# Preliminary Report

# of

# the R/V Hakuho Maru Cruise KH-00-1

## Southern Ocean Expedition

(January 14th - March 10th, 2000)

Ocean Research Institute

The University of Tokyo

2003

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by

The Scientific Members of the Expedition

Edited by

Masahiko Nishimura and Kouichi Ohwada

2003

## Contents

# Foreword

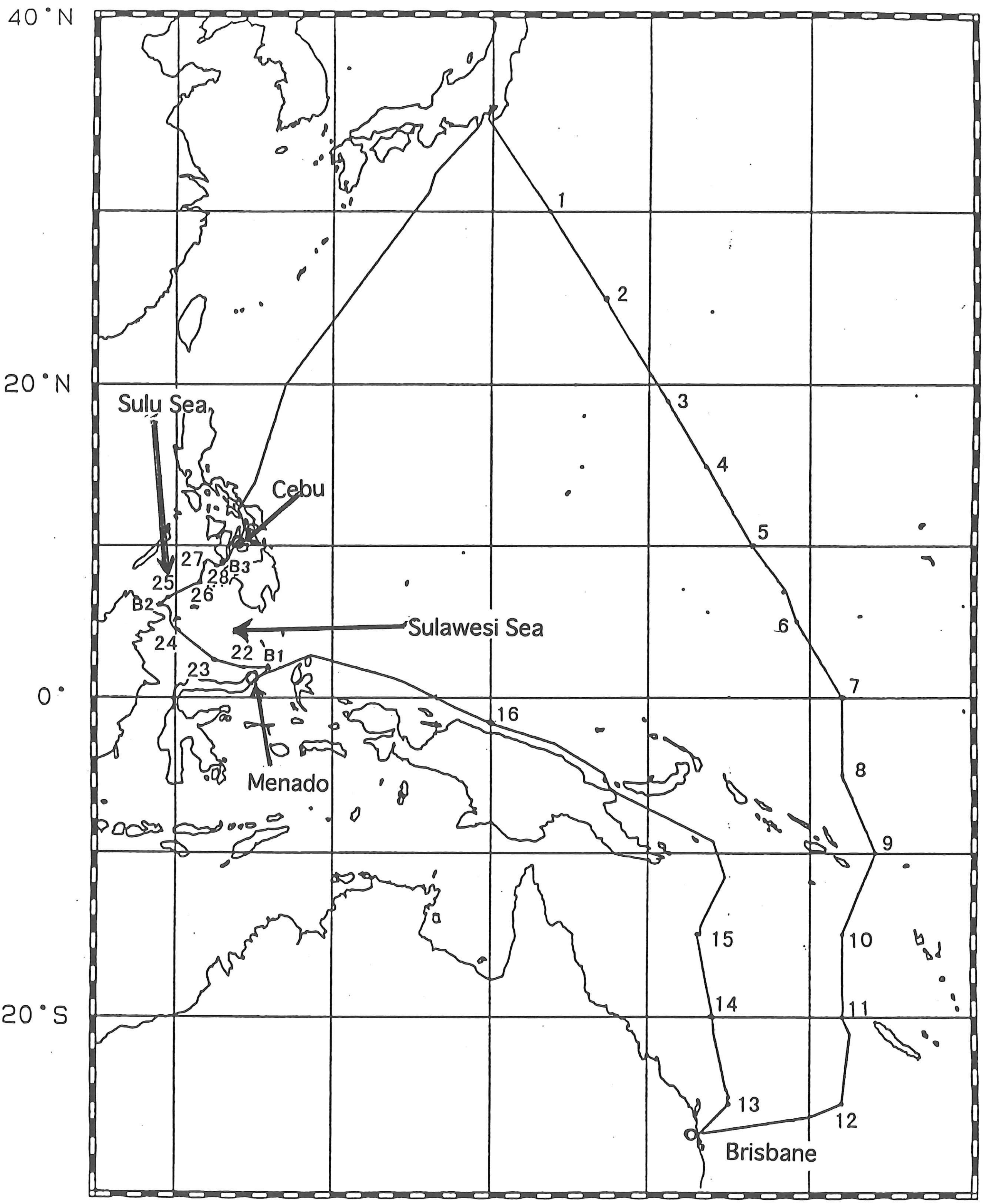
This cruise KH-00-1 was organized by the strong proposals from Biology and Fisheries groups at "The Three Year Planning Symposium for Hakuho-maru from 1998 to 2000 Fiscal Years" held in November, 1996. The researches during this cruise cover microbiology, phyto- and zoo-planktons, micronekton and juvenile fish, benthic organisms, spawning migration and species diversity of Pacific eels, chemical study on carbon dioxide and carbonate ions, and survey on general environmental characteristics.

In the 1st Leg, 12 sampling stations were set at 5 degree intervals from 30 N to 25 S for general researches, and some more additional sampling stations were set for juvenile eels and plankton samplings. In the 2nd Leg, 16 sampling stations including 3 large stations spending for more than 3 days for general researches, and many additional sampling stations for juvenile eels and plankton samplings were set. In the 3rd Leg, only two sampling stations for juvenile eels were set because of the shortage of ship time. Two scientists from France, three scientists and one security officer from Indonesia, two scientists from Philippines, and one scientist from Canada were invited to join this cruise. They all joined us for sampling and research. Although we had to skip several sampling stations along the Indonesian EEZ owing to unexpected accident described below, samplings and researches conducted in this cruise were on the whole evaluated to be successful.

Because of an unexpected serious sickness of two scientists during 2nd Leg, we had to make urgent call of port at the Port of Bitung, Indonesia, on February 17, 2000, and send two patients and an accompanying ship doctor back to Tokyo via Manado-Jakarta-Narita. Indonesian scientists and a security officer contributed very much for us for selecting the nearest port, Port of Bitung, and making arrangement of ambulance and necessary medical material by communicating with Sam Ratulangi University at Manado. On behalf of the scientists and crew members in Hakuho-maru, I would very much like to appreciate Professor S. Berhimpon, Dean, Dr. Inneke Rumengan, both Faculty of Fisheries and Marine Sciences, three scientists and a security officer on board, the Director and related staff members of ORI, and staff members of Japanese Embassy in Indonesia for making very quick response and making arrangements to send the patients back to Japan. I would also thank a ship doctor, Dr. Konosuke Nakayama, for good taking care of the patients and bringing them back to Japan. Finally I would like to thank the Captain and all the crew members of R/V Hakuho-maru for their cooperation to make the cruise successful.

Kouichi Ohwada
Professor of Ocean Research Institute
University of Tokyo, and
Director of Cruise KH-00-1

# KH-00-1 TRACK CHART



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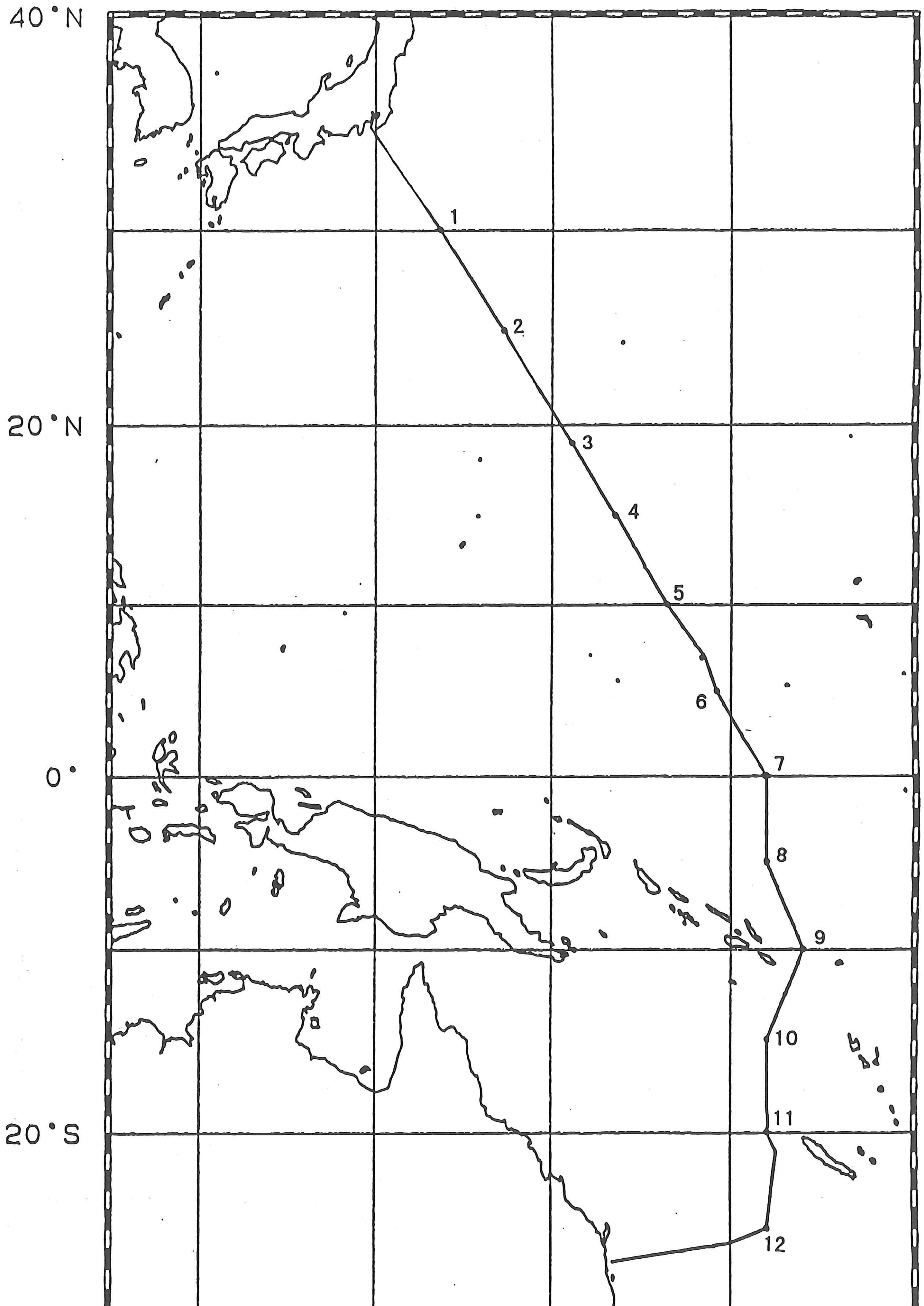

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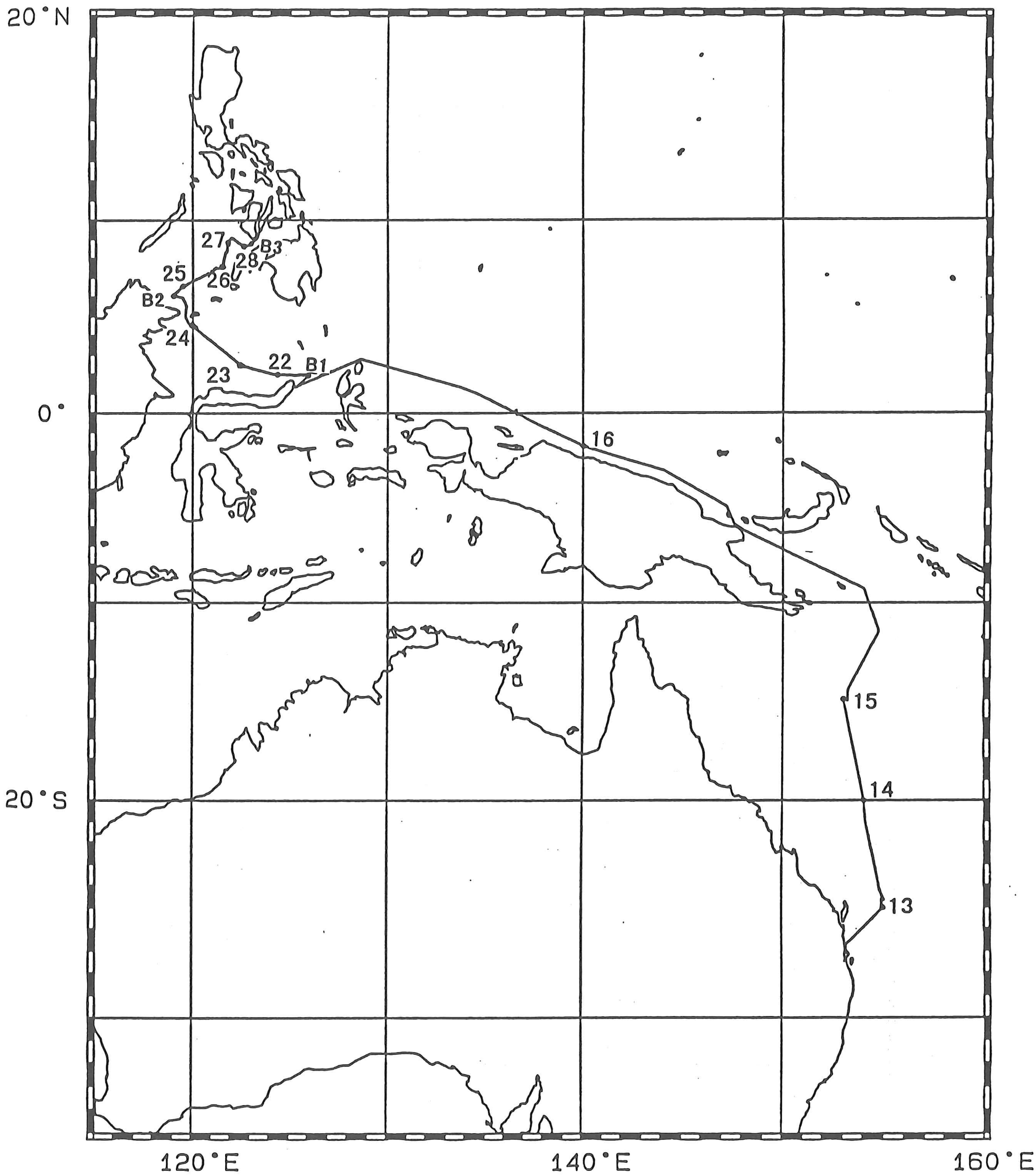

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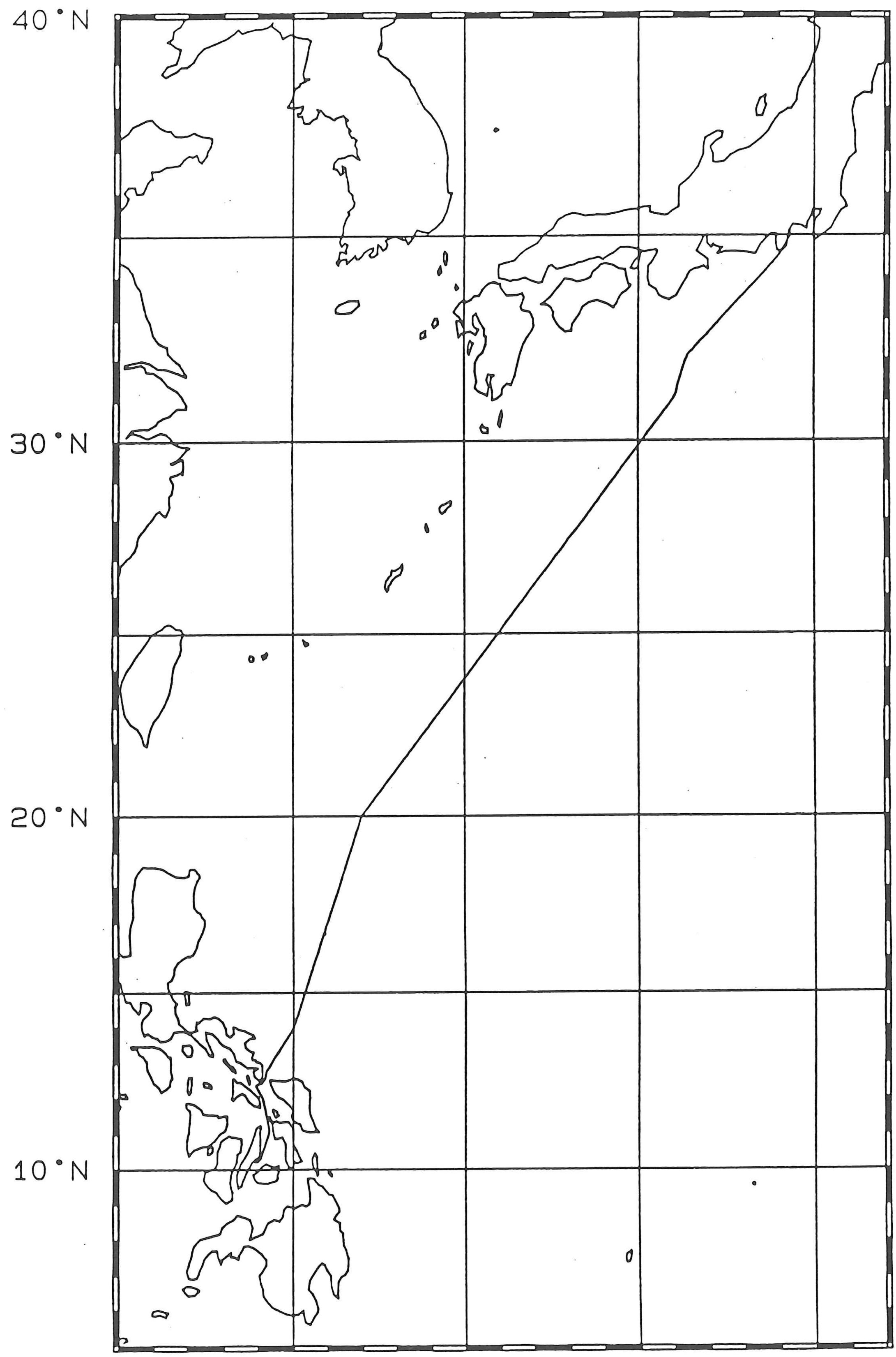

KH-00-1

## Working Schedule Leg.1

| | 0–2 | 3–5 | 6–8 | 9–11 | 12–14 | 15–17 | 18–20 | 21–23 |
|---|---|---|---|---|---|---|---|---|
| 2000/1/14 (Fri.) | | | | | Tokyo Harumi Departure 14:00 | | | |
| 2000/1/15 (Sat.) | | | | | | St.1Multi.core,Norpac*************** 17:10-21:50 29 59.95N,143 40.70E | | |
| 2000/1/16 (Sun.) | | | | | | Sun set 16:43 | St.2 Multi.core,*************** 20:00-22:51 25 00.14'N 147 16.06'E | |
| 2000/1/17 (Mon.) | CTD-Bottm*********** Norpac Niskin butterfly 23:45-03:15 | IKMT Net,ORI****: ***Runup 03:24-06:39 05:57 Sunrise | | Multi core****************** 24 34.81N,147 31.03E 09:06-12:48 | | Sun set 17:00 | | |
| 2000/1/18 (Tue.) | St.U-1IKMTNet,ORI 02:00-02:56 | | | | | St.3 Multi core*************CTD-2000,IKMT* ****** 15:24-19:00 19 00.07N,151 08.07E | Norpa ORI St.U-2 | |
| 2000/1/19 (Wed) | St.U-3IKMTNet,ORI 02:00-02:53 | | | | | St.4 Multi core************ 16:28'-19:59 15 00.014N 153 32.675E | **CTD-Bottom************* Niskin butterfly Norpac | |
| 2000/1/20 (Thu.) | *****************IKMT**Bacteria Rosette Sampler****: ******* *****IKMT********************* ORI St.U-4 | 03:39-08:39 | | ORI 08:50-12:22 | | Sun set 16:36 | St.U-5IKMTNet,ORI 20:06-2 | |
| 2000/1/21 (Fri.) | St.U-6IKMTNet,ORI 01:58-02:51 | | | | St.5 CTD-2000,Norpac 12:20-14:04 09 59.98'N 156 24.05'E | Sun set 16:33 | St.U-7IKMTNet,ORI 20:03-21:03 | |
| 2000/1/22 (Sat.) | St.U-8IKMTNet,ORI 01:59-02:53 | Sun Rise 04:46 | | | St.6 CTD-Bottm*********ORI******* IKMT********* Norpac Niskin butterfly 4 59.85'N, 159 10.04'E | | | IKMT**** ORI St.U-9 |
| 2000/1/23 (Sun.) | St.U-10IKMTNet,ORI 01:59-02:52 | Sun Rise 04:33 | | St.U-11IKMTNet,ORI 10:54-12:33 | | Sun set 16:29 | St.U-12IKMTNet,ORI 20: | St.7 |
| 2000/1/24 (Mon.) | CTD-2000 ,Norpac,IKMT 23:48-01:35 ORI 0 00.13'S 161 59.99'E | Sun Rise 04:18 | | St.U-14IKMTNet,ORI 10:55-12:43 | | Sun set 16:31 | | |
| 2000/1/25 (Tue.) | St.8 CTD-2000,Norpac,IKMT,ORI******* 00:37-02:21 ORI 5 00.04'S, 162 00.06'E | | | St.U-17IKMTNet,ORI 10:55-12:42 | | Sun set 16:34 | | 21→22 GMT+10 St.U-18 IKMT ORI 22:26-23:21 |
| 2000/1/26 (Wed) | St.U-19IKMTNet,ORI 02:01-02:54 | Sun Rise 04:59 | St.9 CTD-2000, 06:00-07:49 Norpac 09:59.92S,164 00.01E | St.U-20IKMTNet,ORI 10:56-12:42 | | Sun set 17:41 | St.U-21IKMTNet,ORI 20:07-21:03 | |
| 2000/1/27 (Thu.) | St.U-22IKMTNet,ORI 01:59-02:53 | Sun Rise 5:00 | St.10 CTD-bottom,Niskin butterfly****************** 08:26-14:01,Norpε 14 59.98S,161 59.99E | | | Rosette Bacteria Sampler*************Multi.corer************IKMT**** 15:03-19:24 | Sun set 17:49 21:06-22:32 | ORI |
| 2000/1/28 (Fri.) | | Sun Rise 04:57 | | St.U-25IKMTNet,ORI 10:58-14:03 | | | Sun set 17:55 St.U-26IKMT 20:06-21:03 ORI | St.11CTD-2000 22:20-23:53 19 59.93S, |
| 2000/1/29 (Sat.) | IKMT****ORI********* Norpac 161 59.99'E | IKMT******************Multi.corer********* Sun Rise 04:54 | | | | | Sun set 17:55 St.U-29IKMT,ORI 20:06-21:04 | |
| 2000/1/30 (Sun.) | St.U-30IKMTNet,ORI 01:51-02:55 | | St.12 CTD-2000 Multi.corer 06:29-07:42 Norpac 24 59.59'S,162 00.09'E | | | | Sun set 18:13 St.U-30IKMT,ORI 20:00-20:58 | |
| 2000/1/31 (Mon.) | | St.U-32IKMTNet,ORI 03:11-03:56 | | | | | | |
| 2000/2/1 (Tue.) | | | | Brisbane a call 10:00 | | | Sun set 18:39 | |

## Working Schedule Leg.2

| | 0–2 | 3–5 | 6–8 | 9–11 | 12–14 | 15–17 | 18–20 | 21–23 |
|---|---|---|---|---|---|---|---|---|
| 2000/2/6 (Sun.) | | | | | Brisbane Departure 14:00 | | | |
| 2000/2/7 (Mon.) | | St.13 CTD-1000 04:07-05:52 Norpac 25 00.1S,154 59.64E | ******* *****Multi.corer 07:50-10:43 | ************** IKMT*******Beem trawl*********************************** | no sample(failure) | | | U-33 IKMT 21:01-22:07 |
| 2000/2/8 (Tue.) | | U-34 IKMT 02:29-03:57 | | | | | St.14 Multi.corer 20 00.2S,154 00.0E U-35 IKMT 20:21-22:37 | |
| 2000/2/9 (Wed) | | | | | | | St.15 CTD-4000 Buttfly***** 18:59-23:00 Norpac 14 59.9S,152 59.9E | U-36 IKMT ORI |

## Working Schedule Leg.2

| Date | 0 1 2 | 3 4 5 | 6 7 8 | 9 10 11 | 12 13 14 | 15 16 17 | 18 19 20 | 21 22 23 |
|---|---|---|---|---|---|---|---|---|
| 2000/2/10 (Thu.) | *********** **Multi.corer************************<br>02:15-06:49 | | Sun Rise 05:42<br>**Beam trawl************************<br>07:11-11:57 no sample(failure) | | | | | |
| 2000/2/11 (Fri.) | | | Sun Rise 05:40 | | | | | |
| 2000/2/12 (Sat.) | | | Sun 06:( Sun Rise 06:02 | | | | | 21→20<br>GMT+9 |
| 2000/2/13 (Sun.) | | | | | | | | |
| 2000/2/14 (Mon.) | | St.16 IKMT ORI,CTD-1000**Beam trawl*****************<br>02:06-04:00 04:12-05:17<br>01 42.0S,140 00.0E | 05:28-09:08<br>no sample(failure) | | | | | U-38 IKMT,ORI<br>20:56-22:52 |
| 2000/2/15 (Tue.) | 01→00 U-39 IKMT,ORI*<br>GMT+8 00:50-02:50 | | | | | Sun set<br>17:25 | | U-40 IKMT,ORI********<br>21:07-01:48 |
| 2000/2/16 (Wed) | ************* | | Sun Rise<br>05:30 | | | Sun set<br>17:45 | | U-41 IKMT,ORI********<br>21:00-22:55 |
| 2000/2/17 (Thu.) | | | | Bitun port of Sulabesi<br>an emergency call | | | | St.B-1************<br>21:14-23:37<br>01 54.36N,125 55.05E |
| 2000/2/18 (Fri.) | U-42 IKMT,ORI*<br>01:00-03:00 | | St.22 CTD-bottom Buttfly*******Multi.corer**************** | 09:39-12:30 Norpac<br>02 00.11N,124 20.08E | 12:52-15:50 | IKPT*****************<br>Sun set<br>17:58 | U-43 IKMT,ORI<br>20:00-21:58 | |
| 2000/2/19 (Sat.) | U-44 IKMT,ORI<br>00:01-01:56 | | St.23 Mocness net*****************Mocness*******Rosette Bacteria****************** *****Mocness net************************Mocness*****<br>06:33-10:58<br>02:29.59N,122 23.94E | 11:49-12:41 | 13:00-17:05 | | 17:52-22:09 | 22:31-00:08 |
| 2000/2/20 (Sun.) | CTD*******IKMT************ ******************************<br>00:55-01:31 01:57-08:26 | | | Multi.corer*****************<br>Norpac<br>09:35-12:54 | CTD-Bottm Buttfly**************************<br>Norpac<br>13:16-19:01 | | Closeing IKMT,ORI*U-48 IKMT******<br>Norpac 20:00-23:48 | |
| 2000/2/21 (Mon.) | Beam trawl***********************************<br>00:08-05:51 | | | | | Sun set<br>18:14 | St.24 CTD-Bottom*U-49 IKMT,ORI*Multi.corer<br>18:16-20:22 Norpac<br>04:30.00N,120 00.02E | |
| 2000/2/22 (Tue.) | *****IKMT,ORI**********Beam trawl***************************************Closeing<br>00:55-03:16 | 05:03-09:40 3153m | | Norpac | | | St.B2 Dradge 1 258m,2 150m,IKM' Dradge3 Dradge4 (failure)<br>19:36-20:39<br>06:04.79N,119 00.17E | |
| 2000/2/23 (Wed) | Dredge 5 118m<br>Dredge 6 279m | IKMT,ORI*****<br>02:59-04:49 | Beam trawl********************<br>05:42-09:33 1088m | | St.25 CTD-Bottm******Multi.core*********<br>11:34-14:07Norpac and Close Norpac<br>06:34.83N,119 28.10E | M-1 IKMT*****<br>17:02-18:45 | U-53 IKMT,ORI<br>19:01-20:56 | M-2 IKMT******<br>21:00-22:45 |
| 2000/2/24 (Thu.) | M-3 IKMT*****<br>01:05-02:49 | M-4 IKMT*****<br>05:00-06:45 | | M-5 IKMT*****<br>08:56-10:40 | M-6 IKMT*****<br>13:00-14:45 | St.26 Multi.core********<br>15:05-18:11 | U-55 IKMT,ORI***<br>18:30-20:52 | Mocness net**********<br>21:17-01:22 |
| 2000/2/25 (Fri.) | ********** CTD-200 Mocness net IKMT*******************************<br>01:30-02:05 | 02:17-03:30 04:07-08:49 | Sun Rise 06:08 | Mocness Net***************************************<br>09:24-15:24 | | CTD-bottm Buttfly*******************<br>16:07-21:50 | Sun set Norpac<br>18:06 | ****IKMT***** U-57<br>21:58-23:54 IKMT |
| 2000/2/26 (Sat.) | U-58 IKMT****<br>00:00-01:50<br>St26 Rosette Bacteria Sample*********<br>02:1906:48<br>07 30.69N,121 27.59E | | ORI*********<br>06:54-08:40 | Beam trawl**************************<br>08:55-13:56 | Rosette Bacteria Sample<br>14:16-15:35 | | U-55 IKMT,ORI<br>Sun set 19:01-20:54<br>18:06 | St27 CTD<br>22:58-<br>08:50.71N |
| 2000/2/27 (Sun.) | bottom Norpac** ***U-60 IKMT,ORI<br>2:34 02:34-04:58 | | IKPT****************************<br>05:04-09:11<br>Sun rise 06:05 | | St.28 CTD-Bottom***********<br>12:43-15:57 Norpac<br>08 38.04N,122 38.02E | IKPT****************<br>16:11-18:30 | U-61 IKMT,ORI<br>19:23-20:53 | U-62 IKMT,ORI**<br>21:59-23:55 |
| 2000/2/28 (Mon.) | St.B3 Multi.corer<br>01:55-03:24<br>08 46.44N,123 00.58E | | | | | | | |
| 2000/2/29 (Tue.) | | | | Cebu<br>a call<br>10:00 | | | | |

## Working Schedule Leg.3

| Date | 0 1 2 | 3 4 5 | 6 7 8 | 9 10 11 | 12 13 14 | 15 16 17 | 18 19 20 | 21 22 23 |
|---|---|---|---|---|---|---|---|---|
| 2000/3/4 (Sat.) | | | | | Cebu<br>Departure<br>14:00 | | | |
| 2000/3/5 (Sun.) | | | | | | | U-63 IKMT,ORI<br>20:10-21:05 | |
| 2000/3/6 (Mon.) | 00→01<br>GMT+9<br>U-64 IKMT,ORI<br>02:14-03;24 | | | | | | U-65,IKMT,ORI<br>19:40-20:26 | |
| 2000/3/10 (Fri.) | | | | Tokyo Harumi<br>a call<br>10:00 | | | | |

# Studies on ecology, taxonomy and biodiversity of marine microorganisms

Minoru Wada, Kumiko Kita-Tsukamoto, Masahiko Nishimura and Kouichi Ohwada
(Marine Microbiology Division, Ocean Research Institute, University of Tokyo)

Following studies have been conducted in the 1st and 2nd Legs of this cruise.

1. Isolation and taxonomy of marine microorganisms from seawater and sediment samples

1) Isolation and taxonomy of microorganisms in the family Vibrionaceae

Members belong to the family Vibrionaceae are one of the main groups of marine microorganisms. Classical identifying characters of these groups are Gram negative rods requiring NaCl for growth and fermenting glucose and some carbohydrates. Molecular characteristics based on 16S rRNA sequences are now necessary for identifying these group of bacteria. In our previous study two strains of bacteria were isolated which are not included in Vibrionaceae from the classical identification, but are identified as Vibrionaceae from 16S rRNA sequences. To make clear the taxonomic positions of these bacteria, we tried to isolate as many strains with similar characteristics from seawater samples taken from different depths in this cruise. Water samples were taken by sterile Niskin Butterfly samplers from different depths from surface water to maximum depths of 4,450 m at Stations 2, 4, 6 and 10.

2) Isolation of psychrophilic marine bacteria from seawater and sediment samples

To isolate psychrophilic bacteria, which are able to grow at 4 C and maximum temperature for growth below 20 C, from seawater at different depths and from surface sediments, small volume of samples were introduced into liquid medium of 1/5 strength ZoBell 2216E and incubated at 4 C. Water samples were taken by sterile Niskin Butterfly samplers at Stations 2, 4, 6 and 10 and sediment samples were taken with Multiple corer at stations 1, 2, 3, 10, 11 and 12 during 1st Leg. Isolation for psychrophilic bacteria will be conducted after going back to laboratory.

3) Isolation of luminescent bacteria from seawater samples

Luminescent bacterial strains were picked up from agar plates of 1/5 strength ZoBell 2216E incubated at 18 C for viable counts. Physiological and molecular characteristics will be studied after going back to laboratory. Water samples were taken by sterile Niskin Butterfly samplers at different depths at Stations 2, 4, 6, 10, 15, 23 and 26 .

2. Distribution and biodiversity of marine microorganisms

1) Direct count of bacteria in the water columns and surface sediments

Samples for direct counting of marine bacteria by DAPI staining method were taken for seawater from different depths at stations 23 and 26 and for surface sediments from Stations 22, 23, 25 and 26. The sample were fixed with glutardehyde solution and kept cold.

2) DVC (Direct Viable Count)

Only metabolizable or viable bacterial cells can grow and therefore become bigger in shapes under fluorescent microscope stained with DAPI compared with other bacterial cells, when seawater or sediment sample is incubated with antibiotics, nalidixic acid, in liquid medium for short incubation time (6 hr) at 18 C, as the antibiotic permits cell growth but inhibits multiplications. Numbers of metabolic active cells in the microbial community in water or sediment samples are measured using this method. DVC was conducted in the deep-sea water samples from stations 10, 15, 22, 23, 25 and 26, and surface sediment samples from stations 22, 23, 25 and 26.

3) Study on microbial communities in seawater and sediments without culture procedures

It is now well known that viable count on agar plates reveals only 1/1000 or much smaller portion of bacteria in the seawater and sediments samples. Chemical or molecular methods have now been tried to elucidate the biodiversity or microbial communities in natural environments from ecological aspects. In this cruise microorganisms were concentrated onto Nuclepore filters (pore size 0.2 micrometers) from 36 to 100 liters of seawater samples from stations 2, 3, 5, 7 and 12. After extraction of DNA in the concentrated samples, molecular sequences characteristic to some genes, such as $Na^+$ motive respiratory chain, and marine luminescent bacteria, will be surveyed using molecular probes specific to each character.

Another methods for studying microbial communities in natural environments is quinone profiling, which is based on the fact that quinone molecules are specific to microbial taxonomic groups. In this cruise surface sediments from most of the samples taken with multiple corer have been collected and frozen to study on the microbial communities.

3. Development of new rosette type sterile water sampler for microbiological study

A new type of rosette sterile water sampler equipped with 15 sampling bags has now been under construction supported by a grant-in-aid from the Ministry of Education, Science, Sports and Culture collaborated with Nichiyu Giken Kogyo, Co. It is composed of 1) on board ultrasonic sound generating system and transducer, and 2) a rosette water sampler, which is comprised of a ultrasonic sound receiving unit, control unit, battery unit, pump unit, drive unit and 15 sterile bags in a sealed water tank. The start of operation in each sampling is provided by ultrasonic sound generated on board and received by ultrasonic sound receiving unit. The control unit houses a microcomputer and controls a series of events from the start and duration of pumping. Maximum 15 sterile bags can be installed in a sealed water tank from which sterile tubes from the bags are connected and fixed in rosette position on drive unit. A series of events for one sampling is as follows; Ultrasonic sound from on board the vessel gives a signal to control unit to start operation. A cutter attached on drive unit cuts the tubing of No.1 bag, then peristaltic pump starts pumping out seawater inside the sealed water tank, and makes negative pressure inside the tank which introduce ambient water to No.1 bag.

After a preset time for pumping is over, drive unit close the tubing. The series of events continue up to No.15 bag at different water depths. A simple principle for water sampling is shown schematically in Figure 1.

During this cruise test operations were conducted at Stations 4, 10, 23 and 26. Although there are still some problems related to the air space in the bag which will be compressed under high pressure in deep-sea, water samplings in stations 10 and 26 from different water depths were successful. Comparisons of water samples taken with this sampler, Niskin bottles and Niskin Butterfly samplers were conducted for salinity and viable counts of bacteria.

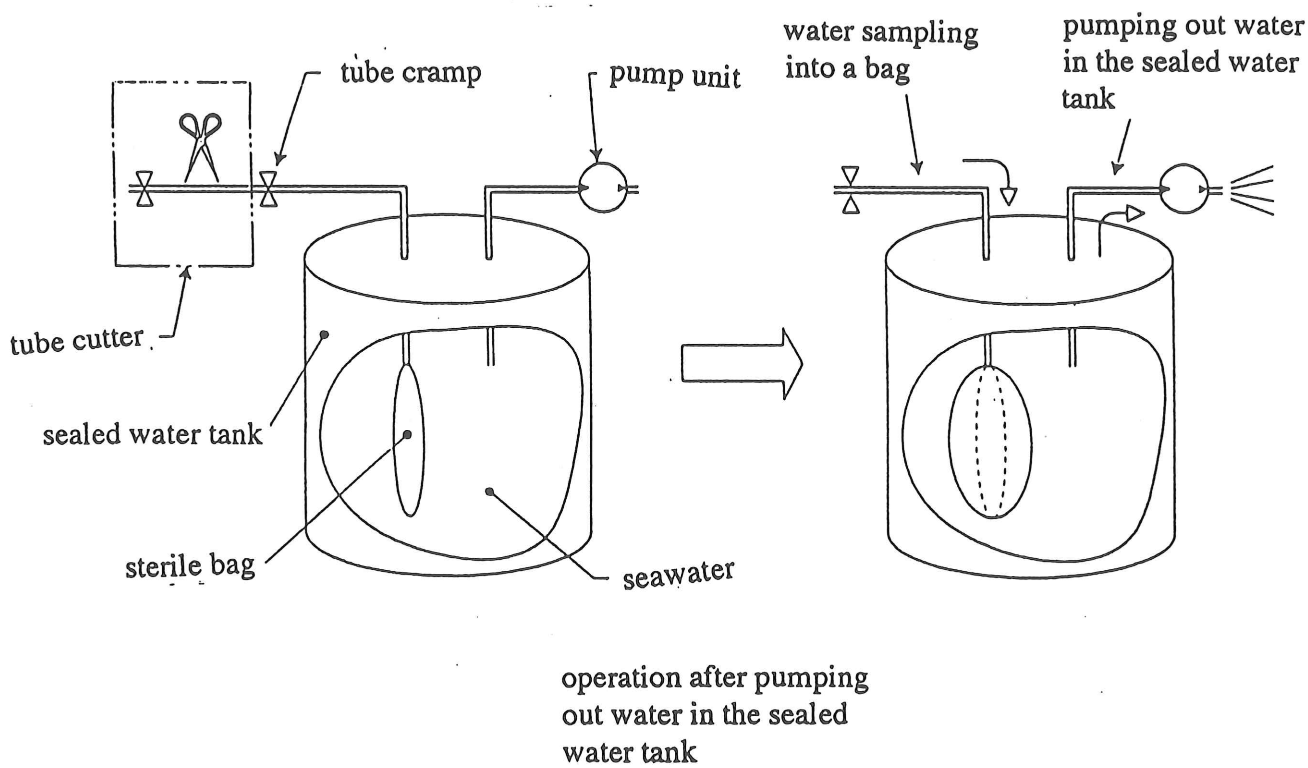


Figure 1. Schematic representation of the principle of this sampler.

# Isolation and cultivation of marine bacteria that are predominant in oceanic seawater by an extinction dilution method

Mitsuru EGUCHI, Taro HIKOSO and Erina FUJIWARA
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When we count marine bacteria in pelagic seawater using either microscopic or ordinary viable counting methods, great differences often occur between direct counts (DC), with values on the order of $10^5$-$10^6$ cells/ml, and viable counts (VC) on nutrient rich media such as ZoBell 2216E and VNSS, which are often only less than 1 % of DC. However, we should not consider this difference a discrepancy. As autochthonous marine bacteria in pelagic seawater, which has an average organic concentration of 0.5 mg C/l, may never have experienced the high organic concentrations of nutrient rich media (e.g., VNSS = 800 mg C/l), the large difference between DC and VC using ordinary nutrient rich media might be reasonable.

A number of explanations have been proposed to explain the large difference between DC and VC results. From a technical point of view, it has been proposed that: 1) concentrations, compositions and/or combinations of nutrients in organic media are not suitable for pelagic marine bacteria and; 2) sudden exposure to nutrient rich external conditions induce suicide responses originating from an imbalance between anabolism and catabolism.

In order to resolve the first technical problem, in situ natural seawater was used as culture media during this cruise. For the second point of the technical problem, catalase and superoxide dismutase (SOD) were added to nutrient rich agar plates and the rescue effect of the enzymes was tested.

## 1) Cultivation and isolation of pelagic marine bacteria by an extinction dilution method

Natural seawater samples were collected during the Leg. 1 of KH-00-1 cruise as shown in Table 1. Bacterial counts in the pelagic seawater samples were estimated by both direct microscopic and viable counting methods. Four different kinds of poor media were used for viable counts. They were basically unamended natural seawater: 0.22 $\mu$m-filtered *in situ* raw natural seawater (FRS, filtered raw seawater); 0.22 $\mu$m-filtered *in situ* autoclaved natural seawater (FAS, filtered and autoclaved seawater); FAS with vitamin $B_{12}$ (final $B_{12}$ concentration 0.05 $\mu$g/l) and MilliQ water with vitamin $B_{12}$ (final $B_{12}$ concentration 0.05 $\mu$g/l). An extinction dilution method (MPN) was employed when using the four different liquid media.

Table 1 Sampling stations, water depths and, types of media used for cultivation.

| | | Media | | | |
|---|---|---|---|---|---|
| Stn. | Depth(m) | FAS*1 | FAS+V.B12*2 | MilliQ+V.B12*2 | FRS*3 |
| 2 | 0 | ○ | ○ | ○ | |

| | | | | | |
|---|---|---|---|---|---|
| | 50 | ○ | ○ | ○ | |
| | 100 | ○ | ○ | ○ | |
| | 200 | ○ | ○ | ○ | |
| | 500 | ○ | ○ | ○ | |
| | 1000 | ○ | ○ | ○ | |
| | 2000 | ○ | ○ | ○ | |
| 4 | 0 | ○ | ○ | ○ | |
| | 50 | ○ | ○ | ○ | ○ |
| | 100 | ○ | ○ | ○ | |
| | 500 | ○ | ○ | ○ | |
| | 1000 | ○ | ○ | ○ | |
| | 2000 | ○ | ○ | ○ | |
| 6 | 0 | ○ | ○ | ○ | |
| | 50 | ○ | ○ | ○ | ○ |
| | 100 | ○ | ○ | ○ | |
| | 500 | ○ | ○ | ○ | |
| | 1000 | ○ | ○ | ○ | |
| | 2000 | ○ | ○ | ○ | |
| 7 | 0 | ○ | ○ | | ○ |
| | 50 | ○ | ○ | | ○ |
| 8 | 0 | ○ | ○ | ○ | |
| | 50 | ○ | ○ | ○ | ○ |
| 9 | 0 | ○ | | | |
| | 50 | ○ | | | |
| 10 | 0 | ○ | | | |
| | 50 | ○ | | | |
| | 100 | ○ | | | |
| | 500 | ○ | | | |
| | 1000 | ○ | | | |
| 11 | 0 | ○ | | | |
| | 50 | ○ | | | |
| 12 | 0 | ○ | | | |
| | 50 | ○ | | | |

Circles indicate media used; *[1] FAS, filtered and autoclaved *in situ* seewater; *[2]V.B12 was added at the final conc.of 0.05 $\mu$ g/l; *[3]FRS, filtered *in situ* raw seawater

In order to check for contamination of filterable small sized bacteria in FRS, the FRS medium, without inoculation of the original seawater sample, was incubated for one month at 15 °C and then tested by microscopy. In addition to the microscopic test, a portion of the incubated FRS medium was inoculated into VNSS liquid medium and incubated for two weeks at room temperature after which the turbidity was also measured. No bacterial growth was recognized in the FRS medium.

This means none of the bacterial cells in the original pelagic seawater sample was able to pass a 0.22-$\mu m$ cellulose ester membrane filter. Some marine bacteria can pass a 0.2-$\mu m$ polycarbonate membrane, however they can not pass a 0.22-$\mu m$ cellulose ester membrane due to its open-celled, foam-like structure.

For total bacterial counting, bacteria in the natural seawater samples were fixed with glutaraldehyde (final concentration 0.5 %), stained with DAPI and observed with epifluorescence microscope. The results of the total bacterial counts were shown in Table 2. In the euphotic zone, bacterial counts were in the range of 1E5 cells/ml as usual. In the deeper layers, the bacterial counts decreased to the range of 1E4 cells/ml.

Table 2 Total direct counts in natural seawater samples ($\times 10^3$ cells/ml)

| Stn. | 0m | 50m | 100m | 200m | 500m | 1000m | 2000m | 4000m | 4500m |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 34 | 290 | 160 | 71 | 24 | 24 | 18 | - | - |
| 4 | 40 | 330 | 250 | - | 33 | 20 | 9.8 | - | - |
| 6 | 260 | 160 | - | 100 | 190 | 51 | - | - | - |
| 7 | 250 | 200 | - | - | - | - | - | - | - |
| 8 | 210 | 230 | - | - | - | - | - | - | - |
| 9 | 160 | 210 | - | - | - | - | - | - | - |
| 10 | 180 | 200 | 18 | - | 24 | 20 | 13 | 81 | 90 |
| 11 | 180 | 240 | - | - | - | - | - | - | - |
| 12 | 350 | 360 | - | - | - | - | - | - | - |

-, no data

For extinction dilution cultivations, 1605 test tubes were used. Seven hundreds of them were already observed by the direct microscopic method described above. Among the 700 tubes, 34 tubes at the dilution level of 1E-5 and 1E-6 showed positive bacterial growth. The test tubes with more than 1E5 cells/ml were judged as bacterial growth positive. Among the 34 tubes, FAS, FRS, (FAS + VB12) and (MilliQ + VB12) are used for 11, 10, 7 and 6 tubes, respectively. Bacterial cells in these positive test tubes are reinoculated into both newly prepared FAS and (MilliQ + VB12). All bacteria grown in the 34 tubes could not show any visible signs of growth in nutrient rich media, such as colonies on nutrient rich agar plates and turbidity in liquid media. Thus, these bacteria can be tentatively treated as "obligate oligotrophs". They can grow in poor but not in rich media. The obligate oligotrphs reinoclulated into the poor media will be incubated at 20 ℃ for more than one month. Then, their growth in the media will be checked microscopically. The bacterial cultures that show positive grow in the poor media will be inoculated into nutrient rich liquid media such as VNSS. If the bacteria grown well in the poor media can also grow well in the rich media, they will be isolated by the ordinal streaking method and stocked. This will mean that they are transformed from "nonculturable" to "culturable" state. Bacteria that can grow in the poor but not in the rich media will be kept in the poor media. There was a tendency for an increase in the number of transformed "culturable" marine bacteria with the length of time of storage in FAS. It has also been pointed out that cold treatment (5 ℃

incubation), in addition to length of storage, enhances the change of pelagic marine bacteria from "nonculturable" to "culturable" states. Thus, some bacterial cultures of obligate oligotrophs in FAS will be incubated at 5°C.

2) Addition of catalase and SOD onto agar plates

It has been reported that superoxide and free radicals can be easily produced by autoclaving nutrient rich media containing large amounts of reduced organic substances, and that addition of catalase in agar plates enhances the ability of stressed microorganisms in a nonculturable state to form colonies on agar plates. When a mixture of catalase and superoxide dismutase (SOD) was added to VNSS agar plates, 3 samples showed the rescue effect. In remaining samples, the addition of the enzymes had no effect. In the 3 samples, the CFU values with the enzymes added was significantly (ten times) higher than that without the enzymes. For example, in the sample collected at Stn. 4 (1000 m), the colony counts by VNSS agar plates with or without the enzymes were 5.7 (cfu/ml) and 0.4 (cfu/ml), respectively. These results indicate that some of the indigenous pelagic marine bacteria are sensitive to the external oxidative substances produced on agar plates and, therefore, can not make colonies.

These results suggest that appropriate technical devises can enable us to isolate and cultivate an increasing number of authochthonas marine bacteria in pelagic seawaters.

# Vertical Distribution of Luminous Bacteria in the Western Pacific Ocean

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**ABSTRACT** More than one thousand luminous colonies were counted as a function of depth at all sampling stations and more than two hundreds were isolated during the cruise (KH-00-1, Leg 1). As compared to the North Pacific Ocean, the sea area of Melanesia was found to be affluent in luminous bacteria throughout a water-column, particularly in the relatively shallow layers around 200 m. Based on the measurements of bioluminescence spectra, most of the isolated luminous bacteria were judged to be the genus *Photobacterium*. Noticeably, in the Melanesia sea area, some strains captured at the depths of 1000 and 1250 m, the niche of psychrophilic *Photobacterium phosphoreum*, showed a broad band spectrum with a maximum around 485 nm, which was clearly distinguishable from that for the *Photobacterium* species.

## INTRODUCTION

Marine luminous bacteria occur ubiquitously in the Oceans from the surface to the bottom (1). The bioluminescence originates from the luciferase reaction ($\lambda_{max}$, ~490 nm), involving reduced riboflavin 5'-phosphate molecular oxygen and long-chain aliphatic aldehyde. Some species produce accessory fluorescent proteins that participate in the luciferase reaction, causing modulation of bioluminescence. During the KH-95-2 research cruise, it was found that almost all luminous bacteria isolated from deep layers emits blue-shifted bioluminescence ($\lambda_{max}$, ~475 nm). Those luminous bacteria were taxonomically identified as *Photobacterium phosphoreum*. Furthermore, the *P. phosphoreum* isolated from the deep-sea water was found to produce a bimodal fluorescent protein with emission maxima at 488 and 517 nm with excitation at 340 nm, when cultured at low temperatures, say 15 °C or below, and the protein was purified to be homogeneity (2). The properties and activities of the bimodal fluorescent protein have already been reported (3).

In this cruise, we have studied the vertical distribution of luminous bacterium in the Western Pacific Ocean, ranging in latitude from 25° N to 25° S (stations 2 to 12).

## MATERIALS AND METHODS

Water sampling were carried out by use of a carrousel type sampler and a sterile Niskin Butterfly sampler. Sampled seawater (100 mL each) was soon filtrated on a sterile Nucleopore membrane (pore size, 0.2 µm; diameter, 47 mm) and was put on a NaCl complete agar plate. After the plate was allowed to leave at 18 °C for 24 h, the number of luminous colonies that came out on the membrane were counted. The value was called the luminous colony forming unit (LCFU) in this report. When about one month has passed after being isolated aboard, the luminous bacteria were again spread onto the NaCl complete agar plates to remove contaminant bacteria. Using those plates, the spectral distribution of bioluminescence from each individual luminous bacterium was measured by a spectrofluorometer with an excitation lamp turned off. In this case, the plate was vertically placed in front of the spectrofluorometer detector.

## RESULTS AND DISCUSSION

The LCFU values in conjunction with the distribution of luminous bacteria at each water layer at all sampling stations are listed in Table 1. At the stations 2 to 5, the luminous bacteria were mainly found in the layers in the range of 100 to 1000 m, centered somewhere between 300 and 500 m. Both in the surface water and in the layers deeper than 1000 m, LCFU was either zero or very small number. Such a vertical distribution pattern appears to be analogous to that observed during the KH-95-2 research cruise (1). However, at the station 6 close to the equator and in the sea area of Melanesia, luminous bacteria were found to occur in almost all water layers unlike the North Pacific Ocean. Particularly, at the stations 8 and 9, near Solomon Islands, the LCFU values were considerably high. Noticeably, the layers, ranging from 50 to 300 m were found to be affluent in luminous bacteria. In such relatively shallow layers, near the islands, fish and/or cuttlefish living together in symbiosis with luminous bacteria may inhabit abundantly, resulting in an increase in the density of the free living luminous bacteria, being exhaled into the seawater.

Comparing the LCFU for the water sampled with the carrousel type sampler with that for the water sampled with the sterile Niskin Butterfly sampler, both the LCFU values seem to be comparable each other except three sampling sites, station 4, 500m; station 6, 500 m; and station 10, 4000 m. It is not clear why the significant difference was come about at those three sites.

We have also examined the spectral distribution of bioluminescence, originating from the isolated luminous bacteria spread on agar plates. Fig. 1 shows representative bioluminescence spectra, of which intensities are normalized to each individual peak intensity (= 1). The bioluminescence spectra can be classified into two groups. One is a blue-shifted emission with a maximum around 475 nm, which slightly fluctuates within several nanometers, depending on the strain. The other is to exhibit a broad band emission peaking around 485 nm.

The blue-shifted bioluminescence probably arises from the genus *Photobacterium*. In the case of *Photobacterium*, the sensitization of the homologous lumazine protein in the luciferase reaction is responsible for the blue-shift. Focusing on the psychrophilic *Photobacterium phosphoreum*, the spectral distribution would also be modulated by the bimodal fluorescent protein as well as the lumazine protein (3). The peak fluctuation might be caused by the participation of the bimodal fluorescent protein in the luciferase reaction.

In the case of the broad band bioluminescence peaking around 485 nm, such a bioluminescence usually originates from the luminous bacteria, possibly the genus *Vibrio*, living in the relatively shallow waters. The *Vibrio* species do not produce fluorescent proteins responsible for the spectral shift except for *Vibrio fischeri* strain Y1. It is noticeable that two luminous strains isolated from the deep-sea waters at 1000 m (station 11) and at 1250 m (station 8) exhibited the broad band bioluminescence with a maximum around 485 nm. The intensity of those bioluminescence was also found to be dimmer than the blue-shifted bioluminescence. Regarding the station 11, 1000 m, remaining four colonies successfully isolated from the 6 colonies came out on the filter membrane exhibited the obvious blue-shifted bioluminescence. At present it is difficult to explain why only one strain produced light with the broad band spectrum peaking around 485 nm. It is also immediately difficult to explain as to whether fluorescent proteins participate in the light producing reaction and as to what kinds of fluorescent proteins are present, if they participate in the photon production.

We are going to analyze the vertical distribution of luminous bacteria in the Western Pacific Ocean in more detail, paying attention to the fact that luminous bacteria occurs affluently in the Melanesia sea area. The biochemical and physico-chemical characterizations of the strains with no blue-shifted bioluminescence isolated from the deep-sea waters as described above are also in progress, focusing both on the functional role of the photon production and on the color of bioluminescence in relation to the physiological and ecological significance of light.

During the cruise, we could fortunately collect aerobic photosynthetic bacteria from the surface water (station 2). As a result of the following growth on the NaCl complete agar plate in dark, the aerobic photosynthetic bacteria came out as red colonies. One of our concerns is also being denoted to the fluorescent proteins produced by them in comparison with those of luminous bacteria.

## ACKNOWLEDGMENT

H. K. is grateful to Prof. Kouichi Ohwada who afforded him a good opportunity to join the cruise.

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Table 1. Vertical distribution of luminous bacteria in the Western Pacific Ocean, presented as Luminous Colony Forming Unit (LCFU/100 mL)

| Depth(m) | S*1.2 | | S.3 | S.4 | | S.5 | S.6 | | S.7 | S.8 | S.9 | S.10 | | S.11 | S.12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | C*2 | B*3 | C | C | B | C | C | B | C | C | C | C | B | C | C |
| 0*4 | 0 | | | | 0 | 0 | | 0 | 5 | | 2 | | 0 | 0 | 0 |
| 50 | 0 | | | | 0 | | 3 | 4 | 5 | 50 | 13 | 12 | 17 | 1 | 2 |
| 100 | 3 | 1 | | | 4 | 3 | 12 | | 15 | | | | 11 | 1 | 0 |
| 200 | 2 | | 3 | 4 | 3 | 8 | 23 | 17 | 56 | | 200 | 25 | 23 | 8 | 2 |
| 300 | 6 | | | | | | | | | 90 | 96 | 24 | | 15 | 9 |
| 400 | 5 | | | | | 2 | 0 | | 25 | | | | | 12 | 12 |
| 500 | 5 | 5 | 1 | 0 | 4 | 1 | 0 | 12 | 11 | 11 | 3 | 10 | 15 | 11 | 12 |
| 600 | 7 | | | 1 | | 3 | 3 | | 8 | 4 | 4 | 6 | | 8 | 11 |
| 700 | | | | | | | | | | | | | | 7 | 12 |
| 750 | | | | | | | | | 3 | 7 | 4 | 6 | | | |
| 800 | 3 | | | 0 | | 1 | 0 | | 4 | | 1 | 4 | | 6 | 9 |
| 1000 | 2 | 1 | 0 | 1 | 1 | 0 | 2 | 3 | 1 | 5 | 5 | 3 | 9 | 7 | 4 |
| 1250 | | | | | | | 0 | | 1 | 1 | 1 | 1 | | 1 | 2 |
| 1500 | 0 | | | | | 0 | | | 0 | 0 | 0 | 7 | | 0 | |
| 2000 | | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2*5 | 0 | 1 | 3 | 1 | |
| 4000 | | | | 0 | 0 | | | | | | | 0 | 14 | | |
| 5000 | | | | 0 | | | | | | | | | 2 | | |

*1, Station (sampling point); *2, Carrousel type sampler with CTD sensor; *3, Niskin Butterfly sampler; *4, the surface water, corresponding to 0 m, was manually sampled using a sterile glass bottle; and *5, 1950 m.

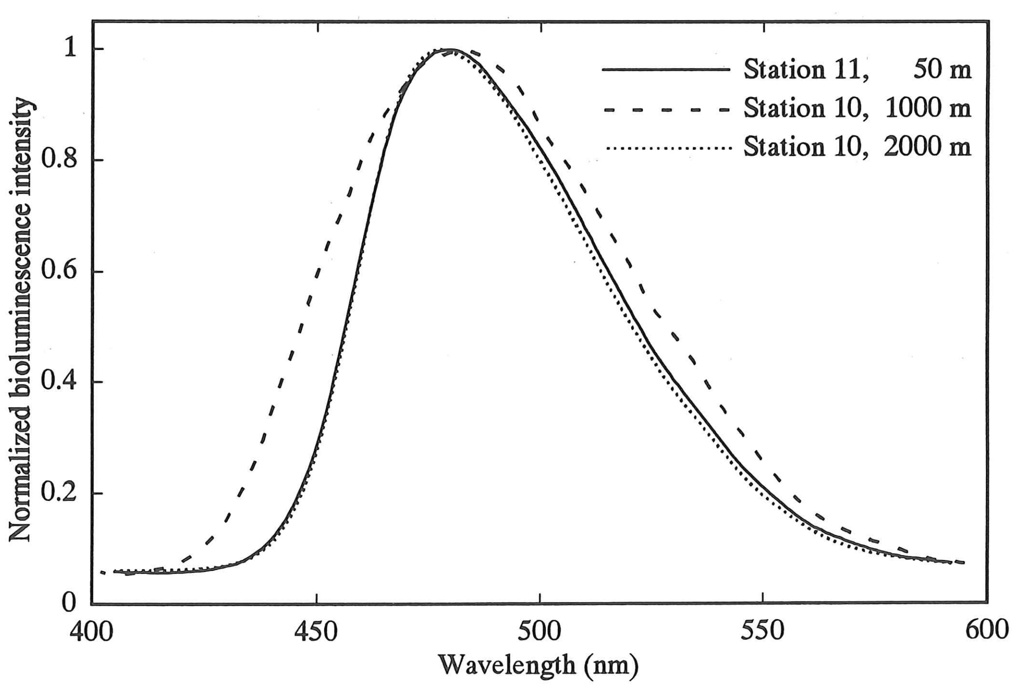


Fig. 1 Representative spectral distributions of bioluminescences, arising from isolated luminous bacteria.

# A chemical study on carbonate and carbon dioxide in the tropical western Pacific

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Increase of carbon dioxide concentration in the atmosphere originating in carbon dioxide discharged to the atmosphere by human activities after the industrial revolution has become a serious problem. About the half of the amount of carbon dioxide release to the atmosphere is known to remain in the atmosphere, however, it is not well understood where the remainder is stored up and often thought to be absorbed by the oceans. Examination of the behavior of carbon dioxide is needed indispensability in order to predict the environment of the earth in the future. Hence, chemical studies of carbon dioxide in the oceans become important.

During this cruise seawater samples were taken at certain depth intervals from surface to the bottom for chemical analyses. Alkalinity and pH were analyzed on board, and dissolved inorganic carbon (DIC) and nutrients will be measured at the laboratories after the cruise.

The concentration of each component of carbonic acid system in seawater can be calculated with any two of four measurable properties (pH, alkalinity, DIC and pCO2). Alkalinity and pH, which are often measured with precision, were chosen to calculate the degree of super saturation with respect to the carbonate mineral calcite, and the potential pCO2 in the samples. Potential pCO2 of a sample would achieve if it is depressurized to 1 atm and warmed to 25 degree. The seawater is super saturated with respect to calcite down to around 4000m, however, the depths of the calcite saturation horizon become shallower around 10 degree N because of the influence of upwelling. In a similar manner there is penetration of potential pCO2 toward the surface around 10 degree N. The high pCO2 as a result of upwelling is not observed at the surface because of mixing, consumption by biological activities, and loss to the atmosphere. However, the supply of nutrients and DIC to the surface from deep water by upwelling is evident. Uptake and release of carbon dioxide in seawater can be discussed in the light of photosynthesis and respiration, and dissolution and precipitation of calcium carbonate.

# Phytoplankton characteristics and ambient concentrations of phytoplankton extracellular exudates in the south-west Pacific Ocean, Celebes Sea and Sulu Sea

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Phytoplankton are important in the production of dissolved and particulate organic matter that help sustain the secondary and tertiary trophic levels in aquatic ecosystem. Formed by coagulation from the dissolved organic pool, transparent exopolymer particles (TEP) offer an important pathway for the transformation of dissolved to particulate organic matter. These polysaccharide particles form the matrix of marine snow, provide a microhabitat, act as substrate for bacteria and is a source of nutrition for micro heterotrophs. Phytoplankton composition is known to influence the concentration of these particles in the sea. Present study was carried out to obtain a comparative account of phytoplankton biomass and composition, TEP, ambient concentrations of total dissolved polysaccharides and bacterial density in the south-west Pacific Ocean, Celebes Sea and Sulu Sea.

Water samples for the estimation of nutrients, chlorophyll concentration and phytoplankton composition (based on HPLC pigment analysis) were collected from the upper 200 m water column from all stations sampled during Legs 1 and 2. TEP concentrations were determined from several depths between the surface and bottom at all the stations. Samples were collected from few selected stations for obtaining complete surface to bottom profiles on nutrients, total dissolved polysaccharides and total number of free and TEP attached bacteria. On-board incubation experiments were conducted with samples collected from Stns. 3, 5, 7 and 9 during Leg 1, to measure primary productivity and the rates of TEP and extracellular exudate formation. Samples collected from 10m and chorophyll maximum layer were spiked with 14C and incubated for 2 hrs in a photosynthetron. At the end of the incubation, samples were filtered for separate estimation of 14C in the dissolved and particulate fractions. Samples for total dissolved polysaccharide were stored frozen for further analysis. Chlorophyll estimations were made on-board and data included in the preliminary cruise report. Results obtained during this study are expected to provide interesting insights into the variations in phytoplankton characteristics and available organic matter reserve in terms of TEP and dissolved polysaccharides in the south-west Pacific Ocean, the Celebes Sea and Sulu Sea.

# Diversity and vertical structure of pelagic communities in the Sulu and Celebes Seas

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and Hiroshi HASUMOTO
(Technical Support Office, Ocean Research Institute, University of Tokyo)

The Sulu Sea is located in the Indo-West Pacific Biogeographic Region and is surrounded by many islands and shallow sills. The exchange of the water in the Sulu Sea with those in the surrounding areas is limited mostly to the epipelagic- and upper-mesopelagic zones, and the water temperature below 500 m through to the sea bottom of ca. 5000 m is almost uniform at ca. 10 °C , rendering the Sulu Sea an area of interest in terms of both biodiversity and matter cycling. While the fauna of the area has been known in some details for selected taxa as a result of previous expeditions, still little is known of the community as a whole and its detailed structure, as well as of biological production and matter cycling.

As a preliminary survey for an interdisciplinary study of the community structure and matter cycling in the Sulu Sea and adjacent waters, we aimed in this cruise at describing the vertical structure of the pelagic communities in the Sulu and Celebes Seas. Zooplankton- and micronekton samples for taxonomy were collected either by oblique tows of a 10-foot Isaacs-Kidd midwater trawl (≤ 4000 m wire out) for deep-water organisms, or by vertical tows of a Norpac net (200 m wire out) for epipelagic plankton. Vertically stratified, day-night series of samples, covering 16 layers in the upper 1000 m, were also taken with 1-$m^2$ MOCNESS (Multiple Opening-Closing Nets and Environment Sensing System) at 2 stations each in the Sulu and Celebes Seas.

Analyses of the species composition, community structure, and vertical distribution of zooplankton and micronekton are now in progress.

# Ichthyoplankton from surface waters of the Sulu Sea and Celebes Sea

Wilfredo L. CAMPOS
(University of the Philippines in the Visayas)

Information on the distribution and taxonomy of ichthyoplankton in the Philippines is scarce and scattered. The importance of such baseline information becomes most apparent particularly in investigating processes involved in their dispersal within the country's waters.

During Leg II of the Cruise KH-00-1 of the R/V Hakuho Maru (6-29 February 2000), plankton samples were collected at 11 stations located in the Celebes and the Sulu Sea areas. All samples were collected at night with the use of a 1.6 m diameter (= 2.0 $m^2$ mouth area) ORI net (mesh size of 330 $\mu$m) towed at the surface alongside the vessel for 20 min at a towing speed of 2-2.5 kt. All samples were fixed in 10% buffered seawater-formalin solution and were taken back to the laboratory where sorting and identification of ichthyoplankton are being conducted. Other organisms in the samples will be used in plankton laboratory undergraduate and graduate courses at the university.

The information gathered from these samples will supplement data and information collected in another on-going local investigation on ichthyoplankton distribution in Philippine interisland waters. It is hoped that integrating the data from the above investigations with those from previous researches will make possible an initial characterization of the large-scale distribution of ichthyoplankton in central and southern Philippines. This, in turn, will enable future biological oceanographic investigations to focus on more specific aspects, such as determining sources and sinks of fish (and/or other) larvae in interisland waters, and the potential influence of the interdependence between shelf an open water areas on recruitment processes in the country's waters.

# Size fractionated plankton production in the tropics: Sulu and Celebes Seas

Lourdes V. CASTILLO
(University of the Philippines Los Banos)

Biological communities in open waters are largely dependent on plankton production in the euphotic zone. In a tropical ecosystem, how much biomass is available to the next trophic level? Can the transfer of energy and materials best be described by a size classification scheme? As a preliminary study, I have collected zooplankton samples with will be processed to determine zooplankton biomass of different size fractions. With the chlorophyll data generated during the Hakuho Maru cruise, an estimate of production within the lower trophic level can easily be done.

Limited studies on plankton production have been conducted on Philippine territorial waters, including the Sulu-Celebes Seas. With the volume of fish harvested from the area, it is considered to be very productive. Further it lies within the Malayan Triangle which is considered by oceanographers to be the center of marine biodiversity.

Together with the transfer of energy and nutrients through the different trophic levels, other materials such as trace levels of pollutants (i.e. heavy metals) are also passed on through the oceanic food chain, and from the euphotic zone down to the deep abyssal region. Considering the closed nature of Sulu Sea as suggested by the temperature profile, is it possible that the deep sea is also becoming a sink for some pollutants? It is interesting to trace the vertical flux of trace metals through the food chain and its adsorption to sedimenting organic matter.

With my participation in the research cruise of Hakuho Maru from Brisbane, Australia to Cebu, Philippines, these questions have served as discussion points which I hope could be answered by further collaborative undertakings. It has been a very stimulating cruise where I have learned a lot. I would like to take this opportunity to thank Dr. Ohwada for inviting me, as well as the rest of the scientists with whom I have shared about 25 cruise days.

# Macrobenthos collected in the western tropical Pacific during the KH00-1 cruise

Tadashi Akiyama (Ushimado Marine laboratory, Univ. Okayama), Hiroshi Hasumoto and Eiji Tsuchida (Ocean Research Institute, Univ. Tokyo)

In the second leg of the KH00-1 cruise, we conducted deep sea benthos survey in the western tropical Pacific. The samples were collected with ORE beam trawl of 4m span at eight stations, off Brisbane (Station 13), Coral Sea (Station 14), off New Guinea (Station 16), off Slawesi (Station B1), Celebes Sea (Station 23,24), and Sulu Sea (Station B2-5, Station 26). At additional four stations located near station B2-5 (Stations B2-1 – B2-4), the samples were also collected with ORI biological dredge of 1m span. Towing speed of the both gears was about 1.5 knots. Duration of each tow was 15-50 minutes for the beam trawl and 5 minutes for the dredge. Sampling data is shown in Table 1.

The samples were sieved through 500 $\mu$m or 1 mm mesh and fixed in 5 or 10% seawater formalin buffered with sodium borate. Benthic animals were sorted from the sediment. Some large echinoderm specimens, remnant of plants, and sand samples collected by the dredge were stored below 0℃.

The beam trawl catches were relatively small in amount, probably due to bad weather condition at Stations 13 and 15, and potential oligotrophic environment at the study sites. However, we could collect considerable numbers of benthic animals from Celebes Sea and Sulu Sea, where deep sea benthic fauna is extremely restricted. The samples are reserved for the identification to the species and further zoogeographical and ecological studies.

The Picnogonidsand Cumacea of the KH00-1 cruise

Koichiro Nakamura (Japan Women's college of Physical Education) and Tadashi Akiyama (Ushimado Marine Laboratory, University of Okayama)

During the KH00-1 cruise, many species of arthropods were collected from the West Pacific. The specimes were taken at 12 stations, most of which were exceeding 1000m depth) using ORE Beam Trawl of 4m span and ORI Biological Dredge of 1m span. The station list is shown in Table 1. The specimens were fixed in 10 or 5% buffered formarine made up with seawater and transferred to 80% ethanol for preservation. The specimens were preliminarily identified and listed below. Although ecological study would be difficult for the paucity of material, the specimens will give valuable information about biodiversity of Celebes Sea and Sulu Sea. The exact specific identification is reserved to further studies.

Picnogonid

Cumacea

Bodotriidae

| | |
|---|---|
| *Cyclaspis* sp. | St. B1: 1 female |
| *Cyclaapoides* sp. | St. B2: 1 male |
| *Bathycuma* sp. | St. 23: 1 female |
| *Bathycuma* (?) sp. | St. B2-5: 1 male |

Leuconidae

| | |
|---|---|
| *Leucon* sp. (A) | St. B2-5: 1 female |
| *Leucon* sp. (B) | St. B2-5: 1 female |
| *Epileucon* sp. | St. B2-5: 1 female |

Nannastacidae

| | |
|---|---|
| *Nannastacus* sp. (A) | St. B2-2: 5 females and 1 male |

| | |
|---|---|
| *Nannastacus* sp. (B) | St. B2-2: 1 female |
| *Cumella* sp. | St. B2-5: 1 female and 3 males |
| Campylaspis (?) sp. (A) | St. B2-3: 1 female |
| *Campylaspis* (?) sp. (B) | St. B2-5: 1 female |
| *Campylaspis* (?) sp. (C) | St. B2-5: 1male |
| *Campylaspis* (?) Sp. (D) | St. B2-5: 3 females |
| *Campylaspis* (?) sp. (E) | St. B2-5: 3 females and 1 male |
| *Campylaspis* (?) sp. (F) | St. B2-5: 1 female |
| *Campylaspis* (?) sp. (G) | St. B2-5: 1 female |
| *Procampylaspis* sp. | St. B2-5: 1 female |
| Lampropidae | |
| *Lamprops* sp. | St. B2-2: 1 female, B2-3: 5 females |
| *Hemilamprops* sp. | St. 24: 1 male |
| *Hemilamprops* (?) sp. | St. B1: 1 male |
| Pseudocumidae | |
| *Petarosarsia* (?) sp. | St. B2-5: 1 male |
| Diastylidae | |
| *Makrokylindrus* sp. (A) | St. 24: many females and males |
| *Makrokylindrus* sp. (B) | St. B2-5:2 males and 3 manca larvae |
| *Leptostylis* sp. (A) | St. B1: 1 female |
| *Leptostylis* sp. (B) | St. B2-5: 2 females |

The Cumacea of KH00-1 cruise

Tadashi Akiyama (Ushimado Marine Laboratory, University of Okayama)

Beam trawl and dredge samples during KH00-1 cruise, were collected from the West Pacific. The specimes were taken at 12 stations, most of which were exceeding 1000m depth) using ORE Beam Trawl of 4m span and ORI Biological Dredge of 1m span. The specimens were fixed in 10 or 5% buffered formarine made up with seawater and transferred to 80% ethanol for preservation. The specimens were preliminarily identified and listed below. Although ecological study would be difficult for the paucity of material, the specimens will give valuable information about biodiversity of Celebes Sea and Sulu Sea. The exact specific identification is reserved to further studies.

| | |
|---|---|
| Family Bodotriidae | |
| *Cyclaspis* sp. | St. B1: 1 female |
| *Cyclaapoides* sp. | St. B2-5: 1 male |
| *Bathycuma* sp. | St. 23: 1 female |
| *Bathycuma* (?) sp. | St. B2-5: 1 male |
| Family Leuconidae | |
| *Leucon* sp. (A) | St. B2-5: 1 female |
| *Leucon* sp. (B) | St. B2-5: 1 female |
| *Epileucon* sp. | St. B2-5: 1 female |
| Family Nannastacidae | |
| *Nannastacus* sp. (A) | St. B2-2: 5 females and 1 male |
| *Nannastacus* sp. (B) | St. B2-2: 1 female |
| *Cumella* sp. | St. B2-5: 1 female and 3 males |
| Campylaspis (?) sp. (A) | St. B2-3: 1 female |
| *Campylaspis* (?) sp. (B) | St. B2-5: 1 female |
| *Campylaspis* (?) sp. (C) | St. B2-5: 1male |
| *Campylaspis* (?) Sp. (D) | St. B2-5: 3 females |
| *Campylaspis* (?) sp. (E) | St. B2-5: 3 females and 1 male |
| *Campylaspis* (?) sp. (F) | St. B2-5: 1 female |
| *Campylaspis* (?) sp. (G) | St. B2-5: 1 female |
| *Procampylaspis* sp. | St. B2-5: 1 female |

Family Lampropidae

| | |
|---|---|
| *Lamprops* sp. | St. B2-2: 1 female, B2-3: 5 females |
| *Hemilamprops* sp. | St. 24: 1 male |
| *Hemilamprops* (?) sp. | St. B1: 1 male |

Family Pseudocumidae

| | |
|---|---|
| *Petarosarsia* (?) sp. | St. B2-5: 1 male |

Family Diastylidae

| | |
|---|---|
| *Makrokylindrus* sp. (A) | St. 24: many females and males |
| *Makrokylindrus* sp. (B) | St. B2-5:2 males and 3 manca larvae |
| *Leptostylis* sp. (A) | St. B1: 1 female |
| *Leptostylis* sp. (B) | St. B2-5: 2 females |

Table 1: Station list of beam trawl and dredge operations (KH00-1)

| St. No | Area | Date | Bottom time | Ship position | | Depth range | Gear | Max. wire out | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | on bottom | off bottom | | | | |
| 13 | Off Brisbene | 6 Feb. 2000 | 14:38-16:08 | 24 38.46S<br>154 57.85E | 24 38.74S<br>154 57.85E | 4230-4246m | 4m ORE BT | 6400m | trawl snagged, weak link broken<br>No catch |
| 15 | Coral Sea | 10 Feb. 2000 | 09:00-10:00 | 15 02.16S<br>153 07.40E | 15 03.06S<br>153 09.11E | 4636-4637m | 4m ORE BT | 6400m | No catch |
| 16 | Northeast of New Guinea | 14 Feb. 2000 | 06:40-08:00 | 01 43.19S<br>139 55.54E | 01 43.00S<br>139 53.18E | 3055-3547m | 4m ORE BT | 4000m | No catch |
| B-1 | Northeast of Sulawesi | 17 Feb. 2000 | 22:05-23:00 | 01 55.35N<br>125 55.48E | 01 54.35N<br>125 55.05E | 1603-1658m | 4m ORE BT | 2600m | yellow silt, concretion blocks |
| 23 | Celebes Sea | 21 Feb. 2000 | 02:09-03:29 | 02 28.39N<br>122 30.09E | 02 28.59N<br>122 32.26E | 5384-5387m | 4m ORE BT | 7300m | |
| 24 | Celebes Sea | 22 Feb. 2000 | 06:31-07:40 | 04 30.12N<br>120 10.24E | 04 25.24N<br>120 11.80E | 3018-3154m | 4m ORE BT | 5600m | |
| B2-1 | Sulu sea | 22 Feb. 2000 | 19:45-19:59 | 06 04.89N<br>119 00.12E | 06 04.96N<br>118 59.94E | 246-260m | 1m ORI BD | 366m | sand |
| B2-2 | Sulu sea | 22 Feb. 2000 | 20:20-20:34 | 06 05.09N<br>118 59.21E | 06 05.21N<br>118 59.10E | 147-150m | 1m ORI BD | 192m | broken corals, lava, muddy sand |
| B2-3 | Sulu sea | 23 Feb. 2000 | 00:13-00:20 | 06 03.40N<br>118 55.38E | 06 03.36N<br>118 55.15E | 101-102m | 1m ORI BD | 160m | sand |
| B2-4 | Sulu Sea | 23 Feb. 2000 | 01:43-02:06 | 06 08.41N<br>118 59.93E | 06 08.60N<br>118 59.58E | 279-295m | 1m ORI BD | 400m | sand |
| B2-5 | Sulu sea | 23 Feb. 2000 | 06:15-08:22 | 06 18.41N<br>119 10.82E | 06 18.65N<br>119 11.34E | 1131-1392m | 4m ORE BT | 2500m | green mud, net torn, a beam bent |
| 26 | Sulu sea | 26 Feb. 2000 | 10:57-11:56 | 07 35.12N<br>121 30.15E | 07 34.45N<br>121 30.84E | 4889-4892m | 4m ORE BT | 7200m | |

4m ORE BT: ORE beam trawl of 4m span
1m ORI BD: ORI biological dredge of 1m span

# Multiple core samplings along North-South transect during KH00-1 Cruise

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## 1. Introduction

During R/V Hakuho Maru Cruise KH00-1, multiple core samplings were carried out at 14 stations along cruise route from Japan to Australia, Indonesia and Philippine (Figure 1 and Table 1). Among them, three stations are situated at West Central Pacific Ocean. Six samples were collected from Coral Sea. Then, five sampling stations were located at both Celebes and Sulu Seas. Water depths of sampling location were ranged between 1234 and 5783 m. The sites situate both above and below the CCD.

Multiple core sampling is able to collect undisturbed surface sediment, in particular to well-preserved fine textures of sediment-water interface. Distributional pattern of benthic organisms including micro-, meio- and macrobenthos can be examined precisely using undisturbed sediment. Scientific goals are different from each scientific group. ORI group tries to separate balophylic or balotolerate bacteria from deep-sea sediments. Ryukyu University group measures distribution of chemical species of both sediments and interstitial water. Shizuoka University group plans to analyse benthic foraminiferal populations dwelled in abyssal to hadal depths, in particular to soft-shelled foraminifera. General purpose and background of deep-sea foraminiferal study should refer to the cruise report of Hakuho Maru cruise KH97-2, the University of Tokyo (Kitazato and Toyofuku, 1997).

## 2. Sample treatments

Following treatments were made on board. Sediments from the cores were sliced every 0.5 cm from the sediment surface through 3 cm and then sliced every 1 cm thick from 3 cm through 15 cm at each locality. Sliced samples were fixed with 5% seawater-formalin-Rose Bengal solution. Fixed samples were washed through 400 mesh (32 μm) sieve in the laboratory. Residial sediment particles with small organisms were stored in 140 ml glass bottles in a 70% ethlene glycol-tapwater solution. Foraminifera were picked from wet sediments in a petri dish with a small pipette and sealed in single-hole micro slide glasses.

Benthic foraminiferal species of sampling stations above the CCD; St. 11, 12, 13, 14, 15, 22, 23, 24, and 25, tried to culture in glass bottles together with sediments and bottom water. Living foraminifera were observed microhabitat prerferences and were used for DNA study.

## 3. Sediment Characters

Sediment characters of mutiple core samples were described on board. Thicknesses of oxygenated layer were also measured. Brief descriptions of sediments at three sea areas, western central Pacific, Coral Sea and Celebes and Sulu Sea, were shown below (Table 1).

Stns. 1~3: Brownish gray pelagic clay. Surficial part of cores was disturbed a little.

Stns. 10~15: Light brown coloured foraminiferal clay. Compositions of biogenic particles are changed in relation to water depth. Biogenic particles of the sediment above the CCD are mainly composed of planktonic foraminiferal tests, whereas siliceous red clay is main component of the sediment below the CCD.

Stns. 22~26: Dark brown coloured mud. A couple of benthic foraminiferal species are alive at these stations.

## 4. Future Study

Deep-sea foraminifera, in particular to soft-shelled foraminifera, shall be described at specific level along north-south transect. Biodiversity of deep-sea benthic foraminifera shall be analysed. Then, biogeography of deep-sea foraminifera will be discussed according to the distributional patterns of each species. Preliminary results of soft-shelled foraminifera have already obtained from the North Pacific Ocean

(Gooday *et al.*, accepted).

**References**

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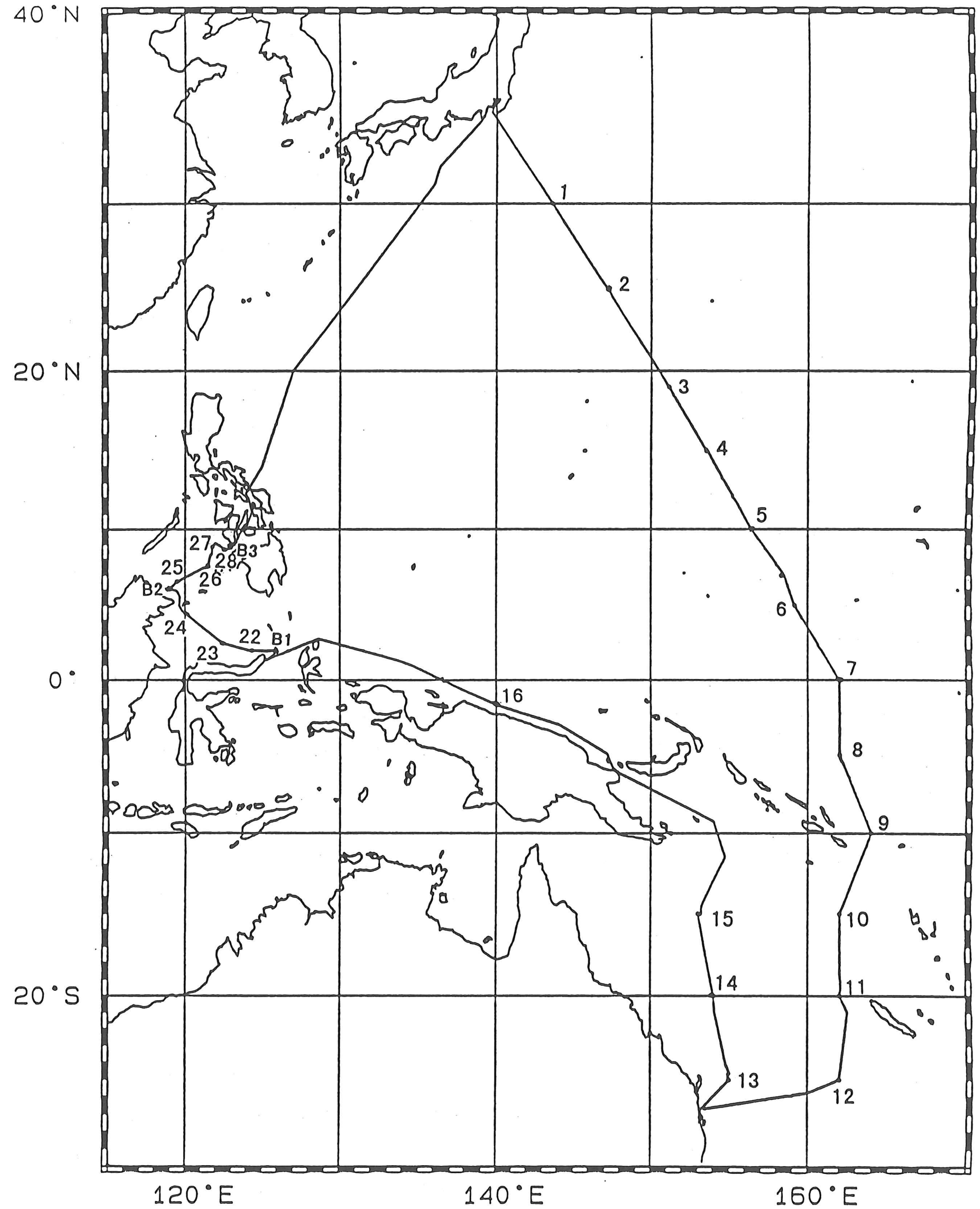
Kitazato, H. and T. Toyofuku (1998), Abyssal benthic foraminifera from the North Pacific. –Toward a better understanding of the origin of deep-sea benthic communities--. *In* Kawaguchi, K., (*ed.*), Preliminary Report of the R/V Hakuho Maru Cruise KH97-2, Ocean Research Institute, University of Tokyo, 94-97.

Table 1. Station list for multiple corer

| Station | Date | Time | Latitude | Longitude | Depth (m) | Gear | Sediment Description |
|---|---|---|---|---|---|---|---|
| 1 | 1/15 | 19:12 | 30°00.19'N | 143°40.164'E | 5378 | MC | Silt |
| 2 | 1/17 | 10:58 | 24°34.83'N | 147°31.78'E | 5783 | MC | Silt |
| 3 | 1/18 | 17:14 | 19°00.21'N | 151°07.13'E | 5494 | MC | Silt |
| 10 | 1/27 | 21:08 | 14°59.78'S | 162°00.93'E | 4578 | MC | Silt |
| 11 | 1/29 | 7:43 | 19°53.10'S | 161°58.23'E | 3521 | MC | Light brownish foraminiferal ooze |
| 12 | 1/30 | 8:36 | 24°59.05'S | 162°00.21'E | 1234 | MC | Light brownish white foraminiferal ooze |
| 13 | 2/7 | 9:30 | 24°38.50'S | 154°54.74'E | 4220 | MC | Foraminiferal ooze |
| 14 | 2/8 | 19:02 | 20°00.64'S | 154°01.21'E | 2618 | MC | Silty clay |
| 15 | 2/10 | 5:35 | 14°59.58'S | 153°02.58'E | 4606 | MC | Silt |
| 22 | 2/18 | 14:24 | 01°58.99'S | 124°20.73'E | 4617 | MC | Dark brownish silt |
| 23 | 2/20 | 11:19 | 02°28.11'N | 122°27.55'E | 5370 | MC | Silt |
| 24 | 2/21 | 23:50 | 04°31.56'N | 120°02.06'E | 2658 | MC | Silt |
| 25 | 2/23 | 15:30 | 06°34.70'N | 119°29.38'E | 3367 | MC | Foraminiferal ooze |
| 26 | 2/24 | 16:41 | 07°36.69'N | 121°31.08'E | 4863 | MC | Dark brownish silty clay |

# KH-00-1 TRACK CHART



# Phylogeography and Mitogenomics of Oceanic Fishes

Masaki Miya, Jun Inoue and Motoomi Yamaguchi

Recently Miya and Nishida (1997) demonstrated the first evidence for unexpectedly large, localized genetic differences within a circumglobal, highly monotypic species (*Cyclothone alba*) in the oceanic pelagic realm. Their study suggested that there were two genetically distinct, allopatric populations in *C. alba* from the western North Pacific. The first purpose of the present study was to examine more fine-scale genetic structure of the two western North Pacific populations of *Cyclothone alba* (including other oceanic species, such as *Ceratoscopelus* spp.) and to corroborate a hypothesis that the two populations are geographically isolated by the subtropical front.

Other oceanic species are also of interests for the mitogenomic studies of fishes, because Miya and Nishida (1999) recently developed a novel, PCR-based approach for sequencing the fish mitochondrial genomes and also because Miya and Nishida (2000) demonstrated that the mitogenomic information obtained using this method is useful for inferring evolutionary history of fishes. Oceanic fish specimens, however, rarely represented in the museum fish collection and therefore it is desirable to collect such valuable specimens at sea.

For the above two purposes, we conducted a series of oblique tows using a 10-foot Isaacs-Kidd midwater trawl to depths of approximately 200–2000 m during this cruise. All fish specimens (excluding larvae) were sorted immediately after collection, preserved in 99.5% ethanol. Subsequently they were primarily sorted into taxonomic categories ranging from families to species. Total genomic DNA was extracted from the muscle tissue using QIAamp tissue kit (Qiagen) following the manufacturer's protocol at sea. A list of the specimens is shown in TABLE. They are being used for the phylogeographic and mitogenomic studies of the oceanic fishes.

We sincerely thank K. Ohwada for him organizations of the sampling program on this cruise. We also thank to the captain, officers, crew, scientists, and students on board the cruise for their assistance in collecting samples.

References

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Miya, M. and M. Nishida. 1999. Organization of the mitochondrial genome of a deep-sea fish Gonostoma gracile (Teleostei: Stomiiformes): First example of transfer RNA gene rearrangements in bony fishes. *Marine Biotechnology*, 1: 416–426.

Miya, M. and M. Nishida. 2000. Use of mitogenomic information in teleostean molecular phylogenetics: A tree-based exploration under the maximum-parsimony optimality criterion. *Molecular Phylogenetics and Evolution* (in press).

**TABLE** Species Extracted Total Genemic DNA

| Sample No.* | Scientific Name | Coll. St. | Coll. Date | Extracted Date |
|---|---|---|---|---|
| 1 | *Sternoptyx diaphana* | St. 2 | | 2000/1/18 |
| 2 | *Vinciguerria nimbaria* | St. 2 | | 2000/1/18 |
| 3 | *Eustomias* sp. 3 | St. 2 | | 2000/1/18 |
| 4 | *Argylopelecus hemigymnus* | St. 2 | | 2000/1/18 |
| 5 | *Valenciennelus tripunctulatus* | St. 2 | | 2000/1/18 |
| 6 | *Bregmaceros japonicus* | St. 2 | | 2000/1/18 |
| 7 | *Astronesthes trifibulata* | St. U3 | | 2000/1/19 |
| 8 | *Ranzania laevis* | St. U3 | | 2000/1/19 |
| 9 | *Echiostoma barbatum* | St. U3 | | 2000/1/19 |
| 10 | *Cyclothone alba* | St. U3 | | 2000/1/19 |
| 11 | *C. atraria* | St. U3 | | 2000/1/19 |
| 12 | *C. pseudopallida* | St. U3 | | 2000/1/19 |
| 13 | *Paralepis atlantica* (?) | St. 2 | | 2000/1/19 |
| 14 | *Scopelarchus analis* (?) | St. U2 | | 2000/1/19 |
| 15 | *Thysanactis dentex* | St. 4 (IKMT-3000m w.o.) | | 2000/1/20 |
| 16 | *Gonostoma elongatum* | St. 4 (IKMT-3000m w.o.) | | 2000/1/20 |
| 17 | *Cyclothone pallida* | St. 4 (IKMT-3000m w.o.) | | 2000/1/20 |
| 18 | *Melamphaes* sp. | St. 4 (IKMT-3000m w.o.) | | 2000/1/20 |
| 19 | *Oneirodes* sp. | St. 4 (IKMT-3000m w.o.) | | 2000/1/20 |
| 20 | Ceratioidei sp. | St. 4 (IKMT-3000m w.o.) | | 2000/1/20 |
| 21 | *Melanostomias melanops* | St. U4 | | 2000/1/21 |
| 22 | *Idiacanthus fasciola* | St. U4 | | 2000/1/21 |
| 23 | *Gonostoma ebelingi* | St. U4 | | 2000/1/21 |
| 24 | *G. atlanticum* | St. U4 | | 2000/1/21 |
| 25 | Nomeidae sp. | | | 2000/1/22 |
| 26 | *Argylopelecus sladeni* | | | 2000/1/22 |
| 27 | *Sternoptyx obscura* | St. 6 (IKMT-3000m w.o.) | 2000/1/22 | 2000/1/23 |
| 28 | *Cyclothone acclinidens* | St. 6 (IKMT-3000m w.o.) | 2000/1/22 | 2000/1/23 |
| 29 | *Melanostomias tentaculatus* | St. 6 (IKMT-3000m w.o.) | 2000/1/22 | 2000/1/23 |
| 30 | *Oneirodes* sp. 2 | St. 6 (IKMT-3000m w.o.) | 2000/1/22 | 2000/1/23 |
| 31 | *Photostomias guernei* | St. 6 (IKMT-3000m w.o.) | 2000/1/22 | 2000/1/23 |
| 32 | *Astronesthes splendida* | St. 6 (IKMT-3000m w.o.) | 2000/1/22 | 2000/1/23 |
| 33 | *Eutaeniophorus festivus* | St. U11 (IKMT-3000m w.o.) | 2000/1/23 | 2000/1/24 |
| 34 | Diretmidae sp. | St. U11 (IKMT-3000m w.o.) | 2000/1/23 | 2000/1/24 |
| 35 | *Howella zina* | St. U11 (IKMT-3000m w.o.) | 2000/1/23 | 2000/1/24 |
| 36 | *Photonectes albipennis* | St. U12 (IKMT-1000m w.o.) | 2000/1/23 | 2000/1/24 |
| 37 | *Idiacanthus fasciola* | St. U12 (IKMT-1000m w.o.) | 2000/1/23 | 2000/1/24 |
| 38 | *Lestidium atlanticum* | St. U12 (IKMT-1000m w.o.) | 2000/1/23 | 2000/1/24 |
| 39 | *Coccorella atrata* | St. U12 (IKMT-1000m w.o.) | 2000/1/23 | 2000/1/24 |
| 40 | *Odontostomops normalops* | St. U12 (IKMT-1000m w.o.) | 2000/1/23 | 2000/1/24 |
| 41 | *Scopelarchus hoedti* | St. U12 (IKMT-1000m w.o.) | 2000/1/23 | 2000/1/24 |
| 42 | *Poromitra oscitans* | St. U14 (IKMT-3000m w.o.) | 2000/1/24 | 2000/1/25 |
| 43 | *Sternoptyx pseudobscura* | St. U14 (IKMT-3000m w.o.) | 2000/1/24 | 2000/1/25 |
| 44 | *Cyclothone obscura* | St. U14 (IKMT-3000m w.o.) | 2000/1/24 | 2000/1/25 |

(*Continues* )

**TABLE** (*Continued* )

| Sample No.* | Scientific Name | Coll. St. | Coll. Date | Extracted Date |
|---|---|---|---|---|
| 46 | *Omosudis loweii* | St. U14 (IKMT-3000m w.o.) | 2000/1/24 | 2000/1/25 |
| 47 | *Astronesthes indica* | St. U14 (IKMT-3000m w.o.) | 2000/1/24 | 2000/1/25 |
| 48 | *Malacosteus niger* | | | 2000/1/25 |
| 49 | *Aluterus* sp. | | | 2000/1/25 |
| 50 | *Coryphaena equiselis* | | | 2000/1/25 |
| 51 | Paralepididae sp. | St. U20 (IKMT-3000m w.o.) | 2000/1/26 | 2000/1/26 |
| 52 | *Scopelosaurus harryi* | St. U20 (IKMT-3000m w.o.) | 2000/1/26 | 2000/1/26 |
| 53 | *Gonostoma ebelingi* | St. U20 (IKMT-3000m w.o.) | 2000/1/26 | 2000/1/26 |
| 54 | *Luzonichthys waitei* | St. U20 (IKMT-3000m w.o.) | 2000/1/26 | 2000/1/26 |
| 55 | *Argylopelecus aculeatus* | St. U21 & U22 | | 2000/1/27 |
| 56 | *Lestrolepis* sp. | St. U21 & U22 | | 2000/1/27 |
| 57 | *Isistius brasiliensis* | St. U21 & U22 | | 2000/1/27 |
| 58 | *Rondeletia loricata* | St. 25 (IKMT-5000m w.o.) | | 2000/1/28 |
| 59 | Cetomimidae sp. | St. 25 (IKMT-5000m w.o.) | | 2000/1/28 |
| 60 | *Bathophilus* sp. | St. 25 (IKMT-5000m w.o.) | | 2000/1/28 |
| 61 | *Anoplogaster* sp. | St. 25 (IKMT-5000m w.o.) | | 2000/1/28 |
| 62 | *Cryptopsarus coeesii* | St. 25 (IKMT-5000m w.o.) | | 2000/1/28 |
| 63 | *Bregmaceros* sp. | St. 25 (IKMT-5000m w.o.) | | 2000/1/28 |
| 64 | *Cyclothone microdon* | St. U28 (IKMT-5000m w.o.) | | 2000/1/29 |
| 65 | *Melanocetus murrayi* | St. U28 (IKMT-5000m w.o.) | | 2000/1/29 |
| 66 | *Rosenblatichthys* sp. | St. U28 (IKMT-5000m w.o.) | | 2000/1/29 |
| 67 | Platytroctidae sp. | St. U28 (IKMT-5000m w.o.) | | 2000/1/29 |
| 68 | *Scopeloberyx robustus* | St. U28 (IKMT-5000m w.o.) | | 2000/1/29 |
| 69 | Paralepididae sp. | St. U28 (IKMT-5000m w.o.) | | 2000/1/29 |
| 70 | *Champsodon* sp. | St. U29 (IKMT-1000m w.o.) | 2000/1/29 | 2000/1/30 |
| 71 | Trichiuridae sp. | St. U29 (IKMT-1000m w.o.) | 2000/1/29 | 2000/1/30 |
| 72 | *Exocoteus* sp. (musclature) | | | 2000/1/31 |
| 73 | *Exocoteus* sp. (gill raker) | | | 2000/1/31 |
| 74 | *Valenciennellus tripunctulatus* | St. 11 (ORI) | 2000/1/29 | 2000/2/9 |
| 75 | *Valenciennellus* sp. | St. 11 (ORI) | 2000/1/29 | 2000/2/9 |
| 76 | *Scopelarchoides danae* (?) | St. U35 (IKPT) | 2000/2/8 | 2000/2/9 |
| 77 | *Polyipnus* sp. | St. 14 (IKPT-2000m w.o.) | 2000/2/8 | 2000/2/9 |
| 78 | *Scopelosaurus hoedti* | St. 14 (IKPT-2000m w.o.) | 2000/2/8 | 2000/2/9 |
| 79 | *Stomias affinis* | St. U37 (IKPT [obl.]) | 2000/2/14 | 2000/2/14 |
| 80 | Melamphaid fish | St. U37 (IKPT [obl.]) | 2000/2/14 | 2000/2/14 |
| 81 | *Icthyococcus elongatus* (?) | St. U40 (IKMT [4000m w.o.]) | 2000/2/15 | 2000/2/16 |
| 82 | *Argyropelecus affinis* | St. U40 (IKMT [4000m w.o.]) | 2000/2/15 | 2000/2/16 |
| 83 | *Polypnus spinifer* (?) | St. U40 (IKMT [4000m w.o.]) | 2000/2/15 | 2000/2/16 |
| 84 | *Oneirodes* sp. | St. U40 (IKMT [4000m w.o.]) | 2000/2/15 | 2000/2/16 |
| 85 | *Benthodesmus* sp. (?) | St. U40 (IKMT [4000m w.o.]) | 2000/2/15 | 2000/2/16 |
| 86 | *Gigantura* sp. | St. U40 (IKMT [4000m w.o.]) | 2000/2/15 | 2000/2/16 |
| 87 | *Astronesthes cyanea* | St. U41 (IKMT [obl.]) | 2000/2/16 | 2000/2/17 |
| 88 | *Pseudoscopelus* sp. | St. U41 (IKMT [obl.]) | 2000/2/16 | 2000/2/17 |
| 89 | *Aristomias polyductylus* (?) | St. U41 (IKMT [step]) | 2000/2/16 | 2000/2/17 |
| 90 | Platytroctid fish | St. 22 (IKMT [4000m w.o.]) | 2000/2/18 | 2000/2/19 |

(*Continues* )

**TABLE** *(Continued )*

| Sample No.* | Scientific Name | Coll. St. | Coll. Date | Extracted Date |
|---|---|---|---|---|
| 92 | Hemiramphid fish | St. U43 (IKMT [obl.]) | 2000/2/18 | 2000/2/19 |
| 93 | *Eustomias bifilis* | St. U43 (IKMT [step]) | 2000/2/18 | 2000/2/19 |
| 94 | Belonid fish | St. U45 (ORI-side [1st]) | 2000/2/20 | 2000/2/20 |
| 95 | *Evermannella indica* | St. U45 (IKMT [Step]) | 2000/2/20 | 2000/2/20 |
| 96 | *Beryx splendens* | St. U46 (IKMT [obl.]) | 2000/2/20 | 2000/2/20 |
| 97 | Pentacerotid fish (?) | St. U46 (IKMT [step]) | 2000/2/20 | 2000/2/20 |
| 98 | Unidentified larva | St. U46 (IKMT [step]) | 2000/2/20 | 2000/2/20 |
| 99 | *Opisthoproctus* sp. | St. 2ÇR (IKMT [4000m w.o.]) | 2000/2/20 | 2000/2/20 |
| 100 | *Opisthoproctus* sp. | St. 2ÇR (IKMT [4000m w.o.]) | 2000/2/20 | 2000/2/20 |
| 101 | *Diplophos orientalis* | St. 2ÇR (IKMT [4000m w.o.]) | 2000/2/20 | 2000/2/20 |
| 102 | *Polyipnus* sp. | St. 2ÇR (IKMT [4000m w.o.]) | 2000/2/20 | 2000/2/20 |
| 103 | *Omosudis loweii* | St. 2ÇR (IKMT [4000m w.o.]) | 2000/2/20 | 2000/2/20 |
| 104 | *Cetostoma regani* | St. 2ÇR (IKMT [4000m w.o.]) | 2000/2/20 | 2000/2/20 |
| 105 | *Caulophryne pelagica* | St. 2ÇR (IKMT [4000m w.o.]) | 2000/2/20 | 2000/2/20 |
| 106 | *Dysalotus alcocki* | St. 2ÇR (IKMT [4000m w.o.]) | 2000/2/20 | 2000/2/20 |
| 107 | *Caranx melampygus* | St. U47 (IKMT [obl.]) | 2000/2/20 | 2000/2/23 |
| 108 | *Eustomias bulbornatus* | St. U47 (IKMT [obl.]) | 2000/2/21 | 2000/2/23 |
| 109 | *Decapterus russelli* | St. U47 (IKMT [obl.]) | 2000/2/21 | 2000/2/23 |
| 110 | *Oxyporhamphus* sp. | St. U47 (IKMT [obl.]) | 2000/2/21 | 2000/2/23 |
| 111 | *Melanostomias* sp. | St. U49 (IKMT [step]) | 2000/2/21 | 2000/2/23 |
| 112 | *Lestidium prolixum* | St. U50 (IKMT [step]) | 2000/2/22 | 2000/2/23 |
| 113 | *Polichthys mauli* | St. U51 (IKMT [obl.]) | 2000/2/22 | 2000/2/23 |
| 114 | *Chanos chanos* | Fish Market in Cebu Island | 2000/3/1 | 2000/3/2 |
| 115 | *Selar crumenophthalmus* | Fish Market in Cebu Island | 2000/3/1 | 2000/3/2 |
| 116 | *Selaroides leptolepis* | Fish Market in Cebu Island | 2000/3/1 | 2000/3/2 |
| 117 | *Carangoides armatus* | Fish Market in Cebu Island | 2000/3/1 | 2000/3/2 |
| 118 | *Mene maculata* | Fish Market in Cebu Island | 2000/3/1 | 2000/3/2 |
| 119 | *Caesio cuning* | Fish Market in Cebu Island | 2000/3/1 | 2000/3/2 |
| 120 | *Nemipterus* sp. | Fish Market in Cebu Island | 2000/3/1 | 2000/3/2 |
| 121 | *Balbometopon bicolor* (?) | Fish Market in Cebu Island | 2000/3/1 | 2000/3/2 |
| 122 | *Rastrelliger kanagurta* | Fish Market in Cebu Island | 2000/3/1 | 2000/3/2 |
| 123 | *Rastrelliger kanagurta* | Fish Market in Cebu Island | 2000/3/1 | 2000/3/2 |
| 124 | *Heterophotus ophistoma* | St. M2 (IKMT [3000m w.o.]) | 2000/2/23 | 2000/3/2 |
| 125 | *Aluterus monoceros* (?) | St. M5 (IKMT [3000m w.o.]) | 2000/2/24 | 2000/3/2 |
| 126 | *Lobotes surinamensis* | St. 27 (Dipp-Netted) | 2000/2/27 | 2000/3/2 |
| 127 | Scyliorhinid shark | Pasil Fish Market in Cebu Island | 2000/3/2 | 2000/3/5 |
| 128 | *Chirocentrus dorab* | Pasil Fish Market in Cebu Island | 2000/3/2 | 2000/3/5 |
| 129 | *Rachycentron canadum* | Pasil Fish Market in Cebu Island | 2000/3/2 | 2000/3/5 |
| 130 | *Echeneis naucrates* | Pasil Fish Market in Cebu Island | 2000/3/2 | 2000/3/5 |
| 131 | *Sarda orientalis* | Pasil Fish Market in Cebu Island | 2000/3/2 | 2000/3/5 |
| 132 | *Priacanthus macracanthus* (?) | Pasil Fish Market in Cebu Island | 2000/3/2 | 2000/3/5 |
| 133 | *Saurida* sp. 1 | Pasil Fish Market in Cebu Island | 2000/3/2 | 2000/3/5 |
| 134 | *Brama* sp. | Pasil Fish Market in Cebu Island | 2000/3/2 | 2000/3/5 |
| 135 | Nomeid fish | Pasil Fish Market in Cebu Island | 2000/3/2 | 2000/3/5 |
| 136 | *Acanthocepola* sp. | Pasil Fish Market in Cebu Island | 2000/3/2 | 2000/3/5 |

*(Continues )*

**TABLE** (*Continued* )

| Sample No.* | Scientific Name | Coll. St. | Coll. Date | Extracted Date |
|---|---|---|---|---|
| 138 | Platytroctid fish | St. 26 (IKMT [4000m w.o.]) | 2000/2/25 | 2000/3/5 |
| 139 | *Anoplogaster cornuta* | St. 27 (IKMT [6000m w.o.]) | 2000/2/27 | 2000/3/5 |
| 140 | *Howella* sp. | St. 28 (IKMT [4000m w.o.]) | 2000/2/27 | 2000/3/5 |
| 141 | *Zu cristatus* (?) | St. U61 (IKMT [step]) | 2000/2/27 | 2000/3/5 |
| 142 | Leptochilichthyd fish | St. M2 (IKMT [3000m w.o.]) | 2000/2/23 | 2000/3/5 |
| BT-1 | *Synaphobranchus* sp. | St. B1 (Beam Trawl) | 2000/2/17 | 2000/2/18 |
| BT-2 | *Eretmichthys pinnatus* (?) | St. B1 (Beam Trawl) | 2000/2/17 | 2000/2/18 |
| BT-3 | *Porogadus* sp. | St. B1 (Beam Trawl) | 2000/2/17 | 2000/2/18 |
| BT-4 | *Coelophrys* sp. | St. B1 (Beam Trawl) | 2000/2/17 | 2000/2/18 |
| BT-5 | *Bathysaurus mollis* | St. 23 (Beam Trawl) | 2000/2/21 | 2000/2/21 |
| BT-6 | *Ipnops* sp. | St. 23 (Beam Trawl) | 2000/2/21 | 2000/2/21 |
| BT-7 | *Bajacalifornia* sp. (?) | St. 24 (Beam Trawl) | 2000/2/22 | 2000/2/23 |
| BT-8 | *Spectrunculus grandis* (?) | St. 24 (Beam Trawl) | 2000/2/22 | 2000/2/23 |
| BT-9 | *Bassozetus* sp. | St. 24 (Beam Trawl) | 2000/2/22 | 2000/2/23 |
| BT-10 | *Lamprogrammus niger* (?) | St. B2 (Beam Trawl) | 2000/2/23 | 2000/3/2 |

* "BT" means the specimen that were collected by beam trawl. Other specimens were basically collected by IKMT, although some specimens were bought at the fish market.

Distribution, abundance and life history characteristics of the anguilliform leptocephali in the Celebes and Sulu Seas during the KH-00-1 cruise

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Of the 3,647 leptocephali collected using IKPT, ORI, and MOCNESS nets during this cruise, 3,201 or 88 % were collected during February in the Celebes and Sulu seas. These areas consist of two relatively small basins surrounded by islands or shallow shelf areas, with both basins reaching depths of about 5,000 m. The two basins are separated by a narrow shelf area with scattered islands that is 50 m or shallower everywhere except for a small channel, 500 m deep, that connects the two basins at the southern end of the Sulu Sea. The majority of the leptocephali in these two seas belonged to the order Anguilliformes (99.1%), and the remaining specimens belonged to the Notacanthiformes (N = 15; 28-217 mm TL) and the Elopiformes (N = 11; 24-45 mm TL). The leptocephali of the marine eel families that live on the continental shelf or around islands were especially abundant in the these areas, and the Congridae (N = 1,829) was the most abundant family due to the 1,442 Ariosoma collected in the two areas. The Muraenidae (N = 431), Ophichthidae (N = 328), Chlopsidae (N = 113), and Moringuidae (N = 93) were also relatively abundant in the two seas.

However, some taxa were more abundant in one of the two seas or had different size distributions in the two areas despite a similar sampling effort in each area. *Ariosoma*, Moringuidae, Derichthyidae, Nemichthyidae, and Serrivomeridae were more abundant in the Celebes Sea, and congrids other than *Ariosoma*, and rare taxa such as the Ilyophinae (*Dysomma* etc.), Elopiformes, and Notacanthiformes were more abundant in the Sulu Sea (Table 1). Relatively small leptocephali of many taxa were collected, indicating that a variety of species were spawning in the region. There was a higher proportion of small leptocephali of the Chlopsidae and Moringuidae in the Celebes Sea, but there was a higher proportion of larger individuals of the Nettastomatidae (Figure 1) and of *Ariosoma* in the Sulu Sea (Figure 2 and 3). The smallest specimens of *Ariosoma* were collected at station U42 near the northeast end of Sulawesi Island, at stations U49-51 in both seas near the northern end of Borneo Island, and at station U60 near the Philippines (Figure 3). This indicated that eels of the genus *Ariosoma* were probably spawning close to the shelf where their juveniles and adults live, and that their leptocephali were advected to offshore areas.

In contrast to *Ariosoma*, the leptocephali of *Nemichthys* were collected in even lower abundances in the Sulu Sea compared to in the Celebes Sea (Figure 4), and the smallest recently spawned individuals were collected closer to the middle of the two seas (Figure 5). Nemichtyids are open ocean mesopelagic eels that live completely pelagic life histories, and therefore it is expected that they spawn in the open ocean away from any shelf areas. The length frequency distribution of their leptocephali indicated that there were a high proportion of small individuals in the Celebes Sea. However, the Sulu Sea is much more closed off from the western Pacific Ocean, and based on the rarity of their leptocephali there, they may have a much smaller population size of Nemichthyid eels there, or there may have been far fewer leptocephali transported into the basin from other areas, than in the Celebes Sea, which has direct inflow from the western Pacific.

Another interesting feature of the leptocephali catches in these two seas was the relatively large number and the frequency of catches of leptocephali in the ORI side nets that were fished at the surface next to the ship at IKPT stations. Surface catches of *Ariosoma* and a few other taxa have been observed during previous Hakuho Maru cruises, but not to the same extent of number of tows, abundance or diversity of taxa as in these two areas. A total of 551 *Ariosoma* leptocephali were collected in 13 tows of the ORI side nets at 8 stations in the Celebes Sea, compared to a total of 88 individuals collected in 12 tows at 8 stations in the Sulu Sea. The size ranges of these leptocephali were similar to those collected in the IKPT tows (Figure 2) and were spread out at stations throughout both seas (Figure 6). Although, there were some greater catches of *Ariosoma* at the surface in the Celebes Sea, there was a greater diversity of taxa collected at the surface in the Sulu Sea (Table 1, Figure 6). These leptocephali were of a wide range of sizes that were caught at eight of the 11 stations, but were most abundant at a station at the northern edge of the Sulu Sea (Figure 6). Other than *Ariosoma*, there were only two ophichthid leptocephali collected at the surface at one station in the Celebes Sea, in contrast to 35 specimens of eight taxa of anguilliform leptocephali that were collected at the surface at eight stations in the Sulu Sea. The Anguillidae, Nettastomatidae, and Serrivomeridae were the only anguilliform families that were not collected at the surface there. The families that had more than 3 specimens collected at the surface were the Congridae (N = 9 at 6 stations), Muraenidae (N = 8 at 3 stations), and the Ophichthidae (N = 12 at 5 stations). These catches of leptocephali at the surface indicate that they were frequently distributed in the upper meter of the ocean at night in these areas, but why more taxa were collected at the surface in the Sulu Sea is unclear.

The catch data of leptocephali collected in both the ORI and IKPT nets that were fished in the Celebes and Sulu Seas provide unique and valuable insight on the distribution and early life history of the anguilliform leptocephali present there in February and on the spawning ecology of the adult eels in the region. Further identification of these leptocephali will provide valuable new information about the diversity and life history of the many different species of eels that inhabit the coastal and offshore areas in the region

Table 1. Number and size ranges of leptocephali collected in the Celebes and Sulu Seas, and the number of leptocephali collected at the surface in tows of the ORI side net.

| | Number of Specimens | | |
|---|---|---|---|
| Taxa | Celebes Sea | Sulu Sea | Total |
| Anguilliformes | | | |
| Anguillidae | 12 (6.3-47.4)* | 2 (9.2-12.3) | 14 |
| Chlopsidae | 45 (13.7-63.7) | 68 (15.6-75.3) | 113 |
| Congridae (part) | 127 (12.1-131.4) | 260 (9.0-185.0) | 387 |
| Ariosoma | 1063 (16.1-223.0) | 379 (11.8-223.0) | 1442 |
| Moringuidae | 82 (10.8-62.3) | 11 (24.7-42.8) | 93 |
| Muraenidae | 212 (19.7-92.3) | 218 (10.3-72.7) | 430 |
| Ophichthidae | 156 (9.0-93.4) | 172 (16.3-100.7) | 328 |
| Nettastomatidae | 11 (19.0-48.4) | 11 (9.8-98.5) | 22 |
| Derichthyidae | 53 (11.0-76.5) | 4 (9.8-27.0) | 57 |
| Nemichthyidae | 213 (8.5-356.0) | 25 (22.7-306.0) | 238 |
| Serrivomeridae | 8 (20.2-68.0) | 0 | 8 |
| Synaphobranchidae | | | |
| Synaphobranchinae | 10 (24.0-54.2) | 14 (17.1-32.0) | 24 |
| Ilyophinae | 4 (26.3-51.3) | 14 (25.7-53.3) | 19 |
| Elopiformes | 0 | 12 (24.3-45.4) | 12 |
| Notacanthiformes | 2 (34.5-42.1) | 13 (28.7-217.5) | 15 |
| Saccopharyngformes | 0 | 0 | 0 |
| Total specimens | 1998 | 1203 | 3201 |
| No. of taxa in ORI surface tows | 2 | 9 | 9 |
| No. of individuals In ORI surface tows | 552 | 124 | 676 |

*Number of specimens (range of mm TL)

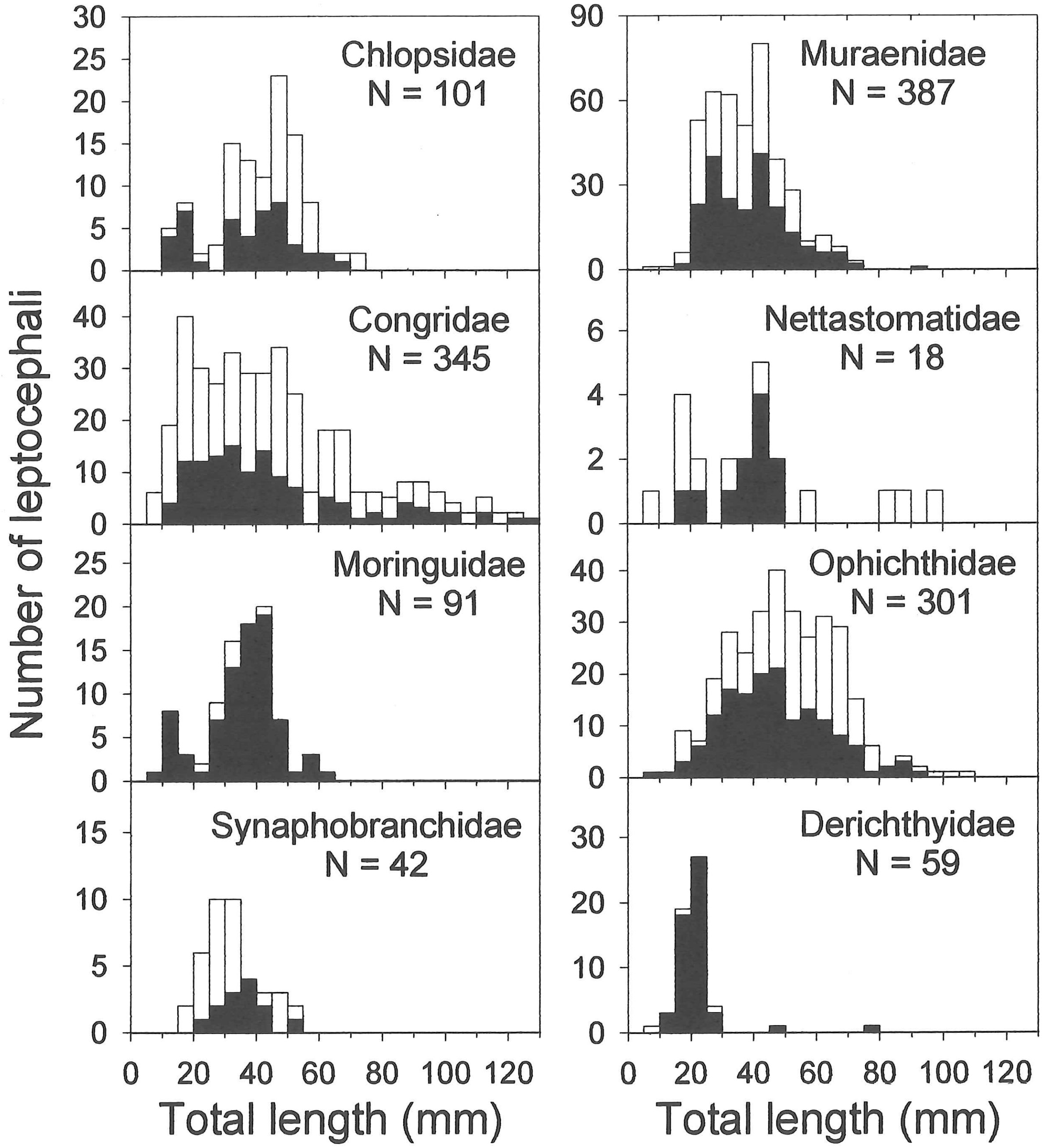


Figure 1. Length frequency distributions of leptocephali collected in the Celebes Sea (black bars) and in the Sulu Sea (white bars).

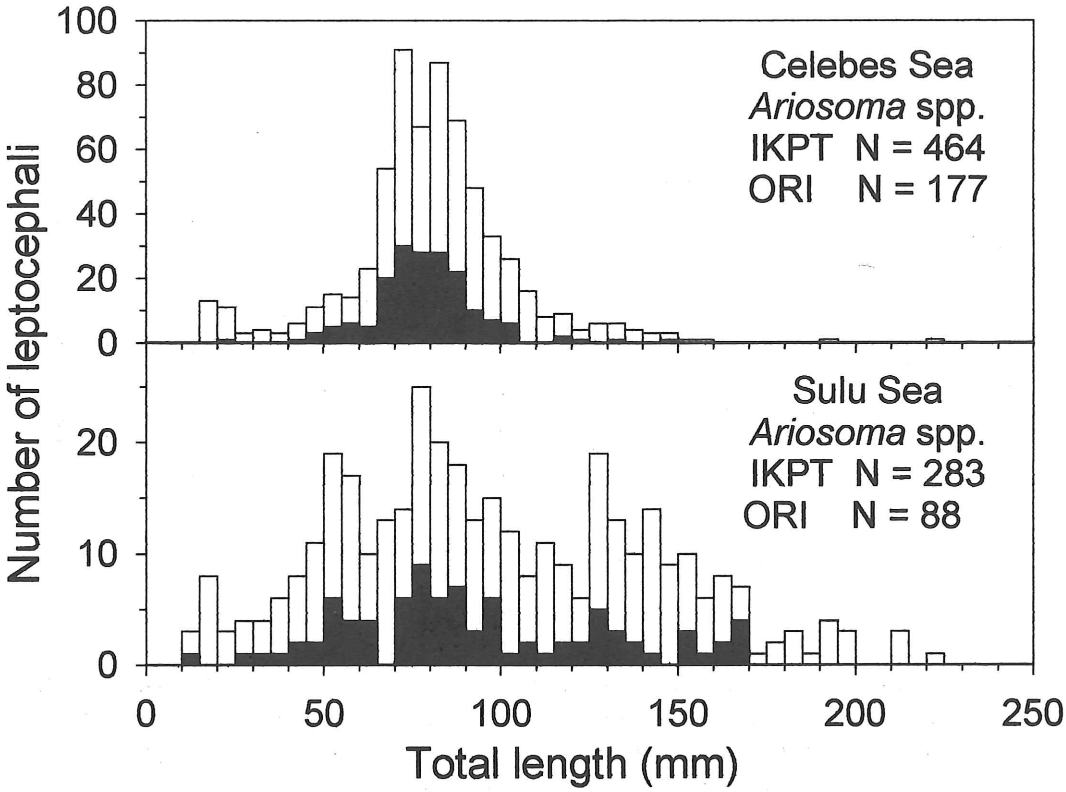


Figure 2. Length frequency distributions of *Ariosoma* leptocephali collected in the Isaacs Kidd Pelagic Trawls (IKPT - white bars) and at the surface in the ORI side net (ORI - black bars) in the Celebes and Sulu Seas.

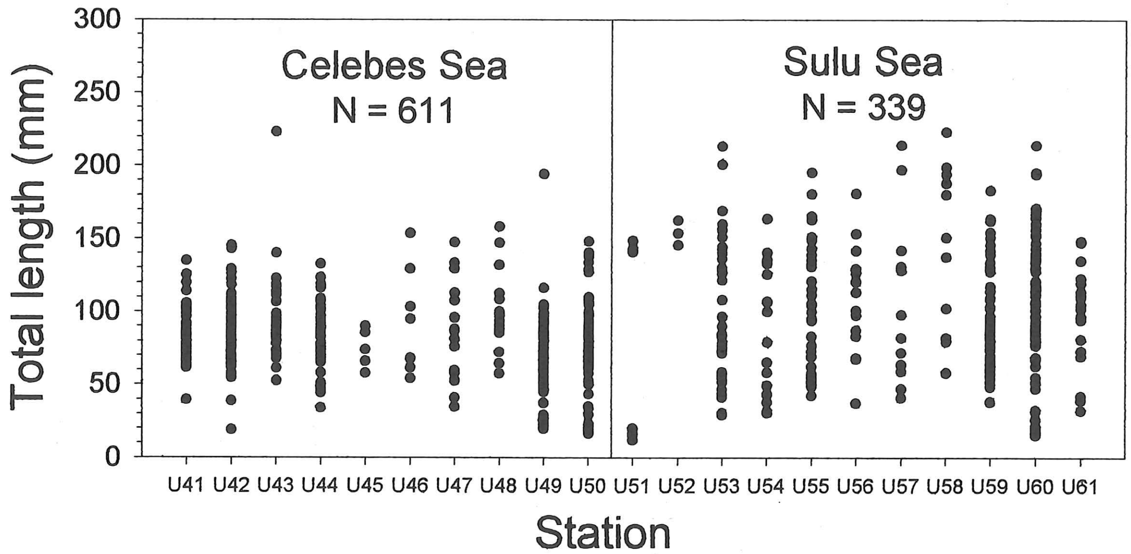


Figure 3. Distribution and size of *Ariosoma* spp. leptocephali in the Celebes and Sulu Seas collected in a series of stations that sampled east to west across the Celebes Sea and then from the southern end to the northeast corner of the Sulu Sea.

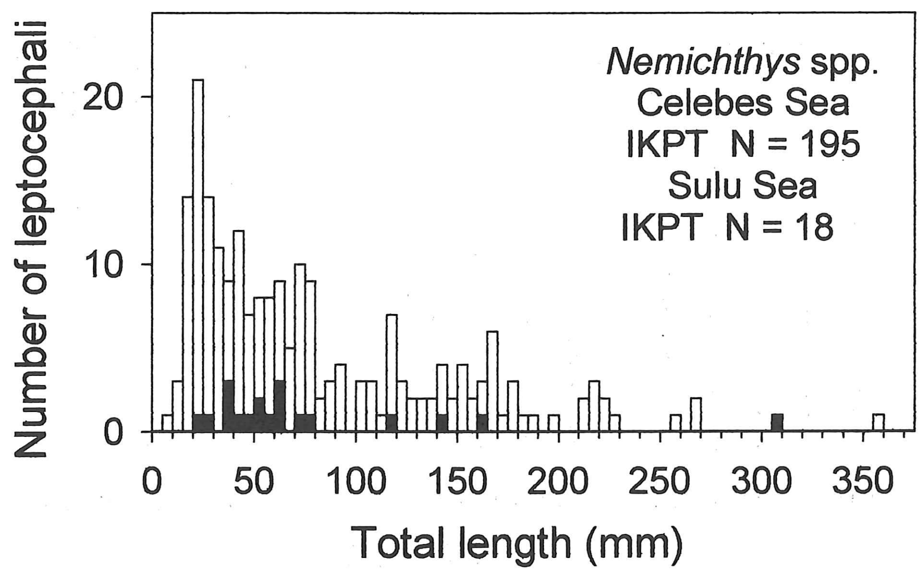


Figure 4. Length frequency distributions of *Nemichthys* leptocephali collected in the Isaacs Kidd Pelagic Trawls in the Celebes Sea (white bars) and Sulu Sea (black bars) Two individuals (55.8 and 95.0 mm TL) collected at the surface in the ORI side net in the Sulu Sea are not shown.

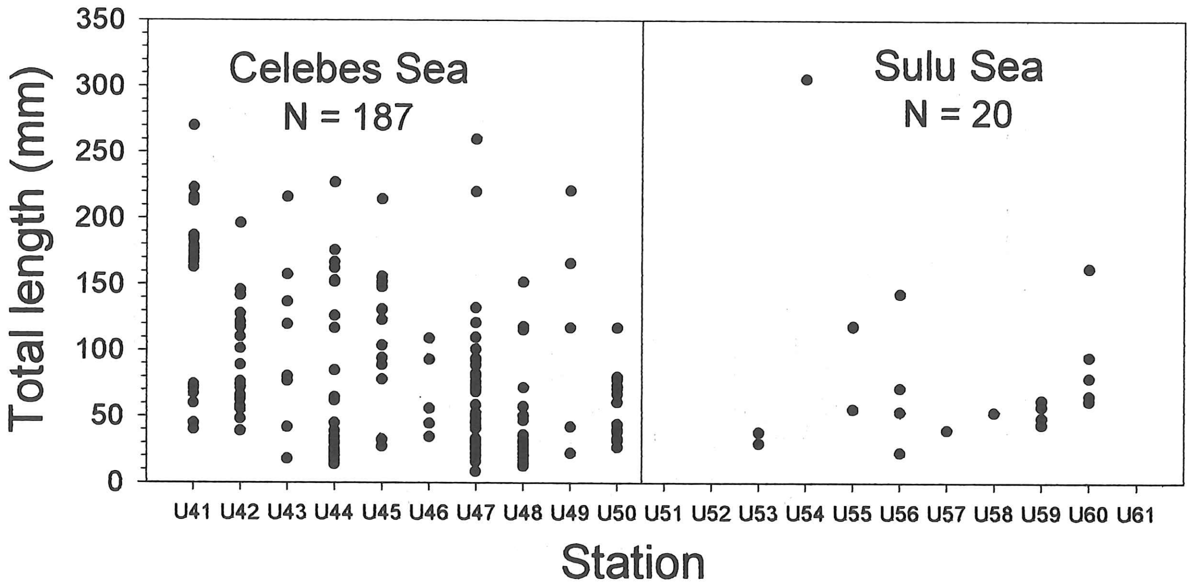


Figure 5. Distribution and size of *Nemichthys* spp. leptocephali in the Celebes and Sulu Seas collected in a series of stations that sampled east to west across the Celebes Sea and then from the southern end to the northeast corner of the Sulu Sea.

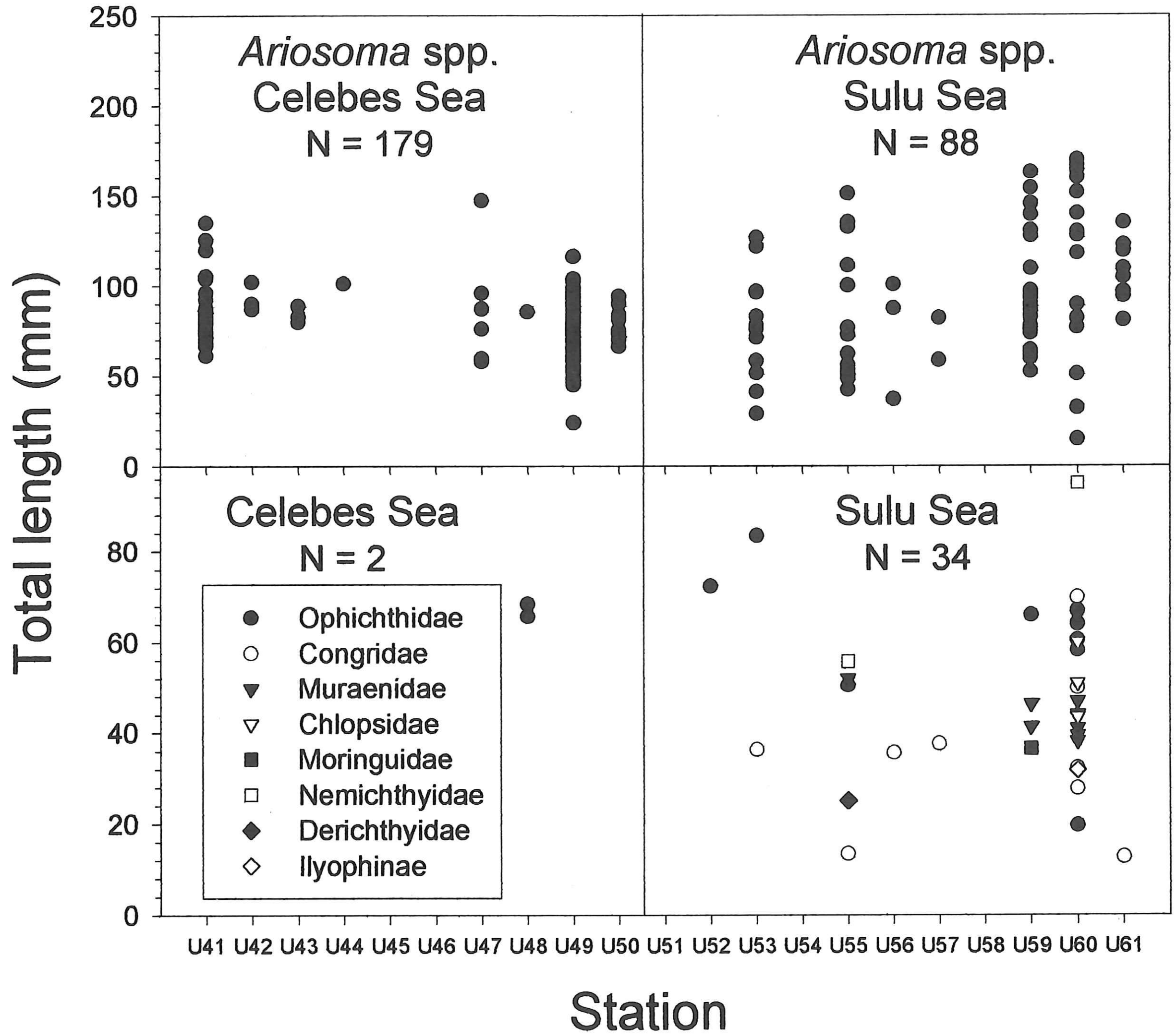


Figure 6. Distribution and size of *Ariosoma* spp. (top panel) and eight families of leptocephali (bottom panel) in the Celebes and Sulu Seas collected at the surface in the ORI side nets at a series of stations that sampled east to west across the Celebes Sea and then from the southern end to the northeast corner of the Sulu Sea. Additional specimens of *Ariosoma* (N = 371) at stations U49 and U50 are not shown.

The bathymetric survey to depths of over 7000 m using SEA BEAM 2120HR

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A new multi-narrow beam echo sounder system, called SEA BEAM 2120HR, was installed on R/V Hakuho-maru at March 1999. The SEA BEAM 2120HR system is the first system operated at a frequency of 20 kHz in the world. As the SEA BEAM 2120 HR system covers depths to 6000 m, several sea trials were carried out at depths shallower than 6000 m during the research cruises in 1999, KH-99-2, KH-99-3, and KH-99-4. After the trials, we installed an option that permits focusing of the transmitted energy into a narrower swath around the vertical with depth capability to over 8000 m, called Focused Beam Mode. After the improvement of the system at Cebu between legs 2 and 3 of KH-00-1, we succeeded to survey to depths of over 7000 m when R/V Hakuho-maru crossed Philippine Trench. Before the arrival at Tokyo port, we carried out a short survey off Suruga Bay to estimate the athwartship alignment error between the hydrophone array and the vertical reference. However, we could not get good data due to a bad weather. The following is a brief outline of the SEA BEAM 2120HR system.

## SEA BEAM 2120HR

The SEA BEAM 2120HR system is a multibeam echo sounder that generates sonar data for wide-swath contour charts and side-scan data for side-scan images. In the study of the geomorphology of the ocean floor, a multibeam echo sounder is more useful than single-point depth sounders (PDR). The SEA BEAM 2120HR system can collect up to 151 soundings each ping cycle over depths varying from 30 to 9000 m. It provides a swath coverage of 150° to 40°, depending on the depth, bottom reflectivity and environmental factors. The bathymetric data of the SEA BEAM 2120HR system have a repeatability of a few meters at a depth of 1000 m.

The brief configuration of the SEA BEAM 2120HR system is shown in Fig. 1. The SEA BEAM 2120HR hardware consists of the shipboard electronics, projector underhull assembly, hydrophone underhull assembly, operation control station, navigation system, and real-time mapping station.

The SEA BEAM 2120HR system uses a software user interface, called HydroStar, on Windows NT for the operation and data acquisition. The SEA BEAM 2120HR system is equipped with a navigation system (POS/MV). The POS/MV system consists of a rack mountable computer system, an inertial measurement unit (IMU), and two GPS antennas. The POS/MV system generates attitude data in three axes. Roll and pitch measurements are accurate to ±0.035° or better, and heading measurements are accurate to ±0.05° or better, regardless of the latitude of the vessel. Heave measurements maintain an accuracy of 5% of the measured vertical displacement or ±5 cm for movements that have a period of up to 20 seconds.

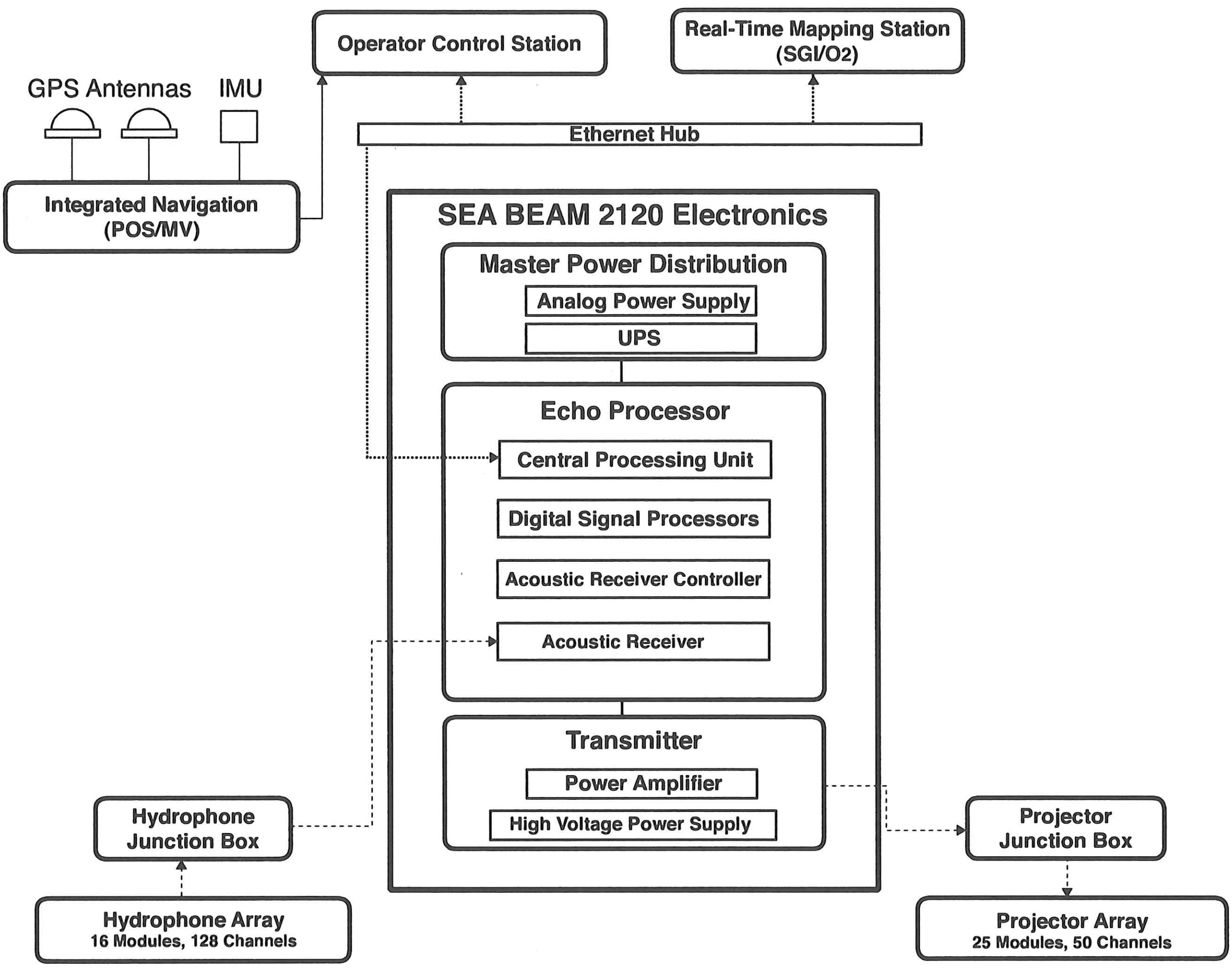


Fig. 1. Block Diagram of *SEA BEAM 2120HR*.

Fish larvae and juveniles collected during KH-00-1

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The cruise KH-00-1 was made in the temperate, subtropical and tropical western Pacific Ocean including Celebes and Sulu Seas from January 14 to March 10, 2000. The sampling was made by IKMT net with oblique and step towing methods. A total of 93 tows of IKMT nets were made at 62 stations. Fish larvae and juveniles were collected abundantly. This study analyzes the occurrence and abundance of dominant systematic groups and some faunistic items with all of the fish larvae and juveniles collected. As the sorting of the fish larvae and juveniles is not completed, this report is based only on one sample at St.13 (00°01'N, 162°00'E ) at 01:41 AM on 24 January 2000,which is shown below. This report does not include leptocephali.

Species of fish larvae and juveniles collected at St.13.

| Species | larvae | meta | juveniles | | larvae | meta | juveniles |
|---|---|---|---|---|---|---|---|
| **Bathylagidae** | | | | **Paralepididae** | | | |
| *Bathylagus* sp. | 1 | | | Paralepididae spp. | 39 | | |
| **Gonostomatidae** | | | | *Lestidium* spp. | 31 | | |
| *Diplophos taenia* | 2 | | | *Lestidium atlanticum* | 12 | | |
| *Vinciguerria nimbaria* | 734 | 162 | | *Lestidium prolixum* | 28 | | |
| *Gonostoma gracile* | 4 | | | *Lestidiops jayakari jayakari* | 62 | | |
| *Gonostoma atlanticum* | 15 | 5 | 1 | *Lestidiops indopacifica* | 14 | | |
| *Gonostoma elongatum* | 48 | 5 | | *Lestrolepis* spp. | 10 | | |
| *Cyclothone alba* | 31 | | | *Stemonosudis rothschildi* | 1 | | |
| *Margrethia obtusirostra* | 3 | | | *Stemonosudis macrura* | 3 | | |
| **Sternoptychidae** | | | | **Evermannellidae** | | | |
| Sternoptychidae spp. | 8 | | | *Coccorella atlantica* | 10 | | |
| **Chauliodontidae** | | | | *Evermannella indica* | 1 | | |
| *Chauliodus* sp. | 72 | 3 | | **Hemiramphidae** | | | |
| **Astronesthidae** | | | | Hemiramphidae spp. | 5 | | |
| Astronesthidae sp.1 | 1 | | | **Bregmacerotidae** | | | |

| | | | |
|---|---|---|---|
| Astronesthidae sp.2 | 3 | | |
| **Malanostomiidae** | | | |
| Malanostomiidae sp. | 1 | | |
| *Leptostomias* sp. | 1 | | |
| *Eustomias* sp.4 | 2 | | |
| **Idiacanthidae** | | | |
| *Idiacanthus* sp. | 4 | | |
| **Scopelarchidae** | | | |
| *Benthalbella* spp. | 13 | | |
| *Scopelarchus* spp. | 8 | | |
| *Scopelarchoides* spp. | 107 | | |
| *Rosenblattichthys alatus* | 3 | | |
| **Giganturidae** | | | |
| Giganturidae sp. | 1 | | |
| **Myctophidae** | | | |
| Myctophidae spp. | 219 | | 5 |
| *Hygophum proximum* | 25 | | |
| *Diogenichthys atlanticus* | 15 | | 1 |
| *Myctophum* spp. | 15 | | 1 |
| *Myctophum nitidulum* | 11 | | |
| *Myctophum aurolaternatum* | 12 | | |
| *Myctophum asperum* | 85 | | |
| *Myctophum obutusirostre* | 22 | | |
| *Myctophum orientale* | 10 | | |
| *Symbolophorus* spp. | 27 | | |
| *Symbolophorus evermanni* | 22 | | |
| *Lampadena luminosa* | 2 | | |
| *Bolinichthys longipes* | 1 | | |
| *Ceratoscopelus warmingi* | 64 | | |
| *Lampanyctus* spp. | 58 | | |
| *Nannobrachium* spp. | 7 | | |
| *Triphoturus microchir* | 1 | | |
| *Diaphus* spp. | | | 93 |
| *Diaphus* A group | 41 | | |
| *Diaphus* B group | 209 | | |
| *Bregmaceros* spp. | 113 | | 2 |
| **Lophiiformes** | | | |
| Ceratioidei spp. | 4 | | |
| **Diretmidae** | | | |
| Diretmidae spp. | 3 | | |
| **Melamphaidae** | | | |
| Melamphaidae spp. | 6 | | |
| **Percichthyidae** | | | |
| *Synagrops* spp. | 22 | | |
| **Serranidae** | | | |
| Serranidae spp. | 2 | | |
| **Epigonidae** | | | |
| Epigonidae spp. | 13 | | |
| **Coryphaenidae** | | | |
| Coryphaenidae spp. | 3 | | |
| **Bramidae** | | | |
| Bramidae spp. | 14 | | |
| **Chiasmodontidae** | | | |
| Chiasmodontidae spp. | 9 | | |
| **Scombridae** | | | |
| Scombridae spp. | 5 | | |
| *Katsuwonus pelamis* | 7 | | |
| *Thunnus albacares* | 5 | | |
| *Thunnus alalunga* | 1 | | |
| **Gempylidae** | | | |
| *Pexea prometheoides* | 1 | | |
| *Gempylus serpens* | 4 | | |
| *Ruvettus pretiosus* | 1 | | |
| **Acanthuridae** | | | |
| *Naso* spp. | 4 | | |
| **Nomeidae** | | | |
| *Psenes cyanophrys* | 3 | | |
| *Psenes arsfurensis* | 3 | | 1 |
| **Scorpaenidae** | | | |
| Scorpaenidae sp. | 1 | | |
| **Tetraodontidae** | | | |
| Tetraodontidae sp. | | | 1 |
| Unidentified | 57 | | |
| Broken | 93 | | |
| Total | 2498 | 175 | 105 |

# Characteristics of the primary producer and nano- and micro-size consumers in the Celebes and Sulu Seas

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The present study focuses on description of the Celebes and Sulu Sea ecosystem structures, within the euphotic zone, from the primary producer to microzooplankton. This information is fundamental to understand the total ecosystem in the both seas. Measurements described below have been done at Stns. 22 to 28 to depict the lower ecosystem structures.

*Primary producer*: Size-fractionated algal biomass in the euphotic zone was evaluated by chlorophyll *a* measurements by the fluorometry using N,N-dymethylformamide (DMF) as a extracted solvent. At Stns. 23 and 26, size-fractionated primary production was also measured by a $^{13}C$ uptake method.

*Nanoplankton*: We tried to count abundance of nanoplankton in the euphotic zone. Nanoplanktons were collected on the Nucleopore filter after double staining with DAPI and FITC and kept frozen for microscopic analysis.

*Microzooplankton*: Water samples (500 ml) were preserved with Bouin's fixative. Individual numbers of planktonic ciliates and copepod nauplii were counted in the laboratory by the Utermöhl method.

Figure 1 shows one of the results on the vertical distribution of planktonic ciliates and copepod nauplii at Stns. 23 and 26. The other samples are now being analyzed.

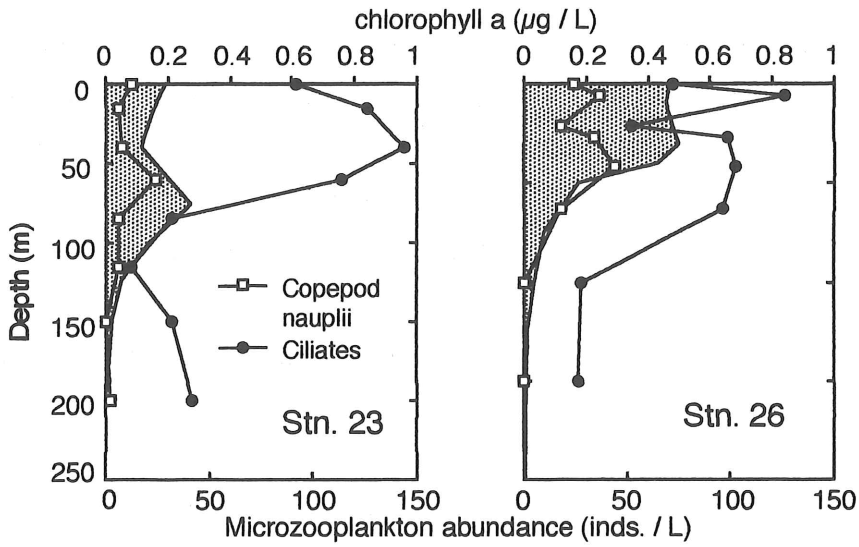


Figure 1. Vertical distribution of chlorophyll *a* and microzooplankton abundance at Stns. 23 and 26.

# Age and growth of *Ceratoscopelus warmingii* (Pisces: Myctophidae) in the Sulu Sea

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The lanternfish *Ceratoscopelus warmingii* is a subtropical-tropical cosmopolite and abundant in the warm waters of the world. Considerable geographical variations found in the number and arrangements of its luminous scales and gill raker counts have caused taxonomic problems. This species is distributed in various environments in the world, and various growth patterns are expected according to environmental difference of habitats. The Sulu Sea has a unique vertical temperature profile, and is one of the highest temperature habitat of this species. This research aims (1) to examine the growth pattern of *C. warmingii* and (2) to make validation of daily otolith increments in *C. warmingii* in the Sulu Sea.

An Isaacs-Kidd Midwater Trawl (IKMT) with 0.5 mm mesh was towed obliquely from 0 to ca. 1000 m depth during the day and at night or 0 to ca 200 m depth at night in February 23 - 24. The specimens of *Ceratoscopelus warmingii* larvae were immediately preserved in 90% ethyl alcohol and adults and juveniles were frozen on board. After measuring standard length (mm SL) and wet body weight, sagittal otoliths of the post-metamorphic fish were removed under a microscope. Otolith radii, defined as the distance from the core to the edge of the rostrum, were measured with an ocular micrometer.

A total of 88 larvae and 138 juveniles and adults were collected. Size distribution of juveniles and adults was multimodal with the maximum size of 64.4 mm SL (Fig. 1). The relationship between the otolith radius and standard length of 73 individuals was linear (Fig. 2). Observation and counting of otolith increments are now in progress.

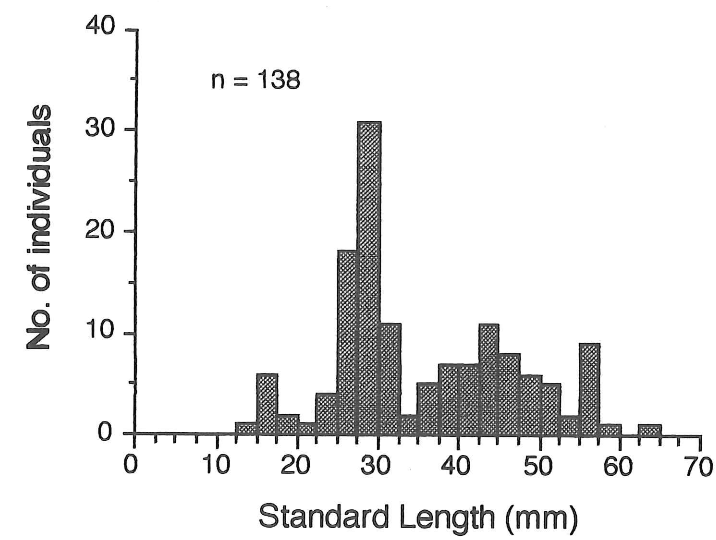


Fig. 1 Size distribution of juvenile and adult *Ceratoscopelus warmingii* collected from the Sulu Sea.

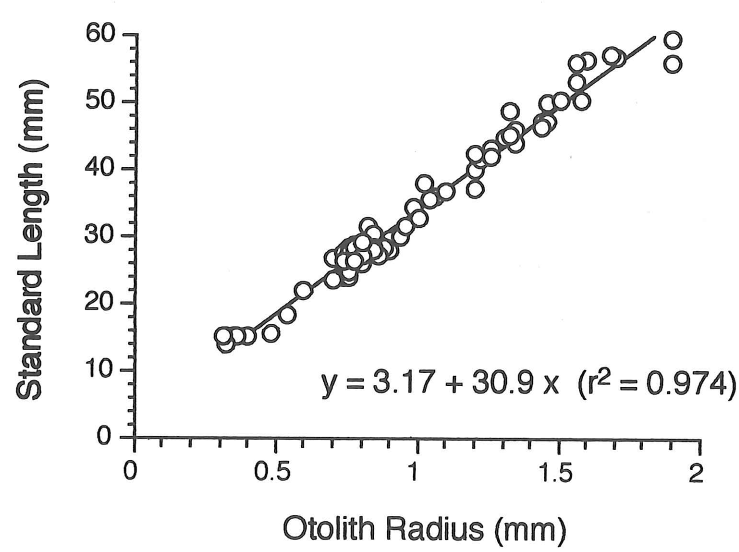


Fig. 2 Relationship between otolith radius and standard length of juvenile and adult *C. warmingii*.

# Ecology of the deep-sea pelagic copepods of the genus *Euaugaptilus*

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The calanoid copepods of the genus *Euaugaptilus* primarily inhabit the meso- and bathypelagic zones of the world oceans. The genus encompasses ca. 70 species which is among the largest numbers in a single genus in all calanoid copepods. *Euaugaptilus* spp. occur in low abundance and sympatrically with many congeneric species. Many species of *Euaugaptilus* have specialized sucker-like structure on the setae of their feeding appendages, which has been termed button. The high species diversity, the low population density, and the development of the button setae in *Euaugaptilus* suggest a specialization in their food habit in the resource-limited deep sea which would be an interesting topic in elucidating speciation and resource partitioning in pelagic communities. During the present cruise we collected copepods of *Euaugaptilus*, and examined their swimming and feeding behaviors, geographical distribution, and vertical distribution in the tropical western Pacific and the Sulu and Celebes Seas.

Plankton samples were collected with either an ORI net (mesh size: 0.33 mm) or an Isaacs-Kidd midwater trawl (mesh size: 1 mm), towed obliquely from ca. 1000 - 1500 m depth to the surface. Immediately after collection, live copepods of *Euaugaptilus* were transferred to bottles containing filtered seawater and kept in a cold room (4 °C). The swimming behavior of copepods was recorded with a video recorder. After observation of swimming behavior, small copepods, chaetognaths, cnidarians or salps were added as possible prey for observation of feeding behavior. The copepods of *Euaugaptilus* swam very slowly and continuously, and the positions of copepods in the bottle were almost stationary, suggesting that they are ambush predators. We were unable to observe the copepods' attack to the prey animals. A detailed analysis of swimming behavior is now in progress.

The occurrence of *Euaugaptilus* spp. was examined in the open Pacific (off New Guinea), the Celebes Sea and the Sulu Sea (Stns. U-40, 23 and 26, respectively), using the IKMT net (1-mm mesh, oblique tows, 4000-m wire out) samples. Immediately after collection, specimens of *Euaugaptilus* spp. were sorted from the plankton samples and fixed in 2 % glutaraldehyde and 2.5 % paraformaldehyde (phosphate buffer, pH 7.4) at 4 °C for later analyses of food habits and functional morphology. A total of 22 species of *Euaugaptilus* were identified. Fifteen and 20 species occurred from the open Pacific and the Celebes Sea, respectively, but only 5 species occurred from the Sulu Sea (Table 1). Among the species from the Sulu Sea, *Euaugaptilus hyperboreus* has been reported from the central Arctic and Pacific Ocean, while the other 4 species are known from the world oceans. *E. magnus* occurred most abundantly in the genus, and is known from the meso- and bathypelagic zones of the world oceans, but did not occur in the Sulu Sea. The low species diversity of *Euaugaptilus* spp. in the Sulu Sea may partly be attributable to the high temperature in the meso- and bathypelagic zones of the area (ca. 10 °C). An analysis of the vertical distribution of *Euaugaptilus* spp. in the upper 1000 m of the Sulu and the Celebes Seas (Stns. 23 and 26) is now in progress on the basis of the vertically stratified day-night series of samples taken by MOCNESS tows.

**Table 1. Occurrence of *Euaugaptilus* spp. at three selected stations.**

| Open Pacific (Stn. U-40) | | Celebes Sea (Stn. 23) | | Sulu Sea (Stn. 26) |
|---|---|---|---|---|
| *E. angustus* | *E. penicillatus* | *E. angustus* | *E. longimanus* | *E. angustus* |
| *E. elongatus* | *E. rectus* | *E. bullifer* | *E. magnus* | *E. bullifer* |
| *E. facilis* | *E. rigidus* | *E. elongatus* | *E. maxillaris* | *E. filigerus* |
| *E. filigerus* | *E. tenuispinus* | *E. fecundus* | *E. nodifrons* | *E. hyperboreus* |
| *E. grandicornis* | | *E. filigerus* | *E. oblongus* | *E. nodifrons* |
| *E. hyperboreus* | | *E. gracilis* | *E. perodiosus* | |
| *E. laticeps* | | *E. grandicornis* | *E. rectus* | |
| *E. longimanus* | | *E. hyperboreus* | *E. rigidus* | |
| *E. magnus* | | *E. indicus* | *E. tenuispinus* | |
| *E. nodifrons* | | *E. laticeps* | | |
| *E. oblongus* | | *E. latifrons* | | |

# Molecular phylogeny of pelagic marine copepods

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Copepods are among the most diverse groups of pelagic animals. According to available information of the zoogeography of pelagic marine copepods, there are distinct geographic patterns among higher taxa (usually at the genus- or family levels) which may be attributable to distinct evolutionary processes. Such processes may be studied by comparing the patterns of distribution and phylogeny among selected taxa. The South-East Asian region is an interesting area for such a study, with high species diversity of copepods and sea areas isolated in different degrees. As a part of a study on the evolution and diversity of pelagic marine copepods , we aimed in the present cruise at collecting copepod specimens from the western tropical Pacific and the Sulu and Celebes Seas to apply genetic markers to some representative taxa.

Samples were collected either by vertical tows of a Norpac net (mesh size: 0.1 mm) from 200 m to the surface (22 stations), oblique tows of an Isaacs-Kidd midwater trawl (mesh size: 1.0 or 0.5 mm; 18 stations) or an ORI net (mesh size: 0.33 mm; 6 stations) through < 1500-m layers, or by surface tows of an ORI net (mesh size: 0.69 mm; 31 stations) to cover epi- and mesopelagic depths and all sizes of copepods. All samples were fixed in 99.5% ethanol immediately after collection.

As a first step, we will investigate the phylogeny of following taxa by using molecular sequence of the mitochondrial ND5 region. (1) The genus *Neocalanus*: comprising 6 oceanic species, 3 of which predominate in the subarctic Pacific, 2 in the tropical and subtropical Pacific, and 1 in the Subantarctic; will be examined as a typical case of allopatric speciation in oceanic environment. (2) The Genus *Euaugaptilus*: a very speciose group comprising ca. 70 species, mostly meso- and/or bathypelagic cosmopolites occurring sympatrically, many species having specialized feeding appendages; will be examined as a case of extensive sympatric speciation through resource partitioning. (3) The Genus *Oithona*: comprising ca. 50 species, with very wide habitat range of genus as a whole including inlet- and oceanic species, epi-, meso- and bathypelagic species, and boreal- to tropical species; will be examined as a case of speciation into different habitats, depth zones, and water-masses. (4) The Family Heterorhabdidae: comprising 7 genera and ca. 40 species ranging in feeding strategy from pure suspension feeders to raptorial predators; will be examined as a case of evolution in feeding habits.

| KH-00-1 | Date | 00.01.16 | | | Lat. | 25 | 0.44 | N | | | | Depth | 3976 m | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 02 | Time | 14:46- 18:15 | | | Long. | 147 | 15.56 | E | | | | | | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | pH | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. |
| No. | m | db | °C | ml/l | (psu) | μg/l | (psu) | (25°C) | db | °C | ml/l | (psu) | | °C |
| | 0 | | 24.2 | **** | **** | 0.038 | | 8.217 | 5 | 24.107 | 4.00 | 34.786 | 0.122 | 24.106 |
| 24 | 10 | 11 | 24.180 | (3.56) | 34.815 | | | 8.220 | 10 | 24.123 | 4.00 | 34.810 | 0.115 | 24.121 |
| 20 | 10 | 10 | 24.179 | (3.48) | 34.817 | 0.018 | | | 20 | 24.133 | 3.98 | 34.827 | 0.122 | 24.129 |
| 19 | 30 | 30 | 24.278 | (3.52) | 34.878 | 0.021 | | 8.218 | 30 | 24.138 | 3.98 | 34.830 | 0.121 | 24.131 |
| 17 | 50 | 50 | 24.285 | (3.40) | 34.880 | | | 8.218 | 40 | 24.139 | 3.99 | 34.831 | 0.120 | 24.131 |
| 18 | 49 | 49 | 24.286 | (3.48) | 34.879 | 0.020 | | | 50 | 24.175 | 3.98 | 34.850 | 0.127 | 24.164 |
| 16 | 100 | 100 | 21.947 | (3.15) | (34.860) | 0.055 | | 8.158 | 60 | 24.183 | 3.98 | 34.865 | 0.128 | 24.171 |
| 21 | 100 | 100 | 21.857 | (3.26) | (34.851) | | | | 70 | 24.182 | 3.99 | 34.865 | 0.135 | 24.167 |
| 22 | 126 | 127 | 20.206 | (3.16) | (34.833) | (0.011) | | | 80 | 24.195 | 3.98 | 34.872 | 0.135 | 24.178 |
| 23 | 150 | 151 | 18.803 | (3.37) | (34.805) | 0.035 | | | 90 | 22.851 | 4.09 | 34.895 | 0.195 | 22.833 |
| 1 | 202 | 204 | 17.668 | (3.15) | (34.793) | | | | 100 | 22.225 | 4.08 | 34.911 | 0.229 | 22.205 |
| 2 | 202 | 203 | 17.676 | (3.23) | (34.801) | | | | 125 | 20.345 | 3.96 | 34.880 | 0.222 | 20.321 |
| 3 | 201 | 203 | 17.700 | (3.12) | (34.796) | | | | 150 | 19.438 | 3.96 | 34.853 | 0.176 | 19.411 |
| 15 | 200 | 201 | 17.744 | (3.15) | (34.789) | | | 8.080 | 200 | 17.898 | 4.04 | 34.806 | 0.103 | 17.864 |
| 14 | 299 | 301 | 16.102 | (3.24) | (34.701) | | | 8.035 | 300 | 16.321 | (3.86) | 34.787 | 0.092 | 16.273 |
| 13 | 398 | 401 | 13.912 | (3.36) | (34.521) | | | 7.974 | 400 | 13.813 | (3.54) | 34.622 | 0.095 | 13.755 |
| 12 | 497 | 501 | 11.054 | (3.00) | (34.294) | | | 7.880 | 500 | 10.798 | (3.79) | 34.339 | 0.096 | 10.737 |
| 11 | 597 | 602 | 8.133 | (2.60) | (34.102) | | | 7.690 | 600 | 7.905 | (3.25) | 34.156 | 0.100 | 7.844 |
| 10 | 696 | 701 | 5.955 | (1.89) | (34.075) | | | 7.622 | 700 | 5.874 | (2.62) | 34.133 | 0.109 | 5.813 |
| 9 | 793 | 800 | 4.886 | (1.31) | 34.138 | | | 7.547 | 800 | 4.907 | (1.80) | 34.193 | 0.112 | 4.843 |
| 8 | 992 | 1001 | 3.780 | (0.78) | 34.300 | | | 7.491 | 1000 | 3.790 | (1.02) | 34.315 | 0.120 | 3.716 |
| 7 | 1237 | 1249 | 3.097 | (0.86) | 34.438 | | | 7.503 | 1250 | 3.104 | (0.99) | 34.447 | 0.115 | 3.016 |
| 6 | 1488 | 1503 | 2.464 | (1.17) | 34.528 | | | 7.530 | 1500 | 2.470 | (1.27) | 34.539 | 0.114 | 2.369 |
| 5 | 1731 | 1749 | 2.134 | (1.62) | 34.578 | | | 7.571 | 1750 | 2.136 | (1.69) | 34.582 | 0.111 | 2.018 |
| 4 | 1978 | 2001 | 1.926 | (1.98) | 34.611 | | | 7.592 | 2000 | 1.924 | (2.03) | 34.614 | 0.108 | 1.789 |

| KH-00-1 | Date | 00.01.18 | | | Lat. | 19 | 0.26 | N | | | | Depth | 5507 m | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 03 | Time | 10:06- 11:49 | | | Long. | 151 | 6.80 | E | | | | | | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | pH | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. |
| No. | m | db | °C | ml/l | (psu) | μg/l | (psu) | (25°C) | db | °C | ml/l | (psu) | | °C |
| | 0 | | 27.1 | **** | **** | 0.045 | | 8.231 | 5 | 27.156 | 3.75 | 34.983 | 0.115 | 27.155 |
| 24 | 9 | 9 | 27.158 | 3.71 | 34.987 | | | 8.247 | 10 | 27.158 | 3.76 | 34.984 | 0.113 | 27.155 |
| 20 | 10 | 10 | 27.162 | 3.70 | 34.987 | 0.034 | | | 20 | 27.171 | 3.76 | 34.989 | 0.114 | 27.167 |
| 19 | 30 | 30 | 27.159 | 3.70 | 34.986 | 0.043 | | 8.250 | 30 | 27.172 | 3.75 | 34.990 | 0.114 | 27.165 |
| 17 | 50 | 50 | 27.168 | 3.72 | 34.985 | | | 8.251 | 40 | 27.167 | 3.76 | 34.993 | 0.126 | 27.158 |
| 18 | 51 | 51 | 27.171 | 3.72 | 34.984 | (0.089) | | | 50 | 27.167 | 3.74 | 34.993 | 0.126 | 27.155 |
| 16 | 99 | 99 | 24.470 | 3.82 | 34.937 | | | 8.193 | 60 | 27.166 | 3.75 | 34.994 | 0.130 | 27.153 |
| 1 | 111 | 111 | 23.888 | 3.80 | 34.935 | | | | 70 | 27.163 | 3.76 | 34.994 | 0.138 | 27.146 |
| 2 | 110 | 111 | 23.926 | 3.78 | 34.934 | | | | 80 | 26.947 | 3.77 | 34.986 | 0.147 | 26.929 |
| 3 | 110 | 111 | 23.951 | 3.79 | 34.935 | | | | 90 | 25.299 | 3.85 | 34.952 | 0.199 | 25.279 |
| 21 | 110 | 111 | 23.840 | 3.78 | 34.935 | 0.078 | | | 100 | 24.484 | 3.84 | 34.946 | 0.232 | 24.463 |
| 22 | 125 | 126 | 23.071 | 3.76 | 34.938 | 0.078 | | | 125 | 22.694 | 3.81 | 34.943 | 0.196 | 22.669 |
| 23 | 151 | 152 | 21.470 | 3.70 | 34.940 | 0.026 | | | 150 | 21.080 | 3.74 | 34.955 | 0.128 | 21.051 |
| 15 | 200 | 201 | 19.010 | 3.96 | 34.832 | 0.004 | | 8.118 | 200 | 18.963 | 4.01 | 34.848 | 0.103 | 18.928 |
| 14 | 299 | 301 | 16.182 | 4.04 | 34.717 | | | 8.056 | 300 | 16.172 | 4.21 | 34.724 | 0.090 | 16.124 |
| 13 | 398 | 401 | 12.648 | 4.05 | 34.422 | | | 7.960 | 400 | 12.963 | 4.32 | 34.466 | 0.086 | 12.908 |
| 12 | 496 | 499 | 9.386 | 3.05 | 34.201 | | | 7.774 | 500 | 9.577 | 3.53 | 34.223 | 0.097 | 9.520 |
| 11 | 595 | 599 | 6.512 | 1.88 | 34.153 | | | 7.610 | 600 | 6.833 | 2.49 | 34.146 | 0.103 | 6.777 |
| 10 | 696 | 701 | 5.505 | 1.27 | 34.254 | | | 7.558 | 700 | 5.769 | 1.58 | 34.230 | 0.099 | 5.708 |
| 9 | 794 | 800 | 4.937 | 1.15 | 34.348 | | | 7.543 | 800 | 5.069 | 1.30 | 34.331 | 0.104 | 5.003 |
| 8 | 991 | 999 | 4.126 | 1.45 | 34.479 | | | 7.571 | 1000 | 4.166 | 1.51 | 34.474 | 0.102 | 4.089 |
| 7 | 1238 | 1250 | 3.304 | 1.73 | 34.539 | | | 7.586 | 1250 | 3.317 | 1.80 | 34.538 | 0.106 | 3.227 |
| 6 | 1486 | 1500 | 2.816 | 1.97 | 34.574 | | | 7.603 | 1500 | 2.815 | 2.02 | 34.574 | 0.105 | 2.709 |
| 5 | 1732 | 1750 | 2.437 | 2.14 | 34.595 | | | **** | 1750 | 2.427 | 2.18 | 34.596 | 0.107 | 2.305 |
| 4 | 1978 | 2000 | 2.132 | 2.35 | 34.616 | | | 7.618 | 2000 | 2.130 | 2.37 | 34.617 | 0.101 | 1.992 |

Parenthesized values had a noise in data collecting.

| KH-00-1 | Date | 00.01.19 | | Lat. | 15 | 1.54 | N | | | | Depth | 5835 m | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 04 | Time | 11:23- 17:30 | | Long. | 153 | 32.92 | E | | BOTTOM-PINGER | | | 275 m | | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | pH | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. |
| No. | m | db | ℃ | ml/l | (psu) | μg/l | (psu) | (25℃) | db | ℃ | ml/l | (psu) | | ℃ |
| | 0 | | 27.8 | **** | **** | 0.021 | | 8.218 | 10 | 27.784 | 3.78 | 34.954 | 0.104 | 27.781 |
| 23 | 10 | 10 | 27.736 | (3.22) | 34.961 | 0.022 | | 8.222 | 20 | 27.786 | 3.77 | 34.954 | 0.104 | 27.781 |
| 22 | 39 | 39 | 27.732 | (3.27) | 34.962 | 0.021 | | | 30 | 27.752 | 3.77 | 34.956 | 0.106 | 27.745 |
| 17 | 51 | 51 | 27.741 | (3.24) | 34.959 | | | 8.223 | 40 | 27.732 | 3.76 | 34.957 | 0.103 | 27.723 |
| 21 | 79 | 80 | 27.716 | (3.05) | 34.962 | 0.024 | | | 50 | 27.722 | 3.76 | 34.957 | 0.101 | 27.710 |
| 16 | 99 | 100 | 27.744 | (2.97) | 34.981 | | | 8.222 | 60 | 27.719 | 3.76 | 34.958 | 0.100 | 27.705 |
| 20 | 123 | 124 | 27.730 | (2.80) | 34.981 | 0.051 | | | 80 | 27.744 | 3.74 | 34.972 | 0.110 | 27.725 |
| 19 | 149 | 150 | 26.081 | (3.01) | (35.039) | 0.127 | | 8.181 | 100 | 27.745 | 3.75 | 34.985 | 0.112 | 27.722 |
| 18 | 175 | 176 | 24.154 | (2.76) | (35.025) | 0.069 | | | 125 | 27.742 | 3.74 | 34.990 | 0.123 | 27.712 |
| 15 | 199 | 200 | 21.702 | (2.64) | (34.975) | 0.019 | | 8.097 | 150 | 26.175 | 3.75 | 35.110 | 0.282 | 26.142 |
| 14 | 298 | 300 | 14.274 | (2.67) | (34.485) | | | 7.938 | 200 | 21.038 | 3.54 | 35.022 | 0.117 | 21.000 |
| 13 | 397 | 400 | 9.840 | 2.28 | (34.204) | | | 7.762 | 300 | 14.762 | 3.94 | 34.586 | 0.093 | 14.717 |
| 12 | 496 | 500 | 6.962 | 1.28 | (34.209) | | | 7.608 | 400 | 10.147 | 3.33 | 34.275 | 0.096 | 10.100 |
| 11 | 595 | 600 | 6.498 | 1.06 | (34.367) | | | 7.587 | 500 | 7.162 | 1.90 | 34.252 | 0.114 | 7.114 |
| 10 | 695 | 700 | 5.820 | 1.11 | 34.443 | | | 7.577 | 600 | 6.348 | 1.56 | 34.403 | 0.101 | 6.294 |
| 9 | 794 | 800 | 5.289 | 1.07 | 34.491 | | | 7.568 | 700 | 5.764 | 1.50 | 34.468 | 0.104 | 5.704 |
| 8 | 991 | 1000 | 4.340 | 1.24 | 34.527 | | | 7.578 | 800 | 5.272 | 1.51 | 34.501 | 0.105 | 5.204 |
| 7 | 1238 | 1249 | 3.574 | 1.44 | 34.554 | | | 7.594 | 1000 | 4.433 | 1.58 | 34.531 | 0.107 | 4.354 |
| 6 | 1485 | 1499 | 2.918 | 1.65 | 34.578 | | | 7.598 | 1250 | 3.596 | 1.83 | 34.560 | 0.104 | 3.502 |
| 5 | 1732 | 1750 | 2.491 | 1.86 | 34.602 | | | **** | 1500 | 2.952 | 2.04 | 34.581 | 0.101 | 2.845 |
| 4 | 1978 | 1999 | 2.188 | 2.01 | 34.619 | | | 7.625 | 1750 | 2.515 | 2.22 | 34.604 | 0.105 | 2.392 |
| 3 | 2961 | 3000 | 1.646 | 2.56 | 34.664 | | | 7.665 | 2000 | 2.171 | 2.44 | 34.624 | 0.102 | 2.032 |
| 2 | 3939 | 3999 | 1.482 | 3.11 | 34.683 | | | 7.704 | 3000 | 1.636 | 3.02 | 34.667 | 0.100 | 1.416 |
| 1 | 4913 | 4999 | 1.465 | 3.60 | 34.692 | | | 7.720 | 4000 | 1.480 | 3.27 | 34.685 | 0.103 | 1.162 |
| 24 | 5593 | 5701 | 1.526 | 3.87 | 34.694 | | | **** | 5000 | 1.465 | 3.73 | 34.693 | 0.100 | 1.032 |
| | | | | | | | | | 5718 | 1.528 | 3.90 | 34.694 | 0.104 | 1.002 |

| KH-00-1 | Date | 00.01.21 | | Lat. | 9 | 59.79 | N | | | | | Depth | 3739 m | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 05 | Time | 03:21- 05:04 | | Long. | 156 | 23.67 | E | | | | | | | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | pH | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. |
| No. | m | db | ℃ | ml/l | (psu) | μg/l | (psu) | (25℃) | db | ℃ | ml/l | (psu) | | ℃ |
| | 0 | | 28.4 | **** | **** | 0.022 | | 8.236 | 5 | 28.243 | 3.76 | 34.037 | 0.096 | 28.242 |
| 24 | 9 | 9 | 28.220 | (3.03) | 34.034 | | | 8.242 | 10 | 28.247 | 3.77 | 34.038 | 0.098 | 28.244 |
| 20 | 10 | 10 | 28.226 | (2.96) | 34.033 | 0.022 | | | 20 | 28.211 | 3.76 | 34.037 | 0.092 | 28.206 |
| 19 | 40 | 40 | 28.191 | (2.93) | 34.136 | 0.027 | | | 30 | 28.193 | 3.76 | 34.037 | 0.098 | 28.186 |
| 17 | 50 | 50 | 28.136 | (2.91) | 34.185 | | | 8.236 | 40 | 28.207 | 3.75 | 34.080 | 0.098 | 28.197 |
| 18 | 80 | 81 | 27.816 | (2.82) | (34.824) | 0.050 | | | 50 | 28.154 | 3.76 | 34.181 | 0.106 | 28.143 |
| 16 | 100 | 100 | 26.823 | (2.82) | (34.872) | | | 8.197 | 60 | 28.127 | 3.76 | 34.204 | 0.105 | 28.113 |
| 1 | 123 | 124 | 24.124 | (2.67) | (35.031) | | | | 70 | 28.055 | 3.76 | 34.431 | 0.111 | 28.038 |
| 2 | 124 | 125 | 23.777 | (2.63) | (35.191) | | | | 80 | 27.899 | 3.78 | 34.759 | 0.123 | 27.881 |
| 3 | 123 | 124 | 23.878 | (2.40) | (34.987) | | | | 90 | 27.584 | 3.83 | 34.856 | 0.133 | 27.563 |
| 21 | 123 | 123 | 23.756 | (2.68) | (35.003) | 0.121 | | | 100 | 27.054 | 3.86 | 34.940 | 0.149 | 27.031 |
| 22 | 149 | 150 | 20.805 | (2.55) | (34.772) | 0.053 | | | 125 | 24.043 | 3.63 | 35.120 | 0.307 | 24.017 |
| 23 | 174 | 175 | 16.832 | (2.54) | (34.665) | 0.012 | | | 150 | 20.795 | 3.46 | 34.990 | 0.182 | 20.766 |
| 15 | 199 | 200 | 14.504 | (2.29) | (34.472) | 0.001 | | 7.914 | 200 | 15.504 | 3.43 | 34.595 | 0.101 | 15.474 |
| 14 | 298 | 300 | 9.395 | 1.07 | (34.429) | | | 7.640 | 300 | 9.655 | 1.68 | 34.442 | 0.126 | 9.621 |
| 13 | 398 | 400 | 7.936 | 1.04 | 34.501 | | | 7.605 | 400 | 7.989 | 1.30 | 34.543 | 0.109 | 7.949 |
| 12 | 498 | 501 | 7.372 | 1.05 | 34.528 | | | 7.590 | 500 | 7.402 | 1.27 | 34.591 | 0.105 | 7.353 |
| 11 | 596 | 600 | 6.551 | 1.20 | 34.497 | | | 7.594 | 600 | 6.521 | 1.40 | 34.514 | 0.105 | 6.466 |
| 10 | 696 | 701 | 5.993 | 1.17 | 34.506 | | | 7.586 | 700 | 5.945 | 1.43 | 34.530 | 0.107 | 5.883 |
| 9 | 795 | 801 | 5.438 | 1.25 | 34.514 | | | 7.578 | 800 | 5.357 | 1.48 | 34.546 | 0.100 | 5.290 |
| 8 | 994 | 1002 | 4.502 | 1.23 | 34.541 | | | 7.577 | 1000 | 4.469 | 1.41 | 34.556 | 0.108 | 4.389 |
| 7 | 1241 | 1251 | 3.569 | 1.53 | 34.572 | | | 7.597 | 1250 | 3.586 | 1.71 | 34.589 | 0.107 | 3.493 |
| 6 | 1488 | 1502 | 2.908 | 1.77 | 34.597 | | | 7.609 | 1500 | 2.929 | 1.86 | 34.605 | 0.108 | 2.822 |
| 5 | 1734 | 1751 | 2.448 | 1.98 | 34.619 | | | | 1750 | 2.447 | 2.07 | 34.625 | 0.106 | 2.325 |
| 4 | 1979 | 2000 | 2.168 | 2.15 | 34.633 | | | 7.634 | 2000 | 2.168 | 2.21 | 34.637 | 0.109 | 2.029 |

| KH-00-1 | Date | 00.01.22 | | | Lat. | 4 | 59.94 | N | | | | | Depth | 3792 m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 06 | Time | 05:17- 08:35 | | | Long. | 159 | 9.92 | E | | | | | | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | pH | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. |
| No. | m | db | ℃ | ml/l | (psu) | μg/l | (psu) | (25℃) | db | ℃ | ml/l | (psu) | | ℃ |
| | 0 | | 29.6 | **** | **** | 0.031 | | 8.275 | 5 | 29.537 | 3.67 | 33.708 | 0.104 | 29.536 |
| 24 | 10 | 10 | 29.457 | 3.57 | 33.706 | | | 8.280 | 10 | 29.535 | 3.68 | 33.708 | 0.098 | 29.532 |
| 20 | 10 | 10 | 29.457 | 3.57 | 33.705 | 0.032 | | | 20 | 29.453 | 3.67 | 33.704 | 0.100 | 29.448 |
| 19 | 40 | 40 | 29.436 | 3.59 | 33.702 | 0.033 | | | 30 | 29.437 | 3.66 | 33.704 | 0.101 | 29.430 |
| 17 | 50 | 50 | 29.425 | 3.58 | 33.704 | | | 8.286 | 40 | 29.429 | 3.67 | 33.706 | 0.106 | 29.419 |
| 18 | 80 | 80 | 29.150 | 3.61 | 33.877 | 0.056 | | | 50 | 29.266 | 3.67 | 33.746 | 0.118 | 29.254 |
| 21 | 99 | 100 | 28.008 | 3.53 | 34.665 | 0.145 | | | 60 | 29.114 | 3.68 | 33.796 | 0.123 | 29.100 |
| 16 | 99 | 100 | 27.933 | 3.53 | 34.665 | | | 8.223 | 70 | 29.137 | 3.69 | 34.111 | 0.138 | 29.120 |
| 23 | 124 | 125 | 24.047 | 2.96 | 34.711 | 0.099 | | | 80 | 29.001 | 3.71 | 34.614 | 0.150 | 28.982 |
| 22 | 149 | 150 | 19.982 | 2.80 | 34.721 | 0.031 | | | 90 | 28.094 | 3.64 | 34.676 | 0.247 | 28.073 |
| 15 | 199 | 200 | 11.560 | 1.58 | 34.533 | 0.005 | | 7.738 | 100 | 27.228 | 3.45 | 34.699 | 0.451 | 27.205 |
| 14 | 298 | 300 | 9.341 | 1.23 | 34.618 | | | 7.656 | 125 | 23.180 | 2.97 | 34.742 | 0.203 | 23.154 |
| 13 | 397 | 400 | 8.421 | 1.73 | 34.603 | | | 7.672 | 150 | 18.934 | 2.77 | 34.738 | 0.139 | 18.907 |
| 12 | 497 | 500 | 7.832 | 1.53 | 34.585 | | | 7.651 | 200 | 12.201 | 2.05 | 34.530 | 0.156 | 12.175 |
| 11 | 596 | 600 | 7.143 | 1.28 | 34.564 | | | 7.611 | 300 | 9.323 | 1.38 | 34.627 | 0.151 | 9.290 |
| 10 | 695 | 700 | 6.367 | 1.51 | 34.546 | | | 7.619 | 400 | 8.422 | 1.89 | 34.607 | 0.117 | 8.380 |
| 9 | 793 | 799 | 5.719 | 1.39 | 34.540 | | | 7.600 | 500 | 7.805 | 1.71 | 34.587 | 0.107 | 7.754 |
| 8 | 991 | 999 | 4.634 | 1.70 | 34.552 | | | 7.615 | 600 | 7.039 | 1.42 | 34.566 | 0.107 | 6.981 |
| 7 | 1239 | 1250 | 3.686 | 1.83 | 34.578 | | | 7.625 | 700 | 6.334 | 1.66 | 34.547 | 0.105 | 6.270 |
| 6 | 1486 | 1500 | 2.985 | 2.02 | 34.602 | | | 7.629 | 800 | 5.692 | 1.49 | 34.542 | 0.107 | 5.622 |
| 5 | 1733 | 1750 | 2.536 | 2.19 | 34.622 | | | 7.640 | 1000 | 4.660 | 1.81 | 34.553 | 0.110 | 4.579 |
| 1 | 1980 | 2000 | 2.129 | 2.47 | 34.642 | | | | 1250 | 3.671 | 1.92 | 34.579 | 0.109 | 3.577 |
| 2 | 1979 | 2000 | 2.129 | 2.47 | 34.642 | | | | 1500 | 2.938 | 2.12 | 34.604 | 0.104 | 2.831 |
| 3 | 1979 | 2000 | 2.129 | 2.47 | 34.642 | | | | 1750 | 2.502 | 2.28 | 34.623 | 0.105 | 2.379 |
| 4 | 1979 | 2000 | 2.129 | 2.47 | 34.642 | | | 7.657 | 2000 | 2.128 | 2.47 | 34.642 | 0.101 | 1.990 |

| KH-00-1 | Date | 00.01.23 | | | Lat. | 0 | 0.47 | S | | | | | Depth | 4188 m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 07 | Time | 14:50- 16:35 | | | Long. | 161 | 59.98 | E | | | | | | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | pH | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. |
| No. | m | db | ℃ | ml/l | (psu) | μg/l | (psu) | (25℃) | db | ℃ | ml/l | (psu) | | ℃ |
| | 0 | | 28.8 | **** | **** | 0.083 | | 8.220 | 5 | 28.699 | 3.84 | 35.177 | 0.259 | 28.698 |
| 20 | 10 | 10 | 28.676 | 3.73 | 35.172 | 0.089 | | | 10 | 28.695 | 3.84 | 35.178 | 0.263 | 28.693 |
| 24 | 10 | 10 | 28.671 | 3.72 | 35.172 | | | 8.221 | 20 | 28.533 | 3.85 | 35.191 | 0.294 | 28.528 |
| 23 | 39 | 40 | 28.075 | 3.72 | 35.201 | 0.114 | | | 30 | 28.190 | 3.86 | 35.204 | | 28.183 |
| 17 | 50 | 50 | 27.956 | 3.62 | 35.191 | | | 8.198 | 40 | 28.067 | 3.84 | 35.205 | 0.324 | 28.057 |
| 22 | 60 | 60 | 27.932 | 3.54 | 35.207 | 0.177 | | | 50 | 27.955 | 3.71 | 35.193 | 0.361 | 27.944 |
| 1 | 74 | 75 | 28.103 | 3.52 | 35.295 | | | 8.199 | 60 | 27.915 | 3.66 | 35.196 | 0.398 | 27.901 |
| 21 | 80 | 80 | 28.065 | 3.49 | 35.283 | | | | 70 | 28.092 | 3.64 | 35.286 | 0.288 | 28.075 |
| 16 | 100 | 100 | 27.939 | 3.40 | 35.262 | | | 8.186 | 80 | 28.105 | 3.65 | 35.296 | 0.278 | 28.086 |
| 19 | 123 | 124 | 27.764 | 3.38 | 35.232 | 0.041 | | | 90 | 28.070 | 3.62 | 35.287 | 0.234 | 28.048 |
| 2 | 150 | 151 | 33.892 | 2.48 | | | | 8.152 | 100 | 28.048 | 3.59 | 35.293 | 0.169 | 28.024 |
| 18 | 149 | 150 | 26.990 | 3.05 | | 0.016 | | | 125 | 27.860 | 3.52 | 35.249 | 0.135 | 27.830 |
| 15 | 199 | 200 | 19.193 | 2.93 | 35.417 | 0.005 | | 8.045 | 150 | 24.215 | 2.85 | 35.072 | 0.109 | 24.183 |
| 14 | 298 | 300 | 12.338 | 2.87 | 34.913 | | | 7.882 | 200 | 19.154 | 2.96 | 35.421 | 0.099 | 19.118 |
| 13 | 398 | 400 | 10.083 | 2.02 | 34.722 | | | 7.755 | 300 | 12.185 | 2.96 | 34.901 | 0.102 | 12.146 |
| 12 | 497 | 500 | 7.976 | 2.48 | 34.600 | | | 7.735 | 400 | 9.573 | 2.52 | 34.693 | 0.104 | 9.527 |
| 11 | 596 | 600 | 7.023 | 2.06 | 34.565 | | | 7.672 | 500 | 7.918 | 2.74 | 34.598 | 0.098 | 7.867 |
| 10 | 695 | 700 | 6.127 | 2.06 | 34.543 | | | 7.660 | 600 | 7.021 | 2.33 | 34.568 | 0.099 | 6.964 |
| 9 | 794 | 800 | 5.592 | 1.75 | 34.546 | | | 7.625 | 700 | 6.190 | 2.19 | 34.548 | 0.097 | 6.127 |
| 8 | 992 | 1000 | 4.544 | 1.92 | 34.554 | | | 7.630 | 800 | 5.636 | 2.04 | 34.547 | 0.103 | 5.567 |
| 7 | 1239 | 1250 | 3.945 | 2.12 | 34.567 | | | 7.645 | 1000 | 4.559 | 2.04 | 34.555 | 0.107 | 4.479 |
| 6 | 1487 | 1501 | 3.112 | 2.24 | 34.597 | | | 7.647 | 1250 | 3.958 | 2.21 | 34.568 | 0.104 | 3.861 |
| 5 | 1733 | 1750 | 2.597 | 2.53 | 34.619 | | | | 1500 | 3.138 | 2.37 | 34.595 | 0.105 | 3.028 |
| 4 | 1979 | 2000 | 2.253 | 2.60 | 34.637 | | | 7.668 | 1750 | 2.600 | 2.59 | 34.618 | 0.106 | 2.476 |
| 3 | 1979 | 2000 | 2.252 | 2.62 | 34.637 | | | | 2000 | 2.253 | 2.64 | 34.637 | 0.103 | 2.113 |

| KH-00-1 | Date | 00.01.24 | | | Lat. | 4 | 59.71 | S | | | | | Depth | 1883 m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 08 | Time | 15:36- 17:21 | | | Long. | 162 | 0.17 | E | | BOTTOM-PINGER | | | 30 m | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL No. | Depth m | Pres. db | Temp. ℃ | $O_2$ ml/l | Sal. (psu) | Chl-a μg/l | Sal. (psu) | pH (25℃) | Pres. db | Temp. ℃ | $O_2$ ml/l | Sal. (psu) | FIC | P.T. ℃ |
| | 0 | | 29.6 | **** | **** | 0.062 | | 8.269 | 5 | 29.526 | 3.66 | 34.477 | 0.125 | 29.524 |
| 20 | 9 | 10 | 29.539 | 3.56 | 34.483 | 0.056 | | 8.272 | 10 | 29.524 | 3.70 | 34.477 | 0.121 | 29.522 |
| 23 | 40 | 41 | 29.848 | 3.55 | 35.211 | 0.086 | | | 20 | 29.639 | 3.66 | 34.623 | 0.119 | 29.634 |
| 17 | 49 | 49 | 29.817 | 3.60 | 35.438 | | | 8.255 | 30 | 29.686 | 3.65 | 34.694 | 0.122 | 29.678 |
| 1 | 81 | 82 | 29.390 | 3.59 | 35.528 | | | | 40 | 29.750 | 3.62 | 35.035 | 0.165 | 29.740 |
| 2 | 81 | 82 | 29.393 | 3.57 | 35.528 | | | | 50 | 29.857 | 3.67 | 35.396 | 0.240 | 29.845 |
| 3 | 81 | 82 | 29.392 | 3.57 | 35.528 | | | | 60 | 29.829 | 3.67 | 35.442 | 0.253 | 29.814 |
| 24 | 81 | 82 | 29.393 | 3.57 | 35.528 | | | | 70 | 29.603 | 3.70 | 35.483 | 0.298 | 29.586 |
| 22 | 81 | 81 | 29.394 | 3.58 | 35.528 | 0.139 | | | 80 | 29.467 | 3.69 | 35.512 | 0.302 | 29.448 |
| 21 | 100 | 101 | 29.252 | 3.55 | 35.531 | 0.142 | | | 90 | 29.362 | 3.65 | 35.534 | 0.313 | 29.340 |
| 16 | 99 | 100 | 29.260 | 3.55 | 35.531 | | | 8.240 | 100 | 29.222 | 3.65 | 35.534 | 0.317 | 29.198 |
| 19 | 125 | 126 | 28.295 | 3.37 | 35.506 | 0.071 | | | 125 | 28.387 | 3.54 | 35.506 | 0.227 | 28.357 |
| 18 | 150 | 151 | 27.434 | 3.23 | 35.531 | 0.037 | | 8.160 | 150 | 27.338 | 3.27 | 35.550 | 0.134 | 27.303 |
| 15 | 200 | 201 | 20.652 | 2.32 | 35.744 | 0.007 | | 7.990 | 200 | 20.664 | 2.34 | 35.775 | 0.097 | 20.626 |
| 14 | 298 | 300 | 11.198 | 1.86 | 34.850 | | | 7.760 | 300 | 12.074 | 1.95 | 34.942 | 0.127 | 12.034 |
| 13 | 397 | 400 | 9.234 | 2.19 | 34.688 | | | 7.737 | 400 | 9.473 | 2.48 | 34.711 | 0.118 | 9.427 |
| 12 | 497 | 500 | 8.293 | 2.37 | 34.625 | | | 7.726 | 500 | 8.482 | 2.48 | 34.642 | 0.099 | 8.429 |
| 11 | 596 | 600 | 7.302 | 2.16 | 34.577 | | | 7.685 | 600 | 7.488 | 2.22 | 34.592 | 0.102 | 7.429 |
| 10 | 695 | 700 | 6.391 | 2.37 | 34.540 | | | 7.686 | 700 | 6.554 | 2.62 | 34.547 | 0.097 | 6.489 |
| 9 | 795 | 800 | 5.650 | 2.72 | 34.519 | | | 7.695 | 800 | 5.813 | 2.86 | 34.525 | 0.094 | 5.742 |
| 8 | 992 | 1000 | 4.555 | 2.74 | 34.528 | | | 7.684 | 1000 | 4.612 | 2.92 | 34.529 | 0.094 | 4.531 |
| 7 | 1239 | 1250 | 3.553 | 2.46 | 34.569 | | | 7.668 | 1250 | 3.545 | 2.56 | 34.571 | 0.104 | 3.452 |
| 6 | 1486 | 1499 | 2.883 | 2.67 | 34.599 | | | 7.674 | 1500 | 2.847 | 2.76 | 34.602 | 0.099 | 2.741 |
| 5 | 1733 | 1750 | 2.386 | 2.83 | 34.627 | | | | 1750 | 2.370 | 2.88 | 34.628 | 0.101 | 2.249 |
| 4 | 1882 | 1901 | 2.273 | 2.85 | 34.633 | | | 7.679 | 1901 | 2.271 | 2.87 | 34.634 | 0.102 | 2.139 |

| KH-00-1 | Date | 00.01.25 | | | Lat. | 9 | 59.76 | S | | | | | Depth | 3629 m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 09 | Time | 20:04- 21:50 | | | Long. | 164 | 0.52 | E | | | | | | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL No. | Depth m | Pres. db | Temp. ℃ | $O_2$ ml/l | Sal. (psu) | Chl-a μg/l | Sal. (psu) | pH (25℃) | Pres. db | Temp. ℃ | $O_2$ ml/l | Sal. (psu) | FIC | P.T. ℃ |
| | 0 | | 29.9 | **** | **** | 0.059 | | 8.286 | 5 | 29.889 | 3.66 | 34.154 | 0.114 | 29.887 |
| 24 | 10 | 10 | 29.911 | 3.55 | 34.152 | | | 8.289 | 10 | 29.887 | 3.67 | 34.150 | 0.115 | 29.884 |
| 20 | 10 | 10 | 29.911 | 3.57 | 34.152 | 0.052 | | | 20 | 29.852 | 3.67 | 34.202 | 0.117 | 29.847 |
| 1 | 30 | 30 | 29.699 | 3.63 | 34.384 | | | 8.275 | 30 | 29.627 | 3.71 | 34.446 | 0.121 | 29.619 |
| 23 | 40 | 40 | 29.314 | 3.65 | 34.621 | 0.091 | | | 40 | 29.245 | 3.71 | 34.649 | 0.141 | 29.235 |
| 17 | 50 | 50 | 28.798 | 3.59 | 34.781 | | | 8.221 | 50 | 28.558 | 3.62 | 34.840 | 0.228 | 28.546 |
| 22 | 69 | 69 | 27.506 | 3.18 | 35.064 | 0.274 | | | 60 | 28.133 | 3.52 | 34.931 | 0.332 | 28.118 |
| 2 | 74 | 75 | 27.441 | 3.16 | 35.072 | | | 8.190 | 70 | 27.621 | 3.31 | 35.048 | 0.365 | 27.604 |
| 21 | 98 | 99 | 25.992 | 2.82 | 35.399 | 0.058 | | | 80 | 27.514 | 3.25 | 35.061 | 0.337 | 27.495 |
| 16 | 101 | 102 | 25.747 | 2.85 | 35.455 | | | 8.145 | 90 | 26.729 | 3.02 | 35.236 | 0.244 | 26.708 |
| 19 | 125 | 126 | 24.250 | 2.73 | 35.657 | 0.010 | | | 100 | 26.181 | 2.94 | 35.372 | 0.186 | 26.158 |
| 18 | 150 | 150 | 23.510 | 2.70 | 35.726 | 0.006 | | | 125 | 24.068 | 2.84 | 35.689 | 0.110 | 24.041 |
| 3 | 149 | 150 | 23.514 | 2.71 | 35.725 | | | 8.101 | 150 | 23.620 | 2.82 | 35.726 | 0.110 | 23.589 |
| 15 | 199 | 200 | 21.873 | 2.65 | 35.755 | 0.000 | | 8.061 | 200 | 20.738 | 2.72 | 35.741 | 0.100 | 20.700 |
| 14 | 298 | 300 | 14.517 | 2.68 | 35.150 | | | 7.908 | 300 | 14.643 | 2.76 | 35.173 | 0.100 | 14.598 |
| 13 | 398 | 401 | 9.838 | 3.10 | 34.711 | | | 7.819 | 400 | 9.278 | 3.24 | 34.687 | 0.129 | 9.233 |
| 12 | 496 | 500 | 7.829 | 2.69 | 34.592 | | | 7.744 | 500 | 7.682 | 3.01 | 34.589 | 0.110 | 7.632 |
| 11 | 597 | 601 | 6.555 | 2.90 | 34.530 | | | 7.731 | 600 | 6.549 | 3.19 | 34.534 | 0.097 | 6.493 |
| 10 | 696 | 701 | 6.024 | 2.80 | 34.519 | | | 7.707 | 700 | 6.006 | 3.11 | 34.517 | 0.092 | 5.944 |
| 9 | 794 | 800 | 5.433 | 2.94 | 34.507 | | | 7.708 | 800 | 5.511 | 3.19 | 34.509 | 0.091 | 5.443 |
| 8 | 993 | 1001 | 4.292 | 2.99 | 34.524 | | | 7.699 | 1000 | 4.299 | 3.15 | 34.524 | 0.092 | 4.221 |
| 7 | 1240 | 1251 | 3.594 | 3.01 | 34.552 | | | 7.697 | 1250 | 3.581 | 3.16 | 34.551 | 0.093 | 3.488 |
| 6 | 1487 | 1500 | 3.001 | 3.03 | 34.584 | | | 7.697 | 1500 | 2.941 | 3.13 | 34.587 | 0.097 | 2.834 |
| 5 | 1733 | 1750 | 2.584 | 3.08 | 34.608 | | | | 1750 | 2.589 | 3.15 | 34.608 | 0.098 | 2.466 |
| 4 | 1977 | 1998 | 2.321 | 3.14 | 34.627 | | | 7.699 | 2000 | 2.326 | 3.15 | 34.627 | 0.097 | 2.185 |

| KH-00-1 | Date | 00.01.26-27 | | Lat. | 14 | 59.65 | S | | | | | Depth | 4594 m | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 10 | Time | 22:25- 04:02 | | Long. | 162 | 0.13 | E | | BOTTOM-PINGER | | | | 150 m | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | pH | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. |
| No. | m | db | ℃ | ml/l | (psu) | μg/l | (psu) | (25℃) | db | ℃ | ml/l | (psu) | | ℃ |
| | 0 | | 29.2 | **** | **** | 0.051 | | 8.278 | 10 | 29.112 | 3.81 | 34.097 | 0.100 | 29.110 |
| 24 | 10 | 10 | 29.126 | (2.68) | 34.094 | | | 8.283 | 20 | 29.072 | 3.81 | 34.103 | 0.103 | 29.067 |
| 20 | 10 | 10 | 29.125 | (3.02) | 34.093 | 0.053 | | | 30 | 28.972 | 3.82 | 34.127 | 0.104 | 28.965 |
| 23 | 40 | 40 | 28.739 | (3.16) | (34.402) | 0.050 | | | 40 | 28.642 | 3.85 | 34.512 | 0.112 | 28.632 |
| 17 | 49 | 49 | 28.133 | (3.26) | (34.656) | | | 8.262 | 50 | 27.818 | 3.99 | 34.806 | 0.120 | 27.807 |
| 21 | 74 | 74 | 25.602 | (3.05) | (35.253) | 0.290 | | | 60 | 27.169 | 3.93 | 35.040 | 0.134 | 27.155 |
| 22 | 100 | 100 | 24.636 | (2.99) | (35.607) | 0.190 | | | 70 | 26.495 | 3.73 | 35.274 | 0.356 | 26.480 |
| 16 | 100 | 101 | 24.623 | (2.47) | (35.578) | | | 8.174 | 80 | 25.278 | 3.97 | 35.483 | 0.429 | 25.261 |
| 19 | 124 | 125 | 23.098 | (2.65) | (35.810) | 0.029 | | | 100 | 24.388 | 3.44 | 35.712 | 0.284 | 24.367 |
| 18 | 150 | 151 | 22.015 | (2.70) | (35.796) | 0.013 | | | 125 | 23.224 | 3.25 | 35.850 | 0.155 | 23.198 |
| 15 | 198 | 199 | 20.560 | (2.23) | (35.688) | 0.000 | | 8.077 | 150 | 22.251 | 3.23 | 35.837 | 0.118 | 22.221 |
| 14 | 298 | 300 | 16.649 | (2.56) | (35.329) | | | 7.994 | 200 | 20.493 | 3.23 | 35.743 | 0.094 | 20.455 |
| 13 | 397 | 400 | 11.877 | (2.56) | (34.868) | | | 7.872 | 300 | 16.143 | 3.33 | 35.326 | 0.094 | 16.095 |
| 12 | 497 | 500 | 9.387 | (2.98) | (34.593) | | | 7.845 | 400 | 12.030 | 3.27 | 34.912 | 0.097 | 11.978 |
| 11 | 596 | 600 | 7.072 | (3.23) | (34.451) | | | 7.799 | 500 | 9.107 | 4.03 | 34.638 | 0.091 | 9.052 |
| 10 | 696 | 701 | 5.748 | (3.07) | (34.425) | | | 7.758 | 600 | 6.888 | 4.29 | 34.475 | 0.094 | 6.831 |
| 9 | 794 | 800 | 4.821 | (3.01) | 34.437 | | | 7.740 | 700 | 5.693 | 4.05 | 34.445 | 0.090 | 5.633 |
| 8 | 992 | 1000 | 4.067 | (2.84) | 34.489 | | | 7.725 | 800 | 4.784 | 3.97 | 34.449 | 0.087 | 4.720 |
| 7 | 1239 | 1250 | 3.408 | (2.70) | 34.546 | | | 7.713 | 1000 | 3.963 | 3.66 | 34.501 | 0.090 | 3.888 |
| 6 | 1486 | 1500 | 2.978 | (2.65) | 34.581 | | | 7.706 | 1250 | 3.304 | 3.36 | 34.558 | 0.096 | 3.213 |
| 5 | 1732 | 1749 | 2.650 | (2.67) | 34.606 | | | | 1500 | 2.901 | 3.23 | 34.591 | 0.097 | 2.794 |
| 4 | 1979 | 2000 | 2.399 | (2.75) | 34.630 | | | 7.707 | 1750 | 2.610 | 3.19 | 34.612 | 0.099 | 2.486 |
| 3 | 2961 | 3000 | 1.910 | (3.16) | 34.679 | | | 7.741 | 2000 | 2.378 | 3.32 | 34.635 | 0.097 | 2.235 |
| 2 | 3938 | 3999 | 1.845 | (3.44) | 34.690 | | | 7.738 | 3000 | 1.898 | 3.67 | 34.682 | 0.103 | 1.672 |
| 1 | 4485 | 4559 | 1.914 | (3.68) | 34.697 | | | 7.745 | 4000 | 1.845 | 3.85 | 34.692 | 0.102 | 1.517 |
| | | | | | | | | | 4558 | 1.914 | (3.70) | 34.698 | 0.098 | 1.519 |

| KH-00-1 | Date | 00.01.28 | | Lat. | 19 | 59.86 | S | | | | | Depth | 3524 m | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 11 | Time | 12:20- 14:00 | | Long. | 161 | 59.80 | E | | | | | | | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | pH | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. |
| No. | m | db | ℃ | ml/l | (psu) | μg/l | (psu) | (25℃) | db | ℃ | ml/l | (psu) | | ℃ |
| | 0 | | 28.5 | **** | **** | 0.075 | | 8.248 | 5 | 28.391 | 3.92 | 34.989 | 0.113 | 28.390 |
| 24 | 10 | 10 | 27.860 | 3.86 | 35.040 | | | 8.251 | 10 | 28.114 | 4.00 | 35.047 | 0.106 | 28.112 |
| 20 | 10 | 10 | 27.881 | 3.86 | 35.043 | 0.047 | | | 20 | 27.495 | 4.00 | 35.035 | 0.106 | 27.490 |
| 23 | 40 | 41 | 25.894 | 4.15 | 35.408 | 0.067 | | | 30 | 26.251 | 4.21 | 35.419 | 0.110 | 26.244 |
| 17 | 50 | 51 | 25.384 | 4.18 | 35.392 | | | 8.239 | 40 | 25.628 | 4.28 | 35.427 | 0.124 | 25.619 |
| 21 | 79 | 80 | 24.055 | 4.24 | 35.476 | 0.083 | | | 50 | 25.208 | 4.27 | 35.400 | 0.123 | 25.197 |
| 16 | 100 | 100 | 23.164 | 4.10 | 35.548 | | | 8.201 | 60 | 24.486 | 4.34 | 35.464 | 0.146 | 24.473 |
| 22 | 100 | 100 | 23.162 | 4.10 | 35.546 | 0.160 | | | 70 | 23.905 | 4.32 | 35.491 | 0.150 | 23.891 |
| 19 | 125 | 125 | 22.583 | 3.90 | 35.601 | 0.150 | | | 80 | 23.356 | 4.27 | 35.542 | 0.166 | 23.339 |
| 18 | 149 | 150 | 22.160 | 3.89 | 35.635 | 0.061 | | | 90 | 23.003 | 4.18 | 35.570 | 0.209 | 22.985 |
| 15 | 198 | 199 | 20.568 | 3.77 | 35.680 | 0.002 | | 8.131 | 100 | 22.729 | 4.10 | 35.595 | 0.331 | 22.709 |
| 14 | 298 | 300 | 16.793 | 3.72 | 35.464 | | | 8.043 | 125 | 22.230 | 4.00 | 35.639 | 0.207 | 22.205 |
| 13 | 398 | 401 | 13.439 | 3.90 | 35.111 | | | 7.971 | 150 | 21.815 | 3.99 | 35.662 | 0.164 | 21.785 |
| 12 | 496 | 500 | 10.723 | 4.02 | 34.820 | | | 7.904 | 200 | 20.392 | 3.88 | 35.686 | 0.100 | 20.355 |
| 11 | 596 | 600 | 8.363 | 4.20 | 34.604 | | | 7.856 | 300 | 17.407 | 3.86 | 35.523 | 0.094 | 17.356 |
| 10 | 695 | 700 | 6.881 | 4.26 | 34.493 | | | 7.820 | 400 | 13.723 | 4.10 | 35.158 | 0.090 | 13.666 |
| 9 | 793 | 800 | 5.841 | 4.13 | 34.448 | | | 7.790 | 500 | 10.650 | 4.35 | 34.822 | 0.102 | 10.589 |
| 8 | 992 | 1000 | 4.446 | 3.78 | 34.484 | | | 7.749 | 600 | 8.517 | 4.58 | 34.624 | 0.110 | 8.453 |
| 7 | 1238 | 1250 | 3.561 | 3.54 | 34.538 | | | 7.729 | 700 | 6.956 | 4.71 | 34.499 | 0.096 | 6.889 |
| 6 | 1485 | 1499 | 3.045 | 3.42 | 34.575 | | | 7.715 | 800 | 5.931 | 4.56 | 34.455 | 0.092 | 5.860 |
| 5 | 1731 | 1749 | 2.632 | 3.39 | 34.616 | | | | 1000 | 4.410 | 4.10 | 34.488 | 0.086 | 4.331 |
| 4 | 1979 | 2001 | 2.339 | 3.46 | 34.643 | | | 7.712 | 1250 | 3.563 | 3.74 | 34.539 | 0.093 | 3.471 |
| 3 | 1979 | 2000 | 2.339 | 3.46 | 34.643 | | | | 1500 | 3.027 | 3.55 | 34.577 | 0.094 | 2.919 |
| 2 | 1979 | 2000 | 2.339 | 3.46 | 34.643 | | | | 1750 | 2.631 | 3.47 | 34.616 | 0.099 | 2.506 |
| 1 | 1979 | 2000 | 2.337 | 3.46 | 34.644 | | | | 2000 | 2.340 | 3.47 | 34.643 | 0.096 | 2.198 |

| KH-00-1 | Date | 00.01.29 | | Lat. | 24 | 59.57 | S | | | | Depth | 1238 m | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 12 | Time | 20:30- 21:42 | | Long. | 162 | 0.08 | E | | | | BOTTOM-PINGER | 75 m | | | | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | pH | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. | | |
| No. | m | db | ℃ | ml/l | (psu) | μg/l | (psu) | (25℃) | db | ℃ | ml/l | (psu) | | ℃ | | |
| | 0 | | 25.0 | **** | **** | 0.045 | | 8.217 | 5 | 24.769 | 4.31 | 35.837 | 0.112 | 24.768 | | |
| 20 | 11 | 11 | 24.597 | 4.19 | 35.832 | 0.042 | | 8.217 | 10 | 25.001 | 4.30 | 35.841 | 0.103 | 24.999 | | |
| 23 | 39 | 40 | 23.787 | 4.39 | 35.789 | 0.051 | | | 20 | 24.509 | 4.31 | 35.835 | 0.111 | 24.505 | | |
| 17 | 50 | 50 | 22.658 | 4.52 | 35.760 | | | 8.210 | 30 | 24.165 | 4.41 | 35.814 | 0.113 | 24.158 | | |
| 21 | 80 | 80 | 21.505 | 4.52 | 35.730 | 0.104 | | | 40 | 23.358 | 4.52 | 35.790 | 0.118 | 23.350 | | |
| 24 | 102 | 103 | 20.729 | 4.47 | 35.722 | | | | 50 | 22.613 | 4.61 | 35.766 | 0.120 | 22.602 | | |
| 6 | 102 | 103 | 20.728 | 4.46 | 35.722 | | | | 60 | 22.109 | 4.63 | 35.744 | 0.127 | 22.097 | | |
| 5 | 102 | 102 | 20.742 | 4.47 | 35.723 | | | | 70 | 21.582 | 4.60 | 35.736 | 0.135 | 21.568 | | |
| 4 | 103 | 103 | 20.732 | 4.45 | 35.722 | | | | 80 | 21.414 | 4.59 | 35.734 | 0.160 | 21.398 | | |
| 3 | 101 | 102 | 20.728 | 4.46 | 35.723 | | | | 90 | 20.760 | 4.56 | 35.732 | 0.235 | 20.743 | | |
| 2 | 101 | 102 | 20.812 | 4.46 | 35.721 | | | | 100 | 20.517 | 4.50 | 35.728 | 0.315 | 20.498 | | |
| 1 | 102 | 103 | 20.728 | 4.46 | 35.723 | | | | 125 | 20.250 | 4.45 | 35.727 | 0.243 | 20.227 | | |
| 22 | 101 | 102 | 20.764 | 4.45 | 35.721 | 0.167 | | | 150 | 19.818 | 4.36 | 35.723 | 0.166 | 19.790 | | |
| 16 | 101 | 101 | 20.797 | 4.47 | 35.723 | | | 8.185 | 175 | 19.546 | 4.35 | 35.717 | 0.115 | 19.514 | | |
| 19 | 126 | 126 | 20.330 | 4.39 | 35.723 | 0.152 | | | 200 | 19.256 | 4.36 | 35.709 | 0.096 | 19.220 | | |
| 18 | 149 | 150 | 19.906 | 4.25 | 35.720 | 0.078 | | 8.157 | 250 | 18.631 | 4.29 | 35.667 | 0.091 | 18.587 | | |
| 15 | 199 | 200 | 19.236 | 4.22 | 35.703 | 0.005 | | 8.142 | 300 | 17.630 | 4.10 | 35.578 | 0.093 | 17.579 | | |
| 14 | 298 | 300 | 17.581 | 3.90 | 35.564 | | | 8.077 | 400 | 15.267 | 4.12 | 35.376 | 0.090 | 15.206 | | |
| 13 | 398 | 400 | 14.900 | 3.89 | 35.310 | | | 8.008 | 500 | 11.665 | 4.29 | 34.942 | 0.087 | 11.600 | | |
| 12 | 497 | 501 | 11.380 | 4.10 | 34.898 | | | 7.927 | 600 | 9.114 | 4.55 | 34.656 | 0.091 | 9.047 | | |
| 11 | 597 | 602 | 8.777 | 4.36 | 34.616 | | | 7.874 | 700 | 7.561 | 4.78 | 34.507 | 0.087 | 7.490 | | |
| 10 | 695 | 701 | 7.545 | 4.51 | 34.502 | | | 7.847 | 800 | 6.677 | 4.77 | 34.457 | 0.082 | 6.602 | | |
| 9 | 794 | 801 | 6.589 | 4.48 | 34.451 | | | 7.823 | 900 | 5.655 | 4.54 | 34.436 | 0.084 | 5.576 | | |
| 8 | 991 | 1000 | 4.909 | 4.15 | 34.440 | | | 7.770 | 1000 | 4.930 | 4.35 | 34.443 | 0.088 | 4.848 | | |
| 7 | 1190 | 1201 | 3.851 | 3.81 | 34.521 | | | 7.738 | 1200 | 3.852 | 3.84 | 34.521 | 0.093 | 3.761 | | |

| KH-00-1 | Date | 00.02.06 | | Lat. | 25 | 0.44 | S | | | | | Depth | 2610 m | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 13 | Time | 18:07- 19:48 | | Long. | 154 | 58.04 | E | | | | | | | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | $O_2$ | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. |
| No. | m | db | ℃ | ml/l | (psu) | μ g/l | (psu) | ml/l | db | ℃ | ml/l | (psu) | | ℃ |
| | 0 | | 26.1 | **** | **** | 0.049 | | | 5 | 26.080 | 4.21 | 35.250 | 0.113 | 26.079 |
| 24 | 11 | 11 | 26.020 | 4.17 | 35.240 | | | | 10 | 26.064 | 4.22 | 35.250 | 0.103 | 26.061 |
| 20 | 10 | 11 | 26.032 | 4.16 | 35.240 | 0.042 | | | 20 | 26.077 | 4.22 | 35.250 | 0.109 | 26.073 |
| 23 | 41 | 41 | 26.022 | 4.18 | 35.240 | 0.047 | | | 30 | 26.076 | 4.21 | 35.250 | 0.105 | 26.069 |
| 17 | 49 | 50 | 25.737 | 4.22 | 35.271 | | | | 40 | 26.069 | 4.22 | 35.250 | 0.105 | 26.060 |
| 21 | 84 | 85 | 25.288 | 4.28 | 35.461 | 0.076 | | | 50 | 25.551 | 4.29 | 35.375 | 0.133 | 25.540 |
| 16 | 98 | 98 | 24.220 | 4.21 | 35.481 | | | | 60 | 25.547 | 4.29 | 35.386 | 0.131 | 25.534 |
| 22 | 98 | 99 | 24.254 | 4.21 | 35.473 | 0.169 | | | 70 | 25.369 | 4.29 | 35.429 | 0.127 | 25.353 |
| 19 | 122 | 123 | 23.131 | 4.16 | 35.662 | 0.058 | | | 80 | 24.769 | 4.31 | 35.375 | 0.167 | 24.752 |
| 18 | 150 | 151 | 21.518 | 4.61 | 35.702 | 0.068 | | | 90 | 24.159 | 4.24 | 35.499 | 0.301 | 24.140 |
| 15 | 199 | 201 | 20.645 | 4.26 | 35.701 | 0.022 | | | 100 | 23.740 | 4.34 | 35.647 | 0.241 | 23.719 |
| 14 | 299 | 301 | 18.184 | 3.68 | 35.551 | | | | 125 | 22.745 | 4.33 | 35.717 | 0.151 | 22.720 |
| 13 | 397 | 400 | 14.636 | 3.86 | 35.236 | | | | 150 | 21.687 | 4.62 | 35.708 | 0.180 | 21.657 |
| 12 | 498 | 501 | 12.093 | 4.13 | 35.002 | | | | 175 | 21.191 | 4.63 | 35.708 | 0.163 | 21.157 |
| 11 | 595 | 599 | 9.592 | 4.38 | 34.730 | | | | 200 | 20.731 | 4.42 | 35.707 | 0.129 | 20.693 |
| 10 | 693 | 699 | 7.844 | 4.54 | 34.556 | | | | 250 | 19.819 | 4.13 | 35.688 | 0.104 | 19.773 |
| 9 | 795 | 801 | 6.778 | 4.53 | 34.481 | | | | 300 | 18.103 | 3.85 | 35.555 | 0.090 | 18.051 |
| 8 | 993 | 1002 | 5.246 | 4.31 | 34.456 | | | | 400 | 14.653 | 4.02 | 35.244 | 0.095 | 14.593 |
| 7 | 993 | 1002 | 5.250 | 4.31 | 34.456 | | | | 500 | 12.030 | 4.36 | 34.998 | 0.095 | 11.964 |
| 6 | 991 | 1000 | 5.259 | 4.32 | 34.455 | | | | 600 | 9.525 | 4.62 | 34.726 | 0.088 | 9.456 |
| 5 | 990 | 999 | 5.264 | 4.32 | 34.455 | | | | 700 | 7.789 | 4.77 | 34.550 | 0.091 | 7.717 |
| 4 | 991 | 1000 | 5.263 | 4.32 | 34.455 | | | | 800 | 6.782 | 4.72 | 34.482 | 0.091 | 6.706 |
| 3 | 990 | 998 | 5.266 | 4.33 | 34.455 | | | | 900 | 5.964 | 4.57 | 34.456 | 0.092 | 5.883 |
| 2 | 989 | 998 | 5.267 | 4.33 | 34.455 | | | | 1000 | 5.270 | 4.38 | 34.456 | 0.096 | 5.185 |
| 1 | 988 | 997 | 5.268 | 4.33 | 34.455 | | | | 1012 | 5.220 | 4.36 | 34.456 | 0.089 | 5.134 |

| KH-00-1 | Date | 00.02.09 | | Lat. | 14 | 59.68 | S | | | | | Depth | 4599 m | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 15 | Time | 08:58- 12:59 | | Long. | 152 | 59.83 | E | | | BOTTOM-PINGER | | | 70 m | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | $O_2$ | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. |
| No. | m | db | ℃ | ml/l | (psu) | μ g/l | (psu) | ml/l | db | ℃ | ml/l | (psu) | | ℃ |
| | 0 | | 28.4 | **** | **** | 0.039 | | | 10 | 29.270 | 4.01 | 33.955 | 0.118 | 29.267 |
| 24 | 10 | 10 | 29.209 | (3.09) | 33.920 | | | | 20 | 29.192 | 4.02 | 34.039 | 0.117 | 29.187 |
| 21 | 10 | 10 | 29.206 | (2.89) | 33.918 | 0.037 | | | 30 | 29.154 | 4.00 | 34.063 | 0.126 | 29.147 |
| 23 | 40 | 40 | 27.552 | (3.40) | (34.949) | 0.076 | | | 40 | 28.478 | 4.23 | 34.728 | 0.130 | 28.468 |
| 17 | 50 | 50 | 26.977 | (3.43) | (34.967) | | | | 50 | 28.048 | 4.26 | 34.804 | 0.130 | 28.037 |
| 20 | 79 | 79 | 25.512 | (2.94) | (35.369) | 0.185 | | | 60 | 27.370 | 4.26 | 34.947 | 0.141 | 27.356 |
| 22 | 99 | 100 | 24.957 | (2.54) | (35.610) | 0.104 | | | 70 | 26.740 | 4.32 | 35.021 | 0.147 | 26.724 |
| 16 | 100 | 101 | 24.929 | (2.36) | (35.548) | | | | 80 | 26.483 | 4.33 | 35.072 | 0.160 | 26.465 |
| 19 | 124 | 125 | 23.390 | (2.55) | (35.749) | 0.041 | | | 100 | 25.516 | 3.82 | 35.433 | 0.367 | 25.494 |
| 18 | 150 | 151 | 22.339 | (2.45) | (35.739) | 0.028 | | | 125 | 24.317 | 3.43 | 35.620 | 0.239 | 24.290 |
| 15 | 200 | 201 | 19.885 | (2.06) | (35.510) | 0.001 | | | 150 | 22.974 | 3.36 | 35.746 | 0.153 | 22.944 |
| 14 | 297 | 299 | 15.358 | (3.02) | (35.236) | | | | 200 | 21.135 | 3.08 | 35.730 | 0.109 | 21.096 |
| 13 | 397 | 400 | 10.856 | (3.29) | (34.785) | | | | 300 | 15.765 | 4.00 | 35.339 | 0.087 | 15.718 |
| 12 | 497 | 501 | 8.024 | (3.49) | (34.530) | | | | 400 | 11.047 | 4.29 | 34.842 | 0.096 | 10.997 |
| 11 | 596 | 600 | 6.416 | (3.34) | (34.440) | | | | 500 | 8.130 | 4.64 | 34.557 | 0.085 | 8.078 |
| 10 | 695 | 700 | 5.560 | (3.33) | (34.424) | | | | 600 | 6.576 | 4.57 | 34.461 | 0.089 | 6.521 |
| 9 | 794 | 800 | 4.754 | (3.14) | 34.451 | | | | 700 | 5.623 | 4.33 | 34.441 | 0.090 | 5.563 |
| 8 | 992 | 1000 | 3.951 | (3.06) | 34.502 | | | | 800 | 4.861 | 4.15 | 34.446 | 0.095 | 4.797 |
| 7 | 1239 | 1250 | 3.337 | (2.84) | 34.554 | | | | 1000 | 4.050 | 3.82 | 34.501 | 0.096 | 3.974 |
| 6 | 1486 | 1500 | 2.904 | (2.76) | 34.590 | | | | 1250 | 3.389 | 3.54 | 34.553 | 0.097 | 3.298 |
| 5 | 1733 | 1750 | 2.603 | (2.78) | 34.614 | | | | 1500 | 2.934 | 3.35 | 34.590 | 0.101 | 2.827 |
| 4 | 1978 | 2000 | 2.363 | (2.90) | 34.634 | | | | 2000 | 2.368 | 3.42 | 34.636 | 0.098 | 2.226 |
| 3 | 2961 | 2999 | 1.991 | (3.64) | 34.695 | | | | 3000 | 1.987 | 4.22 | 34.697 | 0.103 | 1.760 |
| 2 | 3938 | 3998 | 1.834 | (4.00) | 34.711 | | | | 4000 | 1.834 | (4.11) | 34.712 | 0.101 | 1.505 |
| 1 | 4573 | 4650 | 1.888 | (4.14) | 34.712 | | | | 4654 | 1.888 | (4.16) | 34.712 | 0.099 | 1.483 |

| KH-00-1 | Date | 00.02.13 | Lat. | 1 | 43.10 | S | | | | | Depth | 3245 m | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 16 | Time | 19:11- 20:16 | Long. | 139 | 59.29 | E | | | | | | | | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | $O_2$ | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. |
| No. | m | db | ℃ | ml/l | (psu) | μg/l | (psu) | ml/l | db | ℃ | ml/l | (psu) | | ℃ |
| | 0 | | 29.9 | **** | **** | 0.157 | | | 5 | 29.926 | 4.20 | 34.104 | 0.148 | 29.925 |
| 24 | 9 | 9 | 29.917 | (3.01) | 34.099 | | | | 10 | 29.932 | 4.16 | 34.152 | 0.153 | 29.929 |
| 20 | 9 | 9 | 29.921 | (3.31) | 34.099 | (0.236) | | | 20 | 29.837 | 4.21 | 34.184 | 0.150 | 29.832 |
| 23 | 40 | 40 | 29.744 | (3.31) | 34.278 | 0.126 | | | 30 | 29.745 | 4.12 | 34.272 | 0.155 | 29.737 |
| 17 | 49 | 49 | 29.682 | (3.04) | 34.354 | | | | 40 | 29.708 | 4.08 | 34.320 | 0.176 | 29.698 |
| 21 | 69 | 69 | 29.529 | (2.84) | 34.483 | 0.223 | | | 50 | 29.636 | 4.08 | 34.399 | 0.206 | 29.623 |
| 22 | 98 | 99 | 28.095 | (2.47) | (35.226) | 0.132 | | | 60 | 29.583 | 4.08 | 34.439 | 0.220 | 29.569 |
| 16 | 99 | 99 | 27.975 | (2.56) | (35.245) | | | | 70 | 29.275 | 3.86 | 34.820 | 0.346 | 29.258 |
| 19 | 124 | 125 | 27.135 | (2.45) | (35.338) | 0.039 | | | 80 | 29.011 | 3.80 | 34.977 | 0.315 | 28.991 |
| 18 | 149 | 150 | 26.346 | (2.54) | (35.346) | 0.014 | | | 90 | 28.457 | 3.73 | 35.157 | 0.213 | 28.436 |
| 15 | 199 | 200 | 20.055 | (2.56) | (35.444) | 0.002 | | | 100 | 27.850 | 3.60 | 35.303 | 0.208 | 27.826 |
| 14 | 299 | 301 | 11.904 | (3.08) | (34.923) | | | | 125 | 27.105 | 3.47 | 35.353 | 0.132 | 27.076 |
| 13 | 398 | 400 | 9.433 | (3.01) | (34.686) | | | | 150 | 26.412 | 3.42 | 35.396 | 0.116 | 26.378 |
| 12 | 499 | 502 | 8.009 | (3.20) | (34.596) | | | | 175 | 22.804 | 3.18 | 35.503 | 0.103 | 22.768 |
| 11 | 595 | 599 | 6.719 | (2.76) | 34.534 | | | | 200 | 21.111 | 3.04 | 35.597 | 0.100 | 21.073 |
| 10 | 695 | 700 | 6.133 | (2.67) | 34.518 | | | | 250 | 15.568 | 3.45 | 35.263 | 0.105 | 15.529 |
| 9 | 794 | 799 | 5.567 | (2.61) | 34.522 | | | | 300 | 11.971 | 3.86 | 34.958 | 0.132 | 11.931 |
| 8 | 992 | 1000 | 4.677 | (2.16) | 34.545 | | | | 400 | 9.318 | (3.59) | 34.808 | 0.133 | 9.273 |
| 7 | 992 | 1000 | 4.676 | (2.18) | 34.546 | | | | 500 | 8.031 | (3.85) | 34.666 | 0.113 | 7.979 |
| 6 | 992 | 1000 | 4.677 | (2.17) | 34.545 | | | | 600 | 6.727 | (3.68) | 34.564 | 0.106 | 6.671 |
| 5 | 992 | 1000 | 4.676 | (2.18) | 34.545 | | | | 700 | 6.154 | (3.31) | 34.544 | 0.098 | 6.091 |
| 4 | 992 | 1000 | 4.676 | (2.17) | 34.545 | | | | 800 | 5.580 | 2.98 | 34.538 | 0.097 | 5.511 |
| 3 | 992 | 1000 | 4.676 | (2.18) | 34.545 | | | | 900 | 5.097 | 2.71 | 34.536 | 0.096 | 5.022 |
| 2 | 992 | 1000 | 4.675 | (2.20) | 34.545 | | | | 1000 | 4.677 | 2.37 | 34.551 | 0.100 | 4.596 |
| 1 | 992 | 1000 | 4.676 | (2.19) | 34.543 | | | | 1006 | 4.632 | 2.32 | 34.555 | 0.101 | 4.551 |

| KH-00-1 | Date | 00.02.18 | Lat. | 2 | 0.03 | N | | | | | Depth | 4642 m | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 22 | Time | 00:38- 04:30 | Long. | 124 | 20.13 | E | | | BOTTOM-PINGER | | | 65 m | | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | $O_2$ | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. |
| No. | m | db | ℃ | ml/l | (psu) | μg/l | (psu) | ml/l | db | ℃ | ml/l | (psu) | | ℃ |
| | 0 | | 28.7 | **** | **** | 0.078 | 33.195 | 4.55 | 10 | 28.571 | 4.23 | 33.178 | 0.131 | 28.569 |
| 24 | 10 | 10 | 28.650 | 3.40 | 33.180 | * | * | * | 20 | 28.624 | 4.21 | 33.229 | 0.136 | 28.619 |
| 20 | 10 | 10 | 28.650 | 3.37 | 33.179 | 0.089 | 33.195 | 4.54 | 30 | 28.629 | 4.22 | 33.259 | 0.162 | 28.622 |
| 23 | 40 | 40 | 28.576 | 3.29 | 33.217 | 0.155 | 33.225 | 4.56 | 40 | 28.614 | 4.19 | 33.264 | 0.182 | 28.604 |
| 17 | 50 | 50 | 28.631 | 3.18 | 33.255 | | 33.425 | 4.46 | 50 | 28.424 | 4.15 | 33.528 | 0.321 | 28.412 |
| 21 | 65 | 65 | 28.265 | 3.04 | 33.764 | 0.303 | 33.954 | 4.25 | 60 | 28.206 | 4.00 | 33.812 | 0.319 | 28.192 |
| 22 | 100 | 100 | 24.916 | 2.78 | (34.474) | 0.040 | | 3.75 | 70 | 28.039 | 3.86 | 34.064 | 0.269 | 28.022 |
| 16 | 100 | 100 | 25.053 | 2.76 | (34.342) | | 34.541 | 3.74 | 80 | 27.295 | 3.79 | 34.122 | 0.261 | 27.277 |
| 19 | 124 | 125 | 20.895 | 2.78 | (34.657) | 0.008 | 34.675 | 3.56 | 100 | 24.665 | 3.57 | 34.499 | 0.141 | 24.643 |
| 18 | 149 | 150 | 19.877 | 2.64 | (34.644) | 0.004 | 34.683 | 3.52 | 125 | 20.761 | 3.48 | 34.683 | 0.107 | 20.737 |
| 15 | 199 | 200 | 18.278 | 2.44 | (34.600) | 0.002 | 34.660 | 3.36 | 150 | 18.722 | 3.42 | 34.665 | 0.100 | 18.696 |
| 14 | 298 | 299 | 10.607 | 2.02 | (34.463) | | 34.487 | 2.52 | 200 | 17.421 | 3.44 | 34.658 | 0.099 | 17.388 |
| 13 | 397 | 400 | 8.686 | 1.76 | 34.494 | | 34.504 | 2.06 | 300 | 10.532 | 2.82 | 34.481 | 0.144 | 10.496 |
| 12 | 497 | 500 | 7.791 | 1.68 | 34.516 | | 34.524 | 1.96 | 400 | 8.711 | 2.43 | 34.505 | 0.132 | 8.668 |
| 11 | 596 | 600 | 7.033 | 1.88 | 34.530 | | 34.539 | 2.20 | 500 | 7.758 | 2.13 | 34.552 | 0.112 | 7.708 |
| 10 | 695 | 700 | 6.098 | 2.04 | 34.533 | | 34.540 | 2.33 | 600 | 7.004 | 2.28 | 34.565 | 0.106 | 6.946 |
| 9 | 794 | 800 | 5.628 | 1.88 | 34.540 | | 34.544 | 2.18 | 700 | 6.130 | 2.60 | 34.574 | 0.097 | 6.067 |
| 8 | 992 | 1000 | 4.638 | 1.87 | 34.559 | | 34.563 | 2.16 | 800 | 5.710 | 2.31 | 34.561 | 0.102 | 5.640 |
| 7 | 1239 | 1250 | 4.120 | 1.91 | 34.572 | | 34.577 | 2.19 | 1000 | 4.716 | 2.22 | 34.583 | 0.104 | 4.634 |
| 6 | 1486 | 1500 | 3.832 | 1.99 | 34.578 | | 34.582 | 2.21 | 1250 | 4.116 | 2.20 | 34.575 | 0.109 | 4.018 |
| 5 | 1733 | 1750 | 3.704 | 1.95 | 34.582 | | 34.587 | 2.20 | 1500 | 3.827 | 2.22 | 34.580 | 0.107 | 3.710 |
| 4 | 1979 | 2000 | 3.621 | 2.02 | 34.584 | | 34.589 | 2.26 | 2000 | 3.624 | 2.16 | 34.586 | 0.109 | 3.463 |
| 3 | 2962 | 3000 | 3.599 | 1.91 | 34.588 | | 34.591 | 2.13 | 3000 | 3.600 | 2.03 | 34.588 | 0.110 | 3.338 |
| 2 | 3940 | 3999 | 3.691 | 1.92 | 34.588 | | 34.595 | 2.05 | 4000 | 3.691 | 1.98 | 34.588 | 0.110 | 3.312 |
| 1 | 4628 | 4704 | 3.782 | 1.98 | 34.588 | | 34.590 | 2.08 | 4703 | 3.782 | 2.02 | 34.588 | 0.106 | 3.312 |

| KH-00-1 | Date | 00.02.19 | | Lat. | 2 | 28.24 | N | | | | | Depth | 5390 m | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 23S | Time | 16:55- 17:30 | | Long. | 122 | 27.83 | E | | | | | | | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | $O_2$ | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. |
| No. | m | db | ℃ | ml/l | (psu) | μg/l | (psu) | ml/l | db | ℃ | ml/l | (psu) | | ℃ |
| | 0 | | 29.0 | **** | **** | | | | 5 | 28.882 | 4.25 | 33.402 | 0.130 | 28.881 |
| 8 | 2 | 2 | 28.867 | 4.09 | 33.407 | | | | 10 | 28.904 | 4.22 | 33.416 | 0.127 | 28.902 |
| 20 | 10 | 10 | 28.880 | 4.11 | 33.436 | | | | 20 | 28.775 | 4.25 | 33.461 | 0.151 | 28.770 |
| 7 | 15 | 15 | 28.838 | 4.10 | 33.468 | | | | 30 | 28.705 | 4.23 | 33.520 | 0.161 | 28.698 |
| 6 | 15 | 15 | 28.838 | 4.10 | 33.468 | | | | 40 | 28.551 | 4.21 | 33.751 | 0.183 | 28.542 |
| 5 | 40 | 40 | 28.585 | 4.06 | 33.724 | | | | 50 | 28.218 | 4.17 | 33.877 | 0.254 | 28.206 |
| 23 | 40 | 40 | 28.585 | 4.07 | 33.724 | | | | 60 | 28.133 | 4.13 | 33.969 | 0.319 | 28.119 |
| 21 | 60 | 60 | 28.190 | 3.99 | 33.947 | | | | 70 | 28.147 | 4.12 | 34.075 | 0.267 | 28.131 |
| 4 | 60 | 60 | 28.190 | 3.97 | 33.947 | | | | 80 | 28.053 | 4.10 | 34.137 | 0.273 | 28.035 |
| 3 | 60 | 60 | 28.190 | 3.98 | 33.945 | | | | 90 | 27.265 | 3.90 | 34.170 | 0.241 | 27.244 |
| 24 | 80 | 80 | 28.070 | 4.01 | 34.112 | | | | 100 | 26.187 | 3.68 | 34.401 | 0.168 | 26.165 |
| 2 | 83 | 84 | 27.970 | 4.01 | 34.175 | | | | 125 | 21.392 | 3.81 | 34.863 | 0.119 | 21.368 |
| 22 | 99 | 100 | 26.188 | 3.70 | 34.441 | | | | 150 | 17.571 | 3.62 | 34.714 | 0.102 | 17.545 |
| 1 | 115 | 116 | 22.431 | 3.78 | 34.777 | | | | 175 | 15.040 | 3.49 | 34.622 | 0.111 | 15.013 |
| 19 | 124 | 125 | 20.828 | 3.86 | 34.825 | | | | 200 | 12.369 | 3.33 | 34.501 | 0.128 | 12.343 |
| 18 | 150 | 151 | 17.457 | 3.73 | 34.691 | | | | 208 | 12.193 | 3.27 | 34.479 | 0.143 | 12.166 |
| 17 | 201 | 202 | 12.198 | 3.42 | 34.476 | | | | | | | | | |
| 16 | 200 | 201 | 12.190 | 3.43 | 34.475 | | | | | | | | | |
| 15 | 200 | 201 | 12.190 | 3.43 | 34.475 | | | | | | | | | |
| 14 | 200 | 201 | 12.190 | 3.43 | 34.475 | | | | | | | | | |
| 13 | 200 | 201 | 12.190 | 3.43 | 34.475 | | | | | | | | | |
| 12 | 200 | 201 | 12.190 | 3.44 | 34.475 | | | | | | | | | |
| 11 | 200 | 201 | 12.190 | 3.44 | 34.475 | | | | | | | | | |
| 10 | 200 | 201 | 12.189 | 3.44 | 34.476 | | | | | | | | | |
| 9 | 199 | 201 | 12.189 | 3.44 | 34.476 | | | | | | | | | |

| KH-00-1 | Date | 00.02.20 | | Lat. | 2 | 28.19 | N | | | | | Depth | 5370 m | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 23 | Time | 05:16- 11:00 | | Long. | 122 | 28.11 | E | | BOTTOM-PINGER | | | | 130 m | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | $O_2$ | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. |
| No. | m | db | ℃ | ml/l | (psu) | μg/l | (psu) | ml/l | db | ℃ | ml/l | (psu) | | ℃ |
| | 0 | | 29.1 | **** | **** | 0.193 | 33.384 | 4.55 | 10 | 28.896 | 4.25 | 33.406 | 0.121 | 28.893 |
| 23 | 10 | 10 | 28.883 | 3.52 | 33.461 | 0.165 | 33.481 | 4.58 | 20 | 28.794 | 4.22 | 33.617 | 0.143 | 28.790 |
| 20 | 20 | 20 | 28.834 | 3.50 | 33.537 | | 33.589 | 4.57 | 30 | 28.659 | 4.23 | 33.713 | 0.146 | 28.652 |
| 22 | 30 | 30 | 28.794 | 3.52 | 33.618 | | 33.637 | 4.56 | 40 | 28.558 | 4.22 | 33.838 | 0.175 | 28.548 |
| 21 | 40 | 40 | 28.717 | 3.52 | 33.703 | 0.114 | 33.728 | 4.55 | 50 | 28.397 | 4.15 | 33.955 | 0.257 | 28.385 |
| 19 | 50 | 50 | 28.686 | 3.55 | 33.721 | | 33.773 | 4.54 | 60 | 28.337 | 4.13 | 33.986 | 0.312 | 28.323 |
| 18 | 75 | 75 | 28.256 | 3.42 | 33.978 | 0.274 | 34.013 | 4.41 | 70 | 28.108 | 4.12 | 34.059 | 0.323 | 28.091 |
| 17 | 99 | 100 | 27.699 | 3.01 | (34.069) | 0.142 | 34.152 | 4.07 | 80 | 28.014 | 4.07 | 34.070 | 0.330 | 27.995 |
| 16 | 123 | 124 | 26.501 | 2.96 | (34.276) | 0.050 | 34.555 | 3.95 | 100 | 26.771 | 3.69 | 34.232 | 0.199 | 26.749 |
| 15 | 148 | 149 | 23.103 | 3.17 | 34.720 | 0.023 | 34.775 | 3.78 | 125 | 24.915 | 3.57 | 34.493 | 0.150 | 24.888 |
| 14 | 198 | 200 | 16.623 | 2.72 | 34.560 | 0.002 | 34.609 | 3.42 | 150 | 22.620 | 3.78 | 34.796 | 0.117 | 22.590 |
| 13 | 298 | 300 | 10.248 | 2.24 | 34.386 | | 34.399 | 2.67 | 200 | 15.809 | 3.60 | 34.650 | 0.102 | 15.778 |
| 12 | 397 | 400 | 8.562 | 1.70 | 34.467 | | 34.482 | 1.99 | 300 | 10.322 | 3.00 | 34.405 | 0.103 | 10.287 |
| 11 | 496 | 500 | 7.299 | 1.64 | 34.518 | | 34.529 | 1.99 | 400 | 8.612 | 2.28 | 34.476 | 0.105 | 8.569 |
| 10 | 596 | 600 | 6.670 | 1.71 | 34.522 | | 34.533 | 2.11 | 500 | 7.335 | 2.31 | 34.529 | 0.107 | 7.287 |
| 9 | 695 | 700 | 5.989 | 1.79 | 34.527 | | 34.541 | 2.16 | 600 | 6.812 | 2.43 | 34.532 | 0.105 | 6.756 |
| 8 | 794 | 800 | 5.396 | 1.80 | 34.537 | | 34.549 | 2.18 | 700 | 6.431 | 2.47 | 34.534 | 0.099 | 6.367 |
| 7 | 993 | 1001 | 4.679 | 1.79 | 34.559 | | 34.565 | 2.16 | 800 | 5.616 | 2.48 | 34.545 | 0.100 | 5.547 |
| 6 | 1239 | 1249 | 4.070 | 1.88 | 34.571 | | 34.577 | 2.17 | 1000 | 4.807 | 2.42 | 34.560 | 0.106 | 4.725 |
| 5 | 1486 | 1500 | 3.817 | 1.91 | 34.579 | | 34.584 | 2.17 | 1250 | 4.050 | 2.45 | 34.575 | 0.107 | 3.953 |
| 4 | 1980 | 2000 | 3.644 | 1.95 | 34.584 | | 34.589 | 2.24 | 1500 | 3.822 | 2.39 | 34.581 | 0.108 | 3.705 |
| 3 | 2962 | 3000 | 3.600 | 1.87 | 34.587 | | 34.594 | 2.11 | 2000 | 3.636 | 2.40 | 34.586 | 0.108 | 3.475 |
| 2 | 3940 | 4000 | 3.689 | 1.90 | 34.588 | | 34.594 | 2.06 | 3000 | 3.600 | 2.26 | 34.589 | 0.113 | 3.338 |
| 1 | 4915 | 5000 | 3.821 | 1.95 | 34.588 | | 34.593 | 2.06 | 4000 | 3.689 | 1.98 | 34.589 | 0.107 | 3.310 |
| 24 | 5304 | 5400 | 3.878 | 2.01 | 34.588 | | * | * | 5000 | 3.822 | 2.02 | 34.588 | 0.113 | 3.311 |
| | | | | | | | | | 5401 | 3.878 | 2.04 | 34.588 | 0.103 | 3.311 |

| KH-00-1 | Date | 00.02.21 | | Lat. | 4 | 30.10 | N | | | | | Depth | 2704 m | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 24 | Time | 10:17- 12:23 | | Long. | 120 | 0.57 | E | | | BOTTOM-PINGER | | | 75 m | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | $O_2$ | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. |
| No. | m | db | ℃ | ml/l | (psu) | μg/l | (psu) | ml/l | db | ℃ | ml/l | (psu) | | ℃ |
| | 0 | | 29.1 | **** | **** | 0.072 | 33.161 | 4.52 | 10 | 28.699 | 4.23 | 32.943 | 0.130 | 28.697 |
| 1 | 10 | 10 | 28.842 | 4.08 | 32.938 | | 33.110 | 4.56 | 20 | 28.640 | 4.25 | 33.115 | 0.136 | 28.635 |
| 23 | 10 | 10 | 28.973 | 4.07 | 32.924 | 0.084 | 33.017 | 4.54 | 30 | 28.259 | 4.22 | 33.364 | 0.138 | 28.252 |
| 24 | 20 | 20 | 28.685 | 4.09 | 33.017 | 0.084 | 33.132 | 4.56 | 40 | 28.455 | 4.16 | 33.776 | 0.164 | 28.445 |
| 22 | 30 | 30 | 28.553 | 4.10 | 33.134 | 0.074 | 33.317 | 4.54 | 50 | 27.898 | 3.91 | 34.123 | 0.401 | 27.887 |
| 21 | 40 | 40 | 28.306 | 4.04 | 33.572 | 0.083 | 33.674 | 4.47 | 60 | 27.494 | 3.82 | 34.242 | 0.323 | 27.480 |
| 20 | 50 | 50 | 28.441 | 4.01 | 33.793 | 0.134 | 33.966 | 4.36 | 70 | 27.450 | 3.83 | 34.311 | 0.344 | 27.434 |
| 19 | 50 | 50 | 28.421 | 3.99 | 33.823 | | 34.078 | 4.26 | 80 | 27.121 | 3.83 | 34.470 | 0.334 | 27.102 |
| 18 | 74 | 75 | 27.394 | 3.69 | 34.267 | 0.222 | 34.295 | 4.05 | 100 | 24.623 | 3.47 | 34.534 | 0.156 | 24.601 |
| 2 | 74 | 74 | 27.411 | 3.73 | 34.295 | | (34.356) | 4.15 | 125 | 21.435 | 3.22 | 34.366 | 0.155 | 21.410 |
| 17 | 99 | 100 | 25.343 | 3.56 | 34.530 | 0.078 | 34.469 | 3.55 | 150 | 19.844 | 3.04 | 34.320 | 0.143 | 19.817 |
| 16 | 124 | 125 | 21.657 | 3.16 | 34.339 | 0.061 | 34.303 | 3.15 | 200 | 16.047 | 3.50 | 34.635 | 0.114 | 16.016 |
| 15 | 149 | 150 | 19.619 | 2.87 | 34.281 | 0.029 | 34.374 | 2.67 | 300 | 13.123 | 3.34 | 34.513 | 0.130 | 13.082 |
| 14 | 198 | 199 | 15.952 | 3.42 | 34.625 | 0.001 | 34.621 | 3.42 | 400 | 8.799 | 2.57 | 34.466 | 0.149 | 8.756 |
| 13 | 298 | 300 | 12.185 | 2.99 | 34.472 | | 34.473 | 2.90 | 500 | 7.535 | 2.37 | 34.531 | 0.132 | 7.486 |
| 12 | 397 | 400 | 8.727 | 2.11 | 34.470 | | 34.487 | 2.01 | 600 | 6.761 | 2.48 | 34.531 | 0.109 | 6.705 |
| 11 | 496 | 500 | 7.520 | 2.03 | 34.525 | | 34.527 | 1.96 | 700 | 6.085 | 2.50 | 34.532 | 0.103 | 6.023 |
| 10 | 596 | 600 | 6.566 | 2.17 | 34.528 | | 34.532 | 2.09 | 800 | 5.618 | 2.51 | 34.542 | 0.098 | 5.548 |
| 9 | 695 | 700 | 5.924 | 2.22 | 34.532 | | 34.534 | 2.13 | 1000 | 4.839 | 2.44 | 34.556 | 0.102 | 4.756 |
| 8 | 793 | 799 | 5.469 | 2.24 | 34.543 | | 34.548 | 2.18 | 1250 | 4.155 | 2.37 | 34.574 | 0.108 | 4.057 |
| 7 | 992 | 999 | 4.695 | 2.21 | 34.560 | | 34.562 | 2.14 | 1500 | 3.869 | 2.37 | 34.580 | 0.107 | 3.751 |
| 6 | 1240 | 1250 | 4.181 | 2.21 | 34.573 | | 34.576 | 2.10 | 2000 | 3.660 | 2.35 | 34.585 | 0.105 | 3.499 |
| 5 | 1484 | 1497 | 3.869 | 2.24 | 34.580 | | 34.581 | 2.14 | 2703 | 3.596 | 2.31 | 34.588 | 0.108 | 3.366 |
| 4 | 1979 | 2000 | 3.651 | 2.29 | 34.585 | | 34.585 | 2.19 | | | | | | |
| 3 | 2676 | 2708 | 3.597 | 2.30 | 34.588 | | 34.589 | 2.16 | | | | | | |

| KH-00-1 | Date | 00.02.23 | | Lat. | 6 | 34.72 | N | | | | | Depth | 3278 m | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 25 | Time | 03:36- 06:06 | | Long. | 119 | 28.48 | E | | | BOTTOM-PINGER | | | 80 m | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | $O_2$ | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. |
| No. | m | db | ℃ | ml/l | (psu) | μg/l | (psu) | ml/l | db | ℃ | ml/l | (psu) | | ℃ |
| | 0 | | 28.5 | **** | **** | 0.089 | 33.781 | 4.58 | 10 | 28.014 | 4.33 | 33.912 | 0.124 | 28.012 |
| 1 | 10 | 10 | 28.136 | 4.16 | 33.805 | | 33.865 | 4.58 | 20 | 27.950 | 4.31 | 33.943 | 0.150 | 27.946 |
| 23 | 10 | 10 | 28.134 | 4.16 | 33.805 | 0.079 | 33.889 | 4.63 | 30 | 27.631 | 4.30 | 33.989 | 0.254 | 27.624 |
| 24 | 20 | 20 | 28.023 | 4.17 | 33.914 | 0.083 | 33.951 | 4.61 | 40 | 27.282 | 4.29 | 34.043 | 0.452 | 27.272 |
| 22 | 30 | 30 | 27.803 | 4.16 | 33.964 | 0.174 | 33.993 | 4.55 | 50 | 27.091 | 4.08 | 34.049 | 0.500 | 27.079 |
| 21 | 40 | 40 | 27.539 | 4.16 | 33.994 | | 34.030 | 4.42 | 60 | 26.575 | 3.57 | 34.119 | 0.470 | 26.561 |
| 20 | 50 | 50 | 27.137 | 3.96 | 34.044 | 0.290 | 34.062 | 4.22 | 70 | 26.406 | 3.47 | 34.127 | 0.427 | 26.390 |
| 19 | 50 | 50 | 27.126 | 3.89 | 34.043 | | 34.062 | 4.21 | 80 | 25.497 | 2.94 | 34.201 | 0.303 | 25.479 |
| 18 | 75 | 75 | 25.683 | 2.89 | 34.160 | 0.203 | 34.198 | 3.04 | 100 | 24.103 | 2.70 | 34.287 | 0.164 | 24.082 |
| 17 | 100 | 100 | 23.385 | 2.41 | 34.300 | 0.025 | 34.373 | 2.37 | 125 | 20.555 | 2.26 | 34.438 | 0.118 | 20.531 |
| 16 | 124 | 124 | 20.121 | 2.18 | 34.432 | 0.007 | 34.456 | 2.13 | 150 | 17.330 | 2.25 | 34.485 | 0.105 | 17.305 |
| 15 | 149 | 150 | 17.080 | 2.10 | 34.461 | 0.003 | 34.502 | 2.12 | 200 | 14.346 | 2.35 | 34.530 | 0.117 | 14.317 |
| 14 | 199 | 200 | 14.431 | 2.23 | 34.524 | 0.002 | 34.517 | 2.08 | 300 | 12.286 | 1.95 | 34.480 | 0.107 | 12.247 |
| 13 | 298 | 300 | 12.282 | 1.75 | 34.475 | | 34.477 | 1.68 | 400 | 11.303 | 2.04 | 34.468 | 0.106 | 11.253 |
| 12 | 397 | 400 | 11.161 | 1.83 | 34.463 | | 34.466 | 1.79 | 500 | 10.767 | 2.11 | 34.463 | 0.104 | 10.706 |
| 11 | 497 | 500 | 10.576 | 1.90 | 34.458 | | 34.462 | 1.83 | 600 | 10.484 | 2.07 | 34.459 | 0.099 | 10.411 |
| 10 | 596 | 600 | 10.299 | 1.84 | 34.455 | | 34.459 | 1.76 | 700 | 10.332 | 2.00 | 34.457 | 0.102 | 10.248 |
| 9 | 695 | 700 | 10.187 | 1.75 | 34.455 | | 34.459 | 1.68 | 800 | 10.163 | 1.90 | 34.456 | 0.105 | 10.067 |
| 8 | 794 | 800 | 10.121 | 1.79 | 34.454 | | 34.458 | 1.72 | 1000 | 10.102 | 1.75 | 34.456 | 0.108 | 9.981 |
| 7 | 992 | 1000 | 10.096 | 1.60 | 34.456 | | * | * | 1250 | 10.104 | 1.68 | 34.456 | 0.110 | 9.951 |
| 6 | 1239 | 1249 | 10.098 | 1.58 | 34.456 | | 34.459 | 1.51 | 1500 | 10.113 | 1.58 | 34.458 | 0.115 | 9.928 |
| 5 | 1486 | 1500 | 10.111 | 1.50 | 34.458 | | 34.460 | 1.43 | 2000 | 10.147 | 1.43 | 34.463 | 0.109 | 9.894 |
| 4 | 1979 | 2000 | 10.147 | 1.36 | 34.463 | | 34.468 | 1.32 | 3000 | 10.284 | 1.24 | 34.473 | 0.111 | 9.885 |
| 3 | 2962 | 3000 | 10.284 | 1.23 | 34.473 | | 34.475 | 1.17 | 3301 | 10.330 | 1.25 | 34.473 | 0.113 | 9.886 |
| 2 | 3256 | 3300 | 10.330 | 1.25 | 34.473 | | 34.474 | 1.14 | | | | | | |

| KH-00-1 | Date | 00.02.24 | | | Lat. | 7 | 30.62 | N | | | | Depth | 4888 m | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 26S | Time | 17:33- 18:05 | | | Long. | 121 | 27.45 | E | | | | | | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | $O_2$ | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. |
| No. | m | db | ℃ | ml/l | (psu) | μg/l | (psu) | ml/l | db | ℃ | ml/l | (psu) | | ℃ |
| | 0 | | 27.4 | **** | **** | | | | 5 | 27.382 | 4.34 | 33.981 | 0.406 | 27.380 |
| 9 | 6 | 6 | 27.382 | 4.15 | 33.982 | | | | 10 | 27.382 | 4.35 | 33.981 | 0.410 | 27.380 |
| 8 | 6 | 6 | 27.379 | 4.16 | 33.982 | | | | 20 | 27.371 | 4.31 | 33.985 | 0.428 | 27.367 |
| 6 | 21 | 21 | 27.384 | 4.14 | 33.982 | | | | 30 | 27.351 | 4.29 | 33.988 | 0.439 | 27.344 |
| 5 | 27 | 27 | 27.383 | 4.15 | 33.983 | | | | 40 | 27.331 | 4.25 | 33.992 | 0.453 | 27.322 |
| 4 | 27 | 27 | 27.383 | 4.15 | 33.983 | | | | 50 | 26.890 | 4.11 | 34.038 | 0.373 | 26.878 |
| 3 | 42 | 42 | 27.240 | 4.06 | 33.998 | | | | 60 | 26.611 | 3.88 | 34.117 | 0.331 | 26.598 |
| 2 | 63 | 63 | 26.479 | 3.74 | 34.154 | | | | 70 | 26.354 | 3.79 | 34.170 | 0.275 | 26.339 |
| 1 | 80 | 80 | 26.041 | 3.51 | 34.160 | | | | 80 | 26.125 | 3.64 | 34.172 | 0.228 | 26.108 |
| 21 | 100 | 100 | 23.498 | 2.63 | 34.295 | | | | 90 | 25.617 | 3.44 | 34.164 | 0.186 | 25.597 |
| 20 | 119 | 120 | 19.817 | 2.31 | 34.394 | | | | 100 | 23.775 | 2.75 | 34.292 | 0.143 | 23.754 |
| 19 | 149 | 150 | 17.146 | 2.16 | 34.475 | | | | 125 | 19.622 | 2.31 | 34.416 | 0.111 | 19.599 |
| 24 | 200 | 201 | 15.040 | 2.17 | 34.480 | | | | 150 | 17.348 | 2.21 | 34.472 | 0.107 | 17.323 |
| 23 | 200 | 201 | 15.043 | 2.17 | 34.480 | | | | 175 | 16.041 | 2.17 | 34.478 | 0.110 | 16.013 |
| 22 | 199 | 201 | 15.047 | 2.17 | 34.480 | | | | 200 | 15.289 | 2.12 | 34.481 | 0.106 | 15.258 |
| 18 | 199 | 201 | 15.053 | 2.17 | 34.480 | | | | 213 | 14.780 | 2.13 | 34.485 | 0.112 | 14.748 |
| 17 | 199 | 200 | 15.116 | 2.17 | 34.478 | | | | | | | | | |
| 16 | 199 | 200 | 15.123 | 2.17 | 34.478 | | | | | | | | | |
| 15 | 199 | 200 | 15.124 | 2.17 | 34.478 | | | | | | | | | |
| 14 | 199 | 200 | 15.125 | 2.17 | 34.478 | | | | | | | | | |
| 13 | 199 | 200 | 15.146 | 2.18 | 34.477 | | | | | | | | | |
| 12 | 199 | 200 | 15.156 | 2.18 | 34.477 | | | | | | | | | |
| 11 | 199 | 200 | 15.160 | 2.18 | 34.476 | | | | | | | | | |
| 10 | 199 | 200 | 15.168 | 2.17 | 34.476 | | | | | | | | | |
| 7 | | | | | | | | | | | | | | |

| KH-00-1 | Date | 00.02.25 | | | Lat. | 7 | 31.03 | N | | | | Depth | 4847 m | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 26 | Time | 08:07- 13:50 | | | Long. | 121 | 26.16 | E | BOTTOM-PINGER | | | | 53 m | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | $O_2$ | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. |
| No. | m | db | ℃ | ml/l | (psu) | μg/l | (psu) | ml/l | db | ℃ | ml/l | (psu) | | ℃ |
| | 0 | | 27.6 | **** | **** | 0.468 | 33.993 | 4.53 | 10 | 27.482 | 4.43 | 33.985 | 0.620 | 27.480 |
| 23 | 10 | 10 | 27.463 | 3.42 | 33.982 | 0.458 | 33.992 | 4.58 | 20 | 27.479 | 4.42 | 33.986 | 0.605 | 27.475 |
| 20 | 20 | 20 | 27.450 | 3.47 | 33.977 | 0.478 | 33.996 | 4.53 | 30 | 27.467 | 4.40 | 33.986 | 0.649 | 27.460 |
| 22 | 30 | 30 | 27.239 | 3.36 | 33.982 | 0.499 | 34.003 | 4.42 | 40 | 27.385 | 4.36 | 33.990 | 0.655 | 27.376 |
| 21 | 40 | 40 | 27.031 | 3.27 | 33.993 | 0.427 | 34.020 | 4.29 | 50 | 27.273 | 4.30 | 33.992 | 0.651 | 27.261 |
| 19 | 50 | 50 | 26.490 | 2.94 | 34.084 | 0.177 | 34.123 | 3.81 | 60 | 27.172 | 4.18 | 33.993 | 0.490 | 27.158 |
| 18 | 75 | 75 | 25.320 | 2.56 | (34.202) | 0.064 | 34.255 | 3.12 | 70 | 26.589 | 3.87 | 34.040 | 0.312 | 26.573 |
| 17 | 100 | 100 | 23.315 | 2.03 | (34.264) | 0.029 | 34.322 | 2.61 | 80 | 26.187 | 3.70 | 34.075 | 0.232 | 26.169 |
| 16 | 124 | 125 | 20.720 | 1.75 | (34.343) | 0.010 | 34.390 | 2.25 | 100 | 25.848 | 3.52 | 34.188 | 0.188 | 25.826 |
| 15 | 149 | 150 | 18.989 | 1.70 | (34.439) | (0.029) | 34.463 | 2.12 | 125 | 20.142 | 2.33 | 34.403 | 0.114 | 20.119 |
| 14 | 199 | 200 | 16.452 | 1.58 | (34.440) | 0.004 | 34.476 | 2.01 | 150 | 17.231 | 2.23 | 34.482 | 0.105 | 17.207 |
| 13 | 298 | 300 | 13.101 | 1.50 | 34.470 | | 34.482 | 1.72 | 200 | 14.533 | 2.15 | 34.493 | 0.118 | 14.504 |
| 12 | 397 | 400 | 11.982 | 1.43 | 34.464 | | 34.476 | 1.67 | 300 | 12.492 | 1.91 | 34.478 | 0.113 | 12.452 |
| 11 | 496 | 500 | 11.035 | 1.51 | 34.460 | | 34.468 | 1.71 | 400 | 11.542 | 2.05 | 34.474 | 0.108 | 11.491 |
| 10 | 596 | 600 | 10.585 | 1.39 | 34.456 | | 34.463 | 1.62 | 500 | 10.853 | 2.02 | 34.465 | 0.098 | 10.791 |
| 9 | 695 | 700 | 10.371 | 1.43 | 34.455 | | 34.462 | 1.62 | 600 | 10.473 | 1.89 | 34.460 | 0.104 | 10.401 |
| 24 | 794 | 800 | 10.233 | 1.39 | 34.454 | | 34.461 | 1.60 | 700 | 10.292 | 1.82 | 34.458 | 0.104 | 10.208 |
| 8 | 993 | 1001 | 10.122 | 1.42 | 34.454 | | 34.459 | 1.56 | 800 | 10.172 | 1.84 | 34.456 | 0.102 | 10.076 |
| 6 | 1241 | 1252 | 10.098 | 1.35 | 34.455 | | 34.461 | 1.46 | 1000 | 10.115 | 1.74 | 34.456 | 0.104 | 9.995 |
| 5 | 1486 | 1499 | 10.105 | 1.28 | 34.457 | | 34.463 | 1.40 | 1250 | 10.095 | 1.64 | 34.456 | 0.106 | 9.943 |
| 4 | 1978 | 1999 | 10.149 | 1.18 | 34.461 | | 34.467 | 1.30 | 1500 | 10.104 | 1.56 | 34.458 | 0.113 | 9.918 |
| 3 | 2962 | 3000 | 10.281 | 1.08 | 34.472 | | 34.477 | 1.16 | 2000 | 10.149 | 1.43 | 34.462 | 0.114 | 9.896 |
| 2 | 3939 | 3999 | 10.440 | 1.07 | 34.473 | | 34.476 | 1.14 | 3000 | 10.282 | 1.28 | 34.473 | 0.107 | 9.883 |
| 1 | 4914 | 5000 | 10.610 | 1.15 | 34.473 | | 34.478 | 1.13 | 4000 | 10.440 | 1.12 | 34.473 | 0.109 | 9.884 |
| 7 | | | | | | | | | 5000 | 10.610 | 1.15 | 34.473 | 0.109 | 9.885 |

| KH-00-1 | Date | 00.02.26 | | | Lat. | 8 | 50.78 | N | | | | Depth | 4893 m | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 27 | Time | 14:57- 18:33 | | | Long. | 121 | 48.21 | E | | BOTTOM-PINGER | | | 31 m | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | $O_2$ | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. |
| No. | m | db | ℃ | ml/l | (psu) | μg/l | (psu) | ml/l | db | ℃ | ml/l | (psu) | | ℃ |
| | 0 | | 28.4 | **** | **** | 0.073 | 33.894 | 4.54 | 10 | 28.278 | 4.26 | 33.884 | 0.129 | 28.276 |
| 23 | 10 | 10 | 28.276 | 3.30 | 33.876 | 0.076 | 33.890 | 4.53 | 20 | 28.268 | 4.26 | 33.890 | 0.131 | 28.263 |
| 22 | 30 | 30 | 27.476 | 3.37 | 34.004 | 0.114 | 34.033 | 4.61 | 30 | 27.560 | 4.37 | 34.030 | 0.156 | 27.553 |
| 21 | 40 | 40 | 27.115 | 3.24 | 34.022 | 0.235 | 34.041 | 4.51 | 40 | 27.159 | 4.34 | 34.037 | 0.250 | 27.150 |
| 19 | 50 | 50 | 26.863 | 3.03 | 34.029 | 0.335 | 34.080 | 4.06 | 50 | 26.961 | 4.24 | 34.032 | 0.471 | 26.949 |
| 20 | 55 | 55 | 26.750 | 2.92 | (34.042) | 0.277 | 34.102 | 3.90 | 60 | 26.651 | 3.93 | 34.079 | 0.467 | 26.637 |
| 18 | 75 | 75 | 25.172 | 2.17 | (34.161) | 0.106 | 34.289 | 2.80 | 70 | 26.054 | 3.44 | 34.144 | 0.313 | 26.038 |
| 17 | 100 | 100 | 22.098 | 1.65 | (34.327) | 0.073 | 34.294 | 2.76 | 80 | 25.091 | 3.10 | 34.241 | 0.258 | 25.074 |
| 16 | 125 | 125 | 19.602 | 1.72 | (34.410) | 0.005 | 34.485 | 2.27 | 100 | 22.718 | 2.44 | 34.366 | 0.149 | 22.698 |
| 15 | 149 | 150 | 17.065 | 1.54 | (34.441) | 0.003 | 34.491 | 1.99 | 125 | 20.650 | 2.45 | 34.439 | 0.114 | 20.626 |
| 14 | 199 | 200 | 14.969 | 1.46 | (34.460) | 0.002 | 34.495 | 1.90 | 150 | 18.484 | 2.30 | 34.505 | 0.110 | 18.458 |
| 13 | 298 | 300 | 12.871 | 1.31 | 34.471 | | 34.479 | 1.61 | 200 | 15.230 | 2.13 | 34.510 | 0.111 | 15.200 |
| 12 | 397 | 400 | 11.777 | 1.48 | 34.456 | | 34.470 | 1.73 | 300 | 12.880 | 1.92 | 34.482 | 0.109 | 12.839 |
| 11 | 497 | 500 | 11.062 | 1.55 | 34.458 | | 34.465 | 1.80 | 400 | 11.783 | 2.00 | 34.472 | 0.107 | 11.731 |
| 10 | 596 | 600 | 10.620 | 1.54 | 34.456 | | 34.458 | 1.73 | 500 | 11.120 | 2.17 | 34.469 | 0.102 | 11.058 |
| 9 | 695 | 700 | 10.356 | 1.47 | 34.453 | | 34.457 | 1.66 | 600 | 10.643 | 1.80 | 34.470 | 0.104 | 10.570 |
| 24 | 794 | 800 | 10.213 | 1.46 | 34.453 | | 34.459 | 1.60 | 700 | 10.312 | 1.71 | 34.467 | 0.103 | 10.228 |
| 8 | 992 | 1000 | 10.113 | 1.44 | 34.454 | | 34.454 | 1.55 | 800 | 10.197 | 1.60 | 34.460 | 0.106 | 10.101 |
| 6 | 1239 | 1250 | 10.094 | 1.36 | 34.454 | | 34.457 | 1.47 | 1000 | 10.104 | 1.56 | 34.455 | 0.107 | 9.983 |
| 5 | 1486 | 1500 | 10.104 | 1.32 | 34.456 | | 34.460 | 1.40 | 1250 | 10.093 | 1.43 | 34.455 | 0.111 | 9.940 |
| 4 | 1979 | 2000 | 10.147 | 1.21 | 34.461 | | 34.465 | 1.31 | 1500 | 10.105 | 1.33 | 34.456 | 0.115 | 9.919 |
| 3 | 2962 | 3000 | 10.280 | 1.14 | 34.471 | | 34.474 | 1.18 | 2000 | 10.149 | 1.25 | 34.461 | 0.112 | 9.895 |
| 2 | 3941 | 4000 | 10.440 | 1.11 | 34.473 | | 34.476 | 1.14 | 3000 | 10.280 | 1.16 | 34.471 | 0.111 | 9.882 |
| 1 | 4917 | 5003 | 10.610 | 1.17 | 34.473 | | 34.476 | 1.15 | 4000 | 10.440 | 1.12 | 34.473 | 0.115 | 9.884 |
| 7 | | | | | | | | | 5000 | 10.609 | 1.18 | 34.473 | 0.111 | 9.885 |

| KH-00-1 | Date | 00.02.27 | | | Lat. | 8 | 38.50 | N | | | | Depth | 4256 m | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| St. 28 | Time | 04:44- 07:57 | | | Long. | 122 | 37.55 | E | | BOTTOM-PINGER | | | 18 m | |
| CTD BTL DATA | | | | | | | | | CTD DOWN LAY DATA | | | | | |
| BTL | Depth | Pres. | Temp. | $O_2$ | Sal. | Chl-a | Sal. | $O_2$ | Pres. | Temp. | $O_2$ | Sal. | FIC | P.T. |
| No. | m | db | ℃ | ml/l | (psu) | μg/l | (psu) | ml/l | db | ℃ | ml/l | (psu) | | ℃ |
| | 0 | | 27.2 | **** | **** | 0.400 | 33.920 | 4.68 | 10 | 27.199 | 4.14 | 33.901 | 0.466 | 27.196 |
| 23 | 10 | 10 | 27.183 | 3.21 | 33.878 | 0.488 | 33.911 | 4.67 | 20 | 27.073 | 4.14 | 33.903 | 0.580 | 27.069 |
| 21 | 24 | 25 | 26.933 | 3.20 | 33.899 | 0.855 | 33.922 | 4.55 | 30 | 26.956 | 4.08 | 33.886 | 0.529 | 26.949 |
| 22 | 29 | 30 | 26.937 | 3.13 | 33.898 | 0.906 | 33.927 | 4.52 | 40 | 26.848 | 3.94 | 33.964 | 0.950 | 26.839 |
| 20 | 45 | 45 | 26.332 | 2.63 | (34.086) | 0.313 | 34.162 | 3.74 | 50 | 25.954 | 3.46 | 34.170 | 0.337 | 25.943 |
| 19 | 49 | 50 | 26.061 | 2.48 | (34.118) | 0.193 | 34.208 | 3.49 | 60 | 24.714 | 3.02 | 34.288 | 0.151 | 24.702 |
| 18 | 74 | 75 | 24.614 | 2.20 | (34.250) | 0.042 | 34.304 | 2.99 | 70 | 24.598 | 2.98 | 34.298 | 0.131 | 24.583 |
| 17 | 99 | 100 | 23.071 | 1.59 | (34.185) | 0.022 | 34.381 | 2.27 | 80 | 24.076 | 2.85 | 34.296 | 0.128 | 24.059 |
| 16 | 124 | 125 | 20.194 | 1.57 | (34.395) | 0.012 | 34.459 | 2.06 | 100 | 23.302 | 2.65 | 34.313 | 0.115 | 23.281 |
| 15 | (148) | (149) | (18.379) | (1.50) | (34.368) | (0.242) | (34.202) | (3.50) | 125 | 20.294 | 2.12 | 34.443 | 0.105 | 20.270 |
| 14 | 198 | 199 | 14.549 | 1.31 | (34.463) | | 34.495 | 1.63 | 150 | 18.276 | 2.04 | 34.471 | 0.109 | 18.250 |
| 13 | 298 | 300 | 12.682 | 1.07 | 34.458 | | 34.475 | 1.31 | 200 | 15.153 | 1.95 | 34.514 | 0.118 | 15.122 |
| 12 | 398 | 400 | 11.827 | 1.39 | 34.454 | | 34.478 | 1.69 | 300 | 12.713 | 1.51 | 34.476 | 0.119 | 12.672 |
| 11 | 496 | 500 | 10.867 | 1.59 | 34.458 | | 34.466 | 1.85 | 400 | 11.880 | 1.80 | 34.476 | 0.107 | 11.828 |
| 10 | 596 | 600 | 10.533 | 1.47 | 34.457 | | 34.463 | 1.72 | 500 | 10.932 | 2.09 | 34.468 | 0.105 | 10.870 |
| 9 | 695 | 700 | 10.335 | 1.41 | 34.455 | | 34.477 | 1.63 | 600 | 10.538 | 1.97 | 34.462 | 0.105 | 10.465 |
| 24 | 794 | 800 | 10.215 | 1.44 | 34.452 | | 34.460 | 1.66 | 700 | 10.301 | 1.84 | 34.459 | 0.106 | 10.216 |
| 8 | 992 | 1000 | 10.120 | 1.27 | 34.456 | | 34.461 | 1.47 | 800 | 10.200 | 1.88 | 34.457 | 0.104 | 10.104 |
| 6 | 1239 | 1250 | 10.104 | 1.21 | 34.457 | | 34.463 | 1.41 | 1000 | 10.115 | 1.61 | 34.458 | 0.109 | 9.994 |
| 5 | 1486 | 1499 | 10.113 | 1.20 | 34.459 | | 34.463 | 1.36 | 1250 | 10.103 | 1.55 | 34.459 | 0.113 | 9.950 |
| 4 | 1979 | 1999 | 10.151 | 1.16 | 34.463 | | 34.468 | 1.29 | 1500 | 10.113 | 1.48 | 34.460 | 0.113 | 9.928 |
| 3 | 2962 | 2999 | 10.283 | 1.08 | 34.472 | | 34.477 | 1.17 | 2000 | 10.152 | 1.38 | 34.465 | 0.114 | 9.899 |
| 2 | 3941 | 4000 | 10.442 | 1.08 | 34.475 | | 34.472 | 1.12 | 3000 | 10.284 | 1.26 | 34.474 | 0.109 | 9.885 |
| 1 | (4373) | (4443) | (10.516) | (1.09) | (34.475) | | (33.928) | (4.50) | 4000 | 10.442 | 1.11 | 34.474 | 0.107 | 9.886 |
| 7 | | | | | | | | | 4436 | 10.515 | 1.08 | 34.475 | 0.113 | 9.886 |