# Preliminary Report
of
# The Hakuhō Maru Cruise KH-74-2
(N. N. Pacific Cruise)

April 30 - June 26, 1974
Northern North Pacific Ocean

Ocean Research Institute
University of Tokyo
1975

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By

The Scientific Members of the Expedition

Edited by

Toshio KUROKI

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Contents

# Introduction

The purpose of KH-74-2 cruise of R. V. Hakuhō-Maru was to find out the conditions and mechanisms of the bio-productivity in the northern North Pacific Ocean. On the going leg from Tokyo to Hawaii, three longitudinal lines (E165$^{o}$, 180$^{o}$, W165$^{o}$) of observations were decided between 40$^{o}$N and 50$^{o}$N in latitude; and on the comming back leg from Hawaii to Tokyo, the shortest line of observations along the great circle route was selected. Over these lines, there are the row of Emperor seamounts in NNW to SSE direction. Two points of rich investigations were choosen on the Suiko-Kaisan in the northern part and the Kimmei-Kaisan in southern part of Emperor Seamounts. The area over the Suiko-Kaisan has been well known among fisherman for recent years as a good fishing ground of pollack and other kinds of fish.

Observations of various abiotic and biotic characters were attempted to analyze the productivities on primary stage and secondary ones in these areas. Abiotic parameters observed include water temperature of various depths (by BT, STD and free-drifting 3 buoys system), underwater light intensity (turbidity), salinity, phosphate, nitrogen ($NO_2$-, $NO_3$-, $NH_4$), silicate and oxygen. For biotic characters, plankton samplings with various types of net at different depth layers were conducted to get phyto-plankton, neuston, zoo plankton and micro-nekton including larvae and eggs of fishes.

Several operations of deep long-line fishing gears were tried near seamounts, only to fail to catch any pollack and tunny. But, recording of seabirds distribution by sight and continuous recording of cosmic ray intensity by automatic counter of neutron were conducted through the cruise.

The cruise KH-74-2 began at the departure from Tokyo on 30th April and, containing of the 9 days stay in Honolulu (30th May - 7th June), finished at the arrival to Tokyo on 26th June 1974. Only one series of observation at the station point 40$^{o}$N 165$^{o}$E was given up because of the approach of a deep depression, and generally operations were performed satisfactory by the efforts 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. Hakuhō-Maru for their most timely co-operations and helpful assistances.

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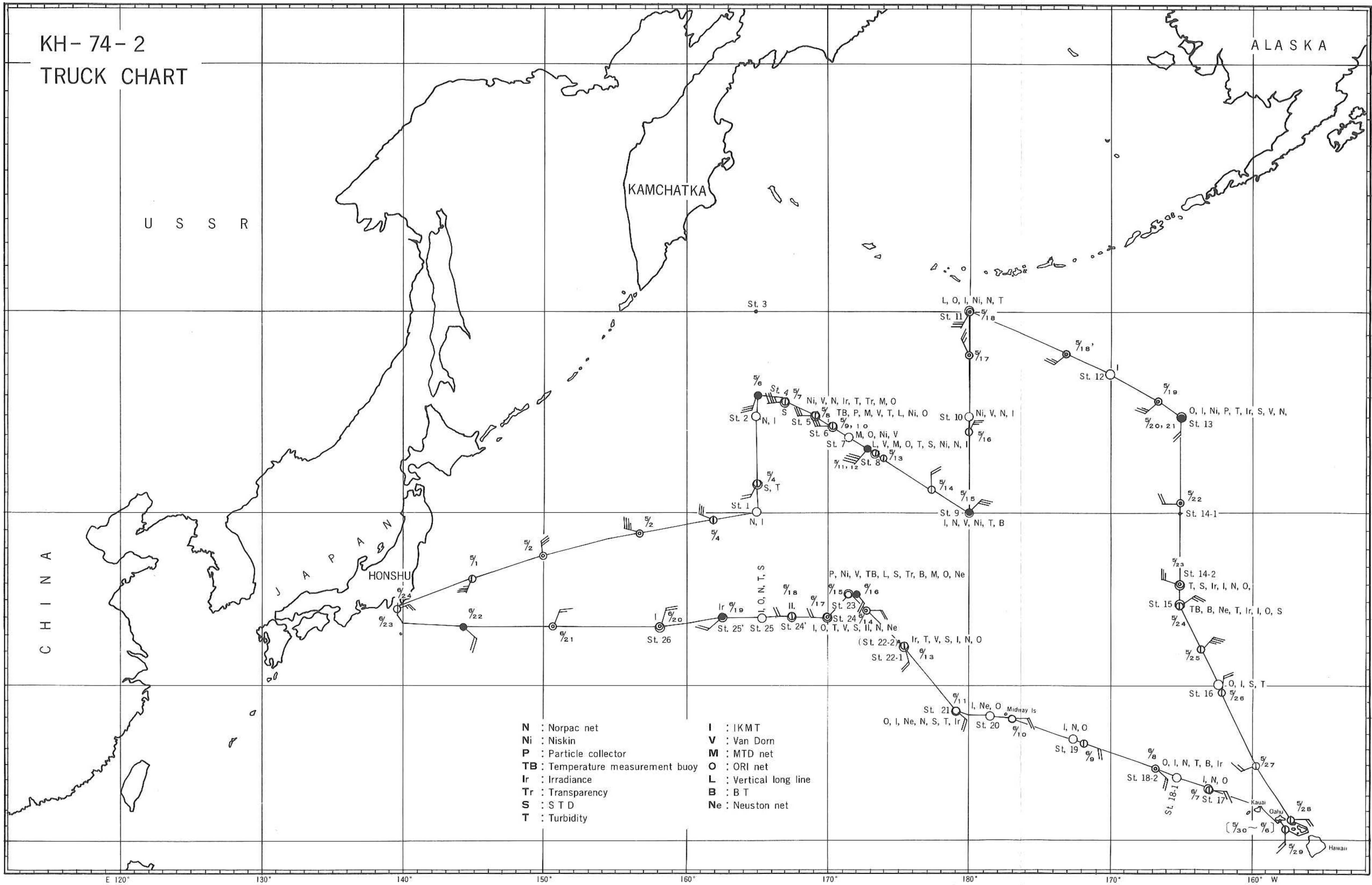
KH-74-2
TRUCK CHART
U S S R
KAMCHATKA
ALASKA
CHINA
JAPAN
HONSHU
Midway Is
Kauai
Oahu
Hawaii
St. 1
St. 2
St. 3
St. 4
St. 5
St. 6
St. 7
St. 8
St. 9
St. 10
St. 11
St. 12
St. 13
St. 14-1
St. 14-2
St. 15
St. 16
St. 17
St. 18-1
St. 18-2
St. 19
St. 20
St. 21
St. 22-1
(St. 22-2)
St. 23
St. 24
St. 24'
St. 25
St. 25'
St. 26
Ni, V, N, Ir, T, Tr, M, O
TB, P, M, V, T, L, Ni, O
M, O, Ni, V
L, V, M, O, T, S, Ni, N, I
I, N, V, Ni, T, B
Ni, V, N, I
L, O, I, Ni, N, T
O, I, Ni, P, T, Ir, S, V, N,
T, S, Ir, I, N, O,
TB, B, Ne, T, Ir, I, O, S
O, I, S, T
O, I, N, T, B, Ir
I, N, O
I, Ne, O
O, I, Ne, N, S, T, Ir
Ir, T, V, S, I, N, O
P, Ni, V, TB, L, S, Tr, B, M, O, Ne
I, O, T, V, S, II, N, Ne
I, O, N, T, S
N : Norpac net
Ni : Niskin
P : Particle collector
TB : Temperature measurement buoy
Ir : Irradiance
Tr : Transparency
S : STD
T : Turbidity
I : IKMT
V : Van Dorn
M : MTD net
O : ORI net
L : Vertical long line
B : BT
Ne : Neuston net
E 120°
130°
140°
150°
160°
170°
180°
170°
160° W
60° N
50°
40°
30°
20°

1. Measurements of the spectral energy distribution for the visible light in the North Pacific Ocean

Shigehiko SUGIHARA and Ryohei TSUDA

A comparative measurement of irradiance, attenuation coefficient and volume scattering function of sea water were carried out during this cruise in order to investigate the relationship among them and also to supply some optical data in the North Pacific Ocean where relevant one lacks.

Upward and downward irradiances were measured at the several subsurface layers by means of a irradiance meter (Ir) or a submersible monochromator (M). The former consists of interference filters to isolate a narrow spectral band while the latter, a grating grid with the wedge type interference filter.

Vertical distribution of the extinction coefficient of the water was continuously measured down to about 80 m depth by means of in situ turbidity meter which light path was 50 cm long. A red glass filter was employed to limit the incident light to a narrow band centered at a wavelength about 635 nm.

The light scatterence measurements were conducted with a light scatterence photometer on samples drawn from the Niskin or Van Dorn bottles. A cylindrical cell was employed for measuring an angular distribution of the scatterence between $25^{\circ}$ and $140^{\circ}$. Blue and green interference filters were employed to obtain the narrow bands of the spectra.

The stations where the measurements of the irradiance and turbidity were made are as follows.

Table 1. Stations, turbidity and irradiance measured

| Station | Date | Time | Meter |
|---|---|---|---|
| 5 | 5/8 | 10:31-10:50 | Turbidity meter |
| | | 11:05-11:43 | Irradiance meter |
| 6 | 5/9 | 14:30-14:50 | Monochromator |
| 8 | 5/13 | 09:38-09:45 | T. |
| 9 | 5/15 | 12:01-13:42 | T. |
| 10-1 | 5/16 | 10:10-10:27 | T. |
| | | 10:27-11:27 | Ir. |
| 11 | 5/18 | 09:10-09:40 | T. |
| 13 | 5/20 | 09:44-11:06 | T. and M. |
| 14-2 | 5/23 | 12:36-12:55 | T. |
| | | 13:04-13:43 | Ir. |
| 15 | 5/24 | 12:10-12:40 | T. |
| | | 12:47-13:30 | M. |
| 16 | 5/26 | 10:13-10:23 | T. |
| 18-2 | 6/8 | 10:55-11:05 | T. |
| | | 11:11-11:45 | Ir. |
| 21-2 | 6/11 | 11:41-11:55 | T. |
| 22-1 | 6/13 | 14:40-15:03 | T. |
| | | 12:54-13:39 | M. |
| 23 | 6/15 | 13:05-13:29 | T. |
| 24 | 6/17 | 14:17-14:53 | T. |
| | | 13:35-14:15 | M. |
| 24-1 | 6/18 | 09:57-10:43 | M. |
| 25 | 6/19 | 00:30-00:40 | T. |
| 25-1 | 6/19 | 13:06-13:40 | M. |

## 2. Relationship between the structure of water mass and the turbidity distribution

Masahiro KAJIHARA and Hideo MIYAKE

### Purpose

Turbidity in seawater is one of the index showing the characteristic nature of water mass. On the cruise KH-74-2, measurements of the vertical distribution of turbidity were attempted to reveal the structure of water mass and its mixing and transport processes, in connection to hydrographic survey and to chemical and biological studies.

### Apparatus and observation

Measurements of turbidity were carried out at 14 stations by two types of the turbidity meter. One is the regular type of a single beam with a lens-pinehole system, which is lowered with an underwater cable. This was used for obtaining the fine structure of turbidity in shallow layer. The other is newly designed, in order to enable the measurement down to 5000 m depth. On this cruise, however measurements were conducted to 1000 m depth. In essence, the latter is assembled with three parts — the main body of the turbidity meter consisting of a light source and a light detector, a depth meter and a recorder. Outputs from the light and the depth detectors are recorded in magnetic tapes after the amplitude modulation, and the data are reproduced by using a X-Y recorder on board. The schematic diagram of recording system is shown in Fig. 1. The records of turbidity are in process of the analysis.

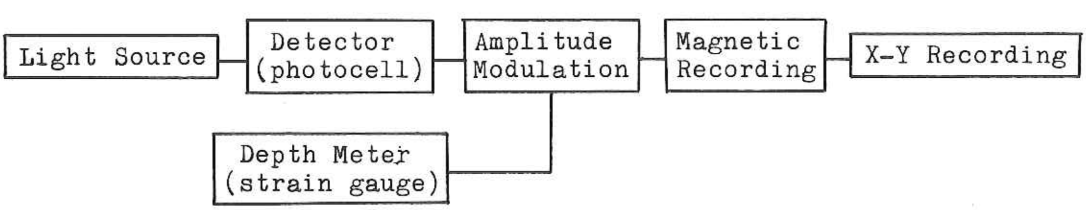


Fig. 1 The schematic diagram of recording system of turbidity

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

Wataru SAKAMOTO and Tadashi INAGAKI

It is necessary to know the process of water mixing not only with physical interest but also for the biological subject, because the reproduction of plankton and forming fish school are dependent on those mixing conditions. To analyze the mixing process and diffusion of water mass in large scale turbulence in the open sea, it is convenient to use free-drifting buoys system. One of the buoys in which contain two channels tape recorders, transformers of thermistor signal and batteries is connected respectively with 150 m length thermistor chain and rinked to radio-beacon and radar-reflector with rope. (Cf. Preliminary Report of KH-71-4). Two of them were used at St. 15 and St. 23 separated one mile apart. Each of them did not be fixed but be separated freely and drifted. Both of the experiments were continued about 18 hours.

The records of temperature fluctuations are under analyzing.

## 4. Assimilation of inorganic nitrogen in phytoplankton

Hiroshi HASUMOTO

The samples were collected by Norpac net (xx13) or bucket at stations 17 and 25. Trichodesmium colonies and Ethmodiscus cell were transferred into a glass bottle with addition of N-labeled nitrate and incubated for 2 or 3 hours. After the incubation, these samples were washed with the sterile sea water and inspected by microscope on board and took microphotographs. These samples were collected on G.F. filters and stored in frozen conditions. Mass spectrometry was made later of N-analysis by E. Wada.

Table 2. Data of assimilation

| Station No. | Sample No. | Genus. | Nitrogen (ng-at N/h) |
|---|---|---|---|
| | | | (for a colony) |
| 17 | 1 | Trichodesmium | 0.11 |
| | 2 | " | 0.31 |
| | 4 | " | 0.12 |
| | 5 | " | 0.07 |
| | 6 | " | 0.10 |
| | 7 | " | 0.25 |
| | 9 | " | 0.01 |
| | 11 | " | 0.05 |
| | | | (for a cell) |
| 25 | 1 | Ethmodiscus | 0.12 |
| | 2 | " | 0.78 |

## 5. Quantity and size distribution of suspended particulate matter

Katsutoshi KIDO

The cycle of nutrients and other chemical elements in the sea is affected by the behavior of the suspended partioulate matters, e. g. production, decomposition, and transportation of it. The purposes of this study are to determine the concentration of particulate matter by filtering method and Coulter Counter method and to determine the size distribution of particulate matter.

Seawater of 2 to 10 liters was filtered by using the Millipore HA type (0.45 μm pore size). Before use, the filters were washed twice in redistilled water at 60°C, and then dried and weighed.

Particle size of suspended matter in seawater was determined by using a Model B Coulter Counter fitted with a 100 μ aperture. Calibration was against mono disperse Ragweed Pollen particles (19.5 μ) provided by the courtesy of Dr. E. Matsumoto, Geological Survey of Japan.

209 particulate samples were obtained from surface water (55 samples) and subsurface water (154 samples from 9 stations).

The data of surface samples are shown in the Table 3.

Table 3. Data of seston quantity

Particulate matter (seston), temperature, and salinity in the surface water.

| Sample | Location | Depth (m) | Temperature (°C) | Salinity (‰) | Seston (mg/l) |
|---|---|---|---|---|---|
| 22-A-30 | 35°01.5'N<br>140°20.2'E | 3.5 | 18.3 | 34.672 | 1.30<br>0.70 |
| 08-M- 1 | 35°52.2'N<br>143°05.9'E | 3.5 | 20.0 | 34.802 | 0.61<br>0.61 |
| 20-M- 1 | 36°44.4'N<br>146°11.6'E | 3.5 | 15.0 | 34.484 | 0.72<br>0.76 |
| 08-M- 2 | 37°23.2'N<br>149°06.1'E | 3.5 | 13.8 | 34.310 | 1.04<br>1.12 |
| 20-M- 2 | 38°05.9'N<br>152°07.0'E | 3.5 | 13.1 | 34.469 | 0.74<br>0.69 |
| 08-M- 3 | 38°41.7'N<br>155°14.1'E | 3.5 | 12.7 | 34.462 | 0.40<br>0.42 |
| 20-M- 3 | 39°12.6'N<br>158°40.1'E | 3.5 | 12.5 | 34.428 | 0.48<br>0.40 |
| 08-M- 4 | 39°37.5'N<br>161°20.2'E | 3.5 | 11.8 | 34.413 | 0.52<br>0.42 |
| 20-M- 4 | 39°57.3'N<br>164°39.3'E | 3.5 | 12.9 | 34.501 | 0.39<br>0.28 |
| 08-M- 5 | 41°18.2'N<br>165°06.3'E | 3.5 | 6.8 | 33.634 | 0.46<br>0.36 |
| 20-M- 5 | 43°08.1'N<br>165°01.1'E | 3.5 | 6.2 | 33.534 | 0.36<br>0.40 |
| 08-M- 6 | 45°08.9'N<br>165°05.3'E | 3.5 | 4.4 | 33.324 | 0.53<br>0.51 |
| 20-M- 6 | 45°49.8'N<br>165°37.8'E | 3.5 | 6.3 | 33.080 | 0.33<br>0.38 |
| 08-M- 7 | 45°49.6'N<br>167°27.3'E | 3.5 | 4.0 | 33.077 | 0.47<br>0.37 |

Note: The water of 3.5 m was taken from the ship's bottom.

(Table 3, continued)

| Sample | Location | Depth (m) | Temperature ($^oC$) | Salinity (‰) | Seston (mg/l) |
|---|---|---|---|---|---|
| 20-M- 7 | 45°44.3'N<br>166°58.7'E | 3.5 | 5.6 | 33.055 | 0.36<br>0.46 |
| St. 11 | 49°59.8'N<br>179°59.0'W | 0 | 4.0 | 32.802 | 0.33<br>0.36 |
| St. 12 | 47°05.8'N<br>170°01.3'W | 0 | 5.6 | 32.732 | 0.28<br>0.29 |
| St. 15 | 34°55.8'N<br>164°57.8'E | 0 | 18.6 | 34.525 | 0.40<br>0.43 |
| St. 16 | 29°49.0'N<br>162°21.3'E | 0 | 22.9 | 35.332 | 0.35<br>0.22 |
| 01-M-27 | 27°02.6'N<br>160°41.9'E | 3.5 | 24.2 | 35.247 | 0.66<br>0.11 |
| St. 17 | 23°26.4'N<br>162°55.6'E | 0 | 25.2 | 35.198 | 0.24<br>0.17 |
| St. 18-1 | 24°09.2'N<br>165°13.0'E | 0 | 26.4 | 34.893 | 0.15<br>0.17 |
| St. 18-2 | 24°28.8'N<br>166°11.2'E | 0 | 25.7 | 35.332 | 0.23<br>0.15 |
| St. 19 | 26°40.0'N<br>172°25.4'E | 0 | 25.7 | 35.335 | 0.18<br>0.18 |
| St. 20 | 28°07.3'N<br>178°25.0'W | 0 | 25.4 | 35.250 | 0.19<br>0.14 |
| St. 21-1 | 28°14.7'N<br>179°41.0'E | 0 | 24.6 | 35.225 | 0.17<br>0.15 |
| St. 21-2 | 28°28.1'N<br>179°09.7'E | 0 | 24.4 | 35.108 | 0.14<br>0.16 |
| St. 22-2 | 32°29.0'N<br>175°15.8'E | 0 | 21.6 | 35.171 | 0.14<br>0.18 |
| St. 24 | 34°00.9'N<br>169°58.8'E | 0 | 18.4 | 34.397 | 0.31<br>0.29 |
| 10.5-J-18 | 34°04.7'N<br>167°30.7'E | 0 | 18.1 | 34.614 | 0.25<br>0.20 |

(Table 3, continued)

| Sample | Location | Depth (m) | Temperature (°C) | Salinity (‰) | Seston (mg/l) |
|---|---|---|---|---|---|
| St. 25 | 34°05.9'N<br>165°35.0'E | 0 | 18.3 | 34.534 | 0.24<br>0.40 |
| 13-J-19 | 34°02.5'N<br>162°38.6'E | 0 | 18.8 | 34.699 | 0.25<br>0.26 |
| St. 26 | 33°33.2'N<br>158°14.2'E | 0 | 20.6 | 34.773 | 0.35<br>0.17 |
| 09-J-21 | 33°35.8'N<br>151°58.9'E | 0 | 22.9 | 34.594 | 0.23<br>0.23 |
| 08-J-22 | 33°34.7'N<br>145°29.9'E | 0 | 22.1 | 34.619 | 0.17<br>0.22 |
| 08-J-23 | 34°19.4'N<br>139°29.4'E | 0 | 23.7 | 34.581 | 0.16<br>0.15 |
| 12:50-J-23 | 34°59.0'N<br>139°43.1'E | 0 | 22.4 | 33.741 | 2.12<br>1.86 |

## 6. Analysis of lipids in sea water and comparison between two processes of determination of dissolved organic carbon

Naoji FUJITA

### 1) Analysis of lipids in sea water

Sea water samples (about 50 l) taken at nine stations (Sts. 1-2, 10, 11, 13, 16, 18-2, 21-2, 24, 26) were filtered through Whatman GF 83 filter. Each filterpad was placed in a glass stoppered test tube and 20 ml methanol-chloroform (1:1) were added. The tubes were stored in dark place. The filtrate was adjusted to pH 2 with hydrochloric acid and an aliquot was transferred to a 50 l glass separatory funnel. After the addition of 200 ml chloroform, a extraction was done by agitation using a labo-stirrer. After 15 minutes agitation, the two phases produced were permitted to separate; the chloroform phase was transferred to a beaker and the sea water was removed. Then the chloroform in the beaker and another aliquot of the sample were transferred to the separatory funnel, and thus the extraction was repeated 8 times using the same solvent. The final extract was put in a glass stoppered dark bottle which was filled with $N_2$ gas in stores for later analysis. Analysis of these extracts is now under progress in our (Tohoku Univ.) laboratory by the use of column, thin-layer and gas chromatography.

2) Comparison between two processes of determination of dissolved organic carbon

The sea water samples taken from 0-4000 m layers at four stations (Sts. 6, 9, 13, 23) were filtered through Whatman GF 83 filters. The filtrates were processed with two different methods of pre-treatment for the determination of dissolved organic carbon (method (a) and method (b)).

(a) This is the method originally by Menzel and Vaccaro (1964).

Five ml of the filtrate were placed in glass ampoules with potassium persulfate and 3 % phosphoric acid. The sample was bubbled for 3 minutes with $N_2$ gas to remove inorganic carbon dioxide and the ampoule was immediately sealed with propane torch.

(b) This method is a recent modification of above method (Sharp 1973).

A 30 ml aliquot of the sample was put in a glass beaker with 0.05 ml syruppy phosphoric acid followed by bubbling with $N_2$ gas for 5 minutes. After bubbling, a 5 ml aliquot of the sample was transferred into a glass ampoule with 0.2 g potassium persulfate, and the ampoule was purged briefly with $N_2$ gas and sealed. Analysis of these samples was done by the use of an infrared gas analyser.

Results of analysis of these samples for dissolved organic carbon by method (a) are given in Fig. 2.

Mean of standard deviations among triplicate analysis was 0.045 mgC/l in method (a) and 0.033 mgC/l in method (b). Mean of the differences of results between the two methods was $0.007 \pm 0.016$ mgC/l being smaller than the variation among triplicate analysis.

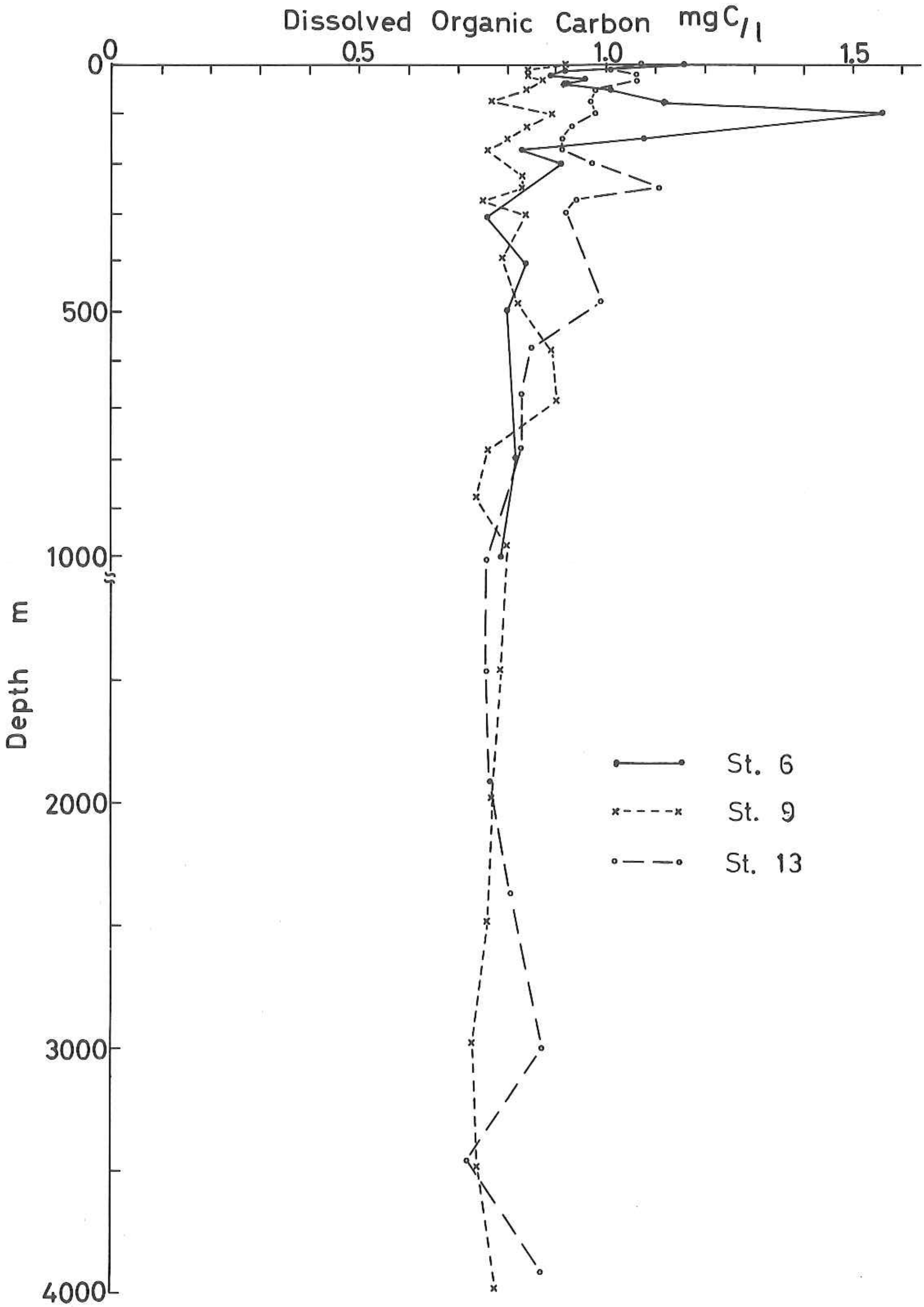


Fig. 2 Vertical profile of dissolved organic carbon.

7. Distribution of particulate protein and protease activity involved in seston

Tsuneo KUME and Nobuo TAGA*

It has been known that most of marine bacteria possess a proteolytic property. However, not enough is known about the actual activity of these proteolytic microorganisms in marine *in situ* environment. Such information is needed to elucidate certain parts of biological processes and biochemical cycles in the sea. In this cruise some observations were made to assess approximately the strength that protease exuded from such proteolytic microorganisms in marine environment catalyze the degradation of sestonic protein *in situ*.

Sea-water samples for the determinations of particulate protein and protease activity in seston were collected vertically by Van-Dorn samplers from various depths at St.6 (0 - 1000 m), St.9 (0 - 4000 m), St. 13 (0 - 4000 m), St.23a (0 - 1500 m) and St.23b (0 - 500 m). These samples were filtered through glass fiber filters (Whatman GF/C) immediately after their collections on board and the particulate samples on their filters were stored at -20°C until the time of their analyses.

After the cruise the analyses of the stored samples are now to be continued.

8. Vertical distribution of particulate organic carbon and downward flux of particulate matter

Satoshi NISHIZAWA* and Kazuo ISEKI

Recently, zooplankton fecal pellets have been considered to play an important role to convey nutritious materials from the surface to deep layers. The purpose of this studies is to observe directly the downward flux of particulate matter, in particular of fecal pellets in natural oceanic conditions.

The collector used, is a polyethylene, 1 m long and 0.25 $m^2$ cross section (top mouth). The bottom of the funnel is connected with a tubing, 2 cm in diameter, which collects falling particles. In the tubing was

---

* Not aboard

added about 20 ml formalin solution to prevent decomposition of particulate matter collected.

The mooring arrangement was shown in Fig. 3. The equipment was suspended in the sea water down to 900 m depth and drifted freely for a couple of days. The observations were performed at Stas. 6, 13 and 23 (Table 4).

A considerable amount of large, green pellets was collected from 200 m and 900 m depths at Sta. 13, and most of the particles have diameters greater than 1 mm. The pellets from 200 m depth was found very fresh, showing no sign of degradation. These material looked very similar to feces voided from <u>Salpa</u>.

Herbivorous plankton are continually grazing small particles and voiding large sized feces in sea water.

These large particles are considered to have high sinking rates, and would be potentially important in transporting nutritious material to deep layers.

Table 4. Particle collector record

| Sta. | Date | Time | Location | | Depth (m) |
|---|---|---|---|---|---|
| | | | Lat. | Long. | |
| 6 | May 9 | 0945 | 44°31.0'N | 170°13.5'E | 700 |
| | May 10 | 1200 | 44°30.1'N | 170°16.6'E | |
| 13 | May 20 | 0813 | 44°58.9'N | 164°59.6'W | 200, 900 |
| | May 21 | 1310 | 45°01.1'N | 164°56.5'W | |
| 23 | June 14 | 2145 | 35°50.5'N | 171°12.0'E | 200, 900 |
| | June 16 | 1736 | 35°48.1'N | 171°51.3'E | |

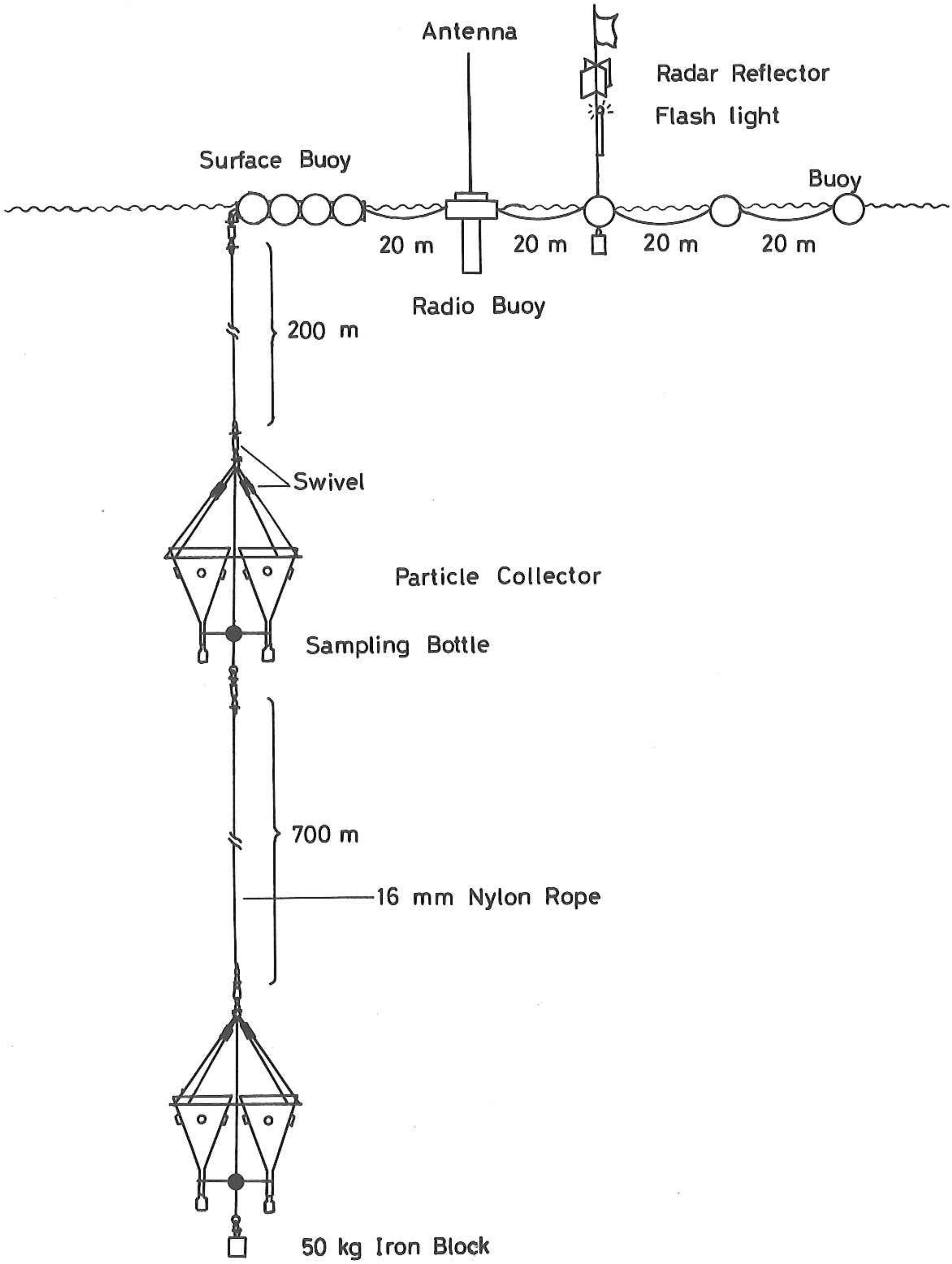


Fig. 3 The mooring arrangement for a set of particle collector.

## 9. Study of Patchiness of Pelagic eggs

Katsumi MATSUSHITA

One of the purposes of this study is to test two methods of continuous sampling in order to investigate the characteristics of patchiness of pelagic eggs.

One of the methods is surface horizontal haul with NORPAC net (mesh size 0.33 mm, ring diameter 45 cm) equipped with a flowmeter at 2 knots speed. Then, two identical NORPAC nets were used in alternation for every 5 minutes during 2 - 3 hours at each station. This method was carried out at 18 stations (see Fig. 4). The average frequence of tow at one station were about 16. The volume of filtered water was estimated by a flowmeter. The length of one tow was about 300 m. The results of NORPAC net tow sampling data are now being examined.

The other method is to filter the pelagic eggs from the sea water which was pumped up from the ship bottom layer (see Fig. 5). This method was carried out during cruise continuously. Then, the time of one sampling fraction is mainly 3 - 6 hours and the number of the fraction during cruise are 173. The number of collected eggs per unit volume at each fractions is shown at Fig. 4.

Situation of the distribution of pelagic eggs at the North Pacific Ocean are understood from Fig. 4, then, it is thought that the characteristics of the NORPAC net tow stations are understood.

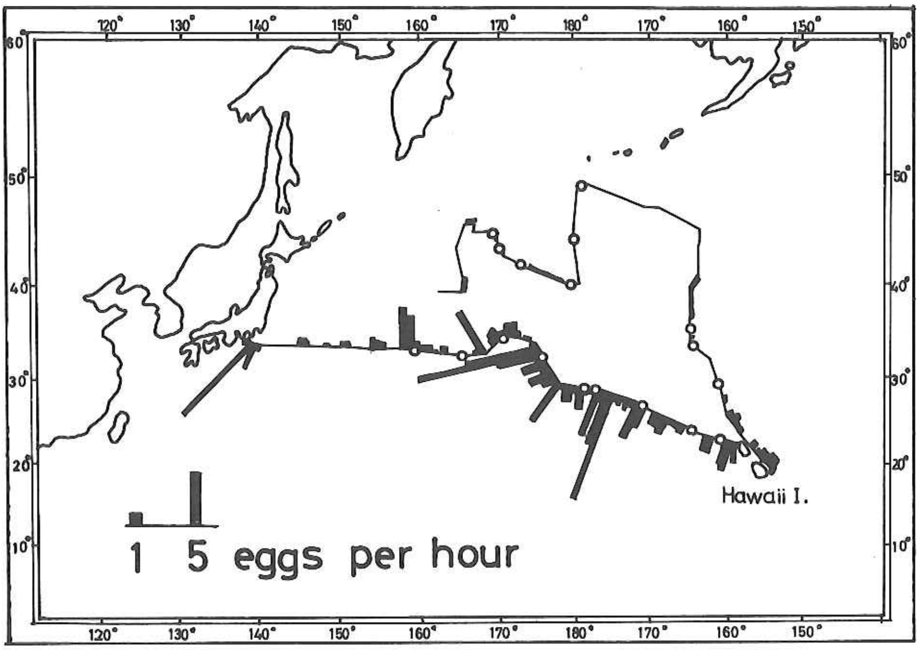


Fig. 4 Distribution of the pelagic eggs at the North Pacific Ocean. NORPAC net tow stations are indicated o mark.

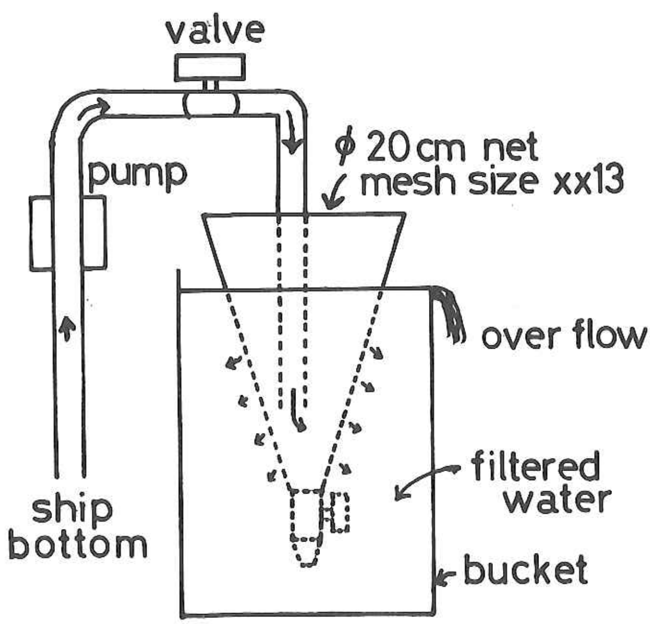


Fig. 5 Continuous sampling method. This method is to filter the sea water which is pumped up from the ship bottom.

## 10. Microplankton Communities

Akira TANIGUCHI and Kazumasa HIRAKAWA

To identify phytoplankton and microzooplankton species and to count their individual number, a 1000 ml aliquot of each sea water sample collected at 10 depth layers from the surface down to 200 m by routine Niskin bottle casts was preserved by adding the Lugol-Eosin solution. The samplings were made at Sts. 5, 6, 7, 8, 9, 10, 11, 13 and 23.

Plankton in the preserved water samples will be concentrated by gentle withdrawing the supernatant water with a siphon into a few ml of water to be offered to microscopic examinations.

1) Vertical distribution of zooplankton

Four series of zooplankton samplings a day with the Motoda closing horizontal tow nets (MTD Nets) down to 500 m at several stations were designed to observe vertical distribution and migration of zooplankton in relation to hydrographic structures of the area around the Emperor Sea Mountains. Because of rough sea condition, only two complete samplings at Sts. 8 & 23, and additional 4 series of samplings scattered to Sts. 5, 6 & 7 were made. Wet weight of samples was measured on board and expressed in gram wet weight per a haul of which duration was adjusted to 30 minutes. A Depth Distance Meter was mounted at triangular frame of the deepest net to estimate the depth of tow.

The vertical distribution of total zooplankton biomass in wet weight revealed the formation of two structural maxima of the zooplankton communities. Among the zooplankton captured at Sts. 5 and 6, copepods (Calanus cristatus, Calanus plumchrus, Eucalanus bungii bungii and Metridia pacifica etc.) were most abundant, followed by chaetognaths, euphausiids, medusae, ostracods, amphipods and mysids. The first three groups of them (copepods, chaetognaths and euphausiids) occupied 80 % or more of total biomass. On the other hand, tunicates (Salpa sp. and Doliolum sp.) characteristically dominated as over the 95 % of total biomass at Sts. 7, 8 and 23.

2) Vertical distribution of juvenile copepods

To observe vertical distribution of small-sized juvenile copepods, which may be unable to be caught by the MTD nets, seawater samples were collected at the stations where the net tows were done.

Approximately 20 l of seawater were taken by a 25-l Van Dorn water sampler, just before or after horizontal tows with MTD nets at the depths of 0, 10, 20, 30, 50, 75, 100, 150, 200 and 300 m at Sts. 5, 6, 8 and 23, and the depths of 0, 10, 50, 100, 200 and 300 m at Sts. 5 and 6.

The fresh sample (seawater) was filtered through a double plankton net consisting of an outer net (26-cm in mouth diameter, 25-cm long, 0.04-mm x 0.04-mm mesh openings) and an inner net (26-cm in mouth diameter, 10-cm long, 0.1-mm x 0.1-mm mesh openings) on board. The catches of the inner and outer nets were rinsed carefully with the filtrate into separate bottles and fixed in approximately 5 % of neutral formalin seawater. One l of the filtrate was also preserved by adding the Lugol-Eosin solution.

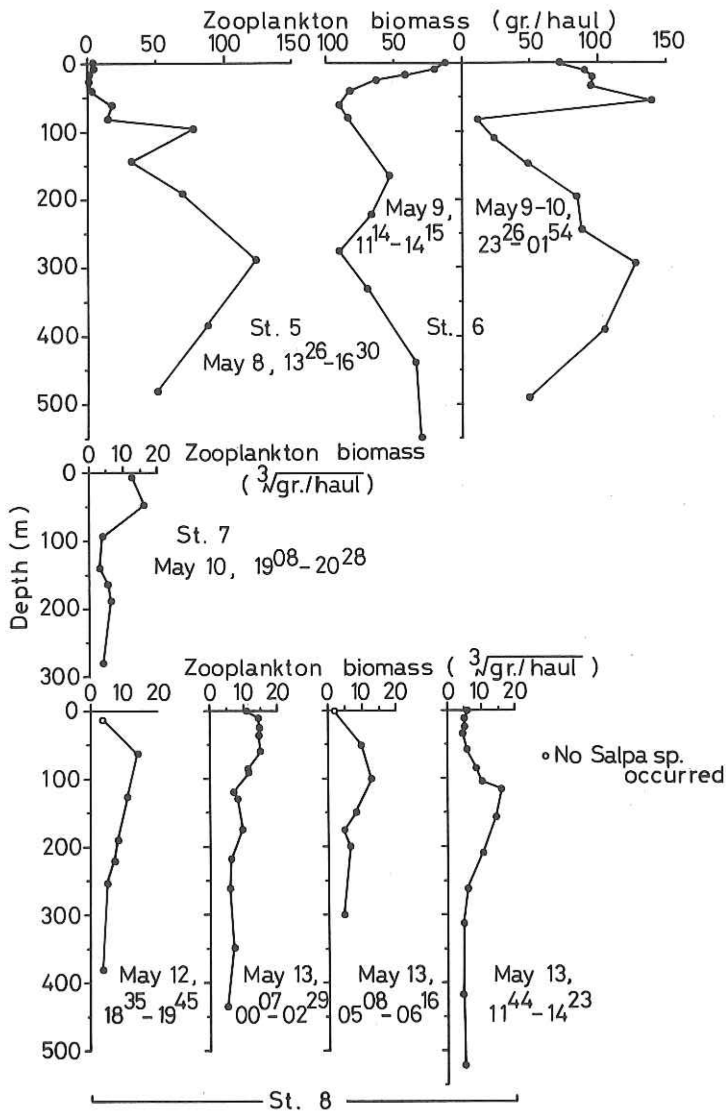


Fig. 6-1 Vertical distribution of zooplankton biomass observed by the MTD nets tows

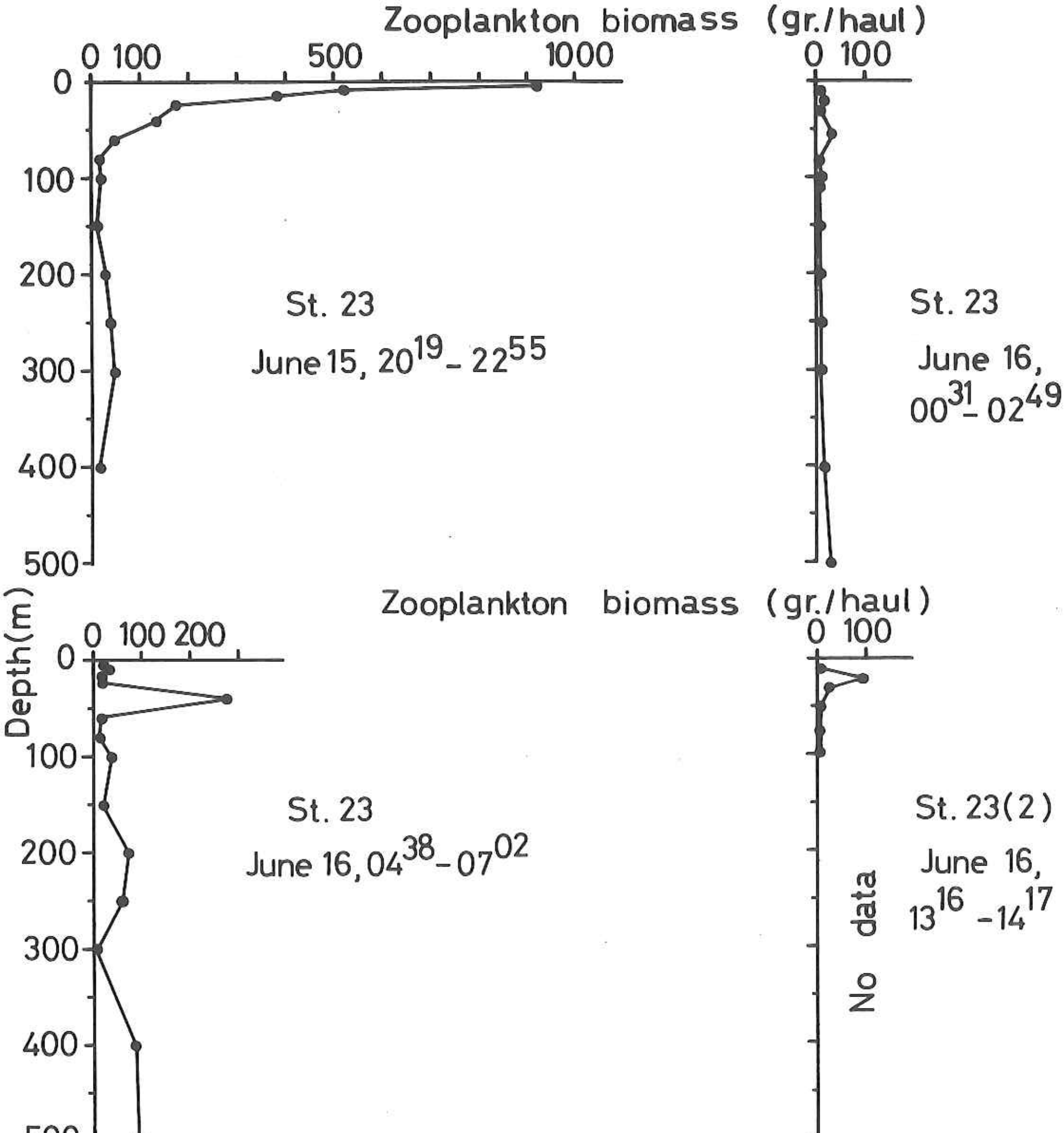


Fig. 6-2 Vertical distribution of zooplankton biomass observed by the MTD nets tows

## 11. Studies on structure and function in the ecosystem of subarctic water in the North Pacific Ocean

Tokimi TSUJITA, Tsuneo NISHIYAMA and Mitsuo FUKUCHI

1) Purpose of study

Ecological clarification of biological productivity was intended in higher trophic level of the ecosystem of the northern and central North Pacific Ocean. On Cruise KH-74-2, community structure at surface and mid-layer was analyzed with regards to species composition, biomass comparison and their circadian changes in zooplankton, micronekton and larval fish. To make clear the energy flow in the community, food chain, caloric values and respiratory metabolism were also investigated. Neuston was obtained as to find its role in the ecosystem of surface layer in the North Pacific Ocean.

2) Works and procedures on board

The works and procedures on board were tentatively divided into the following four items.

(1) Zooplankton and fish larvae samplings at surface layer

Horizontal surface tow was made by using the ORI-100 net (160 cm in mouth diameter, 750 cm in length and 1 mm mesh aperture) at various 18 stations. The net was towed at the speed of 2 knots for 20 or 30 minutes. Samples obtained were preserved in 5 - 10 % formaldehyde solution for taxonomical study. Prior to the preservation, some fresh organisms were taken from the samples and stored in a deep freeze for caloric and lipid analyses. The data on samplings and weight of sample per haul are shown in Table 5-1.

(2) Zooplankton and micronekton samplings at mid-layer

To obtain micronekton at mid-layer, oblique tow was made from 800 m depth to surface by using the ORI-100 net described above at 8 stations. The treatment of samples was done in the same manner as described above. The data on samplings and weight of sample per haul are given in Table 5-2.

(3) Neuston samplings

Neuston samplings were tried with use of a neuston net specially designed by Dr. Y. Komaki (called "Hopping Boy", 30 x 60 cm in square form of frame, 180 cm in length and 0.5 mm mesh size; Komaki and Morioka, 1974). Locations of sampling were chosen at 9 stations in the central North

Pacific Ocean. The net was towed at the speed of 2 to 4 knots for 10 to 15 minutes. Simultaneously a MTD-net (0.5 mm mesh size) was cast just below the neuston net as to obtain the organisms at subsurface layer. Cf. Table 5-3.

(4) Respiratory metabolism of fish larvae

Measurements of routine metabolism were conducted on larvae form of three species of fish, i.e. Atka mackerel (Pleurogrammus monopterygius), Yellow sculpin (Hemilepidotus jordani) and lantern fish (Centrobranchus sp.). The fish larvae were caught with a surface drift net (58 cm in diameter, 180 cm in length and 0.5 mm mesh size) in the northern North Pacific Ocean. The experimental equipments used were consisted of two same-sized bottles with 2 littre in volume; one was used for experiment and the other control. After being rested more than 24 hours in an aquarium, the fish larvae were placed in an experimental bottle for 1 or 4 hours. The oxygen consumption was calculated by the difference of oxygen concentration between the control and experimental one. The oxygen content was determined by a modified Winkler's method. The data on results of measurements on respiratory metabolism are presented in Table 5-4.

Table 5-1 Data on zooplankton and fish larvae samplings by ORI-100 net at surface layer.

| Station | Date | | Ship's time | Position | | Sample weight (wet:g) | Sample No. |
|---|---|---|---|---|---|---|---|
| | | | | Latitude | Longitude | | |
| 5 | May | 8 | 1704-1734 | 44°49.7'N | 169°22.0'E | 9.5 | 74101 |
| 5 | May | 8 | 2045-2115 | 44°58.0'N | 169°16.6'E | 759.6 | 74102 |
| 6 | May | 9 | 0355-0415 | 44°26.5'N | 170°31.5'E | 23.0 | 74103 |
| 7 | May | 10 | 1938-1958 | 43°58.0'N | 171°31.2'E | 354.0 | 74104 |
| 8 | May | 12 | 1900-1920 | 42°59.2'N | 173°20.7'E | 77.4 | 74105 |
| 8 | May | 12 | 2334-2354 | 42°57.4'N | 173°24.8'E | 237.1 | 74106 |
| 8 | May | 13 | 0535-0555 | 42°52.0'N | 173°28.7'E | 46.5 | 74107 |
| 11 | May | 18 | 0215-0235 | 50°03.0'N | 179°58.7'W | 163.0 | 74108 |
| 11 | May | 18 | 1053-1113 | 50°00.3'N | 179°56.0'W | | 74109 |
| 13 | May | 19 | 2240-2300 | 45°02.3'N | 164°57.2'W | 185.1 | 74110 |
| 14 | May | 23 | 1739-1744 | 35°48.2'N | 164°59.2'W | 152.0 | 74111 |
| 15 | May | 24 | 2355-0015 | 34°36.4'N | 164°57.5'W | 374.0 | 74111'-1 |
| 16 | May | 26 | 0340-0400 | 29°59.2'N | 162°16.2'W | 84.4 | 74112-1 |
| 17 | June | 7 | 1805-1825 | 23°27.3'N | 163°04.2'W | 11.0 | 74113-1 |
| 18 | June | 8 | 0305-0325 | 24°08.4'N | 165°08.2'W | 14.0 | 74114-1 |
| 19 | June | 9 | 1745-1805 | 26°41.8'N | 172°32.0'W | 8.0 | 74115 |
| 20 | June | 10 | 2045-2105 | 28°10.3'N | 178°35.2'W | 180.4 | 74116-1 |
| 21 | June | 11 | 0405-0425 | 28°14.7'N | 178°39.7'E | 85.0 | 74117 |
| 22 | June | 13 | 2254-2314 | 32°57.9'N | 174°52.6'E | 562.6 | 74118-1 |
| 23 | June | 15 | 2155-2200 | 35°39.2'N | 171°32.5'E | 729.6 | 74119-1 |
| 23 | June | 16 | 0200-0220 | 35°39.8'N | 171°37.0'E | 181.7 | 74120-1 |
| 23 | June | 16 | 0513-0533 | 35°41.7'N | 171°43.4'E | 113.4 | 74121 |
| 24 | June | 17 | 1918-1923 | 34°03.7'N | 170°12.0'E | 1,671.8 | 74122-1 |
| 24 | June | 17 | 1928-1938 | 34°03.7'N | 170°11.6'E | 261.4 | 74123-1 |
| 25 | June | 18 | 1950-2010 | 34°06.2'N | 165°30.7'E | 553.7 | 74124-1 |

Table 5-2 Data on zooplankton and micronekton samplings by ORI-100 net oblique tow from surface to 800 meter depth

| Station | Date | Ship's time | Position | | Net depth (m) | Sample weight (wet:g) | Sample No. |
|---|---|---|---|---|---|---|---|
| | | | Latitude | Longitude | | | |
| 5 | May 8 | 1648-1726 | 45°00.0'N | 169°20.3'E | 500 | 603.9 | 74001-1,2 |
| 6 | May 9 | 1950-2035 | 44°28.4'N | 170°18.9'E | 500 | 580.5 | 74002-1 |
| 6 | May 10 | 0304-0344 | 44°27.1'N | 170°29.6'E | 650 | 299.5 | 74003-1 |
| 8 | May 12 | 1953-2040 | 42°58.7'N | 173°21.9'E | 590 | 329.9 | 74004-1 |
| 8 | May 12 | 2236-2322 | 42°58.1'N | 173°22.3'E | | 254.6 | 74005 |
| 8 | May 13 | 1842-1935 | 42°59.7'N | 173°28.3'E | 550 | 2,466.0 | 74006-1 |
| 11 | May 18 | 0123-0158 | 50°00.5'N | 179°58.2'W | 750 | 690.6 | 74007 |
| 11 | May 18 | 0952-1037 | 50°01.6'N | 179°53.8'W | 800 | 301.5 | 74008 |
| 13 | May 19 | 2141-2235 | 45°00.9'N | 164°59.5'W | 700 | 1,099.2 | 74009 |
| 14 | May 23 | 1642-1720 | 35°50.4'N | 164°59.7'W | 600 | 200.1 | 74010 |
| 15 | May 24 | 2227-2302 | 34°38.8'N | 164°59.5'W | 550 | 166.1 | 74011-1 |
| 16 | May 26 | 0217-0305 | 30°02.2'N | 162°16.2'W | 650 | 65.6 | 74012-1 |

Table 5-3 Data on neuston samplings by a neuston net and a MTD net

| Sta-tion | Date | Ship's time | Latitude | Longitude | Ship's speed (knot) | Type of net* | Net depth (cm) | Sample weight (wet:g) | Sample No. |
|---|---|---|---|---|---|---|---|---|---|
| 15 | May 24 | 0133-0143 | 34°56.9'N | 164°58.2'W | 2 | NST | 10 | 10.7 | 74201 |
| " | " | 0145-0155 | " | " | " | " | " | 35.9 | 74202 |
| " | " | 0158-0208 | " | " | 3 | " | " | 23.6 | 74203 |
| " | " | 0210-0220 | " | " | " | " | " | 28.1 | 74204 |
| " | " | 0222-0232 | " | " | 4 | " | " | 38.1 | 74205 |
| " | " | 0234-0244 | 34°56.5'N | 164°58.1'W | " | " | " | 12.8 | 74206 |
| 15 | May 24 | 1332-1337 | 34°48.3'N | 165°01.3'W | 1 | NST | 10 | 0.5 | 74207 |
| " | " | 1338-1343 | " | " | " | " | " | 0.5 | 74208 |
| " | " | 1344-1354 | " | " | 2 | " | " | 0.5 | 74209 |
| " | " | 1355-1405 | " | " | " | " | " | 0.5 | 74210 |
| " | " | 1407-1417 | " | " | 3 | " | " | 0.5 | 74211 |
| " | " | 1418-1428 | " | " | " | " | " | 0.5 | 74212 |
| " | " | 1429-1439 | " | " | 2 | " | " | 0.5 | 74213 |
| " | " | 1441-1451 | 34°49.5'N | 165°01.8'W | " | " | " | 0.5 | 74214 |
| 19 | June 9 | 1627-1642 | 26°40.9'N | 172°28.4'W | 2 | NST | 10 | | 74215 |
| " | " | " | " | " | " | MTD | 50 | 4.1 | 74216 |
| 20 | June 10 | 1858-1913 | 28°08.5'N | 178°30.1'W | 2 | NST | 10 | 27.8 | 74217 |
| " | " | " | " | " | " | MTD | 50 | 62.8 | 74218 |
| 21 | June 11 | 0530-0545 | 28°17.7'N | 179°34.0'E | 2 | NST | 10 | 3.6 | 74219 |
| " | " | " | " | " | " | MTD | 50 | 3.8 | 74220 |
| 22 | June 13 | 2103-2118 | 32°57.7'N | 174°52.7'E | 2 | NST | 10 | 321.0 | 74221 |
| " | " | " | " | " | " | MTD | 50 | 428.4 | 74222 |
| 23 | June 15 | 2040-2055 | 35°38.0'N | 175°34.0'E | 2 | NST | 10 | 1,158.3 | 74223 |
| " | " | " | " | " | " | MTD | 50 | 747.5 | 74224 |
| 23 | June 16 | 0050-0105 | 35°39.2'N | 175°36.0'E | 2 | NST | 10 | 22.1 | 74225 |
| " | " | " | " | " | " | MTD | 50 | 53.5 | 74226 |
| 23 | June 16 | 0626-0641 | 35°42.1'N | 171°43.0'E | 2 | NST | 10 | 7.6 | 74227 |
| " | " | " | " | " | " | MTD | 50 | 18.4 | 74228 |
| 23 | June 16 | 1334-1349 | 35°34.2'N | 171°59.1'E | 2 | MTD | 50 | 188.0 | 74229 |
| 24 | June 17 | 1857-1912 | 34°03.9'N | 170°13.6'E | 2 | NST | 10 | 535.5 | 74300 |
| " | " | " | " | " | " | MTD | 50 | 1,179.3 | 74301 |
| 25 | June 18 | 2013-2028 | 34°06.3'N | 165°29.5'E | 2 | NST | 10 | 51.2 | 74302 |
| " | " | " | " | " | " | MTD | 50 | 44.6 | 74303 |
| 26 | June 20 | 0801-0816 | 33°33.3'N | 158°15.8'E | 2 | NST | 10 | 5.7 | 74304 |
| " | " | " | " | " | " | MTD | 50 | 13.2 | 74305 |

*NST, Neuston net: MTD, MTD net

Table 5-4 Data on respiration rates of fish larvae collected in the northern North Pacific

| Body wt. (gr) | Exp. Temp. (°C) | Total respiration rate (μl $O_2$/fish/hr) |
|---|---|---|
| Hemilepidotus jordani BEAN | | |
| 0.194±0.010(2) | 4.4- 4.5 | 32.0 |
| | 4.5- 4.6 | 33.3 |
| | 4.5- 4.7 | 33.0 |
| | 8.0- 8.4 | 89.3 |
| | 8.3- 8.5 | 51.8 |
| Centrobranchus sp. | | |
| 0.915(1) | 4.7- 4.8 | 268.0 |
| | 4.8- 4.9 | 204.0 |
| Pleurogrammus monopterygius (PALLAS) | | |
| 0.321±0.044(4) | 8.5 | 115.0 |
| | 8.5 | 133.8 |
| | 8.6- 8.8 | 158.5 |
| 2.279(1) | 4.4- 4.6 | 375.0 |
| | 4.5- 4.6 | 450.0 |
| | 5.8- 5.9 | 422.0 |
| | 5.9 | 604.0 |
| | 7.5 | 672.0 |
| | 7.5- 7.6 | 714.0 |
| 2.792(1) | 9.4- 9.9 | 652.0 |
| | 9.8-10.5 | 992.0 |
| | 10.6-10.7 | 566.0 |
| | 17.5-18.5 | 1,187.0 |
| | 18.0-18.5 | 1,124.0 |

## 12. Faunal survey of the micronektonic fishes in the North Pacific Ocean

Kouichi KAWAGUCHI and Chikakuni HARUTA

Faunal survey was made by nineteen IKMT and two ORI-net samplings from the surface down to about 1300 m depth. Of twenty one samplings, elevn were made in the subarctic waters and ten were made in the western North Pacific Central Water between 20°N and 35°N. Although all of the samples have not yet been sorted out, it was remarkable that considerable number of subarctic bathypelagic species extended the limit of distribution southward to 30°N under the temperate water of the western North Pacific Central Water.

## 13. Measurement of swimming power of fishes

Tooru YONEMORI and Yoshihiro MINEMOTO

1) Purpose

We intented to breed fishes (especially, salmon and trout) which was expected to caught in the ocean, and to measure their power for several times under the natural change of sea water temperature. We expected to assume the route of migration and to estimate the quantity of food reouirement.

2) Method

We supposed the towing power as a index of fish-power, and the power was measured with an apparatus shown in Fig. 1 and 2.

3) Result

Our study was not successful because of no catch in the ocean. We conducted a tank experiment on scarus caught off Honolulu harbour, and obtained a data about electrical stimulus to drive the fish (Fig. 7-1). Another experiment was carried out in the sea of Tateyama bay on small japanese mackerel, and there we measured the sustained power for over 5 minutes (Fig. 7-2).

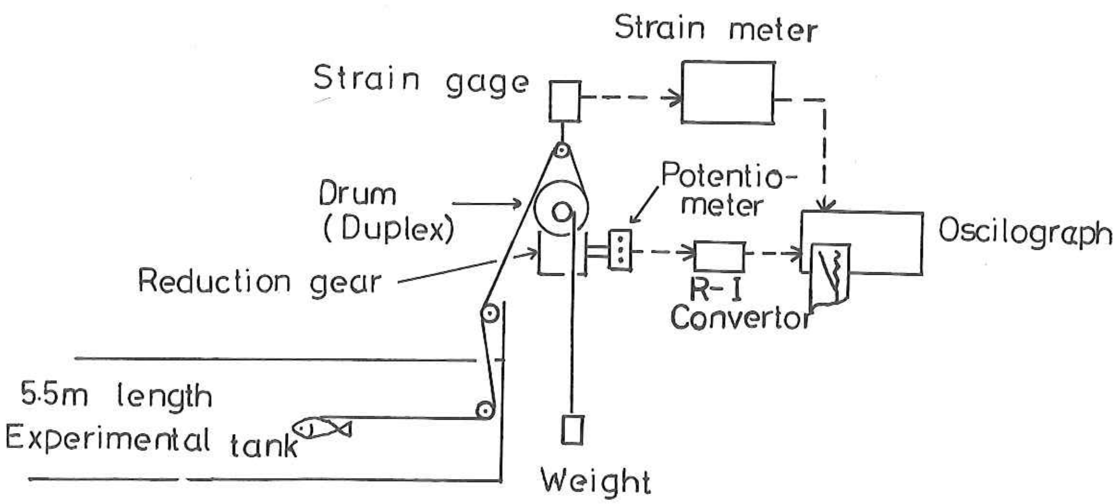


Fig. 7-1 Fish-power measurement using a experimental tank on board

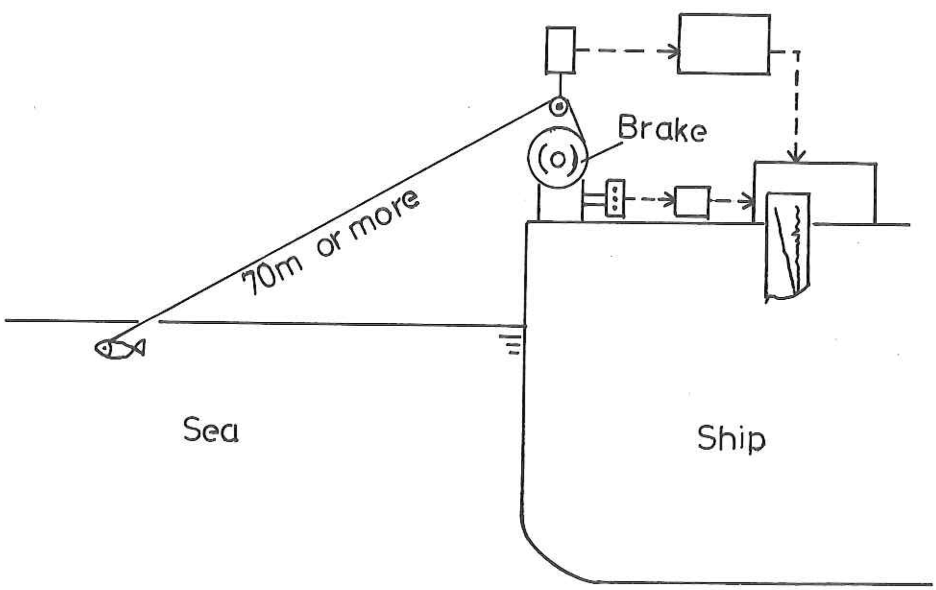


Fig. 7-2 Fish-power measurement discharging fish into the sea.

## 14. Sighting records of seabirds

Kazue NAKAMURA

The principal objectives of this investigation were focussed on the ecological distribution of seabirds. The sighting observations were started on May 1, and ended on June 22, 1974. It carried out at the upper deck or bridge of the ship for an average of six hours a day with one or two hours rest periods. All of the seabirds observed in the anterior semicircle of the ship, were recorded together with pertinent data upon the time, air and water temperatures measured every hour by the crew, and location in latitude and longitude. When flocks of birds were seen, their number was estimated. And also the birds observed when the ship stopped at the hydrographic stations, were recorded separately. For identification of the species at sea two binocular scopes (9x35 Nikon) were used, and Preliminary Smithonian Identification Manual; Seabirds of the Tropical Pacific Ocean written by Warren B. King (1967) and other documents were referred.

A total of 43 oceanic and 2 non-oceanic species were recorded (Table 6). Table 7-1, 2 shows the raw data obtained on the genus Pterodroma, of which Pterodroma sp. recorded as the most interesting species, is included; this small gadfly petrel evidently migrates to western North Pacific from Southern Hemisphere. It is noticeable that a big flock of the species estimated at 3000 was found in the area cruised from 35°10'N, 171°51'E to 35°14'N, 171°46'E on June 14 since very little is known of the dispersal at sea of these gadfly peterls. The problems of identification at sea are further confused by the presence in the North Pacific of at least three more the related forms of the genus Pterodroma. Fortunately we could obtain one specimen landing on the ship at 35°40'N, 171°31'E on June 16, and take many photographs in the field.

Including the identification of the interesting species, the analysis of seabirds recorded will be conducted in some separate papers by the writer.

Table 6. The scientific and common names of seabirds observed

| Scientific name | Common name |
|---|---|
| Family Diomedeidae | Albatrosses |
| Diomedea immutabilis | Laysan Albatross |
| D. nigripes | Black-footed Albatross |
| Family Procellariidae | Petrels, Shearwaters and Fulmars |
| Pterodroma sp. | Gadfly Petrel |
| P. solandri | Solander's Petrel |
| P. hypoleuca | Bonin Petrel |
| P. inexpectata | Mottled Petrel |
| Bulweria bulwerii | Bulwer's Petrel |
| Calonectris leucomelas | Streaked Shearwater |
| Puffinus pacificus | Wedge-tailed Shearwater |
| P. carneipes | Pale-footed Shearwater |
| P. griseus | Sooty Shearwater |
| P. tenuirostris | Slender-billed Shearwater |
| P. nativitatis | Christmas Shearwater |
| P. bulleri | New Zealand Shearwater |
| P. puffinus | Newell's Shearwater |
| Family Hydrobatidae | Storm Petrels |
| Oceanodroma furcata | Grey Fork-tailed Petrel |
| O. leucorhoa | Leach's Fork-tailed Petrel |
| O. monorhis | Swinhoe's Fork-tailed Petrel |
| O. castro | Madeiran Fork-tailed Petrel |
| O. tristrami | Tristram's Fork-tailed Petrel |
| O. matsudairae | Matsudaira's Fork-tailed Petrel |
| Family Phaethontidae | Tropicbirds |
| Phaethon rubicada | Red-tailed Tropicbird |
| P. leputurus | White-tailed Tropicbird |
| Family Sulidae | Gannets and Boobies |
| Sula leucogaster | Brown Booby |
| S. dactylatra | Blue-faced Booby |
| S. sula | Red-footed Booby |
| Family Fregatidae | Fregatebird |
| Fregata minor | Pacific Fregatebird |
| Family Phalaropodidae | Phalaropes |
| Phalaropus fulicarius | Red Phalarope |
| Family Stercorariidae | Skuas |
| Stercorarius skua | Great Skua |
| S. pomarinus | Pomatorhine Skua |
| S. parasiticus | Arctic Skua |
| S. longicaudus | Long-tailed Skua |
| Family Laridae | Gulls, Terns and Noddies |
| Larus tridactylus | Black-legged Kittiwake |
| Sterna lunata | Spectacled Tern |
| S. fuscata | Sooty Tern |
| S. cerulea | Blue Noddy |
| Anous stolidus | Common Noddy |
| A. tenuirostris | Black Noddy |
| A. albus | White Noddy |
| Family Alcidae | Puffins, Murres and Auks |
| Uria spp. | Murre |
| Aethia sp. | Auklet |
| Lunda cirrhata | Tufted Puffin |
| Land birds | |
| Pluvialis dominica | Pacific Golden Plover |
| Hirundo rustica | House Swallow |

Table 7-1 Sight records of _Pterodroma sp._ and _P. hypoleuca_

| Date | Location | | No. of birds | | Obs. | Temperature °C | |
|---|---|---|---|---|---|---|---|
| | cruised from | cruised to | _Pterodroma sp._ | _P. hypoleuca_ | hours | Air | Water |
| 10 June | 27°44'N 175°43'W | 27°56'N 176°41'W | 0 | 8 | 2.0 | 25.4-25.8 | 24.6-25.0 |
| 11 June | 28°21'N 179°24'E | 28°53'N 178°42'E | 0 | 1 | 3.0 | 24.2-25.2 | 22.7-24.8 |
| 13 June | 32°01'N 175°40'E | 32°16'N 175°26'E | 0 | 3 | 1.5 | 20.5-21.5 | 21.3-21.4 |
| 14 June | 34°10'N 173°09'E | 35°10'N 171°51'E | 946 | 21 | 6.5 | 16.6-17.5 | 18.6-19.2 |
| 17 June | 34°01'N 170°10'E | 34°00'N 170°02'E | 8 | 2 | 0.5 | 19.2-19.6 | 18.5-19.0 |
| 18 June | 34°05'N 167°57'E | 34°05'N 167°36'E | 30 | 11 | 1.5 | 18.5-19.1 | 18.2-18.7 |
| 19 June | 34°02'N 163°50'E | 33°56'N 162°03'E | 37 | 55 | 4.5 | 18.0-20.6 | 18.3-19.9 |
| 20 June | 33°32'N 157°24'E | 33°35'N 156°36'E | 9 | 43 | 3.0 | 19.0-19.3 | 22.2-22.9 |
| 21 June | 33°35'N 152°14'E | 33°35'N 151°17'E | 0 | 125 | 3.5 | 19.2-20.7 | 22.5-23.3 |
| 22 June | 33°34'N 145°29'E | 33°43'N 143°26'E | 0 | 66 | 6.5 | 22.6-25.3 | 22.2-25.7 |

Table 7-2 Sight records of *Pterodroma solandri* and *P. inexpectata*

| Date | Location | | No. of birds | | Obs. | Temperature °C | |
|---|---|---|---|---|---|---|---|
| | cruised from | cruised to | *P. solandri* | *P. inexpectata* | hours | Air | Water |
| 5 May | 41°18'N 165°06'E | 42°01'N 165°03'E | 280 | 0 | 6.0 | 6.7-8.4 | 6.0-7.1 |
| 6 May | 45°08'N 165°05'E | 45°47'N 165°05'E | 3 | 0 | 3.0 | 6.2-7.2 | 3.4-4.4 |
| 10 May | 44°32'N 170°23'E | 44°19'N 170°53'E | 78 1) | 0 | 2.0 | 5.7-6.9 | 4.2-4.6 |
| 12 May | (43°03'N 173°26'E | 43°02'N 173°26'E) | 59 2) | 3 | 3.0 | 5.4-6.0 | 8.0-8.1 |
| 14 May | 41°53'N 175°58'E | 40°59'N 177°56'E | 23 | 4 | 6.0 | 6.4-8.0 | 10.1-10.6 |
| 16 May | 43°28'N 179°58'E | 44°38'N 179°59'E | 9 | 4 | 6.0 | 6.2-6.8 | 6.3-8.4 |
| 17 May | 46°36'N 179°58'E | 48°16'N 179°59'E | 0 | 14 | 6.0 | 3.8-4.6 | 4.4-5.3 |
| 18 May | 49°56'N 179°44'W | 49°47'N 179°07'W | 0 | 40 | 7.0 | 5.3-5.9 | 5.1-5.4 |
| 19 May | 46°16'N 167°53'W | 45°49'N 166°47'W | 0 | 5 | 4.0 | 5.0-6.0 | 6.7-7.0 |
| 22 May | 41°20'N 164°59'W | 40°34'N 164°58'W | 0 | 2 | 4.0 | 10.6-11.2 | 10.9-11.5 |

Notes (1); 40 birds seen at St. 7 from 8300 to 1400, were excluded.
(2); counted at St. 8.

## 15. Geophysical measurements in the Northwest Pacific

Kazuhiro KITAZAWA

Measurements of bathymetry and gravity were carried out continuously whole the cruise of KH-74-2. Water depths were obtained every 10 minutes by read-out from recorded chart of the P.D.R. (Precise Depth Recorder) installed on board the Hakuho-Maru. There were some unobvious record on chart by the cause of rough sea condition, however, the major part of record was clear enough to identify the sea-bottom.

Gravity data were obtained by the TSSG ship board type gravity-meter originally designed and developed by Professor Tomoda. Since 1973 the data processing system with a minicomputer was attached to the TSSG gravity-meter. By this processing system, first approximation corrections caused of ship's course and speed, each from gyrocompass and electronic log, were calculated. Both gravity and correction values of ship's heading and speed are typed and punched out every 1 minute on the tele-type connected to the mini-computer. After the cruise, measured gravity data are corrected for Etövös effect and gravity reductions are carried out by use of the computer, FACOM 230-45S, in Nakano campus based upon the data of water depth and ship's course and speed calculated from ship's fixes.

There were three main purposes on the measurements in this cruise. First interest is to clarify the true position of the Suiko Seamount laying on the northern part of the Emperor's Seamount chain. During the Hakuho-Maru cruise of KH-68-3 and KH-70-2, we steamed across that seamount and geophysical measurements along several tracks were carried out. Unfortunately, the fixes were not so accurate at that time. Because of the most of them were determined by the dead recognition based on Loran C fixes. Present cruise the Navy Navigation Satellite System (NNSS) was installed on the Hakuho-Maru and by this apparatus we can get the fix within an error circle of 80 m radius. One of two stations of rich observations for biological studies was set near the top of the Suiko Seamount and ship had two days stay on that point. By this reason position of the seamount was well-determined, but ship moved and changed her headings frequently on the station, so that for the Etövös correction is too complicated to get good gravity result. Investigating the origin and geological history of western Pacific is the one of the most interesting problem today, however, there were not enough reliable geophysical data in this area. So increasing the reliable data in the western Pacific was the second purpose. The third was to obtain some preliminary bathymetric data on the Kinmei Seamount laying near the intersection of the Emperor Seamount chain and the Hawaiian Island chain. On the KH-74-4 cruise, we have a plan to set a station for the first sea bottom drilling by Japanese ship somewhere around this seamount. For this purpose finding out the shallow, broad and flat place was required. Unfortunately we couldn't spend enough time for this survey for avoiding the low pressure system.

Magnetic total force was measured by the proton magnetometer. A magnetometer with a mini-computer was designed before this cruise. Whole the steaming time the sensor of the magnetometer was towed two hundred meters behind the ship and tested on the sensitivity and stability of the instrument. A great contribution to design a new type of magnetometer will be expected by the results of this test.

All the geophysical data are going to process by the computer in the institute and to publish on some geophysical journal.

## 16. Observation of the distribution of cosmic ray neutron intensity in the area of North Pacific Ocean

Masami WADA* and Shinkichi KAWASAKI*

A large $B^{10}F_3$ neutron counter surrounded by a polyethylene cylinder of 2 cm thick was boarded on Hakuho-Maru during the period from 30 April to 26 June 1974. The counting rates recorded were between 4000 and 8000 counts/hr. The barometric pressure changed between 995 and 1033 mb. The course spanned over 140E - 156W and 46N - 20N which covered between 4.3 and 13.4 GV in the geomagnetic cutoff rigidities for the primary cosmic rays coming from vertical direction.

The data were recorded every hour, but the neutron counts and the pressures were averaged for four hour periods, and the cutoff rigidities were calculated for the positions of the ship every four hours. The

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* Not aboard

effects of the pressure and the cutoff rigidity on the neutron counting rates were separated. As a first approximation, if the two effects are independent with each other, the following results are indicated.

The pressure coefficient is -0.5 %/mb which is quite similar to the value obtained at Tokyo. The rigidity dependence of the counting rates can be represented by $a.\exp(-R/R_0)$ where a is the counting rates at the rigidity zero and 10000 counts/hr, and $R_0$ is the specific rigidity which amounts to 14.5 GV in the present experiment.

Besides the above results, a difference in the effects of earth and water on the counting rates was detected. The counting rates decreased by a 5 % when the ship separated the Tokyo, and increased by 10 % when it reached Hawaii. It may indicate different rates of production of neutrons in earth and water.

This experiment was available through the facilities of Ocean Research Institute, the University of Tokyo. The authors' special thanks are due to Professor T. Kuroki, the Chief Researcher of the Experiment KH-74-2. They are also grateful to Dr. S. Sugihara who encouraged the present experiment and operated the apparatus on board.

# Appendices

1-1. Table of Niskin data

| St. No. | Date | Time | Lat. | Long. | Air temp. | Weather | Wind | Swell | Trans. |
|---|---|---|---|---|---|---|---|---|---|
| 5 | May 8 | 06:48 | 45°02.3'N | 169°07.9'E | 3.3°C | bc 4 | W $^{9.0}_{5}$ | 4 | 15 m |

| S. Depth (m) | D (m) | T (°C) | S (‰) | $O_2$ (ml/l) | $PO_4$—P (μgatoms/l) | $SiO_2$—Si ( 〃 ) | $NO_2$—N ( 〃 ) | $NO_3$—N ( 〃 ) | $NH_4$ ( 〃 ) | Chl (μg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 4.2 | 33.053 | $7.25_4$ | 1.54 | 37.0 | 0.26 | 18.2 | – | 0.132 |
| 10 | 10 | 3.99 | 33.030 | $7.36_1$ | 1.57 | 38.5 | 0.23 | 17.9 | – | 0.124 |
| 20 | 20 | 3.99 | 33.041 | $7.26_0$ | 1.65 | 37.5 | 0.25 | 18.0 | – | 0.108 |
| 30 | 30 | 3.98 | 33.029 | $7.24_9$ | 2.21 | 36.8 | 0.25 | 19.6 | – | 0.083 |
| 50 | 50 | 3.97 | 33.032 | $7.24_9$ | 1.58 | 35.5 | 0.24 | 18.6 | – | 0.088 |
| 75 | 74 | 3.93 | 33.039 | $7.36_6$ | 1.61 | 37.5 | 0.24 | 18.9 | – | 0.073 |
| 100 | 99 | 3.26 | 33.282 | $6.56_8$ | 2.12 | 48.5 | 0.03 | 25.9 | – | 0.043 |
| 125 | 124 | 3.11 | 33.596 | $5.29_0$ | – | 56.8 | 0.01 | 30.0 | – | 0.019 |
| 150 | 148 | 3.06 | 33.591 | $4.44_9$ | 2.59 | 68.0 | 0.05 | 33.6 | – | 0.014 |
| 200 | 198 | 3.10 | 33.675 | $3.45_9$ | 2.76 | 80.0 | 0.02 | 35.4 | – | – |
| 250 | 248 | 3.18 | 33.795 | – | 2.99 | 93.5 | 0.01 | 40.6 | – | 0.002 |
| 300 | 297 | 3.27 | 33.878 | $2.36_5$ | 3.12 | 100.0 | 0.04 | 42.1 | – | 0.003 |
| 400 | 396 | 3.34 | – | $1.51_2$ | 3.31 | 113.0 | 0.00 | 43.4 | – | 0.001 |
| 500 | 495 | 3.38 | 34.106 | $1.18_0$ | 3.29 | 119.0 | 0.00 | 44.6 | – | < 0.001 |
| 600 | 594 | 3.24 | 34.192 | $0.92_8$ | 3.36 | 129.0 | 0.00 | 45.0 | – | – |
| 800 | 794 | 2.99 | 34.320 | $0.72_3$ | 3.37 | 143.2 | 0.00 | 45.3 | – | – |
| 1000 | 993 | 2.69 | 34.410 | $0.74_4$ | 3.38 | 155.2 | 0.00 | 44.8 | – | – |

Weather o = overcast, f = fog, bc = partly cloudy, r = rain, c = cloudy

1-2. Table of Niskin data

| St. No. | Date | Time | Lat. | Long. | Air temp. | Weather | Wind | Swell | Trans. |
|---|---|---|---|---|---|---|---|---|---|
| 6' | May 9 | 18:20 | 44°28.7'N | 170°18.1'E | 50°C | o 10 | NSW $^{8.5}_{5}$ | 4 | 17 m |

| S. Depth (m) | D (m) | T (°C) | S (‰) | $O_2$ (ml/l) | $PO_4$—P (μgatoms/l) | $SiO_2$—Si ( 〃 ) | $NO_2$—N ( 〃 ) | $NO_3$—N ( 〃 ) | $NH_4$ ( 〃 ) | Chl (μg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 4.4 | 33.061 | $7.61_1$ | 1.50 | 34.4 | 0.22 | 17.1 | $0.7_9$ | 0.114 |
| 10 | 10 | 4.38 | 33.061 | $8.24_5$ | 1.55 | 16.5 | 0.32 | 16.7 | $0.1_6$ | 0.114 |
| 20 | 19 | 4.37 | 33.051 | $7.55_2$ | 1.57 | 17.0 | 0.25 | 16.5 | $0.1_6$ | 0.122 |
| 30 | 28 | 4.37 | - | $7.58_4$ | 1.51 | 36.8 | 0.26 | 16.5 | $0.0_9$ | 0.127 |
| 50 | 47 | 4.33 | 33.048 | $7.57_9$ | 1.49 | 33.1 | 0.27 | 16.8 | $0.1_9$ | 0.084 |
| 75 | 71 | 4.16 | 33.125 | $7.41_4$ | 1.61 | 35.5 | 0.25 | 17.5 | $0.2_8$ | 0.036 |
| 100 | 94 | 3.87 | 33.226 | $7.18_9$ | 1.63 | 35.5 | 0.16 | 18.8 | $0.0_3$ | 0.014 |
| 125 | 118 | 4.03 | 33.368 | $6.87_8$ | 1.61 | 36.7 | 0.07 | 19.4 | $0.0_9$ | 0.003 |
| 150 | 141 | 3.85 | 33.621 | $5.19_0$ | 2.15 | 53.5 | 0.04 | 28.1 | $0.0_9$ | 0.002 |
| 200 | 188 | 3.49 | 33.739 | $3.57_8$ | 2.67 | 76.0 | 0.05 | 35.2 | $0.0_3$ | 0.001 |
| 250 | 235 | 3.53 | 33.810 | $3.06_3$ | 2.82 | 85.0 | 0.04 | 35.8 | $0.0_6$ | 0.005 |
| 300 | 282 | 3.54 | 33.889 | $2.42_9$ | 2.97 | 91.0 | 0.02 | 38.2 | $0.0_6$ | 0.051 |
| 400 | 377 | 3.44 | 33.967 | $1.90_1$ | 2.16 | 61.0 | 0.12 | 26.4 | $0.0_0$ | 0.005 |
| 500 | 472 | 3.60 | 34.136 | $1.49_8$ | 3.18 | 112.0 | 0.03 | 42.2 | $0.0_6$ | < 0.001 |
| 600 | 572 | 3.38 | 34.209 | $1.20_2$ | 3.25 | 122.0 | 0.02 | 42.1 | $0.0_6$ | - |
| 800 | 758 | 3.08 | 34.323 | $0.96_7$ | 3.33 | 138.0 | 0.03 | 42.1 | $0.0_3$ | - |
| 1000 | 948 | 2.72 | 34.414 | $0.91_0$ | 3.32 | 152.2 | 0.03 | 42.1 | $0.1_1$ | - |

1-3. Table of Niskin data

| St. No. | Date | Time | Lat. | Long. | Air temp. | Weather | Wind | Swell | Trans. |
|---|---|---|---|---|---|---|---|---|---|
| 7 | May 10 | 20:45 | 43°59.7'N | 171°33.4'E | 7.4°C | o 10 | S 12.0 6 | 4 | - |

| S. Depth (m) | D (m) | T (°C) | S (‰) | $O_2$ (ml/l) | $PO_4$—P (μgatoms/l) | $SiO_2$—Si ( 〃 ) | $NO_2$—N ( 〃 ) | $NO_3$—N ( 〃 ) | $NH_4$ ( 〃 ) | Chl (μg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 5.9 | 33.340 | $9.30_2$ | 1.23 | 30.5 | 0.26 | 15.2 | $0.1_6$ | 0.105 |
| 10 | 9 | 5.71 | 33.333 | $8.12_4$ | 1.27 | 33.0 | 0.25 | 15.0 | $0.0_8$ | 0.095 |
| 20 | 18 | 5.70 | 33.326 | $7.52_5$ | 1.27 | 36.0 | 0.29 | 15.2 | $0.1_4$ | 0.085 |
| 30 | 26 | 5.70 | 33.341 | $7.48_7$ | 1.33 | 30.0 | 0.26 | 14.9 | $0.0_8$ | 0.016 |
| 50 | 43 | 5.91 | 33.421 | $7.39_2$ | 1.21 | 32.0 | 0.28 | 14.9 | $0.1_6$ | 0.037 |
| 75 | 64 | 5.86 | 33.422 | $7.42_4$ | 1.25 | 31.0 | 0.28 | 14.7 | $0.1_4$ | 0.016 |
| 100 | 84 | 5.86 | 33.449 | $7.38_6$ | 1.21 | 29.0 | 0.29 | 15.0 | $0.1_4$ | 0.003 |
| 125 | 105 | 6.14 | 33.560 | $7.19_5$ | 1.21 | 28.0 | 0.28 | 14.8 | $0.1_1$ | 0.001 |
| 150 | 125 | 6.10 | 33.736 | $6.70_7$ | 1.43 | 33.0 | 0.04 | 20.5 | $0.2_2$ | 0.001 |
| 200 | 166 | 5.61 | 33.798 | $5.47_2$ | 1.82 | 48.2 | 0.03 | 25.9 | $0.0_0$ | 0.001 |
| 250 | 214 | 5.02 | 33.823 | $4.64_2$ | 2.13 | 55.0 | 0.03 | 30.2 | $0.1_6$ | 0.018 |
| 300 | 252 | - | 33.854 | $3.83_4$ | 2.39 | 70.7 | 0.00 | 34.4 | $0.1_6$ | 0.002 |
| 400 | 347 | 4.09 | 33.938 | $2.81_2$ | 2.00 | 56.0 | 0.12 | 27.8 | $0.7_4$ | 0.001 |
| 500 | 434 | 4.19 | 34.049 | $2.05_4$ | 2.93 | 100.0 | 0.01 | 42.4 | $0.0_3$ | < 0.001 |
| 600 | 529 | 3.94 | 34.150 | $1.57_5$ | 3.02 | 108.0 | 0.02 | 34.6 | $0.0_8$ | - |
| 800 | 718 | 3.39 | 34.259 | $1.08_2$ | 3.30 | 128.0 | 0.02 | 46.5 | $0.1_4$ | - |
| 1000 | 911 | 3.02 | 34.362 | $0.96_8$ | 3.27 | 142.3 | 0.00 | 48.2 | $0.1_1$ | - |

1-4. Table of Niskin data

| St. No. | Date | Time | Lat. | Long. | Air temp. | Weather | Wind | Swell | Trans. |
|---|---|---|---|---|---|---|---|---|---|
| 8 | May 13 | 14:35 | 43°01.0'N | 173°30.5'E | 6.8°C | c 8 | W $\frac{11.0}{6}$ | 4 | 15.5 m |

| S. Depth (m) | D (m) | T (°C) | S (‰) | $O_2$ (ml/l) | $PO_4$—P (μgatoms/l) | $SiO_2$—Si ( 〃 ) | $NO_2$—N ( 〃 ) | $NO_3$—N ( 〃 ) | $NH_4$ ( 〃 ) | Chl (μg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 7.6 | 33.734 | $7.01_3$ | 0.96 | 27.5 | 0.23 | 11.0 | $0.2_8$ | 0.092 |
| 10 | 10 | 7.69 | 33.726 | $7.03_0$ | 1.00 | 25.0 | 0.24 | 11.9 | $0.1_5$ | 0.064 |
| 20 | 20 | 7.66 | 33.726 | $7.01_1$ | 1.00 | 25.0 | 0.26 | 11.3 | $0.0_5$ | 0.095 |
| 30 | 30 | 7.66 | 33.729 | $6.87_0$ | 0.98 | 31.0 | 0.23 | 11.4 | $0.0_7$ | 0.085 |
| 50 | 49 | 7.66 | 33.734 | $7.13_6$ | 0.94 | 24.0 | 0.24 | 11.2 | $0.2_3$ | 0.065 |
| 75 | 74 | 7.63 | 33.733 | $6.98_9$ | 0.96 | 25.0 | 0.27 | 11.3 | $0.1_5$ | 0.063 |
| 100 | 99 | 7.65 | 33.735 | $6.98_3$ | 0.98 | 25.0 | 0.24 | 11.8 | $0.0_5$ | 0.030 |
| 125 | 124 | 7.65 | 33.736 | $6.99_4$ | 0.90 | 24.0 | 0.26 | 10.7 | $0.2_8$ | 0.017 |
| 150 | 148 | 7.76 | 33.805 | $6.72_0$ | 1.03 | 23.0 | 0.13 | 13.7 | $0.0_7$ | 0.003 |
| 200 | 197 | 7.47 | 33.927 | $5.79_5$ | 1.39 | 31.0 | 0.03 | 18.2 | $0.0_7$ | 0.001 |
| 250 | 245 | 6.14 | 33.884 | $5.09_0$ | 1.82 | 47.5 | 0.02 | 24.7 | $0.0_7$ | 0.001 |
| 300 | 296 | 5.28 | 33.884 | $4.05_7$ | 2.22 | 59.4 | 0.01 | 29.6 | $0.0_2$ | 0.001 |
| 400 | 395 | 4.37 | 33.892 | $5.04_7$ | 1.80 | 49.0 | 0.02 | 24.9 | $0.0_5$ | $<$ 0.001 |
| 500 | 495 | 3.92 | 34.017 | $2.01_1$ | 3.00 | 100.0 | 0.02 | 41.3 | $0.0_5$ | $<$ 0.001 |
| 600 | 594 | 3.85 | 34.133 | $1.54_5$ | 3.14 | 112.8 | 0.03 | 41.9 | $0.0_0$ | - |
| 800 | 794 | 3.39 | 34.135 | $0.99_5$ | 3.31 | 130.2 | 0.00 | 43.6 | $0.0_5$ | - |
| 1000 | 988 | 3.02 | 34.378 | $0.81_0$ | 3.37 | 144.5 | 0.07 | 45.7 | $0.0_2$ | - |

1-5. Table of Niskin data

| St. No. | Date | Time | Lat. | Long. | Air temp. | Weather | Wind | Swell | Trans. |
|---|---|---|---|---|---|---|---|---|---|
| 9 | May 15 | 10:40 | 39°56.3'N | 179°59.6'W | 8.0°C | r 10 | ENE 11.2 6 | 4 | - |

| S. Depth (m) | D (m) | T (°C) | S (‰) | $O_2$ (ml/l) | $PO_4$—P (μgatoms/l) | $SiO_2$—Si ( 〃 ) | $NO_2$—N ( 〃 ) | $NO_3$—N ( 〃 ) | $NH_4$ ( 〃 ) | Chl (μg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 11.4 | 34.298 | $6.36_2$ | 0.63 | 18.0 | 0.25 | 7.9 | $0.1_6$ | 0.050 |
| 10 | 10 | 11.47 | 34.304 | $6.35_6$ | 0.62 | 19.0 | 0.22 | 7.6 | $0.1_3$ | 0.056 |
| 20 | 20 | 11.47 | 34.302 | $6.34_8$ | 0.63 | 23.0 | 0.23 | 7.8 | $0.0_6$ | 0.051 |
| 30 | 30 | 11.49 | 34.304 | $6.33_5$ | 0.62 | 18.0 | 0.24 | 7.8 | $0.1_3$ | 0.087 |
| 50 | 49 | 11.26 | 34.290 | $6.25_6$ | 0.68 | 19.3 | 0.25 | 8.4 | $0.1_3$ | 0.047 |
| 75 | 73 | 11.05 | 34.279 | $6.27_9$ | 0.70 | 20.2 | 0.26 | 8.7 | $0.1_6$ | 0.030 |
| 100 | 98 | 10.98 | 34.265 | $6.29_1$ | 0.69 | 17.2 | 0.28 | 8.3 | $0.0_9$ | 0.028 |
| 125 | 122 | 10.81 | - | - | - | - | - | - | $0.0_6$ | - |
| 150 | 146 | 10.70 | 34.248 | $6.23_7$ | 0.73 | 20.0 | 0.27 | 9.6 | $0.0_6$ | 0.004 |
| 200 | 195 | 10.16 | 34.185 | $6.06_6$ | 0.85 | 20.3 | 0.04 | 11.1 | $0.0_6$ | 0.004 |
| 250 | 244 | 9.59 | 34.145 | $5.58_3$ | 1.09 | 32.8 | 0.03 | 15.8 | $0.0_3$ | 0.001 |
| 300 | 293 | 8.88 | 34.140 | $5.05_7$ | 1.32 | 32.8 | 0.02 | 19.3 | $0.0_6$ | < 0.001 |
| 400 | 390 | 6.97 | 34.088 | $4.70_3$ | 1.58 | 51.0 | 0.03 | 22.9 | $0.0_3$ | < 0.001 |
| 500 | 489 | 5.71 | 33.992 | $3.55_1$ | 2.22 | 67.0 | 0.01 | 32.2 | $0.0_6$ | < 0.001 |
| 600 | 583 | 4.88 | 34.038 | $2.50_4$ | 2.62 | 87.6 | 0.02 | 38.0 | $0.0_3$ | - |
| 800 | 784 | 3.84 | 34.211 | $1.16_7$ | 3.07 | 115.6 | 0.00 | 44.3 | $0.0_3$ | - |
| 1000 | 956 | 3.45 | 34.297 | $0.87_9$ | 3.19 | 130.3 | 0.01 | 46.7 | $0.0_3$ | - |
| 1500 | 1434 | 2.55 | 34.473 | $0.72_9$ | 3.31 | 161.8 | 0.02 | 48.5 | $0.1_3$ | - |
| 2000 | 1924 | 2.10 | 34.577 | $1.29_4$ | 3.16 | 172.8 | 0.01 | 46.5 | $0.0_0$ | - |
| 2500 | 2417 | 1.78 | 34.625 | $2.01_3$ | 3.06 | 172.8 | 0.02 | 45.6 | $0.0_3$ | - |
| 3000 | 2913 | 1.58 | 34.665 | $2.76_4$ | 2.86 | 168.3 | 0.02 | 44.3 | $0.0_3$ | - |
| 3500 | 3404 | 1.50 | 34.681 | $3.24_7$ | 2.80 | 168.0 | 0.00 | 40.6 | $0.0_0$ | - |
| 4000 | 3891 | 1.47 | 34.683 | $3.55_0$ | 2.67 | 163.3 | 0.02 | 40.4 | $0.0_3$ | - |

1-6. Table of Niskin data

| St. No. | Date | Time | Lat. | Long. | Air temp. | Weather | Wind | Swell | Trans. |
|---|---|---|---|---|---|---|---|---|---|
| 10 | May 16 | 18:30 | 45°00.2'N | 179°59.7'E | 5.7°C | bc 5 | N 10.0 5 | 4 | 15 m |

| S. Depth (m) | D (m) | T (°C) | S (‰) | $O_2$ (ml/l) | $PO_4$—P (μgatoms/l) | $SiO_2$—Si ( 〃 ) | $NO_2$—N ( 〃 ) | $NO_3$—N ( 〃 ) | $NH_4$ ( 〃 ) | Chl (μg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 6.1 | 33.170 | $7.38_7$ | 1.24 | 32.0 | 0.17 | 14.6 | $0.4_9$ | 0.092 |
| 10 | 9 | 5.85 | 33.149 | $7.41_2$ | 1.39 | 30.5 | 0.14 | 14.6 | $0.0_0$ | 0.107 |
| 20 | 18 | 5.55 | 33.148 | $7.43_3$ | 1.35 | 30.0 | 0.14 | 14.2 | $0.0_0$ | 0.108 |
| 30 | 28 | 5.44 | 33.156 | $7.29_7$ | 1.33 | 31.5 | 0.14 | 16.1 | $0.1_0$ | 0.093 |
| 50 | 46 | 5.45 | 33.153 | $7.55_1$ | 1.28 | 29.0 | 0.16 | 16.4 | $0.1_9$ | 0.083 |
| 75 | 69 | 5.45 | 33.152 | $7.35_9$ | 1.34 | 30.0 | 0.15 | 16.8 | $0.1_6$ | 0.039 |
| 100 | 91 | 5.44 | 33.200 | $7.28_0$ | 1.34 | 30.5 | 0.18 | 16.5 | $0.3_3$ | 0.017 |
| 125 | 114 | 5.95 | 33.461 | $6.86_1$ | 1.29 | 28.5 | 0.14 | 16.6 | $0.1_6$ | 0.002 |
| 150 | 137 | 5.12 | 33.639 | $6.07_4$ | 1.72 | 40.0 | 0.02 | 23.4 | $0.1_0$ | 0.001 |
| 200 | 183 | 4.99 | 33.744 | $5.32_9$ | 1.94 | 47.0 | 0.00 | 27.0 | $0.1_0$ | < 0.001 |
| 250 | 231 | 4.74 | 33.823 | $4.16_9$ | 2.28 | 52.5 | 0.00 | 37.6 | $0.1_0$ | < 0.001 |
| 300 | 278 | 4.11 | 33.826 | $3.60_2$ | 2.56 | 73.0 | 0.00 | 35.9 | $0.1_0$ | < 0.001 |
| 400 | 373 | 4.04 | 33.942 | $2.57_9$ | 2.80 | 88.5 | 0.00 | 39.5 | $0.1_0$ | < 0.001 |
| 500 | 468 | 3.78 | 34.035 | $1.81_7$ | 3.04 | 102.0 | 0.00 | 43.1 | $0.0_3$ | < 0.001 |
| 600 | 564 | 3.56 | 34.117 | $1.35_0$ | 3.21 | 116.5 | 0.00 | 55.4 | $0.1_0$ | - |
| 800 | 757 | 3.22 | 34.266 | $0.91_1$ | 3.33 | 135.0 | 0.00 | 46.6 | $0.1_0$ | - |
| 1000 | 953 | 2.98 | 34.378 | $0.79_8$ | 3.33 | 144.5 | 0.00 | 46.5 | $0.1_6$ | - |

1-7. Table of Niskin data

| St. No. | Date | Time | Lat. | Long. | Air temp. | Weather | Wind | Swell | Trans. |
|---|---|---|---|---|---|---|---|---|---|
| 11 | May 18 | 05:05 | 50°10.5'N | 179°56.8'W | 5.9°C | bc 5 | SW $\frac{7.8}{4}$ | 4 | 15 m |

| S. Depth (m) | D (m) | T (°C) | S (‰) | $O_2$ (ml/l) | $PO_4$—P (μgatoms/l) | $SiO_2$—Si ( 〃 ) | $NO_2$—N ( 〃 ) | $NO_3$—N ( 〃 ) | $NH_4$ ( 〃 ) | Chl (μg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 4.2 | 32.820 | $7.55_3$ | 1.44 | 36.5 | 0.22 | 19.3 | $0.6_5$ | 0.152 |
| 10 | 10 | 3.87 | 32.793 | $7.58_3$ | 1.60 | 36.5 | 0.20 | 19.2 | $0.2_0$ | 0.150 |
| 20 | 20 | 3.82 | 32.792 | $7.59_6$ | 1.60 | 36.5 | 0.21 | 19.2 | $0.0_9$ | 0.179 |
| 30 | 29 | 3.74 | 32.790 | $7.43_3$ | 1.60 | 35.0 | 0.22 | 18.9 | $0.0_6$ | 0.131 |
| 50 | 48 | 3.63 | 32.807 | $7.65_8$ | 1.63 | 35.4 | 0.23 | 18.9 | $0.2_0$ | 0.090 |
| 75 | 72 | 3.75 | 32.804 | $7.47_4$ | 1.62 | 37.0 | 0.23 | 19.3 | $0.5_0$ | 0.055 |
| 100 | 95 | 3.54 | 32.974 | $7.23_9$ | 1.76 | 41.4 | 0.21 | 21.9 | $0.5_3$ | 0.009 |
| 125 | 119 | 3.43 | 33.428 | $4.53_6$ | 2.51 | 66.5 | 0.04 | 35.3 | $0.0_0$ | 0.002 |
| 150 | 143 | 3.54 | 33.673 | $2.89_7$ | 2.88 | 82.8 | 0.06 | 41.2 | $0.0_6$ | 0.001 |
| 200 | 191 | 3.61 | 33.830 | $1.71_6$ | 3.22 | 97.0 | 0.04 | 44.7 | $0.1_1$ | 0.001 |
| 250 | 239 | 3.59 | 33.916 | $1.30_2$ | 3.26 | 102.2 | 0.02 | 46.5 | $0.1_1$ | 0.001 |
| 300 | 286 | 3.48 | 33.974 | $0.97_0$ | 3.29 | 112.0 | 0.03 | 47.9 | $0.0_9$ | 0.001 |
| 400 | 383 | 3.47 | 34.085 | $0.71_1$ | 3.33 | 119.8 | 0.02 | 47.6 | $0.1_1$ | < 0.001 |
| 500 | 480 | 3.38 | 34.184 | $0.68_0$ | 3.34 | 129.2 | 0.03 | 48.6 | $0.1_1$ | < 0.001 |
| 600 | 577 | 3.26 | 34.247 | $0.57_0$ | 3.37 | 135.4 | 0.02 | 47.4 | $0.0_6$ | - |
| 800 | 773 | 2.97 | 34.339 | $0.59_4$ | 3.36 | 148.3 | 0.02 | 48.2 | $0.0_6$ | - |
| 1000 | 969 | 2.72 | 34.408 | $0.59_5$ | 3.33 | 158.6 | 0.02 | 47.9 | $0.0_6$ | - |

1-8. Table of Niskin data

| St. No. | Date | Time | Lat. | Long. | Air temp. | Weather | Wind | Swell | Trans. |
|---|---|---|---|---|---|---|---|---|---|
| 13 | May 20 | 02:00 | 45°08.3'N | 164°49.0'W | 8.4°C | f 10 | SW $\frac{6.0}{4}$ | 1 | - |

| S. Depth (m) | D (m) | T (°C) | S (‰) | $O_2$ (ml/l) | $PO_4$—P (μgatoms/l) | $SiO_2$—Si ( 〃 ) | $NO_2$—N ( 〃 ) | $NO_3$—N ( 〃 ) | $NH_4$ ( 〃 ) | Chl (μg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 8.0 | 33.118 | $7.07_4$ | 1.11/1.05* | 38.7 | 0.12 | 10.5 | $0.1_1$ | 0.051 |
| 10 | 10 | 7.78 | 33.092 | $7.06_9$ | 1.15/1.08 | 41.8 | 0.12 | 10.7 | $0.1_7$ | 0.049 |
| 20 | 19 | 7.64 | 33.117 | $7.09_2$ | 1.08/1.07 | 33.6 | 0.11 | 10.4 | $0.2_0$ | 0.059 |
| 30 | 29 | 7.55 | 33.129 | $7.08_2$ | 1.15 | 33.2 | 0.12 | 10.7 | $0.2_0$ | 0.088 |
| 50 | 49 | 7.56 | 33.140 | $7.07_1$ | 1.08 | 35.2 | 0.11 | 10.3 | $0.1_4$ | 0.061 |
| 75 | 73 | 7.60 | 33.185 | $6.99_8$ | 1.08 | 31.0 | 0.12 | 10.9 | $0.2_0$ | 0.028 |
| 100 | 98 | 7.44 | 33.253 | $6.87_7$ | 1.16 | 36.8/42.2* | 0.14 | 10.4 | $0.3_7$ | 0.004 |
| 125 | 122 | 7.35 | 33.823 | $6.09_5$ | 1.35 | 29.0/51.0 | 0.03 | 16.0 | $0.0_0$ | 0.002 |
| 150 | 146 | 7.25 | 33.848 | $6.03_1$ | 1.38 | 35.0/50.5 | 0.03 | 18.0 | $0.2_0$ | 0.002 |
| 200 | 195 | 7.02 | 33.921 | $5.33_7$ | 1.60 | 38.8/ - | 0.04 | 20.0 | $0.0_6$ | 0.001 |
| 250 | 244 | 6.36 | 33.941 | $4.54_7$ | 2.03/1.81/1.95* | 49.0/73.8 | 0.03 | 27.5 | $0.0_3$ | 0.001 |
| 300 | 293 | 5.66 | 33.921 | $4.05_3$ | 2.01/2.24/2.24 | 60.3/105.2 | 0.00 | 30.6 | $0.0_8$ | $<$ 0.001 |
| 400 | 392 | 4.72 | 33.942 | $2.89_9$ | 2.53/2.74/2.74 | 83.0/103.2 | 0.01 | 37.7 | $0.0_5$ | $<$ 0.001 |
| 500 | 492 | 4.24 | 34.014 | $2.01_5$ | 2.74/3.01/3.01 | 98.6/125.0 | 0.03 | 41.9 | $0.0_3$ | $<$ 0.001 |
| 600 | 591 | 4.02 | 34.129 | $1.47_1$ | 2.93/3.03/3.03 | 110.0 | 0.01 | 44.2 | $0.0_5$ | - |
| 800 | 789 | 3.51 | 34.255 | $0.90_7$ | 3.09/3.39/3.39 | 135.4 | 0.01 | 46.3 | $0.0_5$ | - |
| 1000 | 989 | 3.08 | 34.339 | $0.78_3$ | 3.13/3.45/3.45 | 145.6 | 0.01 | 48.1 | $0.0_8$ | - |
| 1500 | 1425 | 2.44 | 34.492 | $0.76_0$ | 3.15/3.49/3.49 | 175.4 | 0.01 | 48.7 | $0.1_1$ | - |
| 2000 | 1942 | 2.05 | 34.579 | $1.20_0$ | 2.94/3.50/3.50 | 185.0 | 0.01 | 47.6 | $0.0_8$ | - |
| 2500 | 2445 | 1.77 | 34.631 | $1.94_7$ | 2.95/2.78 | 189.0 | 0.01 | 44.9 | $0.0_8$ | - |
| 3000 | 2935 | 1.72 | 34.659 | $2.70_8$ | 3.11/2.36 | 185.0 | 0.01 | 41.8 | $0.0_5$ | - |
| 3500 | 3430 | 1.54 | - | $3.11_2$ | 2.92/2.32 | 179.8 | 0.02 | 42.3 | $0.0_5$ | - |
| 4000 | 3930 | 1.38 | 34.697 | $3.44_8$ | 2.83 | 177.0 | 0.01 | 41.1 | $0.0_3$ | - |

* First/second/third test

1-9. Table of Niskin data

| St. No. | Date | Time | Lat. | Long. | Air temp. | Weather | Wind | Swell | Trans. |
|---|---|---|---|---|---|---|---|---|---|
| 23 | June 15 | 02:10 | 35°51.9'N | 171°14.1'E | 16.5°C | o 10 | ESE $^{12.0}_{6}$ | 4 | - |

| S. Depth (m) | D (m) | T (°C) | S (‰) | $O_2$ (ml/l) | $PO_4$—P (μgatoms/l) | $SiO_2$—Si ( 〃 ) | $NO_2$—N ( 〃 ) | $NO_3$—N ( 〃 ) | $NH_4$ ( 〃 ) | Chl (μg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 18.8 | 34.837 | $5.50_0$ | 0.13 | 15.0 | 0.01 | 0.1 | $0.2_4$ | 0.029 |
| 10 | 10 | 18.76 | 34.825 | $5.56_4$ | 0.12 | 12.5 | 0.02 | 0.1 | $0.1_0$ | 0.031 |
| 20 | 20 | 18.76 | 34.821 | $5.60_0$ | 0.17 | 15.5 | 0.02 | 0.0 | $0.1_4$ | 0.044 |
| 30 | 30 | 17.54 | 34.695 | $5.91_0$ | 0.17 | 13.4 | 0.04 | 0.1 | $0.1_0$ | 0.082 |
| 50 | 49 | 16.22 | 34.742 | $5.65_4$ | 0.32 | 14.0 | 0.25 | 2.5 | $0.2_1$ | 0.030 |
| 75 | 74 | 15.69 | 34.714 | $5.32_2$ | 0.42 | 25.0 | 0.09 | 5.2 | $0.0_0$ | 0.012 |
| 100 | 98 | 14.97 | 34.658 | $5.31_5$ | 0.55/0.69 | 17.5 | 0.04 | 6.3 | $0.0_7$ | 0.012 |
| 125 | 123 | 14.04 | 34.980 | $5.53_6$ | 0.59/0.85 | 20.0 | 0.06 | 7.3 | $0.0_7$ | 0.006 |
| 150 | 147 | 13.48 | 34.558 | $5.65_1$ | 0.68/0.74 | 19.5 | 0.05 | 7.8 | $0.0_7$ | 0.003 |
| 200 | 196 | 12.64 | 34.492 | $5.63_0$ | 0.61 | 29.6 | 0.03 | 9.0 | $0.1_0$ | 0.001 |
| 250 | 245 | 11.67 | 34.413 | $5.41_3$ | 0.74 | 26.0 | 0.03 | 11.2 | $0.0_7$ | 0.002 |
| 300 | 296 | 10.78 | 34.320 | $5.60_6$ | 0.82 | 34.0 | 0.03 | 12.2 | $0.1_0$ | 0.002 |
| 400 | 392 | 9.12 | 34.168 | $5.33_6$ | 1.12 | 38.0 | 0.02 | 17.1 | $0.0_7$ | 0.001 |
| 500 | 490 | 7.02 | 34.047 | $4.08_5$ | 1.74 | 60.4 | 0.02 | 25.0 | $0.0_7$ | < 0.001 |
| 600 | 588 | 5.40 | 34.061 | $3.11_8$ | 2.19 | 76.8 | 0.02 | 30.8 | $0.0_7$ | - |
| 800 | 783 | 4.21 | 34.151 | $1.69_0$ | 2.84 | 109.5 | 0.01 | 38.0 | $0.1_4$ | - |
| 1000 | 973 | 3.52 | 34.291 | $1.01_5$ | 3.06 | 132.3 | 0.01 | 41.5 | $0.1_4$ | - |
| 1500 | 1462 | 2.57 | 34.483 | $0.87_0$ | 3.36 | 161.8 | 0.01 | 43.0 | $0.0_0$ | - |

1-10. Table of Niskin data

| St. No. | Date | Time | Lat. | Long. | Air temp. | Weather | Wind | Swell | Trans. |
|---|---|---|---|---|---|---|---|---|---|
| 23 (2) | June 16 | 11:24 | 35°34.8'N | 171°56.3'E | 17.4°C | o 10 | SE 14.0 7 | 5 | - |

| S. Depth (m) | D (m) | T (°C) | S (‰) | $O_2$ (ml/l) | $PO_4$—P (μgatoms/l) | $SiO_2$—Si ( 〃 ) | $NO_2$—N ( 〃 ) | $NO_3$—N ( 〃 ) | $NH_4$ ( 〃 ) | Chl (μg/l) |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 18.7 | 34.769 | $5.58_0$ | 0.20 | 6.4 | 0.01 | 0.2 | $0.2_2$ | 0.034 |
| 10 | 9 | 18.67 | 34.764 | $5.59_7$ | 0.17 | 6.9 | 0.01 | 0.0 | $0.0_7$ | 0.036 |
| 20 | 18 | 18.61 | 34.763 | $5.50_8$ | 0.21 | 5.5 | 0.01 | 0.0 | $0.1_1$ | 0.043 |
| 30 | 26 | 18.21 | 34.737 | $5.65_2$ | 0.20 | 4.0 | 0.01 | 0.1 | $0.0_7$ | 0.059 |
| 50 | 44 | 18.22 | 34.689 | $5.64_0$ | 0.14 | 8.0 | 0.34 | 2.5 | $0.0_3$ | 0.050 |
| 75 | 65 | 15.42 | 34.681 | $5.53_3$ | 0.34 | 8.4 | 0.15 | 3.3 | $0.0_0$ | 0.014 |
| 100 | 75 | 14.99 | 34.676 | $5.42_0$ | 0.23 | 8.0 | 0.07 | 4.2 | $0.2_2$ | 0.002 |
| 125 | 103 | 14.60 | 34.636 | $5.34_4$ | 0.62 | 9.8 | 0.03 | 7.2 | $0.1_8$ | 0.001 |
| 150 | 120 | 14.26 | 34.600 | $5.14_0$ | 0.73 | 12.0 | 0.01 | 8.6 | $0.0_3$ | 0.001 |
| 200 | 160 | 13.20 | 34.532 | $5.47_9$ | 0.78 | 14.0 | 0.02 | 9.2 | $0.0_7$ | 0.001 |
| 250 | 200 | 12.80 | 34.494 | $5.29_5$ | 0.92 | 16.5 | 0.04 | 10.0 | $0.0_3$ | < 0.001 |
| 300 | 244 | 11.98 | 34.419 | $5.15_1$ | 1.04 | 20.0 | 0.02 | 12.5 | $0.1_1$ | < 0.001 |
| 400 | 332 | 10.56 | 34.301 | $5.35_6$ | 1.19 | 20.8 | 0.03 | 13.9 | $0.1_8$ | < 0.001 |
| 500 | 426 | 8.32 | 34.118 | $4.66_3$ | 1.82 | 36.3 | 0.02 | 21.7 | $0.1_1$ | < 0.001 |

## 2-1. Tables of STD operations

| St. No. | Date | Time | Location Lat. | Location Long. |
|---|---|---|---|---|
| 1-2 | May 5 | 10:36~11:12 | 41-30.1N | 165-06.2E |

| D (m) | T (°C) | S (‰) |
|---|---|---|
| 0 | 6.400 | 33.551 |
| 10 | 6.330 | 33.547 |
| 20 | 6.293 | 33.551 |
| 30 | 6.277 | 33.552 |
| 50 | 6.251 | 33.560 |
| 75 | 6.234 | 33.568 |
| 100 | 5.992 | 33.592 |
| 150 | 5.697 | 33.647 |
| 200 | 5.734 | 33.816 |
| 300 | 4.656 | 33.856 |
| 500 | 4.262 | 34.130 |
| 600 | 3.900 | 34.204 |
| 800 | 3.528 | 34.337 |
| 1000 | 3.134 | 34.418 |

| St. No. | Date | Time | Location Lat. | Location Long. |
|---|---|---|---|---|
| 4 | May 7 | 20:57~21:33 | 45-43.0N | 166-55.4E |

| D (m) | T (°C) | S (‰) |
|---|---|---|
| 0 | (3.6) | - |
| 10 | 3.582 | 33.038 |
| 20 | 3.587 | 33.038 |
| 30 | 3.587 | 33.039 |
| 50 | 3.589 | 33.040 |
| 75 | 3.589 | 33.041 |
| 100 | 3.570 | 33.042 |
| 150 | 2.871 | 33.527 |
| 200 | 3.228 | 33.720 |
| 300 | 3.422 | 33.888 |
| 500 | 3.496 | 34.147 |
| 600 | 3.403 | 34.233 |
| 800 | 3.141 | 34.343 |
| 1000 | 2.894 | 34.423 |

Modification: T=-0.2(°C), S=+0.02(‰)

| St. No. | Date | Time | Location Lat. | Location Long. |
|---|---|---|---|---|
| 8 | May 13 | 10:11~10:55 | 43-02.8N | 173-26.6E |

| D (m) | T (°C) | S (‰) |
|---|---|---|
| 0 | - | - |
| 10 | 7.670 | 33.708 |
| 20 | 7.663 | 33.708 |
| 30 | 7.662 | 33.709 |
| 50 | 7.663 | 33.711 |
| 75 | 7.665 | 33.712 |
| 100 | 7.664 | 33.714 |
| 150 | 8.339 | 33.946 |
| 200 | 7.112 | 33.952 |
| 300 | 5.675 | 33.920 |
| 500 | 4.403 | 34.082 |
| 600 | 3.986 | 34.151 |
| 800 | 3.600 | 34.304 |
| 1000 | 3.137 | 34.392 |

## 2-2. Tables of STD operations

| St. No. | Date | Time | Location Lat. | Location Long. |
|---|---|---|---|---|
| 13 | May 20 | 12:16~12:53 | 45-00.7$^N$ | 164-58.0$^W$ |

| D (m) | T (°C) | S (‰) |
|---|---|---|
| 0 | (8.4) 8.299 | 33.173 |
| 10 | 8.243 | 33.176 |
| 20 | 7.965 | 33.175 |
| 30 | 7.881 | 33.179 |
| 50 | 7.851 | 33.181 |
| 75 | 7.708 | 33.193 |
| 100 | 7.690 | 33.273 |
| 150 | 7.468 | 33.841 |
| 200 | 7.204 | 33.894 |
| 300 | 5.813 | 33.922 |
| 500 | 4.395 | 34.042 |
| 600 | 4.156 | 34.146 |
| 800 | 3.666 | 34.281 |
| 1000 | 3.273 | 34.375 |

| St. No. | Date | Time | Location Lat. | Location Long. |
|---|---|---|---|---|
| 14-2 | May 23 | 11:26~12:00 | 35-58.0$^N$ | 165-01.5$^W$ |

| D (m) | T (°C) | S (‰) |
|---|---|---|
| 0 | (16.7) 16.769 | 34.401 |
| 10 | 16.757 | 34.395 |
| 20 | 14.988 | 34.348 |
| 30 | 14.627 | 34.348 |
| 50 | 14.196 | 34.371 |
| 75 | 13.707 | 34.267 |
| 100 | 13.180 | 34.329 |
| 150 | 12.399 | 34.380 |
| 200 | 11.512 | 34.333 |
| 300 | 10.266 | 34.225 |
| 500 | 7.190 | 34.035 |
| 600 | 5.753 | 34.003 |
| 800 | 4.290 | 34.161 |
| 1000 | 3.646 | 34.315 |

| St. No. | Date | Time | Location Lat. | Location Long. |
|---|---|---|---|---|
| 15-B | May 24 | 08:13~ | 34-53.2$^N$ | 165-00.6$^W$ |

| D (m) | T (°C) | S (‰) |
|---|---|---|
| 0 | (17.6) 17.683 | 34.498 |
| 10 | 17.668 | 34.501 |
| 20 | 17.602 | 34.504 |
| 30 | 17.461 | 34.510 |
| 50 | 15.652 | 34.488 |
| 75 | 14.759 | 34.463 |
| 100 | 13.878 | 34.346 |
| 150 | 12.991 | 34.309 |
| 200 | 12.326 | 34.393 |
| 300 | 10.814 | 34.276 |
| 500 | 7.794 | 34.084 |
| 600 | 6.087 | 34.022 |
| 800 | 4.386 | 34.152 |
| 1000 | 3.718 | 34.309 |

## 2-3. Tables of STD operations

| St. No. | Date. | Time | Location Lat. | Location Long. |
|---|---|---|---|---|
| 16 | May 26 | 08:06~ | 29-50.1 N | 162-21.0 W |

| D (m) | T (°C) | S (‰) |
|---|---|---|
| 0 | | |
| 10 | | |
| 20 | | |
| 30 | | |
| 50 | | |
| 75 | | |
| 100 | No datum by computer trouble, only graphing monitored. | |
| 150 | | |
| 200 | | |
| 300 | | |
| 500 | | |
| 600 | | |
| 800 | | |
| 1000 | | |

| St No. | Date | Time | Location Lat. | Location Long. |
|---|---|---|---|---|
| 21-2 | June 11 | 09:08~09:45 | 28-26.2 N | 179-10.4 E |

| D (m) | T (°C) | S (‰) |
|---|---|---|
| 0 | (24.1) 24.040 | 34.141 |
| 10 | 24.005 | 35.139 |
| 20 | 23.966 | 35.137 |
| 30 | 23.631 | 35.127 |
| 50 | 20.376 | 34.918 |
| 75 | 18.390 | 34.861 |
| 100 | 17.266 | 34.794 |
| 150 | 16.060 | 34.700 |
| 200 | 15.251 | 34.620 |
| 300 | 13.484 | 34.498 |
| 500 | 9.099 | 34.149 |
| 600 | 7.039 | 34.029 |
| 800 | 4.826 | 34.140 |
| 1000 | 3.871 | 34.332 |

| St. No. | Date | Time | Location Lat. | Location Long. |
|---|---|---|---|---|
| 22-1 | June 13 | 16:12~16:47 | 32-30.6 N | 175-20.0 E |

| D (m) | T (°C) | S (‰) |
|---|---|---|
| 0 | (21.9) 21.766 | 35.162 |
| 10 | 21.562 | 35.106 |
| 20 | 20.505 | 35.167 |
| 30 | 20.419 | 35.160 |
| 50 | 20.169 | 35.128 |
| 75 | 18.840 | 34.974 |
| 100 | 17.551 | 34.851 |
| 150 | 16.693 | 34.749 |
| 200 | 15.916 | 34.688 |
| 300 | 14.889 | 34.601 |
| 500 | 10.824 | 34.296 |
| 600 | 8.569 | 34.124 |
| 800 | 5.319 | 34.033 |
| 1000 | 4.119 | 34.222 |

## 2-4. Tables of STD operations

| St. No. | Date | Time | Location Lat. | Location Long. |
|---|---|---|---|---|
| 23 | June 15 | 11:04~11:18 | 35-35.0$^N$ | 171-25.6$^E$ |

| D (m) | T (°C) | S (‰) |
|---|---|---|
| 0 | (18.9) 18.918 | 34.783 |
| 10 | 18.916 | 34.783 |
| 20 | 18.742 | 34.748 |
| 30 | 17.599 | 34.633 |
| 50 | 15.542 | 34.642 |
| 75 | 15.288 | 34.651 |
| 100 | 14.338 | 34.621 |
| 150 | 13.521 | 34.556 |
| 200 | 12.782 | 34.494 |
| 300 | | |
| 500 | | |
| 600 | | |
| 800 | | |
| 1000 | | |

| St. No. | Date | Time | Location Lat. | Location Long. |
|---|---|---|---|---|
| 24 | June 17 | 12:25~12:58 | 34-02.5$^N$ | 169-58.9$^E$ |

| D (m) | T (°C) | S (‰) |
|---|---|---|
| 0 | (18.5) 18.524 | 34.467 |
| 10 | 18.370 | 34.460 |
| 20 | 18.009 | 34.395 |
| 30 | 14.639 | 34.420 |
| 50 | 12.783 | 34.428 |
| 75 | 11.824 | 34.390 |
| 100 | 10.876 | 34.322 |
| 150 | 10.089 | 34.254 |
| 200 | 9.331 | 34.176 |
| 300 | 7.697 | 34.052 |
| 500 | 5.129 | 34.021 |
| 600 | 4.615 | 34.094 |
| 800 | 3.869 | 34.270 |
| 1000 | 3.340 | 34.381 |

| St. No. | Date | Time | Location Lat. | Location Long. |
|---|---|---|---|---|
| 25 | June 18 | 23:05~23:47 | 34-05.4$^N$ | 165-25.7$^E$ |

| D (m) | T (°C) | S (‰) |
|---|---|---|
| 0 | (18.4) 18.381 | 34.522 |
| 10 | 17.827 | 34.535 |
| 20 | 17.637 | 34.527 |
| 30 | 16.589 | 34.584 |
| 50 | 13.561 | 34.508 |
| 75 | 12.743 | 34.480 |
| 100 | 12.257 | 34.476 |
| 150 | 11.613 | 34.399 |
| 200 | 11.086 | 34.366 |
| 300 | 9.267 | 34.173 |
| 500 | 5.697 | 34.004 |
| 600 | 4.946 | 34.077 |
| 800 | 4.063 | 34.244 |
| 1000 | 3.550 | 34.351 |

3-1. Measurement data of turbidity and irradiance

| Station | Date | Time | Location | Remarks |
|---|---|---|---|---|
| 1-1 | May 5 | 0928 ~ 1004 | 41-30.4N, 165-05.0E ~ 41-30.0N, 165-06.1E | STM |
| 5 | May 8 | 1212 ~ 1303 | 45-01.3N, 169-09.5E ~ 45-01.4N, 169-09.8E | DTM |
| 10 | May 16 | 1127 ~ 1139 | 43-49.4N, 179-59.7E ~ 43-49.3N, 179-59.7E | STM |
| 13 | May 20 | 0944 ~ 1106 | 44-59.5N, 164-19.3W ~ 45-00.2N, 164-58.5E | STM |
| 14-2 | May 23 | 1011 ~ 1056 | 35-58.1N, 165-01.4W ~ 35-58.0N, 165-01.5W | DTM |
| " | " | 1122 ~ 1132 | 35-58.1N, 165-01.6W ~ 35-58.2N, 165-01.6W | STM |
| 15 | May 24 | 0940 ~ 1017 | 34-51.6N, 165-01.5W ~ 34-51.9N, 165-01.9W | DTM |
| 16 | May 26 | 0922 ~ 1012 | 29-49.7N, 162-21.3W ~ 29-49.2N, 162-21.3W | DTM |
| 18-2 | June 8 | 1007 ~ 1047 | 24-28.8N, 166-11.2W ~ 24-30.3N, 166-12.0W | DTM |
| " | " | 1150 ~ 1156 | 24-31.1N, 166-12.6W ~ 24-31.2N, 166-12.7W | STM |
| 21-2 | June 11 | 1039 ~ 1126 | 28-27.2N, 179-10.0E ~ 28-27.7N, 179-09.8E | DTM |
| " | " | 1127 ~ 1136 | 28-27.7N, 179-09.8E ~ 28-27.8N, 179-09.8E | STM |
| 22-1 | June 13 | 1343 ~ 1439 | 32-29.5N, 175-16.5E ~ 32-30.2N, 175-17.8E | DTM |
| " | " | 1440 ~ 1503 | 32-30.2N, 175-17.8E ~ 32-30.3N, 175-18.5E | STM |
| " | " | 1510 ~ 1604 | 32-30.3N, 175-18.6E ~ 32-30.6N, 175-19.9E | Van |
| 23 | June 15 | 1203 ~ 1232 | 35-34.6N, 171-26.0E ~ 35-35.2N, 171-26.0E | Van |
| " | " | 1238 ~ 1304 | 35-35.6N, 171-26.1E ~ 35-35.7N, 171-26.5E | DTM |
| " | " | 1305 ~ 1329 | 35-35.7N, 171-26.5E ~ 35-35.9N, 171-26.7E | STM |
| 24 | June 17 | 1000 ~ 1046 | 34-00.9N, 169-58.8E ~ 34-01.7N, 169-59.1E | DTM |
| " | " | 1055 ~ 1200 | 34-01.9N, 169-59.2E ~ 34-02.5N, 169-58.9E | Van |
| " | " | 1417 ~ 1453 | 34-03.9N, 169-59.6E ~ 34-03.9N, 170-00.4E | STM |
| 25 | June 18 | 2212 ~ 2302 | 34-05.9N, 165-25.2E ~ 34-05.5N, 165-25.6E | DTM |
| " | June 19 | 0030 ~ 0040 | 34-05.2N, 165-25.4E ~ 34-05.2N, 165-25.4E | STM |

DTM: Deep-Sea Turbidity Meter

STM: Shallow Water Turbidity Meter

Van: Van Dorn Water Sampling

3-2. Measurement data of turbidity and irradiance

| Sta. | Date | Time | Location | Meter | Transparency |
|---|---|---|---|---|---|
| 5 | May 8 | 10:31~10:50 | 45°-01.3N 169°-08.5E ~ 45°-01.1N 169°-08.7E | Turbidity | 15 m |
| | 〃 | 11:05~11:43 | 45°-01.1N 169°-08.5E ~ 45°-01.2N 169°-09.2E | Irradiance | |
| 6 | May 9 | 14:30~14:50 | 44°-27.5N 170°-21.6E ~ 44°-27.3N 170°-22.9E | Monochromator | 17 m |
| 8 | May 13 | 09:38~09:45 | 43°-03.0N 173°-26.7E ~ 43°-02.9N 173°-26.7E | T. | |
| 9 | May 15 | 12:01~13:42 | 39°-54.7N 179°-58.5E ~ 39°-54.7N 179°-57.4E | T. | |
| 10 | May 16 | 10:10~10:27 | 43°-50.3N 179°-59.9W ~ 43°-50.1N 180°-00.0W | T. | 17.5 m |
| | 〃 | 10:27~11:27 | 43°-50.1N 180°-00.0W ~ 43°-49.4N 179°-59.5E | Ir. | |
| 11 | May 18 | 09:10~09:40 | 50°-00.9N 179°-55.3W ~ 50°-01.4N 179°-54.2W | T. | |
| 13 | May 20 | 09:44~11:06 | 45°-59.5N 164°-19.3W ~ 45°-00.2N 164°-58.5W | T.<br>M. | 22.0 m (10°) |
| 14-2 | May 23 | 12:36~12:55 | 35°-58.1N 165°-01.0W ~ 35°-58.0N 165°-00.8W | T. | 17.5 m |
| | 〃 | 13:04~13:43 | 35°-58.0N 165°-00.8W ~ 35°-57.6N 165°-00.5W | Ir. | |
| 15 | May 24 | 12:10~12:40 | 34°-49.6N 165°-01.5W ~ 34°-49.1N 165°-01.4W | T. | 28.5 m (25°) |
| | 〃 | 12:47~13:30 | 34°-49.0N 165°-01.4W ~ 34°-48.3N 165°-01.3W | M. | |
| 16 | May 26 | 10:13~10:23 | 29°-49.2N 162°-21.3W ~ 29°-49.1N 162°-21.3W | T. | |
| 18-2 | June 8 | 10:55~11:05 | 24°-30.4N 166°-12.1W ~ 24°-30.5N 166°-12.2W | T. | 27 m (0°) |
| | 〃 | 11:11~11:45 | 24°-30.6N 166°-12.3W ~ 24°-31.0N 166°-12.6W | Ir. | |
| 21-2 | June 11 | 11:41~11:55 | 28°-27.9N 179°-09.8E ~ 28°-28.1N 179°-09.7E | T. | 32 m (30°) |
| 22-1 | June 13 | 14:40~15:03 | 32°-30.2N 175°-17.8E ~ 32°-30.3N 175°-18.5E | T. | 27 m (10°) |
| | 〃 | 12:54~13:39 | 32°-29.0N 175°-15.8E ~ 32°-29.5N 175°-16.5E | M. | |
| 23 | June 15 | 13:05~13:29 | 35°-35.7N 171°-26.5E ~ 35°-35.9N 171°-26.7E | T. | |
| 24 | June 17 | 14:17~14:53 | 34°-03.9N 169°-59.6E ~ 34°-03.9N 170°-00.4E | T. | |
| | 〃 | 13:35~14:15 | 34°-03.5N 169°-59.4E ~ 34°-03.9N 169°-59.6E | M. | |
| 24-1 | June 18 | 09:57~10:43 | 34°-05.6N 167°-30.2E ~ 34°-04.7N 167°-30.7E | M. | |
| 25 | June 19 | 00:30~00:40 | 34°-05.2N 165°-25.4E ~ 34°-05.2N 165°-25.4E | T. | 24 m |
| 25 | 〃 | 13:06~13:40 | 34°-02.4N 162°-37.5E ~ 34°-02.3N 162°-37.9E | M. | 20 m |

## 4. Tables of Van Dorn samplings

### 4-1. 50 ℓ Van Dorn (0 ~ 300 m)

| Sta. | Date (1974) | Time | Location Lat. | Location Long. | Sampling depth m | Remarks |
|---|---|---|---|---|---|---|
| 5 | May 8 | 08:15~10:31 | | | 0, 10, 20, 30, 50<br>75, 100, 150, 200, 300 | |
| | " | 21:24~22:05 | | | 0, 10, 50, 100, 200, 300 | |
| 6 | May 9 | 14:30~15:59 | | | 0, 10, 20, 30, 50, 75,<br>100, 150, 200, 300 | |
| | May 10 | 02:05~02:43 | | | 0, 10, 50, 100, 200, 300 | |
| 7 | " | 22:45~23:10 | | | 0, 20, 50, 100 | |
| 8 | May 12 | 12:38~14:07 | | | 0, 10, 20, 30, 50, 75, 100<br>150, 200, 300 | |
| | May 13 | 17:19~18:30 | | | 0, 10, 20, 30, 50, 75, 100<br>150, 200, 300 | |
| 23 | June 15 ~ 16 | 23:35~00:15 | | | 0, 10, 20, 30, 50, 75<br>100, 150, 200, 300 | |

4-2. 200 ℓ Van Dorn (100 ~ 700 m)

| Sta. | Date (1974) | Time | Location Lat. | Location Long. | Sampling depth | Remarks |
|---|---|---|---|---|---|---|
| 6 | May 10 | 12:37~13:28 | 44-31.6~<br>44-33.1 | 170-17.3<br>170-18.7 | 100, 700 m | |
| 13 | May 21 | 08:14~09:45 | 45-00.6~<br>45-00.8 | 164-57.0<br>164-57.4 | 100, 300, 700 m | |
| 23 | June 14<br>~ 15 | 23:05~01:00 | 35-51.0~<br>35-51.9 | 171-12.7E<br>171-14.1 | 100, 300, 700 m | |

4-3. Particle collector operation

| Sta. | Date (1974) | Time | Location Lat. | Location Long. | Sampling depth | Remarks |
|---|---|---|---|---|---|---|
| 6 | May 9 | 09:45~12:00 | 44-31.0<br>44-30.1 | 170-13.5<br>170-16.6 | 700 m | hauling angle 45° |
| 13 | May 20<br>~ 21 | 08:13~13:10 | 44-58.9<br>45-01.1 | 164-59.6W<br>164-56.5 | 200, 900 m | " 0~10° |
| 23 | June 14<br>~ 16 | 21:45/17:36 | 35-50.5<br>35-48.1 | 171-12.0<br>171-51.3 | 200, 900 m | " 45° |

4-4(1). Van dorn record

| St. No. | 6 |
|---|---|
| Date | May, 10 |
| Time | 05:20 ~ 08:22 |
| Lat. | 44°27.6 |
| Long. | 170°22.8 |

| Depth (m) | Wire out (m) | Angle (°) | Sampling Depth (m) |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 10 | 10 | 10 | |
| 20 | 20 | 10 | |
| 30 | 30 | – | 30 |
| 40 | 40 | 6 | |
| 50 | 50 | 12 | |
| 75 | 75 | 0 | 75 |
| 90 | 100 | 20 | |
| 100 | 100 | 6 | |
| 110 | 112 | 10 | |
| 125 | 126 | 8 | |
| 150 | 150 | 10 | |
| 175 | 180 | 15 | |
| 190 | 196 | 19 | |
| 200 | 200 | 0 | 200 |
| 210 | | 15 | |
| 225 | | 15 | |
| 250 | | 16 | |
| 300 | | 16 | |
| 400 | | 16 | |
| 500 | 521 | 16 | |
| 600 | | 12 | |
| 700 | 720 | 15 | |
| 800 | | 12 | |
| 1000 | 1022 | 12 | |

Remarks

Depth to the Bottom 1275 m

Sampling depths order

1) 600, 800, 1000 m
2) 250, 300, 400, 500 m
3) 0, 10, 20, 30, 50, 75, 100, 125, 150, 175, 200 m (repeat cast)
4) 210, 225, 700 m
5) 40, 90, 110, 190 m (repeat cast)

| St. No. | 9 |
|---|---|
| Date | May, 15 |
| Time | 02:57 ~ 08:10 |
| Lat. | 39°58.2 ~ 39°56.3 |
| Long. | 179°57.1W ~ 179°59.6W |

| Depth (m) | Wire out (m) | Angle (°) | Sampling Depth (m) |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 10 | 10 | – | |
| 20 | 20 | – | |
| 30 | 30 | – | |
| 50 | 50 | – | |
| 75 | 75 | – | |
| 100 | 100 | – | |
| 125 | 125 | – | |
| 150 | 150 | – | |
| 175 | 1175 | – | |
| 200 | 200 | – | |
| 225 | 225 | – | |
| 250 | 250 | – | |
| 275 | 275 | 14 | |
| 300 | 300 | 14 | |
| 400 | 400 | 14 | |
| 500 | 500 | 14 | |
| 600 | 600 | 14 | (365?)* |
| 700 | 700 | 13 | |
| 800 | 800 | 13 | |
| 900 | 900 | 13 | |
| 1000 | 1000 | 13 | |
| 1500 | 1500 | 13 | (422?)* |
| 2000 | 2000 | 8 | 1978 |
| 2500 | 2500 | 8 | 2478 |
| 3000 | 3000 | 8 | 2978 |
| 3500 | 3500 | 8 | 3478 |
| 4000 | 4000 | 8 | 3978* |

Sampling depths order

1) 2000~4000 m (simultaneous 5)
2) 700~1500 m ( " )
3) 275~600 m ( " )

At wire lengths of 4010, 1510, 610 m Niskin samplers attached

* Niskin's depth

4-4(2). Van dorn record

| | |
|---|---|
| St. No. | 10 |
| Date | May,16 |
| Time | 19:20 ~ 21:26 |
| Lat. | 45°00.8 ~ 45°00.3 |
| Long. | 179°58.3E ~ 179°57.2E |

| Depth (m) | Wire out (m) | Angle (°) | Sampling Depth (m) |
|---|---|---|---|
| 0 | 0 | | |
| 10 | 10 | | |
| 20 | 20 | | |
| 30 | 30 | | |
| 50 | 50 | | |
| 75 | 75 | | |
| 100 | 100 | | |
| 150 | 150 | | |
| 200 | 200 | | |
| 250 | 250 | | |
| 300 | 300 | 17 | |
| 400 | 400 | 17 | |
| 500 | 500 | 17 | |
| 600 | 600 | 17 | |
| 700 | 700 | 18 | |
| 800 | 800 | 18 | |
| 900 | 900 | 18 | |
| 1000 | 1000 | 18 | |

| | |
|---|---|
| St. No. | 13 |
| Date | May, 20 |
| Time | 13:50 ~ 20:18 |
| Lat. | 45°02.0 ~ 45°04.3 |
| Long. | 164°57.4 ~ 164°52.4W |

| Depth (m) | Wire out (m) | Angle (°) | Sampling Depth (m) |
|---|---|---|---|
| 0 | | | |
| 10 | | | |
| 20 | | | |
| 30 | | | |
| 40 | | | |
| 50 | | | |
| 75 | | | |
| 100 | | | |
| 125 | | | |
| 150 | | | |
| 175 | | | |
| 200 | | | |
| 225 | | | |
| 250 | | | |
| 275 | | | |
| 300 | | | |
| 400 | | 17 | |
| 500 | | 17 | |
| 600 | | 17 | |
| 700 | | 17 | |
| 800 | 814 | 17 | 793 |
| 900 | | 25 | |
| 1000 | | 25 | |
| 1500 | | 25 | |
| 2000 | | 25 | |
| 2500 | 2620 | 25 | 2266 |
| 3000 | | 26 | |
| 3500 | | 26 | |
| 4000 | 4350 | 26 | ( ? )* |

300 m (repeat cast)

1) 3000, 3500, 4000 m (simultaneously)
2) 900 ~ 2500 m (simultaneous 5)
3) 400 ~ 800 m ( " )

4-4(3). Van dorn record

| | |
|---|---|
| St. No. | 23-A |
| Date | June, 15 |
| Time | 04:18 ~ 05:12 |
| Lat. | 35°52.2 ~ 35°52.1 |
| Long. | 171°16.3E ~ 171°17.7E |

| Depth (m) | Wire out (m) | Angle (°) | Sampling Depth (m) |
|---|---|---|---|
| 0 | 0 | - | 0 |
| 10 | 10 | - | 10 |
| 20 | 20 | - | 20 |
| 30 | 30 | - | 30 |
| 50 | 50 | - | 49 |
| 75 | 75 | - | 74 |
| 100 | 100 | - | 98 |
| 150 | 150 | - | 147 |
| 200 | 200 | - | 196 |
| 250 | 250 | - | 245 |
| 300 | 310 | - | 306* |
| 400 | 410 | - | 402 |
| 500 | 510 | - | 500 |
| 600 | 610 | - | 598 |
| 800 | 810 | 5 | 793 |
| 1000 | 1010 | 5 | 983 |
| 1500 | 1510 | 5 | 1472 |

200 m ; Sliding depths from Niskin's ones*

| | |
|---|---|
| St. No. | 23-B |
| Date | June, 16 |
| Time | 10:07 ~ 11:23 |
| Lat. | 35°34.9 ~ 35°34.8 |
| Long. | 171°55.2E ~ 171°56.3 |

| Depth (m) | Wire out (m) | Angle (°) | Sampling Depth (m) |
|---|---|---|---|
| 0 | 0 | - | |
| 10 | 10 | 0 | |
| 20 | 20 | 0 | |
| 30 | 30 | 3 | |
| 50 | 50 | 3 | |
| 75 | 75 | 6 | |
| 100 | 100 | 14 | |
| 125 | 125 | 14 | |
| 150 | 150 | 14 | |
| 200 | 200 | 14 | |
| 250 | 250 | 25 | |
| 300 | 300 | 25 | |
| 400 | 400 | 25 | |
| 500 | 500 | 25 | |

5. Local time table of sun-rise and -set

| Date | Sta. | Sun rise / Sun set | Date | Sta. | Sun rise / Sun set | Date | Sta. | Sun rise / Sun set | Date | Sta. | Sun rise / Sun set |
|---|---|---|---|---|---|---|---|---|---|---|---|
| May 3 | - | 04 : 44 | May 16 | 10 | 04 : 37 | June 8 | 18-1 | 05 : 12 | June 21 | | 04 : 37 |
| | | 18 : 24 | | | 19 : 23 | | 18-2 | 19 : 00 | | | 19 : 17 |
| 4 | 1 | 05 : 16 | 17 | | 04 : 26 | 9 | 19 | 05 : 27 | 22 | | 05 : 05 |
| | | 19 : 02 | | | 19 : 39 | | | 19 : 24 | | | 19 : 43 |
| 5 | 1 | 04 : 53 | 18 | 12, 13* | 04 : 10 | 10 | 20 | 04 : 45 | 23 | | 04 : 30 |
| | | 19 : 05 | | | 19 : 30 | | | 18 : 50 | | | |
| 6 | 2 | 04 : 43 | 19 | 13 | 04 : 35 | 11 | 21-1 | 05 : 04 | | | |
| | | 19 : 11 | | | 19 : 27 | | 21-2 | 19 : 08 | | | |
| 7 | | 04 : 32 | 20 | 13 | 04 : 26 | 12 | | skip | | | |
| | | 19 : 08 | | | 19 : 28 | | | | | | |
| 8 | 5 | 04 : 25 | 21 | 13 | 04 : 25 | 13 | 22-1 | 05 : 11 | | | |
| | | 18 : 56 | | | 19 : 26 | | 22-2 | 19 : 30 | | | |
| 9 | 6 | 04 : 20 | 22 | 14-1 | 04 : 33 | 14 | 23 | 05 : 13 | *May 18 | 13 | 03 : 55 |
| | | 18 : 52 | | | 19 : 12 | | | 19 : 51 | | | 18 : 59 |
| 10 | 6, 7 | 04 : 17 | 23 | 14-2 | 04 : 47 | 15 | 23 | 04 : 17 | (* after pass the date line) | | |
| | | 18 : 48 | | 15 | 19 : 05 | | | 18 : 51 | | | |
| 11 | | 04 : 10 | 24 | 15 | 04 : 51 | 16 | 23 | 04 : 16 | | | |
| | | 18 : 42 | | | 19 : 03 | | | 18 : 51 | | | |
| 12 | 8 | 05 : 07 | 25 | | 04 : 51 | 17 | | 04 : 24 | | | |
| | | 19 : 40 | | | 18 : 47 | | | 18 : 53 | | | |
| 13 | 8 | 05 : 06 | 26 | 16 | 04 : 50 | 18 | 24 | 04 : 33 | | | |
| | | 19 : 40 | | | 18 : 34 | | 25 | 19 : 11 | | | |
| 14 | 9 | 05 : 00 | 27 | | 04 : 50 | 19 | 25 | 04 : 50 | | | |
| | | 19 : 15 | | | 18 : 12 | | | 19 : 28 | | | |
| 15 | | 04 : 45 | 28 | | 05 : 48 | 20 | 26 | 05 : 14 | | | |
| | | 19 : 11 | | | 19 : 02 | | | 19 : 51 | | | |

6-1 IKMT and Norpac* net sampling data

| Sta. | Date | Time | | Location | | Wire | | Net depth | Ship speed | Type of net | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | net in | net out | net in | net out | length | angle | | | | |
| 1 | May 4 | 21:43 | 00:32 | 39-58.5N<br>164-59.7E | 39-54.0N<br>165-09.7E | 3500 m | - | 0~1300 m | 4 kts<br>2 kts | IKMT | |
| 2 | May 6 | 05:24 | 07:39 | 45-00.7N<br>165-00.2E | 45-07.3<br>165-05.1 | 3500 m | 72° | 0~1300 m | 3.5<br>1.5 | " | bucket dislocated, most of sample lost |
| 5 | May 8 | 17:46 | 20:30 | 44-49.8N<br>169-22.2E | 44-58.2<br>169-16.8 | 3500 m | 67° | 0~1600 m | 2.5<br>1.0 | ORI<br>Norpac (12) | 19:37~20:02, oiled to pulley (stopped hauling) |
| 6 | May 9 | 20:38 | 22:23 | 44-29.0N<br>170-22.8E | 44-25.3<br>170-21.0 | 2000 m | 52° | 0~1300 m | 2 kts<br>2 kts | "<br>Norpac (17) | net teared at sea-surface |
| 8 | May 13 | 19:40 | 22:28 | 42-58.3N<br>173-32.6E | 42-54.1<br>173-41.1 | 3500 m | - | 0~1250 m | 3 kts<br>3 kts | IKMT<br>Norpac (25) | |
| 9 | May 15 | 00:42 | 02:25 | 40-00.2N<br>179-59.7E | 39-59.5N<br>179-59.2W | 3500 m | - | 0~1200 m | 4 kts<br>2 kts | "<br>Norpac (11) | |
| 10 | May 16 | 21:58 | 00:14 | 45-00.4N<br>179-56.6E | 45-08.7N<br>179-58.0E | 3500 m | 59° | 0~1100 m | 4 kts<br>2 kts | "<br>Norpac (14) | |
| 11 | May 18 | 02:51 | 04:50 | 50-03.5N<br>179-57.6W | 50-10.0N<br>179-56.9W | 3500 m | - | 0~1300 m | 4<br>2 | "<br>Norpac (14) | |
| 12 | May 18-19 | 22:16 | 00:49 | 47-05.8N<br>170-01.3W | 47-03.3N<br>169-52.7W | 3500 m | - | 0~1450 m | 4<br>2 | " | 3500 m wire out, 22:15 ~ 23:35 steady towing |
| 13 | May 19 | 23:09 | 01:06 | 45-03.2N<br>164-56.0W | 45-08.0N<br>164-51.3W | 3500 m | - | 0~1100 m | 4<br>2 | " | |
| 14 | May 23 | 13:54 | 16:20 | 35-57.5N<br>165-00.5W | 35-50.6N<br>164-59.8W | 3500 m | - | 0~1400 m | 4<br>2 | "<br>Norpac (19) | 3500 m wire out, 14:50 ~ 15:10 steady towing |

* Norpac samplings were operated with 2 kts ship-speed during IKMT hauling up.

6-2 IKMT and Norpac* net sampling data

| Sta. | Date | Time | | Location | | Wire | | Net depth | Ship speed | Type of net | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | net in | net out | net in | net out | length | angle | | | | |
| 15 | May 24 | 20:05 | 22:20 | 34-46.3N<br>165-03.5W | 34-39.2N<br>164-59.9W | 3500 m | 59° | 0~1100 m | 4 kts**<br>2 kts | IKMT<br>Norpac (15) | |
| 16 | May 26 | 04:16 | 06:55 | 29-57.0N<br>162-16.8W | 29-49.4N<br>162-20.6W | 3500 m | - | 0~1380 m | 4 "<br>2 " | IKMT<br>Norpac (14) | 3500 m wire out, 05:27 ~ 05:47 steady towing |
| 17 | June 7 | 15:24 | 18:02 | 23-26.4N<br>162-55.6W | 23-27.1N<br>163-03.3W | 3500 m | - | 0~1100 m | 4 "<br>2 " | IKMT<br>Norpac (14) | |
| 18 | June 8 | 03:33 | 05:38 | 24-08.4N<br>165-09.3W | 24-09.8N<br>165-15.2W | 3500 m | 60° | 0~1200 m | 4 "<br>2 " | IKMT<br>Norpac (11) | |
| 19 | June 9 | 15:36 | 17:44 | 26-40.0N<br>172-25.4W | 26-41.8N<br>172-32.0W | 3500 m | | (17:17, 1518 m wire out, accident happened) | | IKMT<br>Norpac (11) | swivel broken off, net lost |
| 20 | June 10 | 18:10 | 20:40 | 28-07.3N<br>178-25.0W | 28-10.2N<br>178-35.0W | 3500 m | 65° | 0~<br>ca.1200 m | 4 kts<br>2 kts | IKMT<br>Norpac (15) | |
| 21 | June 11 | 04:41 | 07:24 | 28-15.0N<br>178-38.8E | 28-20.2N<br>179-28.7E | 3500 m | 52° | 0~<br>ca.1200 m | 4 "<br>2 " | IKMT<br>Norpac (16) | |
| 22 | June 13 | 20:10 | 22:30 | 32-52.1N<br>174-54.9E | 32-57.7N<br>174-52.7E | 3000 m | - | 0~<br>ca.1200 m | 4 "<br>2 " | IKMT<br>Norpac (11) | |
| 24 | June 17 | 19:57 | 22:41 | 34-04.0N<br>170-10.6E | 34-04.9N<br>170-02.5E | 3500 m | - | 0~<br>ca.1200 m | 4 kts<br>2 kts | IKMT<br>Norpac (20) | |
| 25 | June 18 | 19:08 | 21:55 | 34-06.2N<br>165-33.8E | 34-06.0W<br>165-25.3E | 3000 m | - | 0~<br>ca.1200 m | 4 "<br>2 " | IKMT<br>Norpac (20) | |
| 26 | June 20 | 06:38 | 10:18 | 33-33.3N<br>158-15.8E | 33-31.2N<br>158-06.3E | 4000 m | 65° | 0~<br>ca.1200 m | 4 "<br>2 " | IKMT<br>Norpac (23) | |

* Norpac net samplings were operated during the hauling up of IKMT.

** Ship speed; 4 kts during wire out (0 ~ 2500 m), 2 kts during horizontal towing (3000 ~ 4000 m) and hauling up (3500 ~ 0 m).

6-3-1 ORI* sampling data (Side towing - 1)

| Sta. | Date | Time | | Location | | Net depth | Ship speed | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | net in | net out | net in | net out | | | |
| 5 | May 8 | 17:04 | 17:34 | 44-59.9N 169-21.2E | 44-49.7N 169-22.0E | surface | 2 knot | Net, teared in hauling up |
| 5 | May 8 | 20:45 | 21:15 | 44-58.0N 169-16.6E | 44-57.6N 169-16.2E | " | " | |
| 6 | May 10 | 03:55 | 04:15 | 44-26.5N 170-31.5E | 44-26.3N 170-31.3E | " | " | |
| 7 | May 10 | 19:38 | 19:58 | 43-58.0N 171-31.2E | 43-58.4N 171-31.2E | " | " | |
| 8 | May 12 | 19:00 | 19:20 | 42-59.2N 173-20.7E | 42-59.0N 173-21.6E | " | " | |
| 8 | May 12 | 23:34 | 23:54 | 42-57.4N 173-24.8E | 42-57.2N 173-25.6E | " | " | |
| 8 | May 13 | 05:35 | 05:55 | 42-52.0N 173-28.7E | 42-51.4N 173-29.5E | " | " | |
| 11 | May 18 | 02:15 | 02:35 | 50-03.0N 179-58.2W | 50-00.5N 179-58.2W | " | " | |
| 11 | May 18 | 10:53 | 11:13 | 50-00.3N 179-56.0W | 49-59.8N 179-56.6W | " | " | |
| 13 | May 19 | 22:40 | 23:00 | 45-02.3N 164-57.2W | 45-02.8N 164-56.4W | " | " | |
| 14 | May 23 | 17:39 | 17:44 | 35-48.2N 164-59.2W | 35-48.0N 164-59.2W | " | " | |
| 15 | May 24 | 23:35 | 23:50 | 34-37.1N 164-58.2W | 34-36.5N 164-57.6W | " | " | |
| 15 | May 24 | 23:55 | 00:15 | 34-36.4N 164-57.5W | 34-35.8N 164-56.9W | " | " | |

* ORI: Net mouth dia. 1.6 m, mouth area 2.01 $m^2$.

6-3-2 ORI* sampling data (Side towing - 2)

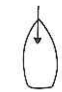
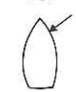
| Sta. | Date | Time | | Location | | Net depth | Ship speed | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | net in | net out | net in | net out | | | |
| 16 | May 26 | 03:16 | 03:36 | 29-59.8N<br>162-16.5W | 29-59.3N<br>162-16.2W | surface | 2 knot | light condition |
| 16 | May 26 | 03:40 | 04:00 | 29-59.2N<br>162-16.2W | 29-58.6N<br>162-16.3W | " | " | half-dark condition |
| 17 | June 7 | 18:05 | 18:25 | 23-27.3N<br>163-04.2W | 23-27.4N<br>163-05.5W | " | " | |
| 18-1 | June 8 | 03:05 | 03:25 | 24-08.4N<br>165-08.2W | 24-08.4N<br>165-09.1W | " | " | |
| 19 | June 9 | 17:45 | 18:05 | 26-41.8N<br>172-32.0W | 26-42.4N<br>172-32.6W | " | " | |
| 20 | June 10 | 20:45 | 21:05 | 28-10.3N<br>178-35.2W | 28-10.7N<br>178-36.1W | " | " | |
| 21-1 | June 11 | 04:05 | 04:25 | 28-14.7N<br>178-39.7E | 28-14.8N<br>178-39.2E | " | " | |
| 22-2 | June 13 | 22:54 | 23:14 | 32-57.9N<br>174-52.6E | 32-58.3N<br>174-52.3E | " | " | |
| 23 | June 15 | 21:55 | 22:00 | 35-39.2N<br>171-32.5E | 35-39.3N<br>171-32.6E | " | " | |
| 23 | June 16 | 02:00 | 02:20 | 35-39.8N<br>171-37.0E | 35-40.2N<br>171-37.1E | " | " | |
| 23 | June 16 | 05:13 | 05:33 | 35-41.7N<br>171-43.4E | 35-41.8N<br>171-43.5E | " | " | |
| 24 | June 17 | 19:18 | 19:23 | 34-03.7N<br>170-12.0E | 34-03.6N<br>170-11.8E | " | " | |
| 24 | June 17 | 19:28 | 19:38 | 34-03.7N<br>170-11.6E | 34-03.7N<br>170-11.4E | " | " | |
| 25 | June 18 | 19:50 | 20:10 | 34-06.2N<br>165-30.7E | 34-06.3N<br>165-29.5E | " | " | Dark condition |

6-3-4 ORI* sampling data (Obliaue towing)

| Sta. | Date | Time | | Location | | Wire | | Net depth | Ship speed | Flow meter reading | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | net in | net out | net in | net out | length | angle | | | | |
| 5 | May 8 | 16:48 | 17:05 | 45-00.0N 169-20.3E | 44-49.7N 169-22.0E | 1000 m | | 0~500 m | 2 knot | 5,550 | Flow meter No. 80307 |
| 6 | May 9 | 19:50 | 20:35 | 44-28.4N 170-18.9E | 44-28.9N 170-22.7E | 1000 m | | 0~500 m | 2 knot | 12,635 | |
| 6 | May 10 | 03:04 | 03:44 | 44-27.1N 170-29.6E | 44-26.8N 170-31.6E | 1000 m | | 0~650 m | 2 knot | 11,190 | |
| 8 | May 12 | 19:53 | 20:40 | 42-58.7N 173-21.9E | 42-57.9N 173-24.4E | 1000 m | | 0~590 m | 2 knot | 16,855 | |
| 8 | May 12 | 22:36 | 23:22 | 42-58.1N 173-22.3E | 42-57.4N 173-24.4E | 1000 m | | 0~ | 2 knot | 12,775 | |
| 8 | May 13 | 18:42 | 19:35 | 42-59.7N 173-28.3E | 42-58.5N 173-32.3E | 1000 m | | 0~550 m | 2 knot | 14,405 | |
| 11 | May 18 | 01:23 | 01:58 | 50-00.5N 179-58.2W | 50-02.7N 179-59.2W | 1000 m | | 0~750 m | 2 knot | 11,393 | |
| 11 | May 18 | 09:52 | 10:37 | 50-01.6N 179-53.8W | 50-00.5N 179-55.5W | 1000 m | | 0~800 m | 2 knot | 11,254 | |
| 13 | May 19 | 21:41 | 22:35 | 45-00.9N 164-59.5W | 45-01.9N 164-57.8W | 1000 m | | 0~700 m | 2 knot | 11,485 | |
| 14 | May 23 | 16:42 | 17:20 | 35-50.4N 164-59.7W | 35-48.7N 164-59.3W | 1000 m | | 0~600 m | 2 knot | 11,485 | |
| 15 | May 24 | 22:27 | 23:02 | 34-38.8N 164-59.5W | 34-37.6N 164-58.6W | 1000 m | | 0~550 m | 2 knot | 14,371 | |
| 16 | May 26 | 02:17 | 03:05 | 30-02.2N 162-16.2W | 29-59.9N 160-16.6W | 1000 m | | 0~650 m | 2 knot | 14,924 | |

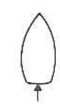
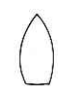
* Net mouth: dia. 1.6 mø mouth area 2.01 $m^2$

6-4-1 Neuston sampling data

| Sta. | Date | Time net in | Time net out | Location net in | Location net out | Net depth | Ship speed | Type of net | Remarks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | May 24, | 01:33 | 01:43 | 34-56.9N 164-58.2W | 34-56.5N 164-58.1W | 10 cm | 2 knot | Hopping Boy* | Wind NNE 4 (7.0 m)<br>Sea condition 3, swell 4<br>W.T 17.7°C |  | 0100 |
| " | " | 01:45 | 01:55 | " | " | " | 2 knot | " | Wind NNE 4 (7.0 m)<br>Sea condition 3, swell 4<br>W.T 17.7°C |  | 0200 |
| " | " | 01:58 | 02:08 | " | " | " | 3 knot | " | Wind NNE 4 (6.5 m)<br>Sea condition 4, swell 4<br>W.T 17.7°C |  | 0300 |
| " | " | 02:10 | 02:20 | " | " | " | 3 knot | " | | | |
| " | " | 02:22 | 02:32 | " | " | " | 4 knot | " | | | |
| " | " | 02:34 | 02:44 | " | " | " | 4 knot | " | | | |
| 15 | May 24, | 13:32 | 13:37 | 34-48.3N 165-01.3W | 34-49.5N 165-01.8W | 10 cm | 1 knot | Hopping Boy | Wind NE 5 (8.0 m)<br>Sea condition 3, swell 4<br>W.T 17.7°C |  | 1300 |
| " | " | 13:38 | 13:43 | " | " | " | 1 knot | " | Wind NE 5 (8.5 m)<br>Sea condition 3, swell 4<br>W.T 17.7°C |  | 1400 |
| " | " | 13:44 | 13:54 | " | " | " | 2 knot | " | Wind NE 5 (9.0 m)<br>Sea condition 3, swell 4<br>W.T 17.8°C |  | 1500 |
| " | " | 13:55 | 14:05 | " | " | " | 2 knot | " | | | |
| " | " | 14:07 | 14:17 | " | " | " | 3 knot | " | | | |
| " | " | 14:18 | 14:28 | " | " | " | 3 knot | " | | | |
| " | " | 14:29 | 14:39 | " | " | " | 2 knot | " | | | |

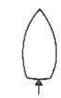
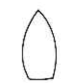
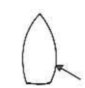
* Neuston Net (Hopping Boy) mouth: 30 x 62 cm mouth area: 930 $cm^2$

6-4-2 Neuston sampling data

| Sta. | Date | Time net in | Time net out | Location net in | Location net out | Net depth | Ship speed | Type of net | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15 | May 24, | 14:41 | 14:51 | 34-48.3N 165-01.3W | 34-49.5N 165-01.8W | 10 cm | 2 knot | Hopping Boy | |
| 19 | June 9, | 16:27 | 16:42 | 26-40.9N 172-28.4W | | 10 cm | 2 knot | Hopping Boy | Wind ESE 4 (6.5 m)<br>Sea condition 3, swell 4<br>W.T 26.2°C  1600 |
| 〃 | 〃 | 〃 | 〃 | 〃 | | 50 cm | 2 knot | MTD net** | |
| 20 | June 10, | 18:58 | 19:13 | 28-08.5N 178-30.1W | 28-08.9N 178-31.8W | 10 cm | 2 knot | Hopping Boy | Wind ESE 4 (6.5 m)<br>Sea condition 3<br>W.T 25.8°C  1900 |
| 〃 | 〃 | 〃 | 〃 | 〃 | 〃 | 50 cm | 2 knot | MTD net | |
| 21-1 | June 11, | 05:30 | 05:45 | 28-17.7N 179-34.0E | 28-17.9N 179-33.0E | 10 cm | 2 knot | Hopping Boy | Wind SE 4 (7.5 m)<br>Sea condition 3, swell 3<br>W.T 24.9°C  0500 |
| 〃 | 〃 | 〃 | 〃 | 〃 | 〃 | 50 cm | 2 knot | MTD net | |
| 22-2 | June 13, | 21:03 | 21:18 | 32-57.7N 174-52.7E | | 10 cm | 2 knot | Hopping Boy | Wind SW 5 (8.0 m)<br>Sea condition 3, swell 3<br>W.T 21.1°C  2100 |
| 〃 | 〃 | 〃 | 〃 | 〃 | | 50 cm | 2 knot | MTD net | |
| 23 | June 15, | 20:40 | 20:55 | 35-38.0N 175-34.0E | | 10 cm | 2 knot | Hopping Boy | Wind E 5 (10.0 m)<br>Sea condition 4, swell 3<br>W.T 19.1°C  2000 |
| 〃 | 〃 | 〃 | 〃 | 〃 | | 50 cm | 2 knot | MTD net | |
| 23 | June 16, | 00:50 | 01:05 | 35-39.2N 175-36.0E | | 10 cm | 2 knot | Hopping Boy | Wind E 6 (12.0 m)<br>Sea condition 4, swell 4<br>W.T 19.2°C  0100 |
| 〃 | 〃 | 〃 | 〃 | 〃 | | 50 cm | 2 knot | MTD net | |

** MTD Net (0.5 mm) mouth dia: 56 cmø mouth area: 2,462 $cm^2$

6-4-3 Neuston sampling data

| Sta. | Date | Time net in | Time net out | Location net in | Location net out | Net depth | Ship speed | Type of net | Remarks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 | June 16, | 06:26 | 04:41 | 35-42.1N<br>171-43.0E | 35-42.2N<br>171-42.7E | 10 cm | 2 knot | Hopping Boy | Wind ESE 6 (12.5 m)<br>Sea condition 4, swell 4<br>W.T 18.9°C |  | 0600 |
| " | " | " | " | " | " | 50 cm | 2 knot | MTD net | | | |
| 23 | June 16, | 13:34 | 13:49 | 35-34.3N<br>175-59.0E | | 10 cm | 2 knot | Hopping Boy | Wind SE 7 (14.0 m)<br>Sea condition 5, swell 4<br>W.T 19.2°C |  | 1300 |
| " | " | " | " | " | | 50 cm | 2 knot | MTD net | | | |
| 24 | June 17, | 18:57 | 19:12 | 34-03.9N<br>170-13.6E | 34-03.7N<br>170-12.2E | 10 cm | 2 knot | Hopping Boy | Wind WNW 4 (7.0 m)<br>Sea condition 3, swell 4<br>W.T 18.8°C |  | 1900 |
| " | " | " | " | " | " | 50 cm | 2 knot | MTD net | | | |
| 25 | June 18, | 20:13 | 20:28 | 34-06.3N<br>165-29.5E | | 10 cm | 2 knot | Hopping Boy | Wind WSW 3 (5.0 m)<br>Sea condition 2, swell 3<br>W.T 18.6°C |  | 2100 |
| " | " | " | " | " | | 50 cm | 2 knot | MTD net | | | |
| 26 | June 20, | 08:01 | 08:16 | 33-33.3N<br>158-15.8E | | 10 cm | 2 knot | Hopping Boy | Wind NE 5 (8.0 m)<br>Sea condition 3, swell 3<br>W.T 20.8°C |  | 0800 |
| " | " | " | " | " | | 50 cm | 2 knot | MTD net | | | |

6-5-1 MTD multi-nets horizontal towing data

STATION 5 (May 8)

| No. of tow | No. of net | Wire length (m) | Depth of tow (m) | Remarks |
|---|---|---|---|---|
| | 1 | 0 | | 13:26-14:22 |
| | 2 | 14 | | |
| | 3 | 28 | | |
| 1 | 4 | 42 | (Estimated by D-D Metre) | |
| | 5 | 71 | | |
| | 6 | 106 | | |
| | 7 | 141 | 80 | |
| | 1 | 141 | | 15:06-16:30 |
| | 2 | 212 | | |
| | 3 | 283 | | |
| 2 | 4 | 354 | (do) | |
| | 5 | 424 | | |
| | 6 | 566 | | |
| | 7 | 707 | 480 | |
| | 1 | 0 | | 22:45-23:15 |
| | 2 | 14 | | |
| | 3 | 28 | | |
| 3 | 4 | 42 | (do) | |
| | 5 | 71 | | |
| | 6 | 106 | | |
| | 7 | 141 | 130 | |

STATION 6 (May 9~10)

| No. of tow | No. of net | Wire length (m) | Depth of tow (m) | Remarks |
|---|---|---|---|---|
| | 1 | 0 | | 11:14-12:20 |
| | 2 | 14 | | |
| | 3 | 28 | | |
| 1 | 4 | 42 | (Estimated by wire angle) | |
| | 5 | 71 | | |
| | 6 | 106 | | |
| | 7 | 141 | 80 | |
| | 1 | 141 | | 13:06-14:15 |
| | 2 | 212 | | |
| | 3 | 283 | | |
| 2 | 4 | 354 | (Estimated by D-D Metre) | |
| | 5 | 424 | | |
| | 6 | 566 | | |
| | 7 | 707 | 550 | |
| | 1 | 0 | | 23:26-00:27 |
| | 2 | 14 | | |
| | 3 | 28 | | |
| 3 | 4 | 42 | (do) | |
| | 5 | 71 | | |
| | 6 | 106 | | |
| | 7 | 141 | 110 | |

(continued)

6-5-2 MTD multi-nets horizontal towing data

STATION 6 (May 9~10)

| No. of tow | No. of net | Wire length (m) | Depth of tow (m) | Remarks |
|---|---|---|---|---|
| | 1 | 141 | | 00:30-01:54 |
| | 2 | 212 | | |
| | 3 | 283 | | |
| 4 | 4 | 354 | (Estimated by D-D Metre) | |
| | 5 | 424 | | |
| | 6 | 566 | | |
| | 7 | 707 | 490 | |

STATION 7 (May 10)

| No. of tow | No. of net | Wire length (m) | Depth of tow (m) | Remarks |
|---|---|---|---|---|
| | 1 | 7 | | 19:08-20:28 |
| | 2 | 71 | | |
| | 3 | 141 | | |
| 1 | 4 | 212 | (do) | |
| | 5 | 247 | | |
| | 6 | 283 | | |
| | 7 | 424 | 280 | |

STATION 8 (May 12~13)

| No. of tow | No. of net | Wire length (m) | Depth of tow (m) | Remarks |
|---|---|---|---|---|
| | 1 | 14+17 | | 18:35-19:45 |
| | 2 | 71 " | | |
| | 3 | 141 " | | #3 net, not close |
| 1 | 4 | 212 " | (do) | |
| | 5 | 247 " | | |
| | 6 | 283 " | | |
| | 7 | 424 " | 380 | |
| | 1 | 0 | | 00:07-01:01 |
| | 2 | 14 | | |
| | 3 | 28 | | |
| 2 | 4 | 42 | (do) | |
| | 5 | 71 | | |
| | 6 | 106 | | |
| | 7 | 141 | 120 | |
| | 1 | 141 | | 01:10-02:29 |
| | 2 | 212 | | |
| | 3 | 283 | | #6 net, not close |
| 3 | 4 | 354 | (do) | |
| | 5 | 424 | | |
| | 6 | 566 | | |
| | 7 | 707 | 435 | |

(continued)

6-5-3 MTD multi-nets horizontal towing data

STATION 8 (May 12~13)

| No. of tow | No. of net | Wire length (m) | Depth of tow (m) | Remarks |
|---|---|---|---|---|
| 4 | 1 | 0 | | 05:08-06:16 |
| | 2 | 71 | | |
| | 3 | 141 | | |
| | 4 | 212 | (Estimated by D-D Metre) | |
| | 5 | 247 | | |
| | 6 | 283 | | |
| | 7 | 424 | 300 | |
| 5 | 1 | 0 | | 11:44-12:49 |
| | 2 | 14 | | |
| | 3 | 28 | | #3 net, not close |
| | 4 | 42 | (do) | |
| | 5 | 71 | | #7 net 85 m depth |
| | 6 | 106 | | |
| | 7 | 141 | 115 | |
| 6 | 1 | 141 | | 12:53-14:23 |
| | 2 | 212 | | |
| | 3 | 283 | | |
| | 4 | 354 | (do) | |
| | 5 | 424 | | |
| | 6 | 566 | | |
| | 7 | 707 | 520 | |

STATION 23 (June 15~16)

| No. of tow | No. of net | Wire length (m) | Depth of tow (m) | Remarks |
|---|---|---|---|---|
| 1 | 1 | 7 | | 20:19-21:24 |
| | 2 | 14 | | |
| | 3 | 28 | | Simultaneously neuston net operated |
| | 4 | 42 | (Estimated by wire angle) | |
| | 5 | 71 | | |
| | 6 | 106 | | |
| | 7 | 141 | 110 | |
| 2 | 1 | 141 | | 21:25-22:55 |
| | 2 | 212 | | |
| | 3 | 283 | | #6 net, not closed |
| | 4 | 354 | (do) | |
| | 5 | 424 | | |
| | 6 | 566 | | |
| | 7 | 707 | 520 | |
| 3 | 1 | 7 | | 00:31-01:29 |
| | 2 | 14 | | |
| | 3 | 28 | | #1 net, codend lost |
| | 4 | 42 | (do) | |
| | 5 | 71 | | Simultaneously neuston net operated |
| | 6 | 106 | | |
| | 7 | 141 | 120 | |

(continued)

6-5-4 MTD multi-nets horizontal towing data

| No. of tow | No. of net | Wire length (m) | Depth of tow (m) | Remarks |
|---|---|---|---|---|
| STATION 23 (June 15~16) | | | | |
| 4 | 1 | 141 | (Estimated by wire angle) | 01:33-02:49 |
| | 2 | 212 | | |
| | 3 | 283 | | |
| | 4 | 354 | | |
| | 5 | 424 | | |
| | 6 | 566 | | |
| | 7 | 707 | 520 | |
| 5 | 1 | 7 | (do) | 06:12-07:02 |
| | 2 | 14 | | |
| | 3 | 28 | | Neuston net operated |
| | 4 | 42 | | |
| | 5 | 71 | | |
| | 6 | 106 | | |
| | 7 | 141 | 80-110 | |
| 6 | 1 | 141 | (do) | 04:38-06:10 |
| | 2 | 212 | | |
| | 3 | 283 | | |
| | 4 | 354 | | |
| | 5 | 424 | | |
| | 6 | 566 | | |
| | 7 | 707 | 520 | |
| 7 | 1 | 14 | (do) | 13:16-14:17 |
| | 2 | 28 | | |
| | 3 | 42 | | MTD (0.5 mm) operated at sea-surface |
| | 4 | 71 | | |
| | 5 | 106 | | |
| | 6 | 141 | 80-110 | |
| 8 | 1 | 141 | | 14:21-14:39 |
| | 2 | 212 | | |
| | 3 | 283 | | #1 net, teared |
| | 4 | 354 | | |
| | 5 | 424 | | |
| | 6 | 566 | | |
| | 7 | 707 | | |

6-6 Norpac sampling data

| No. of St. | Date | Time | Mesh | Wire length (m) | Wire Angle (°) | Flow-Metre | Revolution |
|---|---|---|---|---|---|---|---|
| 5 | May 8 | 09:52 | GG54 | 173 | 31 | 633 | 2090 |
| | | 10:05 | XX13 | 196 | 46 | 878 | 2175 |
| 6 | " 9 | 18:45 | XX13 | 165 | 25 | 878 | 2034 |
| | | 18:50 | GG54 | 152 | 13 | 633 | 1720 |
| 8 | " 13 | 16:00 | GG54 | 167 | 26 | 633 | 1294 |
| | | 17:12 | XX13 | 173 | 30 | 878 | 1920 |
| 10 | " 16 | 21:30 | XX13 | 151 | 8 | 878 | 1410 |
| | | 21:40 | GG54 | 150 | 8 | 633 | 1400+x |
| 11 | " 18 | 07:07 | GG54 | 167 | 25 | 633 | 2088 |
| | | 07:18 | XX13 | 170 | 28 | 878 | 1720 |
| 13 | " 20 | 20:21 | GG54 | 162 | 18 | 633 | 1800 |
| | | 20:29 | XX13 | 160 | 20 | 878 | 1880 |
| 21-1 | June 11 | 07:30 | XX13 | 216 | 45 | 878 | 2760 |
| | | 07:36 | GG54 | 160 | 20 | 633 | 1554 |
| 22-2 | " 13 | 22:36 | GG54 | 164 | 23 | 633 | 1683 |
| | | 22:48 | XX13 | 165 | 25 | 878 | 51 |
| 23 | " 16 | 12:36 | XX13 | 160 | 20 | 878 | (trouble) |
| | | 12:49 | GG54 | 150 | 0 | 633 | 1853 |
| 24 | " 17 | 15:01 | GG54 | Wire broken off, net lost | | | |
| | | 15:55 | XX13 | 170 | 28 | 878 | (trouble) |
| | | 16:08 | XX13 | 197 | 41 | 804 | 1714 |