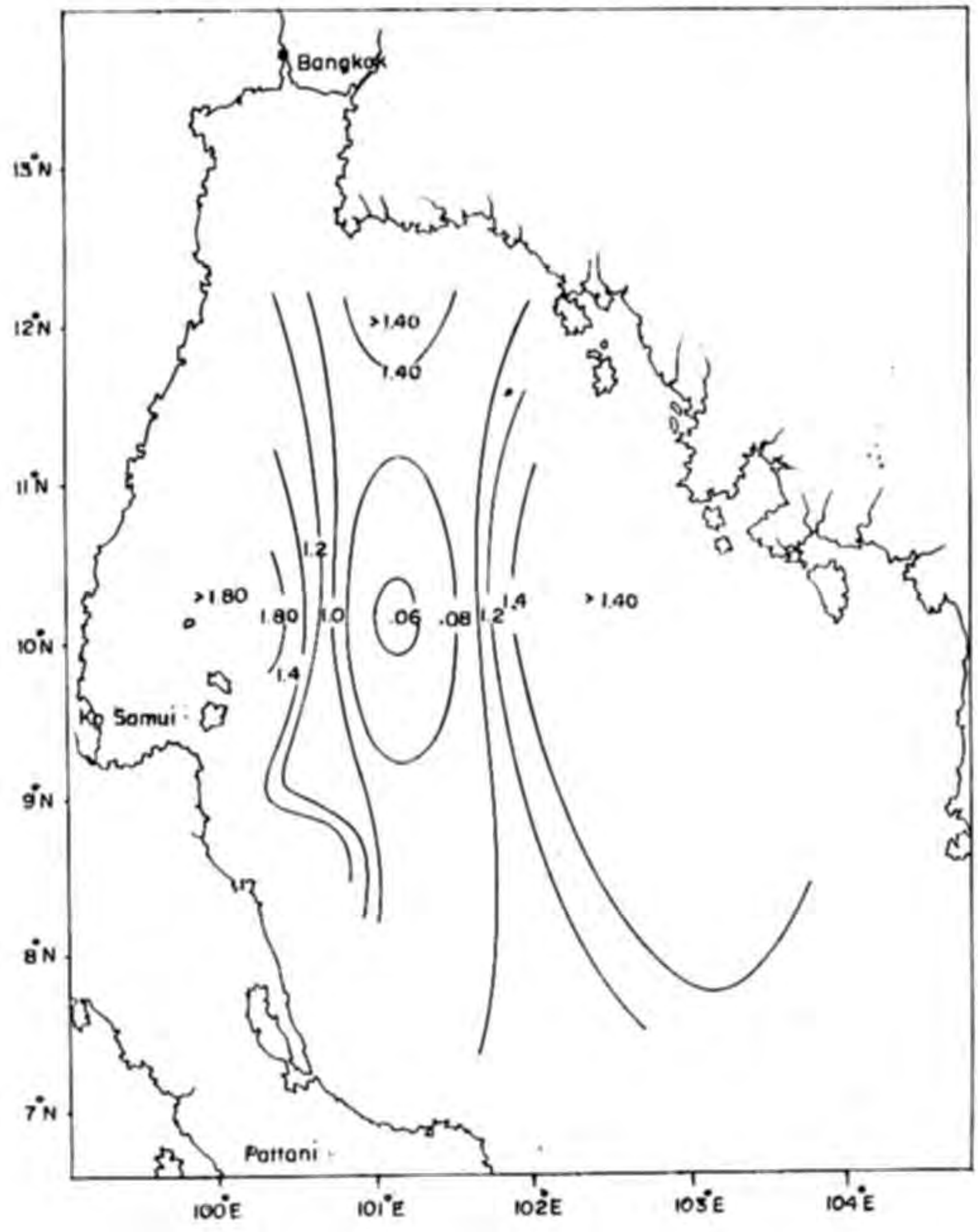

Figure 9. Horizontal distribution of dissolved inorganic phosphate at the surface

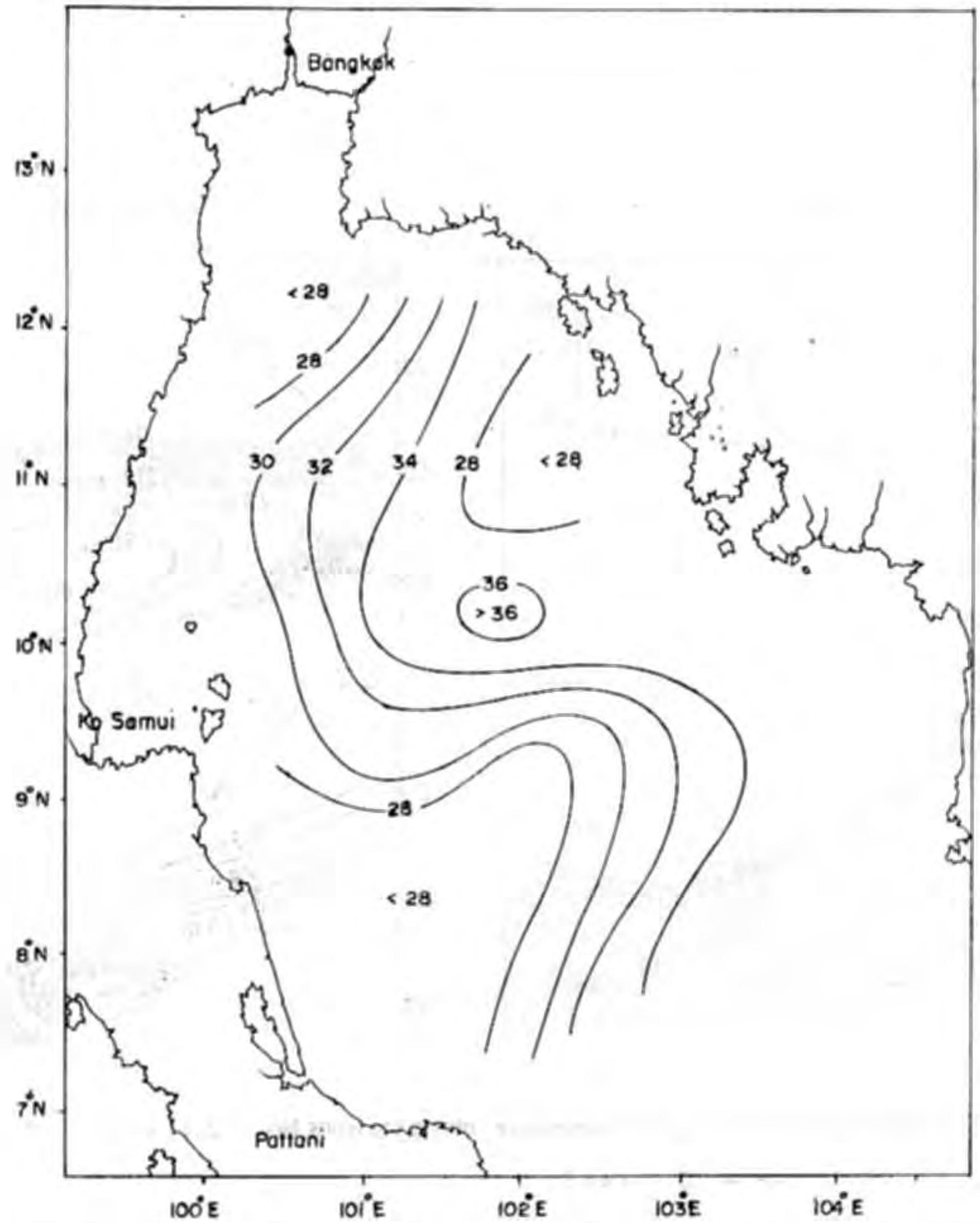

Figure 10. Horizontal distribution of dissolved inorganic silicate at the surface

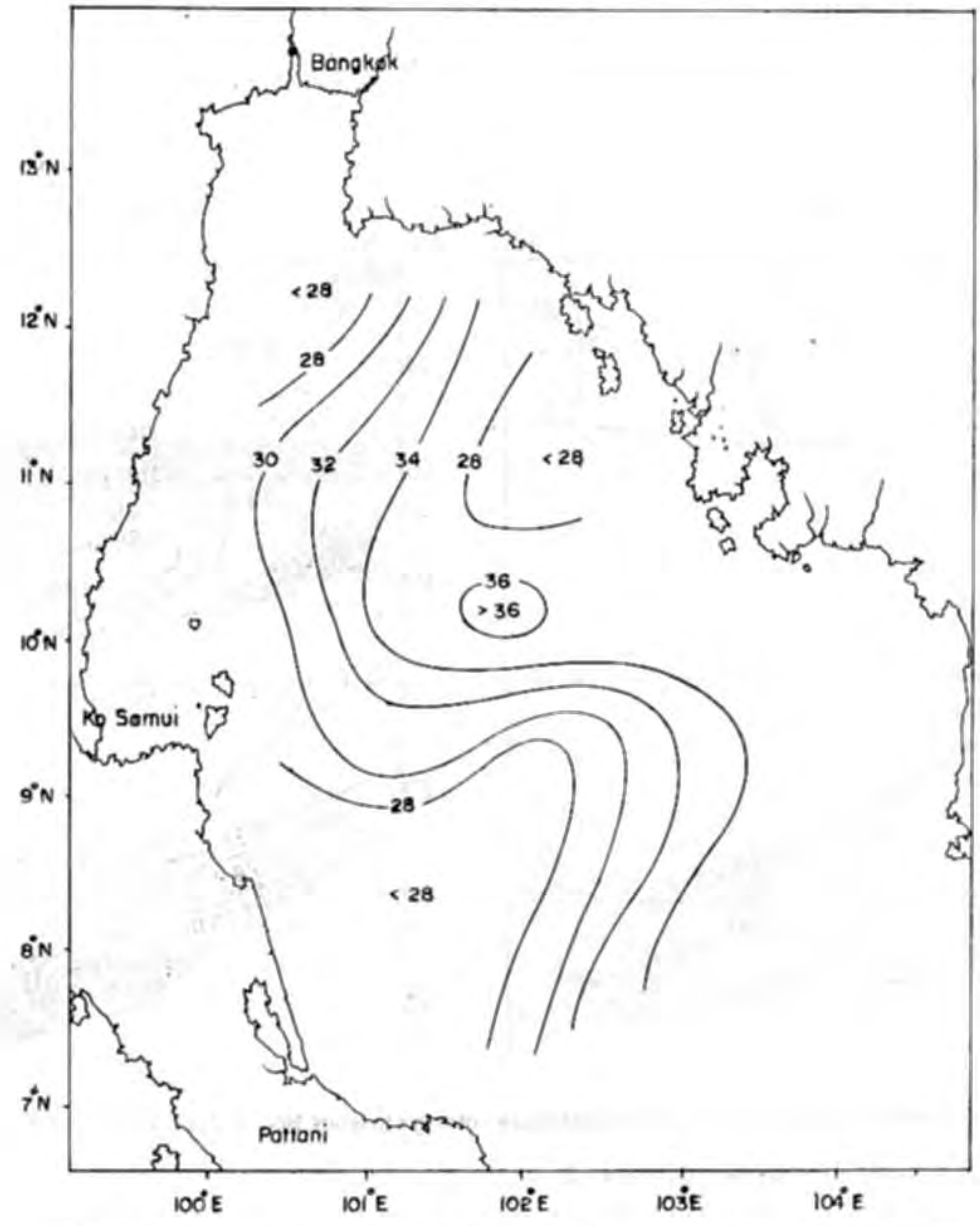

Figure 10. Horizontal distribution of dissolved inorganic silicate at the surface

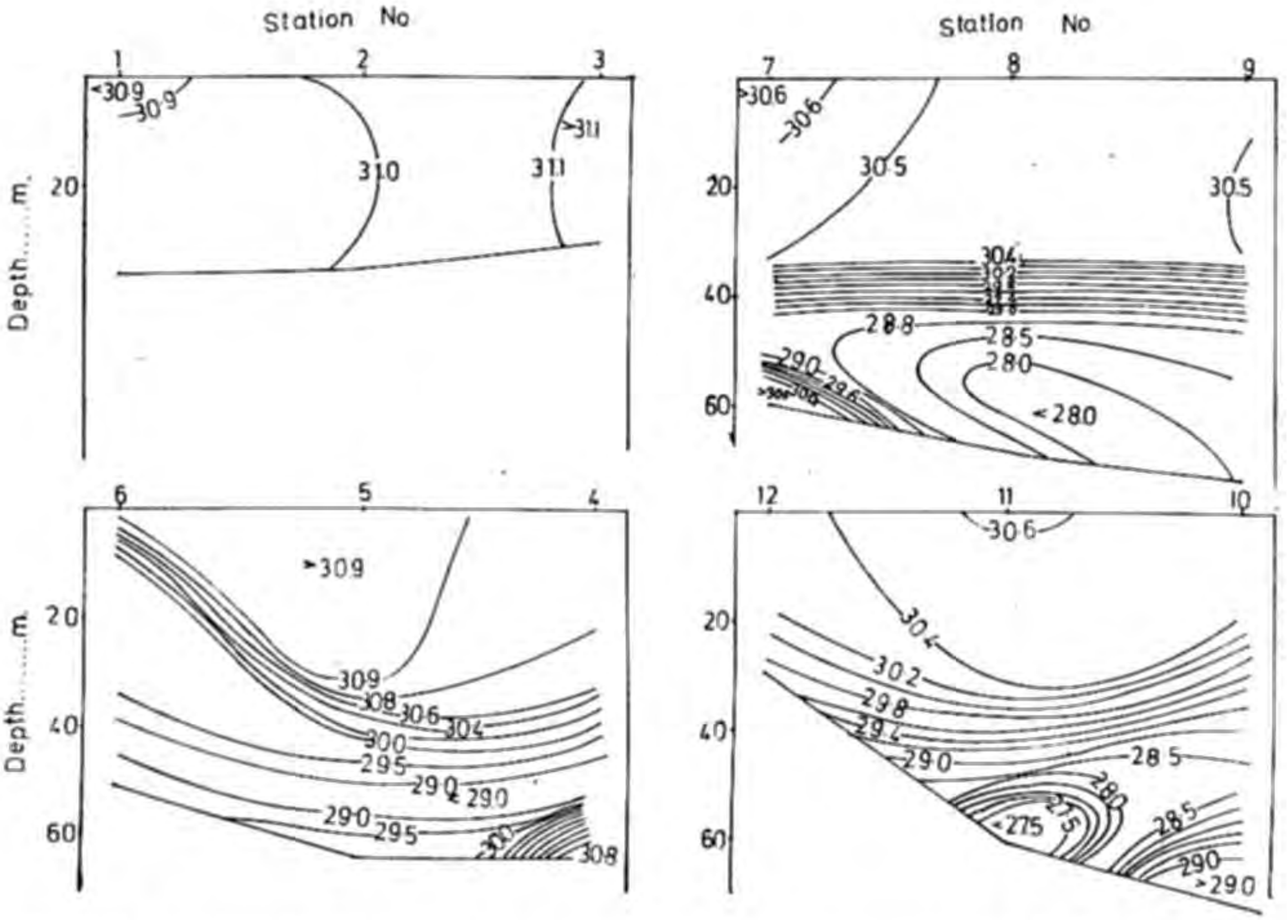

Figure 11 Vertical distribution of temperature along stations No. 1-2-3, 4-5-6, 7-8-9 and 10-11-12 (scale 1 cm. = 10 miles)

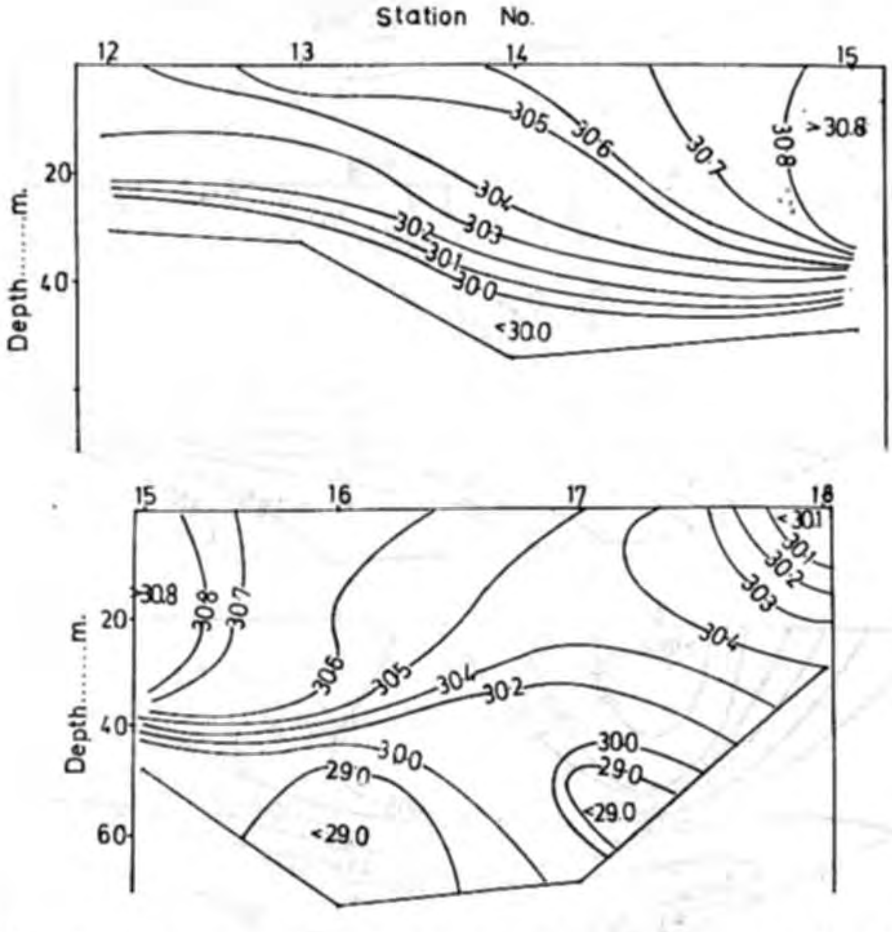

Figure 12 Vertical distribution of temperature along stations No. 12-13-14-15 and 15-16-17-18

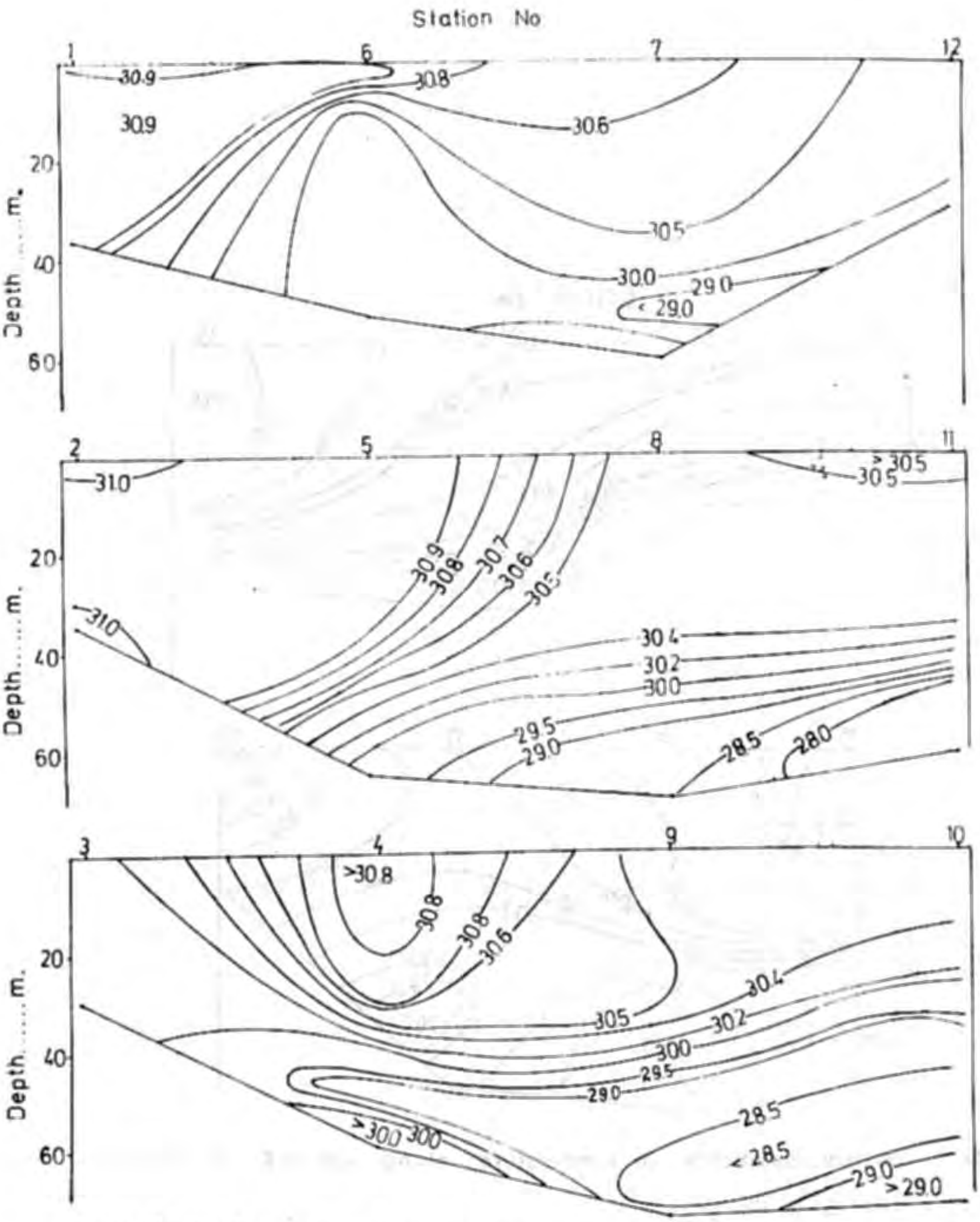

Figure 13 Vertical distribution of temperature along stations No. 1-6-7-12, 2-5-8-11 and 3-4-9-10

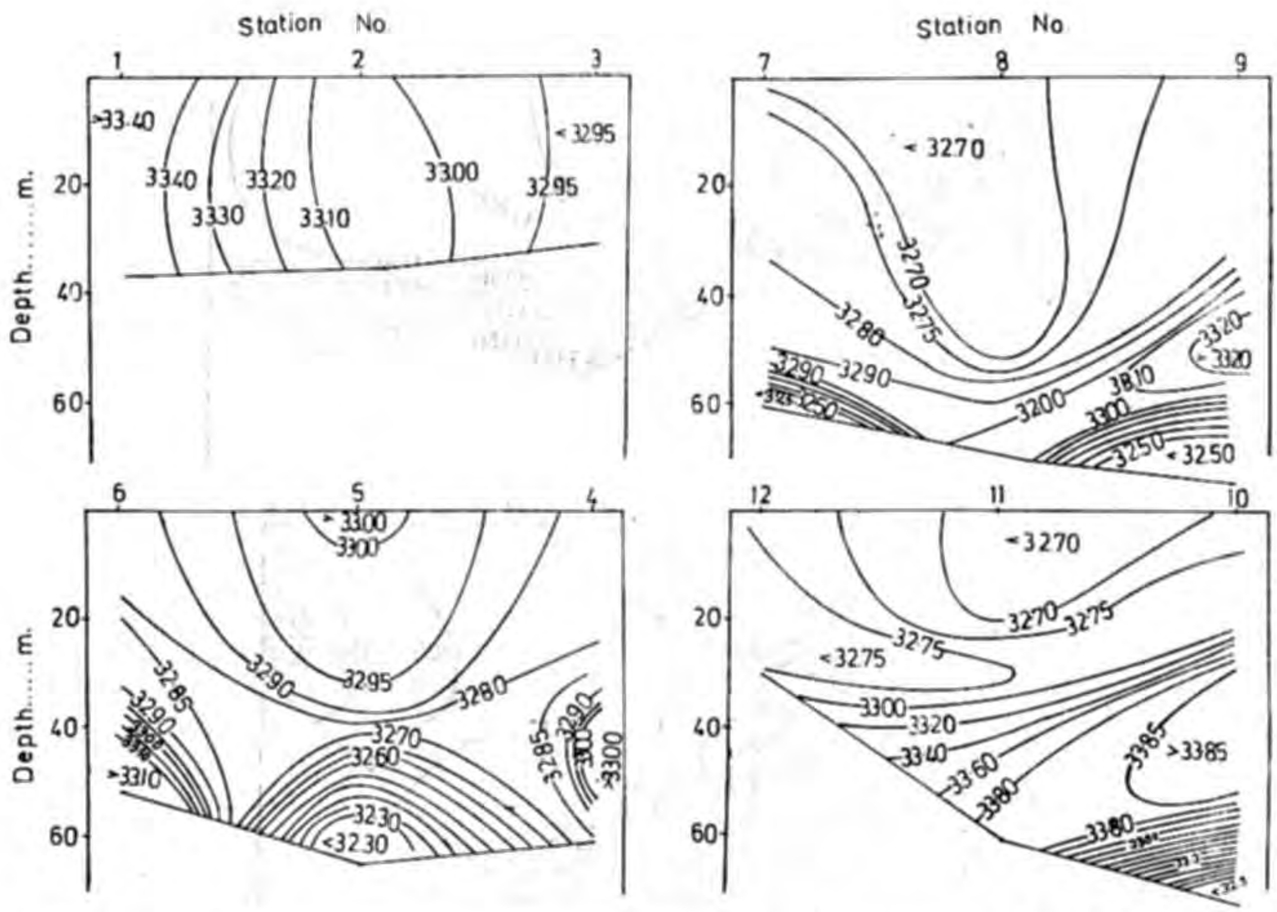

Figure 14 Vertical distribution of salinity along stations No 1-2-3, 4-5-6, 7-8-9 and 10-11-12

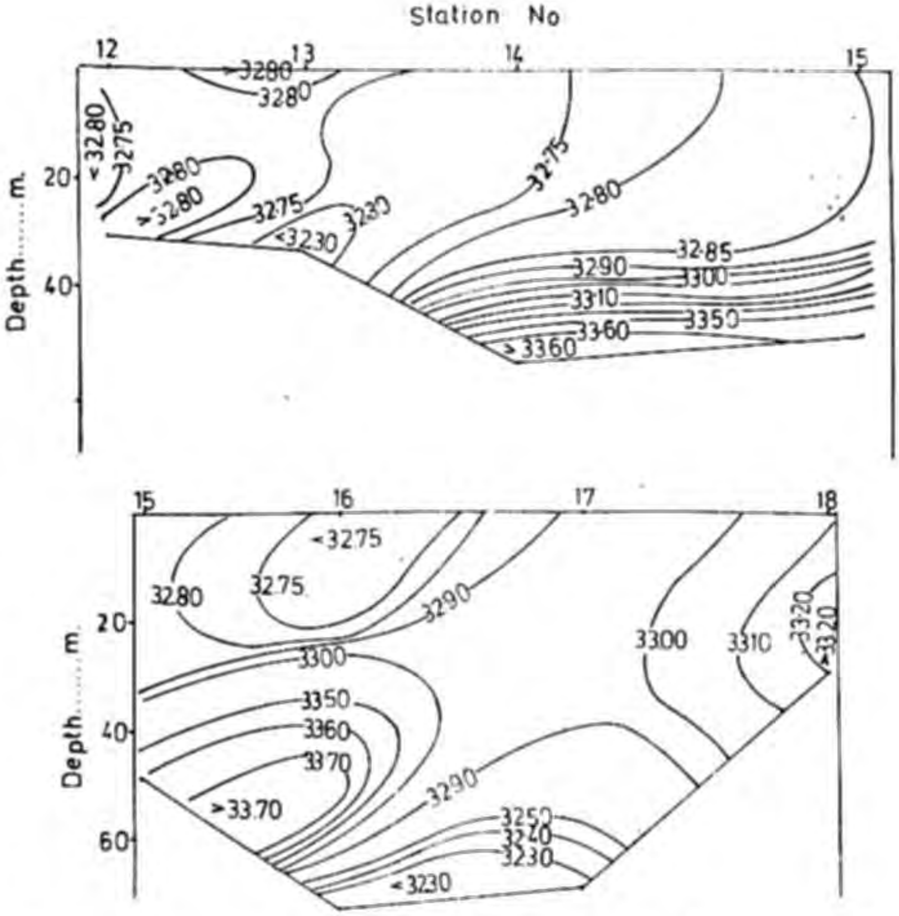

Figure 15 Vertical ditribution of salinity along stations No. 12-13-14-15 and 15-16-17-18

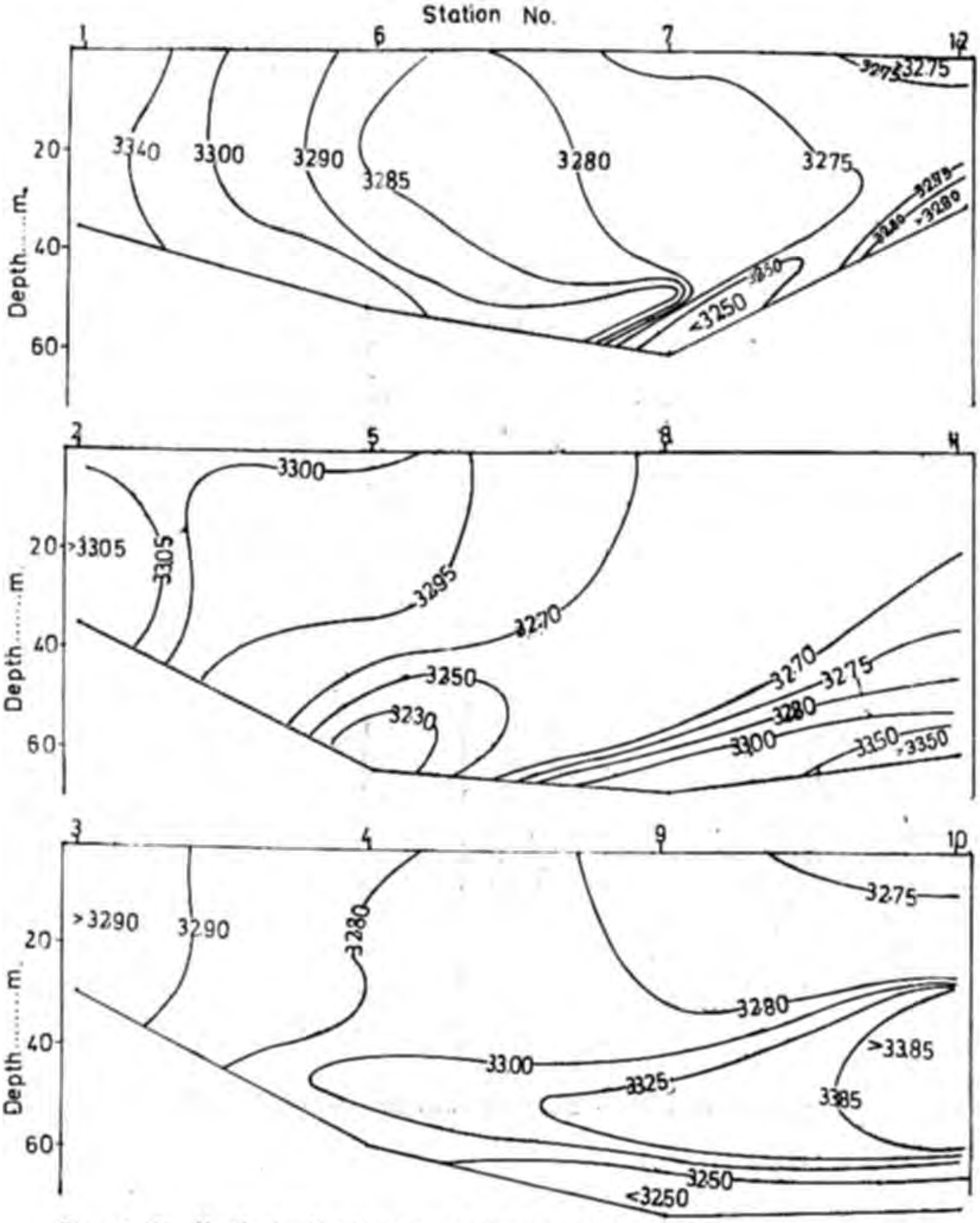

Figure 16 Vertical distribution of salinity along stations No. 1-6-7-12, 2-5-8-11 and 3-4-9-10

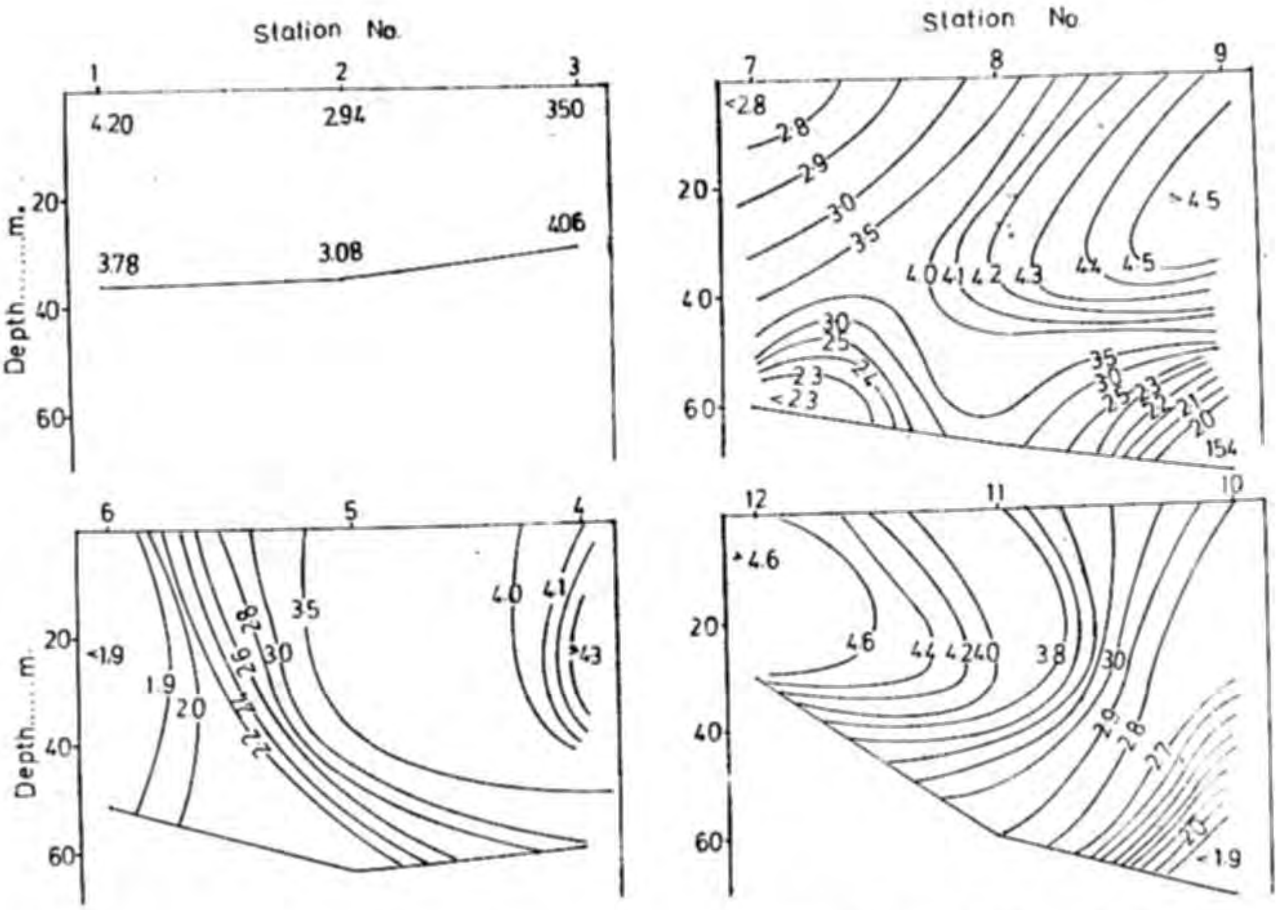

Figure 17 Vertical distribution of dissolved oxygen along stations No. 1-2-3, 4-5-6, 7-8-9 and 10-11-12

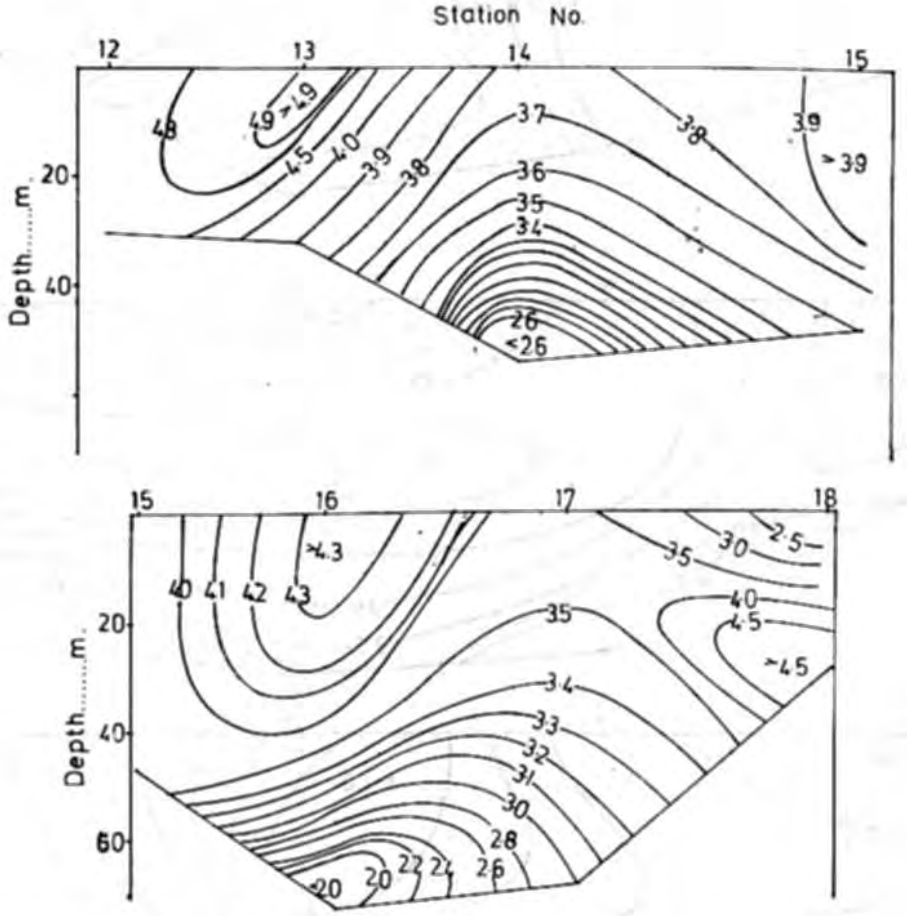

Figure 18 Vertical distribution of dissolved oxygen along stations No. 12-13-14-15 and 15-16-17-18

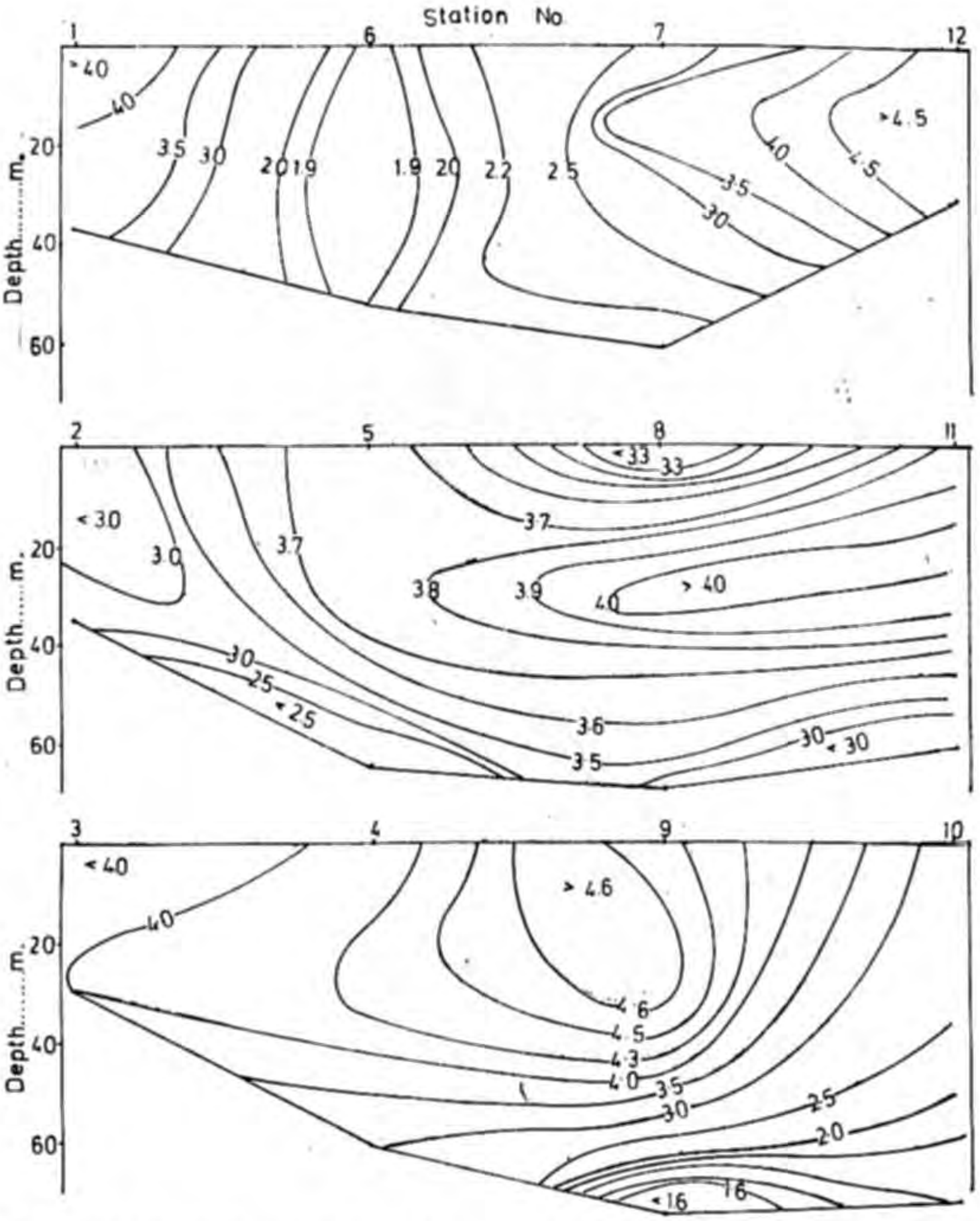

Figure 19 Vertical distribution of dissolved oxygen along stations No. 1-6-7-12, 2-5-8-11 and 3-4-9-10

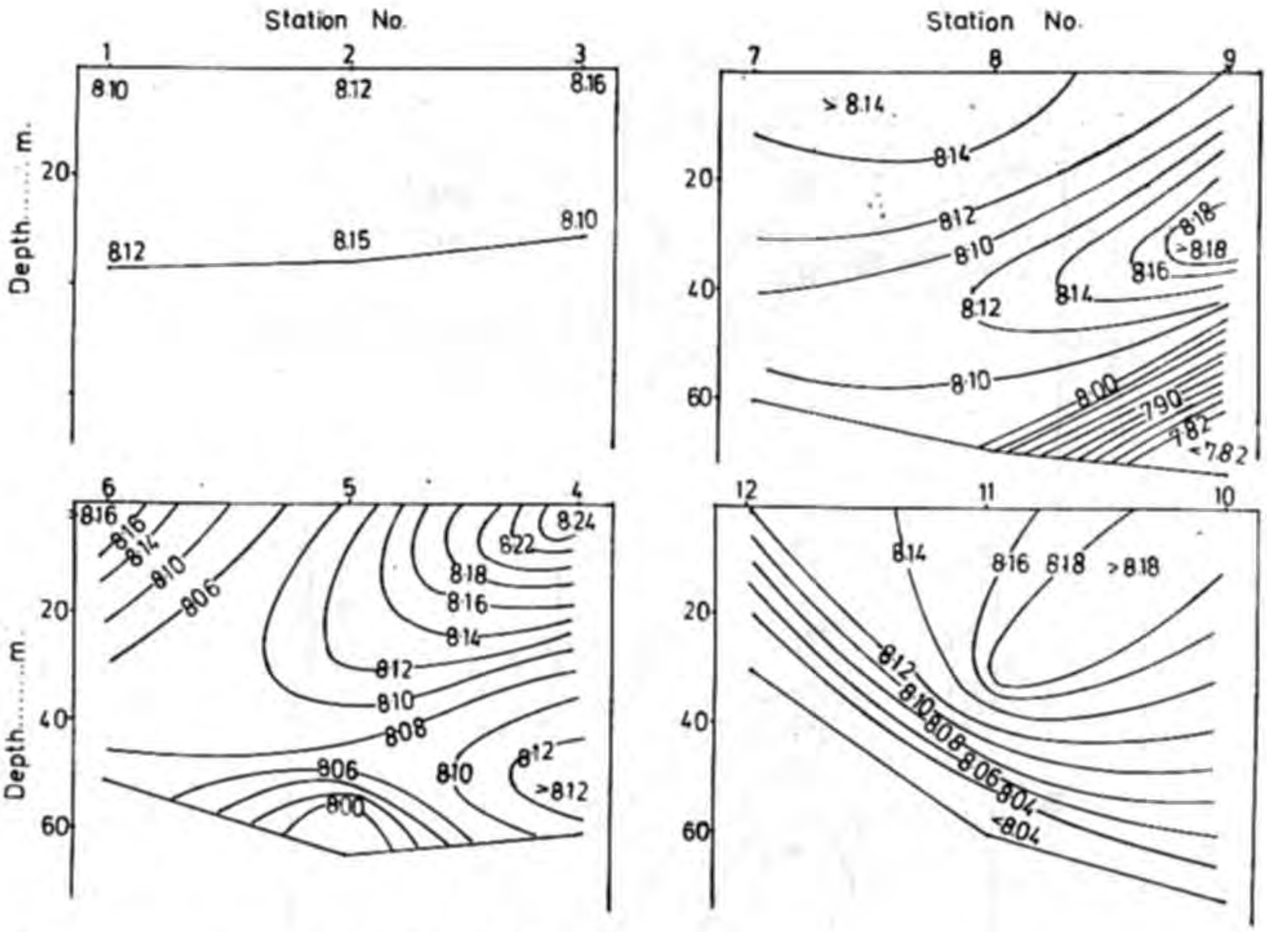

Figure 20 Vertical distribution of hydrogen - ion concentration along stations No. 1-2-3, 4-5-6, 7-8-9 and 10-11-12

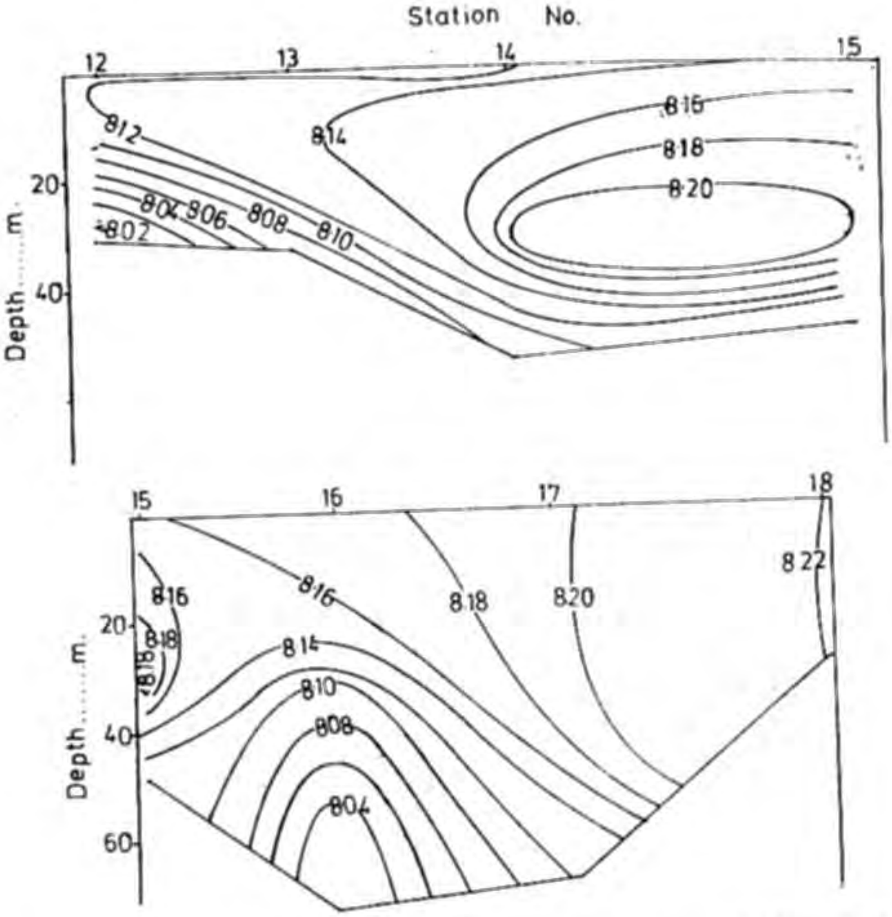

Figure 21 Vertical distribution of hydrogen - ion concentration along stations No. 12- 13-14-15 and 15-16-17-18

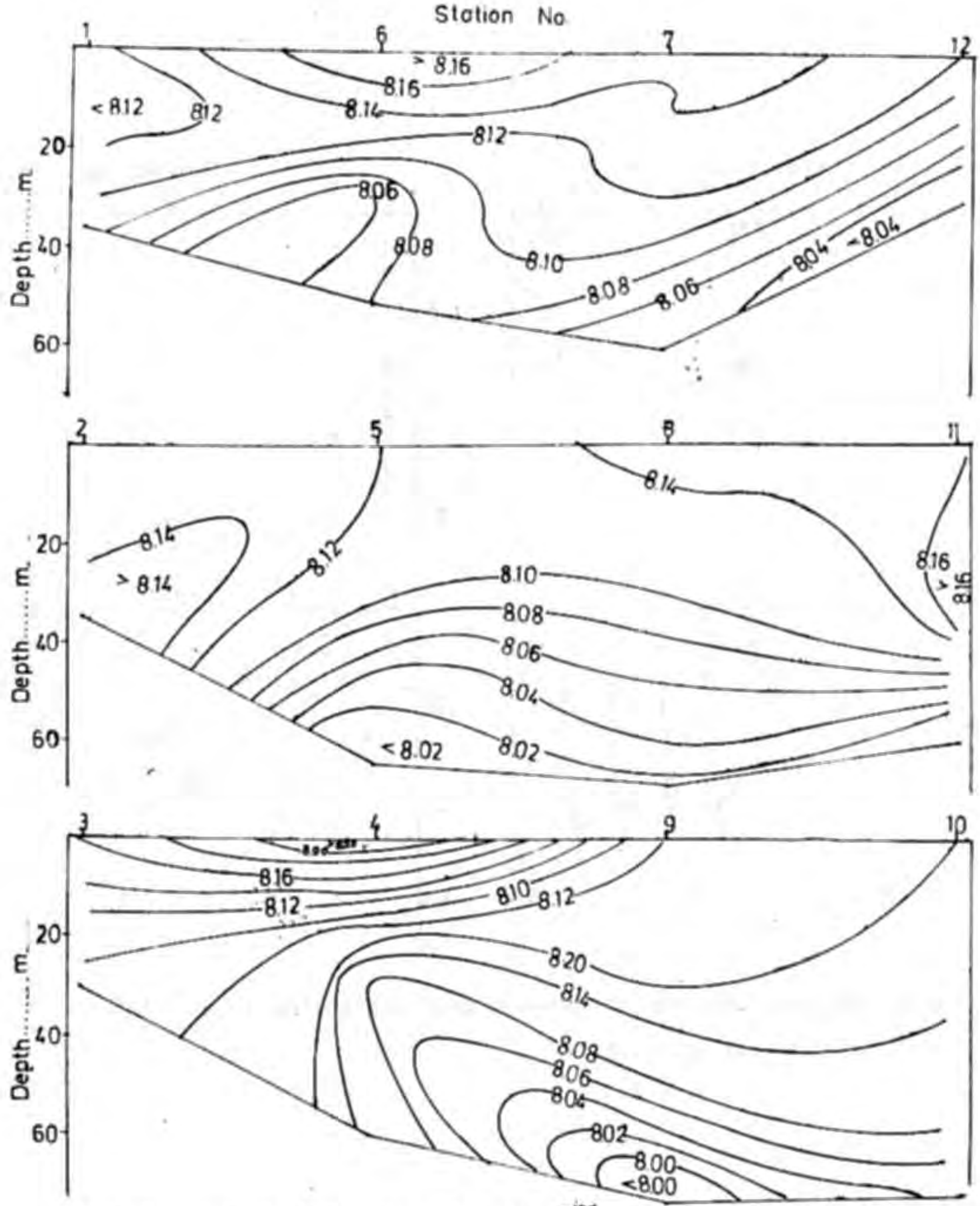

Figure 22 Vertical distribution of hydrogen-ion concentration along stations No. 1-6-7-12, 2-5-8-11 and 3-4-9-10

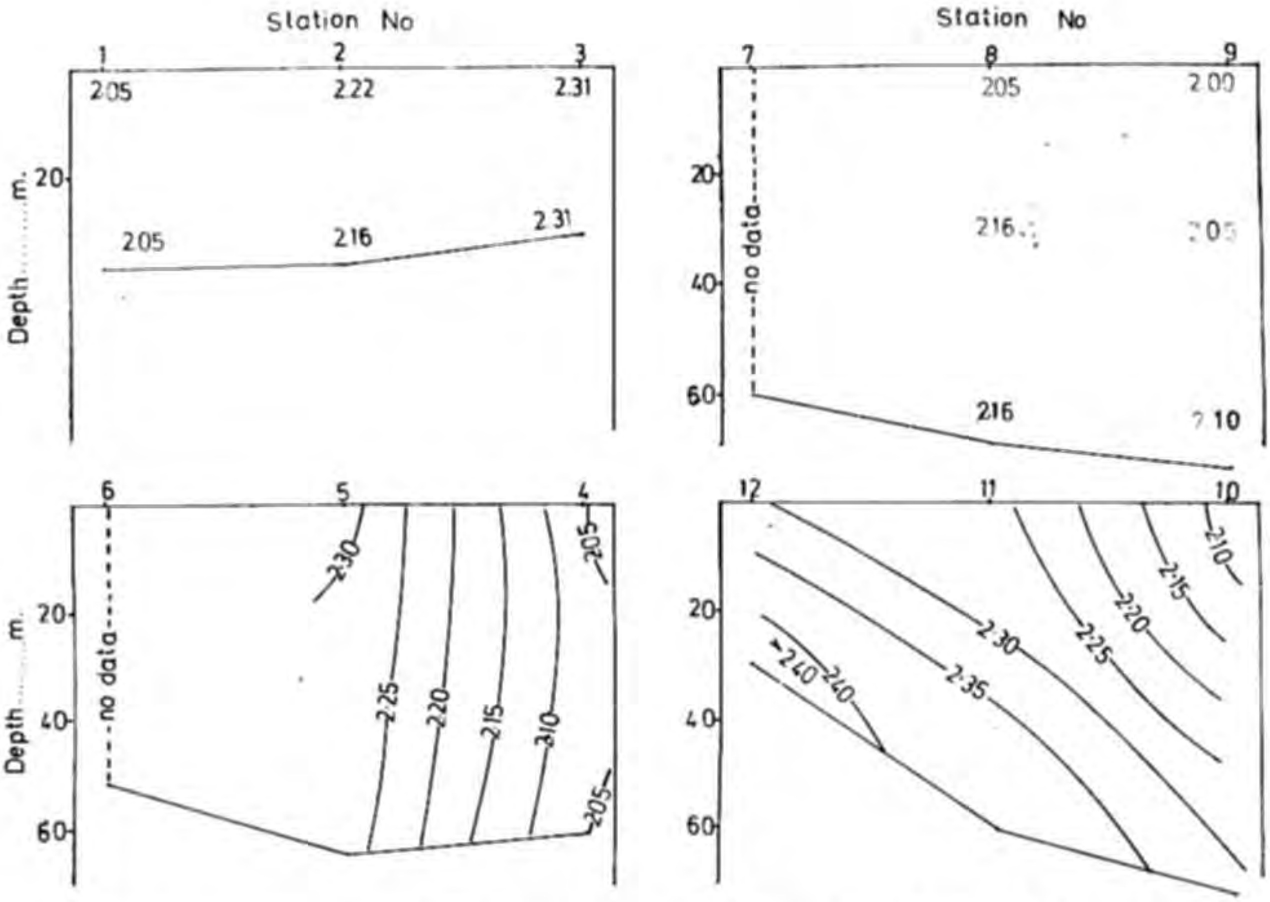

Figure 23 Vertical distribution of alkalinity along stations No. 1-2-3 , 4-5-6 7-8-9 and 10-11-12

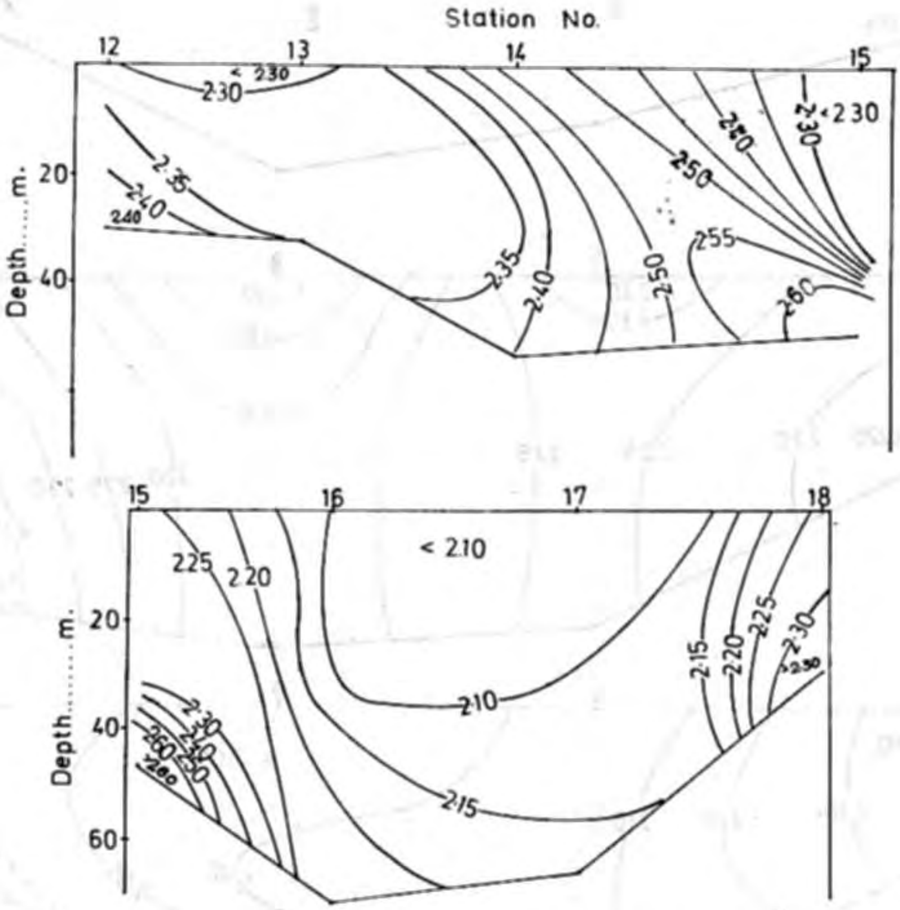

Figure 24 Vertical distribution of alkalinity along stations No. 1-6-7-12, 2-5-8-11 and 3-4-9-10

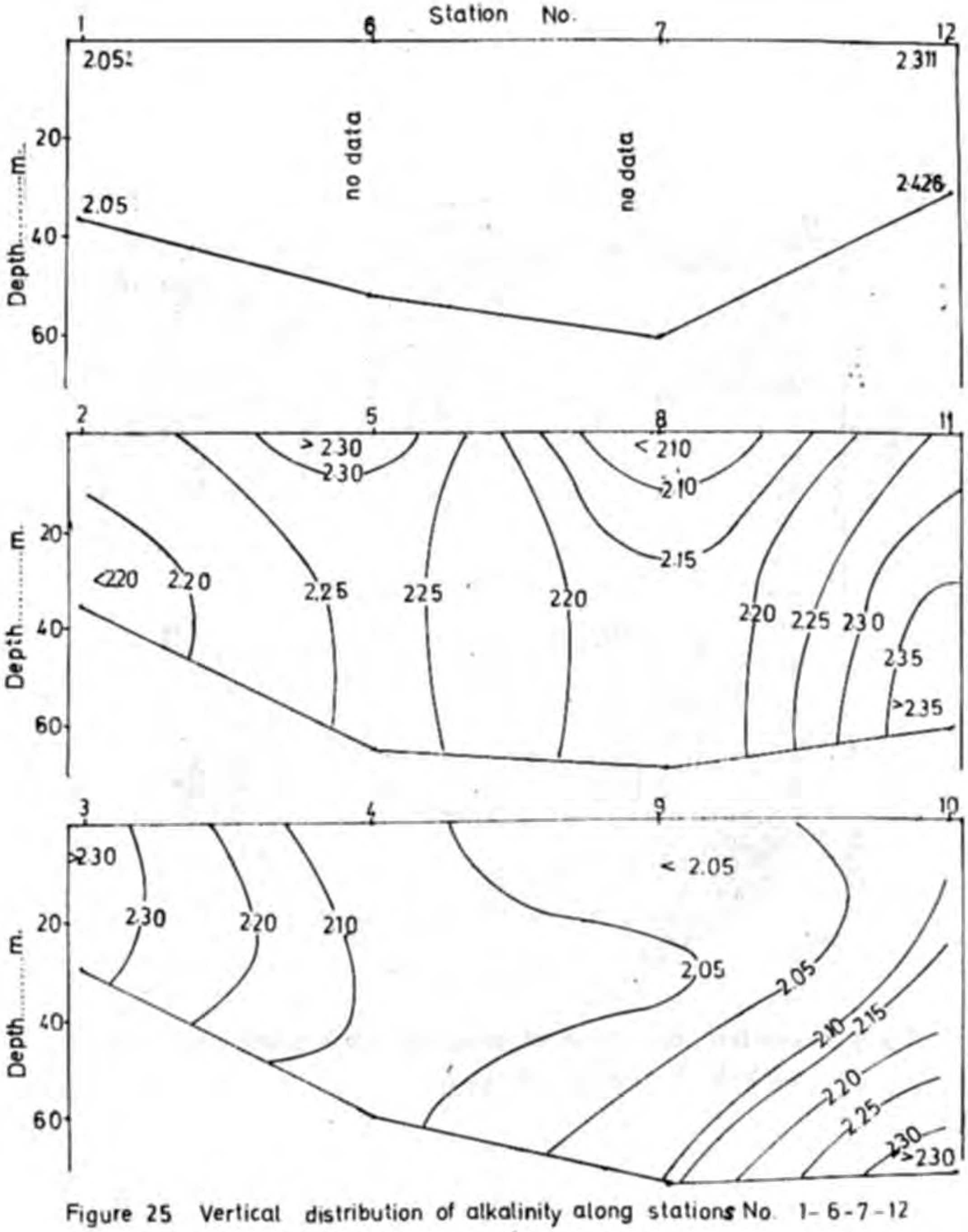

Figure 25 Vertical distribution of alkalinity along stations No. 1-6-7-12 2-5-8-11 and 3-4-9-10

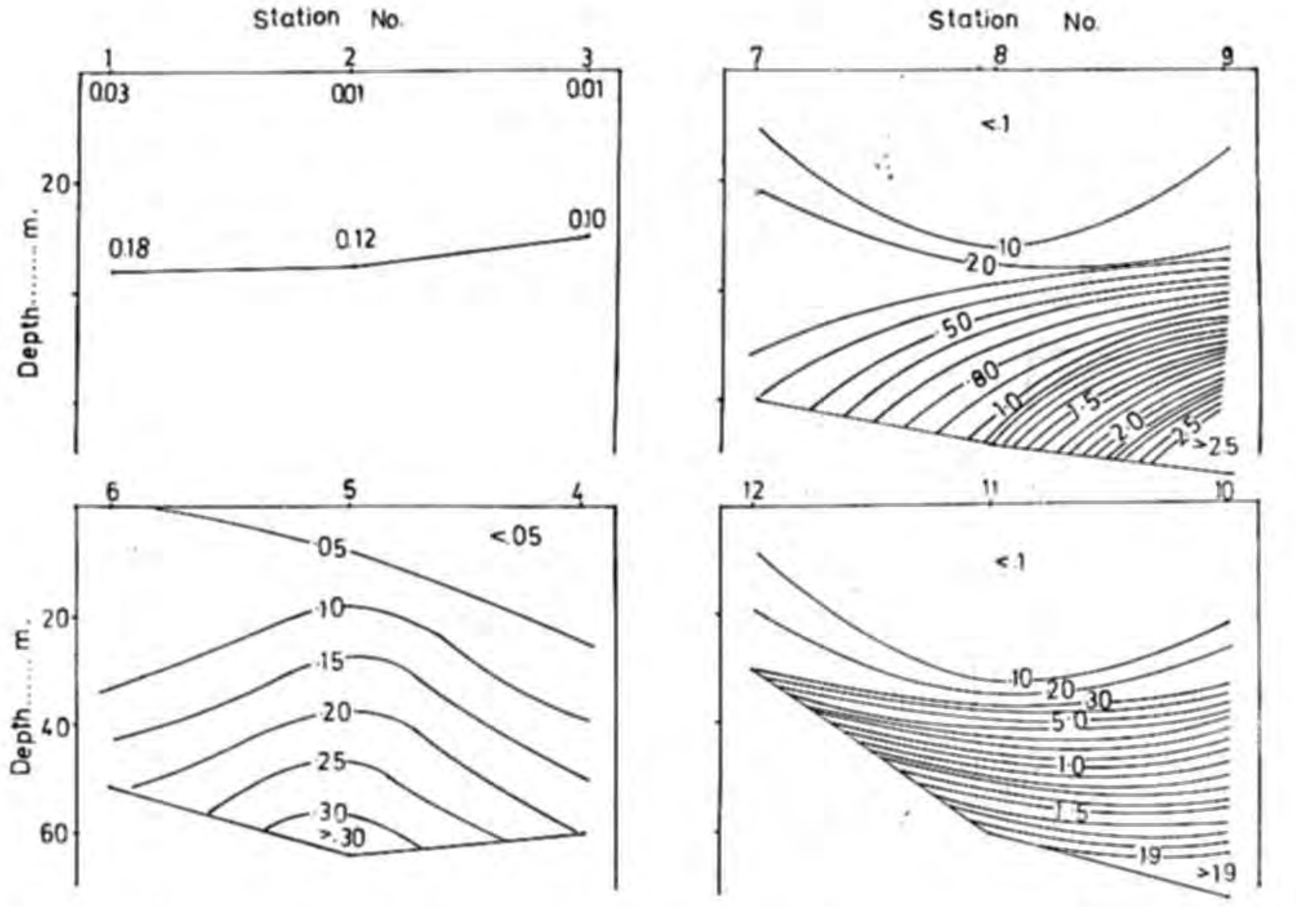

Figure 26 Vertical distribution of dissolved inorganic nitrate along stations No. 1-2-3, 4-5-6 7-8-9 and 10-11-12

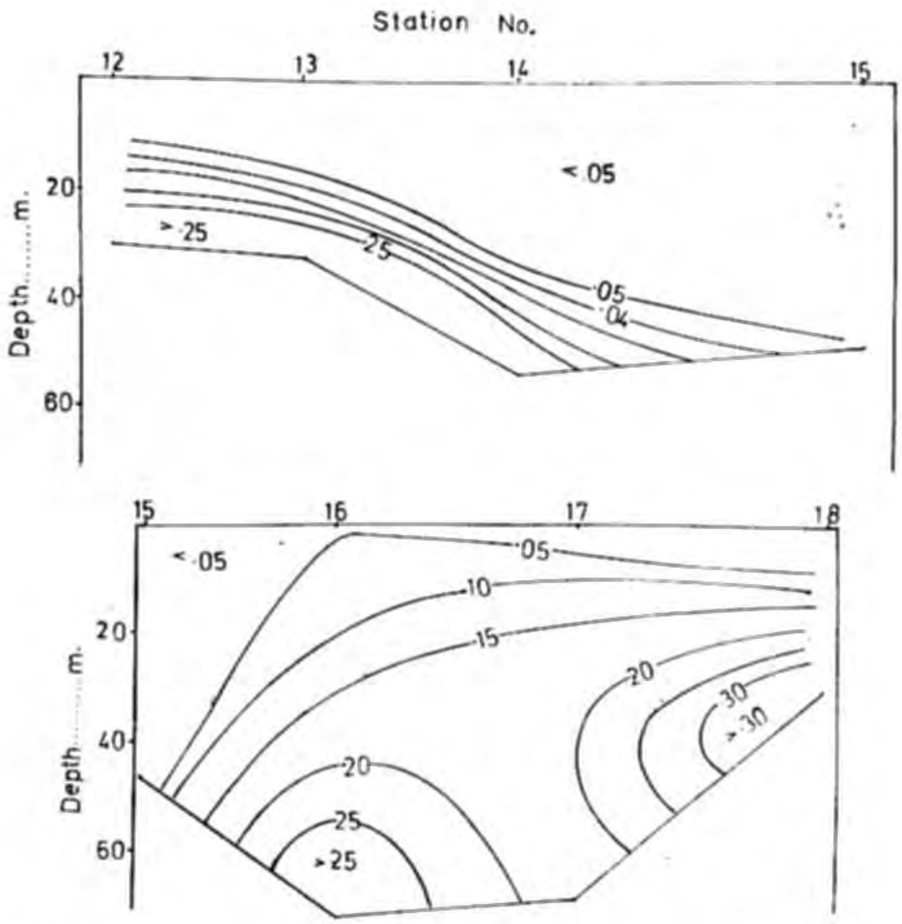

Figure 27 Vertical distribution of dissolved inorganic nitrate along stations No 12-13-14-15 and 15-16-17-18

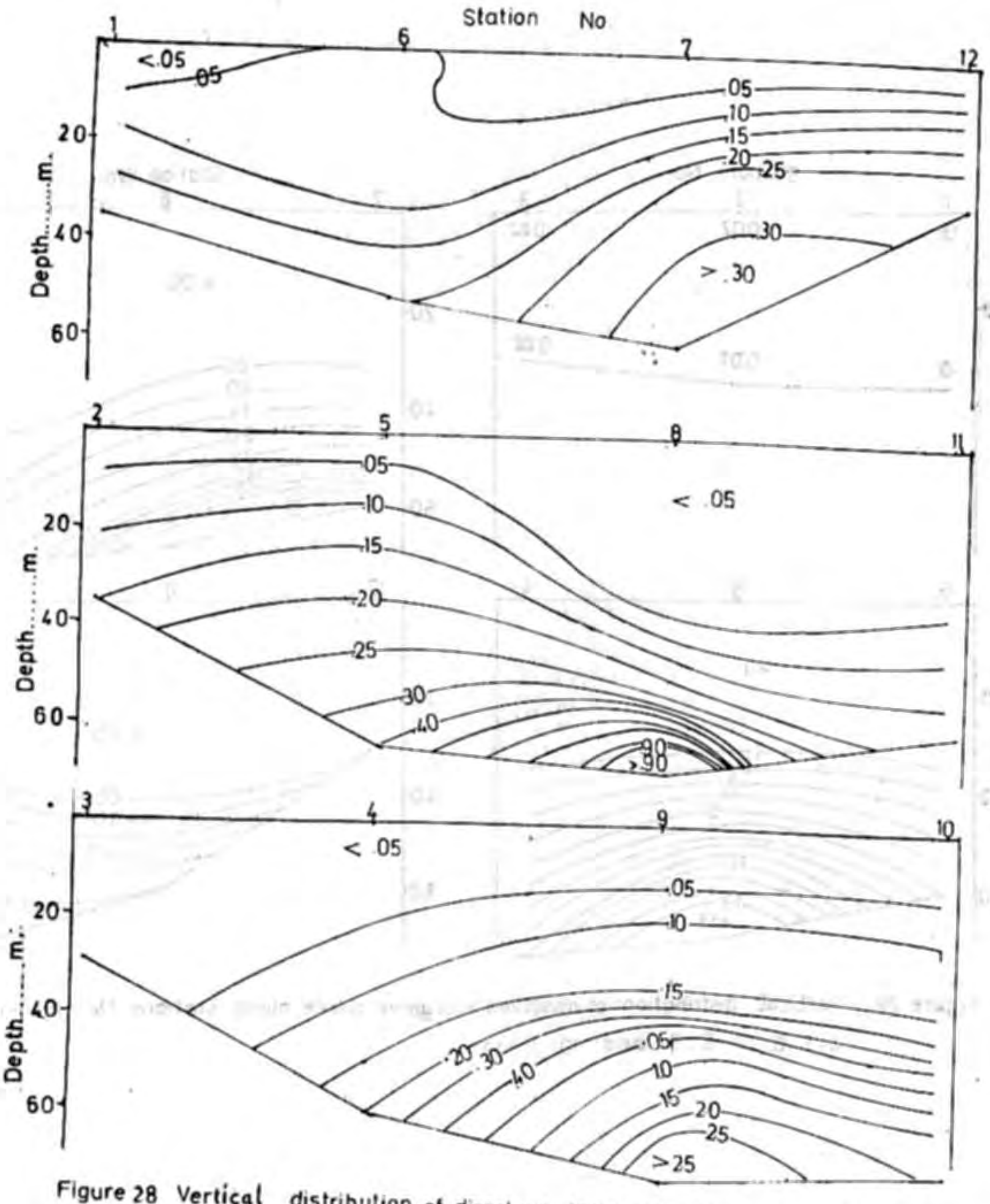

Figure 28 Vertical distribution of dissolved inorganic nitrate along stations No. 1-6-7-12, 2-5-8-11 and 3-4-9-10

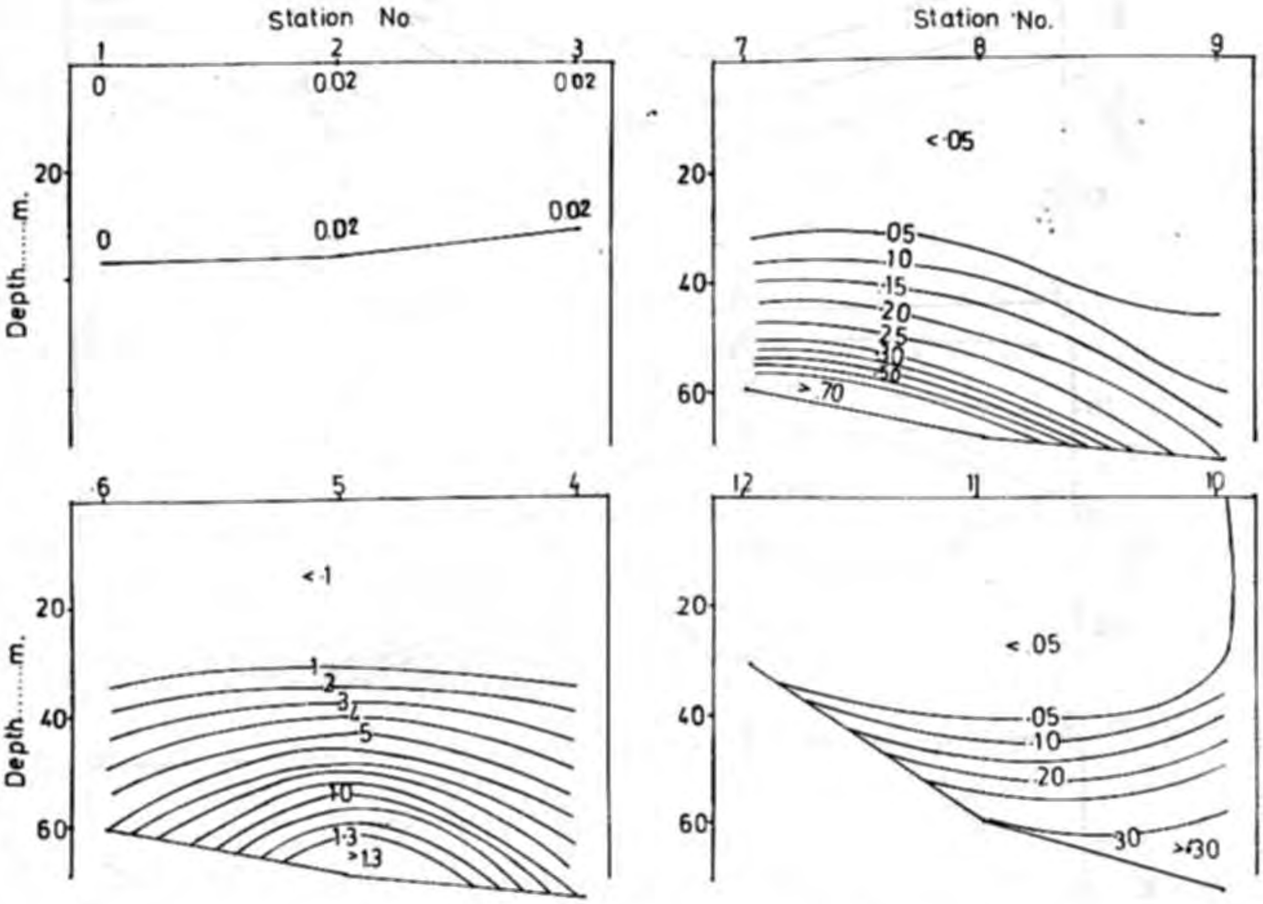

Figure 29 Vertical distribution of dissolved inorganic nitrite along stations No. 1-2-3, 4-5-6, 7-8-9 and 10-11-12

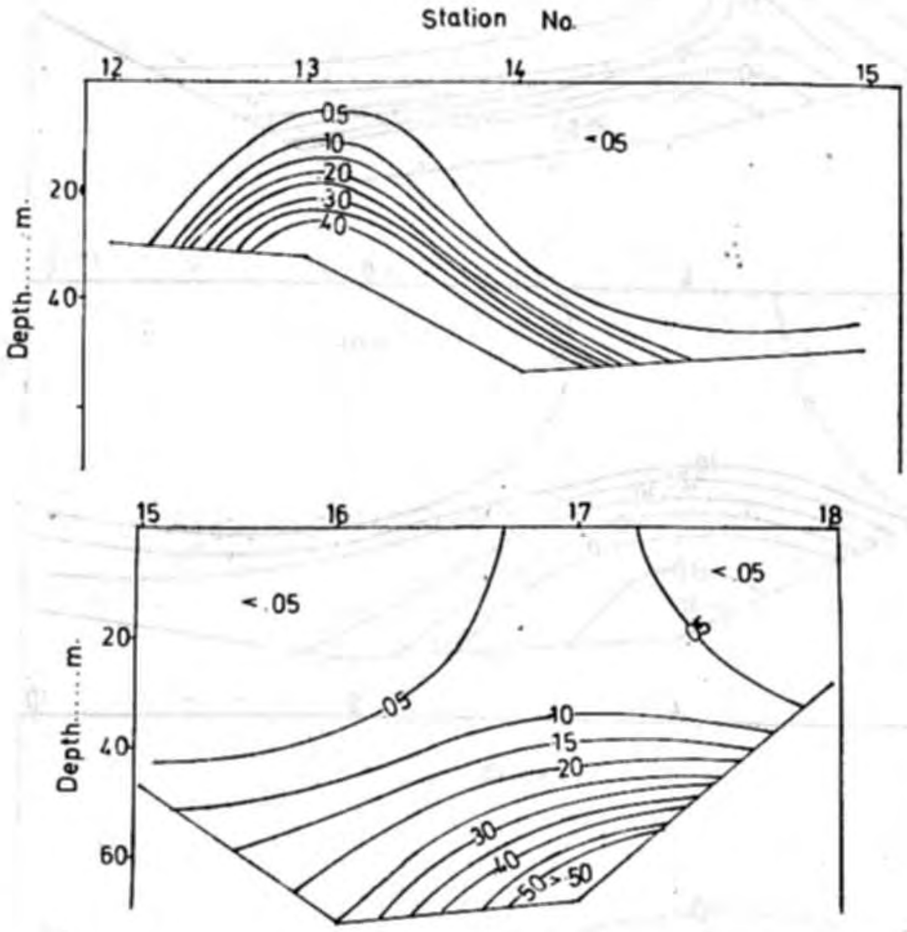

Figure 30 Vertical distribution of dissolved inorganic nitrite along stations No. 12-13-14-15 and 15-16-17-18

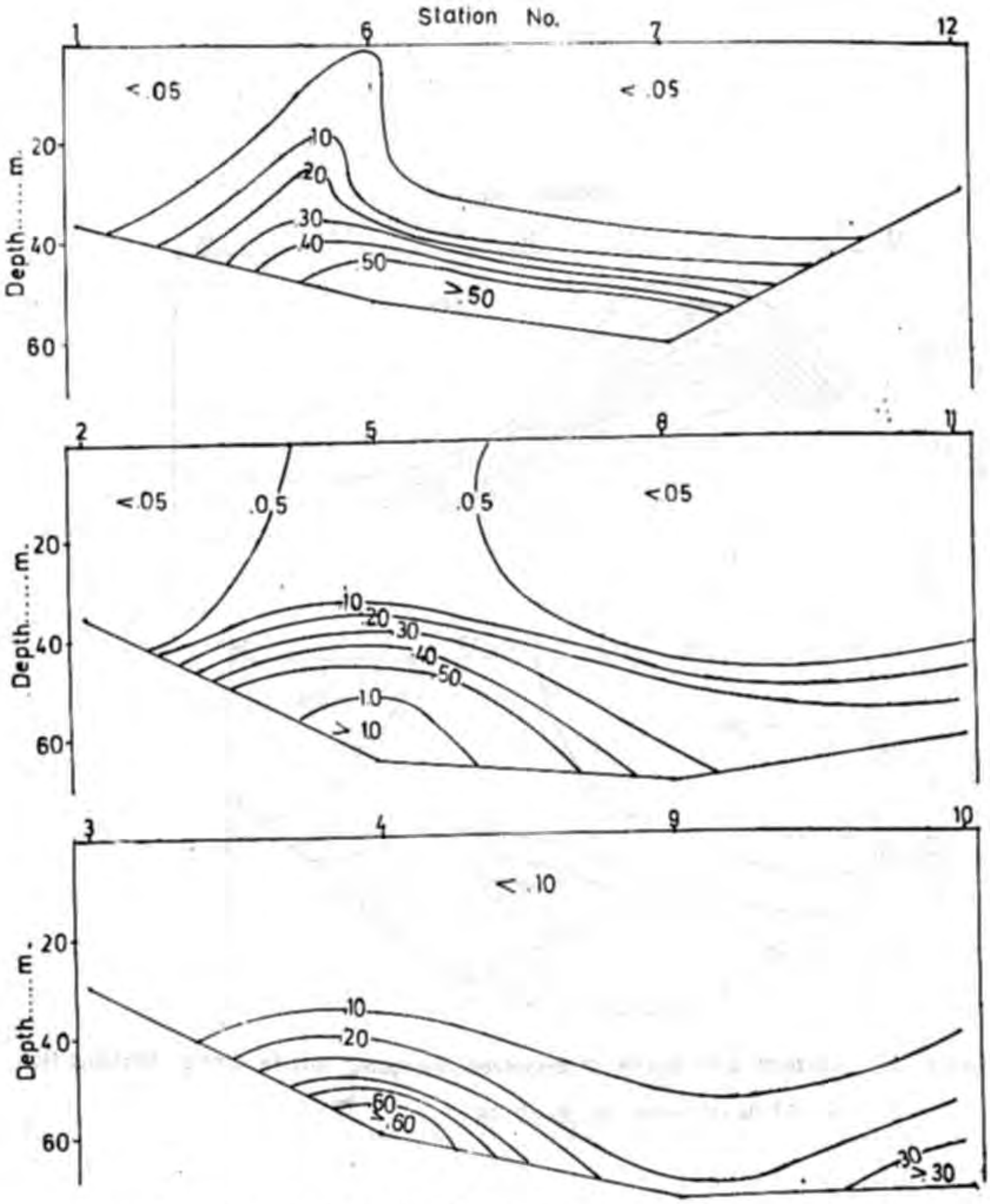

Figure 31 Vertical distribution of dissolved inorganic nitrite along stations No. 1-6-7-12, 2-5-8-11 and 3-4-9-10

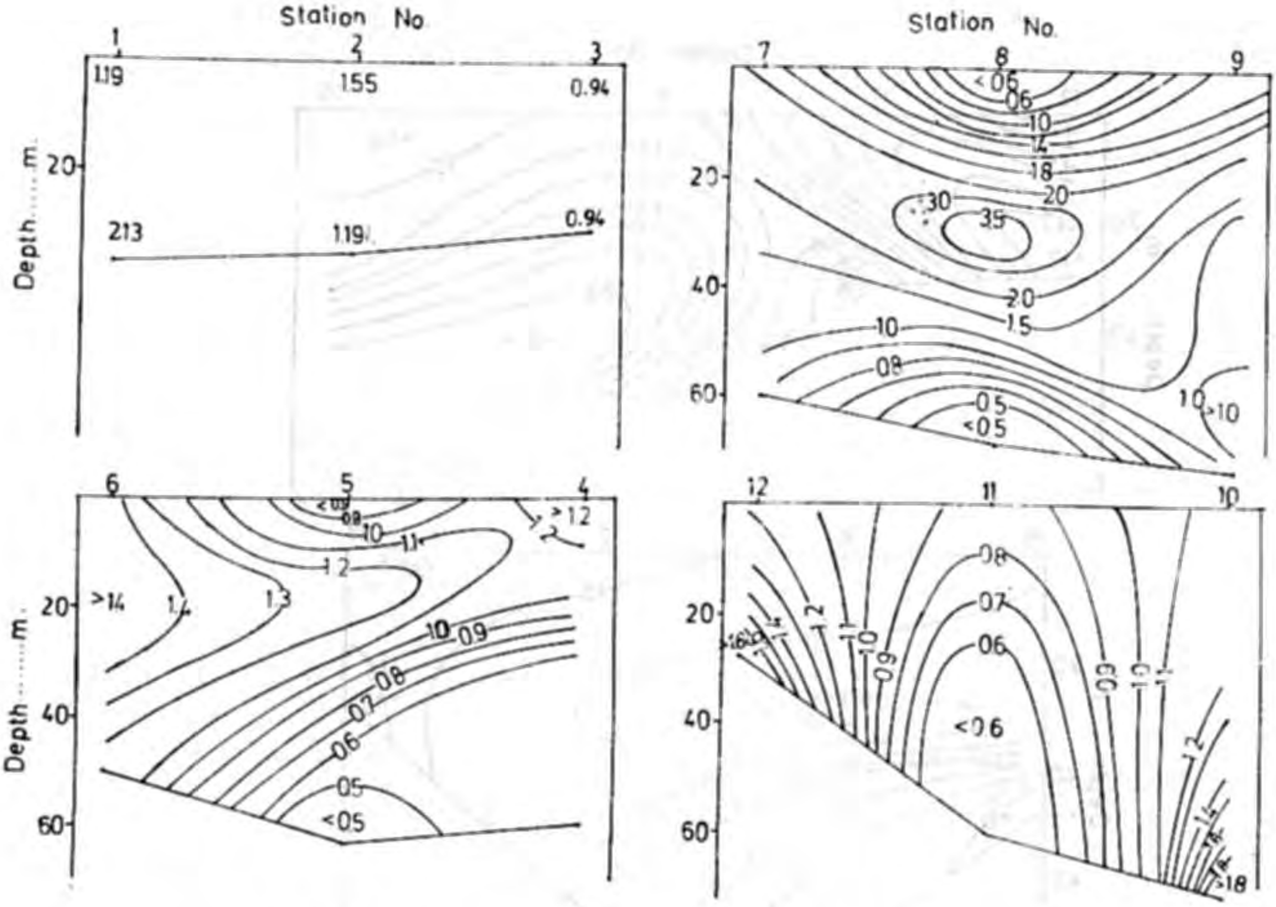

Figure 32 Vertical distribution of dissolved inorganic phosphote along stations No. 1-2-3, 4-5-6, 7-8-9 and 10-11-12

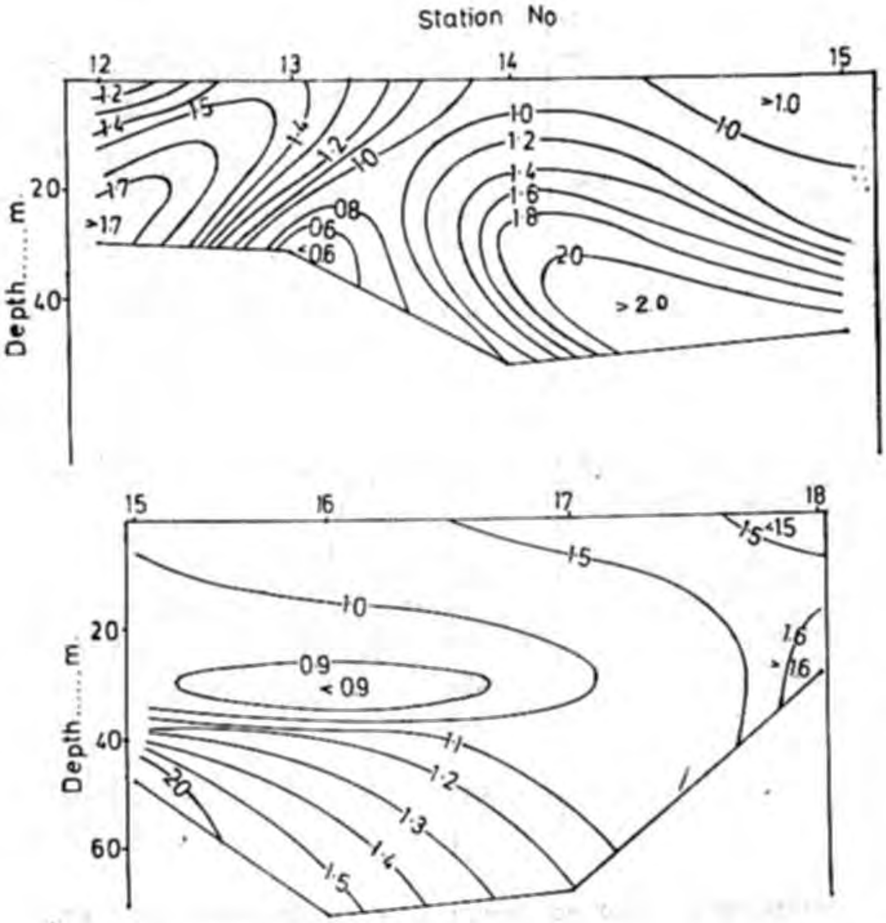

Figure 33 Vertical distribution of dissolved inorganic phosphate along stations No. 12-13-14-15 and 15-16-17-18

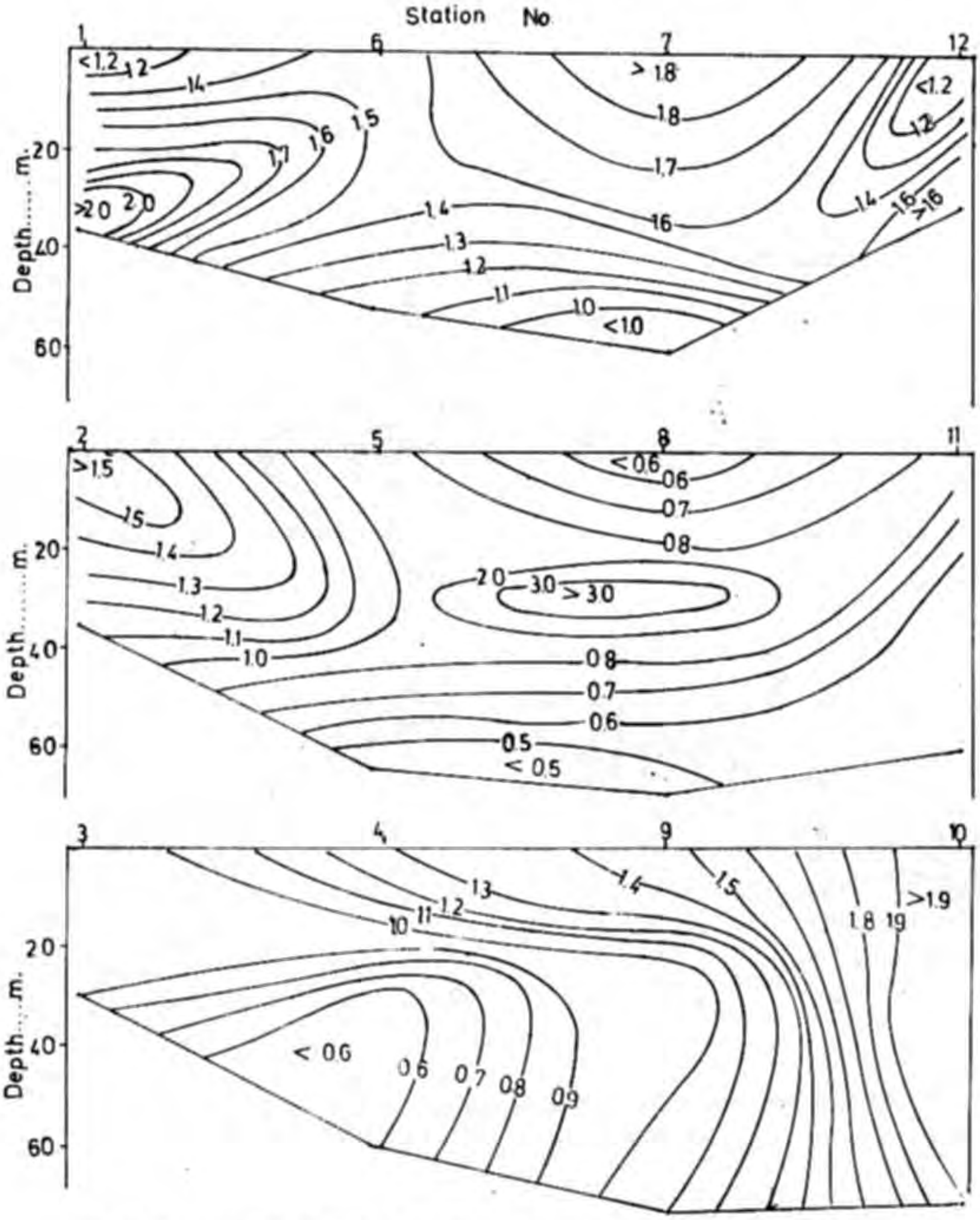

Figure 34 Vertical distribution of dissolved inorganic phosphate along stations No. 1-6-7-12, 2-5-8-11 and 3-4-9-10

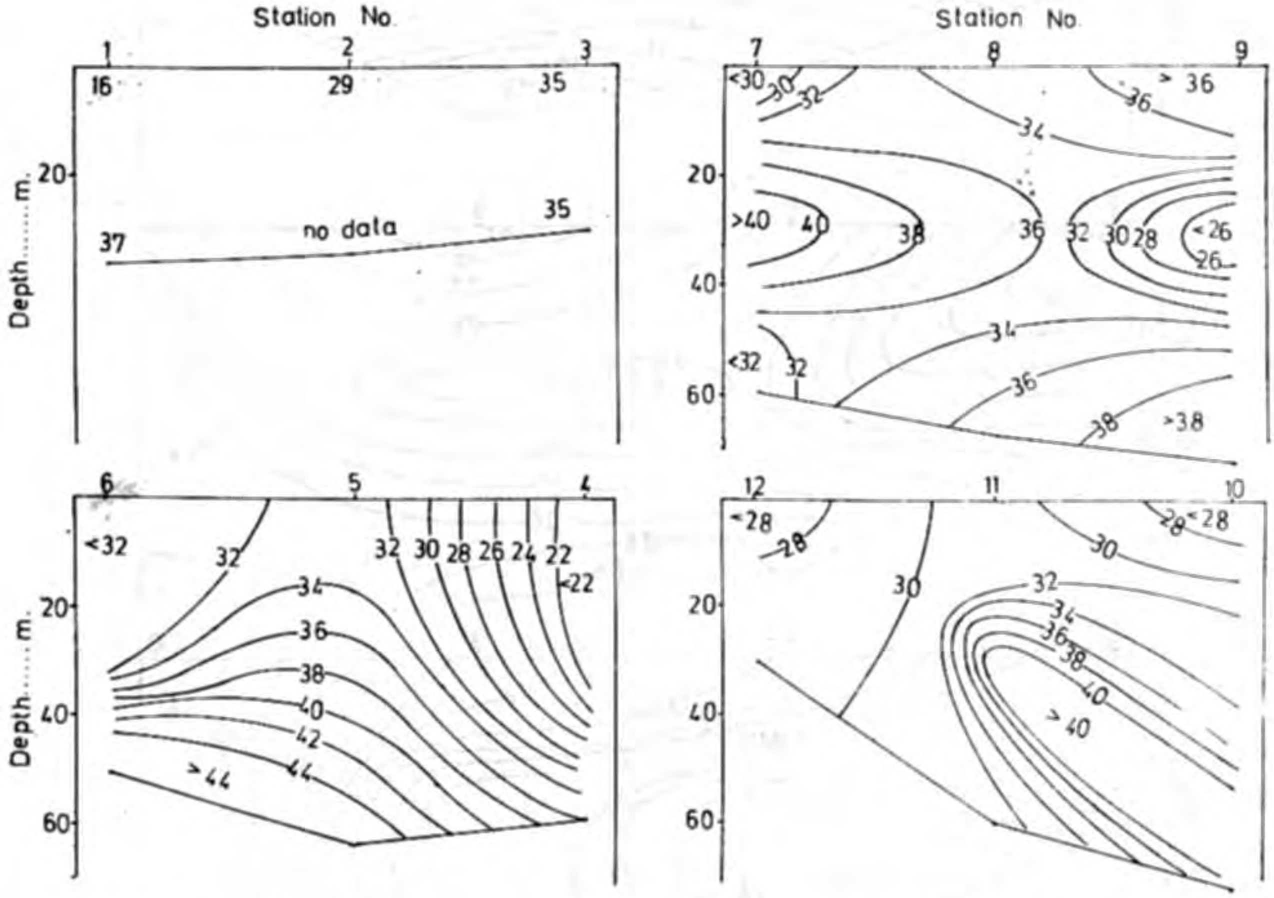

Figure 35 Vertical distribution of dissolved inorganic silicate along stations No 1-2-3, 4-5-6, 7-8-9 and 10-11-12

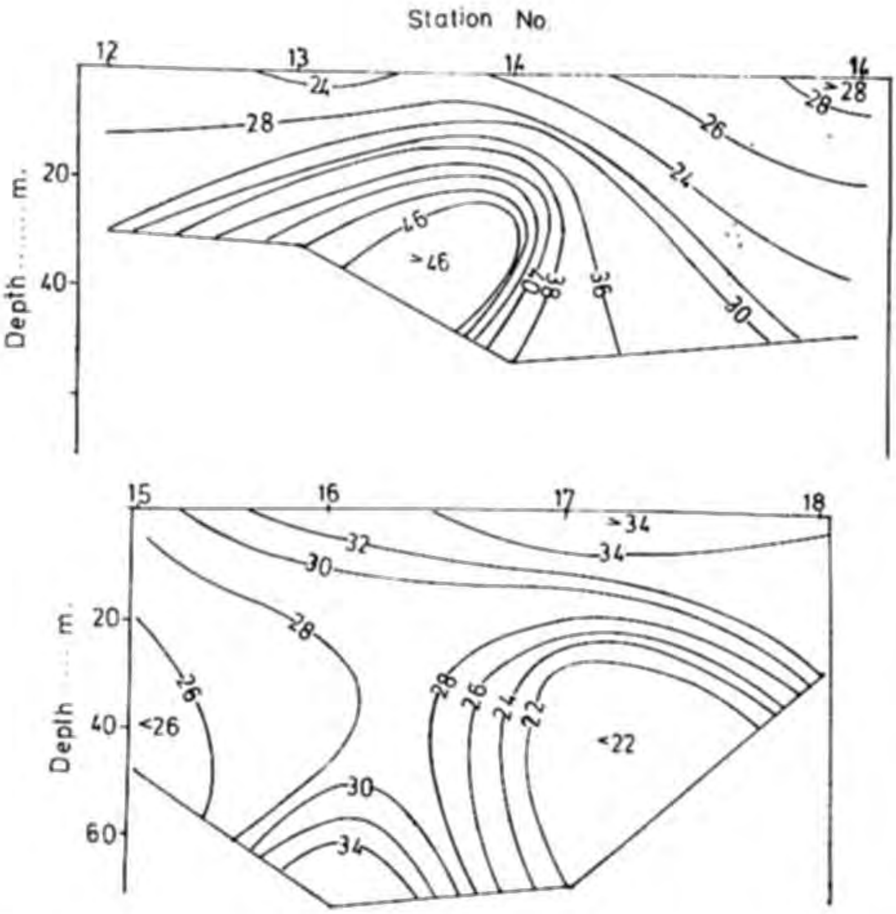

Figure 36 Vertical distribution of dissolved inorganic silicate along stations No 12 - 13 - 14 - 15 and 15 - 16 - 17 - 18

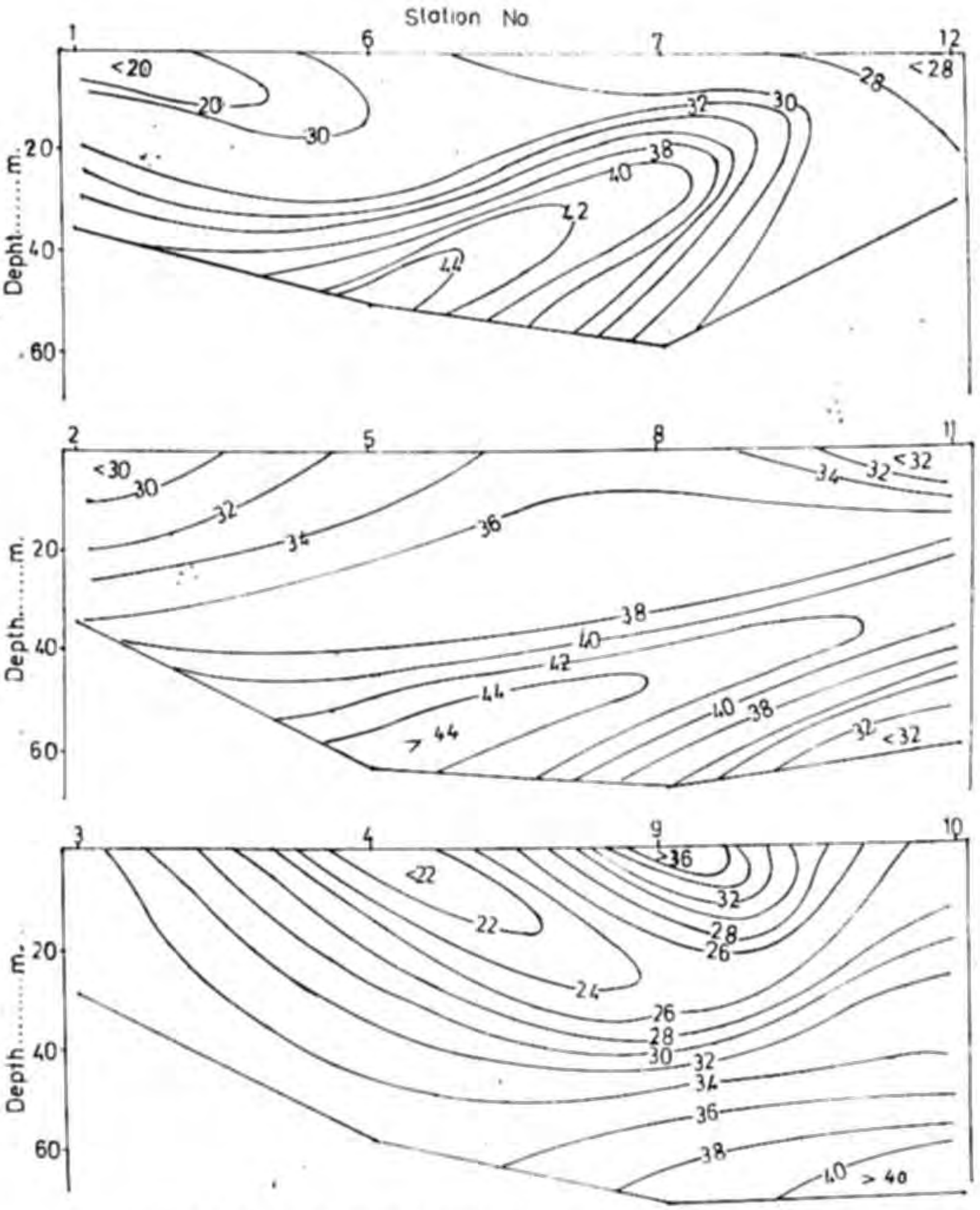

Figure 37 Vertical distribution of dissolved inorganic silicate along stations No 12–13–14–15 and 15–16–17–18