Preliminary Report
of
The Hakuhō Maru Cruise KH-71-4
(Yamato-Tai Cruise)

August 18 ～ September 10, 1971
The Sea of Japan

Ocean Research Institute
University of Tokyo
1972

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By
The Scientific Members of the Expedition
Edited by
Toshiro Kuroki

Contents

Expertises

Appendices

Introduction

The purpose of this cruise of R. V. Hakuho-Maru to the Sea of Japan (KH-71-4) was to find conditions and mechanisms which are concerned with the formation of fishing grounds near a bank ("tai" in Japanese). Yamato-Tai, the bank located at the center of the Sea of Japan was choosen as the object of our investigation. This bank extends in ENE to WSW direction and about 120 miles long and 40 miles wide. The highest point is elevated up to a depth of almost 200 m from the bottom of the basin of about 3,000 m depth. This bank has been well known among fishermen for many years as a good fishing ground of demersal fishes, and in recent years this area is also exploited by pelagic fisheries for such fish as squid and mackerel.

Observations of various abiotic and biotic characters were attempted to evaluate the environments of the fishing grounds. Abiotic parameters observed include water temperature of various depthes, current at the surface and also at the bottom and mid-layers, wind, underwater light intensity (turbidity), salinity, phosphate and oxygen. Frequent BT and STD observations were made for seeing the temperature and salinity structure.

For biotic characters, plankton samplings with various types of net at different depth layers were conducted to get phyto-plankton, zoo plankton, and micronekton including larvae of fishes.

Echo survey was carried on throughout the cruise to get information of the distribution of fishes. This survey was planed to be supplemented by occasional samplings with hooks at the bank area to identify species of fish and to measure biological parameters such as size, maturity, and food.

Contrary to expectation, only squids (Ommastrephes sloani pacificus) were caught in substantial number. Other commercially important species in this area such as mackerel (Pneumatophorus japonicus) and Alaska pollac (Theragra chalcogramma) were not represented in the catch, (except only one mackerel.)

Two types of observation were planned. One type was the frequent observation at one position (Sta. 16) on the bank for 26 hours; STD observations, net samplings and others were made in every 2 hours. The other was spacial observations over the bank area in a short time interval. A total of 9 stations (Stas. 9-17) covering the bank were occupied. The distance between stations was about 40 miles in east-west direction and about 20 miles in north-south direction which were almost permissible minimum length. Bottom current and temperature measurements were done at 2 stations (Stas. 13 and 16). At the same stations, observations of current and temperature of upper layers were made by the free-drifting 3 buoys system (△ -arranged buoy system).

The cruise KH-71-4 began at the departure from Tokyo on 18th August and finished at the arrival to Tokyo on 10th September 1971. The tracks of Hakuho-Maru and the list of scientists aboard are shown in the following pages.

Generally, operations were performed satisfactory and we expect much contributions out of this cruise. Although the scheduled works were interrupted for 3 days due to bad weather by Typhoon # 23, the effects on the works were made minimum by the effort of all scientists and crews.

On behalf of all scientists aboard, I should like to express our sincere thanks to Captain I. Tadama and all the crew of the R. V. Hakuho-Maru for their most timely co-operations and helpful assistances.

Toshiro Kuroki
Chief Scientist

Scientists Aboard

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KASUYA, Toshio	"
SAKAMOTO, Wataru	"
KAWAGUCHI, Kouichi	"
NAKAI, Toshisuke	"
HASUMOTO, Hiroshi	"
KUREHA, Kazuo	"
INAGAKI, Tadashi	"
ARAKI, Masakuni	"
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Fig. 0-1 Track chart of Cruise KH-71-4

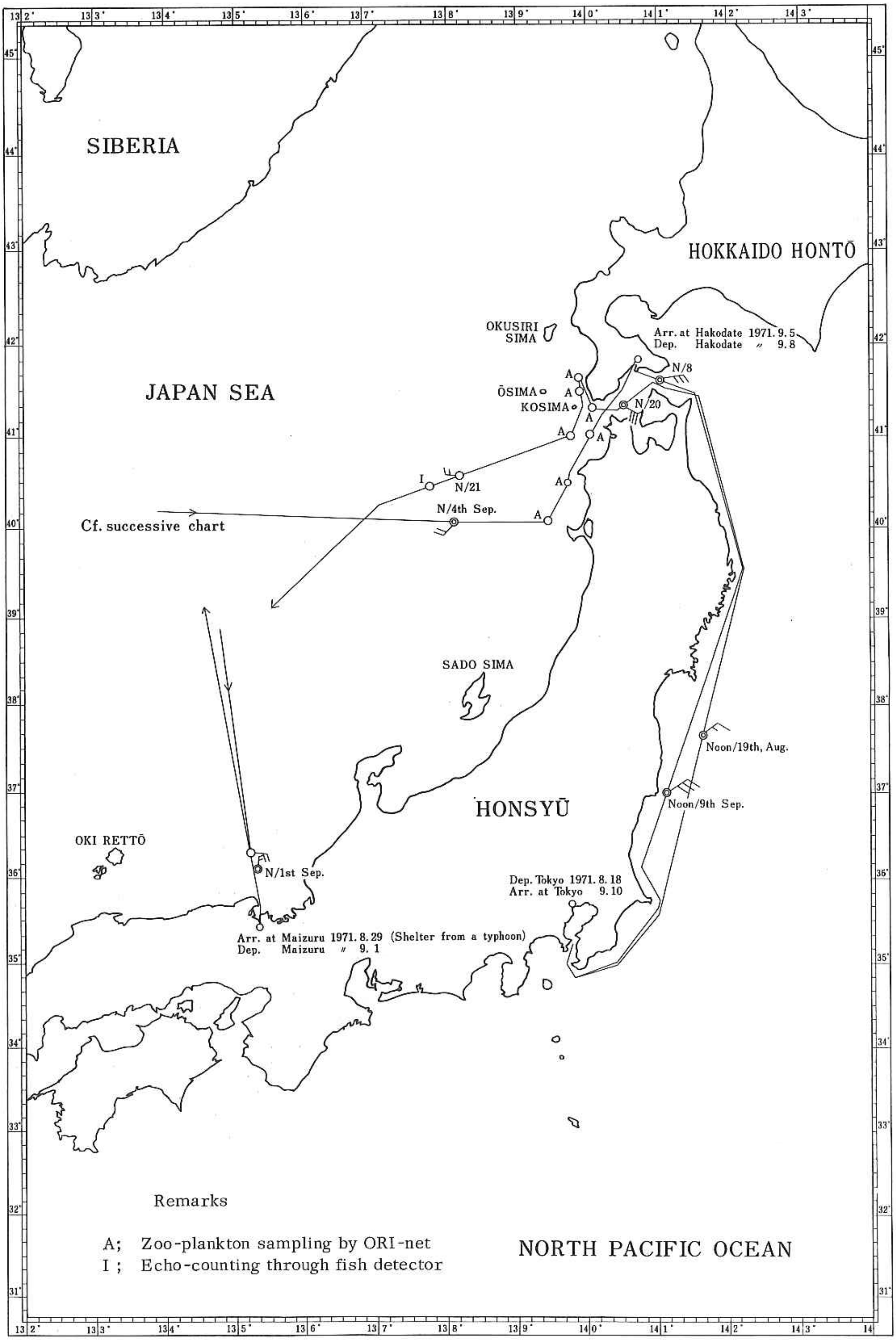
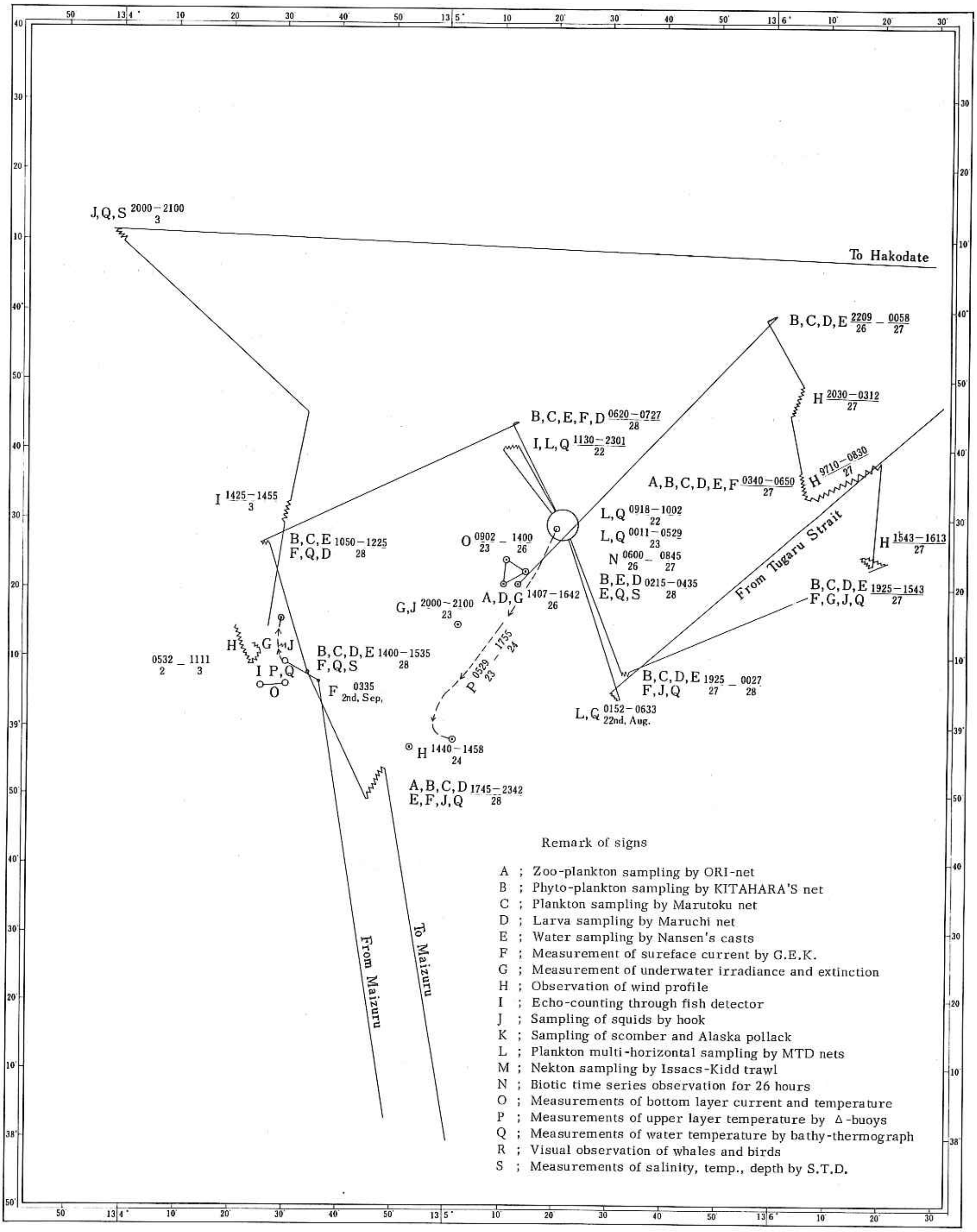


Fig. 0-2 Approaches on the Yamato-Tai



1. Hydrographical survey exploring the formation mechanism of the fishing ground over the "Yamato-Tai" in the Sea of Japan

S. Kudoh, A. Kishi and T. Nakao

The "Yamato-Tai", elevated from the central deep sea-floor in the Sea of Japan, is known as a highly productive fishing ground of squid, mackerel, yellow-taill, Alaska pollack, etc.

Upwelling of deeper nutrient-rich water or so-called "Polar Front" traversing the bank might be responsible to the formation of this favourable fishing ground. At present, we have no appropriate means to measure the vertical flow directly.

Accordingly some physicochemical parameters were measured in order to estimate the vertical flow indirectly using those available methods established by M. Okada, K. Yoshida and others.

Studies including computations shall be followed later through the guidance of Prof. Michitaka Uda.

Hydrographic survey and analysis of sea water (pH, dissoloved oxyen, salinity and phosphate-P) are referred to the Oceanographic Manual (Kaiyo-Kansoku-Shishin published in Japan, 1970).

146 samples of sea water were collected from 9 stations scattered over and around the bank.

Oceanographic data are compiled in the tables of the Appendices and are shown as Figs. 1-1/1-12.

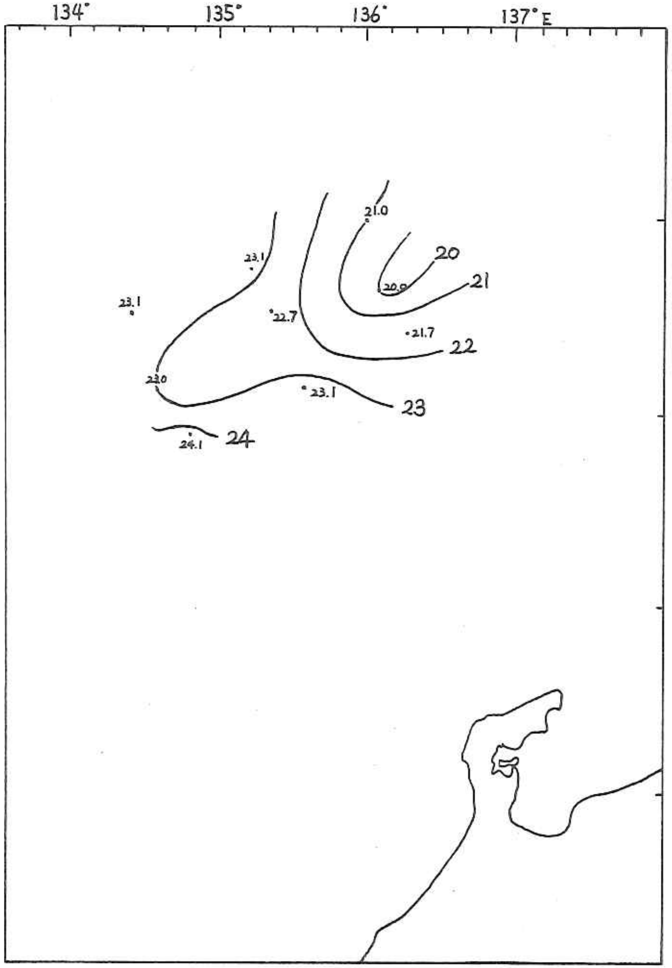


Fig. 1-1 Surface temperature ($^{\circ}C$)

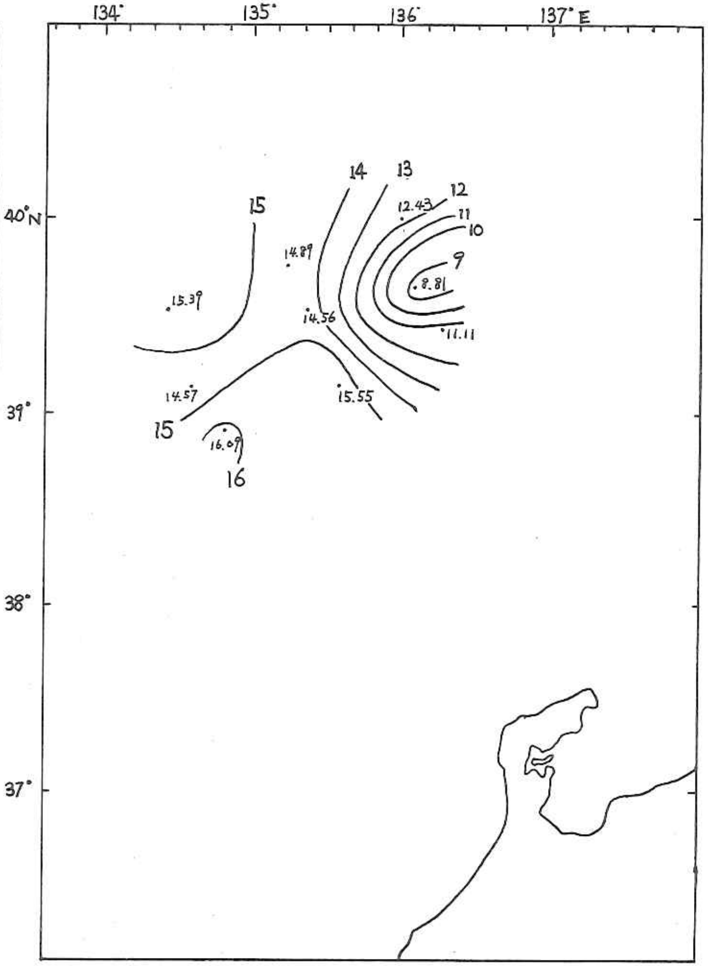


Fig. 1-2 Temperature ($^{\circ}C$) at the 50m depth

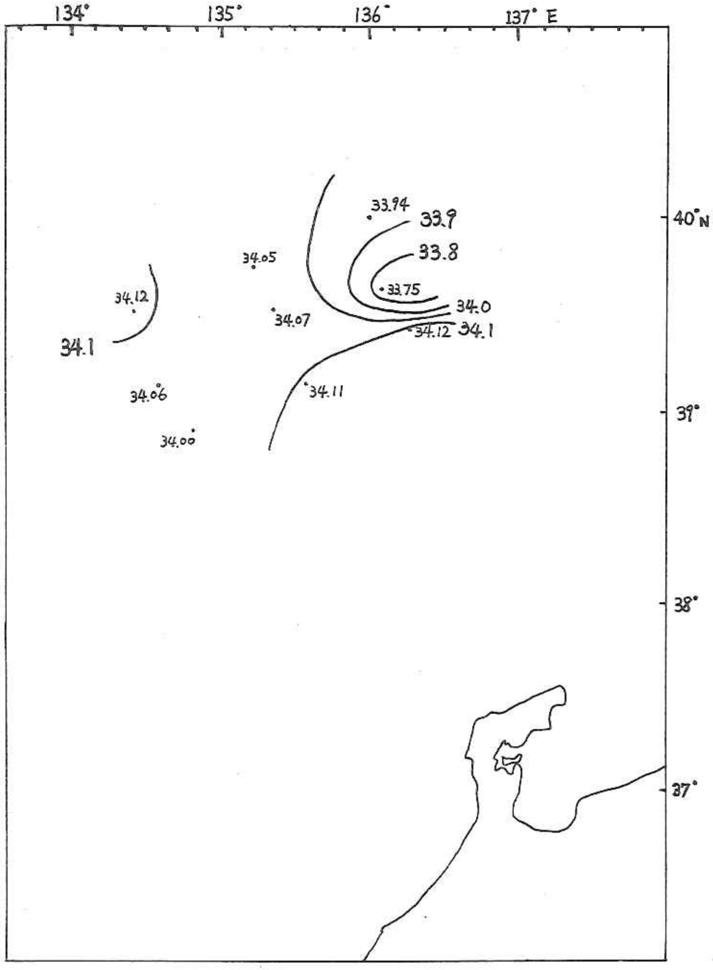


Fig. 1-3 Surface salinity ($^{o}/_{oo}$)

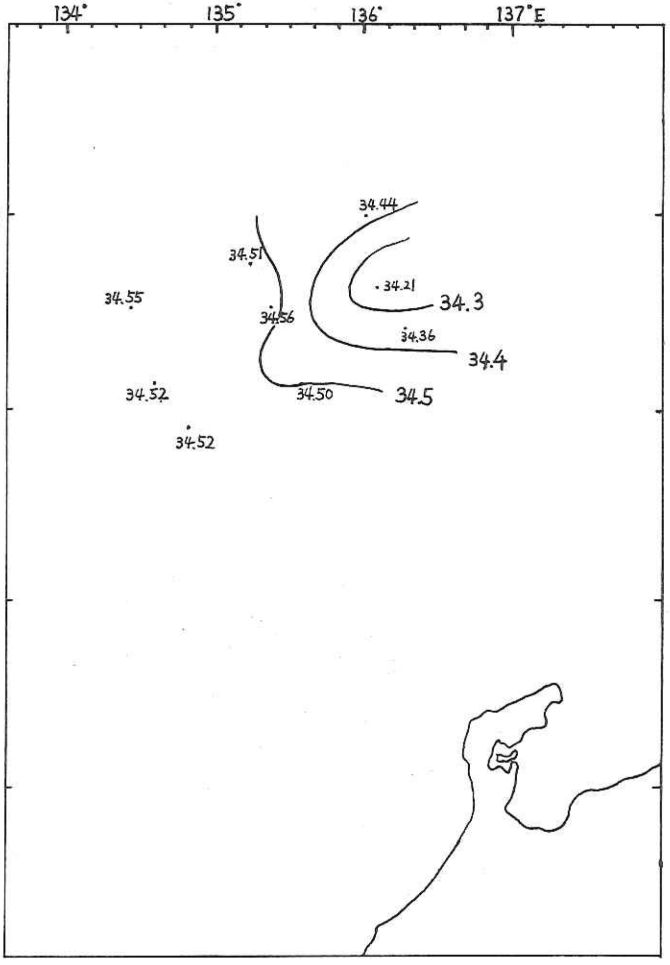


Fig. 1-4 Salinity ($^{o}/_{oo}$) at the salinity max. depth

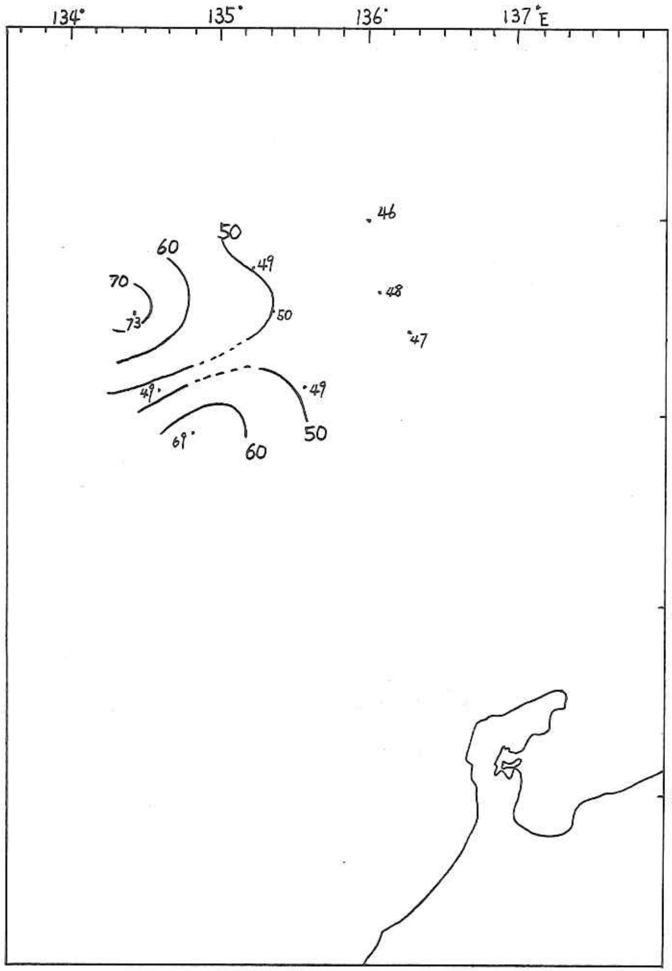


Fig. 1-5 Depth in meter of salinity max.

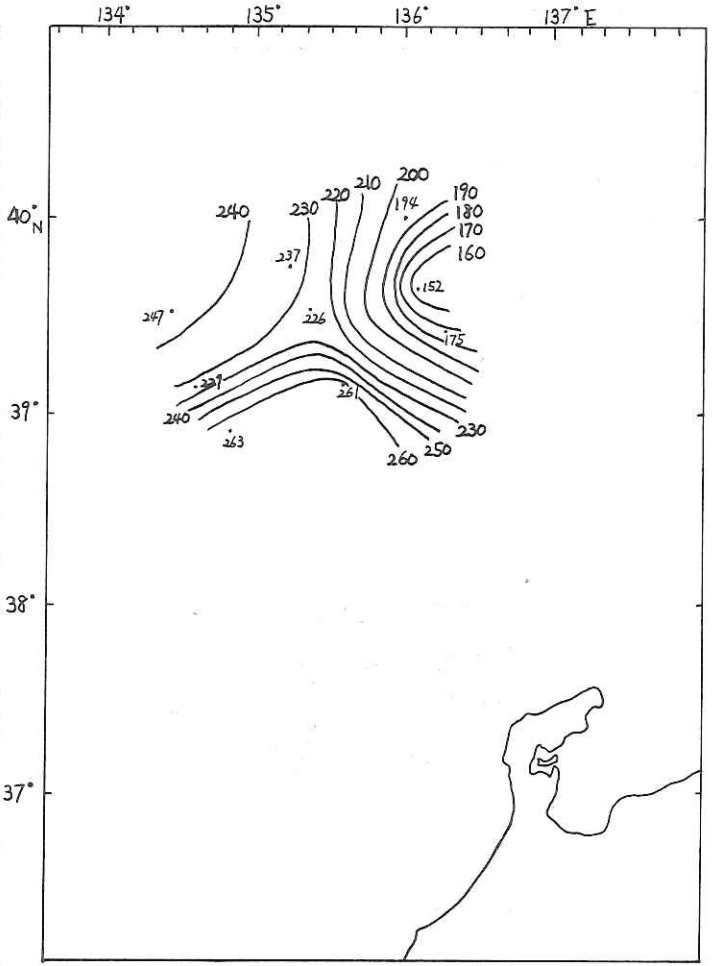


Fig. 1-6 Thermosteric anomaly at the 50m depth

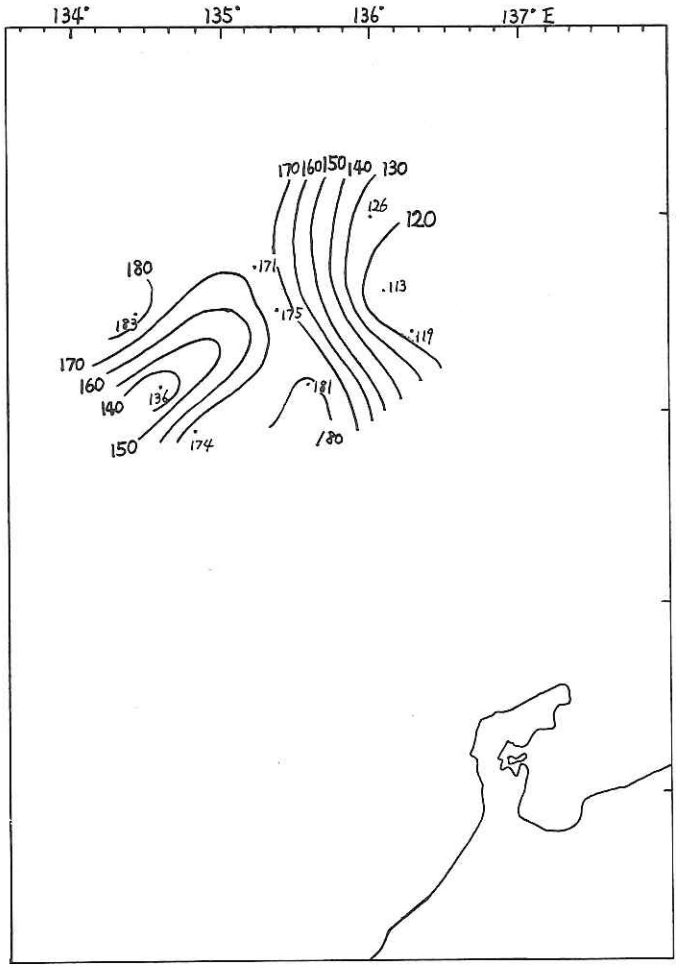


Fig. 1-7 Thermosteric anomaly at the 100m depth

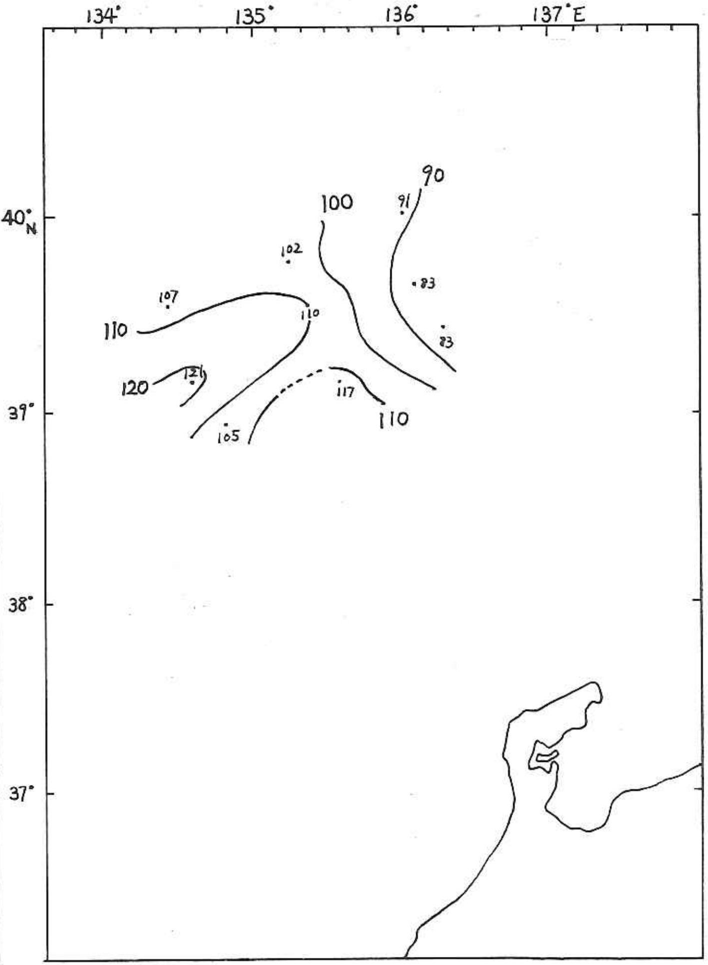


Fig. 1-8 Thermosteric anomaly at the 200m depth

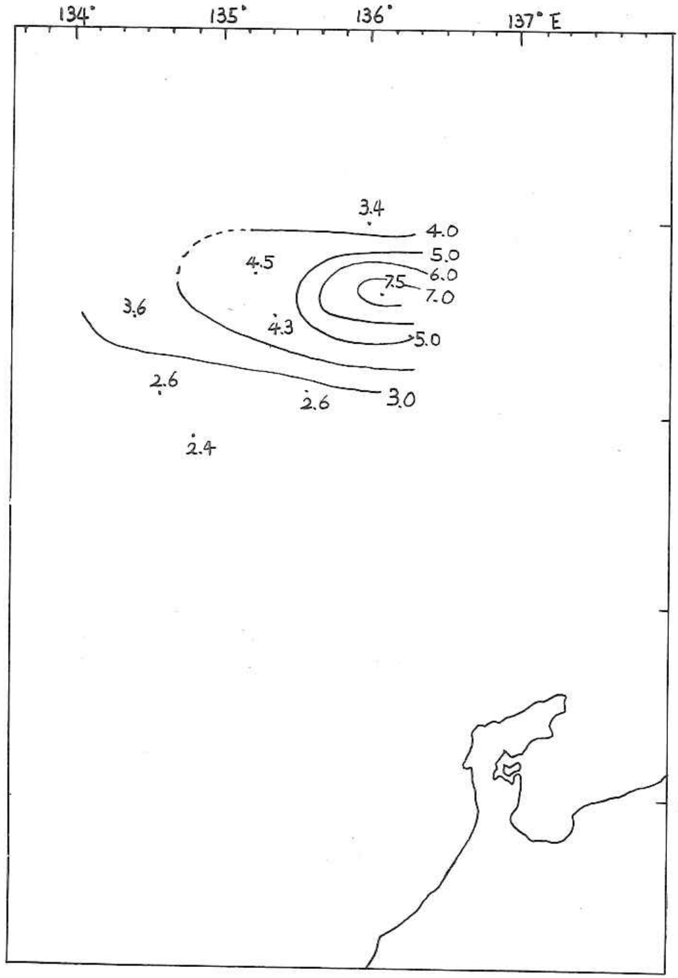


Fig. 1-9 Topography of maximum vertical temperature gradient (thermocline) ∂θ/∂Z max. (degree per 10m)

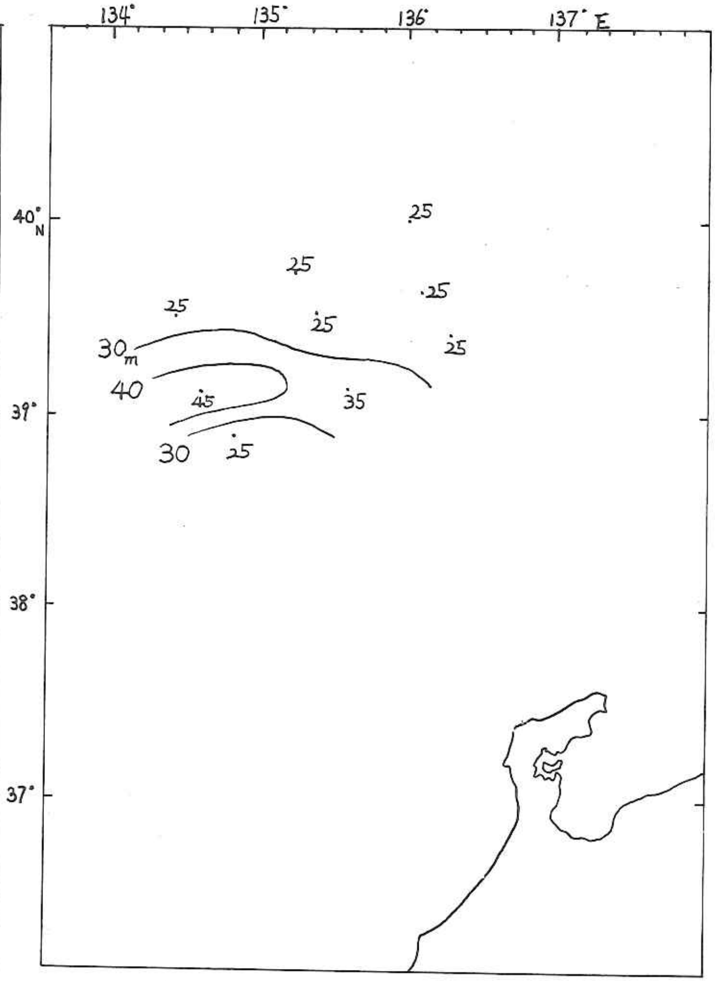


Fig. 1-10 Topography of the depth in meter of thermocline ∂θ/∂Z max.

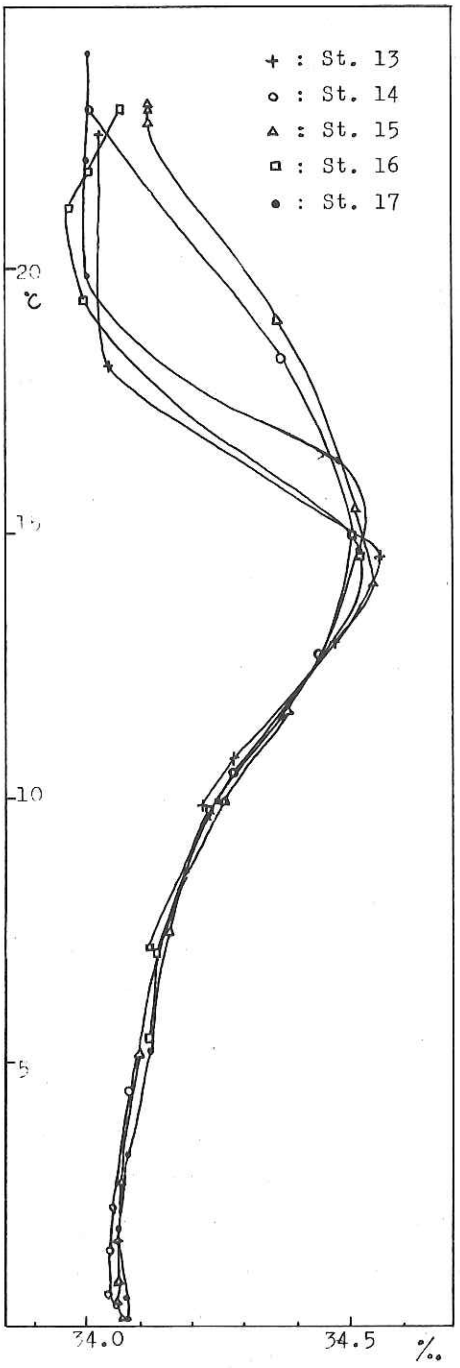


Fig. 1-11 T-S diagram

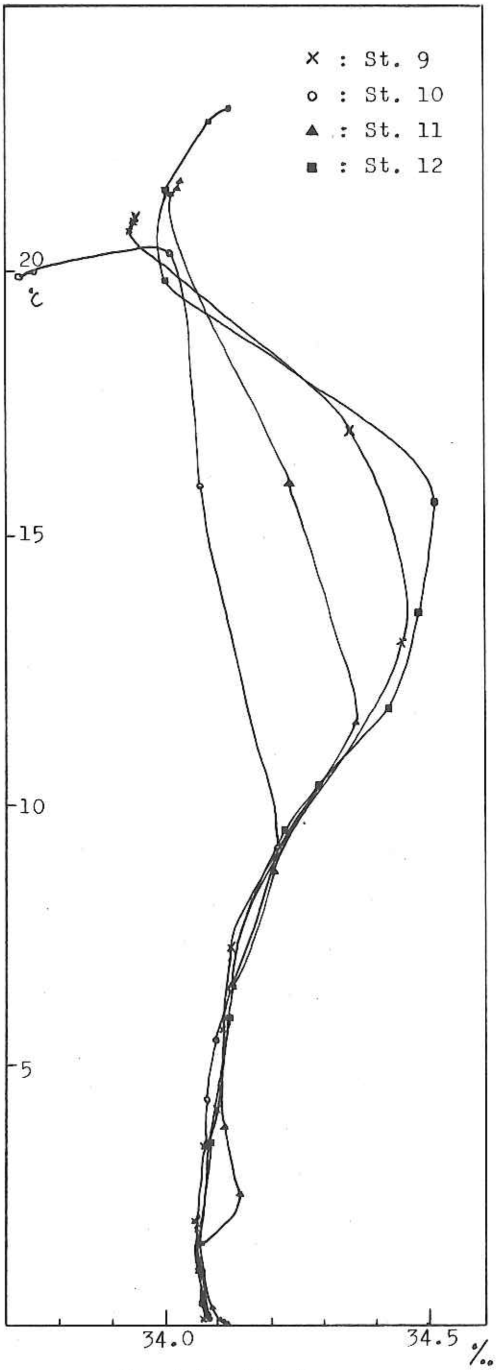


Fig. 1-12 T-S diagram

2. Measurement of water temperature by free-drifting 3 buoys system

T. Kuroki, W. Sakamoto, K. Kawaguchi and T. Inagaki

Purpose: The measurements of the water temperature in the time scale $10^{0\text{-}3}$ minutes and in the space scale $10^{0\text{-}1}$ kms are the most essential to know the mechanism of fishing ground formation, because fish sense should receive thermal stimulations in the microstructure of a water mass in which fish are swimming around.

For the purpose to observe the environmental conditions such as the fluctuations of water temperature and their vectors in the "time and space", 3 buoys with thermisters chain arranged triangularly on the sea surface and drifted freely for several days are used.

These buoys would be dragged by winds or by the surface currents affected with wind, and only those shifting speeds in the water mass will be expected to be comparable with fish swimming speed.

Apparatus and method: A temperature counter system, 1-track FM digital recorder, radio system for beacon and batteries for these electric systems are set in the barrel of the buoy. The cables of thermisters in the depths of 0 - 1, 10, 30, 50, 100, 150 meter are hung along a rope with weight. A corner reflector for radar and flash lamp for warning at night are tied to the buoy. (Cf. Fig. 2-1)

Three buoys are used in one observation, each buoy is set at the positions of apices of one triangle of which three sides are one mile equally.
At one station, 3 drifting buoys are set on the upstream points of well distanced from the station after measuring existent current by GEK. And the drifting buoys are tracked by the radar on the ship and located every hour. (Cf. Photo. 2-1)

It was very valuable that the 3 moored buoys with several current meters and thermisters were set at triangular arrangement near the station at the same time.

Results: Two observations by free-drifting 3 buoys system were carried out on 23th/24th August and 2nd/3rd September in this cruise. The first observation was continued for about 36 hours near the Sta. 13; the tracks of 3 buoys showed reverse sigmoid curves as in Fig. 2-2 (cf. Table 2-1). This result suggests us that there might be two gyres, clockwise and counter-clockwise, with radius of several miles respectively near the Sta. 13.

The second observation was continued for about 26 hours near the Sta. 16; the tracks of 3 buoys showed a trend of northward movement hesitatively as Fig. 2-3 (cf. Table 2-2). It was not clear whether those current (mainly northward but occasionally southward) were normal in this station or not.

The records of the temperature fluctuations in these observations are being processed under a digital analysis, and its results will be published elsewhere.

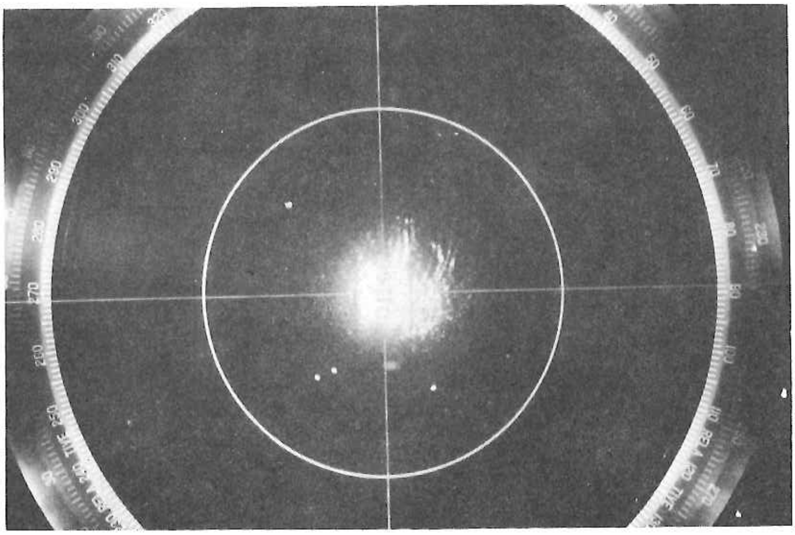


Photo. 2-1

Aug. 24, 1971 (03:00, 8 mile range)

$39^{0}09.5'N, 134^{0}57.8'E$

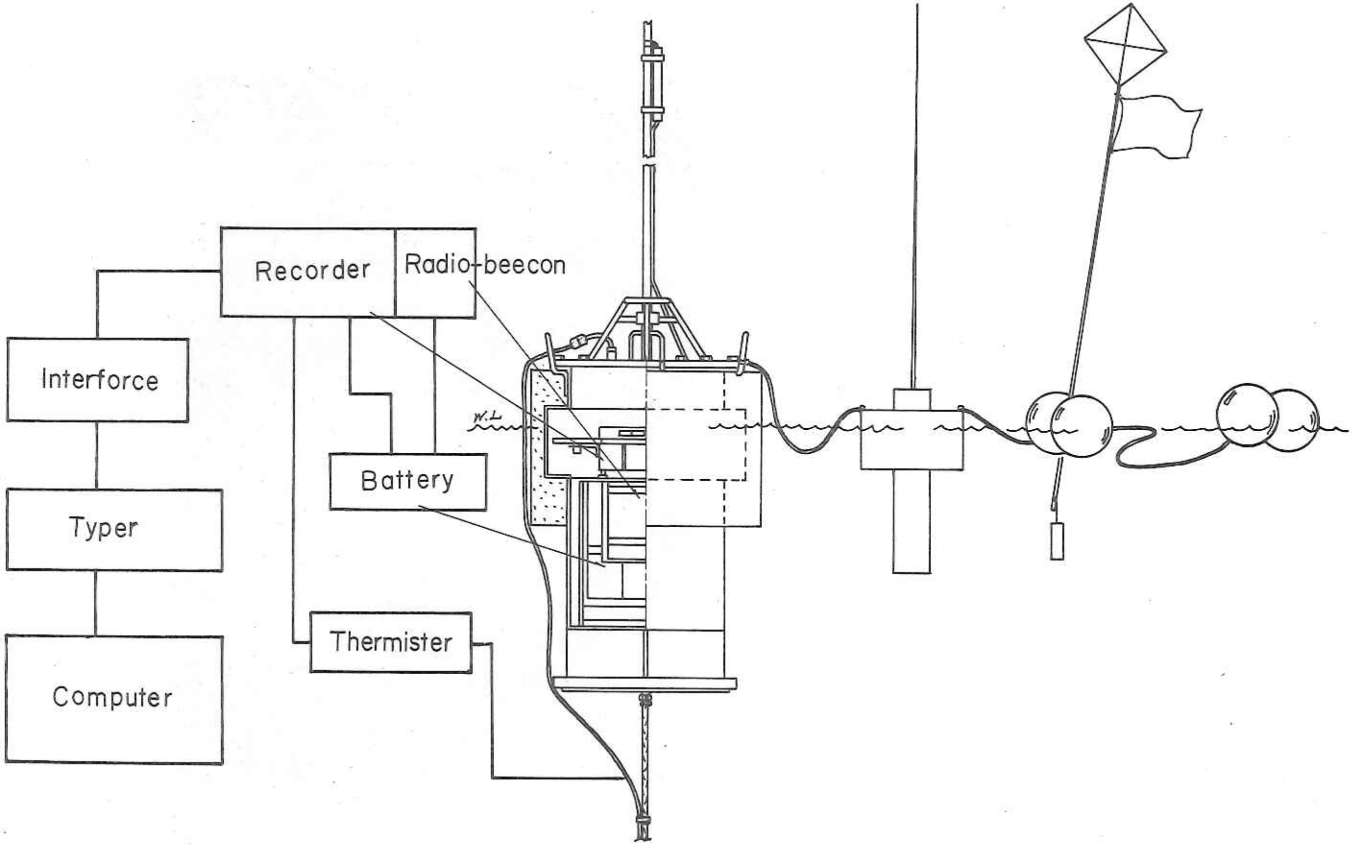


Fig. 2-1 Buoy and block diagram

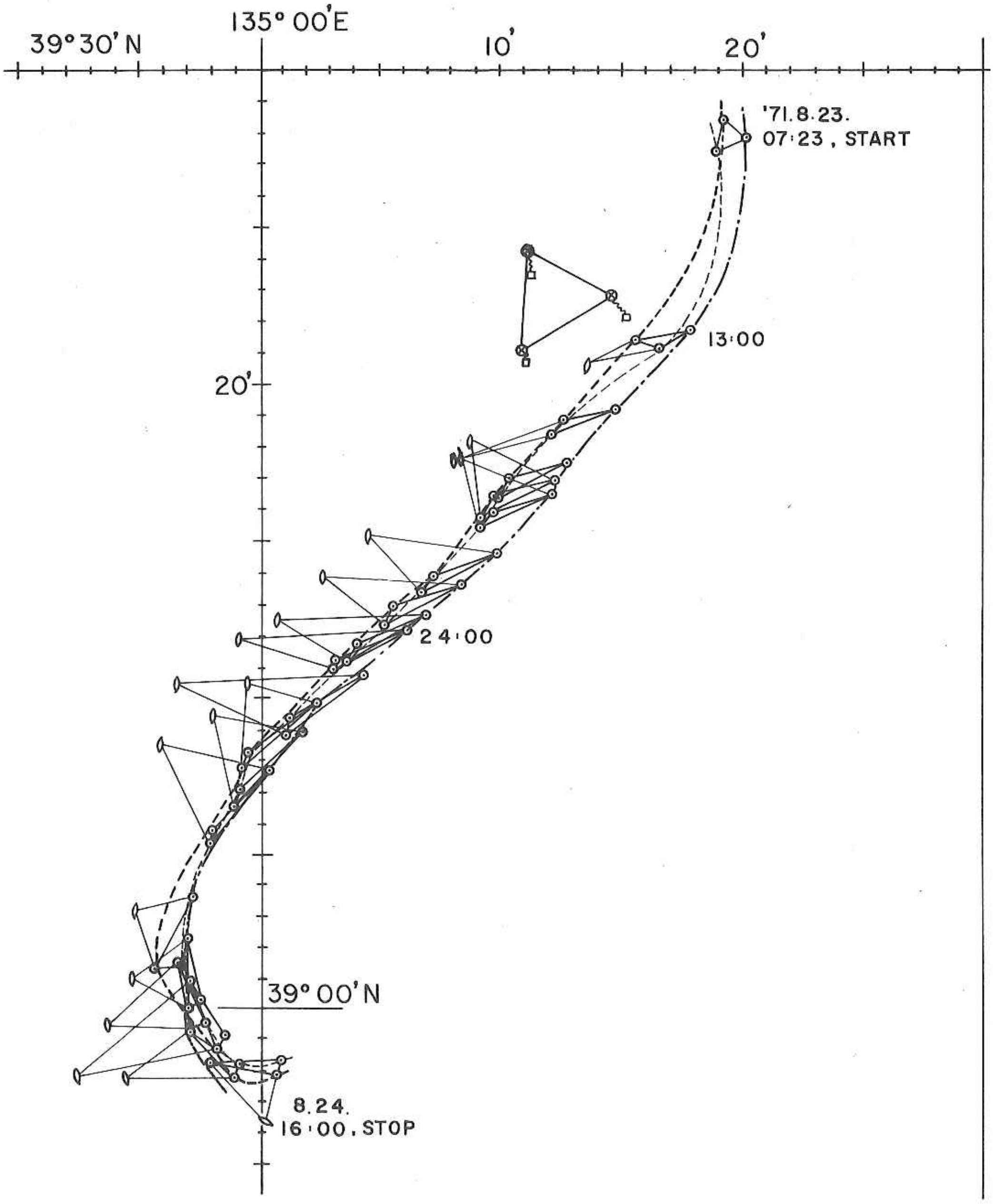


Fig. 2-2 Tracks of buoy-system (1971, Aug. 23/24.)

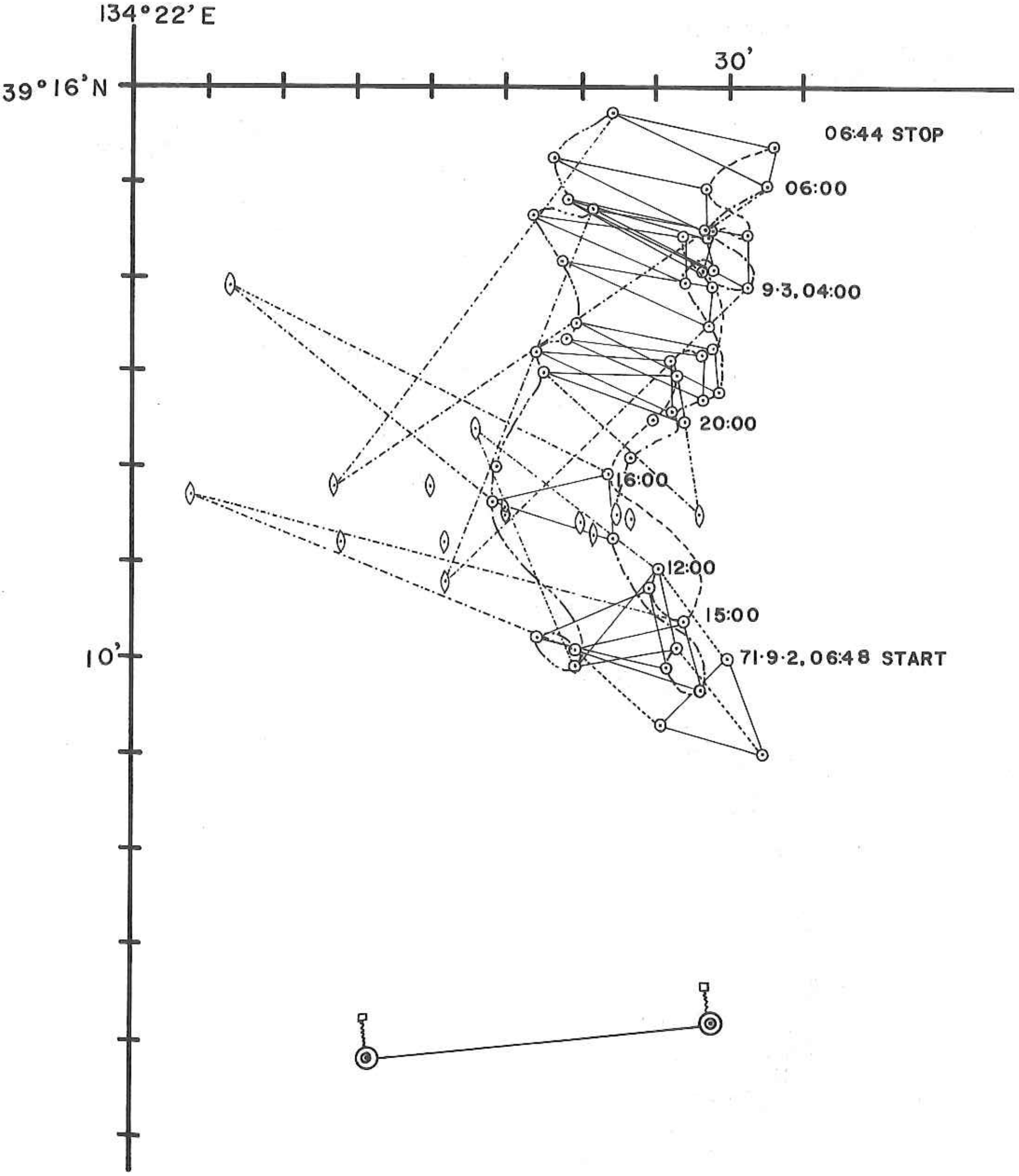


Fig. 2-3 Tracks of buoy-system (1971, Sept. 2/3.)

Table 2-1

Date 1971. 8.23 - 24

Time	Position of ship		
	Latitude	Longitude	
23			
06 : 29	39°29.0' N	135°20.5' E	△1 setting
06 : 52	39°29.8'	135°19.7'	△2 "
07 : 22	39°28.5'	135°19.3'	△3 "
09 : 00	39°22.7'	135°14.4'	
10 : 00	39°25.0'	135°11.2'	
11 : 00	39°22.4'	135°10.2'	
12 : 00	39°21.2'	135°10.6'	
13 : 00	39°20.5'	135°13.4'	
14 : 00	39°19.0'	135°11.5'	
15 : 00	39°18.5'	135°09.7'	
16 : 00	39°17.5'	135°07.9'	
16 : 44	39°16.2'	135°09.9'	△3 reset
17 : 25	39°17.0'	135°10.1'	△2 "
17 : 48	39°17.2'	135°12.8'	△1* "
19 : 00	39°17.5'	135°08.0'	
20 : 00	39°16.8'	135°05.7'	
21 : 00	39°15.2'	135°04.3'	
22 : 00	39°13.8'	135°02.5'	
23 : 00	39°12.5'	135°00.5'	(* record off)
24			
00 : 00	39°11.8'	134°59.0'	
01 : 00	39°10.5'	134°56.5'	
02 : 00	39°10.5'	134°59.3'	
03 : 00	39°09.5'	134°57.8'	
04 : 00	39°08.6'	134°55.7'	
05 : 27	39°06.4'	134°58.5'	△3 reset
06 : 35	39°02.7'	134°56.7'	△2 "
07 : 05	39°02.8'	134°56.4'	△1 "
08 : 00	39°03.1'	134°54.8'	
09 : 00	39°01.1'	134°53.5'	
10 : 00	38°59.4'	134°53.5'	
11 : 00	38°57.8'	134°52.2'	
12 : 00	38°59.0'	134°54.7'	
13 : 00	38°57.8'	134°54.1'	
14 : 00	38°56.5'	134°52.1'	
15 : 00	38°57.7'	134°53.7'	
17 : 00	38°58.3'	135°00.7'	△3 retrieval
17 : 32	38°58.0'	134°59.5'	△2 "
17 : 55	38°58.6'	134°58.8'	△1 "

Table 2-2

Date 1971. 9.2 - 3

	Time	Position of ship		
		Latitude	Longitude	
2				
	05 : 32	39°09.3'N	134°29.1' E	△C setting
	06 : 17	39°09.0'	134°30.5'	△B "
	06 : 48	39°10.0'	134°30.0'	△A "
	12 : 00	39°12.4'	134°26.6'	
	13 : 00	39°11.8'	134°26.0'	
	14 : 00	39°08.5'	134°23.1'	
	15 : 00	39°11.7'	134°22.8'	
	16 : 00	39°13.9'	134°23.3'	
	16 : 46	39°12.0'	134°26.9'	△C reset
	17 : 15	39°12.1'	134°28.7'	△B "
	18 : 05	39°12.5'	134°29.0'	△A "
	20 : 00	39°11.5'	134°29.6'	
	21 : 00	39°11.5'	134°28.7'	
	22 : 00	39°11.5'	134°28.5'	
	23 : 00	39°11.4'	134°28.0'	
3	00 : 00	39°11.3'	134°28.2'	
	01 : 00	39°11.6'	134°27.0'	
	02 : 00	39°11.5'	134°27.0'	
	03 : 00	39°11.2'	134°26.2'	
	04 : 00	39°10.8'	134°26.2'	
	05 : 00	39°11.2'	134°24.8'	
	06 : 00	39°11.8'	134°23.7'	
	06 : 44	39°16.0'	134°27.4'	△C retrieval
	07 : 12	39°15.5'	134°30.0'	△B "
	07 : 39	39°15.3'	134°29.6'	△A "

3. Some current measurements on the Yamato-Tai

M. Okazaki, M. Onitsuka, K. Ishikawa and K. Nakata

1. Purpose

The purpose of this observations is to investigate relation between environment and the currents as the important physical parameter. On Yamato-Tai which is one of the most famous fishing ground and locates at the center of the Sea of Japan, two continuous measurements of currents were carried out during the period of August 23 to September 3.

2. Method

Three mooring systems on the banks were set at the arrangements of three positions formed triangle, having 3 miles sides, and the depth of bottom was about 300 meters. Several current meters were installed vertically in each mooring system and the mooring rope were tightened up by submerged buoys and weights. Two types were used as current meter, one is the pendulum type and the other is Savonious rotor type which utilizes a digital recording system to sense and store the current direction, velocity, temperature and salinity of the ocean. Recording interval can be choosen arbitrarily from continuity, at intervals of 5, 15, 30 minutes and an hour. The Savonious type data recording system diagram is shown in Fig. 3-1.

3. Observation

1) Station 13

Current meters were lowered and set to bottom during 8:00 to 12:00 in August 23 and retrieved during 10:00 to 14:00 in August 26. These set positions were located in the vicinity of a top of Yamato-Tai, whose detailed positions were presented as follows.

No. 1	$39^{o}22.7$ N	$135^{o}14.4$ E	depth 320 m
No. 2	$39^{o}24.3$ N	$134^{o}11.0$ E	depth 314 m
No. 3	$39^{o}21.2$ N	$135^{o}10.6$ E	depth 334 m

The mooring system is skeched in Fig. 3-2. The pendulum current meter which was installed only at the position of No. 1, recorded data every ten minutes, and twelve Savonius rotors every five minutes respectively, and salinity and water temperature were recorded also.

2) Station 16

In this case, setting and retrieving were made 8:40 to 11:00 in September 2 and 9:00 to 11:30 in September 3, respectively.

Set positions were placed near the south-westward top of Yamato-Tai and on east-west line across the Bank. These were as follows.

No. 1	39°06.2' N	134°29.8' E	depth 360 m
No. 2	39°05.8' N	134°25.2' E	depth 390 m

Installed depth of current meters were 5 m, 30 m, 130 m and 200 m over the bottom. Eight Savonius rotors recorded successfully in this case.

4. Analysis

The analysis of data will be made in the future laboratory works.

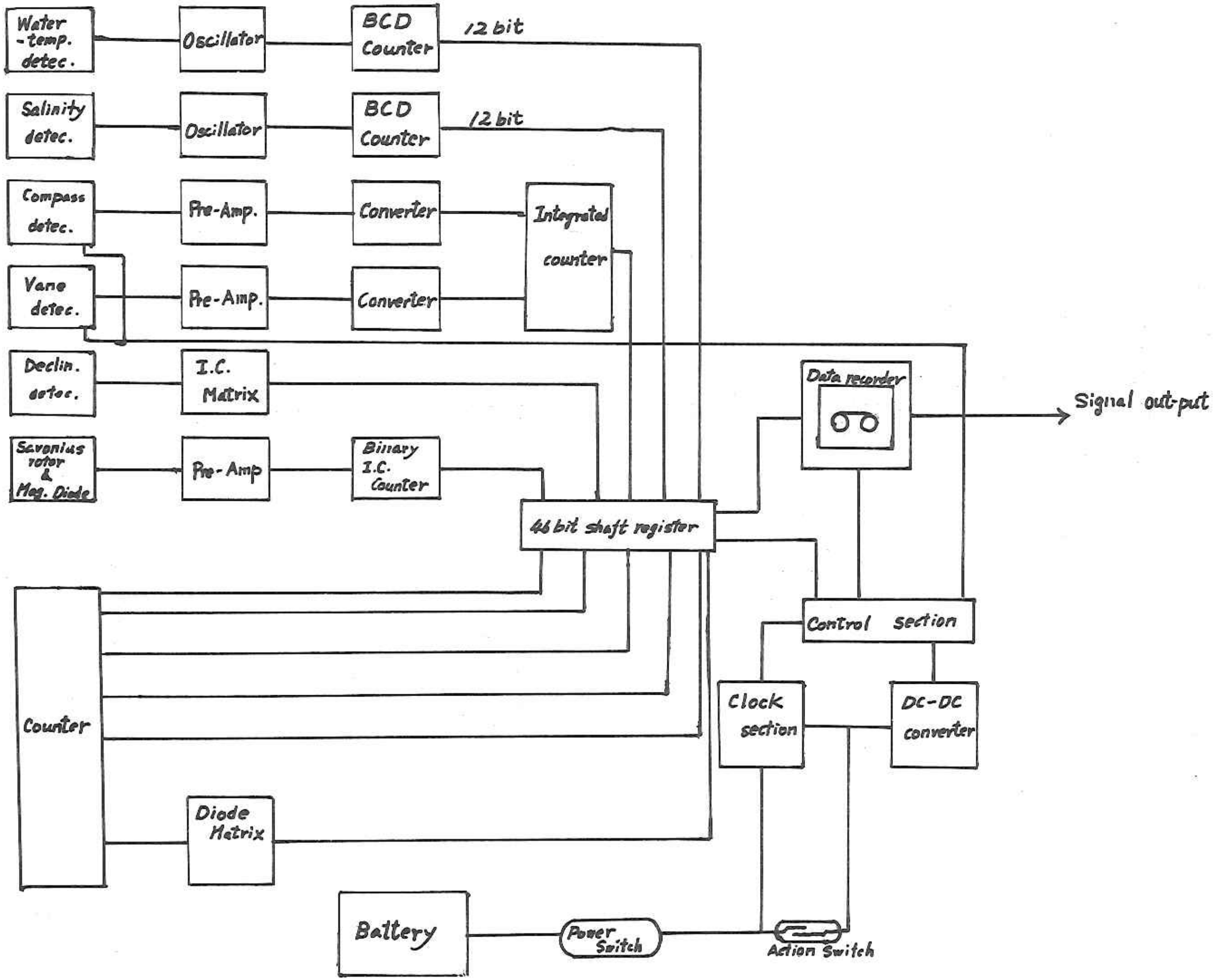


Fig. 3-1 Data recording system

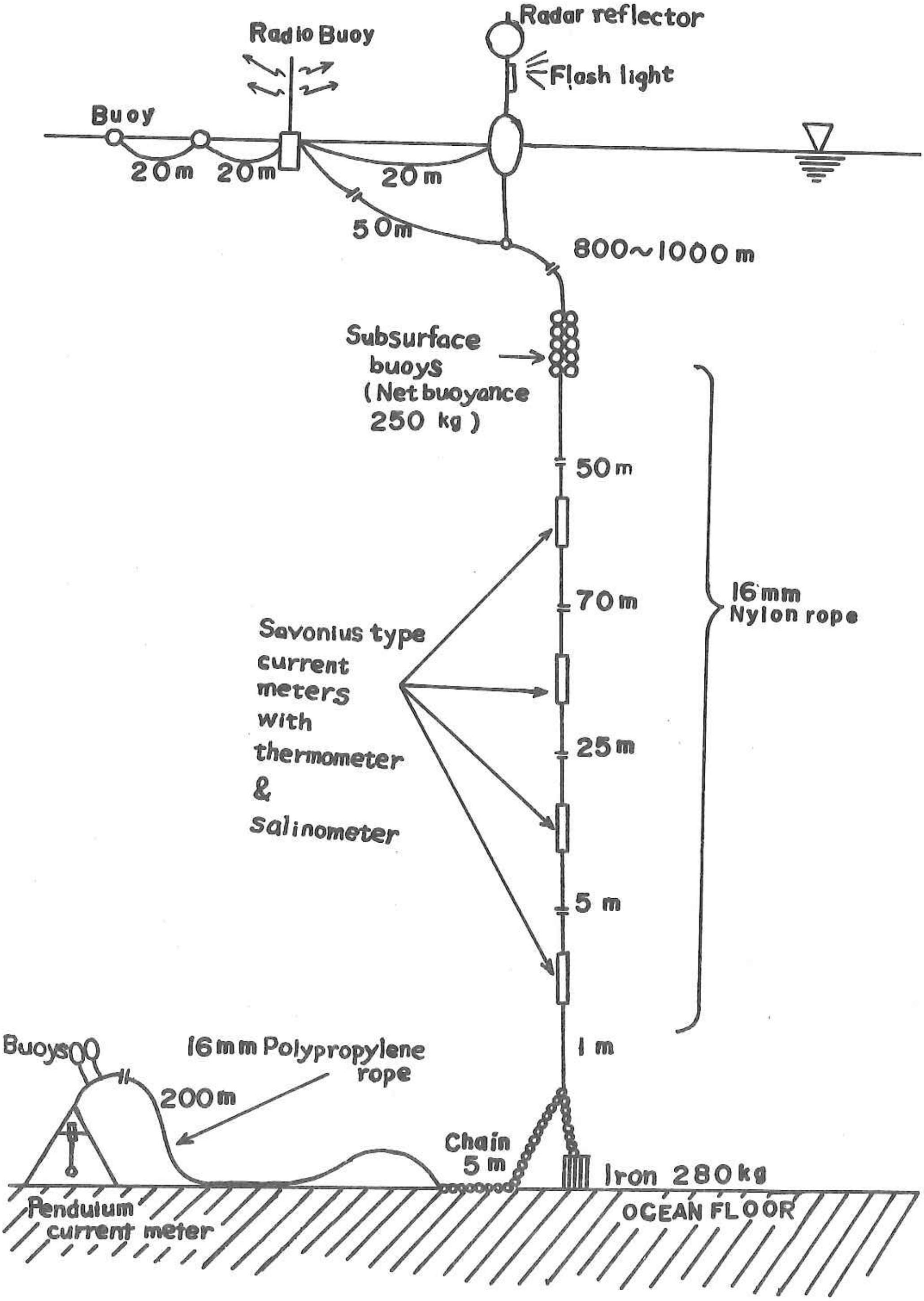


Fig. 3-2 Mooring line

4. STD observation

T. Nakai and H. Hasumoto

The vertical distributions of salinity and temperature were measured with STD (HYTECH Model 9006 Salinity Temperature Depth Data Acquisition System) for the study about the formation mechanisms of fisheries ground on Yamato-Tai in the Sea of Japan.

The observations were made every 2 hours during the period from August 25th 06:00 to August 26th 08:00 1971, at the Sta. 13, together with upper current and bottom current measurements and plankton samplings. The object of the observation was to analyse the variation of basic ocean properties, such as distributions of temperature, salinity, current, biomass and internal wave. STD observations were also carried out at the Stas. 13, 16 and 21 for obtaining accurate and continuous distributions of salinity and temperature as function of depth, combined with other biological works. Data for these operations are shown in Table 4-1.

The analogue data were recorded on charts with X-Y recorder, and digital data were obtained with the computer (FACOM 270-20 system in Hakuho-Maru) at real time, and typed out on sheets corresponds to change of every 10 m depth from surface to bottom layer.

Table 4-1

Station No.	Lowering No.	Date	Time	Lat.	Long.	Lowering depth
13	1	Aug. 25	06:15-06:49	39°30.7'N	135°21.0'E	410 m
13	2		08:01-08:31	39°28.1'	135°20.1'	390
13	3		10:00-10:36	39°28.8'	135°20.2'	380
13	4		12:00-12:31	39°31.3'	135°19.7'	595
13	5		14:00-14:33	39°29.9'	135°22.7'	460
13	6		16:00-16:32	39°28.2'	135°21.5'	395
13	7		18:00-18:30	39°29.1'	135°20.8'	360
13	8		20:00-20:28	39°30.3'	135°22.0'	465
13	9		22:00-22:38	39°28.7'	135°20.5'	405
13	10	Aug. 26	00:00-00:37	39°31.2'	135°23.0'	356
13	11		02:00-02:32	39°30.2'	135°21.8'	350
13	12		04:00-04:32	39°29.5'	135°21.0'	351
13	13		06:05-06:45	39°28.2'	135°20.2'	361
13	14		08:00-08:41	39°26.5'	135°19.5'	358
13	15	Aug. 28	03:53-04:24	39°29.2'	135°19.4'	355
16	16		15:00-15:42	39°07.6'	134°34.7'	269
21	17	Sept. 6	20:02-20.28	40°10.0'	133°59.5'	617

5. Irradiance and Extinction in the Sea Water of Yamato-Tai in the Sea of Japan

K. Kawana

In order to investigate the relation between vertical distribution of irradiance and some optical inherent properties of the sea water, and to estimate the effect of multiple scattering in the sea, irradiance and extinction in the sea were measured near Yamato-Tai in the Sea of Japan.

Three times of measurements on downward and upward irradiance in the sea at Sta. 13 and one at Sta. 16 were made down to about 80 m layers by in situ irradiance meter specially designed for this purpose. The meter employs interference filters to isolate narrow spactral bands. The maximum wavelengths of these filters are 430, 464, 503, 549, 574, 606 and 662 mμ. Desaturation of the band because of large angle of incidence is avoided by a collimating tube located between the filter and the irradiance plate which limits the angle of incidence on the filter to 6^{o}. An optical collector consists of an opal glass which is prepared to collect flux in accordance with the cosine law.

At the same stations, measurements of extinction of sea water were carried out down to about 80 m layers continuously by in situ turbidity meter. It is a single beam type attenuance meter with a lens-pinhole system. Its light path is half meter. The collimated light beam is passed through a filter (Kenko R2) which cuts off the domain the wave-length less than 650 mμ.

6. Biological survey on formation mechanisms of fishing ground over Yamato-Tai

S. Kudoh, T. Hirao and S. Sawamoto

It is well known that fisheries production is concentrated in such relatively narrow areas as Yamato-Tai, except the coastal region, in the Sea of Japan. Present survey has been projected by way of the aim to investigate the formation mechanisms of fishing ground. Our purpose was to observe nutritive relation between living organisms of various trophic levels in such a field.

This survey is divided into two main programs, that is, twenty-six hour continuous observation at Sta. 13 which is positioned near the north-east peak of the bank, and observation in round of nine stations (Sta. 9 - Sta. 17) which are arranged mesh-like over and around the bank.

Besides, test fishing was tried at the interval time of each plankton sampling or at other chances when ship was being drifted.

The details of these observation results will be analyzed in the future after those samples are sorted and measured at the laboratory of the College of Marine Science and Technology of Tokai University. The samples will be stored in the laboratory.

The summary of data obtained on board is as follows:

1) Twenty-six hour continuous observation

Plankton samples were obtained in every successive two hours from 6 am. on August 25th to 8 am. of the next day by means of vertical haulings of both Kitahara's quantitative nets (non-closing type and closing type) and Marutoku nets (MTB of non-closing type and MTA' of closing type). The former whose main purpose was to collect both micro- and macroplankton, was hauled at a speed of one metre per second ablut each layer of 0 - 5 m, 5 - 10 m, 10 - 30 m and 30 - 50 m. The latter which was used for macroplankton collection was hauled at the same speed about each layer of 0 - 50 m, 50 - 150 m and 150 - 300 m.

Some subtropical species such as Trichodesmium appeared in very low concentration in shallow layers. Appearances of diatoms were mostly found in layer of 30 - 50 m depth, and such species of cold current's zooplankton as Calanus plumchrus or Sagitta elegans were observed in more deeper water. Sampling data and wet weight of each sample are shown in Table 6-1.

2) Observation in round of nine stations

In order to collect planktons, two kinds of the above-mentioned nets and ORI-C net were used. Kitahara's quantitative net was hauled vertically about each layer of 0 - 5 m, 5 - 10 m, 10 - 30 and 30 - 50 m, and Marutoku net was used at each layer of 0 - 50 m, 50 - 150 m and 150 - 300 m. A 300 - 500 m collection was conducted in such case when the depth of the station was deeper than 500 m. Besides, collection from layer of 0 - 1,000 m and 1,000 - 2,000 m at Sta. 11, and from layer of 300 - 1,000 m and 1,000 - 2,000 m at Sta. 11, and from layer of 300 - 1,000 m and 1,000 - 2,000 m at St. 17, was tried respectively by means of MTA' net.

For collection of micronekton mainly such as fish larvae, ORI-C net, made of 2.0 mm mesh filtering cloth, was towed horizontally on sea surface for five minutes with two knots of ship speed at each station. Moreover, the net was towed mostly horizontally passing the depth of 30 m at Sta. 13 for the purpose of investigating substances that composed SSL recorded on fish-finder.

Each sample that was obtained by these works was charged in a glass tube bottle and was fixed with 10 per cent formalin. These samples will be used for such studies as vertical and horizontal distribution of plankton.

From result of the surface towings a large number of sirasu, post larvae of Japanese anchovy, was found, but only at night. A considerable abundance of Creseis aciaula, a species of Mollascan Pteropod, was found in water around 30 meters of depth at Sta. 13, and it is thought to be a kind of important food for common squid.

Sampling data and wet weight of each sample are shown in Table 6-2.

3) Test fishing

Haikara, a kind of vertical long line hook, was used for test fishing. Trial fishings were conducted few times at the interval time of each above-mentioned plankton sampling. Also a few trial fishings were conducted always whenever ship was being drifted.

Most of the catch was common squid but a mackerel and a globefish were obtained as a mixture. Besides, a flying fish and two individuals of yellowtail were caught by a dipnet.

The proportion of individuals that has been caught in each time zone of a day to the whole catch of the day was; 83.3 % from 0 to 6 o'clock, 0 % from 6 to 12 o'clock, 2.6 % from 12 to 18 o'clock and 14.1 % from 18 to 24 o'clock. The stomachs of most squids that had been caught in the evening were filled with foods, but those caught during mid-night through early morning were empty.

All sampling data, some measured values and sex of the sample are shown in Table 6-3.

Table 6-1 Sampling data and wet weight of plankton at Sta. 13

Series	Date	Time	Kind of net	Wire length (m)	Wire angle (°)	Wet weight (mg)
1	Aug. 25	06:59	K	0 - 5	4	-
		07:02	Kc	5 - 10	4	-
		07:05	"	10 - 30	8	-
		07:12	"	30 - 50	6	-
		07:17	MTB	0 - 50	7	233
		07:24	MTA'	50 - 150	10	222
		07:47	"	150 - 300	11	359
2	Aug. 25	08:24	K	0 - 5	0	-
		08:27	Kc	5 - 10	8	-
		08:30	"	10 - 30	12	-
		08:35	"	30 - 50	13	-
		08:41	MTB	0 - 50	9	614
		08:48	MTA'	50 - 150	10	251
		08:55	"	150 - 300	4	317
3	Aug. 25	10:21	K	0 - 5	14	-
		10:25	Kc	5 - 10	15	-
		10:28	"	10 - 30	21	-
		10:32	"	30 - 50	24	-
		10:37	MTB	0 - 50	13	382
		10:40	MTA'	50 - 150	27	164
		10:46	"	150 - 300	33	258
4	Aug. 25	12:16	K	0 - 5	3	-
		12:17	Kc	5 - 10	3	-
		12:21	"	10 - 30	15	-
		12:32	"	30 - 50	20	-
		12:35	MTB	0 - 50	11	748
		12:40	MTA'	50 - 150	10	183
		12:48	"	150 - 300	12	37
5	Aug. 25	14:11	K	0 - 5	5	-
		14:17	Kc	5 - 10	5	-
		14:21	"	10 - 30	10	-
		14:25	"	30 - 50	13	-
		14:28	MTB	0 - 50	9	424
		14:33	MTA'	50 - 150	9	241
		14:40	"	150 - 300	5	308

Table 6-1 Cont.

Series	Date	Time	Kind of net	Wire length (m)	Wire angle (°)	Wet weight (mg)
6	Aug. 25	16:05	K	0 - 5	0	-
		16:06	Kc	5 - 10	0	-
		16:09	"	10 - 30	6	-
		16:12	"	30 - 50	6	-
		16:16	MTB	0 - 50	8	419
		16:19	MTA'	50 - 150	7	296
		16:26	"	150 - 300	8	110
7	Aug. 25	18:00	K	0 - 5	2	-
		18:04	Kc	4 - 10	4	-
		18:07	Kc	10 - 30	5	-
		18:12	Kc	30 - 50	13	-
		18:16	MTB	0 - 50	10	474
		18:20	MTA'	48 - 150	10	159
		18:26	MTA'	150 - 300	15	201
8	Aug. 25	20:00	K	0 - 5	10	-
		20:02	Kc	5 - 10	10	-
		20:04	Kc	10 - 30	6	-
		20:07	Kc	30 - 50	6	-
		20:10	MTB	0 - 50	3	652
		20:14	MTA'	50 - 150	10	197
		20:20	MTA'	150 - 300	16	371
9	Aug. 25	22:00	K	0 - 5	2	-
		22:01	Kc	5 - 10	2	-
		22:04	Kc	10 - 30	5	-
		22:08	Kc	30 - 50	13	-
		22:12	MTB	0 - 50	7	532
		22:14	MTA'	50 - 150	13	334
		22:19	MTA'	150 - 300	18	223
10	Aug. 26	00:00	K	0 - 5	0	-
		00:02	Kc	5 - 10	0	-
		00:06	Kc	10 - 30	12	-
		00:11	Kc	30 - 50	8	-
		00:15	MTB	0 - 50	4	1,107
		00:22	MTA'	50 - 150	16	727
		00:31	MTA'	150 - 300	19	327

Table 6-1 Cont.

Series	Date	Time	Kind of net	Wire length (m)	Wire angle (°)	Wet weight (mg)
11	Aug. 26	02:00	K	0 - 5	0	-
		02:01	Kc	5 - 10	3	-
		02:04	Kc	10 - 30	4	-
		02:09	Kc	30 - 50	8	-
		02:11	MTB	0 - 50	7	510
		02:22	MTA'	50 - 150	14	350
		02:29	MTA'	150 - 300	17	928
12	Aug. 26	04:01	K	0 - 5	0	-
		04:04	Kc	5 - 10	0	-
		04:06	Kc	10 - 30	8	-
		04:10	Kc	30 - 50	11	-
		04:14	MTB	0 - 50	4	468
		04:21	MTA'	50 - 150	7	239
		04:28	MTA'	150 - 300	8	220
13	Aug. 26	06:00	K	0 - 5	0	-
		06:01	Kc	5 - 10	3	-
		06:04	Kc	10 - 30	13	-
		06:08	Kc	27 - 50	14	-
		06:11	MTB	0 - 50	8	617
		06:14	MTA'	50 - 150	6	155
		06:20	MTA'	150 - 300	6	201
14	Aug. 26	08:00	K	0 - 5	0	-
		08:01	Kc	5 - 10	5	-
		08:03	Kc	10 - 30	6	-
		08:07	Kc	30 - 50	12	-
		08:11	MTB	0 - 50	5	609
		08:15	MTA'	50 - 150	6	264
		08:37	MTA'	150 - 300	10	367

Note: K is Kitahara's quantitative net
Kc is Kitahara's quantitative net of closing type
MTB is Marutoku net of non-closing type
MTA' is Marutoku net of closing type

Table 6-2 Sampling data and wet weight of plankton at nine stations

Sta.	Date	Time	Kind of net	Wire length (m)	Wire angle (o)	Wet weight (mg)
9	Aug. 26	22:26	K	0 - 5	0	-
		22:32	Kc	5 - 10	14	-
		22:34	Kc	10 - 30	14	-
		22:38	Kc	30 - 50	12	-
		22:42	MTB	0 - 50	16	1,140
		22:50	MTA'	50 - 150	26	529
		23:05	MTA'	150 - 300	33	428
		23:14	MTA'	300 - 500	33	645
10	Aug. 27	04:08	K	0 - 5	0	-
		04:11	Kc	5 - 10	4	-
		04:20	Kc	10 - 30		-
		04:16	Kc	30 - 50	8	-
		04:22	MTB	0 - 50	6	960
		04:29	MTA'	50 - 150	12	1,638
		04:39	MTA'	150 - 300	14	476
		04:52	MTA'	300 - 500	18	1,724
11	Aug. 27	09:51	K	0 - 5	10	-
		09:54	Kc	5 - 10	10	-
		09:59	Kc	10 - 30	9	-
		10:03	Kc	30 - 50	15	-
		10:06	MTB	0 - 50	7	584
		10:11	MTA'	50 - 150	13	403
		10:26	MTA'	150 - 300	15	586
		11:06	MTA'	300 - 500	18	1,083
		13:14	MTA'	0 - 1,000	23	
		14:47	MTA'	1,000 - 2,000	16	
12	Aug. 27	22:55	K	0 - 5	0	-
		23:01	Kc	5 - 10	5	-
		23:06	Kc	10 - 30	20	-
		23:12	Kc	30 - 50	15	-
		23:15	MTB	0 - 50	11	1,014
		23:20	MTA'	50 - 150	15	156
		23:28	MTA'	150 - 300	16	253
		23:44	MTA'	300 - 500	11	1,328

Table 6-2 Cont.

Sta.	Date	Time	Kind of net	Wire length (m)	Wire angle ($^{\circ}$)	Wet weight (mg)
13	Aug. 28	02:52	K	0 - 5	17	-
		02:58	Kc	5 - 10	7	-
		02:55	Kc	10 - 30	5	-
		03:13	Kc	30 - 50	11	-
		03:16	MTB	0 - 50	7	368
		03:21	MTA'	50 - 150	11	157
		03:29	MTA'	150 - 300	10	285
14	Aug. 28	06:21	K	0 - 5	3	-
		06:23	Kc	5 - 10	10	-
		06:26	Kc	10 - 30	9	-
		06:30	Kc	30 - 50	8	-
		06:33	MTB	0 - 50	10	420
		06:37	MTA'	50 - 150	12	187
		06:45	MTA'	150 - 300	10	363
		06:56	MTA'	300 - 500	10	1,120
15	Aug. 28	11:24	K	0 - 5	0	-
		11:22	Kc	5 - 10	6	-
		11:27	Kc	10 - 30	16	-
		11:30	Kc	30 - 50	17	-
		11:33	MTB	0 - 50	7	391
		11:38	MTA'	50 - 150	12	289
		11:46	MTA'	150 - 300	17	289
		11:57	MTA'	300 - 500	18	674
16	Aug. 28	14:27	K	0 - 5	0	-
		14:29	Kc	5 - 10	4	-
		14:32	Kc	10 - 30	3	-
		14:35	Kc	30 - 50	17	-
		14:38	MTB	0 - 50	10	397
		14:42	MTA'	50 - 150	16	495
		14:50	MTA'	150 - 280	14	96
17	Aug. 28	19:06	K	0 - 5	0	-
		19:08	Kc	5 - 10	4	-
		19:10	Kc	10 - 30	2	-
		19:15	Kc	30 - 50	18	-
		19:18	MTB	0 - 50	14	423
		19:31	MTA'	50 - 150	22	1,448
		19:43	MTA'	150 - 300	29	259
		20:38	MTA'	300 - 1,000	36	-
		22:59	MTA'	1,000 - 2,000	42	-

Note: See the foot note of Table 6-1.

Table 6-3 Sampling data of test fishing, some measured values and the sex of the samples

Pneumatophorus japonicus japonicus

Date	Time	Sta.	Individuals	Body length(cm)	Body weight(g)	Sex	Remarks
Aug. 23	03:45	13	1	32.2	550	f	
Sept. 3	01:15	16	2	15.5	40	-	by dipnet
				16.6	50	-	by dipnet

Fugu vermicularis vermicularis

Date	Time	St.	Individuals	Body length(cm)	Body weight(g)	Sex	Remarks
Aug. 27	04:40	10	1	23.4	330	-	

Cypselurus sp.

Date	Time	Sta.	Individuals	Body length(cm)	Body weight(g)	Sex	Remarks
Aug. 28	00:18	12	1	9.2	-	-	by dipnet

Seriola quinqueradiata

Date	Time	Sta.	Individuals	Body length(cm)	Body weight(g)	Sex	Remarks
Aug. 28	00:18	12	2	28.0	435	-	by dipnet
				28.6	440	-	by dipnet

Ommastrephes sloani pacificus

Date	Time	Sta.	Individuals	Mantle length (cm)	Mantle weight (g)	Sex	Remarks
Aug. 23	03:45	13	44	23.4	280	m	
				22.4	220	f	
	03:50			21.0	185	f	
				27.2	450	f	
				22.4	235	m	
				20.2	175	f	
				25.7	300	f	
				22.0	210	m	
				22.6	215	m	
				25.9	365	m	
				19.0	140	m	
				21.2	175	f	
				26.8	405	f	
				24.0	310	m	
				23.7	290	f	

Table 6-3 Cont.

Date	Time	Sta.	Individuals	Body length(cm)	Body weight(g)	Sex	Remarks
				23.3	260	f	
				22.6	210	f	
				24.2	270	f	
				22.4	260	f	
				22.5	225	m	
				42.1	220	m	
				23.4	250	f	
				22.8	270	m	
				20.7	200	m	
				22.1	210	f	
				20.0	170	f	
				23.1	250	f	
				21.2	195	f	
				23.8	270	f	
				22.4	245	m	
				24.4	340	m	
				25.0	350	m	
				23.8	275	f	
				23.0	250	f	
				22.0	165	m	
				21.9	205	f	
				23.0	310	m	
				24.0	300	f	
				24.2	365	m	
				23.0	270	m	
				22.7	215	f	
				20.6	195	m	
				23.4	270	f	
				23.5	280	f	
Aug. 23	15:40	13	1	20.8	220	m	
Aug. 23	19:04	13	1	25.2	370	f	
Aug. 23	19:10	13	2	25.0	310	f	
				23.0	220	m	
Aug. 23	22:10	13	2	12.8	40	-	by dipnet
				11.6	25	-	by dipnet
Aug. 24	22:55	13	2	20.4	156	m	
				22.0	220	m	
Aug. 25	16:00	13	1	21.4	195	f	
Aug. 26	04:40	13	6	30.2	560	f	
				22.0	205	f	
	04:45			21.2	180	f	
				21.9	215	f	
				21.2	195	m	
				24.0	290	f	

Table 6-3 Cont.

Date	Time	Sta.	Individuals	Body length(cm)	Body weight(g)	Sex	Remarks
Aug. 26	22:00	9	6	24.0	280	m	
				21.5	230	m	
				21.0	200	m	
				24.0	270	m	
				23.0	300	m	
				20.5	260	m	
Aug. 28	00:12	12	9	21.0	215	m	
				25.1	315	m	
				21.2	200	m	
				21.9	215	m	
				21.3	212	m	
				23.6	253	f	
				22.8	240	m	
				25.1	338	f	
				23.4	247	m	
Aug. 28	04:00	13	6	28.0	420	f	
				26.6	410	m	
	04:30			23.2	255	m	
				24.8	290	m	
				25.0	330	m	
				23.3	235	m	

Note: Except the sampling data of the fishing when catch was nil.

7. Trophic-dynamics and ecological aspects of zooplankton population in the water on Yamato-Tai in the Sea of Japan

T. Tsujita and T. Nishiyama

1. Purposes of study

Ecosystem of the water on Yamato-Tai which provides with high fisheries productivity in the Sea of Japan is approached in terms of trophic-dynamics. On Cruise KH-71-4, drawings of a profile of zooplankton population, particularly its diel vertical distribution, were atempted relating to feeding habit, food chain and energy flow in the predominant species of fish, such as squid (Todarodes pacificus) and Alaska pollack (Theragra chalcogramma). Geographical comparison, thereafter, will be established on the mechanism and structure of biological production at higher level between the water on Yamato-Tai and some other sea regions, i.e. adjacent waters to Hokkaido, northeastern part of North Pacific Ocean and Bering Sea.

2. Works and procedures of samples on board

Zooplankton was sampled from surface down to middle layer of the sea on the bank twice a day (daytime and night) at each of the three stations (Table 7-1). Simultaneous hauls from five layers of depth, i. e. 10 m, 50 m, 200 m, 500 m and 1,000 m in wire out, were carried out 30 minutes at the speed of 2 knots with a Motoda Horizontal Net (Motoda, 1971: 50 cm in diameter of mouth opening, 180 cm in length and GG 54 in mesh aperture). Plankton obtained were immediately divided into equal halves by a plankton-sample divider. One part of them was preserved in 10 %-formaldehyde solution for taxonomical study, and the other was stored in a deep freezer for calories analysis. Concurrently, at the same stations, a total of 60 specimens of squids was fished with false baits from a considerable depth both in the daytime and at night. The whole of the body was frozen for the identification of stomach contents and determination of caloric values. In addition, several parts of squid body were extracted with chloroform-methanol (2:1 v/v) for lipids analysis.

Table 7-1. Data on zooplankton samplings by a "multi-horizontal closing nets" (Motoda, 1971) in the water on Yamato-Tai in the Sea of Japan

	Sta. 12		Sta. 13		Sta. 14	
	Daytime	Night	Daytime	Night	Daytime	Night
Date	Aug. 22	Aug. 22	Aug. 22	Aug. 23	Aug. 22	Aug. 22
Position	39°02.8'N 135°32.0'E	39°05.2'N 135°31.5'E	39°28.1'N 135°21.5'E	39°30.0'N 135°20.1'E	39°43.5'N 135°12.7'E	39°30.0'N 135°20.1'E
Time of net towed	0537	0156	0916	0050	1238	2052
Time of net closed	0607	0226	0946	0120	1308	2122

8. Zooplankton in the Sea of Japan

M. Araki

For the survey of zooplankton in the Sea of Japan, two types of net, ORI-100 net (160 cm in mouth diameter, 750 cm in length and 1 mm x 1 mm mesh aperture) and Motoda Horizontal Net (50 cm in diameter, 180 cm in length and 0.33 mm x 0.33 mm in mesh aperture) were used.

The former net was hauled obliquely for 300, 600 and 2,000 meters of wire run out at 2 stations in Yamato-Tai and 7 Stations in coastal waters off Hokkaido and Akita Prefecture.

The latter one was hauled for 7 layers of different depths at the same time in Yamato-Tai once in daytime and twice at night.

The following preliminary results were obtained. The dominant zooplankton identified are as follows:

Copepoda	Calanus cristatus, C. plumchrus
Chaetognatha	Sagitta elegans
Euphausiacea	Thysanoessa longipes, T. inermis, Euphausia pacifica
Amphipoda	Parathemisto japonica, Cyphocaris challengeri
Mysidacea	Meterythrops microphtalma

Horizontal distribution of euphausiids collected by ORI-100 net: T. longipes and T. inermis were mainly distributed in the northern part of the Sea of Japan. The juvenile of E. pacifica abundantly occurred in Yamato-Tai and coastal waters off Akita Prefecture and Hokkaido. Thysanoessa gregaria occurred off Akita Prefecture, and it's species was probably associated with the influx of the northern North Pacific through Tsugaru Strait.

Vertical distribution of euphausiids collected by Motoda Horizontal Net: T. longipes was distributed in the waters lower than about 150 meters at night, while E. pacifica was distributed in the waters lower than about 30 meters at night. Stylocheiron affine was rarely found in the upper 100 m layer at night. This species is a typical indicator of the warm Tsusima Current in the Sea of Japan.

In conclusion, the distribution pattern of euphausiids in the Sea of Japan is remarkably influenced by the warm and cold current systems.

9. Studies on squids and their distribution around Yamato-Tai

S. Tanaka and Y. Matsumiya

In order to learn about the distribution of squids in the water around Yamato-Tai in relation to their biological characters and the environmental cinditions in the area, quantitative samplings and biological measurements of the catch were conducted.

Method and materials

Sampling gears were made imitating a commercially used fishing tackle with hooks (Fig. 9-1). At the end of the line of 100 m long, 40 hooks for squid hooking were connected at a interval of about 60 cm, and a weight of one kg was attached at the bottom. This arrangement made the length of entire line about 125 m from the weight to the water surface. Each drum on which two lines of the same srrangement were wound was driven by hand. The depth of sampling was fixed at 60 m or 30 m from the weight to the surface. The sampling period of 60 minutes was divided into four sections of 15 minutes, and 60 m or 30 m depth level was applied alternately to each section. The speed of lowering and raising of lines was one m/sec or faster. The number of lowering and raising in 15 minutes was 15-20 times for 30 m depth level and about 10 times for 60 m depth level. Two gears (drums) of the same type were used simultaneously, and the assignment of the depth level was made that either of the level was sampled by one of the two gears. The samplings were started in the evening after it got completely dark and continued for 60 minutes. Hand-line angling (game fishing by crews and scientists on board) was prohibited during the sampling period and also for 30 minutes before the operation. During this 90 minutes period, sea surface was illuminated with two 300 W lights.

Samplings by the standard procedure mentioned above were practiced 5 times around the bank, and one time in the area west of the Tsugaru Strait. Besides these, two early morning samplings and one daytime sampling were made with a little modified procedure near the bank. In case of the daytime sampling, entire line (125 m) was lowered to meet a deeper swimming layer of squids during the daytime. A total of 366 squids were caught. Data for each operation are given in Table 9-1.

Hand-lines were used to supplement the sampling by the above mentioned gears. Hooks used for the hand-lines were the same as those for the sampling gears and the number of hooks for each line was 5. The hand-line catch measured amounted to 103 squids. Data for these operations are also shown in Table 9-1.

Biological measurements were made for 410 squids caught around the bank, and 53, in the area west of the Tsugaru Strait. These numbers include squds caught with hand-lines. Items of measurements were mantle length, weight, sex, maturity and copulation. Out of these samples, guts of 333 squids were taken out and preserved in 10 % formalin for further detailed studies of maturation (weight of testis and needhanis sac for males, weight of ovary and oviduct for females) and food (including weight of stomach).

Results

Most of analysis of data obtained is left for future studies. Here, only a few points are raised.

Catch per unit effort:

In the bank area, the catch per 100 raisings of the lines in the standard operations ranges from 15-41 squids (Table 9-1), suggesting rather samll variability of the catch. The number of operations of 5 is too small to permit a discussion on the spacial distribution of squid in this area.

It seems that the level of evening catch was generally low but the variability within one hour period was small in comparison with the early morning or daytime catch. The early morning or daytime catch sometimes showed in high peak of catch in a short time interval (30 minutes or shorter). Some examples of catch as time series are given in Table 9-2. This may suggest that the squids disolve school when it gets dark in the evening and form school again in the early morning and daytime.

Catch by depth levels is given in Table 9-3. There is a marked trend that the catch per 100 raisings is higher in the depth level of 60 m than that in 30 m. As the 60 m level covers also the layer between the surface to 30 m, the difference in the catch per 100 rasings between 60 m and 30 m depth levels may be considered to indicate the abundance of squids in the layer of 30-60 m depth. The difference tends to be larger than the value for the 30 m level, suggesting a deeper swimming layer than 30 m of squid. The relationship between the swimming layers of squid and the vertical distribution of water temperature, particularly the depth of thermoline, is not clear.

Size, sex and maturation:

The length compositions by maturation stages are presented in Table 9-4. On the average, the larger the size the more advanced is the maturation stage. However, the length range within the same stage is considerably large.

The maturation ratio (ratio of mature squids among the total) is different from sample to sample, but the ratios are correlated between sexes (Fig. 9-2). The maturation ratio of female is considerably lower than that of male but the copulation ratio of females is about the same level as the latter. The range of ovary weight is 1.5-42.2 g and that of oviduct is 0-11.5 g for mature femles. Maturity condition M (= oviduct/(ovary+oviduct)) for these squid is smaller than 38%. For mature males, the range of testis weight, needhanis sac weight and maturity condition M (= needhanis sac/(testis+needhanis sac)) is 3.2-11.4 g, 1.1-11.6 g and 20-58%, respectively (excluding two abnormal data).

Sometimes, a similarity in both size range and maturity is noticed between successive samples. These samples are lamped together and the length compositions are shown by sexes and maturities in Fig. 9-3. The first group is characterized by low maturity. The second group has the smallest size among 5 groups. The third group has characters of a mixture of the first and second groups. The fourth group came from north of the bank and the size is large and the maturity is fairly advanced. The last group was taken near the Tsugaru Strait, and is characterized by a small size. It is worth noticing that different groups of squid were observed even in a small area near the bank.

Sex ratio is almost 50:50 in the entire sample (♀ : ♂ = 219:244), however, segregated schooling by sexes was suspected from individual samples which sometimes showed a biased ratio to either side (e.g. JS-3, 2:13).

Food:

Most of stomacks are empty. Among 333 stomacks examined, 295 has stomack weight (including its contents) of less than 5 g. Frequency of stomack weight is given in Table 9-5. Identification of food items has not been done yet. It was suggested at a glance that zooplankton which were abundant in the environment formed a predominant part of the food items.

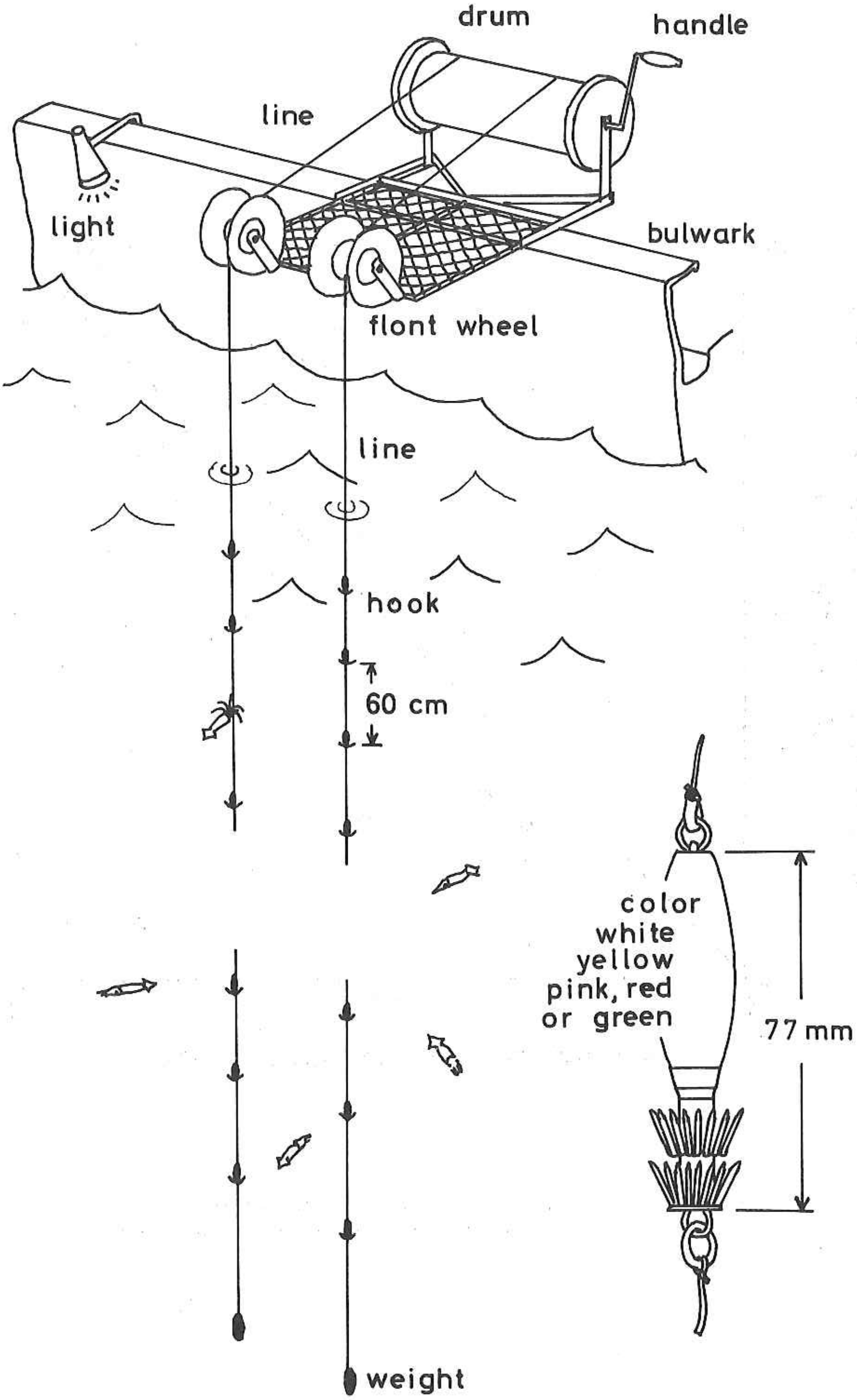


Fig. 9-1 Sampling gear and hook.

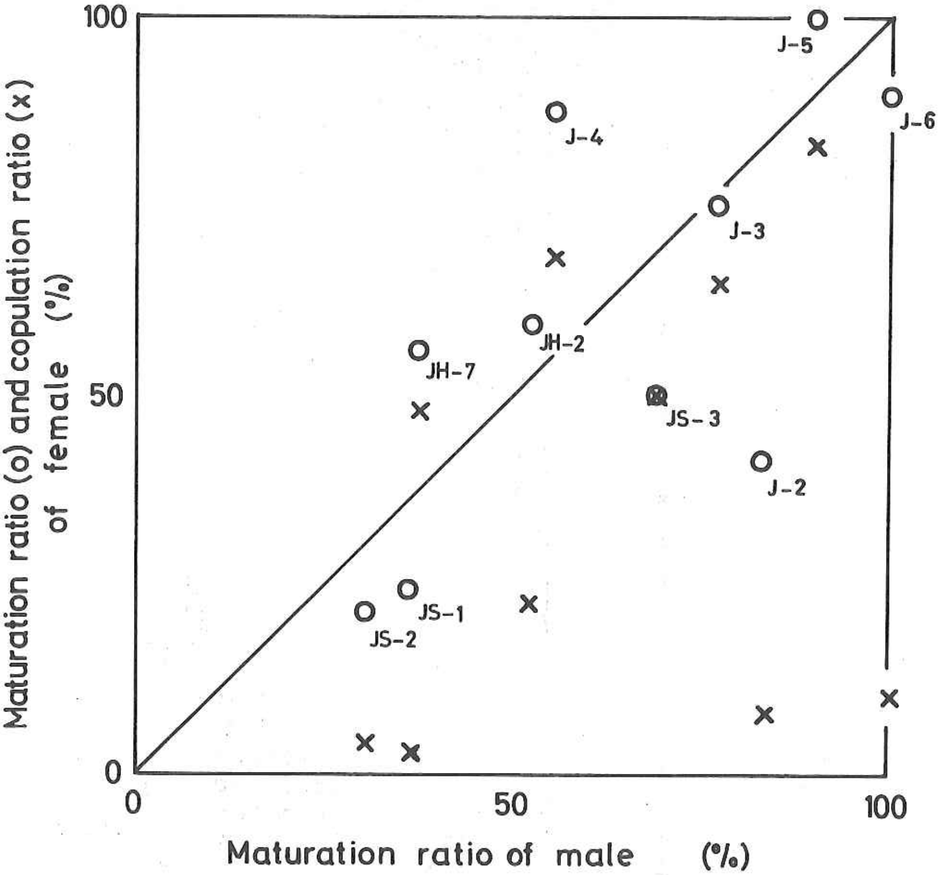


Fig. 9-2 Correlation between the maturation ratio of male and the maturation ratio or copulation ratio of female within a sample.

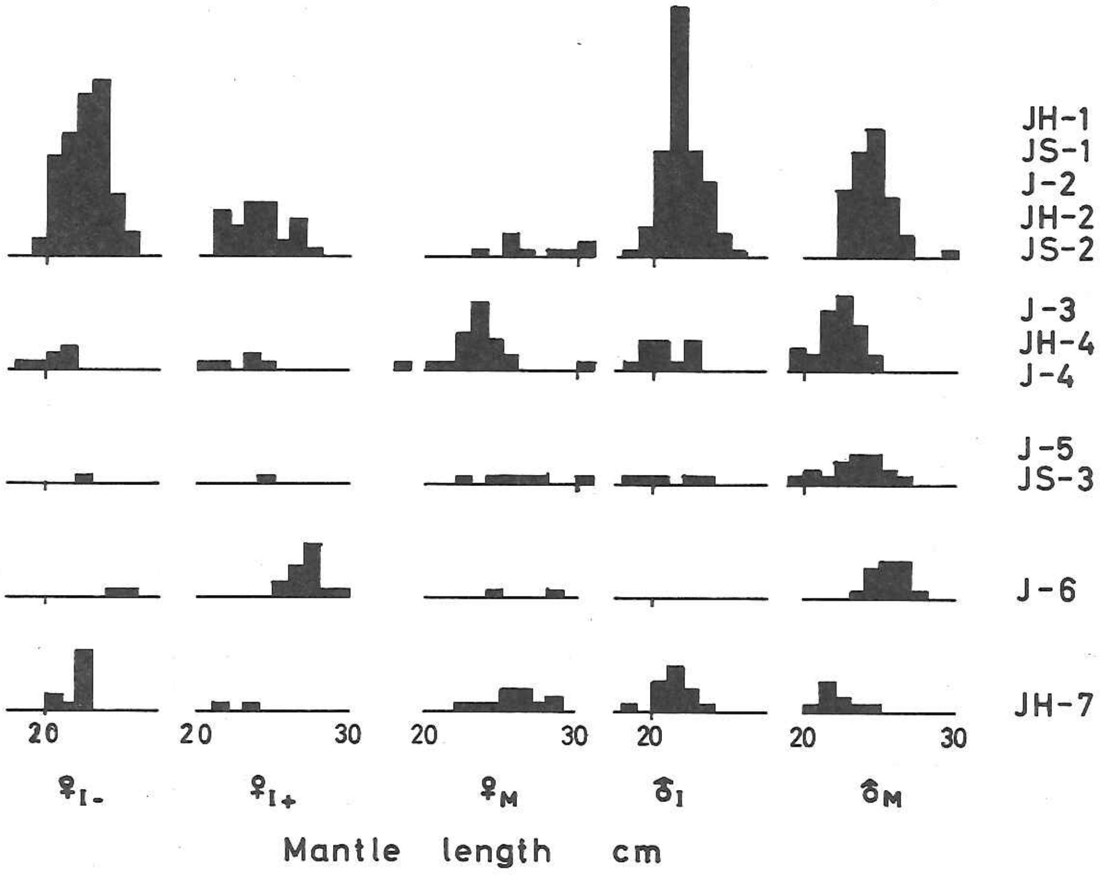


Fig. 9-3 Length composition by sexes and maturities for lamped samples.

Table 9-1 Data for the sampling operations and the catch

Operation number	Station	Date	Time	Depth (m)	Total catch	No. of raisings	Catch per 100 raisings	No. gears used
Catch by sampling gear (standard procedure)								
J-1	4*	Aug. 20	21:45-22:45	30 or 60	4	78	5	2
J-2	13	Aug. 23	20:00-21:00	"	19(1)**	94	20	2
J-3	12	Aug. 27	21:30-22:30	"	46	113	41	2
J-4	17	Aug. 28	20:15-21:15	"	34	124	27	2
J-5	16	Sep. 2	20:00-21:00	"	16	106	15	2
J-6	21	Sep. 3	20:00-21:00	"	35	104	34	2
Total					154(1)	619	25	
Catch by sampling gears (special operation)								
JS-1	13	Aug. 23	03:35-04:15	30 or 60	139(2)**	18	772	1
JS-2	11	Aug. 27	13:00-13:40 14:20-14:33	125	58(3)**	18	322	1
JS-3	16	Sep.3	02:15-02:25	125	4	?	-	2
			02:35-03:35	30 or 60	11	96	11	2
Total					208+4(5)	132+	(82)	
Handline catch measured					Catch	Effort (man x minute)	Catch per 60 effort	Persons engaged
JH-1	14	Aug. 22	18:00-21:00		6	?	-	3
JH-2	13	Aug. 26	02:00-05:00		43	180	14.3	1
JH-3	13	Aug. 28	04:15		2	?	-	1
JH-4	15	"	13:00-13:20		1	20	3.0	1
JH-5	16	Sep. 3	03:45-04:45		1	60	1.0	1
JH-6	16	"	03:30		1	?	-	1
JH-7	24*	Sep. 5	01:40-03:00		49	195	15.1	3
Total					94+9	455+	(12.4)	

* Area west of the Tsugaru Strait. ** Number not measured among the total.

Table 9-2 Examples of catches as time series

JH-2 Station 13 August 26

Time	02:00-03:00	03:00-03:30	03:30-04:00	04:00-04:30	04:30-05:00
Catch	4	4	12	23	0
Catch/hour	4	8	24	46	0

JS-2 Station 11 August 27

Time	12:20-13:00	13:00-13:10	13:10-13:20	13:20-13:30	13:30-13:40	14:20-14:33
No. raisings	about 10	4	2	3	3	6
Catch	0	26	29	1	0	2
Catch/100 raisings	0	650	1,450	33	0	33

J-3 Station 12 August 27

Time	21:30-21:45	21:45-22:00	22:00-22:15	22:15-22:30
No. raisings	26	24	31	32
Catch	13	16	5	12
Catch/100 raisings	50	67	16	38

J-4 Station 17 August 28

Time	20:15-20:30	20:30-20:45	20:45-21:00	21:00-21:15
No. raisings	31	31	30	32
Catch	15	11	7	1
Catch/100 raisings	48	35	23	3

Table 9-3 Catch per unit effort (100 raisings of lines) by depth levels

	J-2	J-3	J-4	J-5	J-6	JS-1	JS-3
60m level							
No. raisings	35	42	41	37	40	7	36
Catch	17	19	18	10	27	83	5
Catch/100 raisings	48.6	45.2	43.9	27.0	67.5	1,185.7	13.9
30m level							
No. raisings	59	71	83	69	64	11	60
Catch	2	27	16	6	8	56	6
Catch/100 raisings	3.4	38.0	19.3	8.7	12.5	509.1	10.0
Difference	45.2	7.2	24.6	18.3	55.0	676.6	3.9

Table 9-4 Mantle length composition by sexes and maturation stages

Mantle length (cm)	Female								Male					
	Immature				Mature		Total		Immature		Mature		Total	
	Copulation(-)		Copulation(+)		Copulation(+)									
16.0 - 16.9									1				1	
17.0 -										1				1
18.0 -	1				1		2		3	1			3	1
19.0 -	3						3		9	1	4		13	1
20.0 -	15	3	1		1		17	3	19	4	4	1	23	5
21.0 -	19	1	5	1	1		26	2	34	6	9	4	43	10
22.0 -	22	8	3		6	1	31	9	19	3	22	2	41	5
23.0 -	23		9	1	10	1	42	2	11	1	25	1	36	2
24.0 -	9		9		6	1	24	1	3		27	1	30	1
25.0 -	4		4		6	4	14	4	1		16		17	
26.0 -			10		2	3	12	3			9		9	
27.0 -			9		1	1	10	1			1		1	
28.0 -			1		2	2	3	2						
29.0 -			1		1		2				1		1	
30.0 -					5		5							
32.0 -					1		1							
Total	96	12	53	2	43	13	192	27	100	17	118	9	218	26

Left column: Yamato-Tai area. Right column: West of the Tsugaru Strait.

Table 9-5 Frequencies of stomack weight with its contents

Weight g	No. squids	Weight g	No. squids	Weight g	No. squids
0 - 0.9	46	7.0- 7.9	7	21.0-21.9	1
1.0- 1.9	113	8.0- 8.9	3	26.0-26.9	1
2.0- 2.9	74	9.0- 9.9	1	32.0-32.9	1
3.0- 3.9	42	10.0-10.9	1	36.0-36.9	3
4.0- 4.9	20				
5.0- 5.9	9	14.0-14.9	2		
6.0- 6.9	8	18.0-18.9	1	Total	333

10. Study on counting the echo patterns of individual fish by pattern analysis method

T. Ishii

The fish detector project was conducted during this cruise for two objects as follows: 1) collection of the records of fish with the detector; 2) development of the program system for counting the echo of fish.

The records of the fish detector were obtained at 4 stations. These echo signals were recorded in the magnetic tape by the data recorder (TEAC Co., R-351F) at the ship speed of 6 knots for 30 minutes at each station.

Besides programs completed previously, some programs were tested for the record of echo pulse and for recognition and counting of pattern.

11. Sighting records of marine mammals and sea birds

T. Kasuya and K. Kureha

Observation of the distribution of marine mammals was conducted by the above two persons, during the cruising hours with good visibility and wind not more than 4 in Beaufort wind scale, at the upper bridge which is situated about 11 m above the sea level.

The sighted marine mammals are shown in Table 11-1 together with the date, position, and the sighting effort shown by the distance cruised under observation.

The observation of the sea birds is accomplished during the observing hours for marine mammals. And the number and the species of the sea birds seen in the anterior semicircle of the ship was counted, with the binoculars (X8), in every 5 minutes with the interval of 10 minutes. The birds observed by the naked eyes in the remaining each 10 minutes were recorded separately. Fig. 11-1 shows the total number of the observed sea birds summed in each 30 minutes, which will indicate the rough estimation of the relative abundance in the observed area. The analysis of the species of the birds will be conducted by K. Kureha.

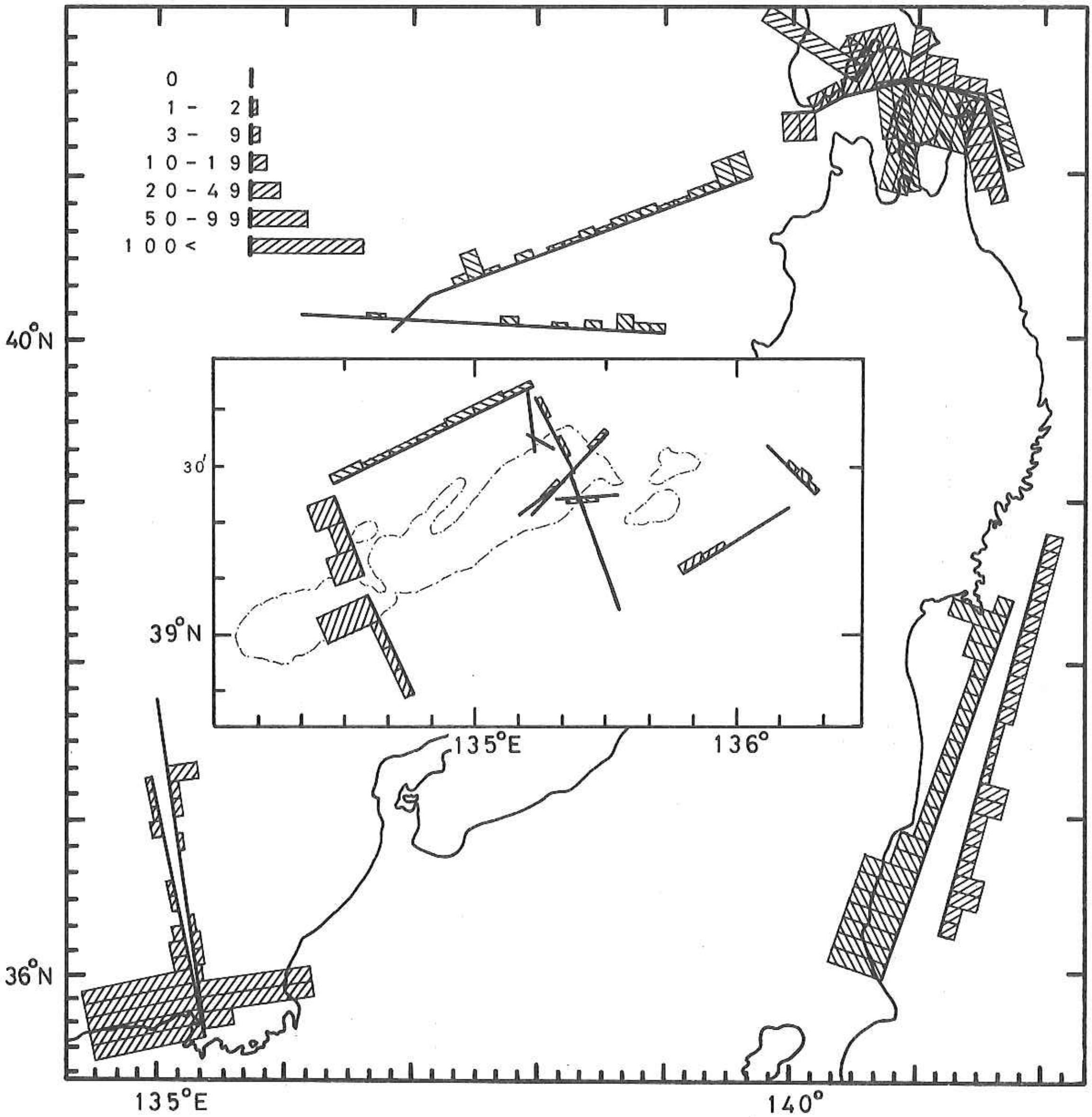


Fig. 11-1. Relative abundance of the sea birds shown by the number of individuals sighted in each 30 minutes. For further explanation, see text.

Table 11-1 Sighting result of marine mammals

Date	Effort				Sighted marine mammals			
	Cruised from	Cruised to	Distance	Hours	Time	Position	Species	No. of individuals
18, VIII	Tokyo port	34 58'N, 139 43'E	49	3:30				
19, VIII	36°11'N, 141°11'E	38°47'N, 141°56'E	164	13:15	12:00	37°39'N, 141°34'E	Dolphin	2
20, VIII	40°58'N, 141°44'E	41°26'N, 141°36'E	25	2:00				
	41°26'N, 141°36'E	41°23'N, 139°55'E	89	7:00				
21, VIII	41°10'N, 139°45'E	40°04'N, 136°49'E	142	12:15				
22, VIII	39°04'N, 135°32'E	39°30'N, 135°21'E	27	1:55				
	39°29'N, 135°23'E	39°43'N, 135°13'E	17	1:55				
	39°33'N, 135°13'E	drifted	11	1:30				
23, VIII	39°24'N, 135°18'E	39°30'N, 135°32'E	6	0:55				
26, VIII	39°21'N, 135°10'E	39°36'N, 135°29'E	37	4:15				
27, VIII	39°33'N, 136°08'E	39°24'N, 136°19'E	21	2:30				
	39°25'N, 136°17'E	39°11'N, 135°47'E	33	3:00				
28, VIII	39°32'N, 135°17'E	39°35'N, 135°12'E	10	0:45				
	39°44'N, 135°13'E	39°27'N, 134°27'E	44	3:40				
	39°27'N, 134°25'E	38°49'N, 134°45'E	42	4:05	16:00	39°04'N, 134°36'E	*Globicephala sp.*	10 ~ 20
29, VIII	37°42'N, 135°02'E	35°40'N, 135°21'E	124	9:45				
1, IX	35°35'N, 135°21'E	37°16'N, 134°54'E	99	9:00				
2, IX	39°16'N, 134°20'E	39°06'N, 134°26'E	26	2:50				
3, IX	39°06'N, 134°30'E	40°02'N, 134°06'E	76	6:45				
4, IX	40°09'N, 136°12'E	40°02'N, 139°00'E	140	8:00				
5, IX	41°32'N, 140°31'E	41°64'N, 140°39'E	14	1:00				
8, IX	41°43'N, 140°41'E	40°51'N, 141°43'E	81	6:45				
9, IX	38°22'N, 141°47'E	35°58'N, 140°04'E	146	12:00				

12. Observation of ship's hull effect on wind profile

T. Fujita and N. Honda

Objective

Since the year before last, we have made many observations of wind profile near the sea surface on the foremast and the pole supported by the horizontal boom of Hakuho-Maru.

Analyzing these wind profiles, obstruction of the air flow by the ship's hull proved to be too large to be neglected.

The aim of the present observation is to clarify the effect of the ship's hull on wind profiles and to utilize these results on the analysis of the former observation data.

Method of estimating ship's hull effect on wind profile

From the comparison between normal and dead slow runs, the correction for hull effect was derived.

For a dead slow run at ship speed S_1, we found the recorded wind ratio, R_1 (Z:22.5 m) relating to the true wind speed U_1 (Z), as follows

$$R_1 = \frac{f_z\left\{U_1 (Z) + S_1\right\} - S_1}{U_1 (22.5)}$$

For a normal run at ship speed $S_2 > S_1$

$$R_2 = \frac{f_z\left\{U_2 (Z) + S_2\right\} - S_2}{U_2 (22.5)}$$

and the difference of these ratios give the following relation.

$$R_2 - R_1 = f_z\left\{\frac{U_2 (Z)}{U_2 (22.5)} - \frac{U_1 (Z)}{U_1 (22.5)}\right\} + (f_z - 1)\left\{\frac{S_2}{U_2 (22.5)} - \frac{S_1}{U_1 (22.5)}\right\}$$

The first term on the right hand side will be zero, if no change in the wind field have taken place between two runs.

Then,

$$f_z = 1 + \frac{(R_2 - R_1) U (22.5)}{S_2 - S_1}$$

This is the formula for effective coefficient f_z.

Observation of hull effect on wind profile

The wind speed was observed by the same small three-cup anemometer as last year. Incidentally, the stability of surface boundary layer was observed by use of three sets of aspirated psychrometers.

In order to obtain acculate ship speed, we observed it from the time duration in which a small floating plate passed through a constant distance along shipboard.

Measurements were made for 10 hours from August 18th to 5th September and more than 18 runs were obtained.

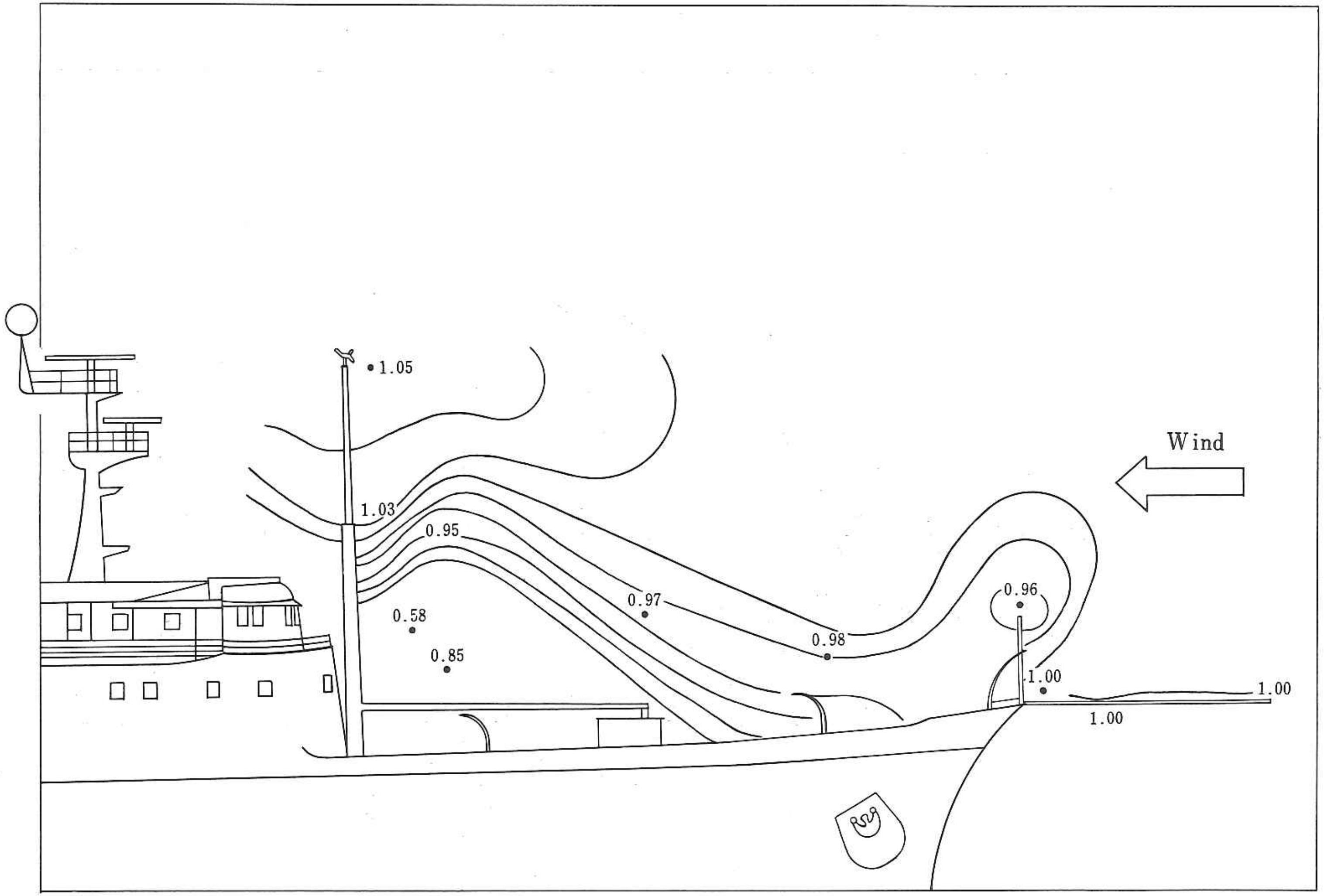


Fig. 12-1 Ship's hull effect on wind profile
(Vertical section)

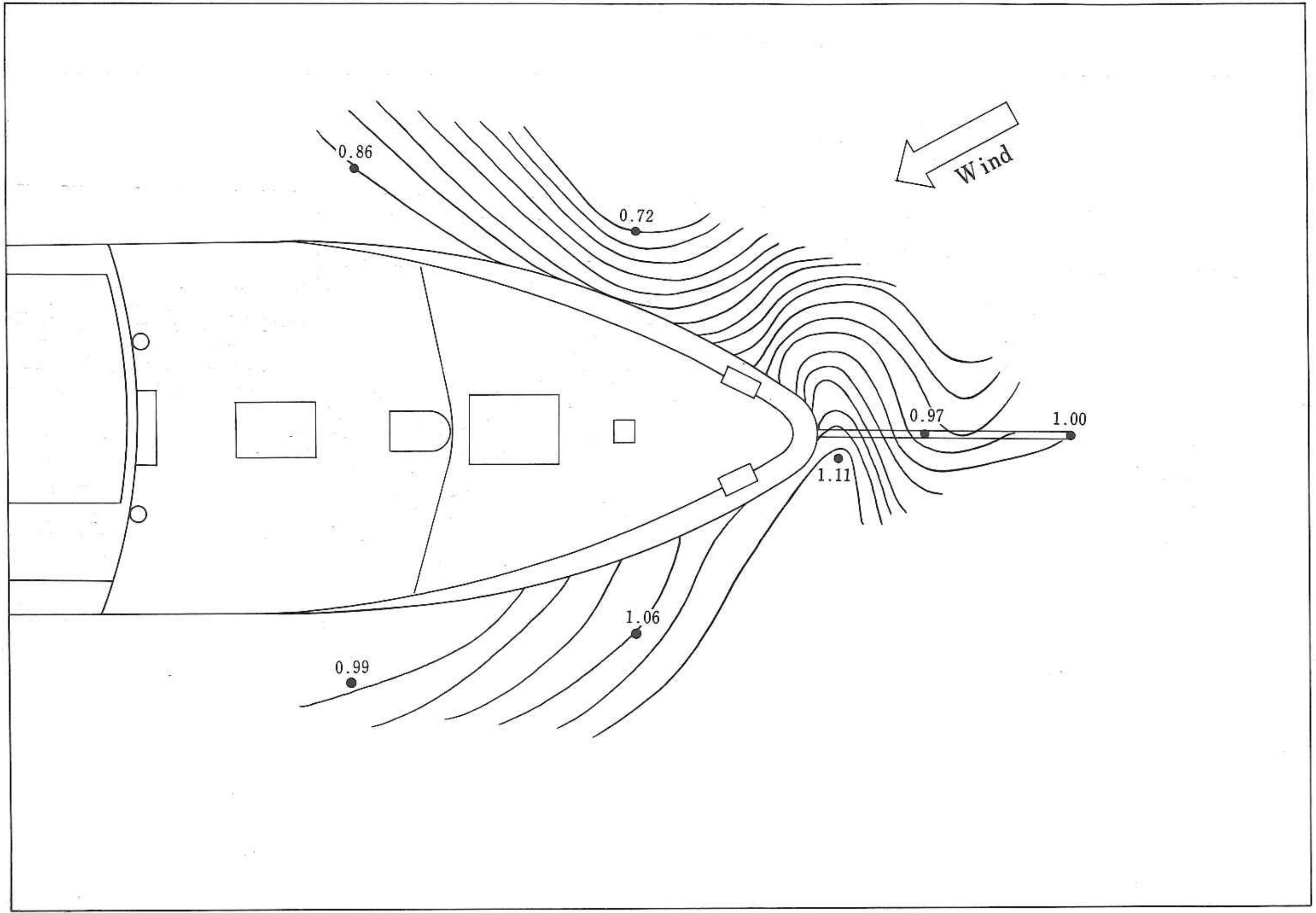


Fig. 12-2 Ship's hull effect on wind distribution

13. Analysis of sea water pollution by gas chromatographic technique

S. Tanaka

In the sea water research, the organic chemicals have not yet been analyzed as pollutant. And, it seems that recent problems such as the transfer of fishing ground, the emergence of odorized fishes and the accumulation of chemicals in fishery products are related with the organic pollution. In order to make these relations clear, gas chromatographic technique which analyze the organic chemicals in sea water is in need for establishment. The method of analysis has been developed from a air pollution technique (ultramicro gas analysis).

The technique is composed of the concentration process and gas chromatographic analysis. Sea water samples are taken in the blowing off bottle (500 ml volume) which has bubbling glass filter. Nitrogen gas pass through the bottle and the organic materials blowed off with nitrogen gas are caught in GC sampler cooled with liquid oxygen. Then samples are inlet to gas chromatograph with flame ionization detector. 30 ml/min, nitrogen gas used as carrier gas, and 25% TCP (tricresyl phosphate) filled up in column and column temperature elevated from 30^{o}C to 120^{o}C at the program rate of 6^{o}C/min enabled us to separate the various organic chemicals. Results of analysis are obtained as chromatograms, from which the organic chemicals are determined and their concentration are measured to ppb-ppt.

In this experiment, especially, the difference between human products as pollutant and natural works which may be derived from planktons, micronectons, etc. and also comparison of these organic materials between littoral zone and open sea are important problems to be solved. Sample waters were taken at Stas. 11, 13 and 17 in Yamato-Tai from depth of 0, 10, 20, 30, 50, 75, 100, 250, 500, 1,000, 1,500 and 2,000 m by using Nansen bottles. In gas chromatographic analysis of these waters, human product was not detected.

Appendix I
(Table of Nansen casts)

(E - 1)

Sta. No. 9

Lat. 39°58.8' N

Date 1971-8-26 - 27

Depth 1,300 m

Long. 135°58.6' E

Time 23:39 - 00:39

Transp. –

Current –

Sea E - 2

Air Temp. 20.2°C

Color of the Sea –

Wind E - 4m/s

Swell 1

Weather cloudy

D	T	S	PH	O_2	PO_4 - P	σ_t
m	°C	°/oo		ml/l	μg atoms/l	
0	21.0	33.940	8.20	5.73	0.01	23.71
9	20.94	933	16	5.86	01	72
18	20.79	928	15	5.93	02	77
28	16.99	34.341	30	8.54	01	25.04
46	12.98	441	22	6.76	17	99
69	9.80	258	13	6.42	44	26.43
92	7.25	129	05	7.44	44	73
115	5.72	112	02	6.86	51	92
139	4.24	103	03	6.49	79	27.07
184	3.47	077	7.98	7.20	91	14
231	2.10	061	92	6.93	1.03	24
276	1.12	067	79	6.17	27	32
370	0.60	-	79	6.00	49	-
462	0.39	064	74	6.17	44	36
553	0.32	071	70	5.83	50	37
735	0.23	079	68	5.73	54	37
930	0.16	072	63	5.59	59	37

(E - 1')

Sta. No. 10	Lat. 39°36.6' N		Date 1971-8-27
Depth 1,350 m	Long. 135°05.4' E		Time 04:21 - 05:20
Transp. —	Current —	Sea 1	Air Temp. 20.2°C
Color of the Sea —	Wind calm	Swell 1	Weather cloudy

D m	T °C	S °/oo	PH	O_2 ml/l	PO_4 - P μg atoms/l	σ_t
0	20.0	33.748	8.12	5.08	1.40	23.84
10	19.93	717	16	5.64	0.01	82
19	20.36	34.004	17	5.49	01	93
29	15.92	061	21	6.76	04	25.07
48	9.18	205	15	6.64	41	26.50
72	6.49	123	09	6.78	56	83
96	5.47	089	06	6.69	64	93
120	4.37	074	04	5.64	78	27.04
144	3.34	068	00	7.61	86	14
192	1.90	052	7.94	6.98	1.08	25
240	1.36	052	90	6.59	15	28
288	1.04	061	86	6.56	27	32
383	0.56	063	82	5.76	35	35
477	0.39	067	78	6.08	47	37
570	0.31	072	76	5.78	50	37
759	0.21	063	74	5.73	57	37
952	0.14	070	72	5.42	59	37

(E - 2)

Sta. No. 11

Lat. $39^{\circ}23.9'$ N

Date 1971-8-27

Depth 2,600 - 2,690 m

Long. $136^{\circ}18.0'$ E

Time 09:52 - 12:27

Transp. 22 m

Current 330° 0.37 kt

Sea ESE-1

Air Temp. 22.0°C

Color of the Sea 2

Wind ESE - 4m/s

Swell 1

Weather clear

D	T	S	PH	O_2	PO_4 - P	σ_t
m	$^{\circ}$C	$^{\circ}/oo$		ml/l	μg atoms/l	
0	21.7	34.119	8.14	5.64	0.05	23.66
9	21.60	113	15	5.78	07	69
19	21.48	108	18	5.54	07	71
28	15.93	227	21	7.22	07	25.22
47	11.47	355	14	6.08	46	26.21
71	8.62	195	10	6.30	66	57
95	6.49	118	06	6.73	61	82
118	4.97	110	03	6.76	76	27.00
142	3.88	101	7.98	6.76	83	11
189	2.58	132	98	6.98	95	25
237	1.65	056	92	6.93	1.10	26
284	1.09	052	82	6.56	29	31
379	0.56	049	82	6.20	35	34
473	0.42	084	79	6.12	54	36
567	0.33	068	76	5.86	54	37
757	0.24	092	70	5.86	59	38
950	0.16	084	64	5.37	71	38
1436	0.16	106	55	5.47	62	40
1916	0.16	112	61	5.39	75	41

(E - 2')

Sta. No. 12

Lat. $39^{o}07.8'$ N

Date 1971-8-28/29

Depth 1.030 m

Long. $135^{o}33.8'$ E

Time 23:02 - 00:18

Transp. –

Current 90^{o} 0.88

Sea E - 1

Air Temp. $22.8^{o}C$

Color of the Sea –

Wind E - 4m/s

Swell 1

Weather fine

D	T	S	PH	O_2	PO_4 - P	σ_t
m	^{o}C	$^{o}/oo$		ml/l	μg atoms/l	
0	23.1	34.110	8.18	5.34	0.02	23.26
10	22.82	071	19	5.61	05	30
20	21.56	33.944	20	7.59	07	57
30	19.82	937	20	4.73	09	24.02
49	15.62	34.501	22	6.37	17	25.47
74	13.58	471	14	5.81	33	89
98	11.72	414	14	5.51	43	26.21
123	10.33	284	12	6.08	53	36
148	9.42	219	12	6.30	54	46
197	5.89	107	12	6.73	65	90
246	3.52	074	7.98	6.42	89	27.12
295	1.95	053	92	6.64	1.10	24
381	0.91	058	84	6.08	32	32
474	0.54	059	77	5.66	47	34
568	0.37	075	74	5.61	62	37
753	0.25	066	74	6.22	52	37
938	0.16	066	73	5.00	62	37

(E - 3)

Sta. No. 13	Lat. 39°29.4' N		Date 1971-8-28
Depth 425 m	Long. 135°19.5' E		Time 02:55 - 03:26
Transp. —	Current 155° 0.31 kt	Sea ESE-2	Air Temp. 22.5°C
Color of the Sea —	Wind ESE - 4m/s	Swell 1	Weather fine

D	T	S	PH	O_2	PO_4 - P	σ_t
m	°C	°/oo		ml/l	μg atoms/l	
0	22.7	34.069	8.16	7.73	0.04	23.35
10	22.73	058	24	5.39	05	33
20	22.50	225	24	5.44	05	51
30	18.17	415	24	6.49	13	24.81
50	14.56	556	17	5.32	67	25.75
74	12.95	478	14	5.73	56	26.02
99	10.73	286	14	6.05	53	30
124	9.87	185	14	6.12	59	36
148	9.56	221	13	6.34	58	44
198	5.50	113	06	6.69	83	95
247	3.76	079	7.96	6.66	93	27.11
297	2.09	067	91	6.69	1.30	25

(E - 3')

Sta. No. 14		Lat. $39^{o}44.0'$ N		Date 1971-8-28
Depth 1,100 m		Long. $135^{o}12.4'$ E		Time 06:27 - 07:15
Transp. 42 m	Current 70^{o} 0.45 kt	Sea ESE-2		Air Temp. 22.4^{o}C
Color of the Sea —	Wind ESE - 4.5m/s	Swell 1		Weather cloudy

D	T	S	PH	O_2	PO_4 - P	σ_t
m	^{o}C	^{o}/oo		ml/l	μg atoms/l	
0	23.1	34.047	8.16	5.42	0.12	23.21
10	23.05	040	22	5.29	05	22
19	22.93	041	23	5.39	07	26
29	18.30	370	20	6.39	10	24.75
49	14.98	507	20	5.27	53	25.62
73	12.78	440	16	5.61	51	26.02
97	10.52	285	14	6.10	58	33
122	9.49	212	12	6.32	65	45
146	7.43	145	10	6.47	71	72
194	4.42	082	03	6.76	95	27.04
242	2.24	054	7.92	6.61	1.30	22
289	1.49	049	87	6.49	44	27
382	0.63	038	84	6.54	50	32
477	0.46	054	80	6.15	66	35
571	0.38	058	77	6.15	74	36
764	0.25	056	73	6.42	91	36
962	0.17	065	71	5.42	93	37

(E - 4)

Sta. No. 15

Lat. $39^{o}26.5'$ N

Date 1971-8-28

Depth 1,900

Long. $134^{o}25.2'$ E

Time 11.15 - 11.54

Transp. 19 m

Current 30^{o} 0.46 kt

Sea E-2

Air Temp. 22.8^{o}C

Color of the Sea —

Wind E - 4m/s

Swell 1

Weather cloudy

D m	T ^{o}C	S $^{o}/oo$	PH	O_2 ml/l	PO_4 - P μg atoms/l	σ_t
0	23.1	34.118	8.23	5.29	0.07	23.27
10	23.02	107	.26	5.31	07	28
19	22.77	105	.24	5.32	05	35
29	19.04	363	.24	6.54	12	24.55
49	15.45	514	.23	5.92	21	25.53
73	14.04	548	.18	5.47	56	86
97	11.64	380	.16	5.86	61	26.20
121	9.92	262	.11	6.12	66	42
145	7.67	154	.07	5.88	71	68
193	5.11	097	7.98	6.51	89	97
241	2.72	064	.86	6.56	1.17	27.19
289	1.69	059	.83	6.30	42	27
381	0.85	051	.78	6.05	67	33
476	0.52	056	.77	5.78	81	34
569	0.36	059	.72	5.61	87	35
752	0.26	061	.76	5.61	94	37
924	0.16	072	.73	5.41	97	37

(E - 4')

Sta. No. 16		Lat. 39°07.6' N	Date 1971-8-28
Depth 300 m		Long. 134°34.6' E	Time 14:25 - 14:57
Transp. –	Current 267° 0.66 kt	Sea S-2	Air Temp. 23.5°C
Color of the Sea –	Wind S - 2m/s	Swell 1	Weather mist

D	T	S	PH	O_2	PO_4 - P	σ_t
m	°C	°/oo		ml/l	μ g atoms/l	
0	23.0	34.064	8.24	5.39	0.05	23.25
10	21.85	003	20	5.39	07	53
20	21.17	33.969	20	5.56	10	69
30	19.38	995	16	5.88	09	24.18
49	14.58	34.518	14	5.78	35	25.72
74	9.75	225	11	7.03	56	26.42
98	7.42	120	06	6.81	41	69
122	7.17	118	04	6.86	47	73
147	7.01	127	02	6.69	51	76
196	6.35	127	7.96	6.58	54	84
244	5.47	114	88	6.95	63	95

(E - 5)

Sta. No. 17

Lat. $38^{\circ}52.6'$ N

Date 1971-8-28

Depth 2,950 - 2,750 m

Long. $134^{\circ}47.8'$ E

Time 19:03 - 22:24

Transp. –

Current 355° 0.28 kt

Sea E-2

Air Temp. 22.7°C

Color of the Sea

Wind E - 3.5m/s

Swell 1

Weather cloudy

D	T	S	PH	O_2	PO_4 - P	σ_t
m	$^{\circ}$C	$^{o}/oo$		ml/l	μ g atoms/l	
0	24.1	34.001	8.24	5.25	0.05	22.88
9	23.20	088	26	5.29	01	23.22
18	22.04	011	26	5.51	01	48
27	19.91	002	24	6.20	05	24.04
46	16.38	477	24	6.00	17	25.28
69	14.61	519	16	5.90	47	70
92	11.51	370	14	6.03	49	26.22
115	9.99	245	14	6.20	54	39
138	8.60	190	09	6.54	54	57
184	5.22	121	00	6.54	83	98
230	3.21	078	7.92	6.64	1.07	27.16
275	1.85	060	85	6.47	30	26
365	0.84	064	72	5.61	71	33
455	0.52	077	70	5.51	73	36
546	0.34	066	68	5.66	76	37
732	0.22	077	66	5.39	82	37
924	0.14	074	64	5.34	89	38
1,399	0.15	080	66	5.47	91	38
1,871	0.15	079	68	5.54	76	38

Appendix II Table of BT operations (Q)

No.	Sta. No.	Date	Lat.	Long.	Depth (m)											Max D	T	SLD
					0	10	20	30	50	75	100	125	150	200	250			
		1971 h m														m	°C	m
1	J-1	8-20, 20:55	41°38.7'	139°52.5'	23.4	23.5	23.5	22.7	16.6	11.5	10.0	8.6	6.4	3.7	1.8	259	1.5	21
2	F-1	8-21, 13:38	40°27.2'	137°49.5'	20.7	20.6	15.1	8.1	3.7	2.4	2.0	1.4	1.2	0.8	0.6	263	0.5	17
3	12(N)	8-22, 03:00	39°05.2'	135°31.5'	22.6*	22.6	26.6	17.7	15.1	14.0	12.6	10.8	10.0	8.2	4.9	268	3.2	25
4	12(D)	8-22, 06:34	" 04.0'	" 32.1'	22.5	22.5	22.5	20.9	15.0	14.2	12.6	11.0	9.8	8.0	4.7	269	2.8	30
5	$13(d_1)$	" 10:02	" 28.8'	" 22.5'	19.5	19.5	19.3	18.9	15.8	8.2	5.0	3.6	3.0	1.5	0.9	270	0.4	19
6	F-2	" 11:39	" 40.5'	" 13.1'	20.3	20.3	20.2	19.0	13.6	10.2	7.6	6.6	5.4	3.8	1.5	256	1.2	28
7	$14(d_2)$	" 13:28	" 41.01	" 12.9'	21.6	21.5	20.6	20.4	14.0	10.3	8.4	6.9	5.6	4.2	1.7	258	1.3	10
8	$14(d_3)$	" 14:36	" 38.0'	" 13.0'	21.9	21.1	20.8	17.4	14.4	10.7	8.2	7.1	6.1	4.7	2.5	255	2.3	28
9	$14(n_1)$	" 20:05	" 43.4'	" 11.7'	22.5	22.7	20.3	17.9	13.5	10.3	8.3	6.5	5.3	3.6	1.9	270	1.3	12
10	$14(n_2)$	" 21:48	" 41.3'	" 11.0'	22.7	22.8	20.1	17.3	14.3	11.3	9.1	6.8	5.8	5.0	3.2	258	2.1	13
11	$14(n_3)$	" 23:01	" 40.5'	" 10.1'	22.7	22.7	19.3	16.1	14.0	10.8	9.0	6.9	6.0	5.0	3.2	263	2.4	17
12	13(n)	8-23, 01:31	" 28.7'	" 19.4'	19.4	19.5	19.6	17.8	11.8	9.0	6.4	4.2	2.6	1.2	0.4	258	0.3	28
13	0-1	" 06:36	" 29.01	" 20.5'	19.5	19.5	19.7	18.3	12.8	9.4	5.9	4.7	3.1	–	–	198	1.2	22
14	0-2	" 06:54	" 29.8'	" 19.7'**	–	–	–	–	–	–	–	–	–	–	–	–	–	–
15	0-3	" 07:24	" 28.5'	" 19.3'	19.6	19.6	20.0	19.3	12.3	10.1	7.5	6.3	4.2	2.1		242	0.6	19
16	1-2	" 17:24	" 17.0'	" 10.1"	20.0	21.0	20.2	19.8	13.0	9.9	7.9	6.2	5.2	2.8	1.5	250	1.5	30
17	1-3	" 17:54	" 17.2'	" 12.8'	19.8	19.8	17.9	18.4	12.9	9.6	7.7	5.7	4.0	2.0	1.4	254	1.3	18
18	F-3	" 20:25	" 16.8'	" 05.7'	22.5	22.5	22.2	20.5	14.2	10.5	8.7	6.4	5.9	4.9	3.2	258	3.0	20
19	2-1	8-24, 05:22	" 06.4'	134°58.5'	19.8	19.7	19.9	20.0	17.1	13.1	10.9	13.6	4.8	3.3	1.9	270	0.9	35
20	2-3	" 06:15	" 06.4'	" 56.71	20.3	20.3	20.4	20.6	18.7	14.8	10.6	73	4.6	3.4	2.0	268	1.3	40
21	I.W. 1 13 (1)	" 09:28	" 00.3'	" 53.9'	22.5	22.6	22.5	21.8	18.5	14.2	11.4	8.8	8.1	4.0	2.1	250	2.1	10
22	I.W. 2 13 (2)	" 09:39	38°59.4'	" 53.5'	22.6	22.6	22.5	21.6	16.9	14.4	12.3	10.6	8.2	3.4	1.7	253	1.6	20
23	I.W. 3 13 (3)	" 09:45	" 59.4'	" 53.5'	22.6	22.6	22.6	21.8	17.5	14.8	12.5	10.4	8.5	3.5	1.7	252	1.6	20
24	I.W. 4 13 (4)	" 09:52	" " 59.4'	" 53.5'	22.7	22.7	22.5	21.6	17.5	14.8	12.5	10.6	8.0	–	–	171	7.3	20
25	3-1	" 17:58	" 58.6'	" 58.8'	20.0	20.0	20.1	20.2	20.2	12.3	10.5	7.7	5.3	2.9	1.6	259	1.4	50
26	9	8-26, 23:22	39°58.8'	135°59.0'	20.8	20.8	20.7	20.0	14.0	10.3	7.3	6.2	4.2	3.0	1.4	261	1.0	28
27	10	8-27, 05:01	" 36.5'	136°05.7'	19.8	20.2	20.4	16.9	10.1	6.7	5.5	4.3	3.3	1.8	1.0	259	0.8	25
28	11	8-27, 11:14	39°24.0'	136°17.5'	22.0	21.9	21.6	18.6	12.7	9.3	6.7	5.3	3.8	2.6	1.5	268	0.9	30
29	12	" 23:53	" 08.0'	135°34.0'	23.1	23.1	21.8	19.8	16.4	13.8	12.2	10.8	9.7	5.8	2.9	270	1.6	10
30	13	8-28, 03:35	" 29.4'	" 19.4'	22.6	22.6	22.6	21.3	15.5	13.2	11.4	10.0	9.6	5.5	3.3	270	1.9	28
31	14	" 07:18	" 44.1'	" 12.6'	23.0	23.0	22.9	20.3	15.4	13.0	10.5	9.2	7.3	3.9	1.8	270	1.0	27
32	15	" 12:05	" 26.5'	134°25.3'	22.9	22.9	22.8	20.8	16.0	14.7	12.3	10.3	8.1	4.8	2.3	269	1.2	28
33	16	" 14:56	" 07.6'	" 34.7'	22.7	21.8	21.3	20.1	15.0	10.0	7.3	7.0	6.9	6.3	4.8	260	4.1	34
34	17	" 21:53	38°53.0'	" 47.0'	23.7	23.3	22.8	21.7	16.8	14.6	11.8	10.0	8.0	4.3	2.0	263	1.3	32
35	16C-1	9-2, 05:45	39°09.3'	" 29.1'	22.6	22.6	22.6	22.6	16.1	14.4	12.7	11.0	10.0	7.1	–	243	3.7	32
36	B-1	" 06:15	" 09.3'	" 29.1'	22.6	22.6	22.6	22.5	16.0	14.2	13.0	11.2	9.4	6.9	–	245	3.7	30
37	A-1	" 06:47	" 10.0'	" 30.5'	22.5	22.5	22.5	22.4	16.3	14.4	12.7	11.2	10.0	7.0	–	242	4.5	32
38	C-2	" 16:37	" 12.0'	" 26.9'	22.8	22.9	22.8	22.5	16.2	14.2	12.8	11.0	9.8	6.4	3.0	254	2.8	32
39	B-2	" 17:09	" 12.1'	" 28.7'	22.5	22.6	22.3	22.3	17.8	14.2	12.4	11.1	9.8	6.3	3.6	255	2.8	32
40	A-2	" 17:34	" 12.5'	" 29.0'	22.8	22.9	22.6	22.5	16.2	14.5	12.6	10.9	10.1	6.4	3.4	256	3.1	30
41	16'	9-3, 02:25	" 11.4	" 26.6'	22.5	22.6	22.6	22.5	15.5	14.0	12.3	10.7	10.0	6.5	–	203	6.4	30
42	C-3	" 06:45	" 16.0'	" 27.4'	22.5	22.6	22.6	19.5	15.5	14.1	12.2	10.8	9.8	6.4	–	245	3.7	27
43	A-3	" 07:15	" 15.5'	" 30.0'	22.6	22.6	22.6	21.5	16.2	14.3	12.7	11.2	10.0	6.1	–	245	4.0	30
44	B-3	" 07:41	" 15.3'	" 29.6'	22.6	22.6	22.6	22.0	16.0	14.4	12.5	10.9	10.0	6.0	–	240	4.8	30
45	21	" 20.03	40°10.0'	133°59.5'	21.0	21.2	21.0	14.4	10.5	7.5	6.7	6.4	6.0	5.5	4.0	256	3.5	20

* Unable to compensate the surface water temperature

** Unable to read out of scratch curve