Preliminary Report of The Hakuhō Maru Cruise KH-68-2

May-June, 1968

East China Sea

Ocean Research Institute
University of Tokyo

1969

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By

The Members of Expedition

Edited by

N. TAGA and M. HORIKOSHI

INTRODUCTION

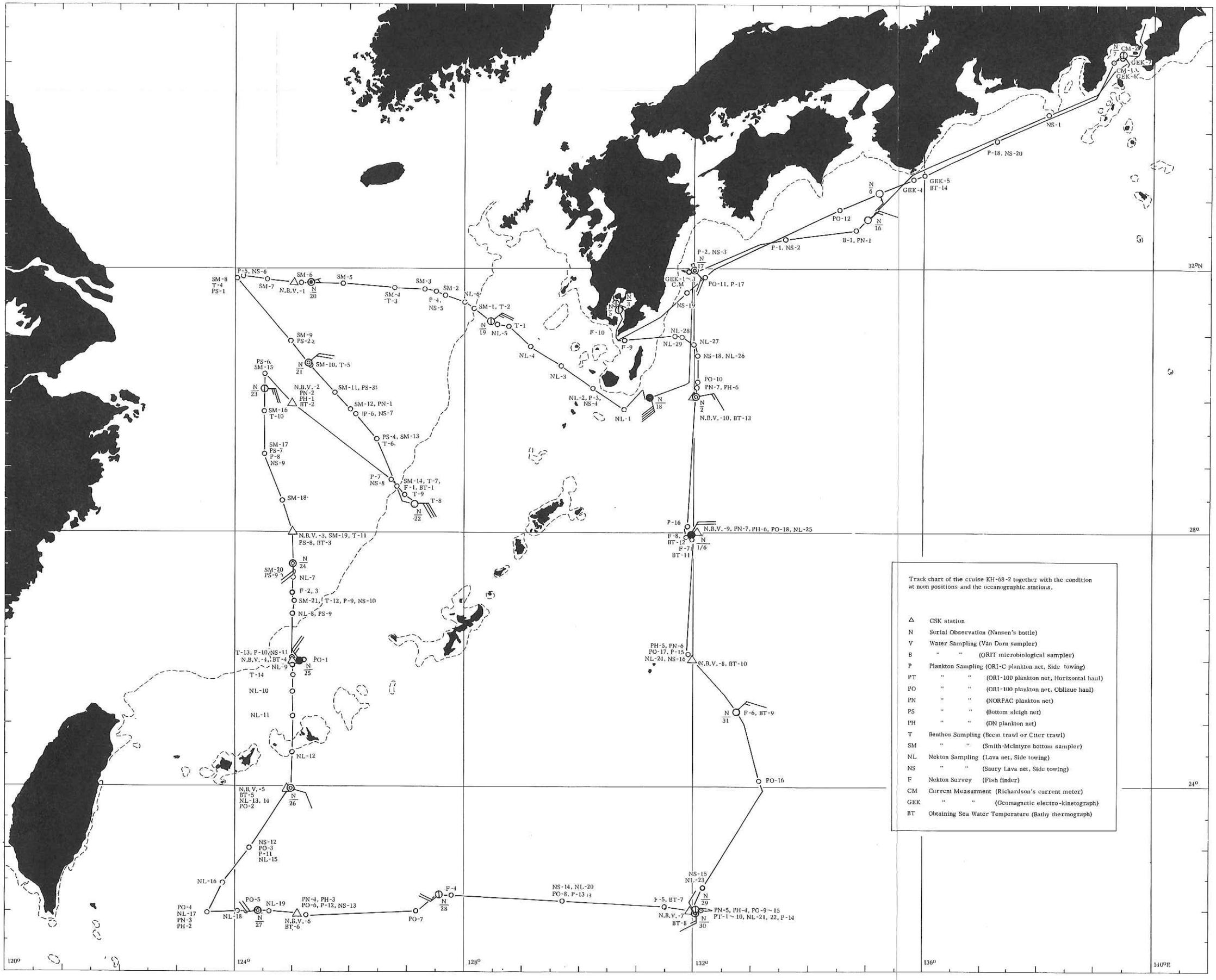
N. Taga
Chief Scientist

The theme of research in the Cruise KH-68-2 is concerned with the studies on the biota and biological production in the East China Sea and its adjacent region. The research projects in this cruise, however, partly participate in the project of Cooperative Study of the Kuroshio and Adjacent Resion (CSK). The track chart of this cruise is shown in an accompanied figure together with the sea condition at noon positions and the location of oceanographic stations, including those of the CSK project.

The itinerary of this cruise over a period of twenty-five days is tabulated as follows.

Departure from Tokyo: May 15, 1968
Arrival at Kagoshima: June 3
Departure from Kagoshima: June 5
Arrival at Tokyo: June 8

In preparing this report, the author wishes to express his gratitude to Captain T. Shirasawa, the other officers and crew of R/V Hakuho-maru for their sustained cooperation during the cruise.



Track chart of the cruise KH-68-2 together with the condition at noon positions and the oceanographic stations.

△	CSK station	
N	Serial Observation	(Nansen's bottle)
V	Water Sampling	(Van Dorn sampler)
B	" "	(ORIT microbiological sampler)
P	Plankton Sampling	(ORI-C plankton net, Side towing)
PT	" "	(ORI-100 plankton net, Horizontal haul)
PO	" "	(ORI-100 plankton net, Oblizue haul)
PN	" "	(NORPAC plankton net)
PS	" "	(Bottom sleigh net)
PH	" "	(DN plankton net)
T	Benthos Sampling	(Beam trawl or Otter trawl)
SM	" "	(Smith-McIntyre bottom sampler)
NL	Nekton Sampling	(Lava net, Side towing)
NS	" "	(Saury Lava net, Side towing)
F	Nekton Survey	(Fish finder)
CM	Current Measurment	(Richardson's current meter)
GEK	" "	(Geomagnetic electro-kinetograph)
BT	Obtaining Sea Water Temperature	(Bathy thermograph)

List of the Members of the Expedition

Cheif Scientist, Taga Nobuo: Ocean Research Institute, University of Tokyo

Nemoto, Takahisa:	Ocean Research Institute
Horikoshi, Masuoki:	"
Murano, Masaaki:	"
Numachi, Kenichi:	"
Ishii, Takeo:	"
Sugimori, Yasuhiro:	"
Nakai, Shunsuke:	"
Hasumoto, Hiroshi:	"
Kureha, Kazuo:	"
Kihara, Yoji:	"
Sasada, Ken:	"
Terasaki, Makoto:	"
Matsuda, Osamu:	"
Lee, Hideo:	"
Saijo, Yatsuka:	Water Research Laboratory, Faculty of Science, Nagoya University
Asaoka, Osamu:	Nagasaki Marine Observatory
Kamatani, Akiyoshi:	Tokyo University of Fisheries
Minoda, Takashi:	Faculty of Fisheries, Hokkaido University
Gamo, Sigeo:	Faculty of Education, Yokohama National University
Imajima, Minoru:	National Science Museum
Ogura, Norio:	Department of Chemistry, Faculty of Science, Tokyo Metropolitan University
Arai, Nagahira:	Department of Fisheries, Faculty of Agriculture, Tohoku University
Tominaga, Yoshiaki:	Zoological Institute, Faculty of Science, University of Tokyo
Nakajima, Kohoki:	Faculty of Fisheries, Hokkaido University
Sugahara, Isao:	Research Institute for Food Science, Kyoto University
Ozawa, Takakazu:	Department of Fisheries, Faculty of Agriculture, Kyushu University
Inamura, Takeshi:	Sanken Electric Co., Ltd.
Tanaka, Yaichi:	Kokusai Electronic Corporation

Items of Research

1. General observation on the CSK project: temperature, salinity, transparency, pH, dissolved oxygen, PO_4-P, SiO_2-Si, NO_2-N, chlorophyll, and plankton sampling by NORPAC-net (GG 54)
2. Ecological survey of plankton (T. Nemoto, O. Asaoka, M. Murano, T. Minoda, M. Terasaki, H. Lee and Y. Kihara)
3. Distribution of fish larvae (T. Ozawa)
4. Collection of the saury (Cololabis saira) and the genetical and systematical analysis of the population (K. Numachi)
5. Systematic survey of the benthic and bathypelagic fishes (Y. Tominaga)
6. Benthic communities and biomass of benthos (M. Horikoshi, S. Gamo and M. Imajima)
7. Observation of marine mammals and sea birds (K. Kureha)
8. Counting of the echo pattern of individual fish by pattern analysis method (T. Ishii, Y. Tanaka and T. Inamura)
9. Ecological survey of marine bacteria (N. Taga, I. Sugahara, K. Sasada and O. Matsuda)
10. Chemical analyses of the substances in sea water and seston (Y. Saijo, A. Kamatani, N. Ogura, N. Arai and K. Nakajima)
11. Measurement of bottom current (Y. Sugimori)

Table of Contents

1. Data on general observations of the CSK project

Table 1-1 Data on temperature, salinity, dissolved oxygen, pH and nutrients salts in the East China Sea and the adjacent region

Station 1 31°48.0'N, 125°01.2'E (31°48.3'N, 124°56.6'E) Air Temp. 15.2°C
Depth 47 m Transparency 9 m Time 14:20-15:30 May 20

Sample No.	Depth (m)	Temp. (°C)	Salinity (‰)	pH	Dissolved Oxygen (ml/l)	(%)	PO_4-P (μg atoms/l)	SiO_2-Si (μg atoms/l)	NO_2-N (μg atoms/l)
1-0	0	14.3	32.854	8.02	6.30	107	0.23	6.9	0.00
1-10	10	14.16	32.878	8.08	6.25	104	0.17	5.7	0.08
1-20	20	13.92	32.893	8.08	7.62	127	0.22	6.6	0.06
1-30	30	13.21	32.909	8.08	6.29	103	0.31	6.9	0.26
1-50	45	13.08	32.932	8.08	7.26	118	0.39	8.0	0.36

Table 1-1 (continued)

Station 2 29°59.7'N, 124°59.7'E (29°59.5'N, 124°59.3'E) Air Temp. 18.0°C
Depth 58 m Transparency 13.5 m Time 05:50-06:16 May 23

Sample No.	Depth (m)	Temp. (°C)	Salinity (‰)	pH	Dissolved Oxygen (ml/l)	(%)	PO_4-P (μg atoms/l)	SiO_2-Si (μg atoms/l)	NO_2-N (μg atoms/l)
2-0	0	16.46	34.256	8.12	5.62	98	0.16	5.2	0.01
2-10	9	16.37	34.229	8.18	5.96	104	0.16	4.9	0.00
2-20	19	15.45	34.256	8.12	5.97	103	0.14	4.9	0.00
2-30	28	14.91	34.295	8.11	5.96	102	0.16	5.5	0.00
2-50	47	14.02	34.423	8.10	5.67	95	0.17	6.0	0.93

Table 1-1 (continued)

Station 3 28°00.3'N, 125°00.5'E (28°01.7'N, 125°00.8'E) Air Temp. 23.4 °C
Depth 100 m Transparency 14 m Time 07:30-08:50 May 24

Sample No.	Depth (m)	Temp. (°C)	Salinity (‰)	pH	Dissolved Oxygen (ml/l)	(%)	PO_4-P (μg atoms/l)	SiO_2-Si (μg atoms/l)	NO_2-N (μg atoms/l)
3-0	0	21.78	34.244	8.15	5.25	100	0.12	2.0	0.00
3-10	9	21.77	34.229	8.16	5.14	98	0.11	2.0	0.00
3-20	19	21.46	34.308	8.16	5.16	98	0.12	4.3	0.00
3-30	28	20.92	34.389	8.16	5.18	97	0.16	2.5	0.00
3-50	48	19.62	34.394	8.14	5.13	95	0.14	2.8	0.13
3-75	71	17.74	34.600	8.04	3.92	70	0.78	15.1	0.14
3-100	95	17.39	34.575	7.96	3.97	71	0.84	17.1	0.25

Table 1-1 (continued)

Station 4 26°00.5'N, 125°00.7'E (26°00.5'N, 125°08.0'E) Air Temp. 26.5°C
Depth 1700 m Transparency 30 m Time 08:40-09:33 May 25

Sample No.	Depth (m)	Temp. (°C)	Salinity (‰)	pH	Dissolved Oxygen (ml/l)	(%)	PO_4-P (μg atoms/l)	SiO_2-Si (μg atoms/l)	NO_2-N (μg atoms/l)
4-0	0	26.17	34.625	8.17	4.67	97	0.08	2.5	0.00
4-10	11	26.14	34.625	8.18	4.78	99	0.02	2.3	0.00
4-20	21	26.10	34.629	8.20	4.74	98	0.02	2.3	0.09
4-30	31	26.02	34.633	8.20	4.77	98	0.00	2.3	0.09
4-50	51	25.77	34.656	8.20	4.71	97	0.03	2.3	0.00
4-75	75	25.23	34.696	8.19	4.78	98	0.08	1.7	0.01
4-100	95	24.27	34.780	8.18	4.81	96	0.08	3.4	0.06
4-125	115	23.55	34.793	8.16	4.70	93	0.12	2.9	0.21
4-150	133	22.96	34.822	8.17	4.70	92	0.09	5.4	0.30
4-200	169	21.09	34.802	8.12	4.34	82	0.39	7.4	0.28
4-300	242	15.26	34.642	7.97	3.85	66	0.88	14.9	0.16
4-400	323	11.11	34.439	7.84	3.28	52	1.66	38.9	0.11
4-500	531	6.72	34.358	7.68	2.34	34	2.04	81.8	0.02
4-600	628	5.89	34.389	7.62	2.12	30	2.64	88.8	0.20
4-800	843	4.62	34.424	7.58	1.86	26	2.82	92.5	0.10
4-1000	1062	4.18	34.431	7.55	1.84	25	2.89	114.4	0.12
4-1200	1265	4.01	34.446	7.56	1.79	24	2.89	121.9	0.03
4-1500	1573	3.80	34.465	7.54	1.82	25	2.97	120.8	0.08

Table 1-1 (continued)

Station 5 23°59.2'N, 124°58.8'E (23°57.8'N, 124°56.0'E) Air Temp. 25.0°C
Depth 2575 m Transparency 28 m Time 11:35-14:20 May 26

Sample No.	Depth (m)	Temp. (°C)	Salinity (‰)	pH	Dissolved Oxygen (ml/l)	(%)	PO_4-P (μg atoms/l)	SiO_2-Si (μg atoms/l)	NO_2-N (μg atoms/l)
5-0	0	25.82	34.820	8.18	4.92	101	0.12	2.8	0.01
5-10	10	25.66	34.815	8.19	4.74	97	0.09	2.1	0.00
5-20	21	24.34	34.830	8.18	(5.41)	(108)	0.08	2.1	0.00
5-30	31	23.34	34.835	8.20	4.91	97	0.09	2.8	0.00
5-50	52	22.33	34.888	8.20	5.13	99	0.06	2.0	0.00
5-75	78	21.18	34.933	8.16	4.78	91	0.09	3.7	0.05
5-100	102	20.32	34.927	8.14	4.63	87	0.17	4.6	0.16
5-125	130	19.71	34.929	8.14	4.58	85	0.25	3.1	0.01
5-150	155	19.23	34.910	8.14	4.62	85	0.17	4.3	0.07
5-200	205	17.81	34.827	8.08	4.43	80	0.44	6.3	0.08
5-300	306	15.25	34.658	8.01	4.24	73	0.64	10.3	0.06
5-400	407	12.67	34.455	7.88	3.88	64	1.17	20.2	0.00
5-500	509	10.12	34.314	7.76	3.29	51	1.58	37.5	0.03
5-600	569	7.96	34.263	7.68	2.82	42	2.08	54.9	0.12
5-800	718	5.32	34.306	7.54	1.98	28	2.67	85.0	0.00
5-1000	888	4.52	34.392	7.54	1.74	24	2.83	99.1	0.00
5-1200	1052	3.50	34.474	7.54	1.72	23	3.06	119.9	0.00
5-1500	1309	2.78	34.535	7.52	1.86	25	3.06	130.8	0.01
5-2000	1759	2.18	34.610	7.64	2.67	35	2.91	133.7	0.05

Table 1-1 (continued)

Station 6 22°00.0'N, 125°01.3'E (21°56.3'N, 125°13.2'E) Air Temp. 27.6 °C
Depth 5960 m Transparency 22 m Time 15.03-22:10 May 27

Sample No.	Depth (m)	Temp. (°C)	Salinity (‰)	pH	Dissolved Oxygen (ml/l)	(%)	PO_4-P (μg atoms/l)	SiO_2-Si (μg atoms/l)	NO_2-N (μg atoms/l)
6-1	0	26.98	34.592	8.14	4.78	100	0.08	1.7	0.00
6-10	7	26.99	34.708	8.14	4.79	104	0.05	1.1	0.00
6-20	15	26.93	34.714	8.14	4.72	99	0.06	1.4	0.02
6-30	22	26.15	34.731	8.16	4.80	99	0.03	1.7	0.01
6-50	37	24.66	34.773	8.16	4.92	101	0.06	1.4	0.00
6-75	54	24.19	34.810	8.16	4.93	99	0.09	2.0	0.06
6-100	70	23.48	34.866	8.16	4.90	97	0.13	2.0	0.03
6-125	84	23.00	34.901	8.16	4.84	95	0.11	1.7	0.00
6-150	97	22.66	34.909	8.16	4.74	92	0.09	4.9	0.03
6-200	122	22.06	34.915	8.16	4.76	92	0.16	5.7	0.18
6-300	175	21.08	34.926	8.06	(4.66)	(88)	0.11	5.7	0.06
6-400	341	16.97	34.792	7.96	(4.43)	(79)	0.49	10.0	0.00
6-500	425	14.98	34.646	7.90	4.32	74	0.66	13.5	0.00
6-600	478	12.04	34.433	7.78	3.90	63	1.57	25.3	0.00
6-800	627	8.07	34.286	7.60	(2.94)	(44)	2.05	51.8	0.04
6-1000	1015	4.06	34.489	7.32	2.08	28	2.84	115.3	0.00
6-1200	1221	3.05	34.550	7.32	2.14	29	2.96	135.1	0.00
6-1500	1528	2.44	34.593	7.36	2.32	31	3.03	140.9	0.00
6-2000	2041	2.00	34.645	7.42	2.83	37	2.91	142.3	0.00
6-2500	2551	1.78	34.673	7.46	3.19	41	2.28	142.3	0.00
6-3000	3059	1.64	34.679	7.46	(3.33)	(43)	2.67	141.4	0.14
6-3500	3567	1.56	34.692	7.50	3.82	49	3.14	139.4	0.22
6-4000	4078	1.60	34.692	7.53	(3.35)	(43)	2.46	138.0	0.17

Table 1-1 (continued)

Station 7 21°59.8'N, 132°01.0'E (22°00.8'N, 132°07.6'E) Air Temp. 27.3 °C
Depth 5650 m Transparency 32 m Time 08:50-16:10 May 29

Sample No.	Depth (m)	Temp. (°C)	Salinity (‰)	pH	Dissolved Oxygen (ml/l)	(%)	PO_4-P (μg atoms/l)	SiO_2-Si (μg atoms/l)	NO_2-N (μg atoms/l)
7-0	0	26.96	34.723	8.21	4.72	99	0.08	0.6	0.00
7-10	10	26.89	34.727	8.22	4.65	97	0.05	0.6	0.00
7-20	21	26.03	34.805	8.22	4.77	98	0.05	1.7	0.01
7-30	31	24.28	34.870	8.22	4.87	99	0.05	2.2	0.00
7-50	52	22.84	34.926	8.20	5.01	98	0.06	0.6	0.01
7-75	78	21.55	34.943	8.20	5.13	98	0.06	1.1	0.00
7-100	102	20.72	34.958	8.18	4.98	94	0.16	1.7	0.00
7-125	138	19.81	34.949	8.16	4.88	91	0.23	1.4	0.03
7-150	149	19.23	34.946	8.16	4.93	91	0.13	4.0	0.03
7-200	198	18.34	34.898	8.12	4.81	87	0.31	4.6	0.13
7-300	297	16.82	34.800	8.08	4.52	80	0.41	13.2	0.01
7-400	400	13.93	34.557	7.74	4.25	71	0.89	17.6	0.01
7-500	477	11.01	34.327	7.58	3.89	62	1.33	25.6	0.05
7-600	575	8.14	34.203	7.54	3.28	49	2.00	49.8	0.02
7-800	772	4.80	34.255	7.36	1.70	24	2.78	94.7	0.06
7-1000	1004	3.66	34.401	7.35	1.40	19	2.95	115.6	–
7-1200	1204	3.04	34.516	7.40	1.69	23	2.95	143.3	0.00
7-1500	1499	2.58	34.570	7.44	2.20	29	2.95	145.6	–
7-2000	1965	1.98	34.642	7.64	2.72	35	2.55	142.2	0.00
7-2500	2492	1.75	34.665	7.62	3.04	39	2.70	142.2	–
7-3000	2986	1.66	34.673	7.64	3.27	42	2.70	142.2	0.00
7-3500	3502	1.60	34.693	7.68	3.31	43	2.64	142.2	–
7-4000	4010	1.60	34.697	7.66	3.42	44	2.52	138.0	0.00

Table 1-1 (continued)

Station 9 26°00.2'N, 131°59.8'E (26°02.0'N, 131°55.0'E) Air Temp. 23.8 °C
Depth 3050 m Transparency 36 m Time 17:45-21:20 May 31

Sample No.	Depth (m)	Temp. (°C)	Salinity (‰)	pH	Dissolved Oxygen (ml/l)	(%)	PO_4-P (μg atoms/l)	SiO_2-Si (μg atoms/l)	NO_2-N (μg atoms/l)
9-0	0	23.35	34.709	8.20	4.94	98	0.02	0.8	0.00
9-10	9	23.28	34.687	8.20	4.96	98	0.00	0.8	0.00
9-20	17	23.00	34.705	8.20	4.94	97	0.05	1.1	0.02
9-30	26	22.71	34.783	8.20	4.96	97	0.03	0.8	0.01
9-50	42	20.85	34.915	8.21	5.26	100	0.05	1.1	0.03
9-75	63	19.92	34.920	8.18	5.12	96	0.11	1.7	0.00
9-100	83	19.13	34.925	8.17	4.79	88	0.17	1.1	0.14
9-125	103	18.76	34.922	8.14	4.81	88	0.22	1.1	0.02
9-150	124	18.39	34.900	8.16	4.79	87	0.08	2.5	0.15
9-200	161	17.87	34.889	8.16	4.88	88	0.27	2.3	0.07
9-300	232	16.80	34.808	8.12	4.53	80	0.42	5.1	0.02
9-400	308	15.14	34.672	8.04	4.26	73	0.70	9.4	0.01
9-500	392	13.02	34.508	7.96	4.03	67	0.99	18.2	0.00
9-600	643	6.61	34.220	7.72	2.58	37	2.32	62.9	0.00
9-800	854	4.34	34.334	7.58	1.65	23	2.94	100.2	–
9-1000	1066	3.44	34.451	7.56	1.66	22	2.96	115.3	0.00
9-1200	1278	2.79	34.524	7.56	1.73	23	3.03	136.0	–
9-1500	1605	2.30	34.593	7.63	2.25	29	2.95	139.4	–
9-2000	2159	1.90	34.653	7.70	2.83	37	2.93	142.3	0.00

Table 1-1 (continued)

Station 10 28°00.2'N, 132°00.0'E (27°57.0'N, 131°58.6'E) Air Temp. 22.6 °C
Depth 2300 m Transparency 24 m Time 09:00-12:05 June 1

Sample No.	Depth (m)	Temp. (°C)	Salinity (‰)	pH	Dissolved Oxygen (ml/l)	(%)	PO_4-P (μg atoms/l)	SiO_2-Si (μg atoms/l)	NO_2-N (μg atoms/l)
10-0	0	22.88	34.729	8.14	5.02	98	0.11	0.8	0.00
10-10	10	22.85	34.741	8.18	5.02	98	0.09	1.1	0.00
10-20	19	22.52	34.759	8.16	5.06	98	0.06	0.8	0.00
10-30	27	22.00	34.781	8.18	5.07	98	0.06	0.6	0.03
10-50	45	21.35	34.827	8.16	5.11	98	0.06	0.8	0.00
10-75	67	20.31	34.909	8.13	4.88	92	0.16	3.1	0.11
10-100	88	20.06	34.947	8.14	5.42	93	0.15	2.0	0.11
10-125	110	18.92	34.931	8.12	5.06	93	0.15	2.3	0.40
10-150	132	18.73	34.920	8.14	4.99	91	0.22	2.5	0.15
10-200	175	18.20	34.895	8.12	4.97	90	0.22	3.4	0.02
10-300	260	17.42	34.888	8.11	5.00	89	0.30	7.7	0.01
10-400	350	16.28	34.752	8.04	4.41	77	0.56	16.7	0.00
10-500	441	13.82	34.558	7.98	4.18	71	0.95	25.3	0.01
10-600	618	8.86	34.232	7.86	3.50	53	1.86	47.5	0.06
10-800	830	5.03	34.261	7.64	1.85	26	2.80	90.7	–
10-1000	1043	3.52	34.401	7.55	1.43	19	3.12	118.2	0.00
10-1200	1255	2.95	34.494	7.59	1.71	23	3.09	132.8	–
10-1500	1579	2.49	34.550	7.60	2.01	26	3.14	138.0	–
10-2000	2154	1.87	34.637	7.64	2.81	36	2.91	139.0	0.00

Table 1-1 (continued)

Station 11 30°01.2'N, 132°00.8'E (30°10.7'N, 132°02.8'E) Air Temp. 21.8 °C
Depth 3700 m Transparency 26 m Time 08:40-16:50 June 2

Sample No.	Depth (m)	Temp. (°C)	Salinity (‰)	pH	Dissolved Oxygen (ml/l)	(%)	PO_4-P (μg atoms/l)	SiO_2-Si (μg atoms/l)	NO_2-N (μg atoms/l)
11-0	0	24.32	34.594	8.14	4.93	99	0.03	0.8	0.00
11-10	11	24.32	34.602	8.18	4.89	98	0.06	1.1	0.00
11-20	22	24.29	34.613	8.18	4.87	98	0.04	0.6	0.00
11-30	34	24.11	34.625	8.20	5.02	100	0.06	0.6	0.00
11-50	56	22.95	34.629	8.17	4.74	93	0.08	0.8	0.11
11-75	84	22.24	34.798	8.14	4.46	86	0.19	2.3	0.16
11-100	112	21.31	34.840	8.14	4.36	83	0.28	2.8	0.03
11-125	140	19.70	34.906	8.11	4.60	86	0.25	2.3	0.01
11-150	168	19.18	34.862	8.08	4.43	82	0.25	3.4	0.00
11-200	224	17.88	34.836	8.10	4.51	81	0.36	4.9	0.02
11-300	337	15.13	34.657	8.02	4.17	71	0.72	13.5	0.00
11-400	439	11.59	34.442	7.88	3.68	59	1.38	31.7	0.00
11-500	561	9.23	34.359	7.77	3.08	47	1.85	53.2	0.00
11-600	601	8.52	34.351	7.80	2.88	43	2.02	57.2	0.01
11-800	801	4.33	34.382	7.60	1.73	24	2.80	106.0	–
11-1000	985	3.48	34.429	7.40	1.92	26	2.92	122.4	0.06
11-1200	1105	3.13	34.476	7.44	1.65	22	3.08	130.8	–
11-1500	1389	2.61	34.539	7.48	1.92	25	3.02	138.3	–
11-2000	1860	2.08	34.611	7.52	2.57	34	2.94	142.3	0.00
11-2500	2334	1.82	(34.648)*	7.57	3.02	39	2.80	139.4	–
11-3000	2817	1.63	(34.675)*	7.60	3.08	40	2.64	135.7	0.00
11-3500	3305	1.54	34.688	7.64	3.39	44	2.63	141.7	–

* interporated value

2. Ecological studies of plankton

T. Nemoto, M. Murano, M. Terasaki, H. Lee and Y. Kihara

The outlines of the research in this cruise are summarized as follows.

1. Plankton sampling:
   (1) Routine sampling of CSK project with NORPAC net (GG54) at 10 stations.
   (2) Series of phytoplankton sampling with NORPAC net (XX13) between 0 and 150 m at 10 stations.
   (3) Zooplankton sampling with ORI-100 net and ORI-C net from the surface to 2000 m depth. 60 samples.
   (4) Bottom epibenthic plankton sampling with "Sori-net" (bottom-net) at 10 stations.
   (5) Seston sampling by filtering with Millipore ® filter HA type from the surface to 4000 m depth at 11 stations.
2. Collection and maintenance of phyllosoma larvae of lobsters:
   Many larvae of Scyllariid lobster which are dominant in the East China Sea were collected. The larva of spiny lobster was rather few in samples.
3. Collection of Apodes larvae:
   Many specimens of apodes fish larvae (Leptocephalus) were collected, however, the larvae of Japanese eel (Anguilla japonica) seemed not to be captured.

4. Investigation of food, feeding and standing volume of the stomach contents in Euphausia nana:

The standing volume of the stomach contents of Euphausia nana was measured by chlorophyll pigment value by fluoro-metric method. The respiration rate, and feeding rate using Artemia nauplii were also examined on euphausiids kept in laboratory.

5. Investigation of the role of Salps in the East China sea as the secondary grazer of the phytoplankton:

Large volume of chlorophyll pigments have been detected in the stomachs of Salpa fusiformis. And it was considered that they play a considerable part as the destroyer of the primary producer, namely phytoplankton.

6. Determination of fluoro-spectrophotometric pattern of stomach contents of zooplankton:

The stomach contents of zooplankton including bathypelagic ones were determined by a fluoro-spectophotometer. The clear indication of fresh chlorophyll a was observed in the surface zooplankton, but degraded chlorophyll pigments were also found in the stomachs of bathypelagic zooplankton. The carnivorous zooplankton sometimes contained plant pigments owing to the feeding on the herbivorous zooplankton especially in the mesopelagic layers.

7. Examination of seston by morphological and histochemical methods:

Seston samples filtered by Millipore ® filter HA type were stained with acid-fucsin, Millons reagent and Sudan black b. The size and vertical distribution of each component such as protain, lipid were somewhat

different according to locality. Fluctuation in the occurrence of stained seston with above reagents showed the different pattern of decomposition.

8. Study on the patch of zooplankton:

The sampling of the ORI-100 and ORI-C net in the surface layer clearly showed that the larger zooplankton, such as chaetognaths, salps and euphausiids forms dense patchnes. The distribution of endemic species Calanus pacificus and Euphausia nana etc, in the East China sea is particularly interesting.

3. Study on the size variation of copepoda

T. Minoda

Calanus pacificus is the most abundant species in the polar front of the northern North Pacific and adjacent Japanese waters. This species is also distributed in the East China Sea. It is well recognized that marine copepods are sensitive to small change in environmental conditions during their life history. The population in the East China Sea may be different from the polar front in the northern North Pacific. Morphological changes of development stages in C. pacificus were studied.

Vertical plankton tows were carried out through Stns. 1 to 11 with 45 cm diameter double net, 180 cm outer net made of Pylen #200 having 0.1 x 0.1 mm mesh opening, and 100 cm long inner net was made of Pylen #60 having 0.35 x 0.35 mm mesh opening, at ascending speed of 60 m/min. The vertical zones of tows were from near bottom to the surface at Stns. 1-3, and from 150 m depth to the surface at Stns. 4-7 and 9-11.

10-20 specimens of Calanus pacificus and Euchaeta sp. removed from the sample were preserved in refrigerator after dried for 10 hours at 60 ^{o}C. After bringing back the sample to the University, dried samples were weighed to estimate biomass. The remainders were preserved in 4 % neutral formalin for the study on the distribution of copepod.

In addition, some of the surface copepods were sorted from the ORI-net samples obtained through whole area of this cruise.

4. Research on the distribution of fish larvae

T. Ozawa

The distribution of fish larvae in regions of the Kuroshio Current was studied by superficial side-towing of a larvae net at 2 knots for 10 minutes. The stations were set into three series crossing the Kuroshio Current. The first series is southward of Kyushu, the second is about midline of Taiwan and Okinawa, the third is southeast of Taiwan.

Besides these samplings, the side-towing by larvae net (for the collection of saury) was performed at every night by Dr. K. Numachi. Myctophid fish caught by the net were provided to me. The detailed studies on these samples will be accomplished later.

5. Data on fish species collected by side towing with larva net (saury)

K. Numachi

Surface net hauls (NS) were carried out at every night on this cruise, to examine the distribution of the saury, Cololabis saira, in the south sea area of Japan, and to study the population of the species through the genetic compositions of polymorphic enzymes.

The net used consists of 5.5 m long filtering cone made of Nylone net, 6 × 6 mm mesh apertures, attached to a ring flame of 1.6 m in diameter. The net towed at the speed of 5 knot for 30 minutes at the side of the vessel, applying a light throwing on the front of the net. Operations were conducted by K. Numachi and K. Kureha.

Some specimens of the saury were subjected to starch gel electrophoresis on the vessel, and three genetically determined variants were found in both of malate dehydrogenase and α-glycerophosphate dehydrogenase, and four variants in esterase. All of the saury and some other species collected were frozen immediately and stored at $-20^{\circ}C$ for further examination of population, genetical, and systematical analysis.

Fish species collected were shown in Table 5-1, which were identified preliminarily by T. Ozawa for the Myctophidae and by Y. Tominaga for the other species.

Table 5-1 List of fish species sampled by surface net hauls (NS) during cruise 68-2 of the Hakkuho-Maru.

Station	Position	Time of Sampling	Surface Temperature (°C)	Species Composition	
				Species name	No. of Individuals (Body Length in mm)
NS-1	34-14.7N 138 12.9E - 34-13.5N 138-09.0E	21.03 - 21.33 15, May 1968	16.5	Cololabis saira " " Scorpaenidae larva Seriola purpuracens Myctophum sp. Myctophum asperum	67 (50 - 120) 2 (300) 20 (30) 4 (40 - 90) 4 (20 - 40) 1 (47)
NS-2	32-25.4N 133-35.5E - 32-26.0N 133-33.5E	21.18 - 21.33 21.30 - 21.50 16, May 1968	23.1	Leptocephalus Myctophum evermanni Engraulis japonica Myctophum asperum Myctophum affine Exocoetidae larva (Diacria tripinosa)	15 (65 - 80) 6 (30 - 34) 6 (20 - 30) 2 (20 - 30) 2 (18 - 28) 1 (30) 12 (10)
NS-3	32-01.2N 131-58.9E - 31-59.6N 131-58.8E	21.07 - 21.37 17, May 1968	23.5	Myctophum affine Acinacea notha Scomber tapeinocephalus Exocoetus volitans Prognichthys agoo Cololabis saira Synodontidae larva	6 (20 - 73) 2 (145 - 155) 2 (35 - 45) 1 (20) 1 (100) 1 (33) 1 (45)
	30-11.0N 130-13.7E - 30-12.1N 130-12.0E	21.05 - 21.35 18, May 1968	22.8	Exocoetus volitans Prognichthys agoo Myctophum sp. Myctophum sp. Synodontidae larva	4 (25 - 30) 3 (240 - 260) 3 (75 - 80) 1 (30) 1 (35)
NS-5	31-39.0N 127-32.1E - 31-39.0N 127-29.3E	20.35 - 21.05 19, May 1968	19.0	Cololabis saira " " Trachurus japonicus Cypselurus sp.	55 (14) 32 (26 - 40) 3 (28) 1 (250)

Station	Position	Time of Sampling	Surface Temperature (°C)	Species Composition	
				Species name	No. of Individuals (Body Length in mm)
NS-6	31-52.7N 124-08.0E - 31-52.0N 124-05.2E	21.00 - 21.30 20, May 1968	14.5	Engraulis japonica Cololabis saira Trachurus japonicus Seriola quinqueradiata	60 (84 - 118) 16 (120 - 140) 2 (30) 1 (20)
NS-7	29-48.5N 126-05.0E - 29-46.7N 126-08.2E	21.03 - 21.33 21, May 1968	17.3	Engraulis japonica " Mullidae larva Trachurus japonicus Cololabis saira " Seriola quinqueradiata	161 (22 - 30) 32 (35 - 55) 19 (30) 10 (25) 1 (104) 1 (18) 2 (20)
NS-8	28-46.8N 126-44.0E - 28-48.8N 126-41.2E	20.52 - 21.22 22, May 1968	23.3	Exocoetidae " Leptocephalus Malakichthys griseus Engraulis japonica Seriola quinqueradiata	1 (21) 5 (25 - 40) 3 (80) 2 (30) 1 (135) 1 (20)
NS-9	29-12.8N 124-30.4E - 29-11.2N 124-31.0E	21.05 - 21.35 23, May 1968	19.5	Trachurus japonicus Engraulis japonica " Mugilidae larva Synodontidae larva	29 (15 - 40) 100 (23 - 30) 4 (50 - 90) 40 (12) 3 (35)
NS-10	26-56.6N 125-04.5E - 26-54.0N 125-03.0E	21.48 - 22.18 24, May 1968	23.3	Upeneus bensasi Engraulis japonica "	40 (30 - 40) 10 (98 - 128) 2 (20 - 25)

Station	Position	Time of Sampling	Surface Temperature (°C)	Species Composition	
				Species name	No. of Individuals (Body Length in mm)
NS-11	26-04.7N 125-01.9E - 26-02.2N 125-02.3E	21.02 - 21.32 25, May 1968	25.9	Myctophum oriental	31 (20 - 38)
				Myctophum asperum	6 (66 - 72)
				Myctophum sp.	5 (18 - 35)
				Diaphus sp.	5 (19 - 28)
				Myctophum affine	3 (60 - 75)
				Myctophum evermanni	2 (18 - 23)
				Centrobranchus sp.	2 (16)
				Exocoetus monocirrhus	2 (30, 50)
				Exocoetidae larva	2 (30, 35)
				Euleptorhamphus viridisc	1 (30)
NS-12	23-04.8N 124-16.7E - 23-04.8N 124-15.9E	20.30 - 21.00 26, May 1968	26.5	Myctophum asperum	3 (21 - 78)
				Myctophum sp.	3 (30)
				Coryphaena hippurus	1 (85)
				Coryphaena equisetis	1 (35)
				Diodon holacanthus	1 (10)
				Synodontidae larva	1 (30)
				Myctophum evermanni	1 (21)
NS-13	21-55.4N 125-16.7E - 21-44.8N 125-20.2E	00.30 - 01.00 28, May 1968	27.0	Myctophum asperum	26 (15)
				Myctophum evermanni	5 (23 - 65)
				Centrobranchus sp.	5 (13 - 26)
				Myctophum affine	5 (20)
				Exocoetidae	4 (120 - 220)
				Coryphaena hippurus	2 (75 - 105)
				Myctophum orientale	2 (24, 25)
				Hemiramphus sajori	1 (85)
				Mullidae larva	1 (32)
				Ophichthyidae larva	1 (60)
				Leptocephalus	1 (80)
NS-14	22-09.0N 129-38.0E - 22-08.0N 129-41.6E	20.42 - 21.12 28, May 1968	27.0	Myctophum evermmani	2 (20)
				Centrobranchus sp.	2 (15, 16)
				Myctophum spinosum	1 (91)
				Myctophum affine	1 (39)
				Exocoetus monocirrhus	1 (35)
				Stephanolepis cirrhifer	1 (8)
				Holocentrus spinosissimus	1 (8)

Station	Position	Time of Sampling	Surface Temperature (°C)	Species Composition	
				Species name	No. of Individuals (Body Length in mm)
NS-15	22-23.0N 132-08.6E - 22-23.0N 132-10.3E	20.15 - 20.45 30, May 1968	25.9	Myctophum affine	7 (20 - 36)
				Exocoetus monocirrhus	4 (19 - 50)
				Progichthys agoo	2 (35, 44)
				Myctophum spinosum	1 (96)
				Stephanolepis japonicus	1 (13)
				Leptocephalus	1 (80)
NS-16	26-06.9N 131-52.4E - 26-09.9N 131-52.2E	23.33 - 00.03 31, May 1968	23.4	Myctophum affine	31 (30 - 70)
				Myctophum evermmani	8 (20 - 75)
				Centrobranchus sp.	3 (15)
				Myctophum asperum	1 (80)
				Leptocephalus	2 (70)
				Naucrates ductor	2 (25)
				Diaphus sp.	1 (55)
				Rhinesomus concatenatus	1 (8)
NS-17	28-03.0N 131-51.8E - 28 -03.7N 131-54.0E	20.16 - 20.46 1, June 1968	23.1	Myctophum affine	39 (17 - 63)
				Myctophum evermmani	6 (30 - 76)
				Myctophum asperum	2 (25, 28)
				Leptocephalus	79 (80)
				Exocoetus monocirrhus	1 (36)
				Pseudoblennius cottoides	1 (20)
				Scomber japonicus	1 (37)
				Stephanolepis japonicus	2 (8, 10)
NS-18	30-37.6N 132-03.8E - 30-41.0N 132-04.0E	20.36 - 21.06 2, June 1968	24.3	Myctophum affine	72 (15 - 75)
				Engraulis japonica	30 (15 - 25)
				Kyphosus larva	15 (21 - 38)
				Seriola quinqueradiata	5 (30 - 45)
				Exocoetidae larve	4 (30 - 45)
				Myctophum asperum	3 (78 - 80)
				Myctophum orientale	2 (26)
				Coryphaena hippurus	2 (80, 90)
				Pomacentrinae larva	2 (20, 38)
				Pseudoblennius cottoides	1 (48)
NS-19	31-36.2N 131-48.0E - 31-38.0N 131-50.7E			Myctophum asperum	25 (74 - 85)
				Myctophum affine	1 (72)

Station	Position	Time of Sampling	Surface Temperature (°C)	Species Composition	
				Species name	No. of Individuals (Body Length in mm)
NS-20	33-52.0N 137-16.0E - 33-53.0N 137 18.5E	20.30 - 21.00 6, June 1968	21.2	Seriola quinqueradiata Myctophum affine Myctophum asperum Mullidae larva Icticus pellucidus Coryphaena hippurus	9 (23 - 32) 6 (33 - 55) 5 (70 - 85) 3 (37) 4 (16 - 36) 1 (60)

6. Performance test of new devices and data collection of echo pattern with fish detector, for the studies of recognition and counting of the echo patterns of larger fish with computer

T. Ishii, Y. Tanaka and T. Inamura

For the analysis of population dynamics of large sized fish, it is very useful to count the number of echo patterns in the record of fish detector. But it has been difficult to recognize and count that pattern automatically without delay, because many steps of data processing are needed for these analysis. When the computer is available for that data processing, it is possible to recognize and count that echo pattern immediately.

Two new attachment devices, which were connected between fish detector (Sanken SU - 32) (pulse length; 0.7 msec, frequency; 28 kHz) and computor (Facom 270-20), were manufactured for trial. One of these is the logarithmic-amplifier (FFP-AD-I) for correcting the effect of depth in the echo level. The function of the other (FFP-AD-II) is to count the time from the emission of the ultrasound to the arrival of the echo of which the level is within the range beforeset and to send such informations to the computer.

In this cruise, fish detector survey (F) was carried out in 10 stations (F-1 F-10) and on course of the cruise, to test the performance of those devices and to collect the records of the fish detector. These records were collected at ship speed of 3 or 5 knot for about 45 minutes at each station.

It was recognized that the performances of those devices were generally at good level except a few points, and the useful data for those studies could be collected and recorded in magnetic- and paper tapes by a combination of data recorder, new devices and computer.

7. Benthic Communities and Biomass of Benthos

M. Horikoshi, S. Gamo,
M. Imajima and Y. Tominaga

For the quantitative sampling of the benthos, the Smith-McIntyre bottom samplers were set within an iron-frame, the "ORI Double Sampler Frame" (Horikoshi, M. 1968: Jour. Mar. Geol., 4 (1): 40-45), together with two Van-Dorn water samplers. The touching bottom of the frame-sampler complex were detected by an echo-sounder (Sanken Netvision Recorder: 200 KC). The transducer (-receiver) for that sounder, set originally on the bottom of the vessel at the middle point of ship-length, did not work properly, because that the object was out of the range of directional angle of the transducer, owing to the shallowness of the sea floor on the continental shelf. A transducer (-receiver) of a portable echo-sounder was hung from the aft end of the vessel, and was connected to the Sanken Netvision Recorder in the No.7 Laboratory.

The content of each sampler was divided into two equal halves on board the vessel by an iron plate. The sediment thus obtained was washed with a set of sieves (1.0 and 0.5 mm opening), and then, fixed with formalin neutralized with hexamin. Twenty-one stations were established along 3 transects, each of which run from the shallower part of the continental shelf in the East China Sea towards the shelf edge (Table 7-1). At present, one half of the content of each sampler at each station have been worked out. The wet weight of the smaller macro-benthos, classified into several animal groups, and that of the remain of the terrestrial plants are shown in Table 7-2.

In order to know the distribution and the faunistic composition of the lager macro-benthos, including demersal fish, a beam trawl (Agassiz-Sigsbee type: 3 m span) and an otter trawl (single warp: 13 m span: used only at Sta. T 12) were operated at nine stations (Stas. T 2-7, 10-12), which were located practically on the same position to those stations of quantitative bottom sampling mentioned above. In addition to these, deepsea-trawlings were made in the bathyal zone along the periphery of the continental shelf in the East China Sea at five stations, whose depth ranged from 320 to 2,150 m. The dominant and characteristic animals collected by trawling are briefly indicated in the Table 7-3.

Table 7-1 Bottom-sampling stations on continental shelf of the East China Sea (KH-68-2).

Two Smith-McIntyre samplers were set within the ORI Double Sampler Frame.

Station	Position	Depth	Note
SM 1.	31°23.3' - 128°09.9'	150 m	
SM 2.	31°36.1' - 127°39.3'	141 m	
SM 3.	31°41.6' - 127°19.4'	123 m	
SM 4.	31°42.5' - 126°48.0'	103 m	Only one sampler worked.
SM 5.	31°46.9' - 125°52.2'	70 m	Only one sampler worked.
SM 6.	31°47.2' - 125°08.7'	45 m	
SM 7.	31°50.0' - 124°32.4'	40 m	Only one sampler worked.
SM 8.	31°51.0' - 124°00.6'	42 m	
SM 9.	30°55.6' - 124°58.4'	58 m	
SM 10.	30°33.3' - 125°17.8'	62 m	
SM 11.	30°08.0' - 125°43.1'	76 m	Only one sampler worked.
SM 12.	29°52.0' - 126°00.8'	88 m	
SM 13.	29°24.9' - 126°27.9'	97 m	
SM 14.	28°40.1' - 126°48.9'	192 m	
SM 15.	30°25.6' - 124°30.6'	64 m	
SM 16.	29°51.8' - 124°29.3'	66 m	
SM 17.	29°09.8' - 124°32.0'	80 m	
SM 18.	28°28.2' - 124°50.5'	105 m	
SM 19.	28°00.4' - 124°59.5'	103 m	
SM 20.	27°23.5' - 125°00.4'	103 m	
SM 21.	26°54.1' - 124°59.8'	121 m	

Table 7-2 Wet weight of benthic animals and remains of terrestrial plants, collected on the continental shelf of the East China Sea (KH-68-2) and washed out of sediments with screen of 1 mm mesh. ($g/\frac{1}{20}\ m^2$)

Station No. / $g/\frac{1}{20}\ m^2$	1	2	3	4	5	6	7	8	9	10
Ophiuroidea	–	0.00	0.00	–	–	–	–	–	0.35	0.01
Crustacea	0.00	0.02	0.17	–	–	0.39	0.02	0.03	0.11	0.01
Polychaeta	0.07	0.06	0.43	0.03	0.00	0.16	0.29	0.08	0.05	0.15
Mollusca	0.03	0.07	0.13	0.00	–	0.02	0.69	0.09	0.08	0.01
miscel-lanea	0.00	0.00	0.00	0.00	0.01	0.01	–	0.02	0.14	–
Total	0.10	0.15	0.73	0.03	0.01	0.57	1.00	0.22	0.73	0.18
(g/m^2)	(2.0)	(3.0)	(14.6)	(0.6)	(0.2)	(11.4)	(20.0)	(4.4)	(14.6)	(3.6)
Remains of Terrestrial Plant	–	–	–	–	–	0.02	0.03	–	–	0.04

Station No. / $g/\frac{1}{20}\ m^2$	11	12	13	14	15	16	17	18	19	20	21
Ophiuroidea	–	0.04	0.79	0.00	0.00	0.16	0.10	0.04	0.03	–	0.03
Crustacea	–	0.12	0.10	0.01	0.06	0.15	0.10	0.13	0.09	0.01	0.03
Polychaeta	0.00	0.27	0.31	0.17	0.53	0.16	0.52	0.25	0.07	0.04	0.04
Mollusca	–*	0.32	0.14	0.06	0.04	0.19	0.27	0.06	0.14	0.04	0.09
miscel-lanea	0.01	0.06	0.08	0.01	0.38	0.03	0.06	0.01	0.05	0.01	0.15
Total	(0.01)*	0.81	1.42	0.25	1.01	0.69	1.05	0.49	0.38	0.10	0.34
(g/m^2)	(0.2)*	(16.2)	(28.4)	(5.0)	(20.2)	(13.8)	(21.0)	(9.8)	(7.6)	(2.0)	(6.8)
Remains of Terrestrial Plant	0.06	0.01	0.00	0.09	0.07	0.02	0.04	0.06	0.00	0.00	–

* Excluding a large bivalve of 16.49 g.

Table 7-3 Trawling stations on the continental shelf of the East China Sea and in the bathyal zone of the continental slope (KH-68-2), with notes on dominant and characteristic species of benthic invertebrates and demersal fishes.

Station	Position	Depth	Notes
T_1	31°08.4'N, 128°45.6'E -31°09.3'N, 128°47.5'E	700 m	Invertebrates—asteroideans (119), Gnathphausia longispira (27), Nephrops thomsoni (23).
T_2	31°24.0'N, 128°09.1'E -31°24.9'N, 128°07.6'E	150 m	Invertebrates—Euplectella imperialis (11), alcyonarians (12); Demersal fish—Lepidotriga (17).
T_3	31°42.7'N, 126°46.5'E -31°42.6'N, 126°44.0'E	103 m	Invertebrates—Carcinoplax longimanus (28), macrurans (20), Venus foveolata (12); Demersal fish—Chaeturichtys scistius (16).
T_4	31°50.7'N, 124°01.2'E -31°50.2'N, 124°02.5'E	42 m	Invertebrates—Metapenaeopsis (barbata-type) (129) Crangon (affinis-type) (56); Demersal fish—cynoglossids (79).
T_5	30°32.2'N, 125°17.6'E -30°31.3'N, 125°18.0'E	62 m	Invertebrates—Siphonalia filosa (with actinians) (229), Metapenaeopsis (barbata-type) (219), Carybdis bimaculata (87), Alphaeus brevicristatus (54), asteriodeans (47); Demersal fish—Chaeturichthys hexanema (many), Apogon lineatus (many)
T_6	29°23.2'N, 126°29.2'E -29°23.7'N, 126°29.5'E	97 m	Invertebrates—brachyurans (9spp., 50); Demersal fish—many spp.
T_7	28°41.7'N, 126°49.8'E -28°42.5'N, 126°.50.4'E	187 m	Invertebrates—Flabellum distinctum (92), Stephanocyatus spiniger (16), gorgonocephalans; Demersal fish—Chaunax fimbriatus, Malthopsis annulifera.
T_8	28°26.8'N, 127°09.8'E -28°28.2'N, 127°07.5'E	1,000 m	Invertebrates—Scotoplanes globosa (125), other holothurians (many), echinothuriid echinoidean (90), Propeamusium (many); Demersal fish—Coryphaenoides nasutus.
T_9	28°33.2'N, 126°57.2'E	320 m	Invertebrates—deimatid holothurian (25), Flabellum distinctum (14), Heterocarpus sibogae (4), Polycheles (2); Fish—Diaphus latus (probably mid-water species).

Station	Position	Depth	Notes
T_{10}	29°50.5'N, 124°30.8'E -29°49.0'N, 124°32.2'E	66 m	Invertebrates—plumulariids hydrozoa (125), Stellaster equestris (78), Achaeus tuberculatus (56), macrurans (80); Demersal fish—Aseraggodes kobensis
T_{11}	28°01.3'N, 124°59.0'E -28°02.0'N, 124°58.7'E	103 m	Invertebrates—Stellaster equestris (117), ophiuroidean (50), Synalpheus neomeris (20), sponge (many) bryozoan (many tubular colonies); Demersal fish—Novodon tesselatus
T_{12}	26°55.0'N, 125°00.5'E -26°56.6'N, 125°02.5'E	120 m	(Otter trawl) Invertebrates—Plicatula muricata (abundant), Chlamys vesiculosa (many), other mollusks (more than 160 spp.), Stellaster equestris (17); Demersal fish—Novodon tesselatus
T_{13}	26°03.8'N, 125°00.8'E -26°03.8'N, 125°01.0'E	1,650 m	Invertebrates—Flabellum distinctum (25), deimatid holothurians (15), Ctenodiscus (14), actiniarians (18), large pantopods; Demersal fish—Acanthonus armatus, Progadus spp.
T_{14}	25°45.8'N, 125°01.1'E -25°46.7'N, 125°02.3'E	2,150 m	Invertebrates—sponge (ca 50), Bentharca (many), Polycheles (2); Demersal fish—Venefica, Synaphobranchus.

8. Sighting records of marine mammals and sea birds

K. Kureha

In order to investigate the distribution and abundance of marine mammals and sea birds in the East China Sea, observations on their occurrences were done only by human eyes throughout the course of KH 68-2 cruise.

During the observation sighting experiment, one or two observers stayed at either the upper deck or the bridge from sunrise to sunset. Whenever the vessel was stopped, the sighting took intervals.

Occurrences of marine mammals are shown in the Table 8-1 and those of sea birds are in the Table 8-2. Generally speaking, the occurrences of those creatures during the period of the voyage were far lesser than we had expected.

Table 8-1 Sighting records of Marine Mammals

Species	Number of individuals observed	Date and Ships time	Position	Weather	Visibility (mile)	Wind direction	Wind force	Air temperature (°C)	Sea temperature (°C)
Delphinus delphis	20	May 16 14:00	32°33.3'N 134°48.8'E	b	8	NE	3	20.5	21.6
Delphinus delphis	10	May 16 14:50	32°33.0'N 134°49.3'E	b	8	NE	3	19.8	21.8
Delphinus delphis	100	May 17 10:50	32°00.4'N 131°56.9'E	c	8	SE	4	21.2	22.9
Tursiops gilli	50	May 24 16:05	27°05.5'N 125°00.6'E	c	7	SSE	5	25.0	23.5
Unidentified delphinids	few	May 26 07:30	24°48.5'N 124°59.6'E	c	7	N	3	23.8	25.5
Pseudorca crassidens	30 - 50	June 1 07:10	30°58.2'N 130°37.0'E	bc	8	NNW	2	20.7	20.1

Table 8-2 Sighting records of Sea-birds

\+ ; Single
++ ; Small flock
+++ ; Large flock

	Common name	Scientific name	Position		
			North of 30° N	30° N 25° N	South of 25°N
1	White tern	Gygis alba	+		
2	White-bellied storm petrel	Fregetta grallaria	+++,+	+	++,++,++,+,+
3	Black-footed albatross	Diomedea nigripes	++,++,++,+		
4	Bonin Petrel	Pterodoroma hypoleuca	+++,+,+++,+++,++	++,++,++	
5	Wedge-tailed shearwater	Pterodoroma pacificus	+++,++,++	+++,++,++,+,+,+, +	+++,+++,++,++,++, +

North of 30°N ; from May 16 to May 23 and from June 2 to June 6
30°N 25°N ; from May 23 to May 25 and from May 31 to June 2
South of 25°N ; from May 26 to May 31

9. Ecological study of marine bacteria

1) Ecological study of N_2 fixing bacteria and chromogenic bacteria in sea water,
2) Ecological study of microorganisms concerning nitrogen cycle in bottom mud

I. Sugahara

In order to demonstrate the vertical distribution of N_2 fixing bacteria and chromogenic bacteria in sea water, certain volume of sea water was filterated, through Millipore filter ® (type HA, pore size 0.45 μ, diameter 47 mm) and the filter was incubated on agar plate media.

On the other hand, certain amounts of muds were inoculated in liquid media (by MPN method) for the demonstration of the occurrence of ammonia oxidizing bacteria, nitrite oxidizing bacteria and N_2 fixing bacteria of bottom mud.

I could observe the occurrence of N_2 fixing bacteria in sea water in East Chinese Sea. However, I cannot obtain detailed results about them at present.

I will study some physiological properties of N_2 fixing bacteria isolated from sea water in East China Sea.

10. Distribution of heterotrophic bacteria in sea water and their biochemical activities

N. Taga, K. Sasada and O. Matsuda

Any approach has not been made up to the present in order to know the basic mode of bacterial life in the East China Sea and its adjacent region. The present investigation was performed to know the basic ecological mode of the heterotrophic bacterial community in sea water of this area.

Collection of samples. Three kinds of water sampler were used in this investigation, i.e., the Nansen's Bottle for collecting the analytical samples of biochemical elements (eg., vitamines, enzymes etc.) and the samples of direct microscopic counting of bacteria; the JZ Sampler (ZoBell, 1946*) and the ORIT Sampler (TAGA, 1968**) for collecting aseptically the microbiological samples from the surface water layer and from the vertical various depths, respectively. All of the seawater samples for microbiological researches were collected at the CSK stations shown in the accompanied chart. Plankton samples were also collected vertically from the depths of 200 meters by the NORPAC net (GG 54) at several stations in order to examine the bacterial flora attached to plankton.

Enumeration of bacterial number. By filteration, bacteria in seawater samples were collected aseptically on the sterilized Millipore ® filters (Type: HA-47 mm) on board. The inoculated filters were placed on the agar plates of Medium PPES-II (TAGA, 1968**) in Petri dishes. These inoculated plates were incubated at 20°C for two weeks before bacterial colonies on filters were counted. In order to estimate the bacterial biomass by direct microscopic counting, seawater samples were also

filtered with the Millipore ® filters (Type:GS-25 mm). Then, these filters were dried on slide glasses and clarified by placing a drop of immersion oil on them. The bacteria on these slide samples were counted microscopically by using of the phase-contrast microscope. Data on the vertical distribution of the heterotrophic bacteria in sea water at each station, determined by the cultural colony counting, are shown in Table 10-1.

Examination of biochemical activities of isolated bacteria. The bacterial colonies, grown on each of the inoculated Millipore ® filters, were purely isolated and examined separately as to the 7 kinds of biochemical properties, such as the hydrolysis of gelatin, fat or tributyrin, starch and laminaran, the decomposition of urea and dextrose and the ammonium formation from peptone. These examinations were carried out in the laboratory of the Ocean Research Institute after the cruise.

* ZoBell, C. E. (1946): Marine Microbiology. Chronica Botanica Co., Waltham, 240 P.

** Taga, N. (1968): Some ecological aspects of marine bacteria in the Kuroshio Current. Bull. Misaki Mar. Biol. Inst., Kyoto Univ., No.12, 65-76.

Table 10 - 1 Heterotrophic bacterial number in vertical layers of sea water at each oceanographic station

Depth* (m)	Bacterial No. in 100 ml of sea water									
	Station No.									
	1	2	3	4	5	6	7	9	10	11
0	1800	180	3400	1900	610	3100	250	2600	500	2300
20	1600	900	1900	1100	580	1900	550	520	350	4600
50	4600	6400	1300	650	510	2500	7000	290	1600	2100
100			5000	490	840	1500	220	450	620	1300
150				700	670	760	140	800	820	700
200				850	250	960	120	350	1100	280
400				330	170	490	5000	200	210	320
600				76	300	150	16	86	130	7200
800				1000	160	160	18	16	62	2500
1000				480	140	18	360	180	46	200
1500				340	42	84	76	900	12	88
200					4	38	76	260	8	42
3000						180	18			5
4000						100	76			

*. . . . Corrected depths of each station are shown in Table 1-1.

11. Influence of fresh water

N. Ogura

Several samples of filtered surface water were stored in a deep freezer for the estimation of the influences of the fresh water by the ultraviolet absorption method.

12. Decomposition of dissolved organic substances in the deep sea

N. Ogura

The samples of deep sea water (2000 m at Sta. V-1 and 4000 m at Sta. -7 were stored in oxygen bottles at 20 ^{o}C for the examination of the nature of organic substances present at great depths. The rate of their decomposition is estimated by measuring dissolved organic carbon and dissolved oxygen at intervals of several ten days.

13. Distribution of dissolved organic carbon

N. Ogura

Sample water from the Nansen sampler was used for determination of dissolved organic carbon (DOC) by the method of Menzel and Vaccaro (1964).

The water filtered by a Millipore ® filter HA type (5 ml), $K_2S_2O_8$ (0.1 g) and 3 % H_3PO_4 (0.2 ml) were added in a glass ampoule and sealed after inorganic carbon has been removed.

DOC was determined in the laboratory by using a infra-red gas analyzer, and the results are shown in Table 13-1.

Table 13 - 1 Distribution of dissolved organic carbon in sea water

Depth	Concentration of Organic Carbon (mg/l)									
	Sta.-1	Sta.-2	Sta.-3	Sta.-4	Sta.-5	Sta.-6	Sta.-7	Sta.-9	Sta.-10	Sta.-11
0	1.37	1.40	1.26	1.18	1.35	1.17	1.05	0.95	0.93	1.12
10	1.19	1.26	-	-	-	-	-	0.97	0.95	-
20	1.15	1.10	1.22	1.22	1.20	-	-	0.94	0.96	1.07
30	1.08	1.14	-	-	-	-	-	0.97	1.01	-
50	1.15	1.14	1.19	1.14	1.18	1.09	0.98	0.87	0.90	1.02
75			0.96	-	-	-	-	0.78	0.84	-
100			1.04	1.24	1.08	1.08	1.06	0.74	0.81	0.98
125				-	-	-	-	0.72	-	-
150				-	-	-	-	0.78	0.90	0.89
200				0.96	0.95	0.95	0.96	0.72	0.88	0.88
300				-	-	-	-	0.73	0.85	0.93
400				0.92	1.08	-	-	0.68	0.70	0.89
500				-	-	0.88	0.89	0.65	0.70	0.89
600				0.87	0.89	-	-	0.63	0.74	0.93
800				0.88	0.90	0.82	0.76	0.69	0.63	0.78
1000				0.78	0.90	0.81	0.66	0.61	0.65	0.76
1200				0.89	-	-	-	0.61	0.70	0.75
1500				0.88	0.78	0.71	0.69	0.59	0.63	0.70
2000					-	0.69	0.66	0.57	0.62	-
2500						-	0.77			0.58
3000						0.69	0.75			0.55
3500						-	0.69			0.55
4000						0.79	0.69			

precision: ± 0.05 mgC/l
dissolved organic carbon,: filtered by 0.45 μ - Millipore Filter

14. Study on the vertical distribution of total silicate and soluble silicate in the ocean

A. Kamatani

A definite volume of the sea water sampled with Van Dorn samplers from selected depths was filtered through a Millipore ® filter (HA, GS), and the seston collected on the filter was preserved in a desiccator for laboratory analysis. The samples were analyzed for the total amount of silicate by the current method. For the determination of the amount of the soluble part of silicate in the seston, the filter was suspended on the sodium chloride solution (3 %) in a polyethylene tube. The tube was dipped in boiling water for 60 minutes, and then the soluble silicate was determined by the calorimetric method.

Another set of seston samples collected with a Millipore ® filter (HA) from a large amount of sea water were prepared for the analysis of clay minerals by X-ray and/or infrared ray.

15. Vertical distribution of suspended matter in sea water

K. Nakajima

To examine the vertical distribution of seston, its chemical composition and the correlation between turbidity and total particulate matter, the total particulated matter, particulated organic carbon, particulated organic nitrogen and turbidity were measured.

1) Measurements of extinction coefficient of sea water were made by in situ NZW turbidity meter at Stas. 1-7. The results on the optical system of turbidity meter are shown in Table 15-1.

2) In order to determine the dry weight of seston, 10 liters of sea water were filtered through Millipore ® filters (Type: HA). These filters had been washed beforehand with distilled water, dried at 70 °C and weighed after one hour acclimatization in the balance room. The filters and residues were washed with 8 % ammonium formate solution and then dryed with the same manner as mentioned before in the laboratory. Weight of seston was caluculated by the difference from the original weight of filter. Data on dry weight of total seston in sea water are shown in Table 15-2.

3) In order to determine the particulated organic carbon and nitrogen, 10 to 20 liters of sea water were filtered through glassfibre filters. The filters and residues were washed with 3 % sodium chloride solution and frozen at -30 °C. Water samples were collected by Van Dorn's at CSK Stns. 1-11 from the depths of 0, 25, 50, 75, 100, 125, 150, 200, 400, 600, 800, 1000, 1500, 2000, 3000 and 4000 meters.

Table 15 - 1 Extinction coefficient of sea water

Sta. 1 Depth (m)	Extinction coefficient/m
0	0.282
10	0.327
20	0.519
30	0.753
40	0.871

Sta. 2 Depth (m)	Extinction coefficient/m
0	0.210
10	0.210
20	0.192
30	0.226
40	0.274

Sta. 3 Depth (m)	Extinction coefficient/m
0	0.145
10	0.145
20	0.138
30	0.116
40	0.135

Sta. 4 Depth (m)	Extinction coefficient/m
0	0.094
10	0.094
20	0.094
30	0.089
40	0.089

Sta. 6 Depth (m)	Extinction coefficient/m
0	0.102
10	0.101
20	0.109
30	0.109
40	0.109

Sta. 7 Depth (m)	Extinction coefficient/m
0	0.094
10	0.089
20	0.094
30	0.094
40	0.089

Table 15-2 Data on dried weight of total seston

Sta. 1 Depth (m)	Seston (mg/l)
0	0.45
10	0.56
25	0.82
40	1.56

Sta. 2 Depth (m)	Seston (mg/l)
0	0.25
10	0.21
20	0.50
30	0.39
50	0.54

Sta. 3 Depth (m)	Seston (mg/l)
0	0.25
25	0.17
50	0.28
75	0.44
100	0.34

Sta. 4 Depth (m)	Seston (mg/l)
0	0.16
25	0.14
50	0.12
75	0.15
100	0.19
125	0.12
150	0.40
200	0.07
433	0.11
573	0.08
853	0.14
1072	0.10
252	

Sta. 5 Depth (m)	Seston (mg/l)
0	0.13
25	0.11
50	0.15
75	0.17
100	0.10
125	0.07
150	0.06
200	0.05
397	0.08
561	0.07
710	0.05
880	0.15

Sta. 6 Depth (m)	Seston (mg/l)
0	0.20
25	0.11
50	0.16
75	0.16
100	0.11
125	0.16
150	0.18
200	0.08
223	0.10
484	0.09
633	0.06
323	

Sta. 7 Depth (m)	Seston (mg/l)
0	0.18
25	0.12
50	0.20
75	0.14
100	0.28
125	0.23
150	0.07
200	0.12
410	0.19
585	0.08
782	0.12
967 1014	0.08
1509	0.06
1975 1985 1995	0.03
2996	0.16
4020 4030 4040	0.14

Sta. 9 Depth (m)	Seston (mg/l)
0	0.14
25	0.19
50	0.12
75	0.11
100	0.07
125	0.07
150	0.10
200	0.09
400 408 416	0.11

Sta. 10 Depth (m)	Seston (mg/l)
0	0.17
25	0.20
50	0.41
75	0.35
100	0.12
125	0.23
150	0.10
200	0.10
359	0.06
628	0.12
840	0.11
1053	0.10
1589	0.10
2164	0.20

Sta. 11 Depth (m)	Seston (mg/l)
0	0.23
25	0.18
50	0.17
75	0.13
100	0.17
125	0.11
150	–
200	0.10
449	0.16
611	0.06
811	0.14
995	0.16
1358	0.06
1717	0.03
2281	0.18
2755	0.05
3315	0.06

16. Measurements of plant pigments and particulate organic matters

Y. Saijo

Sample waters were collected at each CSK station from depths of 0, 25, 50, 75, 100, 125, 150, 200, 400, 600, 800 and 1000 m by using a Van Dorn type twin sampler of a 40 ℓ capacity. Immediately after the sampling, 1 ℓ of sample water was filtered through a glass fiber filter and then, the chlorophyll and pheopigments were determined fluorometrically on board.

For the determination of particulate organic carbon and nitrogen, 10 ℓ of sample water were filtered through a glass fiber filter and stored in a deep freezer. The analysis will be made by an auto-analyzer (Yanagimoto, CHN-corder) in the laboratory.

Data on chlorophyll and pheopigments are shown in Table 16-1.

Table 16-1 Data on chlorophyll and pheopigments

mg/m^3

Depth	Station No. 1		2		3		4		5	
(m)	chl.a	chl.a+pheo.a	chl.a	chl.a+pheo.a	chl.a	chl.a+pheo.a	chl.a	chl.a+pheo.a	chl.a	chl.a+pheo.a
0	0.16	0.56	0.31	0.40	1.16	1.59	1.12	1.08	0.14	0.14
10			0.29	0.46						
20			0.36	0.65						
25	0.65	1.20			1.28	2.01	0.81	0.94	0.18	0.19
30			0.76	1.54						
40	0.58	1.10								
50			0.74	1.32	1.68	3.32	0.55	0.74	0.22	0.30
75					0.32	0.78	0.81	1.19	0.42	0.72
100					0.20	0.52	1.40	3.02	0.36	0.79
125							1.64	4.02	0.19	0.58
150							0.41	1.37	0.049	0.13
200							0.13	0.55	0.005	0.034

Depth	Station No. 6		7		9		10		11	
(m)	chl.a	chl.a+pheo.a	chl.a	chl.a+pheo.a	chl.a	chl.a+pheo.a	chl.a	chl.a+pheo.a	chl.a	chl.a+pheo.a
0	0.13	0.14	0.082	0.12	0.12	0.16	0.19	0.25	0.45	0.56
25	0.15	0.17	0.11	0.16	0.12	0.18	0.18	0.27	0.35	0.54
50	0.18	0.23	0.15	0.22	0.14	0.27	0.23	0.36	0.71	1.28
75	0.56	1.26	0.20	0.33	0.11	0.29	0.52	1.25	0.39	1.04
100	0.20	0.40	0.51	1.41	0.19	0.49	0.24	0.63	0.16	0.66
125	0.21	0.65	0.17	0.51	0.11	0.34	0.24	0.67	0.065	0.30
150	–	–	0.065	0.24	0.077	0.27	0.21	0.51	0.027	0.20
200	0.028	0.01	0.008	0.050	0.003	0.058	0.045	0.12	0.029	0.16

17. Studies on the chlorophyll maximum layer

O. Asaoka and Y. Saijo

Studies were made to explain the occurrence of the chlorophyll maxima in subtropical waters. During this cruise, a clear chlorophyll maximum was observed near the base of euphotic zone at the most of the CSK stations, but there was no indication that the special species are dominating in that layer. Through the incubating experiments on deck, an active growing of diatoms was observed in the water taken from the compensation depth under weak light which has similar light intensity measured at that depth in the East China Sea.

18. On the composition of the pigments in marine mud

N. Arai

It is interesting problem of the biochemistry in the sea to understand the process of the inorganic nutrients reproduction and the change of the pigments after the death of phytoplankton. To analyse the pigments in sestone a large quantity of sea water is necessary. On this problem I will try in a shore laboratory to culture much phytoplankton and to study the process of the decomposition of the pigments. The pigments in marine mud is in the stage that the decomposition of phytoplankton have considerably proceeded. On this cruise 10 marine mud samples were collected. The analyses of the pigments in these samples will be made in the shore laboratory using the chromatography.

19. Measurement of bottom current

Y. Sugimori

Geodyne's current meters were installed at 2 points on the course of the cruise, one at 31°59'N, 131°56'E and the other at 31°58'N, 131°49'E, where the velocity measured by GEK was about 2.9 knots. The movement of the surface floats suggested, however, the ground tackle were too weak. They were withdrawn after 2 hours. After modification, they were reinstalled at Sagami Bay, one at 35°02'N, 139°18'E (1350 m), and the other at 35°08'N, 139°27'E (830 m). All current meters, setting for 18 days, were withdrawn. These are the first data of bottom current in Japan with respect to depth and time.