Report of the Japanese-Thai-SEAFDEC Joint Research in the Gulf of Thailand in 1980.

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Fishery-oceanographic survey of the Gulf of Thailand were jointly carried out by Nagasaki University, Thai and SEAFDEC scientists using T/V Nagasaki-maru from 15 to 28 May, 1980.

1) Geometric and vertical distributions of depth-anomaly of sea water were obtained from records of STD system. High salinity warm water was found in the northern area of the Gulf and rather cool water in the south. Remarkable density gradient was commonly observed in the middle layer throughout the Gulf.

2) Experimental bottom trawl operations were made at 18 stations. The total catch amounted to 592 kg, with a catch per hour of 53 kg. The catch consisted of more than 60 fish species of 27 families, 9 mollusk species of 3 families and some crustacean, of which most important were carangids, lutjanids and nemipterids of fishes and loliginids of mollusks. Size composition of each major fishes and mollusks seemed to consist of some groups of 2 to 6 normal distributions. The squid, *Loligo formosana* in the northern waters are bigger by 30 mm in the mantle length and 50 g in weight than those in the south.

3) Gravity core and Smith-McIntyre samples revealed that the bottom of the most parts of the Gulf was covered by grayish calcareous sandy mud or muddy sand tens of centimeters thick, while the central part was covered with only 1~2 cm thick reddish brown mud suspectedly flowed out from the land of Malay Peninsula. The underlying layer throughout the Gulf consisted of grayish calcareous silty clay.

4) The remarkable ruggedness like square waves on the bottom profile were often observed by an echo sounder on the slope around the central basin of the Gulf. The rugged bottom area seems to be unsuitable for trawl net operation.

The oceanographic and trawling survey was jointly carried out in the Gulf of Thailand from 15 to 28 May, 1980 by the Faculty of Fisheries of Nagasaki University, National Research Council of Thailand (NRCT) and South East Asian Fisheries Development Center (SEAFDEC) using the training vessel Nagasaki-maru (587 tons), Nagasaki University.

In the survey of the Gulf of Thailand in 1980, beside the staff of Nagasaki-maru, Dr. Shojiro Miyahara (chemistry) and Dr. Tetsushi Senta (ichthyology) of Nagasaki University, and Dr. Satoshi Yamamoto (geology) of Ryukyu University participated for Japanese part. For Thai part, joined the survey nineteen scientists including biologists, oceanographers and geologists. They are Mr. Virat Charusombat, Mr. Dhummasakdi Poreeyanond, Miss Chamchoi Tanapong, Mr. Weera Pokapunt, Mr. Dheerasak Wasuthapitak, Mr. Lertchai Podapol, Mr. Taweesak Charnprasertporn and Mr. Saramit Uraiwan from Department of Fisheries, LT. Phon Parn-in R. T. N. and Junior LT. Charnchana Buathep R. T. N. from Department of Hydrography, Mr. Preecha Laochu and Mr. Sunoj Kengkoom from Department of Mineral

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Resources, Mr. Chorraman Wongwit, Miss La-orsri Teeratecha and Miss Chutima Tantikitti from Chulalongkorn University, Mr. Teera Lekcholaryut and Mr. Taweesak Sangsirikul from Kasetsart University, and Dr. Kozo Takahashi and Mr. Prasert Masthawee from SEAFDEC-TD. The leader of participants from Thai part was Mr. Virat Charusombat, Director of Exploratory Fishing Division, Department of Fisheries, and Mr. Dhummasakdi Poreeyanond of the same division took the responsibility for the leader on board on behalf of him.

A preliminary survey in the Gulf was carried out from 26 August to 2 September, 1979. In the fiscal year 1979, Thai staff boarded at Singapore and Songkhla, Southern Thailand, when Nagasaki-maru visited these ports on her way back from a training voyage for Japanese students in the tropical waters. Accordingly, these was only a little time to discuss the plan and procedure of this joint survey in advance. And it was a trip to give the participants some experience on the sea rather than a trip for survey. The results of this survey was published from the Faculty of Fisheries, Nagasaki University (Yasuda and Yada, 1980).

Survey area

The Gulf of Thailand (Fig. 1) extends northwest from the southern part of the South China Sea. It is bordered by the coasts of Vietnam, Cambodia and Thailand on the east by the coast of Thailand on the north and west, and by a line drawn from the Thai-Malaysian border to the tip of Cape Camau of Vietnam on the south. It is about 835 km long on the northwest axis. The maximum width is about 555 Km. The mouth of the Gulf, as indicated by the above-mentioned line, is about 370 Km wide. Being a part of the Sunda Shelf, the Gulf is relatively shallow with a mean depth of 45 m and a maximum depth of about 80 m.

The survey area in the Gulf of Thailand was decided by NRCT, paying due consideration so that the area was well away from the territorial waters of the surrounding other countries. The survey was made at 18 stations as shown in Fig. 1. This area has been surveyed by the research vessel Stranger of the Scripps Institution of Oceanography, University of California, USA, from 1956 to 1960, well known as Naga Expedition (Robinson, 1963), and by the research vessel Kaiyo-maru of the Fishery Agency of Japan in 1970 (Anon., 1972).

Method of survey

1. Oceanographic survey

At each station the following physical oceanographic data were collected; water temperature, salinity, dissolved oxygen concentration, water color and transparency. Water temperature and salinity were measured with an STD (TSK, M-4) and oxygen concentration by a DO meter Meteorological observations on wind, weather and wave were also made (Table 1).

2. Fishery resources survey

Nagasaki-maru has operated trawl fishing at 9 stations shown in Fig. 1 in stern trawling method (Fig. 2). Detailes of the net used is given in Fig. 2. The towing time at each stations was about one hour. The trawling records are shown in Table 2 and catch records in Table 3.

3. Sedimentary survey

At each station bottom sediments were collected with a Smith-McIntyre mud sampler ($300 \times 300 \times 200$ mm) as shown in Fig. 3. To determine the grain size composition, a sample of sediment about 100 g to 300 g was

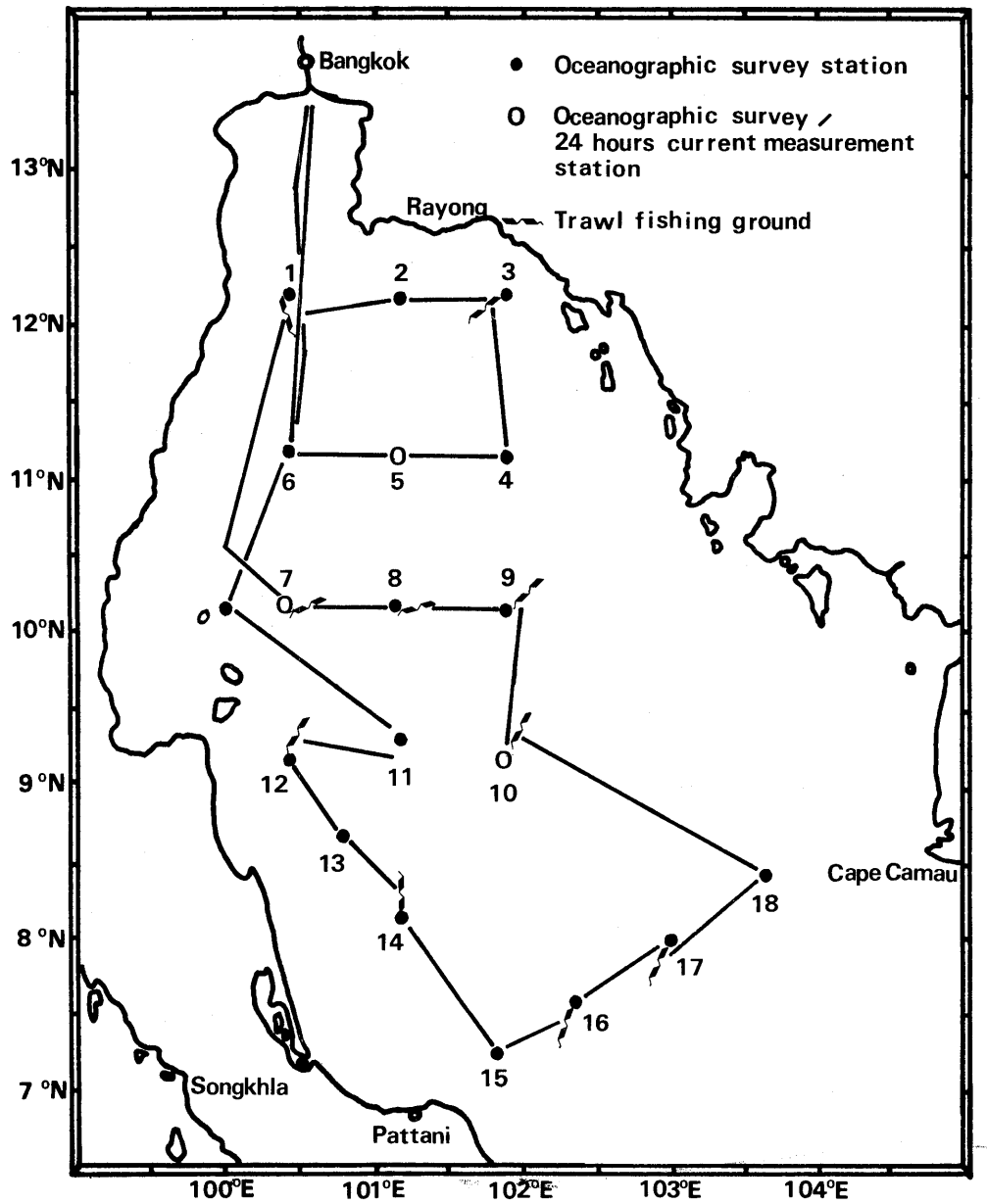

Fig. 1. Chart of the Gulf of Thailand showing the survey stations.

sieved by strainers of −1 and +4 Phi (ϕ) scale, seperating the sample into three parts, viz. granule, sand and mud. Sediments have been classified by the Emery and Niino method (1963). To collect stratified samples of sediments, a gravity core sampler, 50 mm in inside diameter, one meter in sample tube length and provided with a core catcher (Fig. 4) was used. On recovering the sampler onto the deck of the vessel, the core sample of sediment was taken out of the vinyl chloride tube to measure its length, then preserved in refregirator. The color of sediment at wet condition was immediately noted according to the Rock Color Chart (The Rock-Color Chart Committee, 1979).

To study the effect of the bottom sediment to the quantity of suspended matter

Table 1-1. Records of marine and meteorological observations at Station 1~8.

Station No.		1	2	3	4	5	6-1	6-2	7	8
Latitude N		12°11′0	12°10′0	12°10′0	11°10′0	11°10′3	11°08′2	11°10′1	10°10′0	10°09′9
Longitude E		100°28′2	101°09′1	101°55′5	101°54′0	100°11′1	100°24′2	100°24′9	100°24′5	101°09′9
Depth (m)		36	35	30	60	64	55	51	60	69
Date		May 18	May 18	May 18	May 17	May 16	May 16	May 27	May 19	May 20
Time Start		21:00	13:55	08:00	19:40	14:15	06:00	14:35	12:30	20:40
End		22:00	14:20	08:50	20:36	15:10	09:34	14:40	13:10	21:15
Weather		bc	bc	bc	c	c	c	bc	bc	o
Wind Direction		SW	SW	WSW	WEST	WSW	WEST	SSW	SW	WSW
Wind Force		4	3	4	4	5	5	1	4	5
Wave Direction		SW	SW	WSW	WEST	WSW	WEST	SSW	SW	WSW
Wave Class		4	3	3	4	4	3	1	4	4
Transparency (m)			10	9		15	20		11	
Water Color			3	3		2	2		13	
STD Record Temperature (℃)	0m	38.880	31.060	31.115	30.815	30.955	30.5	30.925	30.655	30.440
	10m	30.925	30.990	31.140	30.835	30.975	30.4	29.895	30.580	30.460
	20m	30.925	30.975	31.140	30.805	30.975	30.4	29.835	30.585	30.460
	30m	30.915	30.970		30.765	30.925	30.3	29.715	30.550	30.450
	50m				28.710		29.5		28.955	29.705
	Bottom	30.915	31.055	31.145	30.810	29.910	28.3	29.220	30.315	28.740
STD Record Salinity (‰)	0m	33.49	33.04	32.92	32.86	33.02		32.87	32.63	32.69
	10m	33.44	33.08	32.93	32.85	32.98		32.84	32.79	32.68
	20m	33.44	33.08	32.93	32.84	32.98		32.85	32.79	32.68
	30m	33.45	33.08		32.85	32.96		32.86	32.78	32.69
	50m				33.18				32.91	32.69
	Bottom	33.45	33.09	32.93	32.85	32.28		33.13	32.35	33.07
Salinity (‰)	0m	33.34	33.28	33.03	32.91	32.91	32.97		32.74	32.76
Salinometer	30m				32.85	32.83	32.83		32.80	32.62
	Bottom	33.37	32.99	32.78	33.21	33.21	33.10		32.99	32.95
Oxygen (ppm)	0m	6.0	4.2	5.0	5.8	5.4	2.7		3.9	4.6
DO-meter	10m								5.2	
	30m	5.4	4.4	5.8	6.2	5.4	2.6		4.2	6.0
	Bottom				4.4	3.1	2.7		3.2	5.0

in the water colum above the bottom, a water sample was collected with a Ban Dorn Sampler at surface layer and a layer just above the bottom. The dry weight of the suspended matter in the sample thus collected was determined.

The bottom topography profiles were recorded by an echo sounder (NEC, WG-4) along the tracking of the vessel as shown in Fig. 5.

4. Current observation

The current observation at 10 m depth for 24-hours was carried out at three stations (5, 7 and 10). The component current was calculated from the data divided into the east-west and north-south directions, and the constant current and harmonic constants of tide were obtained using a computer (OKITAC-3000b).

Results and discussion

1. Oceanographic survey

On the results of the oceanographic survey, the water temperature and salinity with a STD are discussed below.

The surface water temperature ranged from 30.02°C, at Stn. 18 to 31.12°C at Stn. 3 with the average of 30.69°C, while the surface salinity ranged from 32.63 ‰ at Stn. 7 to 33.49 ‰ at Stn. 1 with the average of 32.87 ‰. The maximum values of tempera-

Table 1-2. Records of marine and meteorological observations at Station 9~18.

Station No.			9	10	11	12	13	14	15	16	17	18
Latitude N			10°10′2	09°10′1	09°10′0	09°10′8	08°43′2	08°10′1	07°15′0	07°34′7	07°59′3	08°22′7
Longitude E			101°55′4	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′6
Depth (m)			74	72	60	30	32	53	48	73	69	69
Date			May 21	May 21	May 25	May 25	May 24	May 24	May 24	May 23	May 23	May 23
Time	Start		06:18	14:10	13:04	06:00	18:57	13:10	06:15	18:25	13:15	06:05
	End		06:55	14:50	13:40	06:20	19:25	13:38	06:52	19:05	13:58	06:29
Weather			o	c	c	c	o	c	c	o	c	r
Wind Direction			SW	SW	SW	SOUTH	SOUTH	WEST	SSE	SE	SOUTH	SOUTH
Wind Force			4	5	2	2	2	2	3	3	3	4
Wave Direction			SW	SW	SW	SOUTH	SOUTH	WEST	SSE	SE	SOUTH	SOUTH
Wave Class			3	4	2	2	2	2	3	2	2	3
Transparency (m)			22	12	25	12		16	23		20	5
Water Color			2	2	2	3		2	2		2	3
STD Record	Temperature (℃)	0m	30.475	30.440	30.660	30.330	30.510	30.605	30.820	30.640	30.500	30.015
		10m	30.495	30.425	30.465	30.350	30.335	30.475	30.855	30.645	30.435	30.095
		20m	30.500	30.395	30.425	30.220	30.245	30.440	30.860	30.590	30.475	30.335
		30m	30.500	29.625	30.415			30.375	30.865	30.600	30.220	
		50m	28.610	28.400	27.425					28.585	28.795	
		Bottom	28.145	29.195	27.425	29.765	29.655	29.260	29.750	28.105	30.060	30.085
	Salinity (‰)	0m	32.78	32.71	32.68	32.78	32.82	32.74	32.85	32.73	32.91	33.02
		10m	32.79	32.77	32.69	32.71	32.76	32.74	32.84	32.62	32.91	33.15
		20m	32.79	32.76	32.70	32.72	32.78	32.74	32.85	32.62	32.99	33.45
		30m	32.79	33.88	32.73			32.82	32.86	33.08	33.27	
		50m	33.26	33.87	33.79					33.78	33.87	
		Bottom	32.17	32.30	33.80	32.90	32.28	33.64	33.58	32.28	32.30	33.20
Salinity (‰) Salinometer		0m	32.88	32.83	32.76	32.77	32.80	32.84	32.88	32.66	33.03	33.46
		30m	32.80	34.00	32.80			32.77	32.94	32.96	33.13	
		Bottom	33.18	33.86	33.76	32.99	33.21	32.91	33.64	33.96	33.98	33.16
Oxygen (ppm) DO-meter		0m	6.4	4.0	5.5	6.8	7.0	5.4	5.6	6.2	5.1	3.8
		10m					7.1				4.9	
		30m	6.6	3.9	5.6	6.8	5.6	4.8	5.6	6.0		6.6
		Bottom	2.2	2.6	4.2			3.6	5.2	2.8	4.4	

ture observed was 31.15°C at 25 m depth layer of Stn. 3 and the minimum was 27.32°C at 39 m layer of Stn. 7, and those of salinity were 34.03 ‰ at 27 m of Stn. 10 and 32.43 ‰ at 39 m of Stn. 7, the range being 3.85°C for the former and 1.60 ‰ for the latter.

The density shown as $\sigma_{s,t}$ was calculated from the temperature and salinity, using the formulas in "KAIYO KANSOKU SHISHIN" published by the Oceanographical Society of Japan (Anon., 1970, p. 93). Fig. 6 shows the vertical distributions of the water temperature, salinity and density.

The horizontal distribution of the surface water temperature, salinity and density are illustrated in Fig. 7. High temperature and high salinity covered the northern and innermost part of the Gulf. As the survey area is rather shallow as stated earlier, the vertical integral means of the above three factors were calculated for each station. The horizontal distributions of temperature, salinity and density are presented in Fig. 8. For the above calculation, the water temperature and salinity were read from the STD record at intervals of one meter.

A ligulate water area of high density with low temperature and high salinity spread northwest from the entrance of the Gulf. In Fig. 6, one or two remarkable discontinuity layers of temperature and salinity as well as of density are seen at most of the

Table 2. Operation records of the bottom trawl net fishing.

Haul No. (Station No.)	Date	Time of Start	Location		Time of End	Course (°)	Speed (knots)
			Lat. (N)	Long. (E)			
1 (3)	May 18	05:50	12°-10.3 12°-10.5	101°-48.9 101°-52.9	06:50	080	3.3
2 (1)	May 18	19:04	12°-06.2 12°-09.3	100°-23.1 100°-26.6	20:29	050	3.2
3 (7)	May 20	13:30	10°-10.5 10°-11.7	100°-25.3 100°-31.1	15:13	080	3.5
4 (8)	May 20	19:12	10°-07.8 10°-08.8	101°-05.8 101°-08.4	20:09	080	3.3
5 (9)	May 21	07:19	10°-10.1 10°-12.1	101°-56.1 101°-58.5	08:20	030	3.6
6 (10)	May 22	18:48	09°-09.7 09°-12.5	101°-54.4 101°-56.0	17:51	020	3.1
7 (17)	May 23	11:49	07°-56.1 07°-58.6	102°-58.5 102°-59.8	12:49	020	3.3
8 (16)	May 23	19:20	07°-34.7 07°-33.1	102°-19.6 102°-16.0	20:19	220	3.3
9 (14)	May 24	14:00	08°-12.3 08°-15.4	101°-09.5 101°-09.8	14:58	000	2.9
10 (12)	May 25	07:05	09°-12.7 09°-14.6	100°-26.0 100°-27.0	08:03	030 010	3.2

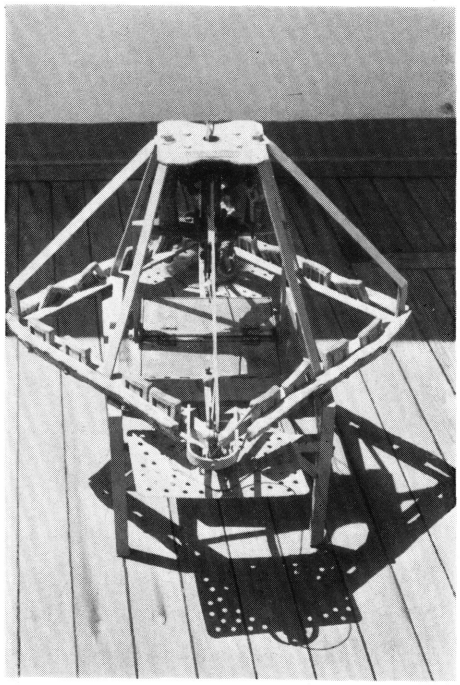

Fig. 3. Smith-McIntyre sampler used in the survey.

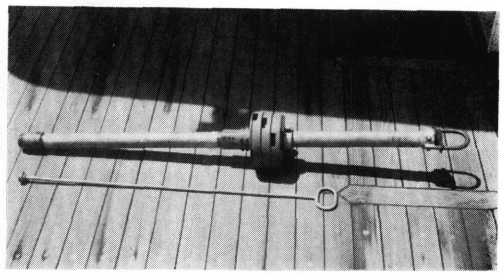

Fig. 4. Gravity core sampler used in the survey

stations. The depths of the upper and lower margins of the discontinuity layer of density at each station were read from the figure. These readings are illustrated in Fig. 9 as vertical profiles along eight lines; three each of east-west and north-south directions, one each northwest-southeast and northeast-southwest directions. It is observed that the discontinuity layer tended to run in parallel with the bottom. The upper margin of it

Wind		Warp Length (m)	Horizontal Angle		Vertical Angle		Warp Tension		Depth (m)	Net Height (m)	Head Line Depth (m)
Direction	Force		Starboard (°)	Port (°)	Starboard (°)	Port (°)	Starboard (tons)	Port (tons)			
WSW	4	120	5	6	19	17	3.3	3.6	32	7.0	25
West	6	140	10	5	15	16	3.0	3.3	36	7.0	29
West	6	130	3	8	23	23	4.2	4.2	54 62	9.0	44
WSW	5	140	6	5	22	22	3.8	3.6	62 66	8.5	48
S W	4	250 270	0 -5	2 10	20 20	21 20	3.4	3.2	74	6.3	65
S W	4	260	-2	12	12	20	3.4	3.2	71	6.0	67
South	4	250	0	4	20	21	3.4	3.2	69	6.5	63
S E	3	160	2	3	28	28	3.4	3.2	68	8.0	60
Calm		130	0	8	24	24	3.6	3.4	52	8.0	44
S E	2	120	2	7	18	18	3.4	3.2	33	8.2	23.5

was the deepest in the central part of the Gulf (Stns. 8 and 9). At the central part (Stns. 16 and 17) of the northeast-southwest line which is close to and in parallel with the border line between the South China Sea and the Gulf, the discontinuity layer of density was very thick, extending from 24 m deep to 58 m deep where the maximum depth of the sea was 70 to 75 m. The thickness of the discontinuity layer became gradually smaller as we go northwest from Stn. 17 through Stns. 10 and 8 finally reaching to Lat. 11° N (Stns. 4, 5 and 6). This seems to agree with the statement of Naga Report (Robinson, 1963) that high salinity and relatively cool water come from the South China Sea flows into the Gulf along an entrance channel, of which the shallowest point is only 58 m deep. The report also mentioned that high temperature and low salinity water of the upper layer has been diluted by heavy precipitation and fresh water river run-off. Although marginal parts of the Gulf were not studied during the present survey, it is suspected that the low salinity water seen at about 40 m layer of Stns. 5, 7, 10 and 11 is attributable to the influence of river run-off. High temperature and low salinity water was existing in the deep layer near the bottom at Stns. 4, 5, 7, 10, 16 and 17 (Fig. 6). We are not sure about the origin of this water.

2. **Fishery resources survey**

The catch of the bottom trawl was first divided into two categories of the good fish and the trash fish. Each of them was secondly divided into fishes, mollusks and crustaceans. Table 3 shows the catch by species of each haul. Regarding the good fish, the total catch and catch per hour by

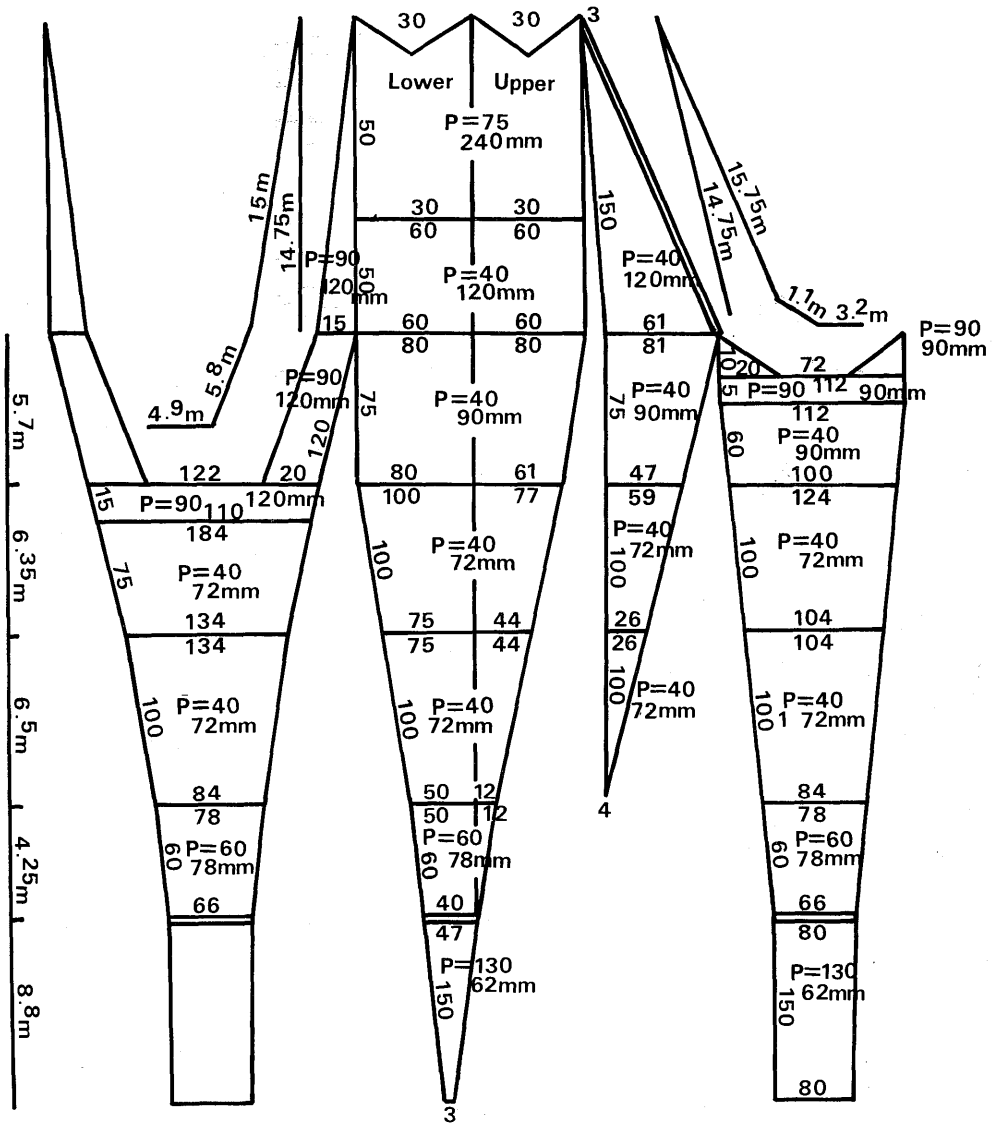

Fig. 2. Design of the bottom trawl net used in the survey.

families were shown in the same table.

In the whole area of the survey, the catch mainly consisted of carangids, lutjanids, nemiperids and *Loligo*. The average catch of good fish per hour was 53.36 Kg (fishes 46.69 Kg, mollusks 6.24 Kg and crustaceans 0.43 Kg). Among them carangids accounted for 8.95 Kg, lutjanids 6.31 Kg, nemipterids 6.37 Kg and *Loligo* 5.02 Kg.

Proportions of good and trash catches of each haul of the trawl net are shown in Table 4. The total catch for 9 hauls was 592.23 Kg (fishes 527.21 Kg, mollusks 60.18 Kg and crustaceans 5.24Kg), of which 498.83 Kg, (fishes 436.50 Kg, mollusks 58.30 Kg and crustaceans 4.03 Kg) was the good fish, accounting for 84.17 % (fishes 82.79 %, mollusks 96.88 % and crustaceans 76.91 %) of the total.

The catch was rather poor, but, as many as 60 fish species of 27 families, 9 mollusk species of 3 families occurred in the catch. The catch of individual species was naturally small.

Table 3-1. Records of useful fishes of the trawl net catches (1).

Family	Species	Haul-No. / Stn.-No. / Date / No.	1 / 3 / 5-18	2 / 1 / 5-18	4 / 8 / 5-20	5 / 9 / 5-21	6 / 10 / 5-22	7 / 17 / 5-23	8 / 16 / 5-23	9 / 14 / 5-24	10 / 12 / 5-25	Total (Kg)
Oretolobidae	*Chiloscyllium* sp.	1-1	-	12.00	-	-	-	-	-	-	-	12.00
	Average (Kg/H)			8.47								1.28
Dasyatidae	*Dasyatis imbricatus*	2-1	1.45	6.60	-	0.50	-	-	-	-	0.64	9.19
	Himantura uarnak	2-2	-	-	-	10.00	-	-	-	-	-	10.00
	Total		1.45	6.60		10.50					0.64	19.19
	Average (Kg/H)		1.45	4.66		10.33					0.66	2.05
Engraulidae	*Stolephorus* sp.	3-1	-	-	0.15	-	-	-	-	-	-	0.15
	Average (Kg/H)				0.16							0.16
Chirocentridae	*Chirocentrus dorab*	4-1	-	-	-	0.38	-	0.27	-	0.28	-	0.93
	Average (Kg/H)					0.37		0.27		0.29		0.10
Synodontidae	*Saurida undosquamis*	5-1	0.06	2.75	-	-	0.77	0.20	1.00	-	0.13	4.91
	S. elongata	5-2	1.37	0.06	-	9.55	10.34	3.45	2.50	-	1.02	28.29
	Total		1.43	2.81		9.55	11.11	3.65	3.50		1.15	33.20
	Average (Kg/H)		1.43	1.98		9.39	10.58	3.65	3.56		1.19	3.55
Ariidae	*Arius thalassinus*	6-1	-	-	-	9.63	1.40	-	-	0.15	-	11.18
	Average (Kg/H)					9.47	1.33			0.16		1.20
Muraenesocidae	*Congresox talabonoides*	7-1	-	-	-	-	-	-	12.00	3.14	-	15.14
	Average (Kg/H)								12.20	3.25		1.62
Sphyraenidae	*Sphyraena forsteri*	8-1	0.05	-	0.13	-	3.40	0.60	-	0.50	-	4.68
	S. obtusata	8-2	-	-	-	0.25	-	-	-	31.00	-	31.25
	Total		0.05		0.13	0.25	3.40	0.60		31.50		35.93
	Average (Kg/H)		0.05		0.14	0.25	3.24	0.60		32.59		3.84
Scombridae	*Rastrelliger kanagurta*	9-1	3.95	-	-	0.65	-	-	-	-	0.10	4.70
	Scomberomorus commerson	9-2	4.00	-	-	1.47	-	-	-	0.71	0.99	7.17
	S. guttatus	9-3	-	-	-	-	0.40	1.70	-	-	1.15	3.25
	Total		7.95			2.12	0.40	1.70		0.71	2.24	15.12
	Average (Kg/H)		7.95			2.09	0.38	1.70		0.73	2.32	1.62
Trichiuridae	*Trichiurus lepturus*	10-1	-	-	-	0.59	1.00	-	-	-	0.23	1.82
	Average (Kg/H)					0.58	0.95				0.24	0.20
Carangidae	*Selar crumenophthalmus*	11-1	0.57	-	0.47	5.00	-	3.45	-	35.50	-	44.99
	Atule mate	11-2	2.62	0.26	-	0.22	0.20	0.95	-	-	1.55	5.80
	Alepes melanoptera	11-3	0.66	0.39	-	-	-	-	-	0.13	0.25	1.43
	Selaroides leptolepis	11-4	6.75	9.00	0.02	-	-	-	-	-	0.61	16.38
	Carangoides sp.	11-5	-	-	-	2.50	0.02	-	-	-	-	2.52
	Uraspis sp.	11-6	-	-	-	-	1.10	-	-	-	-	1.10
	Decapterus maruadsi	11-7	-	-	0.38	-	-	-	-	-	-	0.38
	Formio niger	11-8	1.48	-	-	-	0.25	-	-	0.41	-	2.14
	Seriolina nigrofasciata	11-9	0.15	0.15	-	3.20	1.62	1.66	1.63	-	0.49	8.90
	Total		12.23	9.80	0.87	10.92	3.19	6.06	1.63	36.04	2.90	83.64
	Average (Kg/H)		12.23	6.92	0.92	10.74	3.04	6.06	1.66	37.28	3.00	8.95
Rachycentridae	*Rachycentron canadum*	12-1	0.40	-	-	-	-	-	-	-	-	0.40
	Average (Kg/H)		0.40									0.04
Mullidae	*Upeneus sulphureus*	13-1	-	-	-	4.60	-	2.59	13.00	-	-	20.19
	Parupeneus fraterculus	13-2	-	-	-	0.82	1.76	-	-	-	-	2.58
	Total					5.42	1.76	2.59	13.00			22.77
	Average (Kg/H)					5.33	1.68	2.59	13.22			2.44
Priacanthidae	*Priacanthus tayenus*	14-1	0.72	0.80	0.10	1.30	-	-	1.54	0.38	0.52	5.36
	P. macracanthus	14-2	-	-	-	-	6.96	-	0.42	-	-	7.38
	Total		0.72	0.80	0.10	1.30	6.96		1.96	0.38	0.52	12.74
	Average (Kg/H)		0.72	0.57	0.11	1.28	6.63		1.99	0.39	0.54	1.36
Serranidae	*Epinephelus sexfasciatus*	15-1	0.74	-	-	0.09	0.50	0.17	-	0.57	-	2.07
	E. tauvina	15-2	-	-	-	0.86	4.80	-	-	1.03	-	6.69
	E. hata	15-3	-	0.27	-	0.70	-	0.30	1.90	0.24	-	3.41
	Total		0.74	0.27		1.65	5.30	0.47	1.90	1.84		12.17
	Average (Kg/H)		0.74	0.19		1.62	5.05	0.47	1.93	1.90		1.30
Lethrinidae	*Lethrinus lentjan*	16-1	0.26	-	-	0.15	1.16	-	-	-	-	1.57
	Average (Kg/H)		0.26			0.15	1.11					0.17

Table 3-2. Records of useful fishes of the trawl net catches (2).

Family	Species	Haul-No. / Stn.- No. / Date / No.	1 / 3 / 5-18	2 / 1 / 5-18	4 / 8 / 5-20	5 / 9 / 5-21	6 / 10 / 5-22	7 / 17 / 5-23	8 / 16 / 5-23	9 / 14 / 5-24	10 / 12 / 5-25	Total (Kg)
Lutjanidae	*Lutjanus sebae*	17-1	–	–	–	6.20	3.69	–	–	–	–	9.89
	L. sanguineus	17-2	–	–	–	3.45	–	31.60	–	–	–	35.05
	L. vitta	17-3	0.10	0.08	–	0.70	1.00	–	–	–	–	1.88
	L. lutjanus	17-4	0.38	1.62	–	–	1.50	–	–	–	–	3.50
	L. lineolatus	17-5	–	–	0.04	0.05	–	–	0.77	–	–	0.86
	L. russelli	17-6	–	–	–	0.34	–	–	–	–	–	0.34
	Pristipomoides multidens	17-7	–	–	–	3.50	1.70	2.30	–	–	–	7.50
	Total		0.48	1.70	0.04	14.24	7.89	33.90	0.77			59.02
	Average (Kg/H)		0.48	1.20	0.04	14.01	7.51	33.90	0.78			6.31
Nemipteridae	*Nemipterus japonicus*	18-1	–	–	–	–	–	0.14	1.40	0.65	–	2.19
	N. peronii	18-2	0.22	9.29	–	–	–	–	–	–	0.25	9.76
	N. hexodon	18-3	2.00	0.21	–	–	–	–	–	0.51	0.64	3.36
	N. marginatus	18-4	–	–	–	–	–	0.12	–	–	–	0.12
	N. bleekeri	18-5	–	–	–	10.50	3.70	0.15	1.50	–	–	15.85
	N. tolu	18-6	–	–	–	–	–	0.30	–	–	0.11	0.41
	N. nematophorus	18-7	–	–	–	3.50	–	6.16	5.00	0.93	–	15.59
	N. nemurus	18-8	–	–	–	–	–	0.15	–	–	–	0.15
	N. mesoprion	18-9	0.15	0.27	–	–	–	0.08	–	0.12	0.36	0.98
	N. tambuloides	18-10	–	–	–	4.00	3.50	0.30	3.00	0.38	–	11.18
	Total		2.37	9.77		18.00	7.20	7.40	10.90	2.59	1.36	59.59
	Average (Kg/H)		2.37	6.90		17.71	6.86	7.40	11.09	2.68	1.41	6.37
Pomadasyidae	*Plectorhynchus pictus*	19-1	–	–	–	2.23	4.14	0.64	–	–	–	7.01
	Average (Kg/H)					2.19	3.94	0.64				0.75
Pentapodidae	*Gymnocranius griseus*	20-1	–	–	–	1.10	6.00	0.86	–	–	–	7.96
	Average (Kg/H)					1.08	5.71	0.86				0.85
Scolopsidae	*Scolopsis taeniopterus*	21-1	0.14	1.04	–	–	–	–	–	0.46	–	1.64
	Average (Kg/H)		0.14	0.73						0.48		0.18
Siganidae	*Siganus javus*	22-1	–	–	–	–	–	–	–	–	0.28	0.28
	S. oramin	22-2	–	0.36	–	0.40	–	–	–	–	0.05	0.81
	Total			0.36		0.40					0.33	1.09
	Average (Kg/H)			0.25		0.39					0.34	0.12
Balistidae	*Abalistes stellaris*	23-1	–	–	–	4.69	4.00	7.40	3.00	–	–	19.09
	Average (Kg/H)					4.61	3.81	7.40	3.05	–	–	2.04
Aluteridae	*Aluterus monoceros*	24-1	1.08	–	–	–	–	–	–	–	–	1.08
	Average (Kg/H)		1.08									0.12
Platycephalidae	*Platycephalus* sp.	25-1	–	–	–	–	–	–	0.70	–	–	0.70
	Average (Kg/H)								0.71			0.08
Psettodidae	*Psettades erumei*	26-1	0.15	–	–	–	–	–	0.47	–	–	0.62
	Average (Kg/H)		0.15						0.48			0.07
Cynoglossidae	*Cynoglossus* sp.	27-1	0.75	–	–	–	–	–	–	–	–	0.75
	Average (Kg/H)		0.75									0.08
	Total		30.20	45.15	1.29	93.12	64.91	65.54	49.83	77.09	9.37	436.50
	Average (Kg/H)		30.20	31.87	1.36	91.59	61.82	65.54	50.68	79.75	9.69	46.69

Fig. 10 shows the size composition of 9 major species, together with the mean length, the mean weight, the variance and the standard deviation. *Loligo*'s size composition was shown by haul, while those for others were based on the collective data of all hauls. It seemed that the size composition of fish consisted of some groups of 3 to 6 normal distribution. However, the number of the individuals examined was not large enough and they were not caught in the same area. This prevents us from further analysis.

In *Loligo formosana*, the mean mantle length and the mean weight were approximately 138 mm to 140 mm and 75 g to 78 g at

Table 3-3. Records of useful mollusks of the trawl net catches.

Group	Species	Haul-No. / Stn. -No. / Date / No.	1 / 3 / 5-18	2 / 1 / 5-18	4 / 8 / 5-20	5 / 9 / 5-21	6 / 10 / 5-22	7 / 17 / 5-23	8 / 16 / 5-23	9 / 14 / 5-24	10 / 12 / 5-25	Total (Kg)
Squid	*Loligo formosana*	1-1	17.50	7.57	-	0.53	1.00	3.10	1.21	2.33	5.30	38.54
	L. duvaucellii	1-2	2.00	1.17	-	2.55	0.30	0.40	-	1.44	0.51	8.27
	L. tagoi	1-3	-	-	0.04	-	-	0.06	-	-	-	0.10
	Total		19.50	8.74	0.04	3.08	1.30	3.56	1.21	3.67	5.81	46.91
	Average (Kg/H)		19.50	6.17	0.05	3.03	1.24	3.56	1.23	3.80	6.01	5.02
Cuttlefish	*Sepia pharaonis*	2-1	-	2.13	-	-	-	0.41	-	-	0.24	2.78
	S. aculeata	2-2	0.12	0.15	-	-	-	-	-	-	-	0.27
	S. recurvirostra	2-3	-	1.10	-	-	0.30	0.90	0.11	-	-	2.41
	S. brevimana	2-4	-	-	-	0.15	0.02	0.10	0.28	-	-	0.55
	Sepioteuthis lessoniana	2-5	3.30	0.27	-	0.05	-	-	-	-	0.09	3.71
	Total		3.42	3.65		0.20	0.32	1.41	0.39		0.33	9.72
	Average (Kg/H)		3.42	2.58		0.20	0.31	1.41	0.40		0.34	1.04
Octopus	*Octopus* sp.	3-1	0.40	0.73	-	-	-	-	0.90	-	-	1.67
	Average (Kg/H)		0.40	0.52					0.92			0.18
	Total		22.96	13.12	0.04	3.28	1.62	4.97	2.50	3.67	6.14	58.30
	Average (Kg/H)		22.96	9.26	0.05	3.23	1.54	4.97	2.54	3.80	6.35	6.24

Table 3-4. Records of useful crustaceans of the trawl net catches.

Group	Species	Haul-No. / Stn. -No. / Date / No.	1 / 3 / 5-18	2 / 1 / 5-18	4 / 8 / 5-20	5 / 9 / 5-21	6 / 10 / 5-22	7 / 17 / 5-23	8 / 16 / 5-23	9 / 14 / 5-24	10 / 12 / 5-25	Total (Kg)
Crab	*Portunus pelagica*	1-1	0.82	-	-	-	-	-	-	-	-	0.82
	Charybdis cruciata	1-2	1.05	1.73	-	-	-	-	-	-	-	2.78
	C. sp	1-3	0.07	-	-	0.09	0.06	-	-	-	0.06	0.28
	Total		1.94	1.73		0.09	0.06				0.06	3.88
	Average (Kg/H)		1.94	1.22		0.09	0.06				0.06	0.42
Shrimp	*Penaeus semisulcatus*	2-1	0.03	-	-	-	-	-	-	-	-	0.03
	Miscellaneous	2-2	-	-	-	-	-	-	0.12	-	-	0.12
	Total		0.03						0.12			0.15
	Average (Kg/H)		0.03						0.12			0.02
	Total		1.97	1.73	-	0.09	0.06	-	0.12	-	0.06	4.03
	Average (Kg/H)		1.97	1.22	-	0.09	0.06		0.12	-	0.06	0.43

Stns. 1 and 3 in the northern part of the Gulf of Thailand, on the other hand, 96 mm to 114 mm and 22 g to 31 g at Stns. 12 and 17 in the southern part. The size distribution of *Loligo formosana* consisted of 2 to 4 normal distribution, too.

3. Sedimentary survey

3. 1 Bottom Geology

Sampling of bottom sediments with a Smith-McIntyre grab sampler and gravity core sampler was done at 18 stations. (Fig. 1; Tables 5 and 6)

Grayish calcareous sandy mud or muddy sand is distributed in most of the stations. These are suspected to cover surface tens of centimeters of the bottom sediment, because at some stations the sediments revealed dark semiconsolidated clay underlying the grayish calcareous sandy mud or muddy sand. The stations along the coast of the Malay Peninsula were obtained lateritic (reddish) sandstone pebbles and also the weathered products of the pebble. Stations in the central portion of the Gulf were covered with reddish brown mud of only 1 $\sim$ 2 cm thickness, which was suspected to be weathered products of the lateritic sandstone gravel supplied from the adjacent slopes and the coastal region of the Malay Peninsula. Bottom sediment on three stations

Table 3-5. Records of trash fishes of the trawl net catches.

Family/Group	Species	Haul-No.	1	2	4	5	6	7	8	9	10	
		Stn. -No.	3	1	8	9	10	17	16	14	12	Total
		Date	5-18	5-18	5-20	5-21	5-22	5-23	5-23	5-24	5-25	(Kg)
Dasyatidae	*Dasyatis* sp.						0.97					0.97
	Narcine timlei											–
Clupeidae	*Sardinella jussieu*		0.13	0.03								0.16
Engraulidae	*Stolephorus indicus*		0.02									0.02
Synodontidae	*Saurida tumbil*					0.23		1.54		0.03		1.80
	S. elongata		0.48				0.34				0.02	0.84
	S. undosoquamis		0.10	1.33		0.11	0.05	0.29			0.03	1.91
	S. micropectoralis							0.06				0.06
Fistulariidae	*Fistularia villosa*		0.65			3.54	0.24		0.22	0.18	0.05	4.88
Holocentridae	*Holocentrus rubrum*						0.06					0.06
Sphyraenidae	*Sphyraena obtusata*		0.02					0.31	0.03			0.36
Serranidae	*Epinephelus sexfasciatus*						0.02	0.28				0.30
	E. areolatus					0.03						0.03
Theraponidae	*Therapon jarbua*		0.30									0.30
Priacanthidae	*Priacanthus tayenus*		0.40	0.46					0.11			0.97
	P. macracanthus							0.05				0.05
Apogonidae	*Apogon* sp.		0.42	1.08		0.05	0.07		0.48	0.31	0.02	2.43
Carangidae	*Alectis ciliaris*		0.02								0.03	0.05
	Atropus atropus		0.18									0.18
	Caranx leptolepis		0.15	1.52				0.42			0.25	2.34
	C. mate		0.07	0.03	0.10	0.03		0.03	0.01	5.00	0.70	5.97
	C. malam		0.07		0.02							0.09
	C. crumenophthalmus							0.33			0.02	0.35
	C. sp.				0.04	0.03	0.05	0.03		0.07	0.06	0.24
	Seriola nigrofasciata		0.16			0.15						0.31
Rachycentridae	*Rachycentron canadus*		0.03								0.18	0.21
Lutianidae	*Lutianus malabaricus*		0.02								0.21	0.23
	L. sangunineus											–
	L. lineolatus				0.04				0.06	0.11		0.21
	L. vitta									0.03		0.03
Caesiodidae	*Caesio* sp.			0.02	0.01							0.03
Nemipteridae	*Nemipterus hexodon*										0.06	0.06
	N. peronii		0.12	0.20					0.43			0.75
	N. japonicus										0.03	0.03
	N. mesoprion			0.02			0.44					0.64
	N. nematophorus					0.25	0.74			0.14		1.13
Gerridae	*Pentaprion longimarus*				0.05	2.65	1.10	7.20		0.35		11.35
Leiognathidae	*Leiognathus* sp.		0.37	0.03	0.24	0.45			4.14	18.00	2.78	26.01
Scolopsidae	*Seolopsis* sp.		0.27	0.02			0.10					0.39
Plectorhynchidae	*Plectorhynchus pictus*		0.05								0.08	0.13
Mullidae	*Upeneus* sp.		0.10	0.16	0.11	0.39	0.07	0.31		1.53		2.67
Scaridae	*Callyodon* sp.						0.02					0.02
Uranoscopidae	*Uranoscopus oligolepis*		0.17	0.35					0.45	0.03		1.00
Siganidae	*Siganus oramin*		0.07									0.07
Trichiuridae	*Trichiurus haumela*							0.35	0.18	1.66		2.19
Scombridae	*Rastrelliger kanagurta*			0.04								0.04
Stromateidae	*Parastromateus niger*		0.38			0.32						0.70
Scorpaenidae	*Pterois volitans*		0.04				0.40		0.12			0.56
Platycephalidae	*Platycephalus* sp.		0.17	0.14					0.09			0.40
Dacthlopteridae	*Dactyloptena* sp.					0.56	2.50					3.06
Bothidae	*Pseudorhomorus* sp.		0.30								0.05	0.35
Cynoglossidae	*Cynoglossus* sp.						0.04					0.04
Echeneidae	*Echeneis naucrates*					0.90	0.91					1.81
Balistidae	*Abalistes stellaris*											–
Triacanthidae	*Pseudotriacanthus strigilifer*					0.42	0.31		0.62			1.35
Aluteridae	*Alutera monoceros*		0.11	0.15		0.04						0.30
Diodontidae	*Diodon maculifer*						0.99		0.47			1.46
Lagocephalidae	*Gasterophysus lunaris*		0.45			0.05	0.07		0.16	5.70	2.26	8.69
Anacanthidae	*Anacanthus barbatus*		0.09									0.09
Total	(Kg)		5.91	5.76	0.61	10.20	9.49	11.20	7.57	33.14	6.83	90.71
Loliginidae	*Loligo* sp.					0.07	0.09	1.09	0.08		0.22	1.55
Sepiidae	*Sepia* sp.						0.13	0.12	0.04			0.29
Octopodidae	*Octopus* sp.								0.04			0.04
Total	(Kg)		–	–	–	0.07	0.22	1.21	0.16	–	0.22	1.88
Portunidae	*Charybdis* sp.			0.92		0.09	0.06		0.08		0.06	1.21
Total	(Kg)		5.91	6.68	0.61	10.36	9.77	12.41	7.81	33.14	7.11	93.80

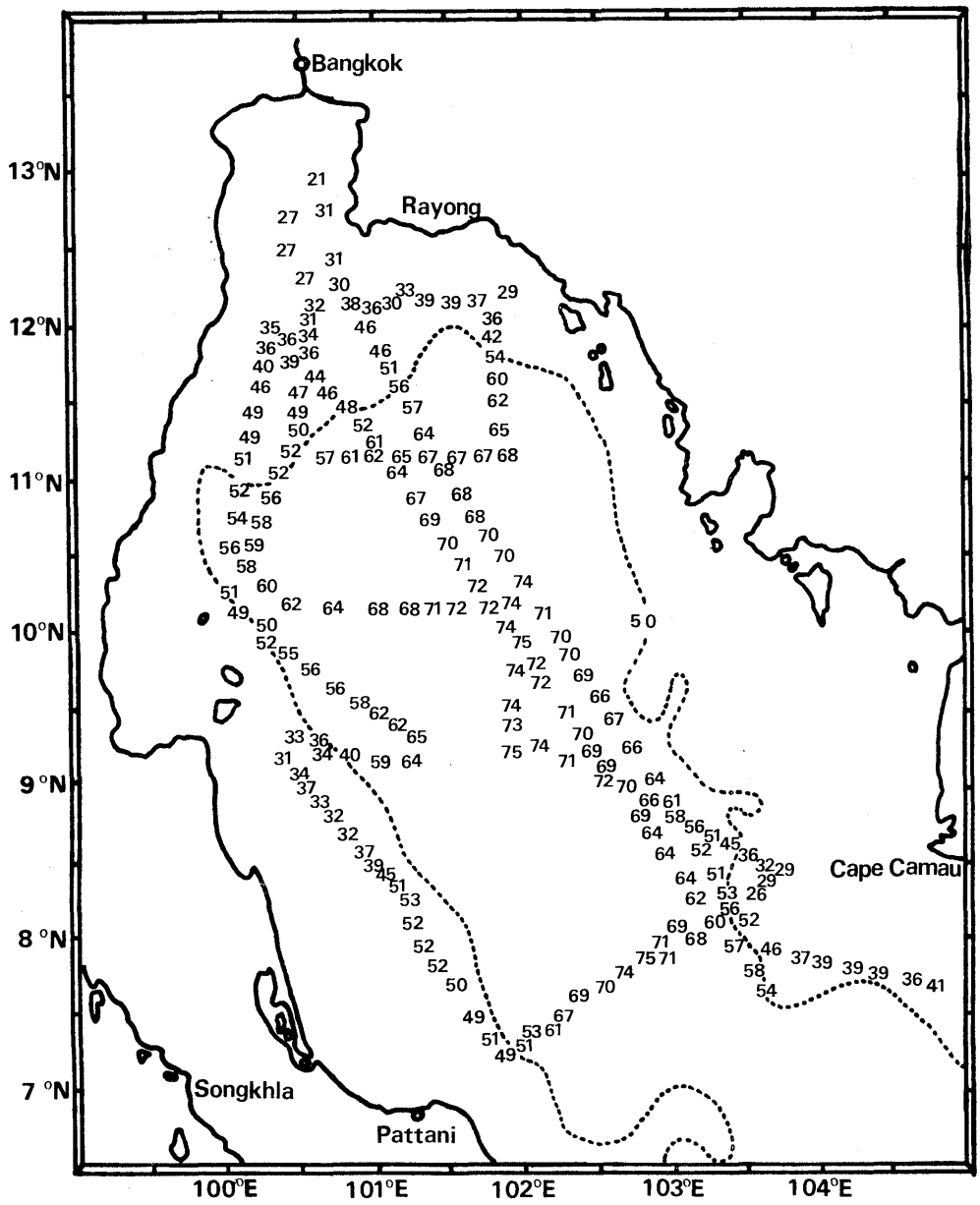

Fig. 5. Bottom topography of the Gulf of Thailand recorded by an echo sounder.

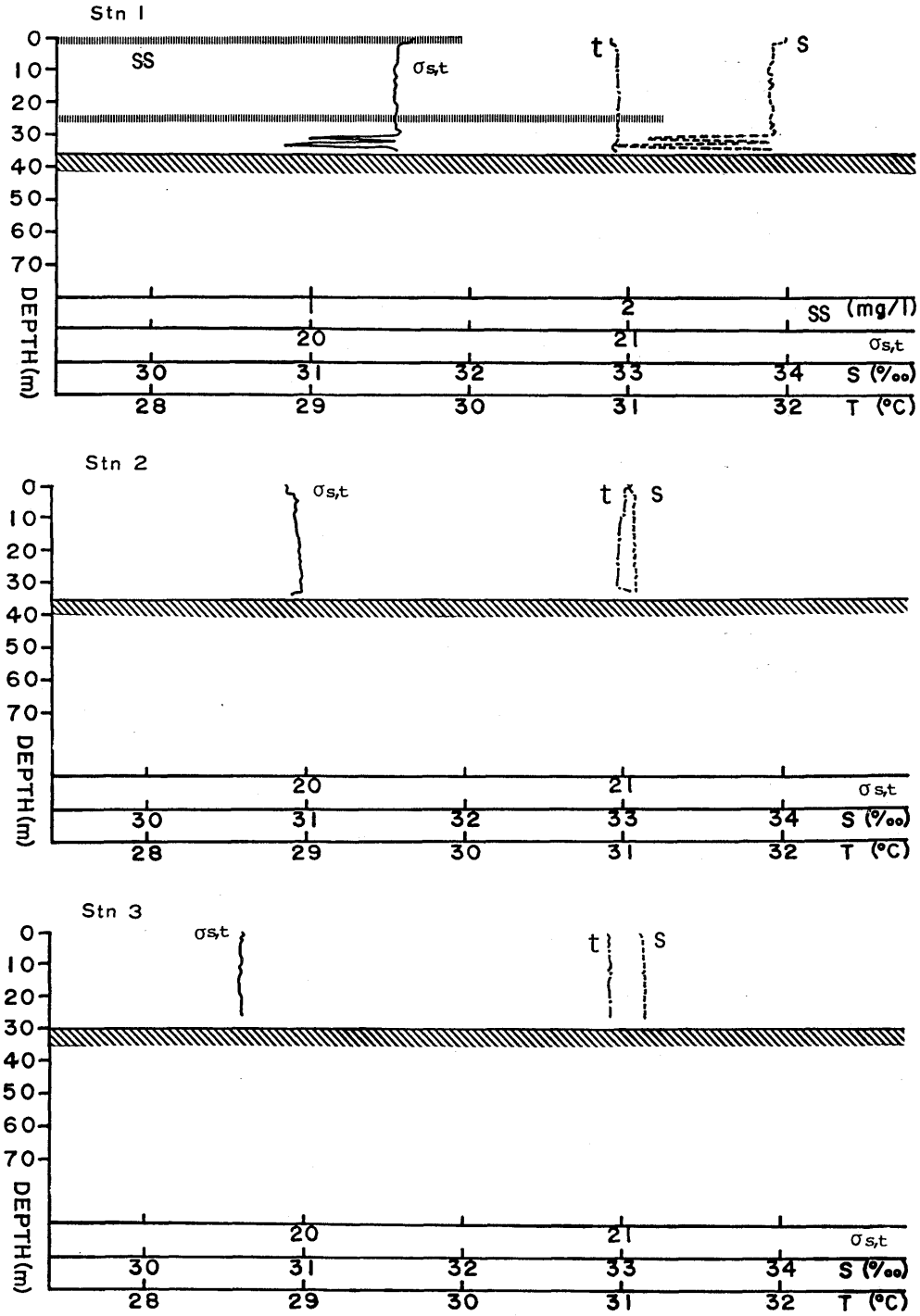

Fig. 6-1. Vertical distribution of temperature, salinity, density and suspended matter at Station 1~3.
t: temperature, s: salinity, $\sigma_{s,t}$: density, ss: suspended matter.

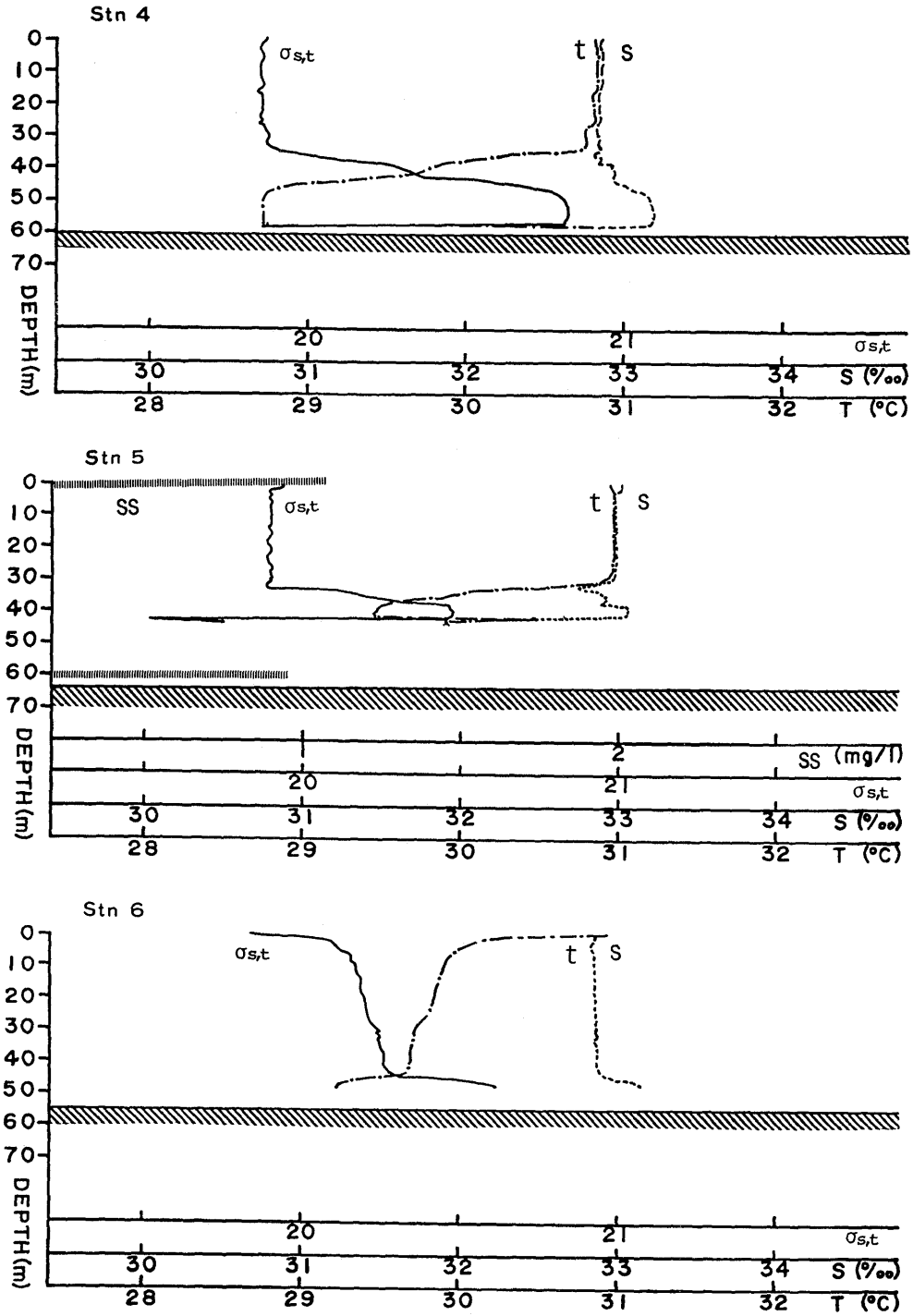

Fig. 6-2. Vertical distribution of temperature, salinity, density and suspended matter at Station 4~6.
t: temperature, s: salinity, $\sigma_{s,t}$: density, ss: suspended matter.

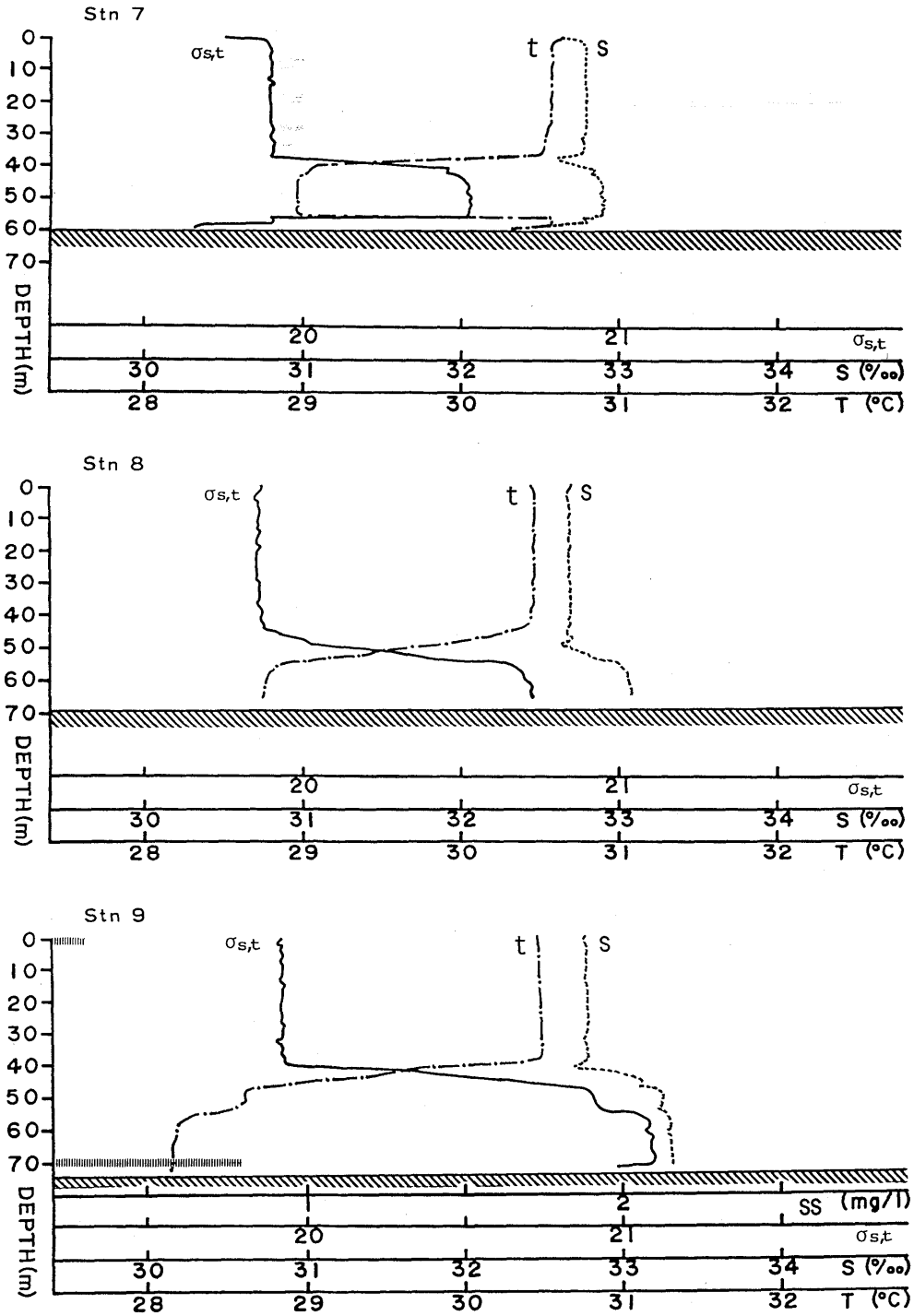

Fig. 6-3. Vertical distribution of temperature, salinity, density and suspended matter at Station 7~9.
t: temperature, s: salinity, $\sigma_{s,t}$: density, ss: suspended matter.

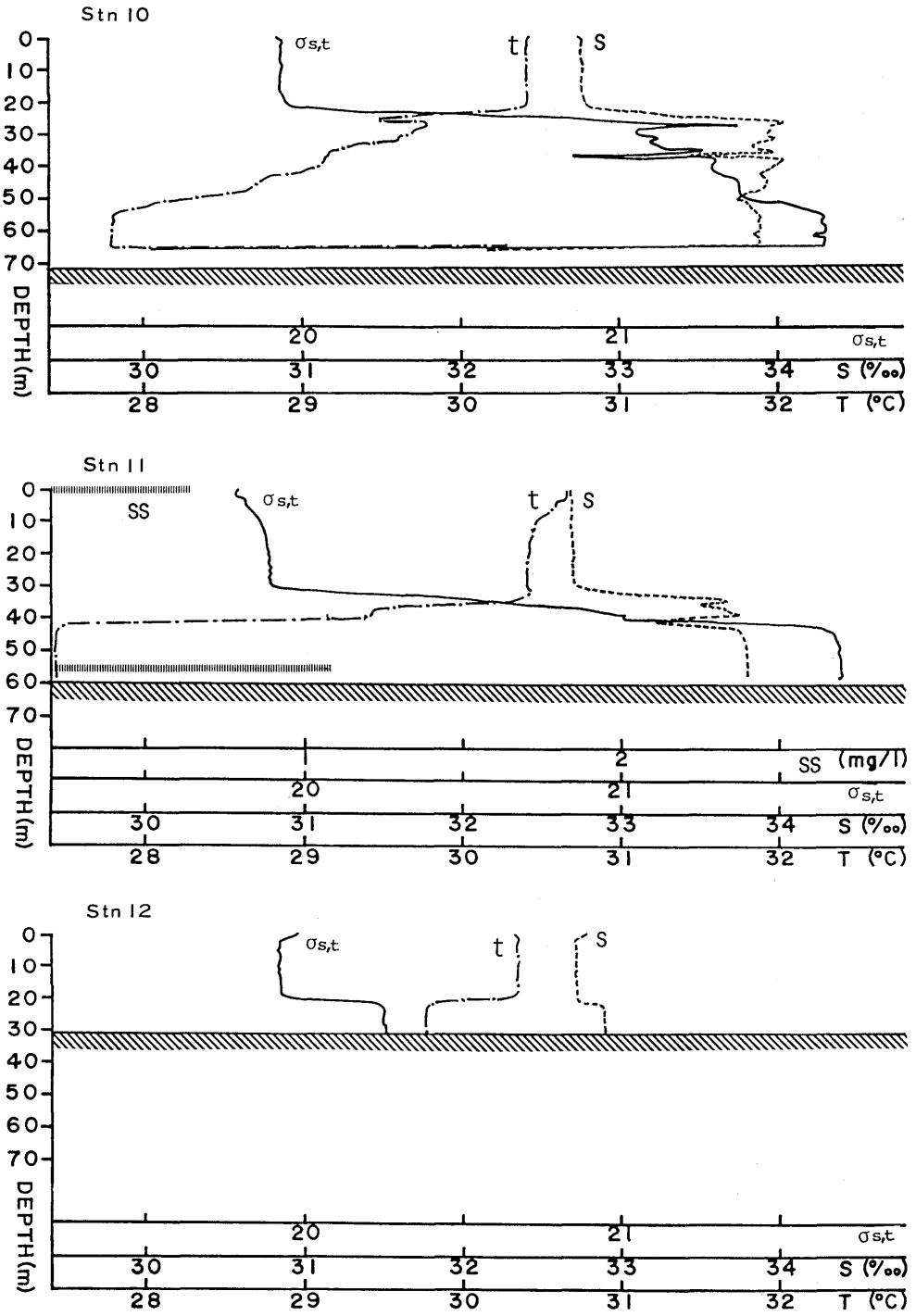

Fig. 6-4. Vertical distribution of temperature, salinity, density and suspended matter at Station 10~12.
t: temperature, s: salinity, $\sigma_{s,t}$: density, ss: suspended matter.

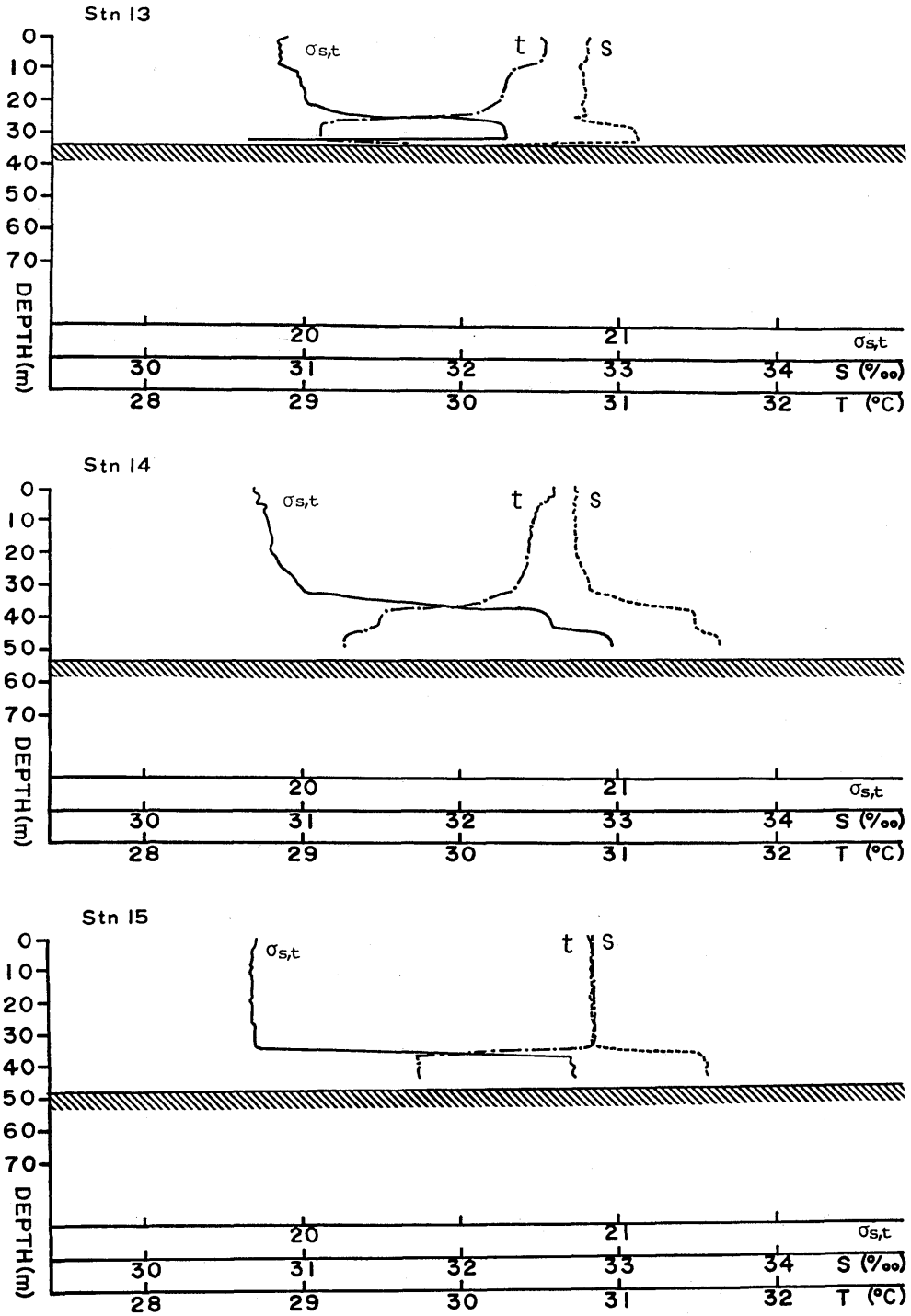

Fig. 6–5. Vertical distribution of temperature, salinity and density at Station 13~15.
t: temperature, s: salinity, $\sigma_{s,t}$: density

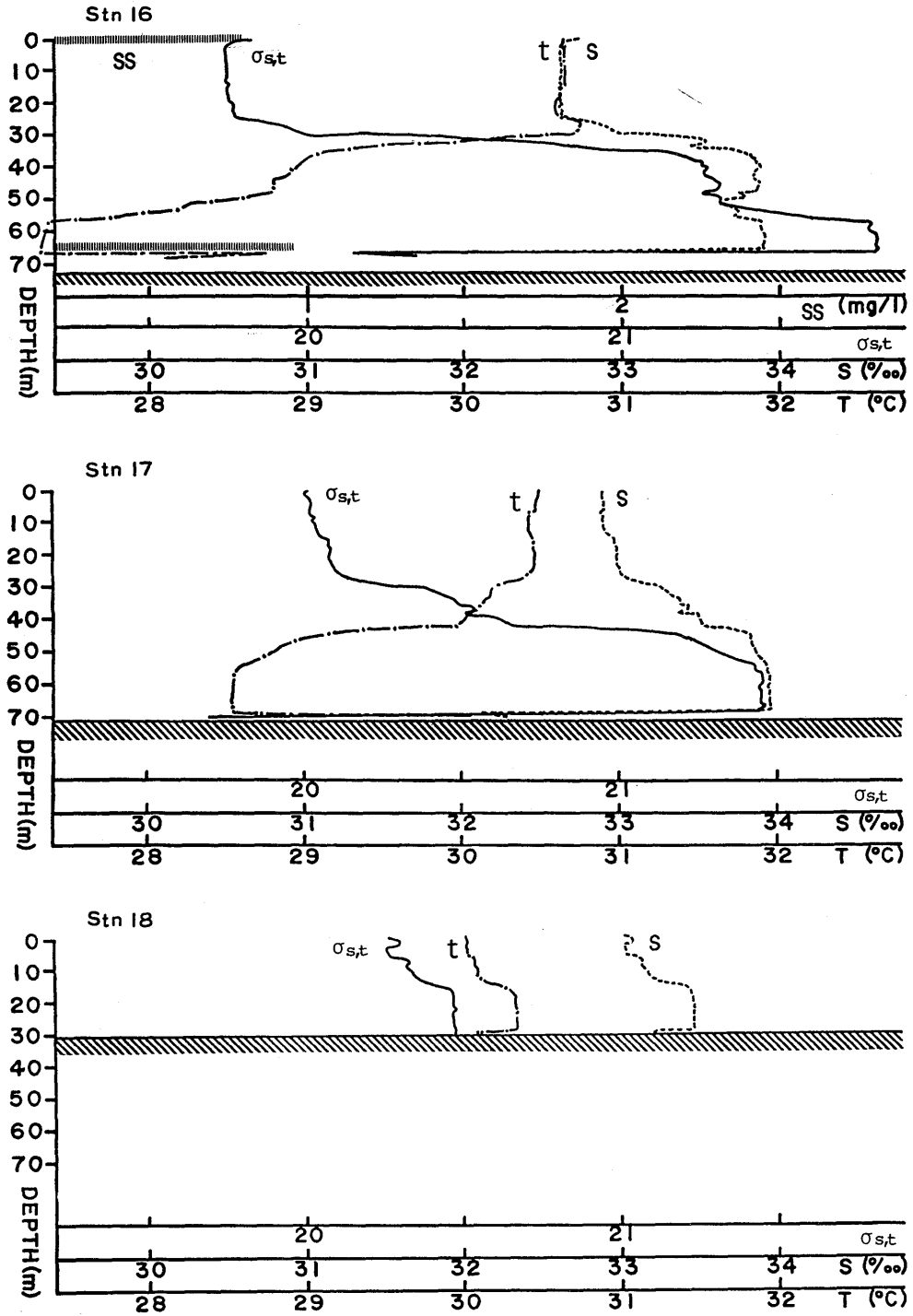

Fig. 6-6. Vertical distribution of temperature, salinity, density and suspended matter at Station 16~18.
t: temperature, s: salinity, $\sigma_{s,t}$: density, ss: suspended matter

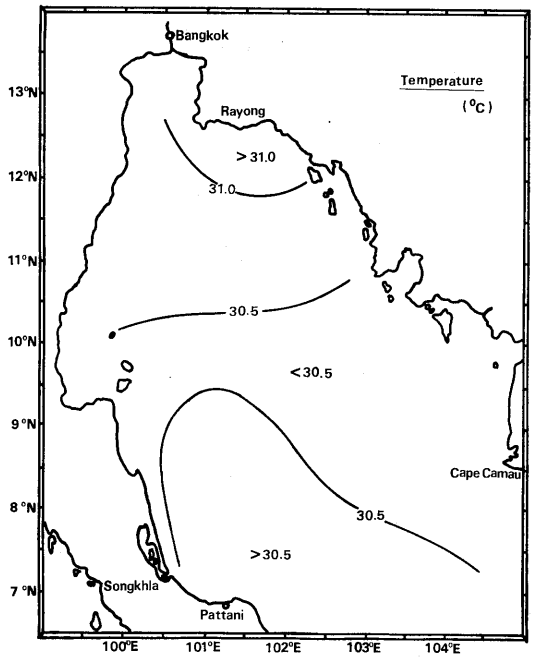

Fig. 7-1. Horizontal distribution of temperature at the surface.

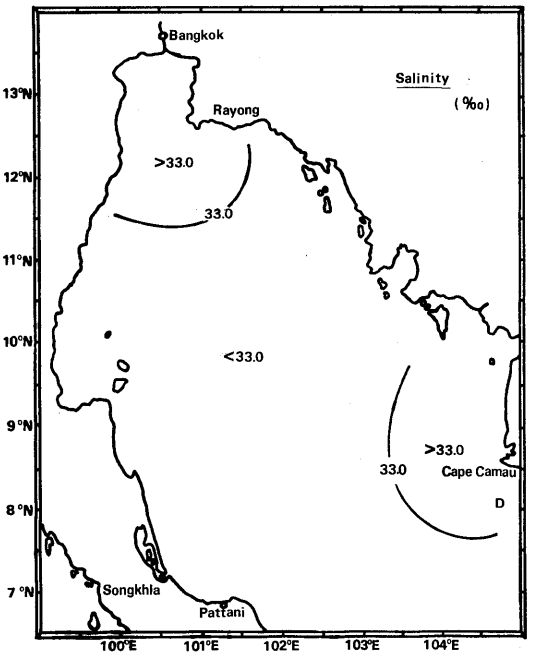

Fig. 7-2. Horizontal distribution of salinity at the surface.

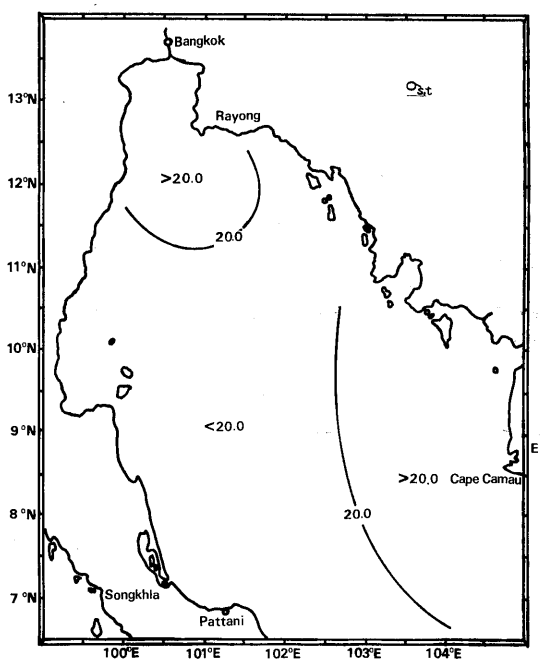

Fig. 7-3. Horizontal distribution of density at the surface.

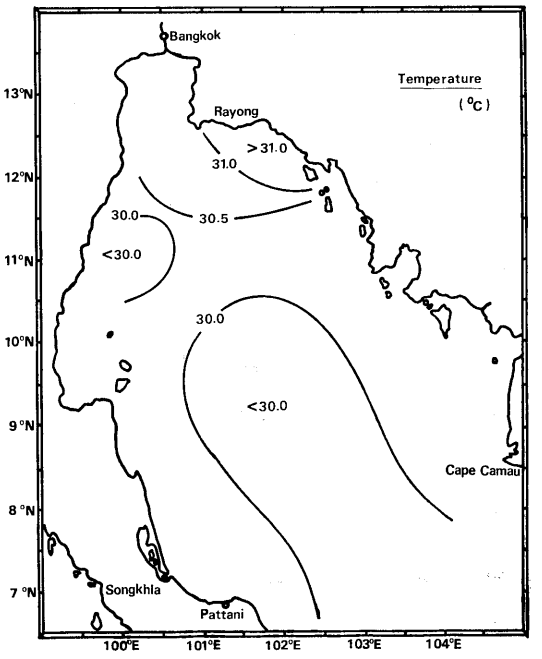

Fig. 8-1. Horizontal distribution shown as vertical integral means of temperature.

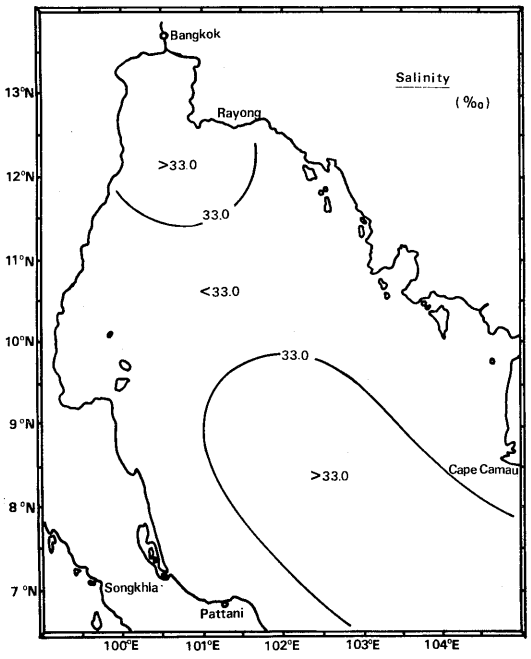

Fig. 8-2. Horizontal distribution shown as vertical integral means of salinity.

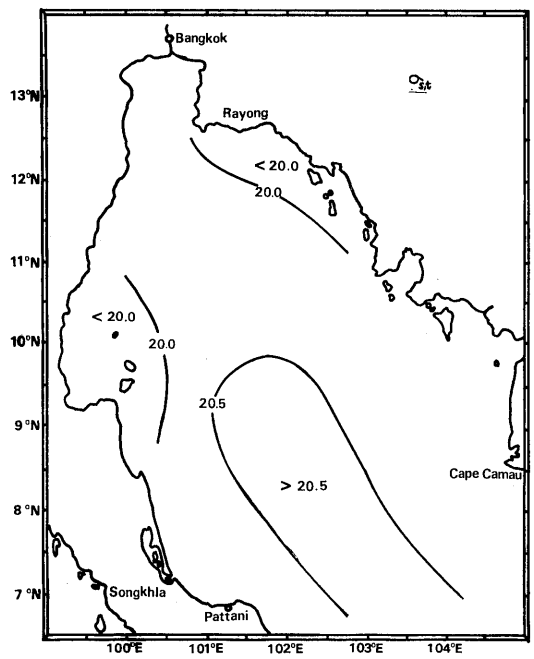

Fig. 8-3. Horizontal distribution shown as vertical integral means of density.

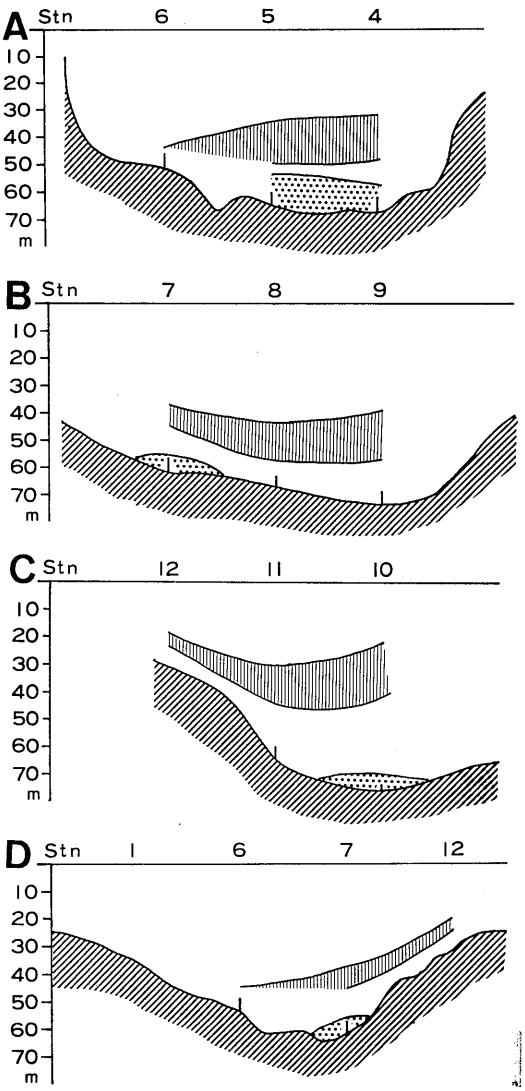

Fig. 9-1. Vertical profile of density along the line connecting the stations. A: from Station 6 to Station 4. B: from Station 7 to Station 9. C: from Station 12 to Station 10. D: from Station 1 to Station 12.

(5, 7 and 10) was comprised of grayish calcareous silty clay which contained abundant mannofossils and foraminiferal remains (Table 7).

Suspended brownnish silty clay is dispersed abundantly into the Gulf from the Chao Phraya and associated rivers but not deposited in the offshore bottom floor, judging from the lithology of bottom sediments.

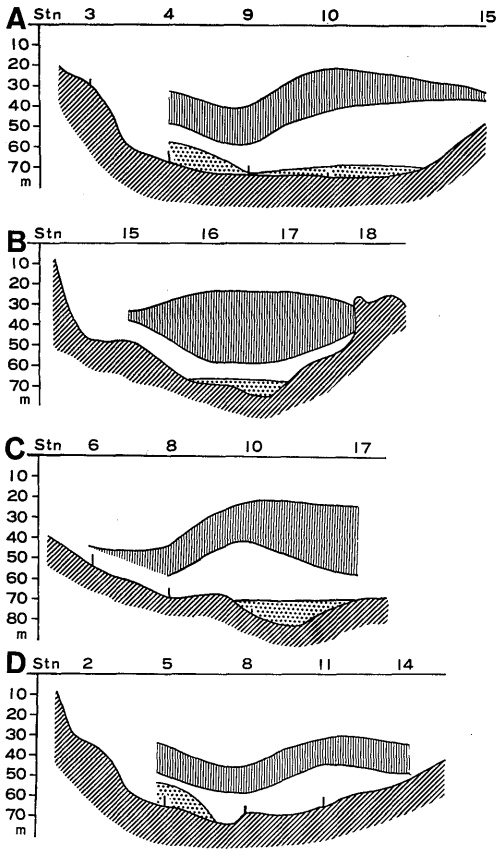

Fig. 9-2. Vertical profile of density along the line connecting the stations.
A: from Station 3 to Station 15.
B: from Station 15 to Station 18.
C: from Station 6 to Station 17.
D: from Station 2 to Station 14.

Suspended-matter concentrations in overlying waters were twice to thrice higher in the bottom water than in the surface waters.

The origin of this bottom structure and the sedimentation of the topography in this areas were reported by Yamamoto and Yada (1982).

3. 2 Bottom topography

A large part of the survey area in the Gulf showed furiously uneven ground, judging from the records of an echo sounder (Fig. 11). The distribution of the rugged bottom area is shown in Fig. 12, based on records along the track of Nagasaki-maru during the survey and the round-trip to the Thailand, and the research vessel Kaiyo-maru of Fishery Agency in 1970.

The central part of the Gulf seems unsuitable for the trawl operation. The unsuitable area observed by Nagasaki-maru was much wider than that by Kaiyo-maru (Anon., 1972), extending to lat. 10° N and northward.

In a wide area of this part numerous ridges are distributed with a wide flat top, about 5 m in height and from 50 m to more than 4, 000 m in length, the distance between neighboring ridges ranging from 500 m to 2, 000 m. The echo sounder records showed that the rising angle of the slope of the ridges averages 10 degrees.

The frequency of distribution of these ridges is now being analysed in the laboratory of our faculty.

4. Current observation

The results of current measurement were very complicated, being probably influenced by various factors. Here, however, assuming that the results were mainly subject to the tidal and constant currents, the authors established tidal constants by harmonic analysis. The currnt ellipses are shown in Fig. 13, and the component vectors of constant current, diurnal tide and semi-diurnal tide are illustrated in Fig. 14. In these figures, the time is expressed in the lunar time, viz. the time elapsed from the culmination of the moon at each station.

The velocity and direction of constant current, and the velocity and direction at the maximum velocity of diurnal and semi-diurnal tides at each survey station are shown in Table 8.

According to the vectors, the current at Stn. 5 flowed southeasterly for 16 hours a day, while at Stn. 7 it flowed north or northwest almost all day except for a very

Table 4. Proportions of good and trash catches of the trawl net.

	Haul-No.	1	2	4	5	6	7	8	9	10	
	Stn. -No.	3	1	8	9	10	17	16	14	12	Total
	Date	5-18	5-18	5-20	5-21	5-22	5-23	5-23	5-24	5-25	
Fish	Good (Kg)	30.20	45.15	1.29	93.12	64.91	65.54	49.83	77.09	9.37	436.50
	Trash (Kg)	5.91	5.76	0.64	10.20	9.49	11.20	7.57	33.14	6.83	90.71
	Total (Kg)	36.11	50.91	1.90	103.32	74.40	76.74	57.40	110.23	16.20	527.21
	Good (%)	83.63	88.68	67.89	90.13	87.24	85.41	86.81	69.94	57.84	82.79
Mollusk	Good (Kg)	22.96	13.12	0.04	3.28	1.62	4.97	2.50	3.67	6.14	58.30
	Trash (Kg)	-	-	-	0.07	0.22	1.21	0.16	-	0.22	1.88
	Total (Kg)	22.96	13.12	0.04	3.35	1.84	6.18	2.66	3.67	6.36	60.18
	Good (%)	100.00	100.00	100.00	97.91	88.04	80.42	93.98	100.00	96.54	96.88
Crustacean	Good (Kg)	1.97	1.73	-	0.09	0.06	-	0.12	-	0.06	4.03
	Trash (Kg)	-	0.92	-	0.09	0.06	-	0.08	-	0.06	1.21
	Total (Kg)	1.97	2.65	-	0.18	0.12	-	0.20	-	0.12	5.24
	Good (%)	100.00	65.28	-	50.00	50.00	-	60.00	-	50.00	76.91
Total	Good (Kg)	55.13	60.00	1.33	96.49	66.59	70.51	52.45	80.76	15.57	498.83
	Trash (Kg)	5.91	6.68	0.61	10.36	9.77	12.41	7.81	33.14	7.11	93.80
	Total (Kg)	61.04	66.68	1.94	106.85	76.36	82.92	60.26	113.90	22.68	592.63
	Good (%)	90.32	89.98	68.56	90.30	87.21	85.03	87.04	70.90	68.65	84.17

Good: good catch. Trash: trash catch.

feeble current for a short time of 2 or 3 hours. In contrast to these 2 stations, the southeast current and the north-north-west current prevailed at Stn. 10, the former lasting for 15 hours and the other for 7 hours.

As the diurnal and semi-diurnal tides tended to offset each other at Stns. 5 and 7, the effect of constant current dominated in the current direction. On the other hand, at Stn. 10, the effects of both the tides were always added each other. Furthermore, the maximum velocity of diurnal tide was two times greater that of constant current, therefore, the tidal current, especially the diurnal tide, affected more than constant current on change in the current direction in the vectors (Tamai et al., 1970).

The common feature for these three survey stations in this area was that diurnal tide excelled semi-diurnal tide. This was remarkable at Stn. 10, where the maximum velocity of the former was approximately 5 times that of the latter.

Acknowledgments

We express our heartfelt gratitude to Dr. Sanga Sabhasri, Ex-Secretary General of the National Research Council of Thailand and Dr. Deb Menasveta, Ex-Director General, SEAFDEC, for their painstaking effort to materialize this joint survey. Special thanks are due to Dr. Masato Yasuda, Dean, the Faculty of Fisheries, Nagasaki University, for his consideration to facilitate the international utilization of the training vessel. A deep feeling of appreciation is due to Dr. Shigeaki Shindo, Deputy Secretary-General, SEAFDEC, Dr. Boon Indrambarya, NRCT, and Dr. Keishi Shibata, the Faculty of Fisheries, Nagasaki University, who acted as

the coordinator for this joint survey. Last but not least, our sincere thanks are to all the participants of the cruise, Thai and Japanese scientists and the crew staff of training vessel Nagasaki-maru, for their cooperation.

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1980年の日本—タイ—東南アジア漁業開発センターによるタイ湾の共同調査報告

矢田殖朗・高木保昌・兼原壽生・久野俊行・山本　聡*

タイ湾の漁業開発についての基礎資料を得るために，1980年5月15～28日に，同湾で日本・タイおよび東南アジア漁業開発センターの研究者が共同で，本学部練習船長崎丸を用いて海洋およびトロール漁業調査を行なった．得られた調査結果は次の通りである．

1)　STDの記録から水温，塩分の垂直および水平分布を求めた．これらより，タイ湾北部には，比較的高温で高塩分の水域があり，一方，湾南部には比較的低温で高塩分の水域が認められた．また，湾全般について，中層部に密度躍層がみられた．

2)　底曳トロール網の試験操業では，その漁獲物をまず有用種と雑用種とにわけた．次いで，前者を魚類，イカ・タコ類およびエビ・カニ類にわけて，一回の曳網ごとに，それぞれの漁獲量を計測した．全漁獲物については，魚類は27科60種，イカ・タコ類は3科9種，エビ・カニ類は数種であった．有用種については，魚類はアジ類・イトヨリ類・フエダイ類，イカ・タコ類はジンドウイカ類が主であった．

全漁獲量は592Kgであり，曳網1時間あたりの漁獲量は53Kgであった．

有用種の主なるものについて，その体長組成を調べた結果では，それぞれの種類で2～6の体長の正規分布を示すいくつかの集団よりなることが推察された．なお，ジンドウイカ類の重要種 *Loligo formosana* では，北部海域のものは南部海域のものと比べて，外套長の平均で約30mm，体重の平均で約50 g 大きかった．

3)　重力コアとスミスーマッキンタイヤ採泥器で得られた海底堆積物についての分析を行なった．その結果から，当湾の中央部の海底表層には赤茶色の泥が1～2 cmの厚さに積っていた．また，その他の湾全般の海底表層には，灰色がかった石灰質の砂泥が約10cmの厚さに堆積しており，その下層には，黒味を帯び，かなり固まった粘土層があった．

4)　音響測深機の記録によると，当湾の中央部にある海盆の周辺には，顕著な起伏のある傾斜面がみられる．このような海底の状況を示す水域は，底曳トロール網の操業には適しないと思われる．

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FAMILY NO. 5- 2
NAME *Saurida elongata*

RANK	NO.	FR.	ANO	FR.	10 20 30 40
120.1-130.0	1	1	1	1	I*
130.1-140.0	0	0	1	1	I
140.1-150.0	0	0	1	1	I
150.1-160.0	5	6	6	7	I*****
160.1-170.0	3	3	9	10	I***
170.1-180.0	7	8	16	18	I*******
180.1-190.0	2	2	18	20	I**
190.1-200.0	3	3	21	23	I***
200.1-210.0	2	2	23	26	I**
210.1-220.0	2	2	25	28	I**
220.1-230.0	7	8	32	36	I*******
230.1-240.0	14	16	46	51	I**************
240.1-250.0	12	13	58	64	I************
250.1-260.0	8	9	66	73	I********
260.1-270.0	7	8	73	81	I*******
270.1-280.0	5	6	78	87	I*****
280.1-290.0	4	4	82	91	I****
290.1-300.0	3	3	85	94	I***
300.1-310.0	4	4	89	99	I****
310.1-320.0	0	0	89	99	I
320.1-330.0	1	1	90	100	I*

TOTAL CATCH	= 90	TOTAL WEIGHT	= 15.710 KG
MEAN LENGTH	= 234.000 MM	MEAN WEIGHT	= 174.556 G
VARIANCE	= 1824.555		
STANDARD DEVIATION	= 42.715 MM		

Fig. 10-1. The histogram showing of the body length composition of *Saurida elongata* in a computer record.

FAMILY NO. 8- 2
NAME *Sphyraena obtusata*

RANK	NO.	FR.	ANO	FR.	10 20 30 40
100.1-110.0	1	1	1	1	I*
110.1-120.0	5	3	6	3	I*****
120.1-130.0	13	7	19	10	I**********
130.1-140.0	21	11	40	20	I**********
140.1-150.0	24	12	64	32	I**********
150.1-160.0	14	7	78	40	I**********
160.1-170.0	15	8	93	47	I**********
170.1-180.0	14	7	107	54	I**********
180.1-190.0	19	10	126	64	I**********
190.1-200.0	24	12	150	76	I**********
200.1-210.0	23	12	173	88	I**********
210.1-220.0	10	5	183	93	I**********
220.1-230.0	6	3	189	96	I******
230.1-240.0	3	2	192	97	I***
240.1-250.0	2	1	194	98	I**
250.1-260.0	0	0	194	98	I
260.1-270.0	1	1	195	99	I*
270.1-280.0	1	1	196	99	I*
280.1-290.0	1	1	197	100	I*

TOTAL CATCH	= 197	TOTAL WEIGHT	= 31.000 KG
MEAN LENGTH	= 173.325 MM	MEAN WEIGHT	= 157.360 G
VARIANCE	= 1173.336		
STANDARD DEVIATION	= 34.254 MM		

Fig. 10-2. The histogram showing of the body length composition of *Sphyraena obtusata* in a computer record.

FAMILY NO. 11- 1
NAME *Selar crumenophthalmus*

RANK	NO. FR.	ANO FR.	10 20 30 40
110.1-120.0	6 4	6 4	I******
120.1-130.0	8 5	14 8	I********
130.1-140.0	5 3	19 11	I*****
140.1-150.0	5 3	24 14	I*****
150.1-160.0	6 4	30 18	I******
160.1-170.0	9 5	39 23	I*********
170.1-180.0	7 4	46 27	I*******
180.1-190.0	20 12	66 39	I********************
190.1-200.0	35 21	101 59	I**********************************
200.1-210.0	21 12	122 72	I*********************
210.1-220.0	24 14	146 86	I************************
220.1-230.0	12 7	158 93	I************
230.1-240.0	8 5	166 98	I********
240.1-250.0	2 1	168 99	I**
250.1-260.0	2 1	170 100	I**

TOTAL CATCH = 170 TOTAL WEIGHT = 24.520 KG
MEAN LENGTH = 190.000 MM MEAN WEIGHT = 144.235 G
VARIANCE = 1022.647
STANDARD DEVIATION= 31.979 MM

Fig. 10-3. The histogram showing of the body length composition of *Selar crumenophthalmus* in a computer record.

FAMILY NO. 11- 4
NAME *Selaroides leptolepis*

RANK	NO. FR.	ANO FR.	10 20 30 40
70.1- 75.0	2 2	2 2	I**
75.1- 80.0	3 2	5 4	I***
80.1- 85.0	8 6	13 10	I********
85.1- 90.0	18 14	31 25	I******************
90.1- 95.0	12 10	43 34	I************
95.1-100.0	20 16	63 50	I********************
100.1-105.0	16 13	79 63	I****************
105.1-110.0	13 10	92 74	I*************
110.1-115.0	13 10	105 84	I*************
115.1-120.0	11 9	116 93	I************
120.1-125.0	4 3	120 96	I****
125.1-130.0	1 1	121 97	I*
130.1-135.0	2 2	123 98	I**
135.1-140.0	1 1	124 99	I*
140.1-145.0	1 1	125 100	I*

TOTAL CATCH = 125 TOTAL WEIGHT = 2.110 KG
MEAN LENGTH = 101.020 MM MEAN WEIGHT = 16.880 G
VARIANCE = 186.410
STANDARD DEVIATION= 13.653 MM

Fig. 10-4. The histogram showing of the body length composition of *Selaroides leptolepis* in a computer record.

FAMILY NO. 18- 2
NAME *Nemipterus peronii*

RANK	NO. FR.	ANO FR.		10 20 30 40
85.1- 90.0	1	1	1	1 I*
90.1- 95.0	2	2	3	3 I**
95.1-100.0	1	1	4	3 I*
100.1-105.0	0	0	4	3 I
105.1-110.0	6	5	10	8 I******
110.1-115.0	9	7	19	16 I*********
115.1-120.0	9	7	28	23 I*********
120.1-125.0	9	7	37	31 I*********
125.1-130.0	6	5	43	36 I******
130.1-135.0	9	7	52	43 I*********
135.1-140.0	12	10	64	53 I************
140.1-145.0	6	5	70	58 I******
145.1-150.0	11	9	81	68 I***********
150.1-155.0	8	7	89	74 I********
155.1-160.0	4	3	93	78 I****
160.1-165.0	2	2	95	79 I**
165.1-170.0	3	3	98	82 I***
170.1-175.0	5	4	103	86 I*****
175.1-180.0	10	8	113	94 I**********
180.1-185.0	4	3	117	97 I****
185.1-190.0	1	1	118	98 I*
190.1-195.0	0	0	118	98 I
195.1-200.0	1	1	119	99 I*
0.1- 5.0	1	1	120	100 I*

10 20 30 40

TOTAL CATCH = 120 TOTAL WEIGHT = 9.860 KG
MEAN LENGTH = 139.208 MM MEAN WEIGHT = 82.167 G
VARIANCE = 736.893
STANDARD DEVIATION= 27.146 MM

Fig. 10-5. The histogram showing of the body length composition of *Nemipterus peronii* in a computer record.

FAMILY NO. 18- 5
NAME *Nemipterus bleekeri*

RANK	NO. FR.	ANO FR.	
80.1- 85.0	1 1	1 1	I*
85.1- 90.0	0 0	1 1	I
90.1- 95.0	0 0	1 1	I
95.1-100.0	0 0	1 1	I
100.1-105.0	2 1	3 2	I**
105.1-110.0	2 1	5 3	I**
110.1-115.0	6 4	11 8	I******
115.1-120.0	5 3	16 11	I*****
120.1-125.0	4 3	20 14	I****
125.1-130.0	3 2	23 16	I***
130.1-135.0	6 4	29 20	I******
135.1-140.0	5 3	34 24	I*****
140.1-145.0	4 3	38 27	I****
145.1-150.0	4 3	42 29	I****
150.1-155.0	8 6	50 35	I********
155.1-160.0	14 10	64 45	I**************
160.1-165.0	12 8	76 53	I************
165.1-170.0	13 9	89 62	I*************
170.1-175.0	10 7	99 69	I**********
175.1-180.0	9 6	108 76	I*********
180.1-185.0	8 6	116 81	I********
185.1-190.0	3 2	119 83	I***
190.1-195.0	6 4	125 87	I******
195.1-200.0	6 4	131 92	I******
200.1-205.0	4 3	135 94	I****
205.1-210.0	3 2	138 97	I***
210.1-215.0	3 2	141 99	I***
215.1-220.0	2 1	143 100	I**

10 20 30 40

TOTAL CATCH = 143 TOTAL WEIGHT = 4.800 KG
MEAN LENGTH = 160.996 MM MEAN WEIGHT = 33.566 G
VARIANCE = 796.516
STANDARD DEVIATION= 28.223 MM

Fig. 10-6. The histogram showing of the body length composition of *Nemipterus bleekeri* in a computer record.

FAMILY NO. 18- 7
NAME *Nemipterus nematophorus*

```
                                                    10        20        30        40
   RANK      NO. FR. ANO FR.  ----+----+----+----+----+----+----+----+----+---
 70.1- 75.0   1    0    1    0 I*
 75.1- 80.0   2    1    3    1 I**
 80.1- 85.0   7    2   10    3 I*******
 85.1- 90.0  13    4   23    6 I*************
 90.1- 95.0  19    5   42   11 I*******************
 95.1-100.0  26    7   68   18 I**************************
100.1-105.0  25    7   93   25 I*************************
105.1-110.0  26    7  119   32 I*************************
110.1-115.0  37   10  156   42 I************************************
115.1-120.0  54   15  210   57 I****************************************************
120.1-125.0  40   11  250   68 I****************************************
125.1-130.0  32    9  282   76 I********************************
130.1-135.0  12    3  294   79 I************
135.1-140.0   6    2  300   81 I******
140.1-145.0   7    2  307   83 I*******
145.1-150.0  11    3  318   86 I***********
150.1-155.0   3    1  321   87 I***
155.1-160.0  15    4  336   91 I***************
160.1-165.0   7    2  343   93 I*******
165.1-170.0   9    2  352   95 I*********
170.1-175.0   9    2  361   98 I*********
175.1-180.0   4    1  365   99 I****
180.1-185.0   4    1  369  100 I****
185.1-190.0   0    0  369  100 I
190.1-195.0   0    0  369  100 I
195.1-200.0   1    0  370  100 I*
                      ----+----+----+----+----+----+----+----+----+---
                          10        20        30        40
```

TOTAL CATCH = 370 TOTAL WEIGHT = 15.590 KG
MEAN LENGTH = 121.000 MM MEAN WEIGHT = 42.135 G
VARIANCE = 554.709
STANDARD DEVIATION= 23.552 MM

Fig. 10-7. The histogram showing of the body length composition of *Nemipterus nematophorus* in a computer record.

FAMILY NO. 18- 10
NAME *Nemipterus tambuloides*

RANK	NO.	FR.	ANO	FR.	10 20 30 40
80.1- 85.0	1	1	1	1	I*
85.1- 90.0	0	0	1	1	I
90.1- 95.0	4	2	5	3	I****
95.1-100.0	2	1	7	4	I**
100.1-105.0	8	5	15	9	I********
105.1-110.0	3	2	18	11	I***
110.1-115.0	3	2	21	12	I***
115.1-120.0	17	10	38	22	I******************
120.1-125.0	16	9	54	32	I*****************
125.1-130.0	9	5	63	37	I*********
130.1-135.0	11	6	74	43	I**********
135.1-140.0	17	10	91	53	I******************
140.1-145.0	9	5	100	58	I*********
145.1-150.0	11	6	111	65	I**********
150.1-155.0	6	4	117	68	I******
155.1-160.0	9	5	126	74	I*********
160.1-165.0	4	2	130	76	I****
165.1-170.0	8	5	138	81	I********
170.1-175.0	6	4	144	84	I******
175.1-180.0	10	6	154	90	I**********
180.1-185.0	8	5	162	95	I********
185.1-190.0	4	2	166	97	I****
190.1-195.0	1	1	167	98	I*
195.1-200.0	2	1	169	99	I**
200.1-205.0	0	0	169	99	I
205.1-210.0	0	0	169	99	I
210.1-215.0	0	0	169	99	I
215.1-220.0	1	1	170	99	I*
220.1-225.0	0	0	170	99	I
225.1-230.0	0	0	170	99	I
230.1-235.0	1	1	171	100	I*

TOTAL CATCH	=	171	TOTAL WEIGHT =	11.180 KG
MEAN LENGTH	=	142.178 MM	MEAN WEIGHT =	65.380 G
VARIANCE	=	746.827		
STANDARD DEVIATION	=	27.328 MM		

Fig. 10–8. The histogram showing of the body length composition of *Nemipterus tambuloides* in a computer record.

FAMILY NO. 1- 1
NAME *Loligo formosana*

RANK	NO.	FR.	ANO	FR.	10 20 30 40
90.1-100.0	4	8	4	8	I****
100.1-110.0	10	20	14	28	I**********
110.1-120.0	2	4	16	32	I**
120.1-130.0	5	10	21	42	I*****
130.1-140.0	8	16	29	58	I********
140.1-150.0	5	10	34	68	I*****
150.1-160.0	3	6	37	74	I***
160.1-170.0	2	4	39	78	I**
170.1-180.0	4	8	43	86	I****
180.1-190.0	4	8	47	94	I****
190.1-200.0	0	0	47	94	I
200.1-210.0	0	0	47	94	I
210.1-220.0	0	0	47	94	I
220.1-230.0	1	2	48	96	I*
230.1-240.0	2	4	50	100	I**

TOTAL CATCH = 50 TOTAL WEIGHT = 3.750 KG
MEAN LENGTH = 140.400 MM MEAN WEIGHT = 75.000 G
VARIANCE = 1264.840
STANDARD DEVIATION= 35.565 MM

Fig. 10-9. The histogram showing of the body length composition of *Loligo formosana* caught by No. 1 haul of the trawl net at Station 3 in a computer record.

FAMILY NO. 1- 1
NAME *Loligo formosana*

RANK	NO.	FR.	ANO	FR.	10 20 30 40
60.1- 70.0	1	1	1	1	I*
70.1- 80.0	4	4	5	5	I****
80.1- 90.0	2	2	7	7	I**
90.1-100.0	8	8	15	15	I********
100.1-110.0	3	3	18	19	I***
110.1-120.0	5	5	23	24	I*****
120.1-130.0	9	9	32	33	I*********
130.1-140.0	10	10	42	43	I**********
140.1-150.0	19	20	61	63	I********************
150.1-160.0	12	12	73	75	I************
160.1-170.0	14	14	87	90	I**************
170.1-180.0	6	6	93	96	I******
180.1-190.0	3	3	96	99	I***
190.1-200.0	1	1	97	100	I*

TOTAL CATCH = 97 TOTAL WEIGHT = 7.570 KG
MEAN LENGTH = 137.990 MM MEAN WEIGHT = 78.041 G
VARIANCE = 843.639
STANDARD DEVIATION= 29.045 MM

Fig. 10-10. The histogram showing of the body length composition of *Loligo formosana* caught by No. 2 haul of the trawl net at Station 1 in a computer record.

```
FAMILY NO.  1-  1
NAME        Loligo formosana

                                          10        20        30        40
   RANK      NO. FR. ANO FR.  ----+----+----+----+----+----+----+----+---
 50.1- 60.0   1   1   1   1  I*
 60.1- 70.0   8   8   9   9  I********
 70.1- 80.0  24  24  33  33  I************************
 80.1- 90.0  22  22  55  54  I**********************
 90.1-100.0  12  12  67  66  I************
100.1-110.0   7   7  74  73  I*******
110.1-120.0   7   7  81  80  I*******
120.1-130.0  10  10  91  90  I**********
130.1-140.0   2   2  93  92  I**
140.1-150.0   3   3  96  95  I***
150.1-160.0   2   2  98  97  I**
160.1-170.0   2   2 100  99  I**
170.1-180.0   0   0 100  99  I
180.1-190.0   0   0 100  99  I
190.1-200.0   1   1 101 100  I*
                              ----+----+----+----+----+----+----+----+---
                                          10        20        30        40

TOTAL CATCH          =       101          TOTAL WEIGHT =       3.100 KG
MEAN LENGTH          =     96.188 MM      MEAN WEIGHT  =      30.693  G
VARIANCE             =    699.578
STANDARD DEVIATION=         26.450 MM
```

Fig. 10-11. The histogram showing of the body length composition of *Loligo formosana* caught by No. 7 haul of the trawl net at Station 17 in a computer record.

```
FAMILY NO.  1-  1
NAME        Loligo formosana

                                          10        20        30        40
   RANK      NO. FR. ANO FR.  ----+----+----+----+----+----+----+----+---
 60.1- 70.0   2   2   2   2  I**
 70.1- 80.0   5   5   7   6  I*****
 80.1- 90.0  20  18  27  25  I*********************
 90.1-100.0  22  20  49  45  I************************
100.1-110.0  12  11  61  56  I************
110.1-120.0  13  12  74  68  I*************
120.1-130.0   4   4  78  72  I****
130.1-140.0   9   8  87  80  I*********
140.1-150.0   8   7  95  87  I********
150.1-160.0   6   6 101  93  I******
160.1-170.0   1   1 102  94  I*
170.1-180.0   2   2 104  95  I**
180.1-190.0   1   1 105  96  I*
190.1-200.0   0   0 105  96  I
200.1-210.0   1   1 106  97  I*
210.1-220.0   0   0 106  97  I
220.1-230.0   1   1 107  98  I*
230.1-240.0   0   0 107  98  I
240.1-250.0   2   2 109 100  I**
                              ----+----+----+----+----+----+----+----+---
                                          10        20        30        40

TOTAL CATCH          =       109          TOTAL WEIGHT =       2.450 KG
MEAN LENGTH          =   114.450 MM       MEAN WEIGHT  =      22.477  G
VARIANCE             =  1196.028
STANDARD DEVIATION=         34.584 MM
```

Fig. 10-12. The histogram showing of the body length composition of *Loligo formosana* caught by No. 10 haul of the trawl net at Station 12 in a computer record.

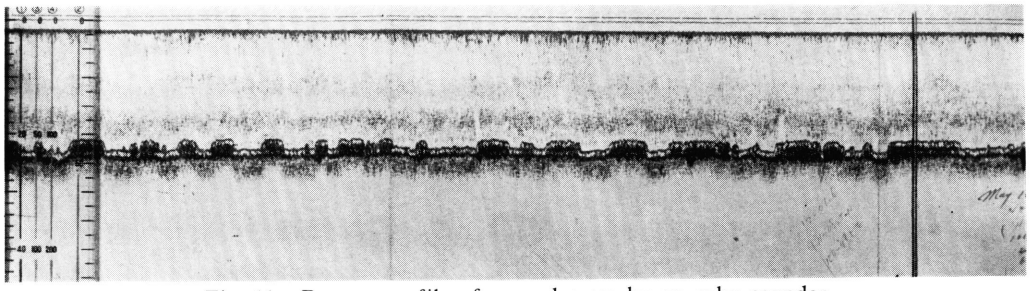

Fig. 11. Bottom profile of rugged areas by an echo sounder.

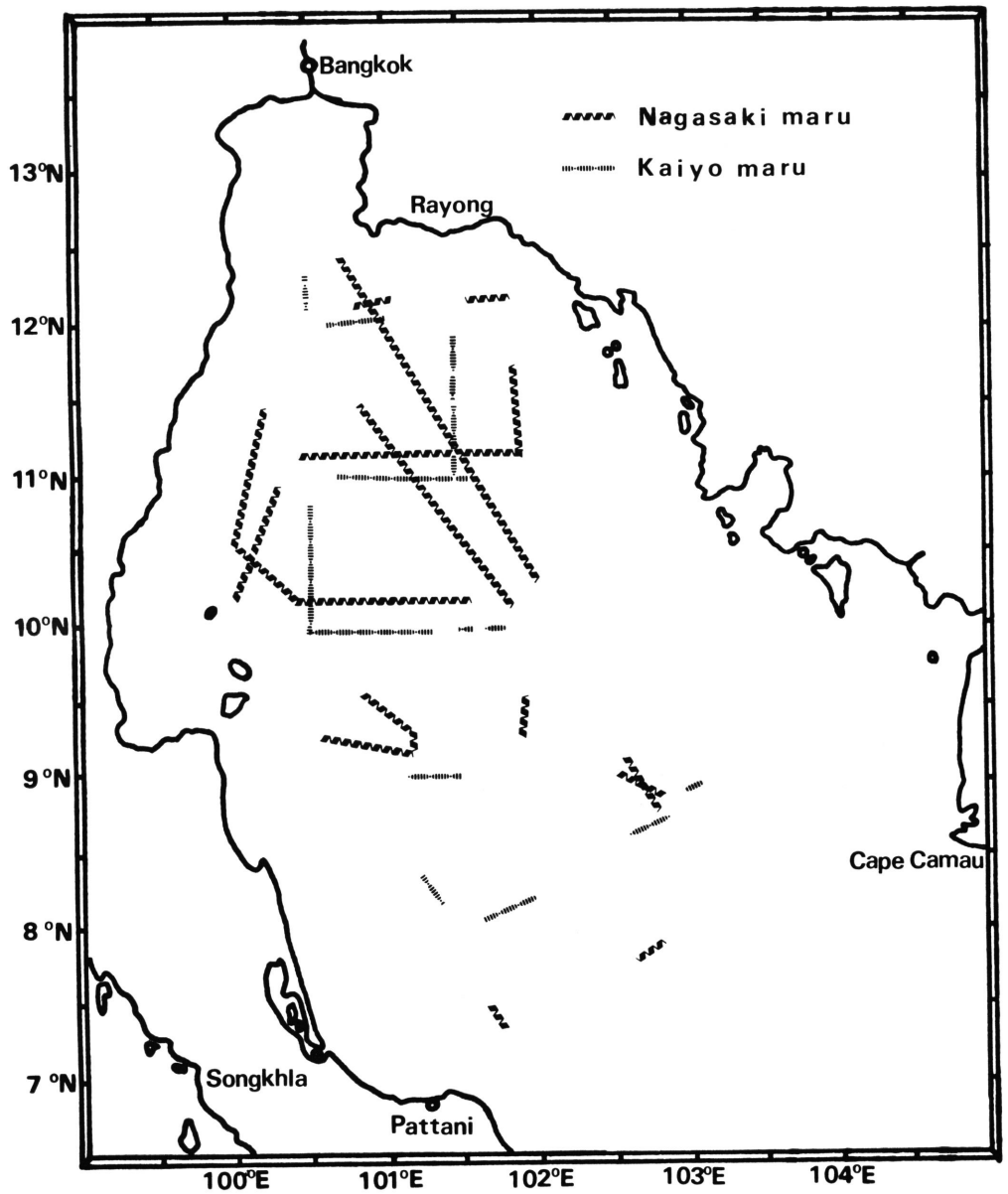

Fig. 12. Distribution of the rugged bottom areas along the track of T/V Nagasaki-maru and R/V Kaiyo-maru.

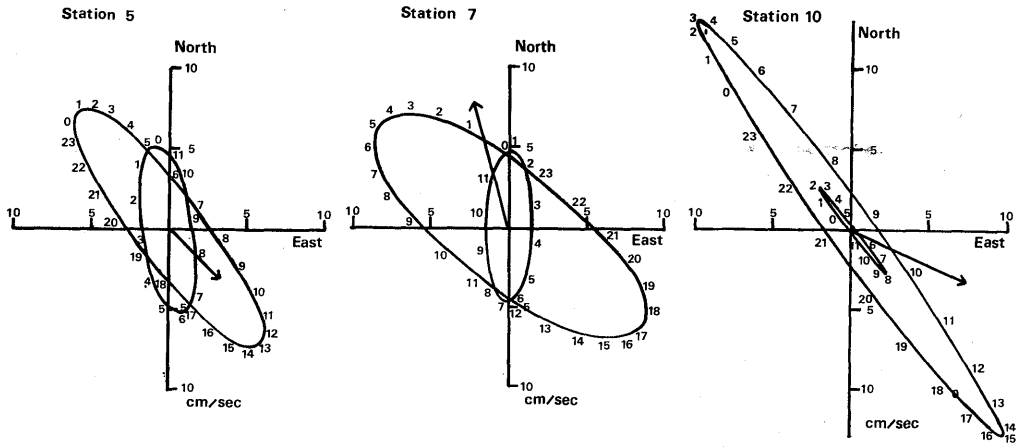

Fig. 13. Current ellipses at Station 5, 7 and 10.

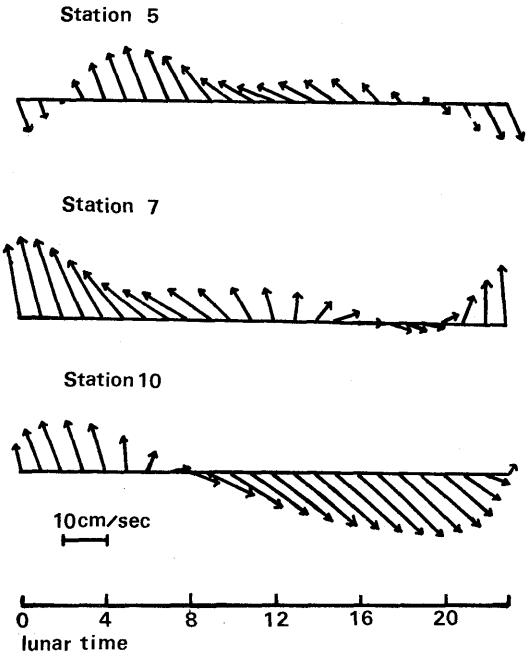

Fig. 14. Component vectors of the current at Station 5, 7 and 10.

Table 5. Records of Smith-McIntyre mud samplings.

Station No.	Position	Water Depth	Date	Time*	Wire-out (m)	Remark of Sediment	Benthos Record
1	12°10.56′N 100°28.62′E	30m	5/18	21:25 21:36	20–32 20–28	Sand, shell fragments (bivalves), no smell	3 Polychaetes, 1 Shrimp 2 Stomatopods, 1 Crab
2	12°10.03′N 101°09.10′E	32m	5/18	14:00 14:14	20–31 20–31.5	Grayish fine sand and reddish consolidated clay, shell fragments, no smell	7 Polychaetes, 3 Shrimps, 8 Stomatopods, 1 Crab
3	12°09.64′N 101°55.22′E	29m	5/18	08:15 08:26	20–27 20–26.5	Greenish gray silt and fine sand, sandy laminae at the bottom, coarse shell fragments, some smell	2 Polychaetes, 1 Shrimp, 1 Stomatopod, 1 Crab
4	11°09.98′N 101°53.96′E	65m	5/17	19:52 20:29	50–72 50–66	Grayish silty mud, shell fragments, no smell	2 Polychaetes, 2 Stomatopods, 1 eel
5	11°10.30′N 101°11.10′E	65m	5/16	14:40 14:55	55–64 50–67	Greenish gray mud, shell fragments, no smell	No benthos
6	11°06.00′N 100°27.50′E	50m	5/16	07:52 08:48	48 54	Greenish gray calcareous silt and fine sand with shell fragments (bivalves)	6 Polychaetes
7	10°11.49′N 100°23.20′E	60m	5/19	12:50 13:00	50–57 52–57	Grayish calcareous mud	3 Polychaetes, 1 Stomatopod, 2 Brittle stars
8	10°09.80′N 101°09.50′E	68m	5/20	21:00 21:10	55–74 55–73	Brownish gray calcareous mud, shell fragments, no smell	1 eel
9	10°10.15′N 101°55.60′E	74m	5/21	06:37 06:49	65–75 65–74	(Surface 2 cm) brownish silt, (below) grayish silty calcareous mud, some shell fragments, no smell	2 Stomatopods, 1 Brittle star
10	09°15.91′N 101°35.05′E	72m	5/22	14:22 14:36	60–72 60–74	(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	60m	5/25	13:27 13:37	50–61 50–60	(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	31m	5/25	06:10 06:19	25–31 25–31	Grayish calcareous silty mud with some brownish silt and sandy laminae, lateritic gravel, shell fragments, no smell	3 Polychaetes
13	08°43.25′N 100°41.42′E	32m	5/24	19:06 19:20	25–32 25–31.5	Grayish calcareous mud, no fragment, no gravel, no smell, worms and crabs	4 Polychaetes, 1 Stomatopod, 2 Crabs, 1 fish (Gobiidae sp.)
14	08°10.13′N 101°10.16′E	52m	5/24	13:24 13:32	45–54 45–54	Grayish calcareous mud with some brownish silt on surface, no gravel, no smell	20 Polychaetes, 1 Shrimp, 1 Crab, 1 Brittle star
15	07°15.12′N 101°49.92′E	49m	5/24	06:40 06:48	35–55 35–44	Brownish silt and grayish sandy silt with shell fragments, lateritic gravel, sandy patch, swimming baby fish, no smell	5 Polychaetes
16	07°34.70′N 102°20.20′E	65m	5/23	18:46 18:57	60–71 63–71	Yellowish gray calcareous mud with abundant sponge spicules, no smell	No benthos
17	07°59.32′N 102°58.92′E	69m	5/23	13:37 13:43	60–72 60–71	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	29m	5/23	06:16 06:27	20–30 20–27	Grayish calcareous mud with shell fragments, patchy sand laminae, no smell	No benthos

* time when sampler hits bottom

Table 6. Coring records.

Station No.	Position	Water Depth	Date	Time*	Wire-out (m)	Approximate corelength recovered	Remark
1	12°10.56′N 100°28.62′E	30m	5/18	21:55 	20–33 20–32	15cm 22cm	Grayish sand and silt (sandy→silty)
2	12°10.03′N 101°09.10′E	32m	5/18	14:10 14:20	20–33 20–33	20cm 20cm	Grayish fine sand and hard lateritic clay at the bottom
3	12°09.64′N 101°55.22′E	29m	5/18	08:20 08:38	18–29 15–27	100cm 100cm	Greenish gray calcareous sandy silt
4	11°09.98′N 101°53.96′E	65m	5/17	20:00 20:33	50–66 50–66	30cm 100cm	Grayish silt and consolidated dark gray in core catcher
5	11°10.30′N 101°11.10′E	65m	5/16	 15:03 15:25	50–67 50–67 50–65 50–68.5	100cm 30cm 100cm 20cm	Greenish gray calcareous mud and consolidated dark clay in core catcher
6	11°06.00′N 100°27.50′E	50m	5/16	07:05 07:25	40–55 38–54	30cm 30cm	Grayish silty sand with dark clay (consolidated) in core catcher
7	10°11.49′N 100°23.20′E	60m	5/19	12:38 12:55 13:04 13:12	— 51–59 50–58 52–57	100cm 100cm 100cm 100cm	Grayish calcareous mud
8	10°09.80′N 101°09.50′E	68m	5/20	20:47 21:04	55–75 55–71	50cm 100cm	Brownish gray calcareous mud
9	10°10.15′N 101°55.60′E	74m	5/21	06:30 06:43	65–77 65–79	30cm 20cm	Grayish calcareous mud with semiconsolidated clay in core catcher
10	09°15.91′N 101°35.05′E	72m	5/22	14:10 14:27 14:40 14:48	65–73 61–73 60–73 60–74	15cm 100cm 15cm 10cm	Brownish gray calcareous mud with shell fragments, semiconsolidated clay in core catcher
11	09°10.17′N 101°09.02′E	60m	5/25	13:22 13:32	50–59 50–60	100cm 100cm	Grayish calcareous mud
12	09°11.05′N 100°24.49′E	31m	5/25	06:02 06:13	25–34 25–30	50cm 50cm	Grayish calcareous mud with some shell fragments
13	08°43.25′N 100°41.42′E	32m	5/24	19:00 19:10	25–32 25–34	80cm 100cm	Grayish calcareous mud with shell fragments
14	08°10.13′N 101°10.16′E	52m	5/24	13:15 13:27	45–53 45–53	100cm 100cm	Grayish calcareous mud
15	07°15.12′N 101°49.92′E	49m	5/24	06:25 06:35	40–50 35–55	10cm 10cm	Grayish silty sand with consolidated lateritic (red) clay in core catcher
16	07°34.70′N 102°20.20′E	65m	5/23	18:41 18:52	60–71 60–70	100cm >100cm	Grayish calcareous mud
17	07°59.32′N 102°58.92′E	69m	5/23	13:28 13:36	60–71 60–77	>100cm >100cm	Grayish calcareous mud
18	08°35.65′N 103°18.78′E	29m	5/23	06:13 06:20	20–29 20–34	50cm 20cm	Grayish calcareous mud and some shell fragments

* time when sampler hits bottom

Table 7. Lithologic summary of bottom sediments.

Station No.	Color	Grain Size (%) Gravel	Sand	Mud	Total	Microscopic Remark	Name of Sediment according to Emery and Niino (1963)
1	Dusky yellowish green(10GY3/2)	27.7	61.1	11.1	99.9	Shell fragments, Foraminifera and Coccolith rich	Dusky yellowish green calcareous mudium sand
2	Grayish olive green (5GY3/2)	40.0	53.3	6.7	100.0	same above	Grayish olive green calcareous coarse sand
3	Dusky yellowish green (10GY3/2)	20.0	40.0	40.0	100.0	same above	Dusky yellowish green calcareous muddy sand
4	Dusky yellow green (5GY5/2)	0	70.0	30.0	100.0	same above	Dusky yellow green calcareous muddy sand
5	Grayish olive (10Y4/2)	0	33.3	66.7	100.0	same above	Grayish olive calcareous sandy mud
6	Dusky yellow green (5GY5/2)	7.7	46.1	46.1	99.9	same abevo	Dusky yellow green calcareous muddy sand
7	Dusky yellow green (5GY5/2)	0	8.3	91.7	100.0	same above	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	Shell fragments, Foraminifera and Coccolith, brown mud contains more quartz than grayish mud	Brown calcareous mud & Dusky yellow green calcareous muddy sand
9	(Surface) Moderately olive brown (5Y4/4) (Below) Grayish olive (10Y4/2)	15.0	35.0	50.0	100.0	same above	Brown calcareous mud & Grayish olive calcareous sandy mud
10	(Surface) Moderate yellowish brown (10YR5/4) (Below) Dusky yellow green (5GY5/2)	20.6	44.1	35.2	99.9	same above	Brown calcareous mud & Dusky yellow green calcareous muddy sand
11	(Surface) Moderately olive brown (5Y4/4) (Below) Grayish olive (10Y4/2)	12.0	28.0	60.0	100.0	same above	Brown calcareous mud & Grayish olive calcareous sandy mud
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
13	Dusky yellow green (5GY5/2)	11.5	34.6	53.8	99.9	Quartz and feldspar > calcareous gralns	Dusky yellow green (non-calcareous) sandy mud
14	Dusky yellow green (5GY5/2)	0	20.0	80.0	100.0	same above	Dusky yellow green (non-calcareous) sandy mud
15	Grayish olive (10Y4/2)	18.2	36.4	45.4	100.0	Calcareous grains, quartz and feldspar, black rock fragments	Grayish olive (non-calcareous) muddy sand
16	Dusky yellow green (5GY5/2)	0	6.3	93.7	100.0	Shell fragments, Foraminifera and Coccolith rich	Dusky yellow green calcareous mud
17	Dusky yellow green (5GY5/2)	3.3	3.3	93.3	99.9	same above	Dusky yellow green calcareous mud
18	Grayish olive (10Y4/2)	16.7	33.3	50.0	100.0	Calcareous grains rich, quartz and feldspar	Grayish olive calcareous sandy mud

Table 8. Direction and velocity of constant current and those of diurnal and semi-diurnal tides at its height.

		Station-5	Station-7	Station-10
Constant current	Direction	133°	343°	113°
	Velocity	4.55cm/sec	8.00cm/sec	8.16cm/sec
Diurnal tide	Direction	141°(13h) 321°(01h)	125°(17h) 305°(05h)	143°(03h) 323°(15h)
	Velocity	9.23cm/sec	10.44cm/sec	16.26cm/sec
Semi-diurnal tide	Direction	169°(06h) (18h) 349°(00h) (12h)	004°(01h) (13h) 184°(07h) (19h)	141°(08h) (20h) 321°(02h) (14h)
	Velocity	5.22cm/sec	4.56cm/sec	3.37cm/sec

Numbers in parenthensis show lunar hours.