

**Preliminary Report  
of  
The Hakuho Maru Cruise  
KH-12-2 Leg 1, 2**

Leg 1: May 13, 2012 - June 1, 2012

Leg 2: June 6, 2012 - June 28, 2012

(Eel Cruise XVIII)

Atmosphere and Ocean Research Institute  
The University of Tokyo  
2012

**Preliminary Report  
of  
The Hakuho Maru Cruise  
KH-12-2 Leg 1, 2  
(EEL XVIII)**

Leg 1: May 13, 2012 - June 1, 2012

Leg 2: June 6, 2012 - June 28, 2012

Atmosphere and Ocean Research Institute  
The University of Tokyo  
2012

By  
The Scientific Members of the Expeditions

Edited by  
Shun Watanabe, Ryusuke Sudo  
and Katsumi Tsukamoto



## Contents

01	Preface	1
02	Stations and schedule	2
03	List of participants	5
04	Track chart	6
05	XCTD and CTD Observations and Distribution of the Surface Salinity in the Hakuho Maru Cruise 2012	10
	Masahiro Nakamura and Shun Watanabe	
06	<i>Anguilla japonica</i> Eggs Collected Near the West Mariana Ridge During the Hakuho Maru Cruise 2012 in the West North Pacific	14
	Jun Aoyama, Michael J. Miller, Ryusuke Sudo, Shun Watanabe and Katsumi Tsukamoto	
07	<i>Anguilla japonica</i> Preleptocephali Collected along the West Mariana Ridge, North Pacific Ocean	21
	Michael J. Miller, Seishi Hagihara, Shun Watanabe, Jun G. Inoue and Katsumi Tsukamoto	
08	<i>Anguilla japonica</i> leptocephali Collected in the North Equatorial Current Region During the KH-12-2 Sampling Survey in the Western North Pacific	27
	Michael J. Miller, Shun Watanabe and Katsumi Tsukamoto	
09	Distribution and Migration of Tropical Anguillid Leptocephali in the western North Pacific Ocean During the Hakuho Maru Cruise 2012	29
	Mari Kuroki	
10	Daily Age Estimation of Japanese Eel Preleptocephali Collected During the Hakuho Maru Cruise 2012 in the western North Pacific	33
	Hiroyuki Kusune	
11	Collection of Japanese Eel Embryos and Preleptocephali for Transcriptome Analysis	34
	Noriaki Matsuya, Hiroaki Matsukawa and Shigeo Ijiri	

<b>12</b>	<b>Early T-cell Development in Japanese eel <i>Anguilla japonica</i> collected During the Hakuho Maru Cruise 2012 in the western North Pacific .....</b>	<b>37</b>
	Yuzuru Suzuki	
<b>13</b>	<b>Transcriptome Analysis of All life stage of the Japanese eel .....</b>	<b>39</b>
	Yu-San Han, Jun Aoyama, Michael J. Miller and Katsumi Tsukamoto	
<b>14</b>	<b>Studies on Bacterial Degradation Process of Marine Snow for Developing New Diet for Eel <i>Leptocephalus</i> .....</b>	<b>41</b>
	Yoshiaki Yamada and Akihiro Okamura	
<b>15</b>	<b>Studies on Oceanic Conditions of Larval Transport of the Japanese eel in North Equatorial Current During the Hakuho Maru Cruise 2012 in the western North Pacific .....</b>	<b>42</b>
	Kei Zenimoto, Diane Cambrillat and Shingo Kimura	
<b>16</b>	<b>Leptocephali Collected During the KH-12-2 Sampling Survey .....</b>	<b>43</b>
	Michael J. Miller, Seishi Hagihara, Shun Watanabe, Mari Kuroki and Katsumi Tsukamoto	
<b>17</b>	<b>Species Composition and Larval Growth Rates of Leptocephali of the Genus Conger (Family Congridae) .....</b>	<b>47</b>
	Hiroyuki Kusune, Michael J. Miller, Tatsuki Yoshinaga, Jun Aoyama, Noritaka Mochioka and Katsumi Tsukamoto	
<b>18</b>	<b>Early Life History Study of the Open-ocean Longneck Eels of the Family Derichthyidae collected in the western North Pacific .....</b>	<b>50</b>
	Yu-San Han, Michael J. Miller and Katsumi Tsukamoto	
<b>19</b>	<b>Detection of Defense Factors acting in Innate immunity of an Anguilliformes <i>Leptocephalus</i> larvae, <i>Ariosoma</i> sp. collected in the western North Pacific 2012 .....</b>	<b>54</b>
	Shigeyuki Tsutsui	
<b>20</b>	<b>Progress Report on Whole-Body Photography of Leptocephali during KH-12-2 .....</b>	<b>55</b>
	Michael J. Miller	

<b>21</b>	<b>Study on Leptocephali with Low number of Vertebrae, less than 90, in relation with Larval Fish Fauna of Epipelagic zone .....</b>	<b>59</b>
	Hitoshi Ida	
<b>22</b>	<b>Fauna of Fish Larvae and Zooplankton around the west Mariana ridge collected in the western North Pacific .....</b>	<b>61</b>
	Tatsuki Yoshinaga	
<b>23</b>	<b>Species Composition and Early Life History of the Oceanic Sunfish collected in the western North Pacific During the Hakuho Maru Cruise .....</b>	<b>62</b>
	Tatsuki Yoshinaga	
<b>24</b>	<b>Whalefish Larvae and Juveniles Collected in the western North Pacific During the Hakuho Maru Cruise 2012 .....</b>	<b>63</b>
	Michael J. Miller, John R. Paxton and Katsumi Tsukamoto	
<b>25</b>	<b>Population Structure of Vinciguerria nimbaria in Relation to Ocean Basin Scale Distributions and Oceanic Currents .....</b>	<b>65</b>
	Shun Watanabe	
<b>26</b>	<b>Pelagic Mollusks collected in the western North Pacific During the Hakuho Maru Cruise 2012 .....</b>	<b>66</b>
	Mari Kuroki	
<b>27</b>	<b>Artificial Upwelling Experiment based on the Principal of Perpetual Salt Fountain in the western North Pacific During the Hakuho Maru Cruise 2012 .....</b>	<b>67</b>
	Kogawa Takuma, Moriya Shuichi, Shoji Eita, Takahashi Yuya, Tsurumaki Youichirou, Naito Shunsuke and Shigenao Maruyama	
<b>28</b>	<b>Net record .....</b>	<b>69</b>
<b>29</b>	<b>CTD data .....</b>	<b>81</b>
<b>30</b>	<b>XCTD data .....</b>	<b>96</b>
<b>31</b>	<b>Working log .....</b>	<b>100</b>

## Preface

It was in the early 20th century when Johannes Schmidt first discovered the spawning areas of Atlantic eels in the Sargasso Sea by collecting tiny eel larvae. In the Pacific Ocean, research on eel spawning started around the Japanese coast in the 1930s. The Ocean Research Institute of The University of Tokyo started conducting Eel Cruises using the R/V *Hakuho Maru* in 1973 to find where the Japanese eel spawns in the Pacific, and succeeded in outlining its spawning area in the North Equatorial Current by collecting almost a thousand tiny leptocephali in 1991.

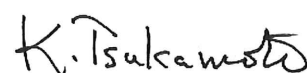
Surveys in the Pacific continued unabated afterwards, and 130 preleptocephali two to five days old after hatching were successfully collected by the *Hakuho Maru* near the Suruga Seamount of the West Mariana Ridge in 2005. In 2008 the *Kaiyo Maru* of the Fisheries Agency Japan collected spawning adults near the southern tip of the ridge, and finally the *Hakuho Maru* collected 31 Japanese eel eggs in 2009 and 147 in 2011. With these discoveries, a mystery that had survived for two thousand years since the days of Aristotle in ancient Greece was at last revealed.

During this cruise KH-12-2, on 18 May and 17 June 2012, both two days before new moon, we successfully collected Japanese eel eggs at the crossing points of the seamount chain of the West Mariana Ridge and salinity fronts in each month. These timings and locations of eel spawning were predicted based on the three hypotheses, *i.e.* the Seamount Hypothesis, New Moon Hypothesis and Front Hypothesis, and the four successful collections of eel eggs in May 2009, June 2011, May and June 2012 have strongly validated the above hypotheses scientifically. The next step of studies on eel spawning ecology should be understanding of the mechanism of forming spawning aggregations by measuring geomagnetism, upwelling and chemical substances as well as by observing the spawning behavior directly by submersible.

On behalf of all scientists on board, I sincerely thank the captain S. Okubo and his crew of the *Hakuho Maru* for their heartfelt cooperation. I also thank Drs. T. Otake, N. Mochioka, T.-W. Lee, Hans Fricke, A. Fukui and other old eel cruise members who have been working with us, supporting and encouraging us continuously during this cruise and previous ones, and to all AORI and JAMSTEC staff who support the operations of the *Hakuho Maru*. Without their help, we could not come so far and so rapidly.

27 June 2012

In the cabin of *Hakuho Maru*



Katsumi Tsukamoto  
Chief Scientist

Station and Working log.: KH-12-2

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
13.May (Sun)										<b>Leg 1</b>		GMT+9 Leave (Tokyo Port)												
14.May (Mon)																								
15.May (Tue)																								
16.May (Wed)									●	ST.X1	●	ST.X2	●	ST.X3	●	ST.X4	●	ST.X5	●	ST.X6	●	ST.X7	●	ST.X8
17.May (Tue)	●	ST.X9	●	ST.X10	●	ST.X11	●	ST.X12					●	ST.X13	●	ST.X14	●	ST.X15	●	ST.X16	●	ST.X17	●	ST.X18
18.May (Fri)		ST.X19		ST.1			ST.2		ST.3		ST.4		ST.5		ST.6		ST.7		ST.8		ST.9		ST.10	
19.May (Sat)			ST.8-2			ST.8-3		ST.8-4		ST.8-5		ST.8-6	ST.8-7	ST.8-8		ST.8-9		ST.8-10		ST.8-11		ST.8-12		
20.May (Sun)			ST.8-13		ST.8-14		ST.8-15					ST.10		ST.11		ST.12		ST.13						
21.May (Mon)			St.15									ST.16		ST.17		ST.18		ST.19						
22.May (Tue)										ST.21	ST.22		ST.23		ST.24									
23.May (Wed)		ST.25	ST.26		ST.27		ST.28		ST.29		ST.30	ST.31	ST.32		ST.33		ST.34							
24.May (Thu)								ST.OH1																
25.May (Fri)				ST.35															ST.3&					
26.May (Sat)					ST.37							ST.38												ST.39
27.May (Sun)								ST.40										ST.41						
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

Station and Working log.: KH-12-2

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
28.May (Sun)				ST.42									ST.43								ST.44			
29.May (Mon)					ST.45										ST.46									
30.May (Tue)	ST.47									ST.48											ST.49			
31.May (Wed)							ST.50						ST.51						ST.52					
1.Jun (Thu)													Arrival (Palau)											
6.Jun (Wed)									Leg 2		Leave (Palau)				ST.53						ST.54			
7.Jun (Thu)			ST.55						ST.56															
8.Jun (Fri)													ST.OH2											
9.Jun (Sat)														ST.57			ST.58			ST.59				
10.Jun (Sun)					ST.62		ST.63				ST.64			ST.65				ST.66			ST.67			
11.Jun (Mon)					ST.69					ST.70														
12.Jun (Tue)						ST.C1				ST.C2			ST.C3			ST.C4			ST.C5		ST.C6		ST.C7	
13.Jun (Wed)				ST.C8			ST.C9			ST.C10					ST.C11				ST.C12		ST.C13		ST.C14	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

Station and Working log.: KH-12-2

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
14.Jun (Thu)			ST.C15			ST.C16		ST.C17				ST.C18	ST.C19							ST.72				
15.Jun (Fri)	ST.74		ST.75		ST.76		ST.77	ST.78		ST.79		ST.80	ST.81		ST.82		ST.83						ST.73	
16.Jun (Sat)	ST.85		ST.86		ST.87		ST.88	ST.89		ST.90		ST.91	ST.92		ST.93		ST.94			ST.95				ST.96
17.Jun (Sun)		ST.97		ST.98		ST.99		ST.100		ST.101		ST.102	ST.103	ST.104	ST.105	ST.106		ST.107		ST.108			ST.109	
18.Jun (Mon)		ST.110	ST.111		ST.112		ST.113	ST.114				ST.115	ST.116		ST.117		ST.118		ST.119		ST.120			ST.121
19.Jun (Tue)	ST.122		ST.123		ST.124		ST.125	T.126		ST.127		ST.128	ST.129		ST.130			ST.136						
20.Jun (Wed)		ST.130			ST.131		ST.132			ST.133		ST.134		ST.135	8Shape									ST.137
21.Jun (Thu)		ST.138	ST.139		ST.140		ST.141			ST.142		ST.143	ST.144	ST.145	ST.146		ST.147				ST.148			
22.Jun (Fri)	ST.149		ST.150		ST.149-2		ST.151			ST.152		ST.153	ST.154	ST.155	ST.156		ST.157						ST.158	
23.Jun (Sat)		ST.159	ST.160		ST.161		ST.162	ST.163				ST.164			ST.C21									
24.Jun (Sun)																								
25.Jun (Mon)												8Shape												
26.Jun (Tue)																								
27.Jun (Wed)																								
28.Jun (Thu)											Arrival (Tokyo Port)													
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23

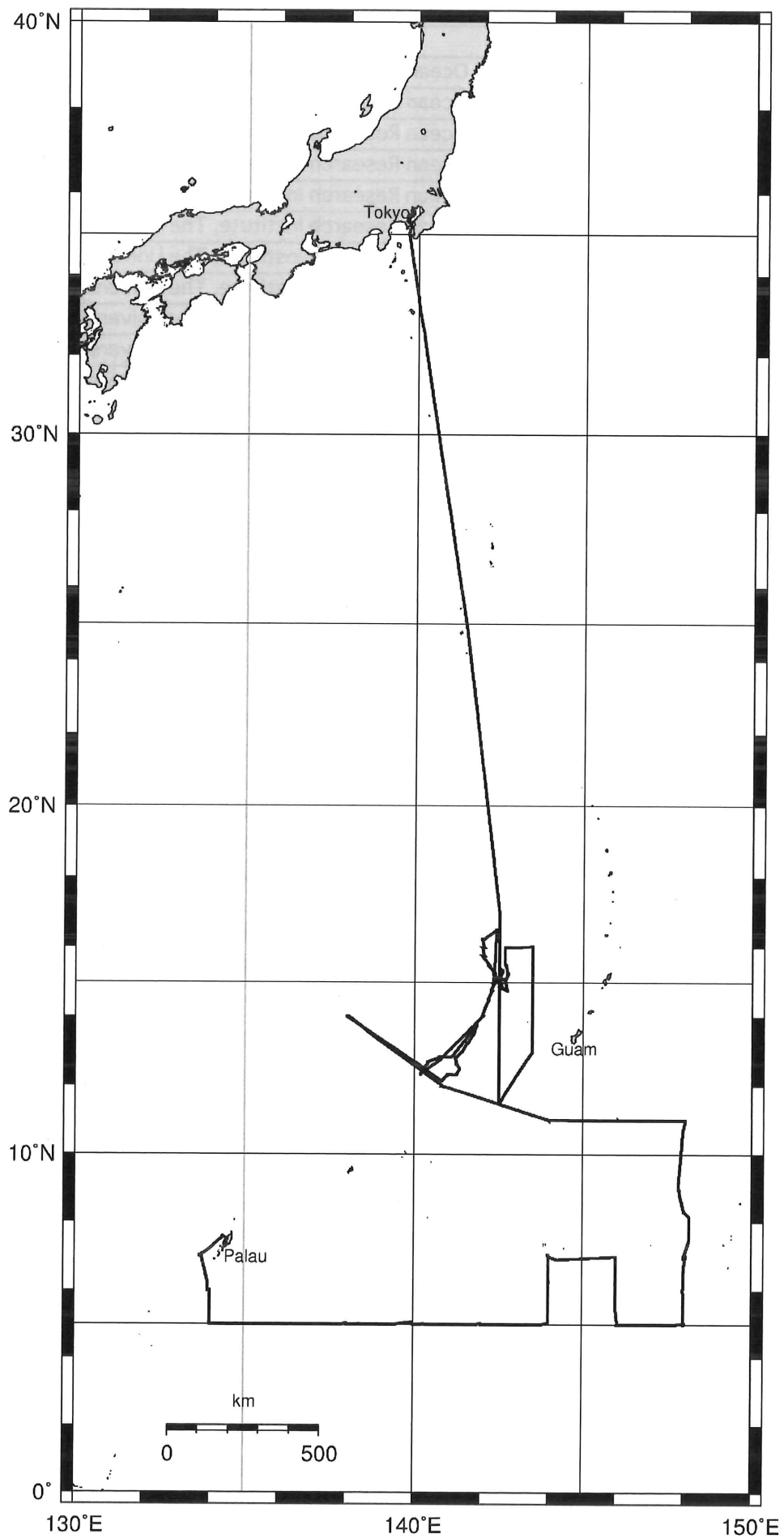


## Scientists on board HAKUHO-MARU (KH-12-2 Leg 1, 2)

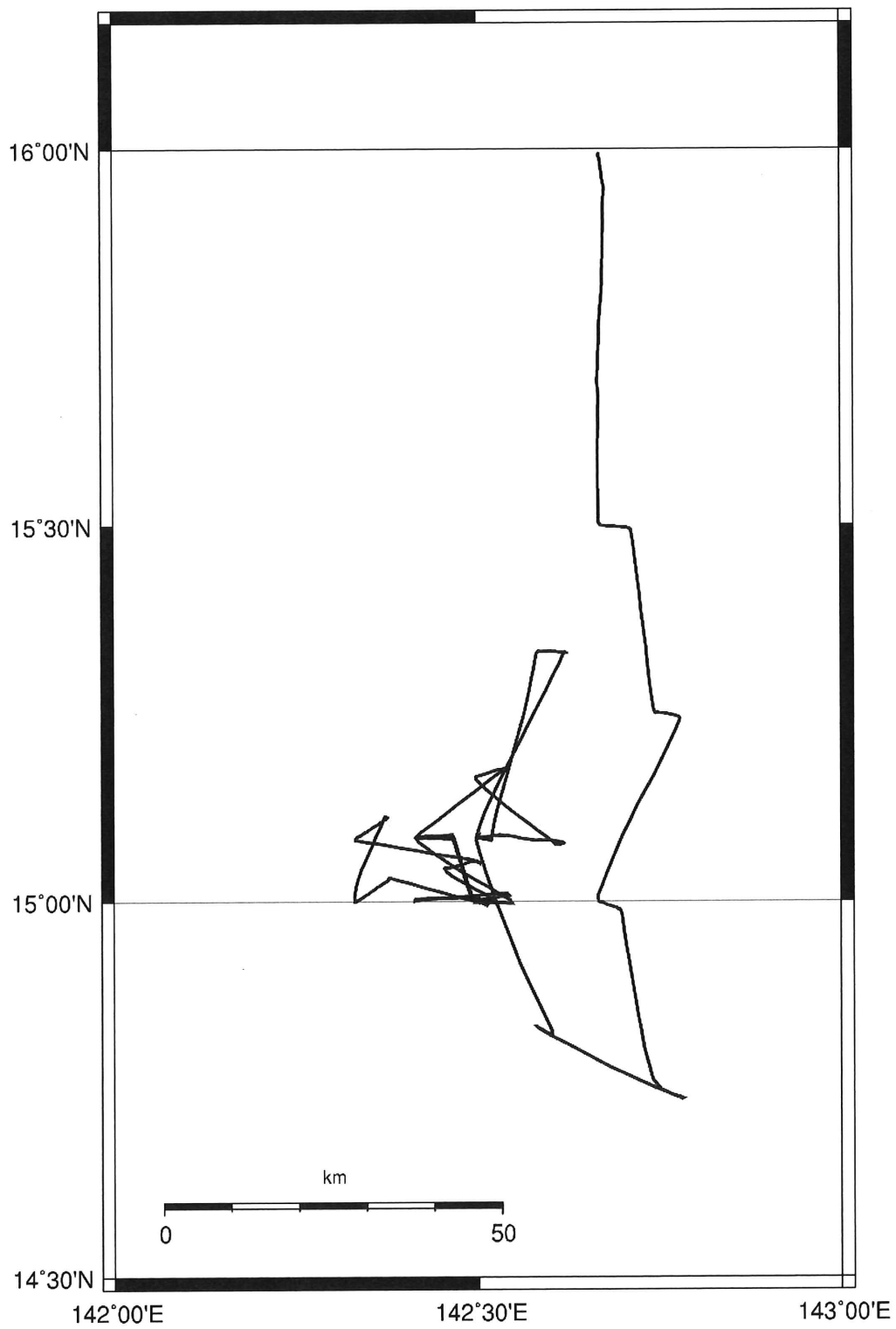
Name	Affiliation
TSUKAMOTO Katsumi	Atmosphere and Ocean Research Institute, The University of Tokyo
Machiko Oya	Atmosphere and Ocean Research Institute, The University of Tokyo
MILLER Michael J.	Atmosphere and Ocean Research Institute, The University of Tokyo
WATANABE Shun	Atmosphere and Ocean Research Institute, The University of Tokyo
INOUE Jun	Atmosphere and Ocean Research Institute, The University of Tokyo
SUDO Ryusuke	Atmosphere and Ocean Research Institute, The University of Tokyo
HAGIHARA Seishi	Atmosphere and Ocean Research Institute, The University of Tokyo
NAKAMURA Masahiro	Atmosphere and Ocean Research Institute, The University of Tokyo
MOKU Masatoshi	Atmosphere and Ocean Research Institute, The University of Tokyo
ISHIGAKI Hideo	Atmosphere and Ocean Research Institute, The University of Tokyo
NAGASAWA Maki	Atmosphere and Ocean Research Institute, The University of Tokyo
AOYAMA Jun	Atmosphere and Ocean Research Institute, The University of Tokyo
CAMBRILLAT Diane	Atmosphere and Ocean Research Institute, The University of Tokyo
SUZUKI Yuzuru	Graduate School of Agricultural and Life Sciences, The University of Tokyo
KUROKI Mari	The University Museum, The University of Tokyo
KATAYAMA Yukitoshi	Faculty of Agriculture, The University of Tokyo
IJIRI Shigeo	Graduate School of Fisheries Sciences, Hokkaido University
Matsuya Noriaki	Graduate School of Fisheries Sciences, Hokkaido University
Matsukawa Hiroki	Graduate School of Fisheries Sciences, Hokkaido University
MORIYA Shuichi	Institute of Fluid Science, Tohoku University
SHOJI Eita	School of Engineering, Tohoku University
KOGAWA Takuma	School of Engineering, Tohoku University
NAITO Shunsuke	School of Engineering, Tohoku University
TAKAHASHI Yuta	School of Engineering, Tohoku University
TSURIMAKI Yoichiro	School of Engineering, Tohoku University
KUSUNE Hiroyuki	Faculty of Agriculture, Kyushu University
SAKATA Ryosuke	Faculty of Agriculture, Kyushu University
HARIMA Eizabro	Faculty of Agriculture, Kyushu University
YOSHINAGA Tatsuki	School of Marine Biosciences, Kitasato University
TSUTSUI Shigeyuki	School of Marine Biosciences, Kitasato University
ZENIMOTO Kei	Nagasaki University
HAN Yu-San	Institute of Fisheries Science, National Taiwan University, Taiwan
YAMADA Yoshiaki	IRAGO Insitute Co. Ltd
OKAMURA Akihiro	IRAGO Insitute Co. Ltd
SO Akira	MARINE WORKS JAPAN LTD.
OSHITANI Akihiro	MARINE WORKS JAPAN LTD.
IDA Hitoshi	Bio Industry Co. Ltd
AI Bunpei	NPO Nihon Sakana no Kai
WATANABE Kazunori	NHK
KISHI Kensuke	KOZO-PRO,INC.



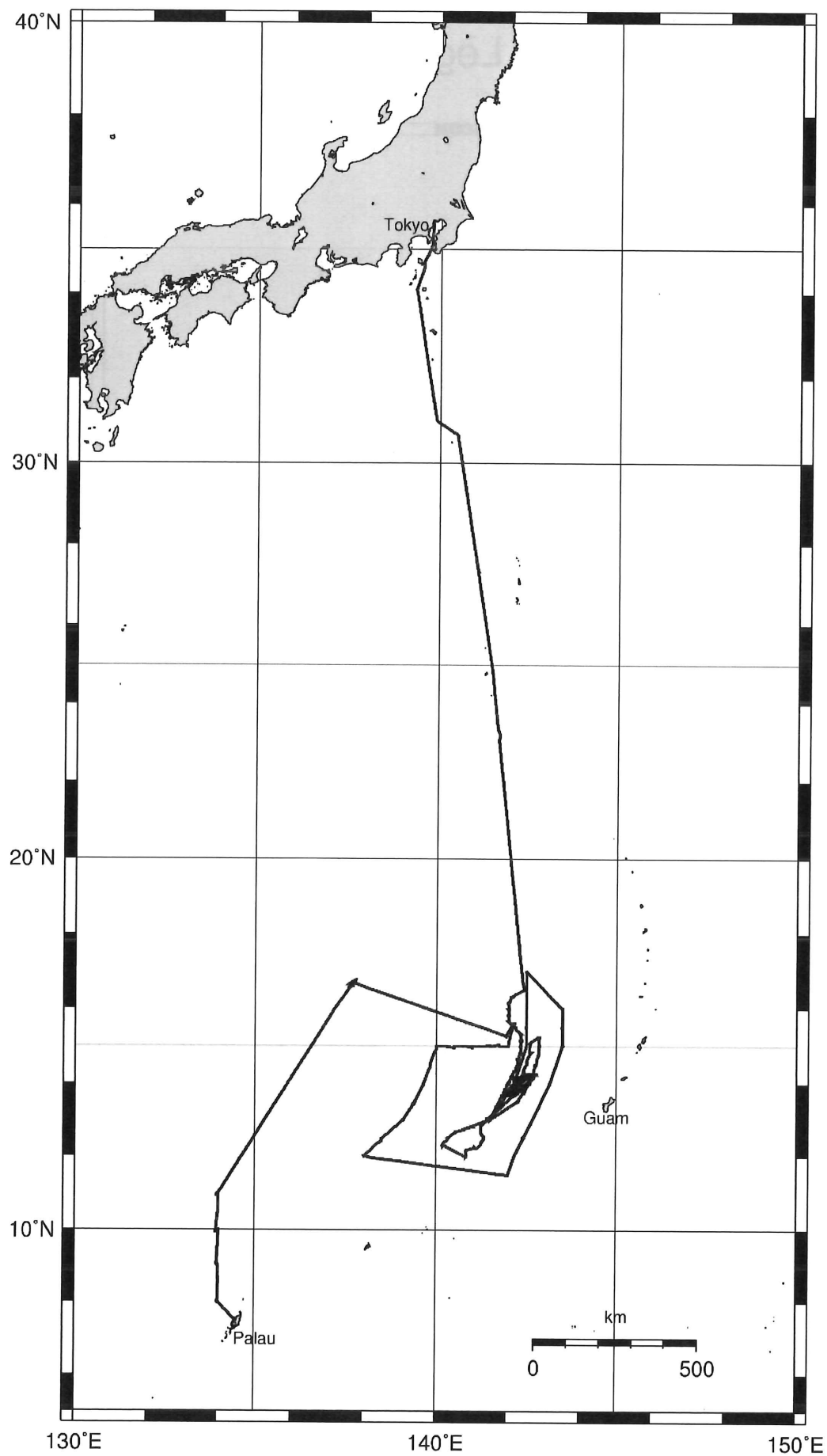
# KH-12-2\_Leg1 (Tokyo-Palau)



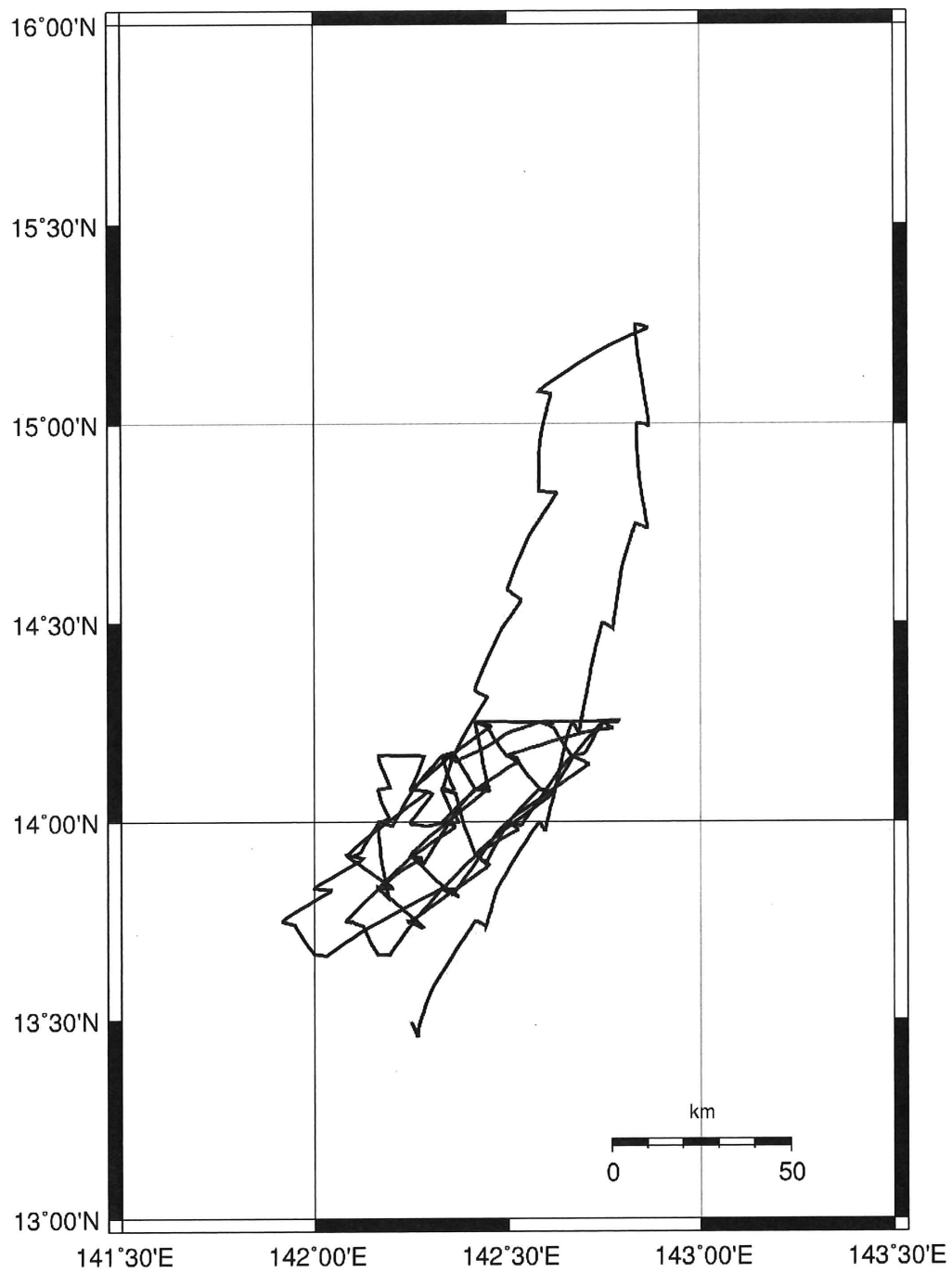
# KH-12-2\_Leg1 (St.1 - St.9)



# KH-12-2\_Leg2 (Palau-Tokyo)



## KH-12-2\_Leg2 (St.72 - St.C20)



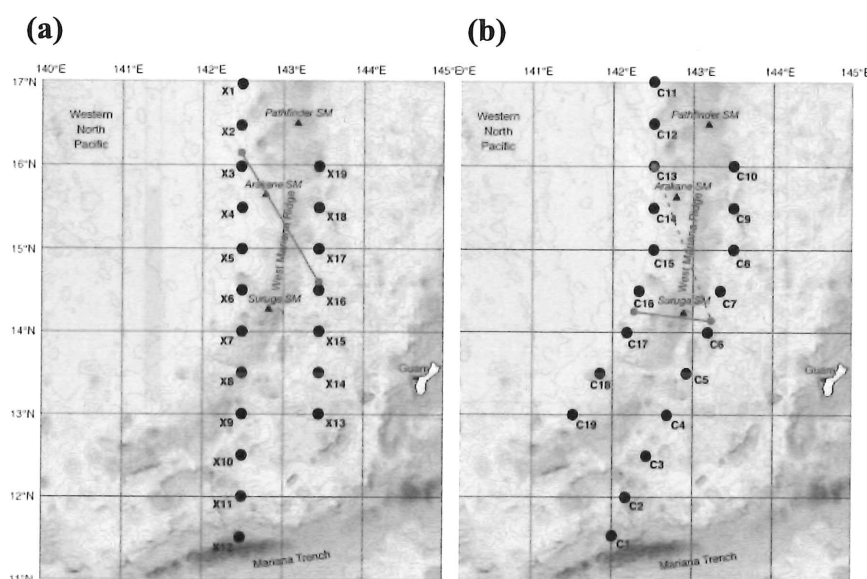
# XCTD and CTD Observations and Distribution of the Surface Salinity in the Hakuho Maru Cruise 2012

Masahiro Nakamura and Shun Watanabe

*Atmosphere and Ocean Research Institute, The University of Tokyo*

## 1. Introduction

In the western North Pacific, the spawning area of the Japanese eel *Anguilla japonica* was found to be located in the westward flowing North Equatorial Current to the west of Guam, by catching their small larvae and eggs (Tsukamoto, 2006; Tsukamoto et al. 2011). A steep north to south gradient of salinity (salinity front, 34.5 psu) is formed at the surface as a result of high precipitation in the southern area and high evaporation in the northern area. It has been inferred from larval distributions that Japanese eels spawn to the south of salinity front (Kimura et al., 2001; Kimura and Tsukamoto, 2006). Until now, the salinity front was located by using information from CTD, X-CTD and Surface S-T system. From this Cruise, we made an attempt to use the salinity logger as additional equipment. Aims of this study are as follows 1) Detection of salinity front, 2) Figure out whether salinity logger is useful for detection of salinity front or not, 3) If so, monitor the location of salinity front and see whether it moves during the short period or not.



**Figure 1.** Location of XCTD and CTD observation sites during Leg. 1 (a) and Leg. 2 (b). Black circle shows location of each stations and the red line shows the location of salinity front.

## 2. Materials and Methods

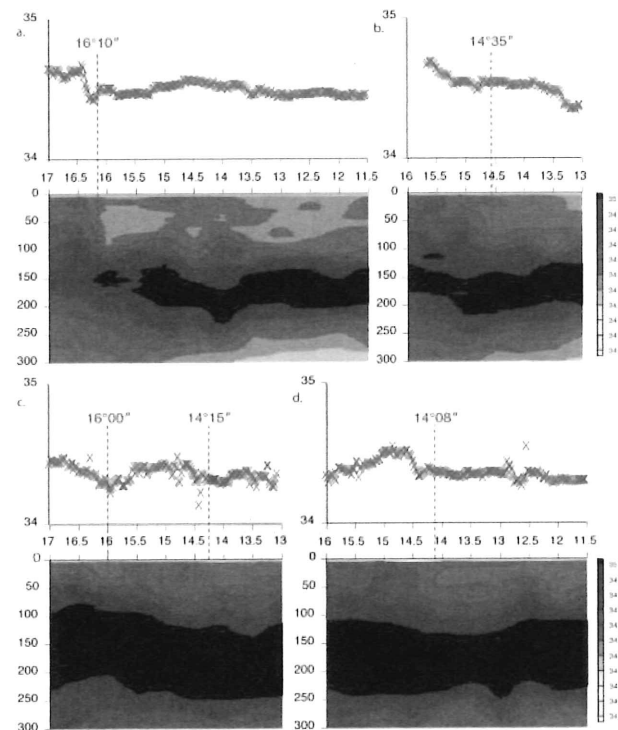
During the KH-12-2 cruise Leg. 1, XCTD observations were carried out at the station shown in Fig. 1a and during Leg. 2 CTD observations were carried out at the station shown in Fig. 1b. The surface salinity was recorded using both salinity logger and Surface S-T system. By comparing these 2 data sets, the validity of the salinity logger was evaluated. The salinity front was determined as the changing point of 34.5 psu.

## 3. Results

### 1) Detection of salinity front

The vertical temperature and salinity structures along the 2 lines were investigated using the data obtained from XCTD and CTD observations. There seemed to be correspondence relation between XCTD and Surface S-T system observations in western line, carried out in Leg. 1 (Fig. 2a).

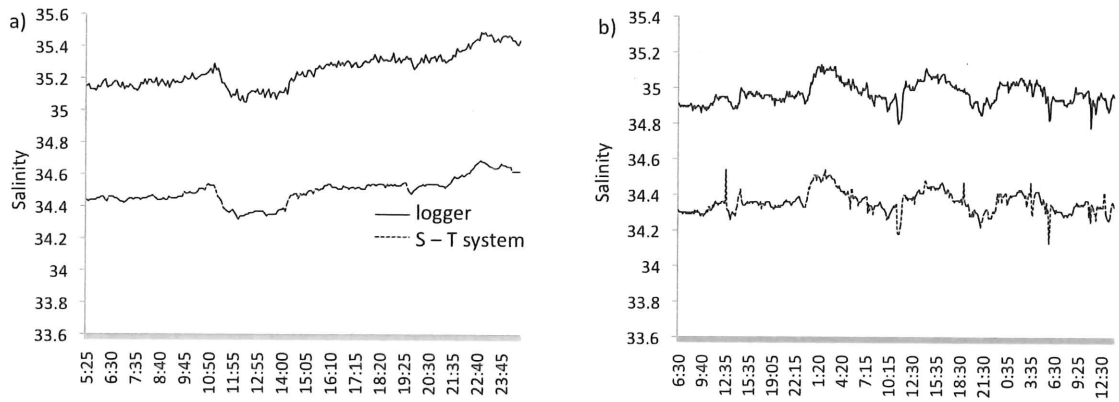
However no relationships was observed in eastern line (Fig. 2b). Salinity front was determined to be around 16°10'N in western line and 14°35'N in the western line, where changing point of 34.5 psu existed in the deeper layer. In Leg. 2, correspondence relation between CTD and Surface S-T system observations could not been seen in both eastern and western line (Fig. 2c, d). The location of salinity front was determined to be around 14°08'N in the eastern line and around 14°15'N and 16°00'N in the western line. The location of salinity front was assumed to be the straight line which connect the location of 34.5 changing point in both lines (Fig. 1). In case of Leg. 2, 2 lines were assumed since 2 changing points were found in western line.



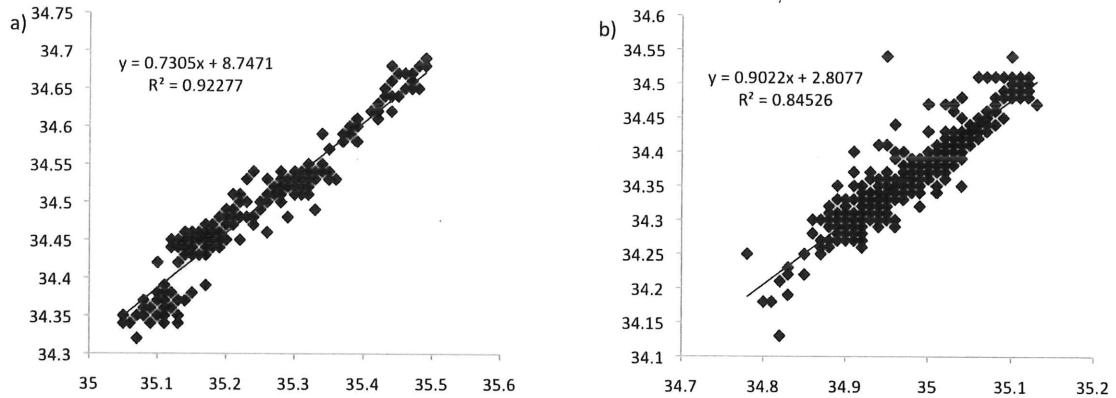
**Figure 2.** Salinity measured by Surface S-T system, CTD and XCTD. Red line shows the location of Salinity front.

## 2) Usefulness of Salinity logger

In both Leg. 1 and Leg. 2, the measured value of salinity logger and Surface S-T system were out of square (Fig. 3a, b). However very high correlations were observed between the measured values in both cases (Fig. 4a, b). Thus, salinity logger is considered to be useful equipment to observe the dynamics of salinity. The value measured by salinity logger was relatively higher than the value that Surface S-T system showed in both Leg. s (Fig. 3). In Leg. 1, logger showed 0.75 higher salinity and in Leg. 2 0.61 higher value, respectively. The calibration was conducted during Leg. 1 and Leg. 2, and this can be the possible cause of this change.



**Figure 3.** Measured salinity by salinity logger and s-t system of Leg. 1 (a) and Leg. 2 (b) .

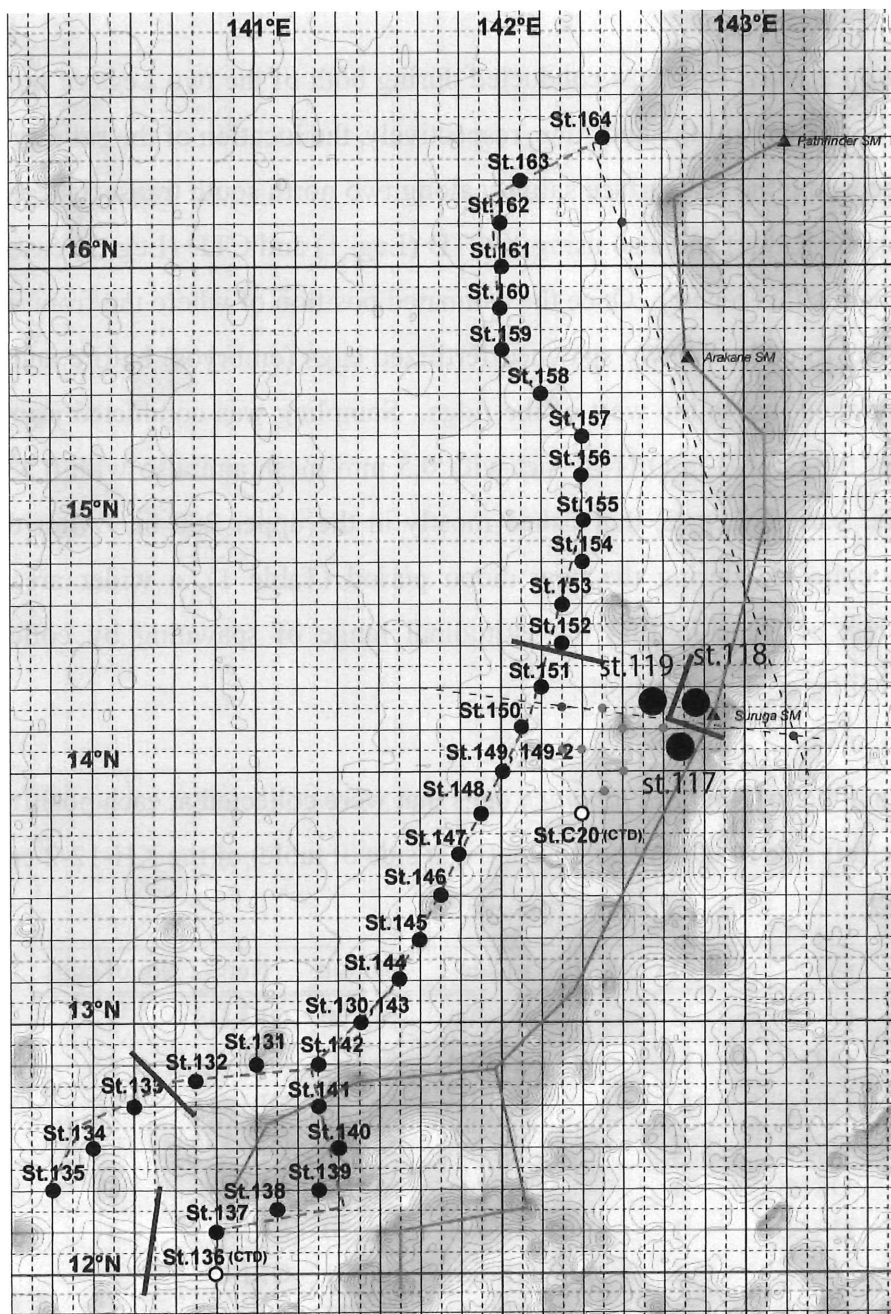


**Figure 4.** Relationships between measured salinity by salinity logger and surface s-t system of Leg. 1 (a) and Leg. 2 (b).

## 3) Monitoring of salinity front

Several points, which salinity changed sharply were observed from the observation of surface salinity (Fig. 5). The change was about 0.2 psu likewise the change seen at salinity front. The assumed straight line shaped salinity front seemed to be correct in

broad terms. However the drastic change of salinity was observed between st.117, St. 118 and St. 119 (Fig. 5). This indicates that the front is curving line. The drastic salinity change observed between St. 131 and St. 134 indicates the existence of another salinity front in far south. The drastic change was also observed between St. 151 and 152. However there were no such change between St. 150 and St. 151 (Fig. 5). These facts indicate that front might have shifted northward within short period.



**Figure 5.** Location of points where drastic surface salinity change was observed. Points where changes were observed are shown as blue lines.



# ***Anguilla japonica* Eggs Collected Near the West Mariana Ridge During the Hakuho Maru Cruise 2012 in the western North Pacific**

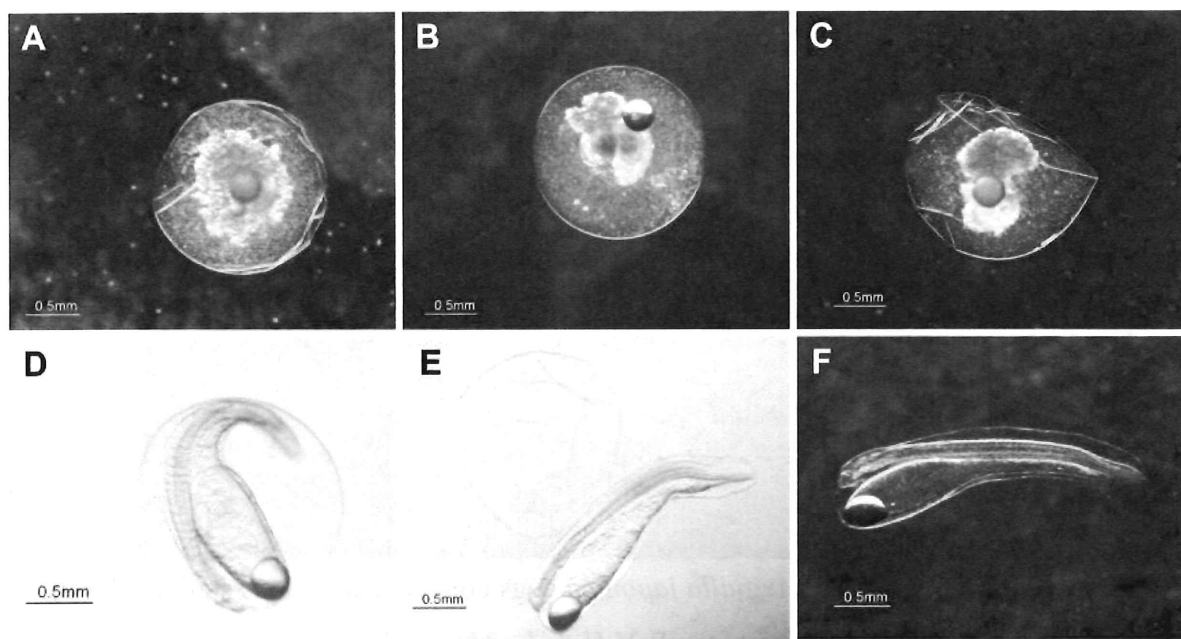
Jun Aoyama<sup>1</sup>, Michael J. Miller, Ryusuke Sudo, Shun Watanabe  
and Katsumi Tsukamoto

*Atmosphere and Ocean Research Institute, The University of Tokyo*

Sampling for *Anguilla japonica* eggs was conducted during both of the two Legs of the KH-12-2 cruise. During each Leg, in May and June, respectively, the location of the salinity front was first found by recording the sea surface salinity along two north south transects (east and west of the West Mariana Ridge) and also using X-CTD (Leg. 1) and CTD (Leg. 2) casts (see Nakamura and Watanabe, this report). Once the estimated position of where the front would cross the ridge, stations to collect newly spawned fertilized eggs (embryos) before and after new moon were positioned just to the west of the ridge. Sampling was conducted primarily using oblique tows of the large 3-m ORI-BF net with 0.5 mm mesh and also with 0.33 mm mesh during the latter part of Leg. 2, that fished mostly in the upper 200 m. After the *A. japonica* eggs were collected during the new moon period (Table 1), a wider area was sampled along the rest of ridge to find the latitudinal range of spawning by collecting preleptocephali (see Miller et al., this report).

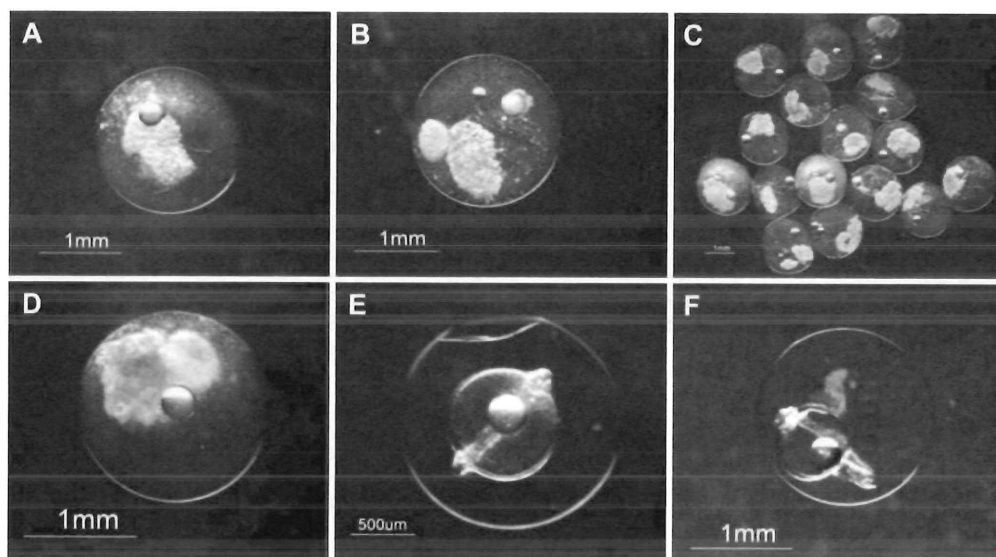
**Table 1.** List of the number of *Anguilla japonica* eggs that were collected at each positive station during Leg. 1 (left side of table) and Leg. 2 (right side of table) of the KH-12-2 cruise in May and June 2012.

Date	Station	Net	No. of eggs	Date	Station	Net	No. of eggs
18-May	St.8	ORI-O	2	17-Jun	St.100	ORI-O	1
19-May	St.8-4	ORI-S	56	17-Jun	St.109	ORI-O	1
19-May	St.8-5	ORI-S	57	18-May	St.115	ORI-O	236
19-May	St.8-6	ORI-S	2	18-Jun	St.116	ORI-O	35
19-May	St. 8-8	ORI-S	1	18-Jun	St.117	ORI-O	5
19-May	St. 8-12	ORI-S	1	18-Jun	St.120	ORI-O	3
20-May	St. 8-13	ORI-S	3	18-Jun	St.121	ORI-O	2
20-May	St. 8-14	ORI-S	5	19-Jun	St.123	ORI-S	1
21-May	St. 16	ORI-O	4				284
131							



**Figure 1.** Photographs of *Anguilla japonica* eggs collected during Leg. 1 in several of the tows made at St. 8 of the KH-12-2 cruise of the R/V *Hakuho Maru*. Early stage eggs that are not still alive were observed (A, No. 8-1; B, No. 8-4-7), or where heavily damaged (C No. 8-2), and a few later stage eggs (embryos) that were still alive (D, No. 8-4-1) or that hatched while they were being observed under the microscope (E, No. 8-4-3; F, No. 8-4-6) were also collected. Egg No. 8-1 and 8-2 were the first *A. japonica* eggs collected during the KH-12-2 cruise (collected on 18 May 2012), and they were genetically confirmed as being *A. japonica* onboard using real time PCR. The first number(s) of the egg numbers show the stations where they were collected.

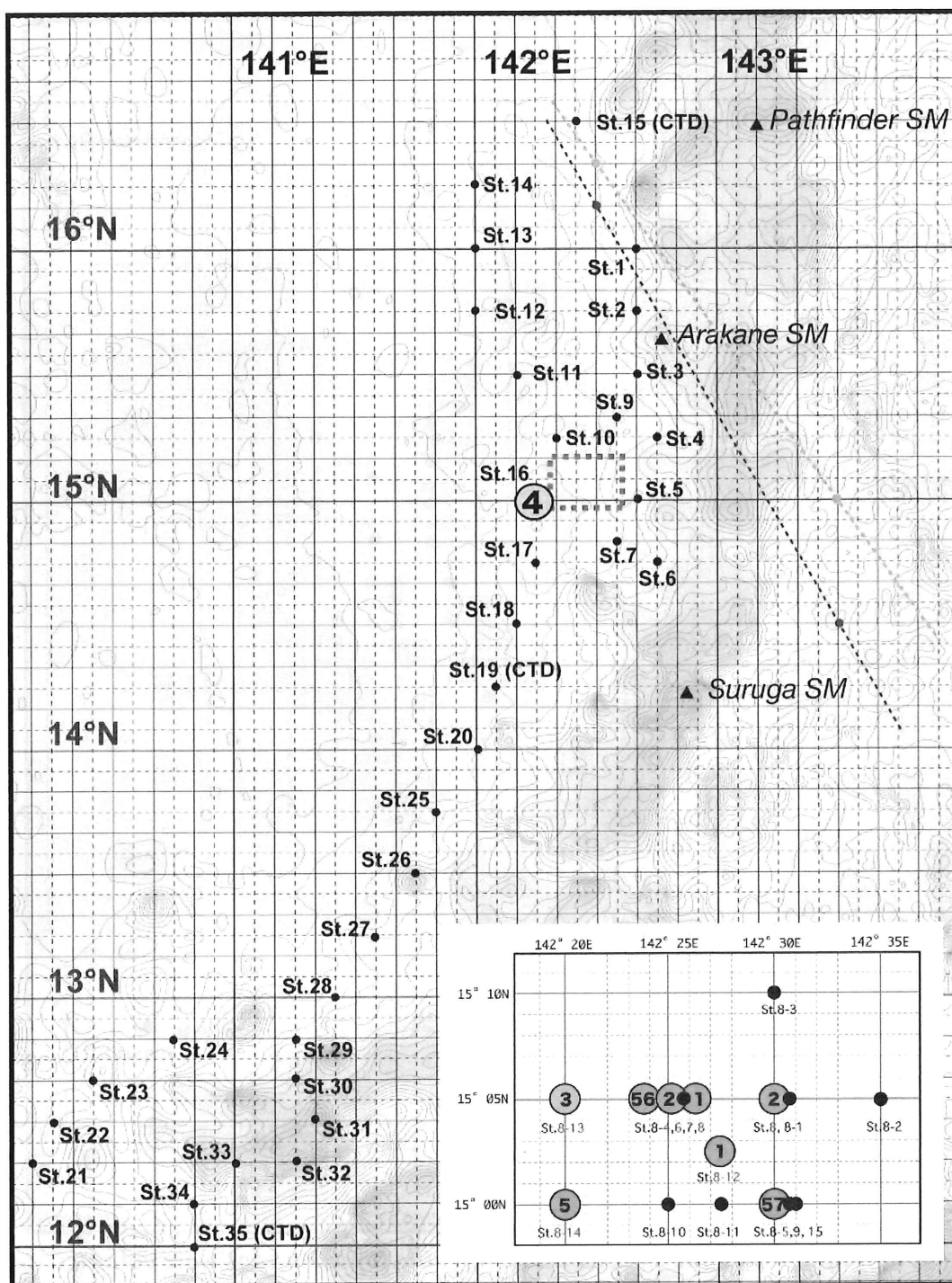
The eggs collected during both Leg. 1 and Leg. 2 were mostly at the early developmental stage when the embryos seem to be fragile, so they are probably easily damaged by agitation in the net or by rapid changes of water temperature. Many eggs were not still alive or had damaged chorions, so they did not have clear morphological features that distinguished them as being eggs of *A. japonica* (Figure 1A-C; Figure 2A-D). The eggs with intact chorions were all mostly about 1.6 mm in diameter, which is a key character of *A. japonica* eggs (Tsukamoto et al. 2012; Yoshinaga et al. 2012), and these were genetically confirmed onboard to be *A. japonica* using Realtime PCR (see Yoshinaga et al. This report). Some later stage eggs with the embryos still intact were also collected (Figure 1D; Figure 2E,F), but only a few of these eggs were collected.



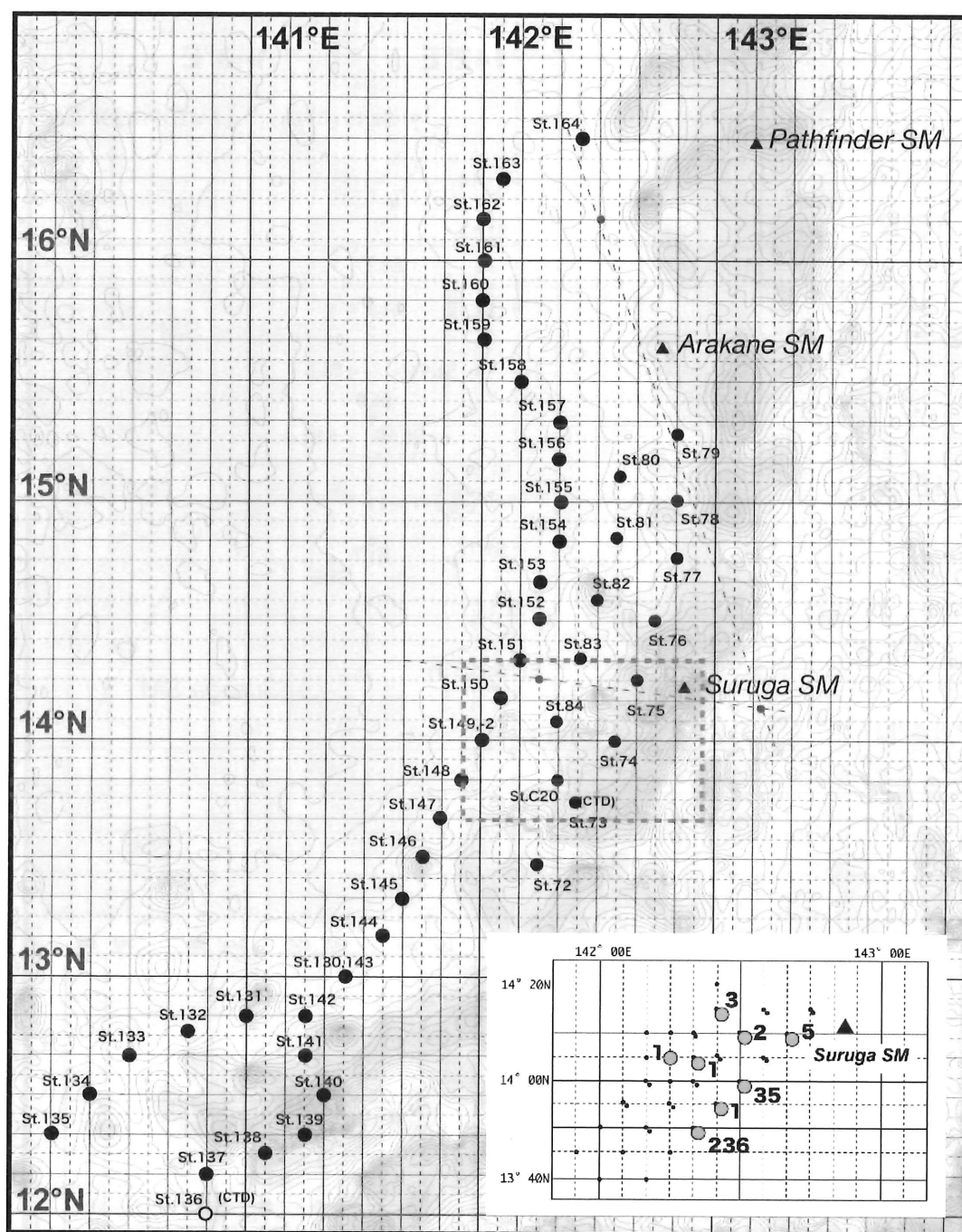
**Figure 2.** Photographs of *Anguilla japonica* eggs collected at various stations during Leg. 2 of the KH-12-2 cruise of the R/V *Hakuho Maru*. Early stage non-living eggs were also observed (A, No. 115-1; B, No. 115-8; C, eggs that were preserved in 5% formalin; D, No. 115-12), as well as a few later stage or undamaged eggs (E, No. 121-1; F, 120-1). The first numbers of the egg numbers show the stations where they were collected.

In Leg. 1 the salinity front crossed the West Mariana Ridge diagonally somewhere near about 15°10' N (blue dotted lines in Figure 3), and a survey for eggs was conducted along the ridge from 16°N to just south of 15°N, until the first two *A. japonica* eggs (Figure 1A,C) were caught at St. 8 and identified onboard with RT-PCR during the survey in St. 9. Then the stations of the egg grid were set just west of the ridge at around St. 8 (inset of Figure 3) to make intensive net sampling until new moon. Other stations were later sampled to the north (St. 10 to St.14), but no eggs were collected at those stations. Four eggs were also collected at St. 16 near the southwest corner of the egg grid. In total, 131 *A. japonica* eggs were collected in Leg. 1, in 9 tows at 7 different locations. The eggs were collected in Leg. 1 were found in 1 day before and after new moon.

In Leg. 2 the location of the salinity front was uncertain due to a shallow area of low salinity water much further north and a deeper front in the south at about 14.3°N (Figure 4). Therefore, a longer set of stations for collecting eggs was set first to cover both shallow and deeper salinity fronts just west of the ridge.



**Figure 3.** Map showing the stations where *Anguilla japonica* eggs were collected in the egg grid at St. 8 (inset, from dashed red rectangle) and the other stations that were sampled during Leg. 1 of the KH-12-2 cruise. The dotted blue lines show the estimated positions of the salinity front at the surface (light blue) and at 70 m (dark blue). The numbers in the blue circles show the number of eggs at each station, and 4 eggs were collected at St. 16 outside the egg grid.



**Figure 4.** Map showing the stations where *Anguilla japonica* eggs were collected in the egg grid (inset, from dashed red rectangle), the numbers of eggs at each location, and the other stations that were sampled during Leg. 2 of the KH-12-2 cruise. The dotted blue lines show the estimated positions of the salinity front according to a shallow low salinity area (north line) and a deeper low salinity area (south line). Most the egg grid was sampled twice at different times.

The sampling survey was later concentrated to stations set for the deeper salinity front and one *A. japonica* egg was first caught at St. 100 on 17 June 2012. The same grid was then sampled again, and 1 egg was caught at St. 109, before 236 eggs were collected at St. 115.

The catch of *A. japonica* eggs at St. 115 was the largest ever made in one tow compared to in May 2009 and June 2011 when eggs were previously collected. There were also 35 eggs collected at St. 116 during Leg. 2, but fewer eggs were collected at later stations (Table 1). In Leg. 2 the eggs were collected from 3 days to 1 day before new moon. They were collected at a total of 8 stations within the egg grid (Figure 4) that was sampled twice.

During both Legs of the cruise, eggs were only collected in the few days before and 1 day after new moon, which is consistent with the New Moon Spawning Hypothesis (Ishikawa et al. 2001; Tsukamoto et al. 2003). Catches of eggs and preleptocephali in previous years starting in 2005 were also completely consistent with new moon spawning (Tsukamoto 2006; Tsukamoto et al. 2011). Back-calculated hatching dates of larger sizes of *A. japonica* leptocephali also show a pattern of new moon spawning (Ishikawa et al. 2001; Tsukamoto et al. 2003), so one major result of the surveys of the spawning area has been to reveal this lunar cycle of spawning.

The first discovery of the spawning area of the Japanese eel indicated that the front lying at around 15°N may be important in determining their spawning site (Tsukamoto 1992). The importance of salinity front was confirmed again by collecting Japanese eel eggs south of the salinity front during two consecutive months in KH-12-2. Recent collections of the spawning-condition adults in 2008 -2010 by KAIYO-MARU (Chow et al. 2009) and *A. japonica* eggs in 2009 and 2011 by HAKUHO-MARU (Tsukamoto et al. 2011) were made from the southern edge of West Mariana Ridge at around 12-13°N when the salinity front was shifted southward to that latitude. However, these findings yielded an impression for the Japanese eel spawning site to be much lower latitude than previously estimated (15°N) by Tsukamoto et al. (2003). It is interesting that, the last 3 years when the evidence of the spawning site of Japanese eels were found relatively in south, the glass eel recruitment simultaneously showed historical low levels in East Asia. During this cruise, we found the Japanese eel eggs at higher latitudes ever reported (about 14-15°N). Assuming that the spawning of Japanese eels has occur at an



abnormally low latitude in recent years due environmental or oceanographic condition etc. and subsequently the glass eels drastically decline in their whole species range, the next season could be expected to have relatively abundant glass eel recruitment.

## References

- Chow S, H Kurogi, N Mochioka, S Kaji, M Okazaki and K Tsukamoto (2009)  
Discovery of mature freshwater eels in the open ocean. *Fish Sci* 75:257–259
- Ishikawa S, K Suzuki, T Inagaki, S Watanabe, Y Kimura, A Okamura, T Otake, N Mochioka, Y Suzuki, H Hasumoto, M Oya, M J. Miller, T-W Lee, H Fricke and K. Tsukamoto. 2001. Spawning time and place of the Japanese eel, *Anguilla japonica*, in the North Equatorial Current of the western North Pacific Ocean. *Fish Sci.* 67: 1097–1103
- Kimura S and K Tsukamoto. 2006. The salinity front in the North Equatorial Current: A landmark for the spawning migration of the Japanese eel (*Anguilla japonica*) related to the stock recruitment. *Deep-Sea Res. II* 53: 315–325.
- Tsukamoto K (1992) Discovery of the spawning area for the Japanese eel. *Nature* 356: 789-791.
- Tsukamoto K (2006) Spawning of eels near a seamount. *Nature* 439: 929
- Tsukamoto K, T Otake, N Mochioka, T-W Lee, H Fricke, T Inagaki, J Aoyama, S Ishikawa, S Kimura, M J. Miller, H Hasumoto, M Oya and Y Suzuki (2003)  
Seamounts, new moon and eel spawning: the search for the spawning site of the Japanese eel. *Environ Biol Fish* 66:221-229
- Tsukamoto K, S Chow, T Otake, H Kurogi, N Mochioka, M J. Miller, J Aoyama, S Kimura, S Watanabe, T Yoshinaga, A Shinoda, M Kuroki, M Oya, T Watanabe, K Hata, S Ijiri, Y Kazeto, K Nomura and H Tanaka (2011) Oceanic spawning ecology of freshwater eels in the western North Pacific. *Nature Comm* 2:179
- Yoshinaga T, M J. Miller, K Yokouchi, Otake T, Kimura S, Aoyama J, Watanabe S, Shinoda A, Oya M, Miyazaki S, Zenimoto K, Sudo R, Takahashi T, Ahn H, Manabe R, Hagihara S, Morioka H, Itakura H, Machida M, Ban K, Shiozaki M, Ai B, Tsukamoto K (2011) Genetic identification and morphology of naturally spawned eggs of the Japanese eel *Anguilla japonica* collected in the western North Pacific. *Fish Sci* 77:983–992

# ***Anguilla japonica* Preleptocephali Collected along the West Mariana Ridge, western North Pacific Ocean**

Michael J. Miller, Seishi Hagihara, Shun Watanabe, Jun G. Inoue  
and Katsumi Tsukamoto

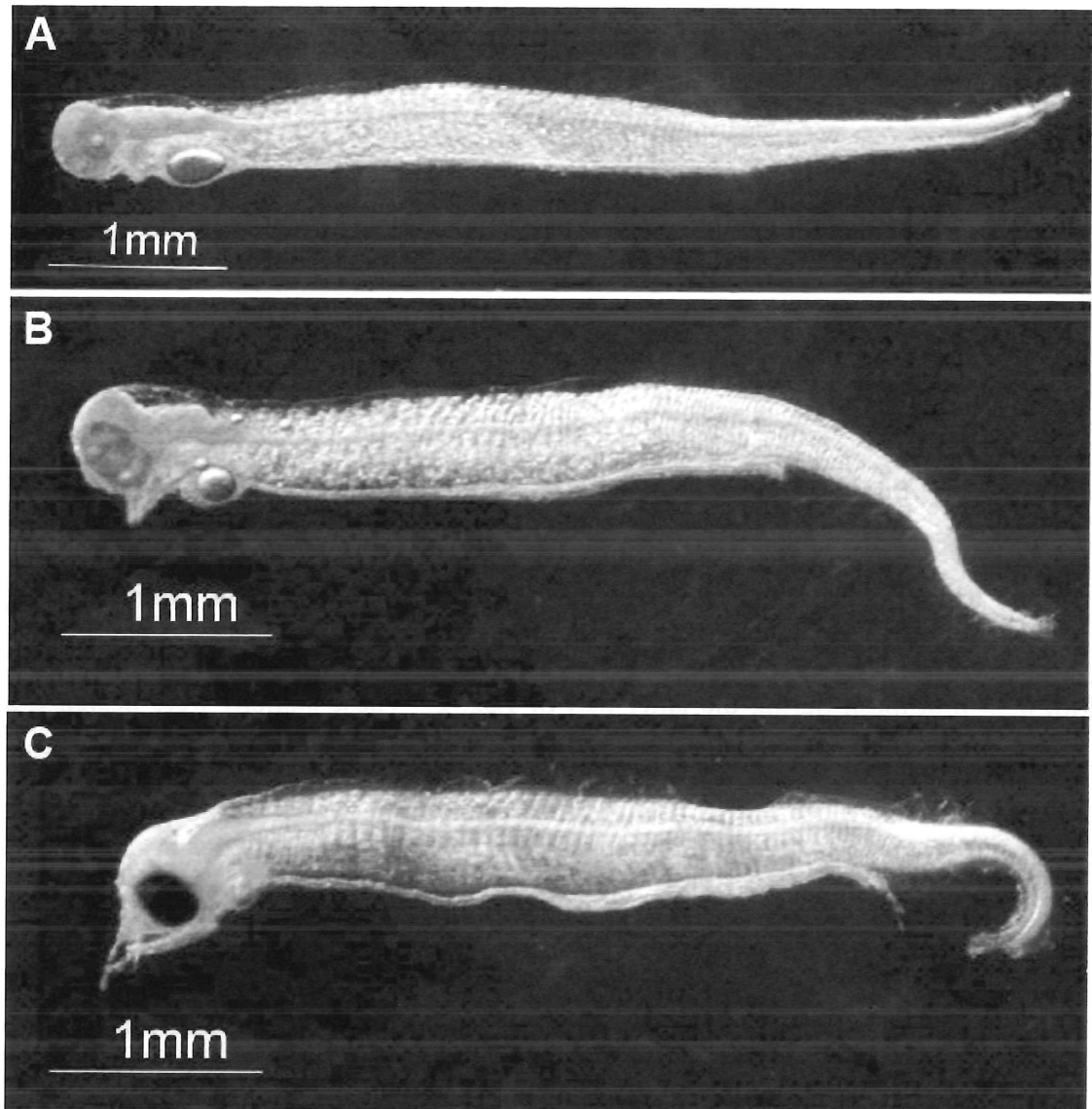
*Atmosphere and Ocean Research Institute, The University of Tokyo*

Sampling for *Anguilla japonica* preleptocephali during the two legs of the KH-12-2 cruise was primarily conducted in identical north-south transects to the west of the West Mariana Ridge in the north and over the deeper ridge in the south. Sampling was conducted using the large 3-m ORI-Big Fish (ORI-BF) net with 0.5 mm mesh and also with 0.33 mm mesh during the latter part of Leg. 2. These stations were designed to determine the latitudinal variation of spawning along the ridge and to see if spawning was also occurring much further south of the salinity front, which was located at around 14-15°N in both legs of KH-12-2.

**Table 1.** List of the number of possible *Anguilla japonica* preleptocephali collected during the two legs of the KH-12-2 cruise in May and June in the western North Pacific.

Date	Station	Net	No. of preleptos	Date	Station	Net	No. of preleptos
19-May	St.8-5	ORI-O	1	20-Jun	St.133	ORI-O	1
19-May	St.8-8	ORI-S	2	21-Jun	St.143	ORI-O	11
21-May	St.16	ORI-O	16	21-Jun	St.144	ORI-O	1
21-May	St.17	ORI-O	3	21-Jun	St.147	ORI-O	1
21-May	St.18	ORI-O	21	22-Jun	St.150	ORI-O	4
21-May	St.19	ORI-O	6	22-Jun	St.149-2	ORI-O	4
21-May	St.20	ORI-O	66	22-Jun	St.151	ORI-O	3
23-May	St.25	ORI-O	36	22-Jun	St.152	ORI-O	2
23-May	St.26	ORI-O	2	22-Jun	St.153	ORI-O	4
17-Jun	St.104	ORI-O	1	22-Jun	St.155	ORI-O	2
19-Jun	St.123	ORI-O	3	22-Jun	St.156	ORI-O	4
19-Jun	St.C20	ORI-O	2	23-Jun	St.162	ORI-O	2
20-Jun	St.130	ORI-O	2			Total	200





**Figure 1.** Photographs of different stages of *Anguilla japonica* preleptocephali that were collected during the KH-12-2 cruise, showing specimens No. 634 (A), 636 (B), 631 (C) from St. 143.

During this cruise we succeeded to collect about 200 *A. japonica* preleptocephali (Table 1), but the final number will be determined by genetic identification using mitochondrial DNA sequences in the laboratory in addition to the real time PCR that was used to find out if some preleptocephali were *A. japonica* during the cruise.

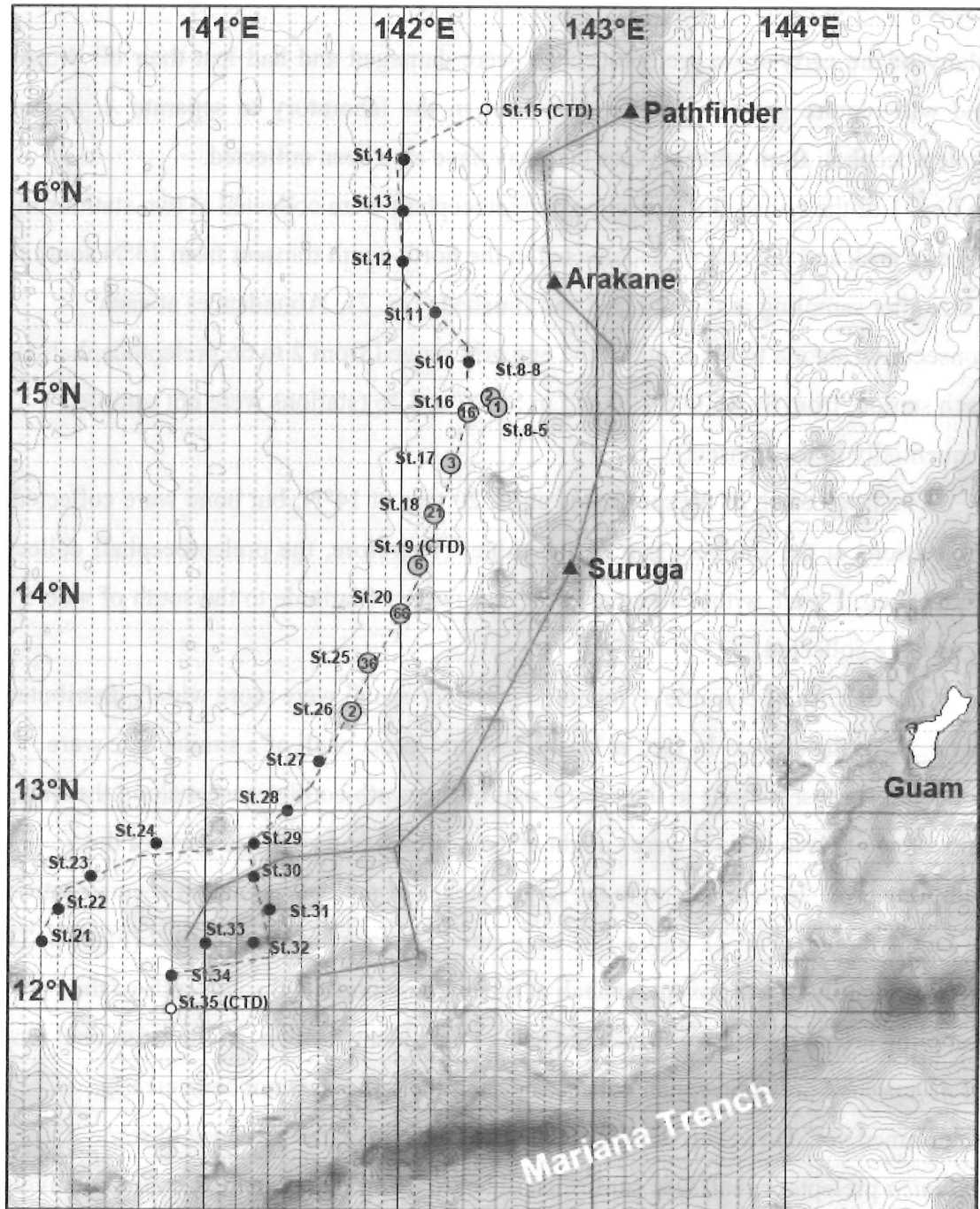
During both legs, preleptocephali were collected that were at the very early developmental stage with no teeth or eye pigment and an oil droplet (Fig. 1A, B) or with pigmented eyes and teeth (Fig. 1C). The preleptocephali were mostly about 5 mm.

Many of the early-stage preleptocephali were damaged and had lost their oil droplets, and will require genetic identification later in the laboratory to separate *A. japonica* preleptocephali from other species that may have also been collected.

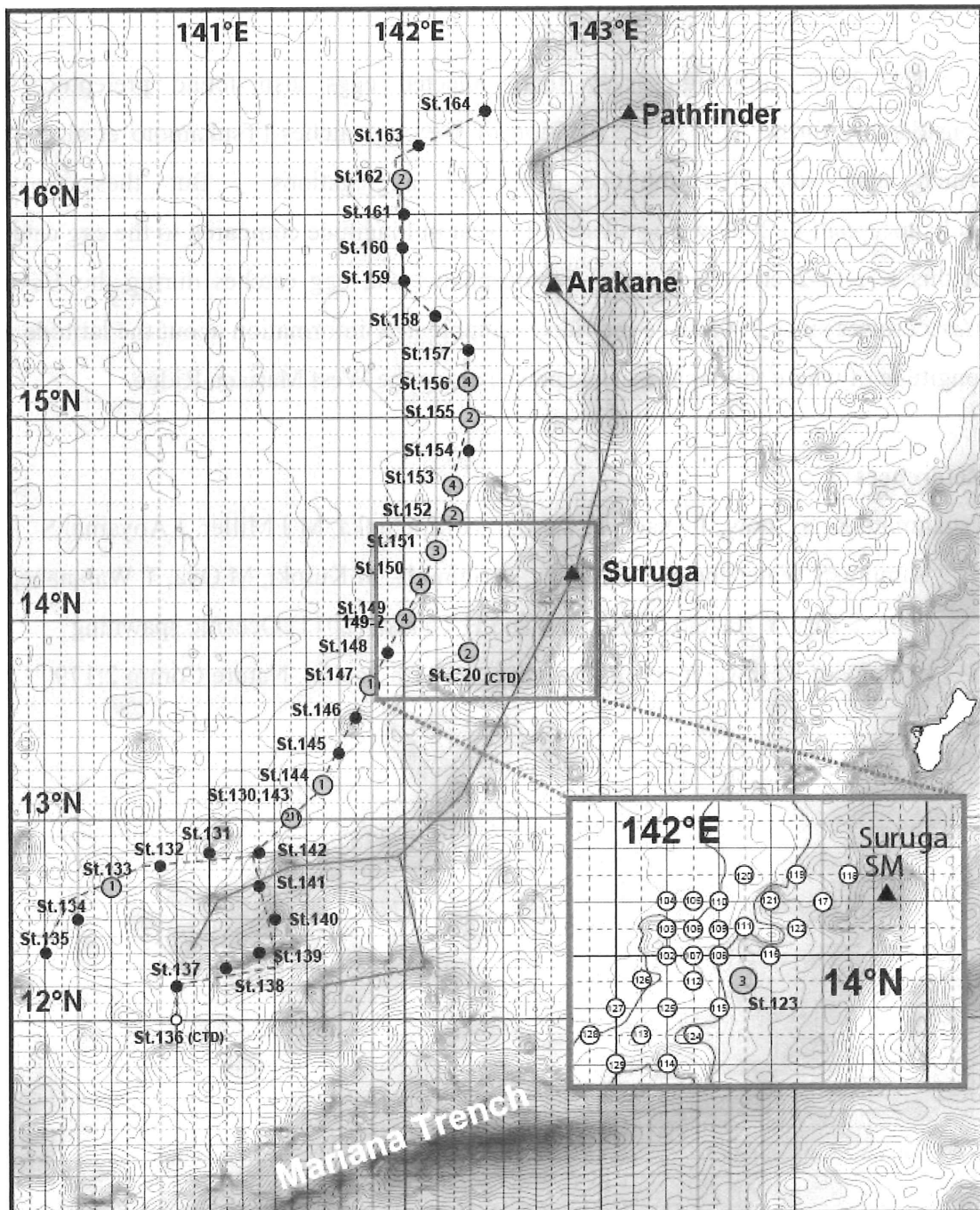
In Leg. 1 of the cruise, 3 *A. japonica* preleptocephali were collected at two stations in the egg grid, and the rest were collected in the north-south transect from 15°N south to 13°N after sampling in the egg grid had finished (Fig. 2). Abundances at each consecutive station to the south of the egg grid ranged from 2 to 66 preleptocephali at each station, from St. 16 to St. 20 and in St. 25 and 26 (stations were not sampled sequentially in the transect).

The large catch of 66 specimens at St. 20 was at 14°N, but none were collected in the stations at the southern part of the ridge. Therefore, the preleptocephali collected during Leg. 1 were within about a 1.5 degree range of latitude to the south of where the eggs were collected.

The catches of possible *A. japonica* preleptocephali were more widely distributed in Leg. 2 of the cruise. In fact, at least a few preleptocephali of a similar size were collected at most stations in the central part of the north-south transect along the ridge, and a few of various sizes were caught at the northern and southern parts of the sampling area. In comparison to the large catches of preleptocephali at several stations in Leg. 1 though (Fig. 2), only a few were caught at each station in Leg. 2 (Fig. 3). The species identity of the preleptocephali at the extreme north and south ends of the sampling area were not confirmed yet using DNA identification, so the latitudinal range of *A. japonica* preleptocephali collected during the cruise has not been clearly determined yet. However, during both legs of the cruise, the presence of some *A. japonica* preleptocephali was confirmed onboard using real time PCR over a relatively wide latitudinal range south of the salinity front, which suggests that there were spawning aggregations occurring whose eggs were not collected during the two sampling surveys. This suggests that when the salinity front has shifted northward, spawning may occur at several latitudes along the ridge. It is also possible to suppose that adult eels which have spawned the last month near the salinity front located further south may have still remained at around the same latitude and spawned again near the same place.



**Figure 2.** Map showing the stations where *Anguilla japonica* preleptocephali were collected during Leg 1 of the KH-12-2 cruise. The numbers in the green circles indicate the number of preleptocephali collected at each station. Black dots show negative stations.



**Figure 3.** Map showing the stations where *Anguilla japonica* preleptocephali were collected during Leg 2. The *A. japonica* preleptocephali caught at one station of the egg grids are shown in the inset. The numbers in the green circles indicate the number of larvae collected at each station. Black dots show negative stations. Some larger size preleptocephali were collected in other stations during the egg sampling (not shown), but were likely not *A. japonica*.

The 2009 sampling survey that collected eggs also found preleptocephali considerably further east of the location of the egg catches (Tsukamoto et al. 2001), which also suggested multiple spawning aggregations. But these eastern preleptocephali in 2009 were still slightly west in longitude compared to the egg catches in this KH-12-2 cruise, so the preleptocephalus and egg catches during the *Hakuho Maru* cruises since 2005 have provided valuable new information about the latitude and longitude of where the Japanese eel spawns along the West Mariana Ridge.

## References

- Tsukamoto K, S Chow, T Otake, H Kurogi, N Mochioka, M J Miller, J Aoyama, S Kimura, S Watanabe, T Yoshinaga, A Shinoda, M Kuroki, M Oya, T Watanabe, K Hata, S Ijiri, Y Kazeto, K Nomura and H Tanaka (2011) Oceanic spawning ecology of freshwater eels in the western North Pacific. *Nature Comm* 2:179

***Anguilla japonica* leptocephali Collected in the North Equatorial  
Current Region During the KH-12-2 Sampling Survey  
in the Western North Pacific**

Michael J. Miller, Shun Watanabe  
and Katsumi Tsukamoto

*Atmosphere and Ocean Research Institute, The University of Tokyo*

During sampling for eggs, preleptocephali and leptocephali during the two legs of the KH-12-2 cruise, about 32 *Anguilla japonica* were collected (Table 1). Sampling occurred in a variety of grids of stations, north-south transects along the West Mariana Ridge, and over a wider area of the North Equatorial Current. Sampling near the ridge was conducted using the large 3-m ORI-Big Fish (ORI-BF) net with 0.5 mm or 0.33 mm mesh, and using the IKMT in areas further south or near Palau. However, *A. japonica* leptocephali were only collected in the ORI-BF stations and were not collected at lower latitudes or near Palau in the IKMT stations.

The collected Japanese eel leptocephali ranged in size 10.5–24.8 mm in total length, with an average length of 15.4 mm. These mostly small size leptocephali, around 12–15 mm, are likely larvae that were collected about a month after they were born during the previous new moon before each leg of the cruise, or after a longer period for the few larger size leptocephali.

Eighteen of the 32 specimens were collected in the egg grid at St. 8 located at about 15°N, close to the ridge. These larvae had either been retained relatively close to the ridge by eddies, or had been transported back to the east after initial westward transport. The other *A. japonica* larvae were caught at a variety of stations (Table 1)

**Table 1.** List of the leptocephali of *Anguilla japonica* that were collected during KH-12-2 showing their size (TL), total myomere (TM) and last vessel (LVBV) counts, and the specimen allocation. E: ethanol preservation, F-vial, both allocation to AORI. PCR: indicates if real time PCR was conducted, and + indicates positive identification.

Spec. No.	Date	St.	Net	TL	TM	LVBV	PCR	Fix./allocation
6	18-May-12	3	ORI-O	13.7	~116	47		PCR
18	18-May-12	8-1	ORI-S	12.8	~119	47		E
26	19-May-12	8-2	ORI-S	16.2	123	45		E
25	19-May-12	8-2	ORI-S	16.6	124	45		E
24	19-May-12	8-2	ORI-S	17.6	~120	44		E
28	19-May-12	8-4	ORI-S	19.2	~110	46		E
40	19-May-12	8-9	ORI-S	13.4	~123	47	+	E
39	19-May-12	8-9	ORI-S	13.5	116	46	±	E
38	19-May-12	8-9	ORI-S	15.8	120	48		E
47	19-May-12	8-10	ORI-S	12.9	119	46		E
46	19-May-12	8-10	ORI-S	13.8	117	47		E
45	19-May-12	8-10	ORI-S	14.1	118	47		E
44	19-May-12	8-10	ORI-S	15.4	111	46		E
55	19-May-12	8-11	ORI-S	16	112	47		Hokaido Univ.
56	19-May-12	8-11	ORI-S	16.5	117	47		Hokaido Univ.
54	19-May-12	8-11	ORI-S	18	114	47		E
64	19-May-12	8-12	ORI-S	15.2	114	43		E
65	19-May-12	8-12	ORI-S	15.6	115	45		E
66	19-May-12	8-12	ORI-S	16.3	114	43		E
83	20-May-12	11	ORI-O	13.5	~115	48		E
96	20-May-12	14	ORI-O	12.1	~112	47		E
161	21-May-12	19	ORI-O	13.1	120	46		E
471	9-Jun-12	58	ORI-O	11	~118	46	+	E-vial
475	9-Jun-12	59	ORI-O	12	~112	44	+	E-vial
479	10-Jun-12	60	ORI-O	22.4	116	47		Nat. Taiwan Univ.
483	10-Jun-12	61	ORI-O	22.2	115	46	+	Kyushu Univ.
482	10-Jun-12	61	ORI-O	24.8	112	46		Nat. Taiwan Univ.
494	10-Jun-12	66	ORI-O	10.5	~120	46		Nat. Taiwan Univ.
508	11-Jun-12	71	ORI-O	12.9	116	46	+	E
509	11-Jun-12	71	ORI-O	13.2	119	48		Nat. Taiwan Univ.
572	18-Jun-12	110	ORI-O	15	120	45		Nat. Taiwan Univ.
683	23-Jun-12	161	0.33 mm ORI-O	18.3	119	48		F-vial



# Distribution and Migration of Tropical Anguillid Leptocephali in the western North Pacific Ocean During the Hakuho Maru Cruise 2012

Mari Kuroki

*The University Museum, The University of Tokyo*

## 1. Introduction

Two-thirds of the 19 species/subspecies of anguillid eels worldwide are tropical species. Understanding the life histories of tropical species, which appear to be the most ancestral (Aoyama et al. 2001), is essential for understanding the evolution and larval ecology of this remarkable group of catadromous fishes. It was revealed that tropical eels of *Anguilla marmorata* and *Anguilla bicolor pacifica* in the western North Pacific Ocean region have higher larval growth rates and shorter oceanic larval durations than temperate eels such as *Anguilla japonica* based on otolith analysis (Kuroki et al. 2006). Based on recent research surveys, it was revealed that the North Pacific population of *A. marmorata* spawns in the same area as *A. japonica* from the collections of both the larvae (Miller et al. 2002, Kuroki et al. 2009) and spawning adults (Chow et al. 2009). Moreover, the leptocephali of the newly reported anguillid species of *Anguilla luzonensis* (Watanabe et al. 2009) distribute in the western North Pacific (Kuroki et al. *in press*). However, information about the detailed spawning areas and geographic distribution patterns of most tropical eels has been lacking. In this cruise we aimed to collect the leptocephali of the tropical anguillid eels and reveal the distribution patterns in the western North Pacific Ocean for understanding their spawning ecology and larval migration.

## 2. Materials and Methods

Tropical eel leptocephali were collected during the KH-12-2 cruise during 13 May – 2 June 2012 (Leg. 1) and 6 – 28 June 2012 (Leg. 2). These leptocephali were collected using the large ORI ring net (ORI-BF) with a 3 m diameter or the IKMT net. The ORI ring net has a 7.1 m<sup>2</sup> mouth opening and 0.5 or 0.33 mm mesh and the IKMT net has a 8.7 m<sup>2</sup> mouth opening. The nets were fished in oblique tows during daytime and nighttime. Collected leptocephali were observed and measured onboard. Total myomeres, preanal myomeres, predorsal myomeres, number of myomeres of the blood vessels, total length, preanal length, predorsal length, head length, and body depth



were measured and counted using a dissecting microscope (Nikon SMZ-1500). After the morphological measurement, the leptocephali were preserved in 99% ethanol for identification using mitochondrial DNA 16S ribosome RNA sequences and for otolith aging analysis, except for a single *A. marmorata* leptocephalus (No. 502, 23.0 mm TL) that was preserved in 5% formalin for the museum collection at the University of Tokyo.

### 3. Results and Discussion

A total of six longfined anguillid leptocephali (*A. marmorata* or *A. luzonensis*) over 10 mm TL were collected during 21 May – 16 June 2012 (Table 1, Figure 1B), and the sizes varied from 12.2 mm to 55.5 mm TL. A large number of small anguillid preleptocephali that had oil globules and small leptocephali under 10 mm TL were collected in the region to the west of the Mariana Islands. The spawning area of *A. japonica* is located to be west of the Mariana Islands in the western North Pacific Ocean (Tsukamoto et al. 2011). Therefore, it is reasonable that such huge number numbers of eggs and preleptocephali confirmed using the real time PCR on board were found during this cruise. On the other hand, a spawning area of *A. marmorata* has been found (Kuroki et al. 2009) at same area, suggesting that *A. marmorata* preleptocephali may have been included as well as *A. japonica*. The genetic identification of all eggs and preleptocephalli that are possibility of an anguillid species will be done after the cruise. Even for the large sized longfined leptocephali, genetic identification is indispensable because the information about morphological characters for identification is limited. All collected longfined tropical eel leptocephali during this cruise were distributed in the North Equatorial Current (Figure 2). The *A. marmorata* spawned in this research region would first be transported westward by the North Equatorial Current and then some would be transported northward into the Kuroshio and others transported southward by the Mindanao Current. The leptocephali of nother longfined tropical eel, *A. luzonensis*, would be transported westward by the North Equatorial Current and recruit to the Philippines based on the previous data (Watanabe et al. 2009, Kuroki et al. in press).

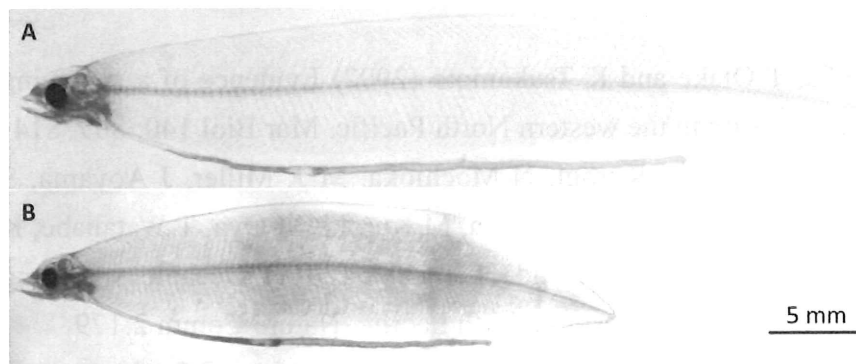
A total of five shortfined leptocephali of *A. bicolor pacifica* were collected during 26 May – 30 May 2012 (Table 1, Figure 1A). The shortfined types of leptocephali in this region are clearly identified the species by the morphological characters. One leptocephalus was large (41.6 mm TL), but the other leptocephali were relatively small (22.3—32.6 mm TL). All leptocephali of this species were distributed in southern part of the North Equatorial Current (Figure 2). However, the spawning area and

migration route of this mysterious species is still not known. It is necessary to have a survey in the much more southern areas such as north of New Guinea to understand their early life history in the future.

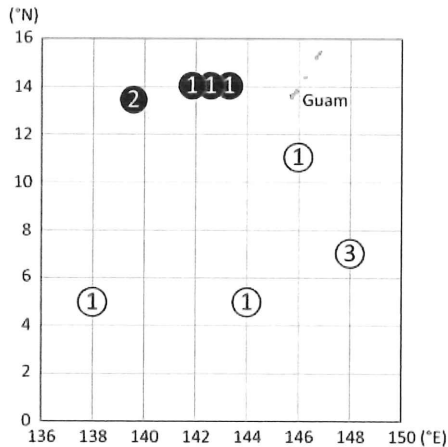
The geographic distribution patterns and the size of tropical eels of *A. marmorata*, *A. luzonensis* and *A. bicolor pacifica* will be compared with the distribution of the leptocephali collected during the cruise and the larval migration will be discussed in relation to ocean current conditions. These results will also be compared with the temperate *A. japonica* collected in this region and other tropical eels to reveal the specific strategy of migration and recruitment of tropical eels (Kuroki et al. 2006, 2007). The otolith microstructure of these tropical eel species of leptocephali collected during the cruise will be analyzed as part of an ongoing larger study on the early life history and age and growth of tropical anguillid leptocephali.

**Table 1.** Collection data of morphologically identified tropical anguillid leptocephali over 10 mm TL. Total length (TL, mm), total myomeres (TM), last vertical blood vessel (LVBV), preanal myomeres (PAM), predorsal myomeres (PDM).

No.	Date	St.	Net	Latitude	Longitude	TL	TM	LVBV	PAM	PDM	Fintype
175	21-May-12	20	ORI-O	142.0°E	14.0°N	55.5	107	42	70	61	Longfin
293	26-May-12	37	IKMT-O	146.0°E	11.0°N	41.6	110	46	78	73	Shortfin
343	27-May-12	40	IKMT-O	148.0°E	7.0°N	32.6	103	43	71	67	Shortfin
344	27-May-12	40	IKMT-O	148.0°E	7.0°N	29.1	107	46	72	67	Shortfin
345	27-May-12	40	IKMT-O	148.0°E	7.0°N	29.8	108	46	72	68	Shortfin
390	29-May-12	45	IKMT-O	144.0°E	5.0°N	22.3	109	46	73	-	Shortfin
399	30-May-12	48	IKMT-O	138.0°E	5.0°N	24.6	104	43	71	65	Longfin
502	11-Jun-12	68	ORI-O	139.4°E	13.5°N	23.0	106	44	72	62	Longfin
503	11-Jun-12	68	ORI-O	139.4°E	13.5°N	23.7	106	45	72	61	Longfin
525	15-Jun-12	84	ORI-O	142.3°E	14.0°N	12.2	>106	45	74	-	Longfin
533	16-Jun-12	86	ORI-O	142.5°E	14.0°N	12.9	~104	47	67	-	Longfin



**Figure 1.** A: Shortfinned anguillid leptocephalus (No.345, 29.8 mm TL),  
B: Longfinned anguillid leptocephalus (No.503, 23.7 mm TL).



**Figure 2.** Geographic distribution map of the longfined leptocephali (*Anguilla marmorata* or *Anguilla luzonensis*, solid circles) and the shortfined leptocephali (*Anguilla bicolor pacifica*, open circles). The number in the circles shows the number of larvae collected at each station.

#### 4. References

- Aoyama J, M Nishida and K Tsukamoto (2001) Molecular phylogeny and evolution of the freshwater eel, genus *Anguilla*. *Mol Phylogenet Evol* 20:450–459
- Chow S, H Kurogi, N Mochioka, S Kaji, M Okazaki and K Tsukamoto (2009) Discovery of mature freshwater eels in the open ocean. *Fish Sci* 75: 257–259
- Kuroki M, J Aoyama, M J Miller, S Wouthuyzen, T Arai and K Tsukamoto. (2006) Contrasting patterns of growth and migration of tropical anguillid leptocephali in the western Pacific and Indonesian Seas. *Mar Ecol Prog Ser* 309: 233–246
- Kuroki M, J Aoyama, S Wouthuyzen, K Sumardiharga, M J. Miller and K Tsukamoto (2007) Age and growth of *Anguilla bicolor bicolor* leptocephali in the eastern Indian Ocean. *J Fish Biol* 70: 538–550
- Kuroki M, J Aoyama, M J Miller, T Yoshinaga, A Shinoda, S Hagihara and K Tsukamoto (2009) Sympatric spawning of *Anguilla marmorata* and *Anguilla japonica* in the western North Pacific Ocean. *J Fish Biol* 74: 1853–1865
- Kuroki, M, M J Miller, J Aoyama, S Watanabe, T Yoshinaga and K Tsukamoto Evidence of offshore spawning for the newly discovered anguillid species *Anguilla luzonensis* (Teleostei: Anguillidae) in the western North Pacific. *Pac Sci in press*.
- Miller M J, N Mochioka, T Otake and K Tsukamoto (2002) Evidence of a spawning area of *Anguilla marmorata* in the western North Pacific. *Mar Biol* 140: 809–814
- Tsukamoto K, S Chow, T Otake, H Kurogi, N Mochioka, M J. Miller, J Aoyama, S Kimura, S Watanabe, T Yoshinaga, A Shinoda, M Kuroki, M Oya, T Watanabe, K Hata, S Ijiri, Y Kazeto, K Nomura and H Tanaka (2011) Oceanic spawning ecology of freshwater eels in the western North Pacific. *Nature Comm* 2:179
- Watanabe S, J Aoyama and K Tsukamoto (2009) A new species of freshwater eel *Anguilla luzonensis* (Teleostei: Anguillidae) from Luzon Island of the Philippines. *Fish Sci* 75:387–392

# Daily Age Estimation of Japanese Eel *Preleptocephali* Collected During the Hakuho Maru Cruise 2012 in the western North Pacific

Hiroyuki Kusune

*Laboratory of Fisheries Biology, Kyushu University*

Over 150 specimens of *preleptocephali* that were morphologically or genetically identified as being the Japanese eel were collected by the ORI-Big Fish plankton net with 0.5mm and 0.33 mesh during the KH-12-02 cruise. Out of all the collected *preleptocephali*, 120 specimens were selected for studying their otoliths (Table 1). These *leptocephali* were collected from 24 sampling stations.

Thus, we will observe the microstructure and daily increments of the otoliths to determine their ages using microscopes. These data will provide important information about their early life history and spawning ecology.

**Table 1.** Sample No., Date, and Sampling stations of the *preleptocephali* that will be used for otolith analysis.

No.	Leg	St.	Date	No.	Leg	St.	Date
32,33	1	8-5	19-May-12	611	2	133	20-Jun-12
115-118, 123-128	1	16	21-May-12	628-630	2	143	21-Jun-12
147-154	1	18	21-May-12	636,637	2	143	21-Jun-12
155-160	1	19	21-May-12	640	2	144	21-Jun-12
182-187,,189,191-195,197-233	1	20	21-May-12	643	2	147	21-Jun-12
259-274	1	25	23-May-12	647,648	2	150	22-Jun-12
496	2	67	10-Jun-12	658,659	2	151	22-Jun-12
519	2	81	15-Jun-12	662	2	152	22-Jun-12
561	2	101	17-Jun-12	664-667	2	153	22-Jun-12
564	2	104	17-Jun-12	669	2	155	22-Jun-12
591,592,594	2	123	19-Jun-12	671-675	2	156	22-Jun-12
602,603	2	C20	19-Jun-12	684	2	162	23-Jun-12
606,607	2	130	20-Jun-12				

# Collection of Japanese Eel Embryos and Preleptocephali for Transcriptome Analysis

Noriaki Matsuya, Hiroaki Matsukawa and Shigeho Ijiri

*Graduate School of Fisheries Sciences, Hokkaido University*

## 1. Introduction

After the past 50 years research of controlled reproduction in the Japanese eel *Anguilla japonica*, a second generation of eel larvae was produced in 2010 in the laboratory. However, the quality of eggs, that assessed by fertilization rate and the early survival rate, obtained through artificial maturation is still highly variable and the early survival rates of the larvae are extremely low in the most case. One possible reason for such a difficult situation on rearing artificially produced eel larvae may be accounted by poor quality of eggs. Histological and proteome analysis of artificially produced eggs has been investigated in recent years. The histological analysis revealed that some case of artificially produced eggs could not complete the correct process of their nuclear maturation. It was also demonstrated that MPFs (maturation promoting factors) were remained immature in some case of eggs. However, those two factors cannot account for the quality of eggs in many cases. In addition, proteome analysis were also carried out between high and low quality of eggs, however such analysis using eggs was difficult because variety of protein fragment catalyzed from yolk proteins covered wide area of the two dimensional electrophoregram. The other factor which may determine the quality of eggs may be sought by contents of RNAs that accumulated in the eggs. To address this question, we aimed to investigate whole transcriptome analysis using developing eggs (embryos) corrected from spawning ground of wild Japanese eel.

## 2. Sample Collection

*KH-12-2, Leg. 1*

On 19 May at St. 8-5, 59 embryos were corrected. Two of 59 embryos were alive and hatched soon after sort-out from plankton source. The hatched two embryos were immersed in RNAlater solution for fixation of RNA. On 21 May at St. 17 and St. 18, one and five preleptocephali were captured, respectively. These preleptocephali were thought as 3 - 4 days after fertilization (dah). On 22 May at St. 20, total 15 preleptocephali were fixed in RNAlater, that are thought as 4 - 5 dah. At the last, on 23 May at St. 25, 36 preleptocephali were captured and total 10 larvae were fixed in

RNA later, those were thought as 5 - 6 dah. In total, two embryos and 31 preleptocephali in three different developmental stages (probably 3 - 6 dah) were obtained (Table 1).

#### *KH-12-2, Leg. 2*

On 18 June at St. 115, 236 embryos were collected. Sub-sampled six embryos (No. 115-2 and 115-4 to 115-8) were identified as *A. japonica* by a convenient real-time PCR checking. Thirty of 236 embryos that sustained the construction of the egg membrane and 1.5 - 1.6 mm in diameter but were not alive, were immersed in RNA later solution for fixation of RNA. According to their developing stages, these embryos were probably thought to be in a short time after the fertilization but not clear. Furthermore, single fresh embryo was collected at St. 120 and St. 121 on 18 June and St. 123 on 19 June, and the morphological observation suggested that they were Japanese eel eggs (1.6, 1.6 and 1.8 mm in diameter respectively). These embryos were well developed and seem to be at just before hatching. In total, 33 embryos in different developmental stages were obtained (Table 2). In addition, at St. 127 on 19 June, an anguilliform embryo (No. 127-1, probably family Serrovoimeridae) that was alive and 2.1 mm diameter was collected and immersed in RNA later solution.

### **3. Future analysis**

The embryos and preleptocephali are to use for whole transcriptome analysis. Total RNA will be extracted by column based RNA extraction kit specialized for micro-volume RNA. The cDNA will be synthesized by the smart technology which is commonly used for amplification of extreme small volume of RNA using oligo-dT based primer. The cDNA will be subjected to Next Generation Sequencing machine and the contigs are to be constructed. The levels of RNA expression will be estimated by counting the number of mapped reads to contigs. Characteristic RNA expression will be analyzed by comparison with artificially produced embryos and larvae. The relationship between transcripts in the embryo and artificially produced eggs is also to be analyzed. These information concerning transcripts comparison will give new insight for advanced understanding of the quality of eel eggs.

Table 1. Eel embryos and preleptocephuli that fixed in RNAlater at KH-12-2, Leg. 1

Date	Time of fixed	St.	Status	The no. of sample in a tube	Specimen No.
19 May 12	12:00	8-5	embryos 1 dah	2	8-5-32, 34
21 May 12	16:00	17	prelepto 3-4 dah	1	132
	19:00	18	prelepto 3-4 dah	5	136-140
22 May 12	1:00	20	prelepto 4-5 dah	9	166-174
	1:20	20	prelepto 4-5 dah	6	176-181
23 May 12	1:00	25	prelepto 5-6 dah	6	244-249
	1:30	25	prelepto 5-6 dah	4	253-256

Table 2. Eel embryos and preleptocephuli that fixed in RNAlater at KH-12-2, Leg. 2

Date	Time of fixed	St.	Status	The no. of sample in a tube	Specimen No.
18 June 12	12:30	115	not clear	1	115-1, 3, 10-37
	23:20	120	Just before hatching	1	120-1
19 June 12	0:15	121	Just before hatching	1	121-1
	4:00	123	Just before hatching	1	123-1

**Early T-cell Development in Japanese eel *Anguilla japonica* collected  
During the Hakuho Maru Cruise 2012 in the western North  
Pacific**

Yuzuru Suzuki

*Fisheries Laboratory, Graduate School of Agricultural and Life Sciences,  
The University of Tokyo.*

A system to produce artificial seed of the Japanese eel for culture has not yet been completed, largely due to a low survival rate during preleptocephalus and leptocephalus stages. Development of defense mechanisms against disease will be a big problem to be solved. Histological observations showed that the leptocephalus lacks both the spleen and lymphoid tissue of the kidney, although it does have a well-developed thymus (Suzuki and Otake 2000). The thymus is the main organ of T-cell maturation. T cells are the key players in the immune response that recognize non-self by the T-cell receptor (TCR) on the cell surface (Suetake et al. 2006). Knowledge of the development of the thymus and T-cell function are thus important for evaluating the ontogeny of functional immune organ. We have identified lymphocyte-specific protein tyrosine kinase (*lck*) as the T-cell marker gene in eel, and found that eel preleptocephalus obtained by artificial fertilization showed mRNA expression of the *lck* even at 3 and 7 days post-fertilization (Kawabe et al. 2012). These results suggest that *lck* expression would be an index to assess the larval condition of disease resistance. To establish a system to evaluate the seed quality, we need to compare the results with those of naturally captured preleptocephalus. Thus I joined this cruise to obtain egg and preleptocephalous samples.

During this cruise, we succeeded to capture many eggs and preleptocephali of the Japanese eel. I was able to obtain two eggs of good quality, and in addition, eleven samples of 1 to 2 dph and seven samples of 3 to 4 dph preleptocephalus. These were fixed in RNAlater (Ambion, Austin, TX) and stored at -80°C. I will analyze mRNA expression of the *lck* and other genes related to T-cell functions of these samples.

## References

Suzuki Y and Otake T (2000) Skin lectin and the lymphoid tissues in the leptocephalous larvae of the Japanese eel *Anguilla japonica*. Fish Sci 66:636-643



Suetake H, Saha N. R, Araki K, Akatsu K, Kikuchi K and Suzuki Y (2006)  
Lymphocyte surface marker genes in fugu. *Comp Biochem Phys* 1D:102–108  
Kawabe M, Suetake H, Kikuchi K, and Suzuki Y (2012): Early T-cell and thymus  
development in Japanese eel *Anguilla japonica*. *Fish Sci* 78:539-547

# Transcriptome Analysis of All Life Stage of the Japanese eel

Yu-San Han<sup>1</sup>, Jun Aoyama<sup>2</sup>, Michael J. Miller<sup>2</sup>, and Katsumi Tsukamoto<sup>2</sup>

<sup>1</sup>*Institute of Fisheries Science, National Taiwan University*

<sup>2</sup>*Atmosphere and Ocean Research Institute, The University of Tokyo*

## 1. Goal

To establish and analyze the EST bank of the Japanese eel for all life stage

## 2. Rationale

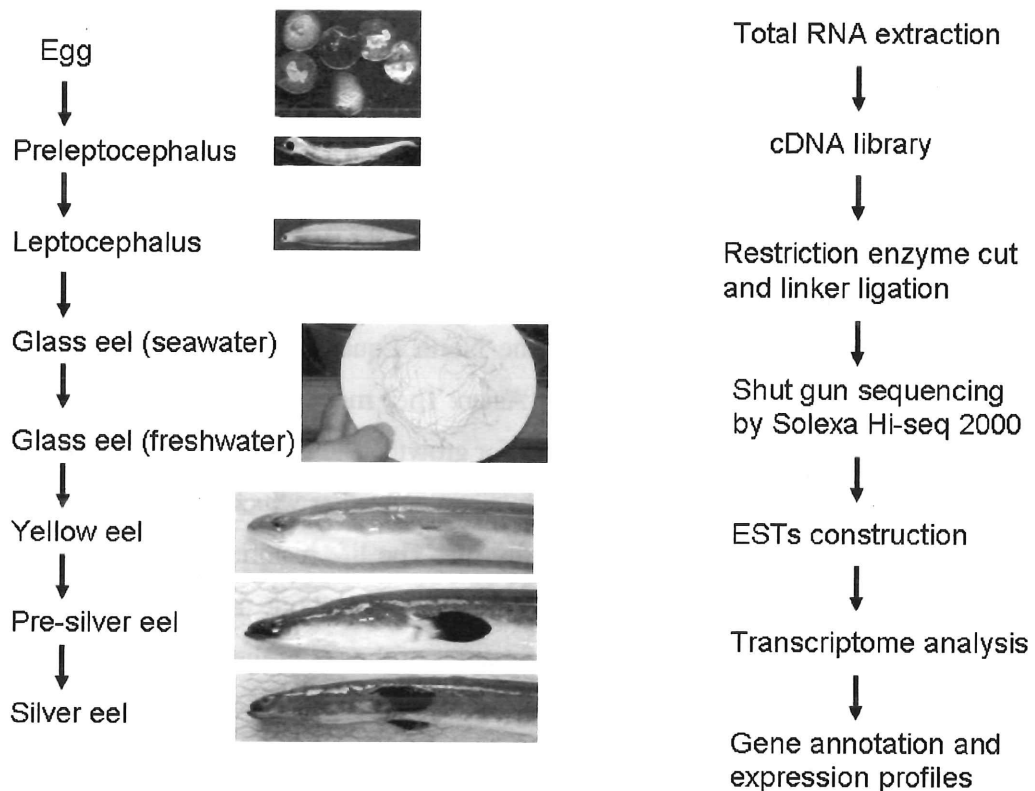
The Japanese eel (*Anguilla japonica*) is a temperate catadromous fish. Mature eels spawn west of Mariana Island near 12°–16° N, 141–142° E. After hatching, the larvae (leptocephali) passively drift from the spawning sites on the North Equatorial Current (NEC) and the Kuroshio for 4–6 months before reaching East Asian. They metamorphose into glass eels and actively swim toward the nearby estuarine/river for growth. The eels live in rivers or estuaries for at least 4 years before metamorphosing into silver eels, after which they migrate back to their marine birthplace to spawn and eventually die. The life histories of the Japanese eel include many unique life stages. However, little is known about the developmental and acclimate mechanism during the stage transformation of the eel in the whole genome scale. Thus, this study aims to establish the eel EST bank and analyze the gene expression profiles among each developmental stage.

## 3. Strategy:

1. Sample collection: Most important life stages of the Japanese eel, including developing embryo (n=10), preleptocephalus (n=5), leptocephalus (n=3), glass eel in the seawater and freshwater, yellow eel, pre-silver eel, and silver eel (Fig. 1) were collected in the wild. Samples were stored at RNA later solution immediately when caught for total RNA extraction.
2. ESTs constructions: For embryo, preleptocephalus and leptocephalus, whole body was used for total RNA extraction. For glass eel and thereafter, some target organs, such as brain, pituitary, gonad, and liver are taken for total RNA extraction using a commercial RNA purification and extraction kit. Total RNA was then used to prepare cDNA library. After restriction enzyme treatment, linker ligation, and PCR amplification, Solexa Hi-seq

2000 was used for shut gun sequencing. ESTs gene bank was established after assembling and annotation (Fig.1).

3. Transcriptome analysis: The gene expression profiles among stages, such as preleptocephalus and leptocephalus, leptocephalus and glass eel (metamorphosis), glass eel in seawater and freshwater (habitat acclimation), yellow to silver eels (onset of puberty), will be compared to identify potentially important genes involved in these transformation.



**Figure 1.** Stage used for transcriptome analysis and experiment flowchart

## **Studies on Bacterial Degradation Process of Marine Snow for Developing New Diet for Eel *Leptocephalus***

Yoshiaki Yamada and Akihiro Okamura

*IRAGO Institute Co., ltd.*

In 2002, Tanaka et al (2003) succeeded to produce glass eels by feeding shark egg based diet. Recent progress in developing rearing systems and some nutritional refinements of the diet have improved the growth rate of leptocephali to 0.2 to 0.3 mm TL/day, but these rates were apparently lower than those found in wild larvae (ca. 0.5 mm/day). These rates are far from the mass production of glass eels at a commercial level. Marine snow is considered to be natural food source for eel leptocephali (Otake et al., 1993).

Marine snow is suggested to be complex object composed by core-material (ie. fecal pellet or dead body of animal plankton), attached microorganism (ie. bacteria) and intermediate water existing among them. The intermediate water may contain much water soluble nutrients digested from core-material by extra-cellular enzymes excreted by attached bacteria. These water soluble nutrients are supposed to be suitable foods for eel leptocephali which have low digestion ability. However, the nutritional aspects of marine snow as fish diet have been rarely studied to date.

In this cruise, we conducted the cultivation experiment of marine snow on board to observe the bacterial degradation process in marine snow *in vitro*. We used particulate organic matter (POM) as a start material for bacterial degradation in this study. POM was collected onto GF/F glass filters by filtering the sea water collected at chlorophyll max layer (St. 15, 35, C20, 136, C21). The filters with POM were incubated in non-filtered sea water as culture media at 23°C for 0, 1, 2, 4 days and then stored at -20°C. After this cruise, we will analyze the chemical composition of digested nutrients in these culture media.

### **References**

- Otake T, K Nogami and Maruyama K (1993) Dissolved and particulate organic matter as possible food sources for eel leptocephali. *Mar. Eco. Prog. Ser.* **92**: 27-34
- Tanaka H, H Kagawa, H Ohta, T Unuma and K Nomura (2003) The first production of glass eel in captivity: fish reproductive physiology facilitates great progress in aquaculture. *Fish Physiol Biochem* **28**:493–497

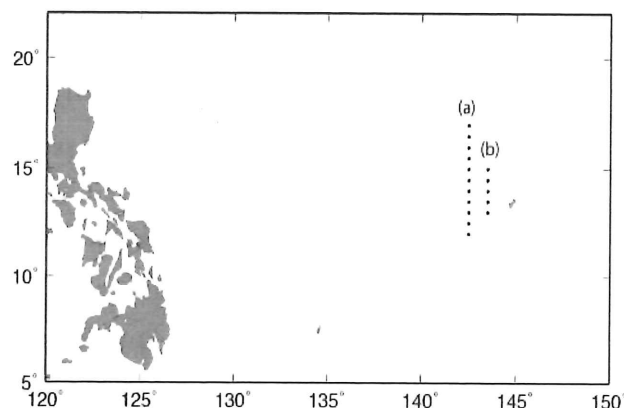
# Studies on Oceanic Conditions of Larval Transport of the Japanese eel in North Equatorial Current During the Hakuho Maru Cruise 2012 in the western North Pacific

Kei Zenimoto<sup>1</sup>, Diane Cambrillat<sup>2</sup> and Shingo Kimura<sup>2</sup>

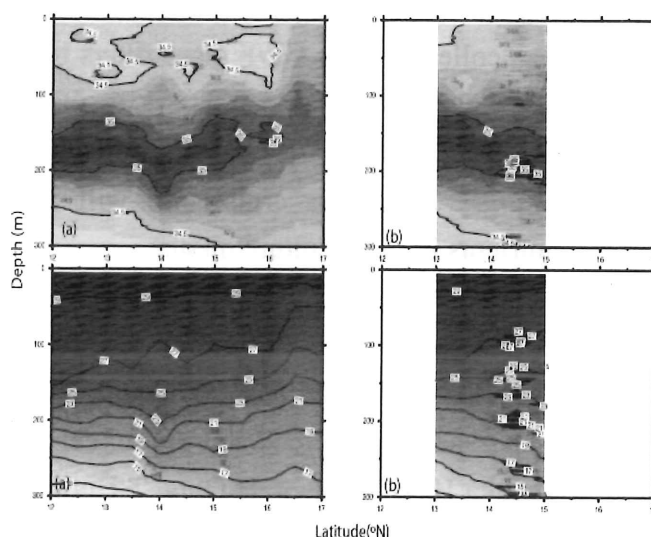
<sup>1</sup>Nagasaki University

<sup>2</sup>Atmosphere and Ocean Research Institute, The University of Tokyo

The spawning area of Japanese eel (*Anguilla japonica*) was identified in the North Equatorial Current (henceforth NEC) to the west of the Mariana Islands. Since small larvae of the species were collected at and on the south side of the salinity front, the front considered as a landmark for detection of the spawning area. In this cruise, the XCTD observation was carried out along 142.5 and 143.5°E to detect the salinity front latitude (Fig 1). The vertical temperature and salinity structures along the each line were investigated by using there data (Fig 2). At the surface of the southern area, low salinity water is formed by high precipitation. On the other hand, salinity in the northern area is higher than south. Therefore, north to south salinity front is formed (Fig 2). The salinity front was formed around 16°N and 13.5°N along 142.5°E and 143.5°E respectively (Fig 2). We will investigate correspondence relationship of position between physical structure and captured egg and pre leptocephali.



**Figure1.** Locations of CTD observation lines (a) 142.5, (b) 143.5°E.



**Figure 2.** Vertical profiles of the salinity (upper panels) and temperature (lower panels) along (a) 142.5 and (b) 143.5°E

## Leptocephali Collected During the KH-12-2 Sampling Survey

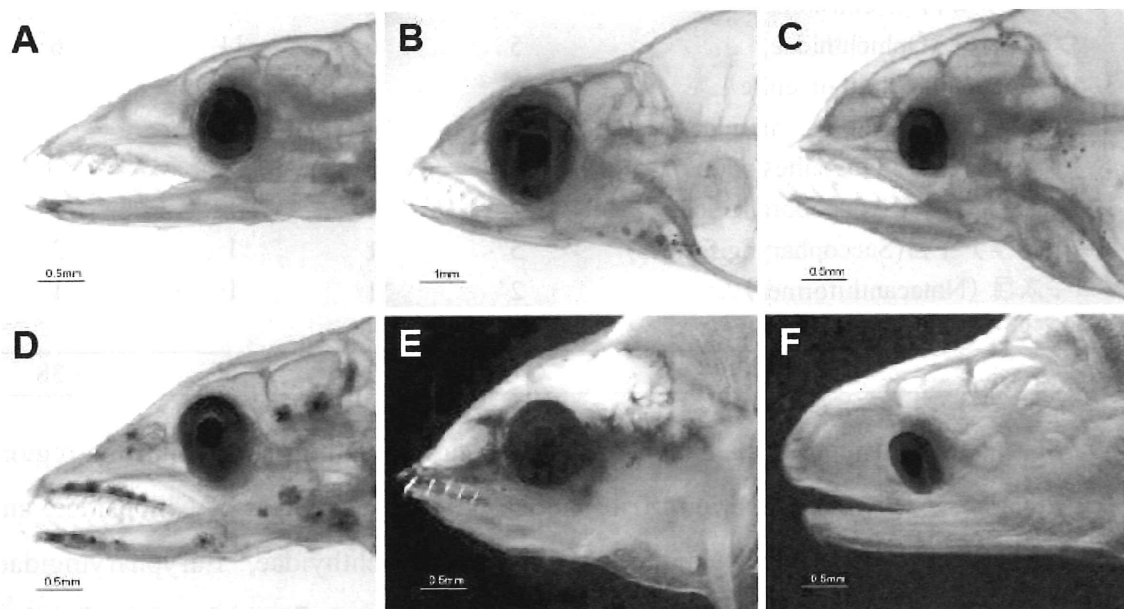
Michael J. Miller<sup>1</sup>, Seishi Hagihara<sup>1</sup>, Shun Watanabe<sup>1</sup>, Mari Kuroki<sup>2</sup> and Jun Aoyama<sup>1</sup>

<sup>1</sup>*Atmosphere and Ocean Research Institute, The University of Tokyo*

<sup>2</sup>*University Museum, The University of Tokyo*

A wide range of species of leptocephali were collected during the two legs of the KH-12-2 cruise that sampled along the West Mariana Ridge and in other areas to the south and near Palau from May to July 2011. Sampling was conducted using the large 3-m ORI-Big Fish (ORI-BF) net with 0.5 or 0.33 mm mesh and for leptocephali with an IKMT with 0.5 mm mesh during Leg. 1, mostly in more southern regions. The ORI-BF and IKMT nets were primarily fished in oblique tows in the upper 200 m.

During sampling along the West Mariana Ridge a wide variety of taxa of leptocephali with different head shapes (Fig. 1) and body shapes were among the 689 larvae and juveniles collected. The leptocephali included species from at least 11 families and 65 species of anguilliform eels and 1 species of notocanth larvae (Table 1).



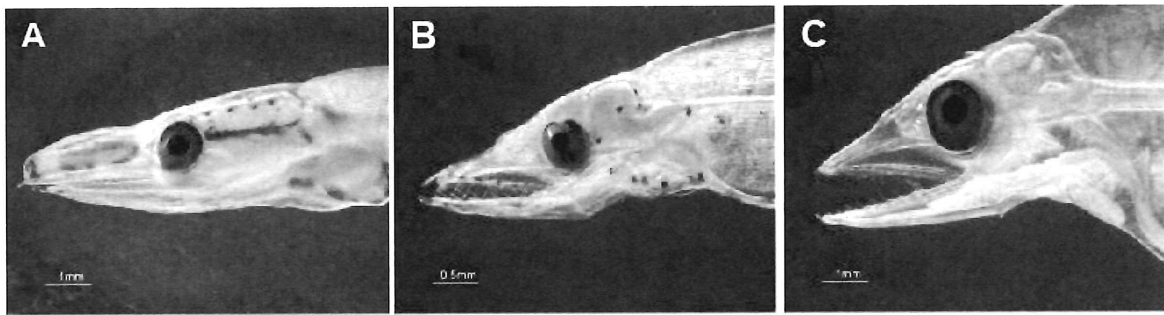
**Figure 1.** Photographs of Myrophinae (A), *Bathycongrus* (B), Muraenidae (C), *Heteroconger hassi* (D), Chlopsidae (E), and a metamorphic Muraenidae (F) from the KH-12-2 sampling survey.

**Table 1.** Catches of leptocephali and approximate number of species during KH-12-2 in May and June 2012 separated by type of net used and a comparison to the number of species collected in the KH-11-6 cruise in May to July 2011.

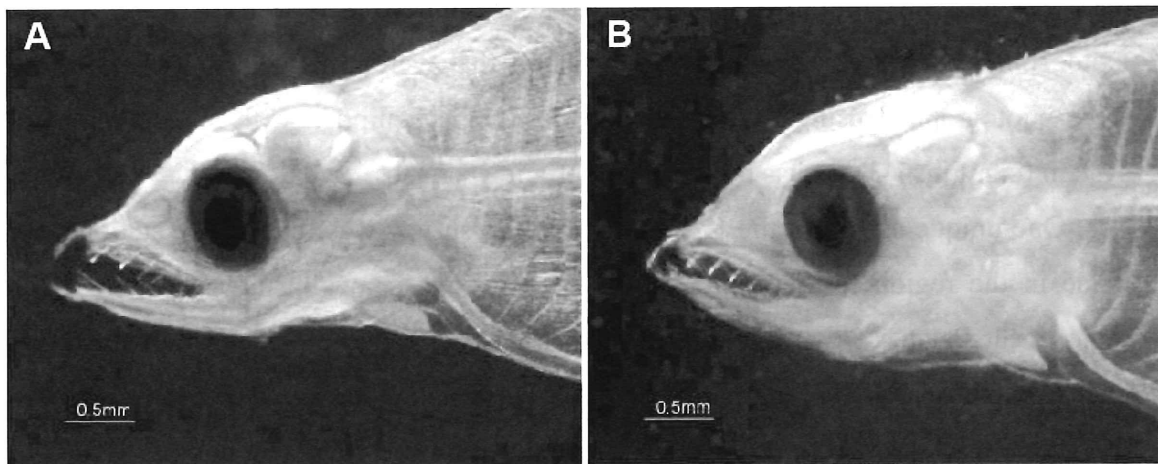
Taxa	KH-12-2 ORI-BF	KH-12-2 IKMT	Number of species	KH-11-6 No. of species
ウナギ目 (Anguilliformes)				
ウナギ科 (Anguillidae)				
<i>Anguilla japonica</i>	32	-	1	1
<i>Anguilla marmorata</i>	6	-	1	
<i>Anguilla bicolor pacifica</i>	1	6	1	
<i>Anguilla preleptocephali</i>	200	-		1
イワアナゴ科 (Chlopsidae)	10	12	7	5
アナゴ科 (Congridae)				
<i>Ariosoma</i> sp. 7	56	-	1	1
<i>Ariosoma</i> sp. 4	12	-	1	1
<i>Conger</i> sp.	7	1	2	-
Congridae spp.	8	13	15	3
ヘラアナゴ科 (Derichthyidae)	47	2	2	1
<i>Nessorhamphus</i> juvenile	-	1		1
ハリガネウミヘビ科 (Moringuidae)	-	-	-	
ウツボ科 (Muraenidae)	26	50	~14	~11
シギウナギ科 (Nemichthyidae)	40	22	2	1
<i>Nemichthid</i> juvenile	1	2		
クズアナゴ科 (Nettastomatidae)	5	1	3	1
ウミヘビ科 (Ophichthidae)	5	6	11	6
<i>Ophichthid</i> juvenile	2	-		
ノコバウナギ科 (Serrivomeridae)	18	54	1	1
Serrivomerid juveniles/adults	10	3	~1	~1
ホラアナゴ科 (Synphobranchidae)	-	1	1	
フウセンウナギ目 (Saccopharyngiformes)	5	1	1	3
ソコギス目 (Notacanthiformes)	2	1	1	1
所属不明 (Unidentified)	17	3		
	510	179	~66	~38

The collected leptocephali included the typically common species in this region, *Ariosoma* sp. 7 (*Ariosoma major*), *Ariosoma* sp. 4, various species of Chlopsidae, and Muraenidae, and the mesopelagic eel families Derichthyidae, Eurypharyngidae, Nemichthyidae and Serrivomeridae. As usual, *Ariosoma* sp. 7 was the most abundant species in the ORI-BF net collections, but instead of serrivomerid leptocephali being second most abundant like in some previous cruises, derichthyid leptocephali were





**Figure 2.** Photographs of a *Facciolella* of the Nettastomatidae (A, 112.3 mm), an unknown species of the Congridae that has never been collected during *Hakuho Maru* cruises (B, 27.7 mm) and a rare specimen of an *Ariosoma* sp. A4 leptocephalus (C, 134.0 mm) that were collected during the KH-12-2 cruise.



**Figure 3.** Photographs of the head regions of *Anguilla marmorata* (A, 23.7 mm No. 345, St. 68), and *Anguilla bicolor* (B, 29.8 mm, No. 503, St. 40) leptocephali collected during the KH-12-2 sampling survey.

abundant near the West Mariana Ridge (see Han et al., this report). Serrivomerid leptocephali were common further south in the IKMT stations, and various different species were collected near Palau.

In addition to the typical species collected in the North Equatorial Current region and the many *Anguilla japonica* preleptocephali that were collected in the ORI-BF sampling near the ridge, several rare or previously uncollected specimens were collected during the KH-12-2 sampling survey. A species of Congridae with a sharp snout (Fig.

2B) and lateral pigment scattered over the side of the body was collected, which had morphological characteristics that do not match with any previously encountered species of congrid taxa in the Indo-Pacific. By comparing to leptocephali from other zoogeographic regions and using DNA analysis, it will be interesting to explore the possible taxonomic identity of this rare leptocephalus. A large leptocephalus of a *Facciolella* of the Nettastomatidae was also collected (Fig. 2A), which is a genus that is rarely collected. An *Ariosoma* sp. A4 leptocephalus with one row of myoseptal pigment and an exterillium gut was collected, which rarely is caught as well.

There were also 3 species of *Anguilla* were collected that included both *A. japonica* (see Miller et al. This report) and the two tropical anguillid species *A. marmorata* and *A. bicolor pacifica* (see Kuroki This report). The larvae of *A. bicolor pacifica* seemed to have a slightly different head shape with a larger forehead as is seen in Fig. 3. Various leptocephali such as the anguillid leptocephali that were collected in good condition were photographed using the dissecting microscope equipped with a digital imaging system (e.g. Fig. 1-3), as has been done in previous cruises.

One unique aspect of the KH-12-2 sampling survey was that IKMT stations were made in the region further south of the Japanese eel spawning area and also in the region near Palau. This sampling resulted in a wider range of species being collected than in typical ORI-BF sampling near the West Mariana Ridge. For example, during this cruise a total of about 66 species of leptocephali were collected, compared to about 38 in KH-11-6 that mostly sampled near the ridge. Some of the same IKMT stations sampled during KH-12-2 will also be sampled in 2013 when a much wider survey of the western Pacific will be conducted, which will provide valuable information about the zoogeography of leptocephali, their seasonal occurrence, and the locations of anguillid spawning areas.

## Species Composition and Larval Growth Rates of Leptocephali of the Genus *Conger* (Family Congridae)

Hiroyuki Kusune<sup>1</sup>, Michael J. Miller<sup>2</sup>, Tatsuki Yoshinaga<sup>3</sup>, Jun Aoyama<sup>2</sup>  
Noritaka Mochioka<sup>1</sup> and Katsumi Tsukamoto<sup>2</sup>

<sup>1</sup>*Faculty of Agriculture, Kyushu University*

<sup>2</sup>*Atmosphere and Ocean Research Institute, The University of Tokyo*

<sup>3</sup>*School of Marine Biosciences, Kitasato University*

A collaborative study on the species composition and early life history of the leptocephali of the genus *Conger* will be conducted between members of the cruise. A total of 10 specimens of *Conger* leptocephali (Figure 1) were obtained during KH-12-2 (Table 1). This research will focus on the morphology and species identity of *Conger* leptocephali in the western North Pacific using both morphological and molecular genetic techniques, because the characteristics of these larvae are not yet known, and therefore they cannot be identified using only morphological features. In addition, there is some uncertainty about the adult species composition and where these various conger eels are distributed in the region.

The larval growth rates can also be examined using otolith microstructure to know how fast the leptocephali of each species grow in the ocean. The growth rates of *Conger* leptocephali have only been studied after the larvae have reached coastal areas and their growth would have slowed down, so the open ocean growth rates of this genus of leptocephali have not been studied yet using otolith microstructure.

Studies on the of *Conger* leptocephali are needed also to help to understand the oceanic early life history of *Conger myriaster*, an important commercial fisheries species.

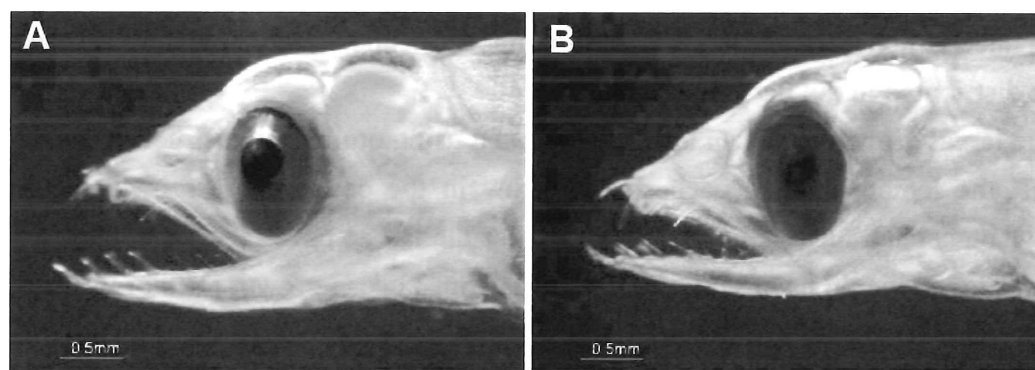
This species has recently been discovered to spawn in an offshore area in the western North Pacific by collecting preleptocephali (Miller et al. 2011) and also catching them at a second location (Kurogi et al. 2012). The location of this spawning area is northwest of where the Japanese eel, *Anguilla japonica* spawns (Tsukamoto et al. 2011). Because it is now known that *Conger myriaster* spawns offshore, it is essential to study its larval distribution patterns and to understand its spawning and larval recruitment strategy.

Almost nothing is known about the early life history of other *Conger* species in the region either, so this study can begin to provide information about *Conger myriaster*

and other species in the region by genetically identifying the larvae, and by searching for morphological characters to separate the different species of leptocephali.

**Table 1.** Specimen numbers, collection dates and stations and the morphometric data of the *Conger* leptocephali that were collected during KH-12-2.

No.	Date	St.	TL	TM	PDL	PDM	PAL	PAM	LVBV
23	2012.5.19	8-2	52	151	-	-	47.8	125	54
42	2012.5.19	8-9	33.5	143	25.7	74	31.6	120	52
61	2012.5.19	8-11	44.9	146	29.6	71	41.8	124	54
77	2012.5.20	8-13	27.1	~140	-	-	25.5	108	45
107	2012.5.21	15	35	144	22	65	32.3	120	51
196	2012.5.21	20	23.5	152	17	64	22.3	113	53
285	2012.5.23	34	18.7	141	12	58	17.3	110	55
373	2012.5.28	43	17	171+	12.6?	51?	15.7	129	57
395	2012.5.30	47	50	139	37.6	75	46.7	115	55
506	2012.6.11	71	37.8	145	23.8?	68?	34.4	120	54



**Figure 1.** The head regions of specimens No. 61 (44.9 mm) and No. 506 (37.8 mm) that appear to be the same species of *Conger*.

## References

- Kurogi H, N Mochioka, M Okazaki, M Takahashi, M J. Miller, K Tsukamoto, D Ambe, S Katayama and S Chow (2012) Discovery of a spawning area of the common Japanese conger *Conger myriaster* along the Kyushu-Palau Ridge in the western North Pacific. *Fish Sci* 3:525-532
- Miller M. J, T Yoshinaga, J Aoyama, T Otake, N Mochioka, H Kurogi and K Tsukamoto (2011) Offshore spawning of *Conger myriaster* in the western North Pacific: evidence of convergent migration strategies of anguilliform eels in the Atlantic and

Pacific. *Naturwissenschaften* 98: 537–543.

Tsukamoto K, S Chow, T Otake, H Kurogi, N Mochioka, M J. Miller, J Aoyama, S Kimura, S Watanabe, T Yoshinaga, A Shinoda, M Kuroki, M Oya, T Watanabe, K Hata, S Ijiri, Y Kazeto, K Nomura and H Tanaka (2011) Oceanic spawning ecology of freshwater eels in the western North Pacific. *Nature Communications* 2:170

# Early Life History Study of the Open-ocean Longneck Eels of the Family Derichthyidae collected in the western North Pacific

Yu-San Han<sup>1</sup> Michael J. Miller<sup>2</sup> and Katsumi Tsukamoto<sup>2</sup>

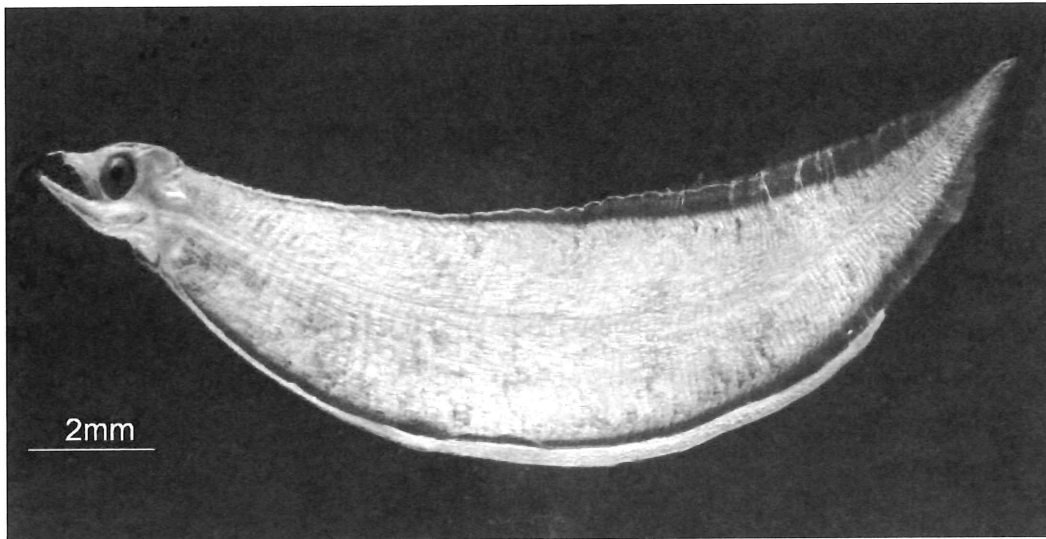
<sup>1</sup>*Institute of Fisheries Science, National Taiwan University*

<sup>2</sup>*Atmosphere and Ocean Research Institute, The University of Tokyo*

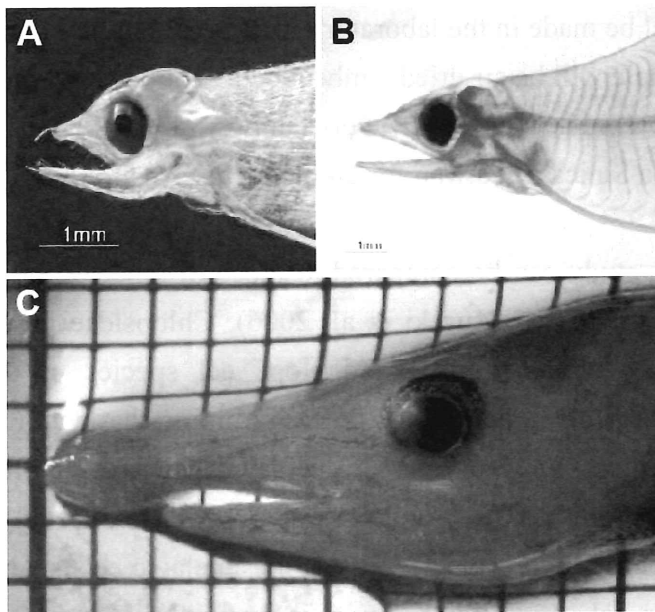
A collaborative study on the early life history of the leptocephali of the family Derichthyidae will be conducted between members of the cruise from AORI and the Institute of Fisheries Science of the National Taiwan University using specimens from the KH-12-2 cruise. The research will focus on determining the larval growth rates and estimating the duration of the leptocephalus stage of these eels. The longneck eels of the Derichthyidae are distributed worldwide and they live pelagically in the open ocean in the upper mesopelagic layers as juveniles and adults. The family includes 2 genera and 3 species that appear to be very widely distributed cosmopolitan species in the world's oceans. Their actual larval growth rates and leptocephalus duration, or if there are life history differences between the two genera of *Derichthys* (1 species) and *Nessorhamphus* (2 species) are not yet known. Thus, it is needed to clarify these issues for a better understanding eels. About 49 leptocephali were collected during KH-12-2 that will be used in this study (Table 1).

Total length range (mm)	Number of specimens	Species
<12	4	<i>Derichthys</i>
10-20	14	<i>Derichthys</i>
20-30	6	<i>Derichthys</i>
30-40	4	<i>Derichthys</i>
40-50	4	<i>Derichthys</i>
>50	3	<i>Derichthys</i>
12	1	<i>Nessorhamphus</i>
14.3	1	<i>Nessorhamphus</i>
38.5	1	<i>Nessorhamphus</i>
46.5	1	<i>Nessorhamphus</i>
48	1	<i>Nessorhamphus</i>
104	1	<i>Nessorhamphus</i>
2006.4.17	8	Derichthyidae,

**Table 1.** List of the specimens and sizes of the Derichthyidae leptocephali and one juvenile that were collected during the KH-12-2 cruise.



**Figure 1.** Photograph of a 20 mm leptocephalus of *Derichthys serpentinus* (No. 680) collected at St. 159 on 23 June 2012 during the KH-12-2 cruise. The leptocephali of this genus often have a curved body shape after they have been collected and are no longer living. When alive, their body shape is not curved like it appears in this photograph.



**Figure 2.** Photographs of the head regions of the *Derichthys serpentinus* leptocephalus shown in Figure 1 (A), a *Nessorhamphus* leptocephalus (B, No. 583, 38.5 mm) and a *Nessorhamphus* juvenile (C, No. 292, 104 mm).

The two genera of leptocephali have slightly different body shapes (see Miller and Tsukamoto 2004), with *Derichthys serpentinus* often being more short and curved after capture (Figure 1) and *Nessorhamphus* being more long and thinner in appearance with only the tail tip curving upward. Their head shapes also appear to be somewhat



different with NS being longer and more pointed (Figure 2). However, little is known about their early life history except for a study on the distribution, size and morphological changes during metamorphosis in the North Atlantic (Castle 1970). This study will use several approaches to learning about the early life history of the Derichthyidae that are outlined below.

**Research strategy:**

1. Morphometric measurements were made during KH-12-2: The total, predorsal, and preanal lengths, and numbers of total, preanal, predorsal, and last vertical blood vessel myomeres were measured, and the samples preserved in 99% ethanol.
2. Molecular genetic species identification will be conducted in the laboratory in Taiwan: Genomic DNA of specimens will be extracted from a small piece of muscle tissue using a commercial DNA purification and extraction kit. DNA will be stored at  $-20^{\circ}\text{C}$  before PCR analysis. Primers designed for cytochrome b with high conservation sequences will be used for PCR and sequencing.
3. Otolith increment counts will be made in the laboratory in Taiwan: Sagittal otoliths taken from each sample will be air dried, embedded in Epofix resin, and ground and polished until the core is exposed. After etching with 0.5N HCl, they will be sent to Academia Sinica in Taiwan for taking pictures with SEM.

The larval growth rates of this study can be compared to those of other different species of leptocephali such as anguillid (e.g. Kuroki et al. 2006), Chlopsidae in the Indonesian Seas (Lee et al. 2008), or outer shelf and slope eel species of the Nettastomatidae and Synphobranchidae (Ma et al. 2005). Determining the length of the larval duration of Derichthyidae leptocephali can be evaluated using the otolith microstructure of the juvenile collected in KH-12-2, and possibly juveniles collected in previous cruises. It should also be possible to evaluate if these mesopelagic eels spawn using a lunar cycle. The Japanese eel, *Anguilla japonica*, is known to spawn only during new moon periods based on otolith analyses of their leptocephali and catches of their eggs and preleptocephali (Ishikawa et al. 2001; Tsukamoto et al. 2003, 2011). However, the chlopsid eel, *Kaupichthys*, was found to spawn during full moon (Lee et al. 2008). Examining derichthyid leptocephali for possible lunar spawning in the open ocean will be an interesting part of this collaborative study.

## References

- Castle P. H. J (1970) Distribution, larval growth, and metamorphosis of the eel *Derichthys serpentinus* Gill, 1884 (Pisces, Derichthyidae). *Copeia* 1970: 444-452
- Ishikawa S, K Suzuki, T Inagaki, S. Watanabe, Y. Kimura, A Okamura, T. Otake, N. Mochioka, Y Suzuki, H Hasumoto, M Oya, M J. Miller, T W Lee, H Fricke, and K Tsukamoto (2001) Spawning time and place of the Japanese eel, *Anguilla japonica*, in the North Equatorial Current of the western North Pacific Ocean. *Fish Sci* 67: 1097–1103
- Kuroki M, J Aoyama, M J. Miller, S Wouthuyzen, T Arai and K Tsukamoto (2006) Contrasting patterns of growth and migration of tropical anguillid leptocephali in the western Pacific and Indonesian Seas. *Mar Ecol Prog Ser* 309: 233–246
- Ma T, M J. Miller, A Shinoda, G Minagawa, J Aoyama and K Tsukamoto (2005) Age and growth of *Saurenchelys* (Nettastomatidae) and *Dysomma* (Synphobranchidae) leptocephali in the East China Sea. *J Fish Biol* 67: 1619–1630
- Miller M. J and K. Tsukamoto. 2004. An introduction to leptocephali: Biology and identification. Ocean Research Institute, University of Tokyo, 96 pages
- Tsukamoto K, T Otake, N Mochioka, T W Lee, H Fricke, T Inagaki, J Aoyama, S Ishikawa, S Kimura, M J Miller, H Hasumoto, M Oya, and Y Suzuki (2003) Seamounts, new moon and eel spawning: the search for the spawning site of the Japanese eel. *Environ Biol Fish* 66: 221-229
- Tsukamoto K, S Chow, T Otake, H Kurogi, N Mochioka, M J. Miller, J Aoyama, S Kimura, S Watanabe, T Yoshinaga, A Shinoda, M Kuroki, M Oya, T Watanabe, K Hata, S Ijiri, Y Kazeto, K Nomura and H Tanaka (2011) Oceanic spawning ecology of freshwater eels in the western North Pacific. *Nature Comm* 2:170

# Detection of Defense Factors acting in Innate immunity of an Anguilliformes Leptocephalus larvae, *Ariosoma* sp. collected in the western North Pacific 2012

Shigeyuki Tsutsui

*School of Marine Biosciences, Kitasato University*

Immune mechanism is largely classified into two systems, namely innate immunity and adaptive immunity. The former is non-specific defense mechanism in which phagocytes and many soluble molecules, such as complements, lectins and anti-microbial peptides, play key roles. On the other hand, the latter, represented by antibody, T cells and B cells, is highly specific system. Although fish is the most primitive animal that possesses both immune systems, it is generally accepted that adaptive immune system is not well developed in fish larvae.

Little is known about innate defense factors in Anguilliformes larvae. Only study about that is Suzuki and Otake (2000); they demonstrated that a lectin, which is defined as carbohydrate-binding protein and so often binds to sugar chain on the surface of pathogens, is included in the club cells of epidermis in Japanese eel larvae.

Relatively large leptocephali of *Ariosoma* sp. are often captured in net sampling. In this cruise, 12 leptocephali of *Ariosoma* sp. were collected by oblique or step tows of an ORI-Big Fish (3m diameter) towed at the sea surface with 0.5 mm mesh (Table 1). In order to understand innate immune system of Anguilliformes leptocephali, bioactive activities against infection, such as anti-bacterial, lysozyme and lectin activities, will be analyzed with whole larvae extract or extract of skin that is first defense line for them.

Table 1 Catch of *Ariosoma* leptocephali during KH-12-2.

No.	Date	Station	TL(mm)
10	18-May	7	160.8
11	18-May	8	181.3
16	18-May	9	124
37	19-May	8-8	100
84	20-May	12	160
99	21-May	15	125
100	21-May	15	145
101	21-May	15	123.4
102	21-May	15	114
103	21-May	15	103
104	21-May	15	115
105	21-May	15	121

## Reference

Suzuki Y and Otake T (2000) Skin lectin and the lymphoid tissues in the leptocephalus larvae of the Japanese eel *Anguilla japonica*. Fish Sci 66:636–43

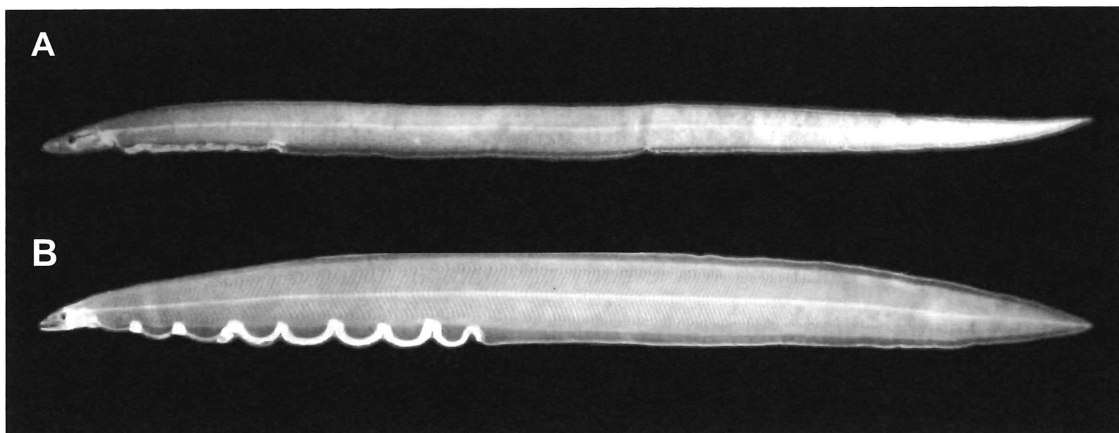
# Progress Report on Whole-Body Photography of Leptocephali during KH-12-2

Michael J. Miller

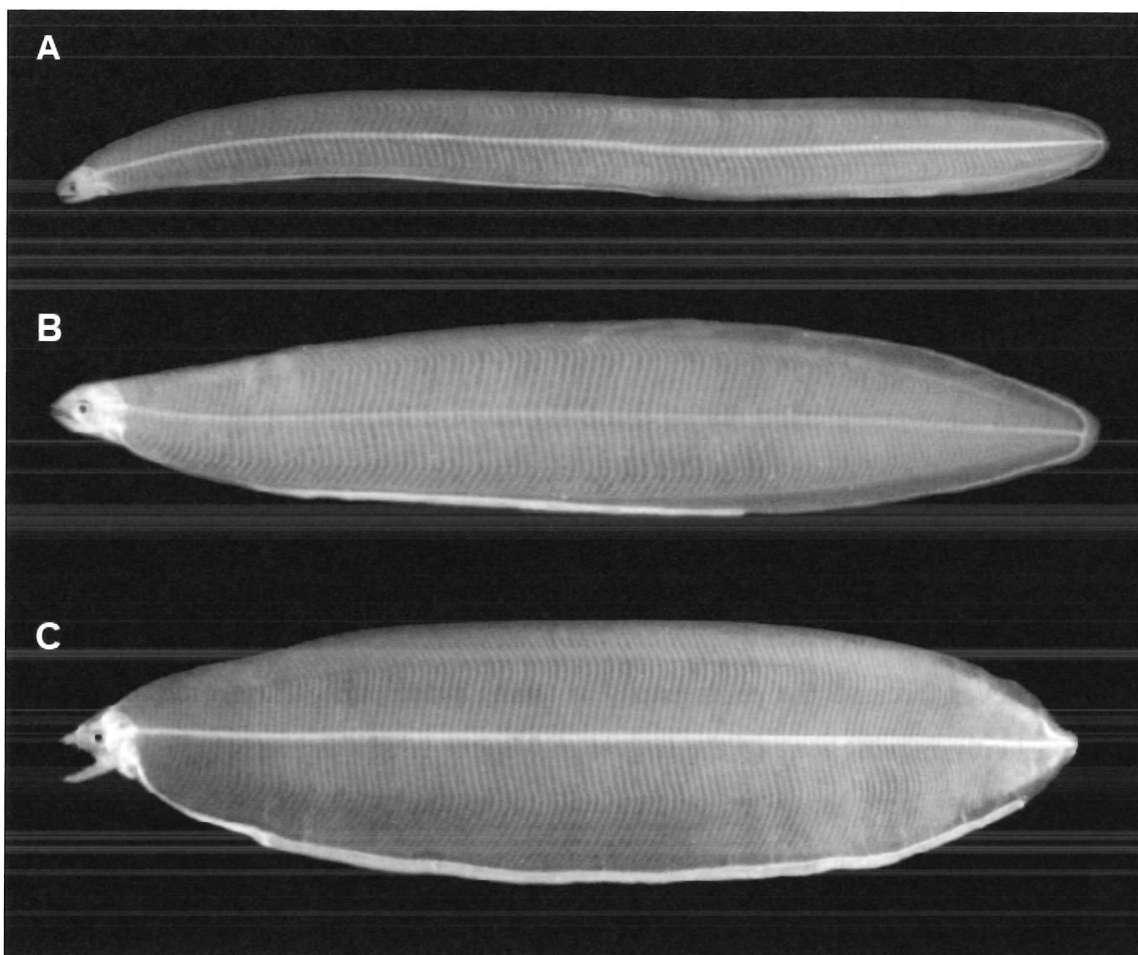
*Atmosphere and Ocean Research Institute, The University of Tokyo*

It has been an ongoing effort during sampling surveys for leptocephali to obtain whole body photographs of these unusually large size larvae. Normal fish larvae are typically small enough that they can be photographed using dissecting microscopes equipped with cameras, but leptocephali are too large for that method. Therefore, a professional digital camera on a copy stand approach has been used.

However, because the photography is taking place onboard research vessels that are constantly moving, one of the largest challenges is that the leptocephali cannot be immersed completely in water, or they will move too much, so too many reflections appear. Another major problem is the formation of small bubble apparently due to the leptocephali being transferred from the chilled seawater onto a warmer glass surface, causing bubbles to form as the seawater around the larva as it warms up.

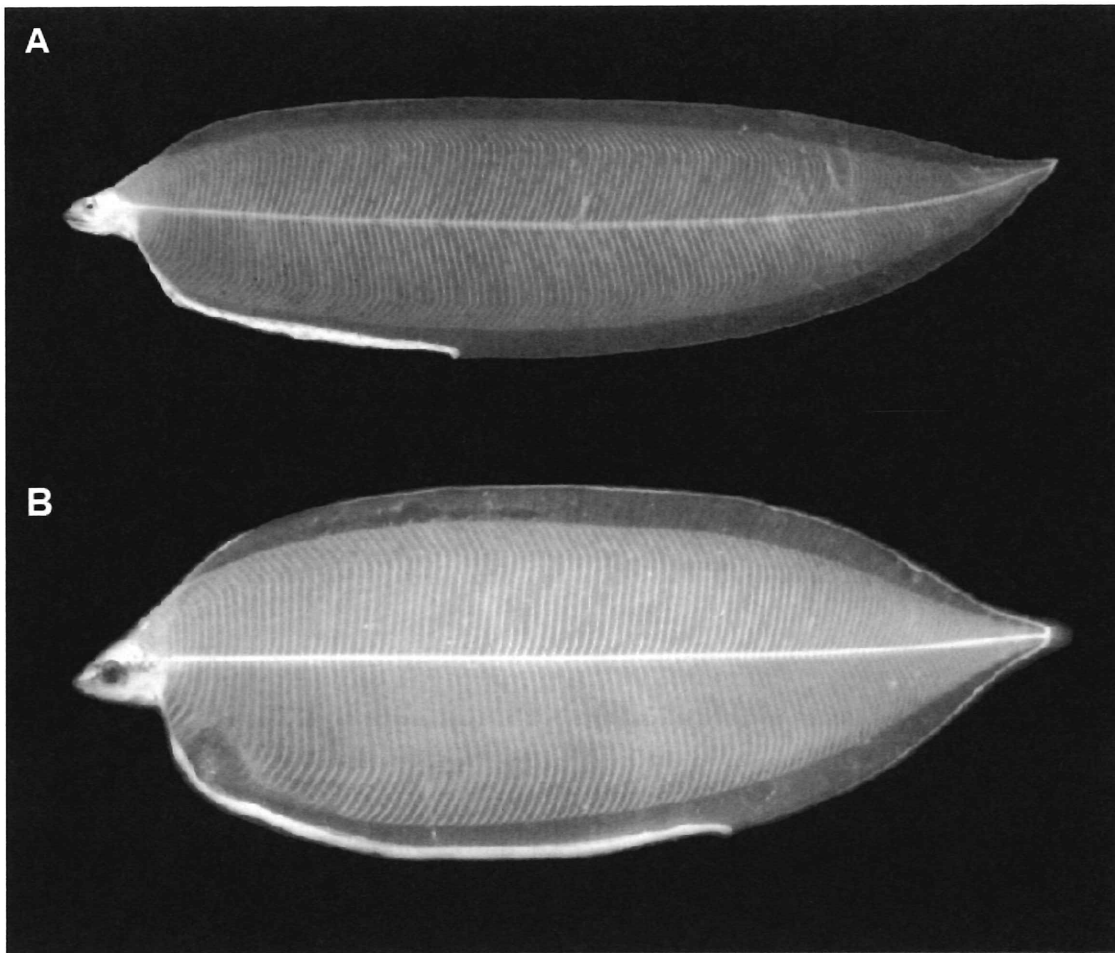


**Figure 1.** Whole body photographs of a leptocephalus of *Facceolela* of the family Nettastomatidae (A, 112.3 mm), which is a very rare type of leptocephalus, and a Myrophinae (Ophichthidae) leptocephalus with very high gut loops (B, 92.6 mm) that were collected during the KH-12-2 sampling survey.



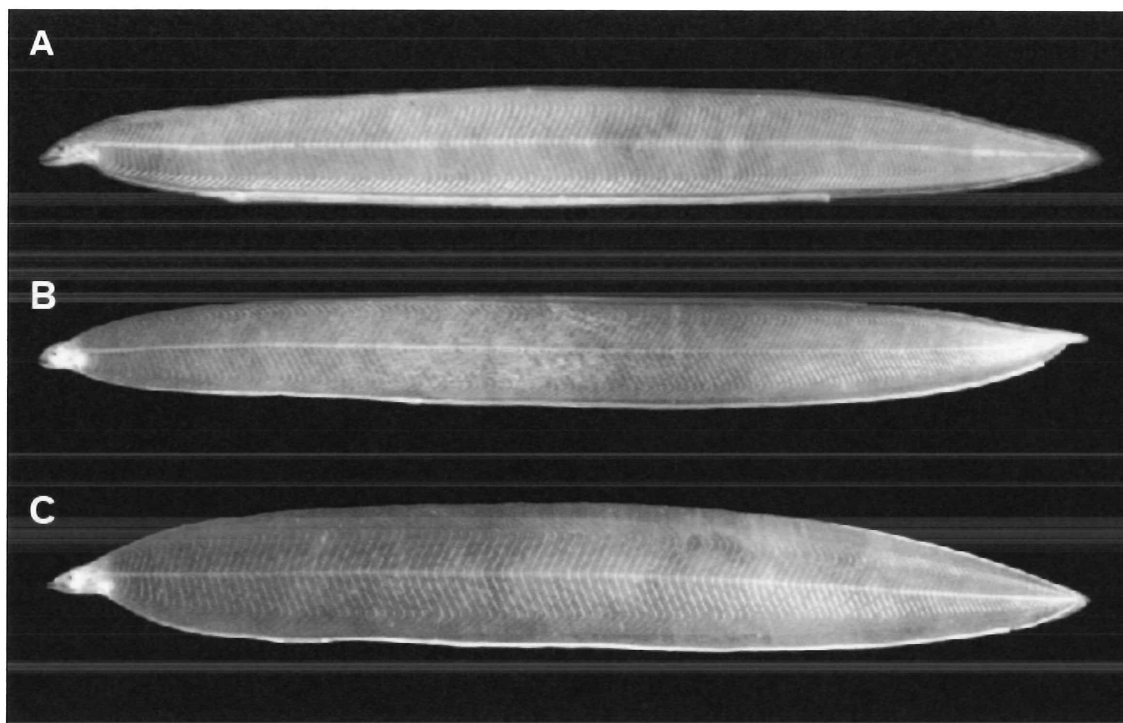
**Figure 2.** Whole body photographs of 3 species of Muraenidae leptocephali including a rare long-thin bodied species with spots all over the body (A, 76.8 mm), a more typical body shaped muraenid larva (B, 42.0 mm), and a *Channomuraena* type leptocephalus with a deep body and long gut (C, 40.3 mm).

The new method of obtaining whole-body photographs using a Nikon D-7000 digital SLR camera with a Nikon 60 mm macro-type lens for medium size leptocephali and a normal 35 mm lens with a macro filter for larger sizes is succeeding to obtain publishable whole body photographs as seen in Figures 1-4. However, for this method to be highly efficient during busy sampling surveys when many leptocephali are collected at a single station and need to be photographed, improvements need to be made. One improvement is an elevated clear plastic tray placed on top of a plastic box, which was used during KH-12-2 that enables more different lighting angles to be used.



**Figure 3.** Whole body photographs of *Chlopsidae* sp. 7 (A, 79.6 mm) with patches of pigment scattered all over the body, and an undescribed species of *Chlopsidae* with dense head pigment (B, 40.7 mm). No chlopsid species that have been described in the Indo-Pacific have this dense head pigment.

The biggest problem to be solved is to find a way to stabilize the larvae while immersed in seawater while being photographed so there are no reflections. One way to solve this will be to fix 2 or 3 tiny pin heads, cut from the tips of insect pins onto the surface of a plastic tray. The leptocephalus would then be pressed into the pins to hold the larva stable on the bottom of the tray, while immersed in seawater. This method can be tried in future surveys for leptocephali. Also placing the leptocephali in room-temperature seawater before placing them in the tray for being photographed, may help



**Figure 4.** Whole body photographs of three species of Congridae leptocephali that are *Heteroconger hassi* (A, Heterocongrinae, 79.4 mm), which is a species of garden eel, *Bathycongrus* (B, 151.2 mm), and a deep-bodied *Gnathophis*-type (C, 108.5 mm) with a sharp snout. The *Heteroconger* leptocephalus has spots all over its body, which can be seen in the photograph.

eliminate the creation of tiny bubbles, which often cannot be seen until zooming into the images that are taken with the camera, thus slowing down the process for cleaning out the bubbles.



# **Study on Leptocephali with Low number of Vertebrae, less than 90, in relation with Larval Fish Fauna of Epipelagic zone**

Hitoshi Ida

*School of Marine Biosciences, Kitasato University*

## **1. Background**

Recently the most primitive eel was described by the present author (Johnson, Ida et al 2012. Publ. Roy. Soc. Biol.) from an underwater cave located a western fringing reef of Koror, Palau. The species is characterized by fewest count for vertebrae, less than 90 in number; semi-independent caudal fin; and flattened body. Leptocephali of the species will be expected to appear the survey area of the Cruise KH-12-2. Because of the primitive characters in morphology of the adult, leptocephali of the species will show some special outer morphology and will show some clues for phylogeny of the order. The present study aims to get leptocephali of the species with special interest of phylogeny of the order Anguilliformes. And also from the ecological view point, their mode of appearance will be checked in relation with usual larval fish.

## **2. Materials and Methods**

Net samples of ORI net towed obliquely from 200m deep 40 times, and those of IKMT towed 10 times were analyzed. Larval fishes were removed from plankton sample and then preserved in formalin solution. Photos were taken for most species. Samples were identified to species as far as possible. Larvae were categorized as pelagic, mesopelagic, and coastal fishes.

## **3. Results**

Leptocephalus with lower number of vertebrae less than 90 was not collected in the present survey. The number of larval fish collected exceed more than 337 individuals (up to tow number 42) in total. Number of fish species was 60(+α), belonging more than 30 families. Out of which several larval forms seemed to be not recorded. From the habitat of adult, 51% (31 species) were occupied by mesopelagic, 26% (16 spp) were represented by coastal, 12% (7 spp) were demersal, and 11% (6 spp) were epipelagic. Details can be seen in the additional files on this report.

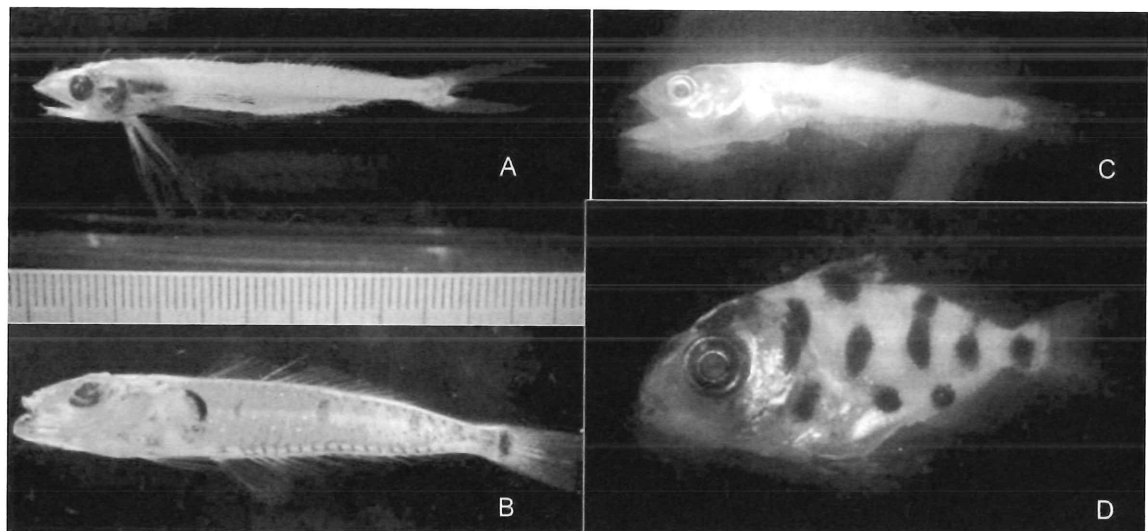
#### 4. Discussion and further perspectives

Leptocephalus of the most primitive species, *Protanguilla palau*, of the order Anguilliformes was not collected by present survey. Most plausible area of the appearance of the species is western waters of Palau. As the present survey was focused on the waters around seamounts, Pathfinder, Arakane, and Suruga, north of Challenger Deep, for *Anguilla japonica*, possibility of appearance of *Protanguilla palau* was low. Further survey on the waters west off of Palau is needed.

As mentioned in results, species found in epipelagic habitat of the present survey, were consisted more than half of mesopelagic and the epipelagic species and the rest near half was consisted of coastal and demersal species. Thus off shore area seems to be playing as a nursery ground for the coastal and benthic species. More detailed role of the off shore area for coastal fish is needed.

#### 5. Acknowledgment

I would like to express my deep thanks to Professor Katsumi Tukamoto and other membes of his lab., offering the opportunity for this study.



**Figure 1.** Fish species yet to be described (A and B) and species at rarely known stages (C and D). A: Chiasmodontidae sp. Genus is not known. Seems yet to be described. B: Percophidae sp. Genus is not known, seems yet to be described. C: Bembropidae sp. Scrutiny is needed. D: *Psenes cyanophrys*. Color pattern is no known at this stage.

# **Fauna of Fish Larvae and Zooplankton around the west Mariana ridge collected in the western North Pacific**

Tatsuki Yoshinaga

*School of Marine Biosciences, Kitasato University*

Distributions of fish larvae and zooplankton have been studied in the western Northern Pacific. These organisms show vertical migration with diurnal cycle for forage and predator avoidance. In addition to the horizontal distribution, vertical transition is also important to characterize the fauna in a certain region.

A large number of eggs and pre-leptocephalus of the Japanese eel *Anguilla japonica* have been collected around the west Mariana ridge since 2009, including the KH-12-2 cruise. Their vertical distribution was found to be the water depth around 150-170 m, as being the most abundant layer of the eggs and pre-leptocephalus. Accordingly, characterizing the layer will be of great interest to understand not only for the early dispersal process of *A. japonica*, but also for estimating the extent of mortality at very young period.

Among various taxa of organisms inhabit in the ocean, zooplanktons including Cnidaria, crustacean, and some vertebrates play a critical role in the ecosystem. Especially, Copepoda is important because they are feed by adult fish, but also compete the food resources with fish larvae. Further some large and carnivorous zooplankton species such as Cnidaria and Chaetognatha may feed on the pre-leptocephalus. Accordingly, examining the co-existing organisms with the *A. japonica* will be important to understand the eel's very early life history.

The aim of this study is thus to understand the biotic and abiotic environments around west Mariana ridge at high resolution, and for this I have focused on the micro-scale analysis of fauna and its relation to the oceanic physical condition such as the salinity front. Plankton samples collected during the KH-12-2 cruise will be analyzed, which are the present and absent stations of *A. japonica* eggs. The analysis will be performed as follows. The fish specimens are sorted out, and identified at species/genus level. Subsequently, species composition of zooplankton and their abundance are determined, and then distribution pattern of each taxa will be analyzed. The analysis will especially focused on certain species such as copepoda which appears dominantly in this region, and Appendicularia and some carnivorous species as a potential food source or predator of the pre-leptocephalus, respectively.

# **Species Composition and Early Life History of the Oceanic Sunfish collected in the western North Pacific During the Hakuho Maru Cruise 2012**

Tatsuki Yoshinaga

*School of Marine Biosciences, Kitasato University*

The dispersal pattern at early life stages, larval period, is important to understand the spawning ecology and geographical distribution of fish. The fish larvae appearing in the western Northern Pacific can be divided into two types by the place where the spawning occurs: ones are those spawn in the open ocean, and the others are at coastal or shelf waters, and then transported to the open ocean. Both types of larvae can be collected simultaneously, but the spawning ecology of adults is quite different each other. Accordingly, the comparative approach of these two types of spawning will be of great interest to understand the diverse reproductive strategy of fish.

The western Northern Pacific is utilized for spawning by numerous fish species, including commercially important one such as the Japanese eel *Anguilla japonica* and Big-eye tuna *Thunnus albacares*. Information about the distribution and dispersal pattern of these fish is, however, very limited due to the difficulty of sampling survey in the open ocean. During the KH-12-2 cruise, various body sizes of the oceanic sunfish (Molidae) larvae were collected ( $n = 232$ ). Interestingly, 219 specimens were observed in the leg 1 (31 stations) while only 13 in the leg 2 (11 stations). The species composition and distribution will be interesting due to their limited occurrence in both spatial and special scale. Accordingly, the study aims to clarify the (1) species composition of the oceanic sunfish in the western North Pacific, and (2) distribution of each species in relation to the current and moon phase. Further, I will estimate the number of mothers by genetic analysis to know the larvae with various body sizes were from single or multiple spawners. Combining the results from these analyses, I will attempt to understand the spawning ecology of the oceanic sunfish in the North Equatorial Current region of the western Northern Pacific.

## Whalefish Larvae and Juveniles Collected in the western North Pacific During the Hakuho Maru Cruise 2012

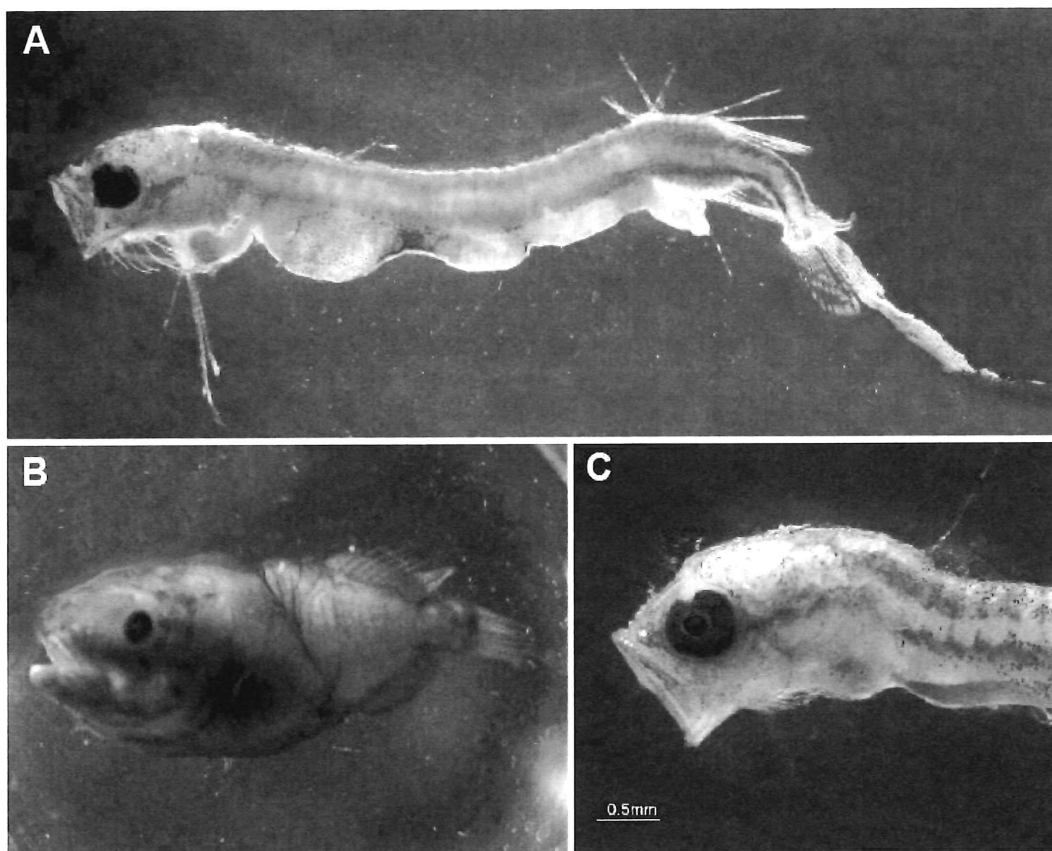
Michael J Miller<sup>1</sup>, John R Paxton<sup>2</sup> and Katsumi Tsukamoto<sup>1</sup>

<sup>1</sup>*Atmosphere and Ocean Research Institute, The University of Tokyo, Japan*

<sup>2</sup>*The Australian Museum, Sydney, Australia*

Three families of fishes with greatly differing morphologies, the Mirapinnidae (tapetails), Megalomycteridae (bignose fishes) and Cetomimidae (whalefishes), were found recently to actually be the larvae, males, and females, respectively, of a single family, the Cetomimidae (Johnson et al. 2009). The cetomimids were named the whalefishes because they resembled the body shapes of whales, but only females were ever found of this family (Paxton 1989). Ongoing research and work on developing identification keys is being conducted by John Paxton and his colleagues, so the specimens collected during this cruise will contribute to those efforts, and will be deposited in the Australian Museum collections.

During KH-12-2 two whalefish larvae and one juvenile were collected with the ORI-BF net. The two larvae were of the genus *Eutaeniophorus* (Figure 1A,C), possibly of the species *Eutaeniophorus festivus*.



**Figure 1.** Photographs of the two whalefish larvae of *Eutaeniophorus* (A,C) and one juvenile of *Rondeletia* (B) that were collected during the KH-12-2 sampling survey.

The first larva was caught at St. 11 on 20 May 2012 (Figure 1A), and was 14 mm, plus a 4 mm caudal filament. The second was collected at St. 84 on 15 June, and was also 14 mm long, but with a 2.3 mm caudal filament (Figure 1B). The 21 mm juvenile whalefish was caught at St. 159 on 23 June and was of the genus *Rondeletia* (Figure 1B) and may be *R. loricatata*. The larva caught at St. 11 was unusually pink in coloration (Figure 1A) compared to previously collected larvae in this region (Miller et al. 2009). Like many of the other whalefish larvae that have been collected, that larva also contained large copepods in its intestine, which are the large yellow oval objects seen in its gut in Figure 1A.

Sampling using the ORI-BF net during the KH-09-1,2 sampling survey also collected specimens of two other species, which were likely *Ditropichthys storeri* and *Cetostoma regani* (Miller et al. 2009), but these species were not collected during KH-12-2. The photographs and specimens obtained during the *Hakuho Maru* cruises will help contribute to the publication of an identification key (Paxton et al. 2009) that can be used to identify these unusual larvae.

## References

- Johnson G. D, J R. Paxton, T T. Sutton, T P. Satoh, T Sado, M Nishida and M Miya (2009) Deep-sea mystery solved: astonishing larval transformations and extreme sexual dimorphism unite three fish families. *Biol Lett* 5: 235-239
- Miller M J, J R. Paxton, D Johnson and K Tsukamoto (2009) Whalefish Larvae Collected During the KH-09-1, 2 Sampling Survey of the R/V Hakuho Maru in the western North Pacific in 2009. *Hakuho Maru* Cruise Report. 3 pages
- Paxton J R 1989. Synopsis of the whalefishes (family Cetomimidae) with descriptions of four new genera. *Rec Aust Mus* 41: 135–206
- Paxton J. R and G D. Johnson. Field Identification Guide to Larval Whalefishes (Family Cetomimidae, formerly Mirapinnidae) draft April 2009. Unpubl. key, 6 pages

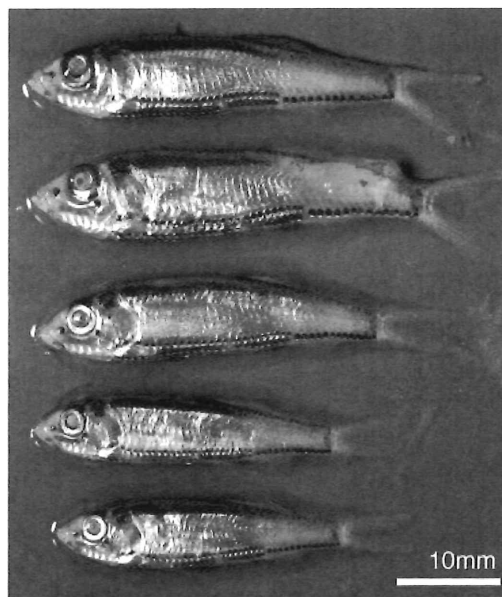
# Population Structure of *Vinciguerria nimbaria* in Relation to Ocean Basin Scale Distributions and Oceanic Currents

Shun Watanabe

*Atmosphere and Ocean Research Institute, The University of Tokyo*

*Vinciguerria nimbaria* (Fig.1) is an abundant mesopelagic fish that is widely distributed over the tropical and subtropical regions of the world's oceans, in a variety of areas of the Pacific, Indian and Atlantic oceans. There have been few biological and ecological studies on this species. However, no studies have examined the population structure of this cosmopolitan species in all of the world's oceans. The objectives of this study are as follows: 1) to analyze their population structures using molecular genetic and morphological techniques, 2) to find the relationship between their population structures and major current systems, and 3) to determine their life stages by counting of daily growth increments from core to the edge of otoliths in the larvae and adults.

During the sorting activity on board of KH-12-2, particular attention was given to their larvae and adults, and we attempted to identify them based on morphological criteria. A total of 87 ethanol preserved possible *Vinciguerria nimbaria* from 21 stations were obtained (St. 8, 8-10, 13, 15, 39, 42, 47, 49, 54, 59, 84, 94, 107, 108, 120, 136, 147, 150, 156, 157, 158). Their standard length ranged widely (13 - 37 mm). All individuals have been preserved in 99% ethanol for further molecular genetic, morphological and otolith analyses.



**Figure 1.** Adults of *Vinciguerria*



# Pelagic Mollusks collected in the western North Pacific During the Hakuho Maru Cruise 2012

Mari Kuroki

*The University Museum, The University of Tokyo*

Planktonic organisms have adaptations such as floats or lighter substances to obtain buoyancy to help them remain in the surface layer of the open ocean where photosynthetic primary production occurs and food is most abundant. Pelagic mollusks with shells are one of the common planktonic organisms of the open ocean. These animals have swimming appendages and have heavy calcareous outer shells, but they have a functionally designed body shape and size, and various floatation mechanisms to avoid sinking down into deeper water. In the KH-12-2 Leg 2 cruise, we collected several types of shells of different taxa to examine the species composition and genetic population structure of these remarkable small sized organisms in the open ocean.

Pelagic mollusks were collected during 6 – 28 June 2012. These were collected using the large ORI ring net with a 3 m diameter or the IKMT net together with fish larvae and other invertebrate plankton. Shells were sorted out of the plankton from a total of 36 tows (Table 1). Collected mollusks were immediately preserved in 5% formalin for morphological examination and species identification or 99% ethanol for genetic population structure analyses that will be conducted later in the laboratory.

**Table 1.** Pelagic mollusk collection data in the western North Pacific Ocean during KH-12-2 (Leg 2)

Date	St.	Latitude	Longitude	Net	Preservation	Bottle	Date	St.	Latitude	Longitude	Net	Preservation	Bottle
6.Jun.12	54	9.0°N	134.0°E	IKMT	5% Formalin	20 ml vial	17.Jun.12	108	14.0°N	142.3°E	ORI-BF	95% Ethanol	1.5 ml tube
9.Jun.12	59	15.0°N	141.8°E	ORI-BF	5% Formalin	1.5 ml tube	18.Jun.12	112	14.0°N	142.3°E	ORI-BF	95% Ethanol	1.5 ml tube
10.Jun.12	64	15.0°N	141.5°E	ORI-BF	5% Formalin	1.5 ml tube	18.Jun.12	118	14.3°N	142.8°E	ORI-BF	5% Formalin	1.5 ml tube
10.Jun.12	67	14.0°N	140.0°E	ORI-BF	5% Formalin	20 ml vial	18.Jun.12	119	14.3°N	142.6°E	ORI-BF	95% Ethanol	1.5 ml tube
11.Jun.12	70	12.5°N	138.5°E	ORI-BF	5% Formalin	20 ml vial	18.Jun.12	120	14.3°N	142.6°E	ORI-BF	95% Ethanol	20 ml vial
14.Jun.12	72	13.5°N	142.3°E	ORI-BF	5% Formalin	1.5 ml tube	19.Jun.12	125	13.8°N	142.2°E	ORI-BF	95% Ethanol	1.5 ml tube
14.Jun.12	73	13.8°N	142.4°E	ORI-BF	5% Formalin	1.5 ml tube	19.Jun.12	126	13.9°N	142.1°E	ORI-BF	5% Formalin	20 ml vial
15.Jun.12	77	13.8°N	142.8°E	ORI-BF	5% Formalin	1.5 ml tube	19.Jun.12	C20	13.8°N	142.3°E	ORI-BF	95% Ethanol	20 ml vial
15.Jun.12	78	15.0°N	142.8°E	ORI-BF	5% Formalin	1.5 ml tube	20.Jun.12	132	12.8°N	140.8°E	ORI-BF	95% Ethanol	1.5 ml tube
15.Jun.12	83	14.3°N	142.4°E	ORI-BF	95% Ethanol	20 ml vial	20.Jun.12	133	12.7°N	140.5°E	ORI-BF	95% Ethanol	1.5 ml tube
15.Jun.12	84	14.0°N	142.3°E	ORI-BF	5% Formalin	1.5 ml tube	20.Jun.12	135	12.3°N	140.2°E	ORI-BF	5% Formalin	20 ml vial
16.Jun.12	88	14.2°N	142.5°E	ORI-BF	5% Formalin	1.5 ml tube	21.Jun.12	141	12.7°N	14.3°E	ORI-BF	95% Ethanol	1.5 ml tube
16.Jun.12	89	14.0°N	142.3°E	ORI-BF	5% Formalin	1.5 ml tube	21.Jun.12	142	12.8°N	141.3°E	ORI-BF	95% Ethanol	1.5 ml tube
16.Jun.12	94	14.2°N	142.7°E	ORI-BF	5% Formalin	1.5 ml tube	22.Jun.12	151	14.3°N	142.2°E	ORI-BF	5% Formalin	1.5 ml tube
16.Jun.12	95	14.0°N	142.5°E	ORI-BF	5% Formalin	1.5 ml tube	22.Jun.12	156	15.1°N	141.3°E	ORI-BF	95% Ethanol	1.5 ml tube
17.Jun.12	100	14.0°N	142.3°E	ORI-BF	5% Formalin	1.5 ml tube	22.Jun.12	157	15.3°N	141.3°E	ORI-BF	5% Formalin	20 ml vial
17.Jun.12	101	14.0°N	142.1°E	ORI-BF	5% Formalin	1.5 ml tube	23.Jun.12	162	16.2°N	142.0°E	ORI-BF	95% Ethanol	20 ml vial
17.Jun.12	107	14.0°N	142.3°E	ORI-BF	95% Ethanol	1.5 ml tube	23.Jun.12	163	16.3°N	142.1°E	ORI-BF	5% Formalin	1.5 ml tube



# **Artificial Upwelling Experiment based on the Principal of Perpetual Salt Fountain in the western North Pacific During the Hakuho Maru Cruise 2012**

Kogawa Takuma, Moriya Shuichi, Shoji Eita, Takahashi Yuya, Tsurimaki Youichirou,  
Naito Shunsuke and Shigenao Maruyama

*Institute Fluid Science, Tohoku University*

## **1. Introduction**

The objective of this study is increasing oceanic productivity by providing nutrient-rich deep seawater for euphotic zone. Perpetual Salt Fountain is used for the artificial upwelling of deep sea water. In the large area of subtropical and tropical region, the area where the salinity of intermediate water is less than that of surface water exist. When the vertical pipe is installed in this region, and the position of the pipe bottoms adjusted in the minimum saline layer, upwelling flow in the pipe occurs because of buoyancy by heated low salinity water. The ocean experiment was conducted in the past R/V Hakuho-maru cruise, and succeeded in measuring upwelling flow and an increase in chlorophyll concentration. We conducted similar experiment in order to obtain further evidence to confirm increasing ocean productivity locally.

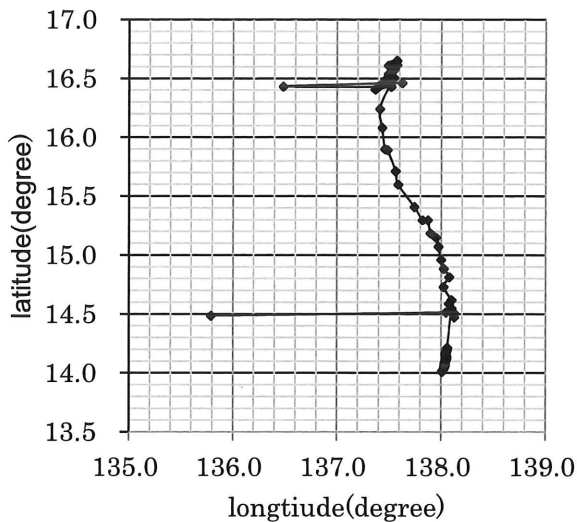
## **2. Floating Upwelling Pipe System**

The schematic image of the upwelling pipe system is presented in Fig. 1. The pipe is made of a fiber-reinforced PVC (polyvinyl chloride) sheet, 0.5 mm in thickness, and steel rings were attached to the pipe at every 0.25 m to maintain a circular cross section. Buoys on the sea surface (plastic buoys, 12G-1 and deep sea buoys) and a 100 kg sinker at the bottom are used to keep the pipe vertical. Plastic buoys (8B-1) is used on the side of the pipe. A GPS (global positing system) (ORBCOMM Buoy, Zeni Lite Buoy Co.) was installed with Marker buoy (Zeni Lite Buoy CO.). The position data of the floating pipe system were monitored by interval from 30 to 720 minutes. Tracer injector was installed 15 m below the top and 3 sensors (Compact-CLW, JFE-ALEC) were installed 2 m below, 2 m above and 4 m above the tracer injector. 0.5% rhodamine wt is used as tracer. Diluted rhodamine wt was made from 5% rhodamine wt and seawater at the depth of 300 m sampled by CTD system with a concentration of 1 to 10. To measure depth and oscillation number of pipe, 2 Temperature-Depth profilers were installed at each top, 150m below and 300m below of the pipe. To measure the

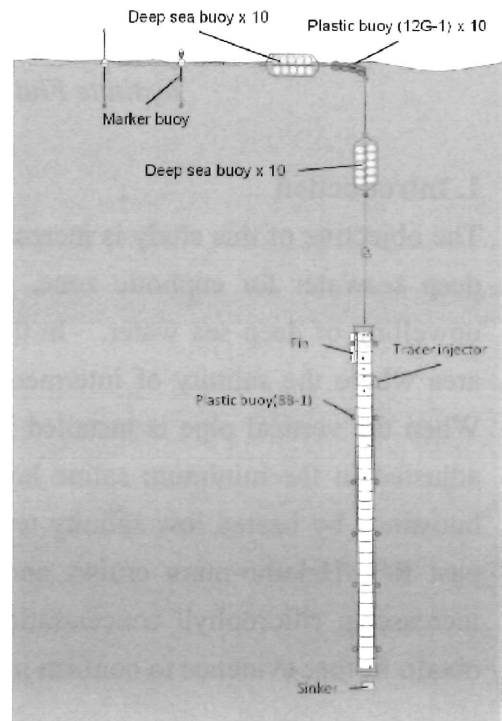
difference of salinity of the seawater between inside and outside of pipe, two Conductivity-Temperature profilers were installed 150m below the top in the inside and outside. Four Chlorophyll sensors were installed pipe. Two sensors were set up at top, the other 2 sensors were set up at 1m and 150m below top.

### 3. Results

The pipe system was released on May 25 at 14°N and 138°E. After floating periods of 14 days only the marker buoy was retrieved on June 8 at 14°27'N, 140°27'E. The trajectory of floating the marker buoy is presented in Fig. 2. During the period the marker buoy was floating, pipe had been lost. As a cause of lost, it is considered that the connection between the marker buoy and the deep sea buoy was broke down.



**Figure 2.** The track of the marker buoy. Distant points were error.



**Figure 1.** Schematic diagram of floating upwelling pipe system.

## KH-12-2 Net Record (ORIBF, IKMT)

St.	Location		Date	Time		Net Type	Mesh size (mm)	Towing Method	Wire out (m)	Sampl. layer (m)	Reel. speed (m/s)	Ship speed (kt)	Filt. volume (m <sup>3</sup> )	Flow-meter Revol.	Flow-meter No.	Sea Depth (m)
	Net in	Net out		Net in	Net out											
1	N 15-59.5 E142-40.0	N 15-57.2 E142-40.4	120518	04:14	05:03	ORIBF	0.5	Obl.	537	0-225	1.0~0.2	2.5~2.0	21482	37760	2854	3610~3640
2	N 15-44.3 E142-40.0	N 15-42.1 E142-39.9	120518	06:19	07:05	ORIBF	0.5	Obl.	564	0-224	0.6~0.2	2.5~2.0	21357	37540	2854	3462~3508
3	N 15-30.0 E142-40.4	N 15-29.8 E142-42.4	120518	08:16	08:57	ORIBF	0.5	Obl.	521	0-208	1.0~0.2	2.5~1.9	19024	33440	2854	3656~3755
4	N 15-15.0 E142-44.9	N 15-14.8 E142-46.4	120518	10:24	11:01	ORIBF	0.5	Obl.	510	0-204	1.0~0.2	2.5~1.4	17022	29920	2854	3533~3596
5	N 14-59.9 E142-40.0	N 14-59.4 E142-41.5	120518	12:30	13:10	ORIBF	0.5	Obl.	474	0-191	1.0~0.2	2.5~1.4	16675	29310	2854	3504~3624
6	N 14-44.9 E142-45.2	N 14-44.3 E142-46.7	120518	14:36	15:11	ORIBF	0.5	Obl.	456	0-183	1.0~0.2	2.5~1.5	15582	27390	2854	3507~3618
7	N 14-50.0 E142-34.8	N 14-49.3 E142-36.0	120518	16:34	17:08	ORIBF	0.5	Obl.	468	0-189	1.0~0.2	2.5~1.5	13050	22938	2854	4014~4068
8	N 15-05.1 E142-30.0	N 15-04.9 E142-31.0	120518	18:44	19:20	ORIBF	0.5	Obl.	388	0-177	1.0~0.2	2.5~1.5	14038	24675	2854	4001~4047
9	N 15-19.9 E142-35.2	N 15-19.9 E142-37.0	120518	20:52	(21:32)	ORIBF	0.5	Obl.	488	0-188	1.0~0.2	2.5~1.5	19622	34490	2854	3862~3995
8-1	N 15-05.1 E142-30.1	N 15-05.2 E142-32.2	120518	23:04	24:19	ORIBF	0.5	Step	374	0-192	1.0~0.2	2.5~1.8	29151	51240	2854	3944~4044
8-2	N 15-04.9 E142-35.0	N 15-04.7 E142-37.0	120519	01:33	02:42	ORIBF	0.5	Step	408	0-194	1.0~0.2	2.5~1.9	31768	55840	2854	3636~3783
8-3	N 15-10.0 E142-29.9	N 15-10.7 E142-32.3	120519	04:24	05:40	ORIBF	0.5	Step	378	0-190	1.0~0.2	2.5~2.1	29543	51929	2854	3826~4013
8-4	N 15-05.1 E142-24.0	N 15-05.3 E142-27.7	120519	07:09	08:22	ORIBF	0.5	Step	351	0-185	1.0~0.2	2.5~2.3	27458	48265	2854	4145~4200
8-5	N 14-59.9 E142-30.1	N 14-59.8 E142-32.6	120519	09:29	10:41	ORIBF	0.5	Step	412	0-179	1.0~0.2	2.5~1.9	28784	50595	2854	4076~4204
8-6	N 15-05.2 E142-25.0	N 15-05.2 E142-26.2	120519	12:05	12:41	ORIBF	0.5	Step	351	0-143	0.9~0.2	2.5~2.0	19864	34915	2854	4184~4200
8-7	N 15-05.2 E142-26.5	N 15-05.1 E142-27.6	120519	12:54	13:28	ORIBF	0.5	Step	333	0-150	1.0~0.2	2.3~2.2	18757	32970	2854	4149~4177

KH-12-2 Net Record (ORIBF, IKMT)

St.	Location		Date	Time		Net Type	Mesh size (mm)	Towing Method	Wire		Reel speed (m/s)	Ship speed (kt)	Filt. volume (m <sup>3</sup> )	Flow-meter Revol.	Flow-meter No.	Sea Depth (m)
	Net in	Net out		Net in	Net out				(m)	out layer (m)						
8-8	N 15-05.0 E142-25.0	N 15-05.0 E142-27.8	120519	14:03	15:22	ORIBF	0.5	Step	423	0-180	1.0~0.2	2.5~1.8	30215	53110	2854	4144~4198
8-9	N 15-00.1 E142-29.7	N 15-00.4 E142-32.5	120519	16:19	17:38	ORIBF	0.5	Step	412	0-156	1.0~0.2	2.6~2.1	32584	57274	2854	4070~4207
8-10	N 15-00.1 E142-24.8	N 15-00.3 E142-27.7	120519	18:44	20:04	ORIBF	0.5	Step	412	0-170	1.0~0.2	2.6~2.2	36597	64328	2854	4184~4250
8-11	N 15-00.3 E142-27.8	N 15-00.1 E142-30.9	120519	20:12	21:36	ORIBF	0.5	Step	412	0-165	1.0~0.2	2.7~2.2	30971	54439	2854	4158~4208
8-12	N 15-02.7 E142-27.4	N 15-03.1 E142-30.1	120519	22:36	23:53	ORIBF	0.5	Step	412	0-171	1.0~0.2	2.7~2.1	34809	61185	2854	4138~4173
8-13	N 15-05.1 E142-20.0	N 15-06.6 E141-22.4	120520	01:03	02:23	ORIBF	0.5	Step	454	0-183	1.0~0.2	2.6~2.2	33856	59510	2854	4213~4249
8-14	N 15-00.1 E142-20.0	N 15-01.8 E142-22.6	120520	03:47	05:12	ORIBF	0.5	Step	473	0-187	1.0~0.2	2.6~2.2	35629	62626	2854	4280~4331
10	N 15-14.9 E142-20.1	N 15-14.5 E142-22.3	120520	12:22	13:13	ORIBF	0.5	Obl.	500	—	0.6~0.2	2.3~1.9	21565	37905	2854	4189~4240
11	N 15-30.0 E142-10.0	N 15-30.0 E142-11.4	120520	15:00	15:39	ORIBF	0.5	Obl.	410	—	1.0~0.2	2.6~2.1	18669	32815	2854	4158~4237
12	N 15-45.2 E141-60.0	N 15-45.4 E142-02.3	120520	17:28	18:25	ORIBF	0.5	Obl.	540	0-200	0.5~0.2	2.5~2.1	27611	48534	2854	4383~4456
13	N 15-59.9 E142-00.1	N 15-59.5 E142-02.3	120520	19:55	20:45	ORIBF	0.5	Obl.	548	0-195	1.0~0.2	2.6~2.2	24349	42800	2854	4398~4409
14	N 16-14.8 E142-00.1	N 16-14.2 E142-01.7	120521	22:25	23:07	ORIBF	0.5	Obl.	432	0-200	1.0~0.2	2.7~2.4	17338	30475	2854	4314~4343
15	N 16-29.9 E142-25.1	N 16-30.3 E142-26.8	120521	01:38	02:25	ORIBF	0.5	Obl.	462	0-192	1.0~0.2	2.5	19753	34720	2854	3978~4017
16	N 14-59.9 E142-20.1	N 14-59.6 E142-22.0	120521	12:30	13:21	ORIBF	0.5	Obl.	500	0-270	1.0~0.2	2.4~2.2	20071	35280	2854	4327~4339
17	N 14-44.8 E142-15.1	N 14-44.5 E142-16.5	120521	15:02	15:40	ORIBF	0.5	Obl.	380	0-197	1.0~0.2	2.4~2.1	20137	35395	2854	4318~4334
18	N 14-29.8 E142-10.0	E142-29.5 E142-11.1	120521	17:09	17:44	ORIBF	0.5	Obl.	380	0-202	0.5~0.2	2.3~2.1	13827	24305	2854	4102~4168

## KH-12-2 Net Record (ORIBF, IKMT)

St.	Location		Date	Time		Net Type	Mesh size (mm)	Towing Method	Wire		Reel speed (m/s)	Ship speed (kt)	Filt. volume (m <sup>3</sup> )	Flow-meter Revol.	Flow-meter No.	Sea Depth (m)
	Net in	Net out		Net in	Net out				out (m)	layer (m)						
19	N 14-15.2 E142-04.7	N 14-15.5 E142-05.4	120521	20:35	21:19	ORIBF	0.5	Obl.	422	0-224	1.0~0.2	2.6~1.7	16034	28183	2854	4317~4350
20	N 14-00.2 E141-59.9	N 14-01.0 E142-01.0	120521	23:28	24:10	ORIBF	0.5	Obl.	468	0-198	1.0~0.2	2.6~2.5	19775	34760	2854	4268~4274
21	N 12-20.0 E140-09.8	N 12-20.3 E140-11.5	120522	10:22	11:06	ORIBF	0.5	Obl.	470	0-210	1.0~0.2	2.6~2.5	18393	32330	2854	4364~4386
22	N 12-30.0 E140-15.0	N 12-31.0 E140-15.9	120522	12:14	12:59	ORIBF	0.5	Obl.	470	0-228	1.0~0.2	2.5~2.4	18581	32660	2854	4339~4360
23	N 12-40.0 E140-20.8	N 12-41.3 E140-23.6	120522	14:17	15:05	ORIBF	0.5	Obl.	470	0-211	1.0~0.2	2.7~2.5	19935	35040	2854	4096~4134
24	N 12-50.0 E140-45.1	N 12-50.8 E140-46.1	120522	17:03	17:50	ORIBF	0.5	Obl.	470	0-242	0.5~0.2	2.7~2.4	18790	33028	2854	4280~4293
25	N 13-44.8 E141-50.0	N 13-43.4 E141-49.7	120523	0:06	0:46	ORIBF	0.5	Obl.	418	0-207	0.5~0.2	2.6~1.8	17312	30430	2854	4273~4311
26	N 13-29.9 E141-44.8	N 13-28.8 E141-43.5	120523	02:12	02:53	ORIBF	0.5	Obl.	417	0-201	0.6~0.2	2.6~1.6	19585	34425	2854	3066~3232
27	N 13-14.9 E141-34.8	N 13-14.0 E141-32.8	120523	04:22	05:11	ORIBF	0.5	Obl.	468	0-204	0.6~0.2	2.6~2.2	21784	38290	2854	3154~3327
28	N 12-59.9 E141-24.9	N 12-59.1 E141-23.9	120523	06:44	07:21	ORIBF	0.5	Obl.	365	0-202	0.6~0.2	2.5~2.1	13965	24547	2854	4011~4026
29	N 12-49.8 E141-14.6	N 12-49.2 E141-13.0	120523	08:41	09:22	ORIBF	0.5	Obl.	429	0-203	0.7~0.2	2.7~2.5	17461	30692	2854	2344~2897
30	N 12-39.8 E141-15.0	N 12-38.6 E141-14.6	120523	10:33	11:15	ORIBF	0.5	Obl.	396	0-199	—	2.6~2.3	16134	28359	2854	3219~3249
31	N 12-29.9 E141-20.0	N 12-28.4 E141-19.5	120523	12:25	13:08	ORIBF	0.5	Obl.	436	0-188	0.5~0.2	2.5~2.2	18586	32670	2854	1718~2051
32	N 12-20.0 E141-14.9	N 12-18.9 E141-13.2	120523	14:08	14:59	ORIBF	0.5	Obl.	460	0-198	0.5~0.2	2.5~2.1	19922	35018	2854	4402~4628
33	N 12-19.8 E140-59.9	N 12-18.6 E140-58.5	120523	16:17	17:05	ORIBF	0.5	Obl.	470	0-225	0.5~0.2	2.6~2.1	19337	33990	2854	2094~2301
34	N 12-09.9 E140-50.0	N 12-08.7 E140-48.8	120523	18:21	19:07	ORIBF	0.5	Obl.	470	0-248	0.5~0.2	2.6~2.2	17451	30674	2854	3374~3437

KH-12-2 Net Record (ORIBF, IKMT)

St.	Location		Date	Time		Net Type	Mesh size (mm)	Towing Method	Wire		Reel speed (m/s)	Ship speed (kt)	Filt. volume (m <sup>3</sup> )	Flow-meter Revol.	Flow-meter No.	Sea Depth (m)	
	Net in	Net out		Net in	Net out				in (m)	out (m)							
35	N 12-00.1 E140-50.0	N 11-59.4 E140-48.8	120525	05:37	06:17	ORIBF	0.5	Obl.	386	0-218	1.0~0.2	2.2~2.5	15891	27933	2854	3896~3908	
36	N 11-00.7 E143-59.9	N 11-00.9 E144-02.5	120525	19:45	20:42	IKMT	0.5	Obl.	711	0-200	0.8~0.3	3.0~2.8	42546	61032	2854	3738~4492	
37	N 11-00.0 E146-00.1	N 11-00.2 E146-02.2	120525	04:27	05:17	IKMT	0.5	Obl.	701	0-210	0.8~0.3	3.0~2.8	37038	53130	2854	3009~3274	
38	N 11-00.0 E147-59.8	N 10-59.7 E148-02.2	120526	14:01	15:04	IKMT	0.5	Obl.	860	0-198	1.0~0.3	3.0~2.8	45128	64735	2854	5621~5628	
39	N 08-59.7 E147-50.2	N 08-57.8 E147-52.3	120526	22:55	23:53	IKMT	0.5	Obl.	741	0-210	1.0~0.3	3.0~2.8	43186	61950	2854	2857~2963	
40	N 07-00.4 E148-00.1	N 07-01.8 E148-03.0	120527	08:05	09:08	IKMT	0.5	Obl.	872	0-212	1.0~0.3	3.2~3.0	50592	72574	2854	3179~3513	
41	N 05-00.0 E147-59.9	N 05-01.6 E148-01.7	120527	17:59	18:55	IKMT	0.5	Obl.	785	0-212	1.0~0.3	3.0~2.8	55231	79228	2854	3486~4144	
42	N 05-00.0 E146-00.0	N 04-58.8 E146-02.8	120528	02:42	03:48	IKMT	0.5	Obl.	823	0-212	1.0~0.3	3.0~2.8	51653	74095	2854	4276~4378	
43	N 07-00.0 E145-59.9	N 07-00.1 E146-01.5	120528	11:39	12:26	IKMT	0.5	Obl.	653	0-210	1.0~0.3	3.0~2.9	30509	43765	2854	3051~3089	
44	N 07-00.4 E143-59.9	N 07-03.6 E143-59.3	120528	20:07	21:10	IKMT	0.5	Obl.	801	0-207	1.0~0.3	3.0~2.2	48957	70228	2854	2491~2720	
45	N 04-59.8 E143-59.6	N 05-01.7 E143-59.3	120529	05:57	06:42	IKMT	0.5	Obl.	656	0-207	1.0~0.3	3.0~2.0	30730	44081	2854	3783~3795	
46	N 05-00.0 E141-51.0	N 05-01.9 E141-58.6	120529	14:29	15:28	IKMT	0.5	Obl.	800	0-289	1.0~0.3	3.0~3.3	45194	64830	2854	2623~2690	
47	N 05-00.3 E139-59.8	N 05-03.1 E139-58.3	120530	00:33	01:30	IKMT	0.5	Obl.	763	0-190	1.0~0.3	3.0	41865	60055	2854	4160~4182	
48	N 04-59.7 E138-00.0	N 05-01.4 E138-01.0	120530	10:03	10:57	IKMT	0.5	Obl.	782	0-222	1.0~0.3	3.0	38317	54965	2854	4255~4346	
49	N 05-00.0 E136-00.1	N 04-58.8 E135-58.3	120530	20:25	21:30	IKMT	0.5	Obl.	835	0-220	1.0~0.3	3.0	44226	63442	2854	4190~4396	
50	N 05-00.1 E134-00.4	N 05-01.4 E133-59.2	120531	07:32	08:27	IKMT	0.5	Obl.	800	0-242	1.0~0.3	3.0~2.6	34002	48775	2854	3831~4027	

KH-12-2 Net Record (ORIBF, IKMT)

St.	Location		Date	Time		Net Type	Mesh size (mm)	Towing Method	Wire		Reel speed (m/s)	Ship speed (kt)	Filt. volume (m <sup>3</sup> )	Flow-meter Revol.	Flow-meter No.	Sea Depth (m)	
	Net in	Net out		Net in	Net out				(m)	out layer (m)							
51	N 06-00.1 E134-00.0	N 05-59.6 E133-57.0	120531	13:10	14:10	IKMT	0.5	Obl.	811	0-200	1.0~0.3	3.0~2.8	38788	55640	2854	4416~5670	
52	N 07-00.2 E133-44.8	N 07-01.4 E133-41.6	120531	18:57	20:04	IKMT	0.5	Obl.	846	0-216	1.0~0.3	3.0~2.6	51123	73335	2854	3508~4272	
53	N 07-59.9 E133-59.9	N 07-59.1 E133-58.2	120606	14:23	15:13	IKMT	0.5	Obl.	741	0-216	1.0~0.3	2.7~2.4	40638	58295	2854	4408	
54	N 09-00.2 E133-59.8	N 09-03.3 E133-57.6	120606	20:04	21:10	IKMT	0.5	Obl.	858	0-211	1.0~0.3	3.0~2.5	50984	73135	2854	5166~5199	
55	N 09-59.7 E133-59.7	N 09-56.6 E133-56.2	120607	01:48	03:02	IKMT	0.5	Obl.	963	0-216	1.0~0.3	2.5~2.3	60893	87350	2854	4683~4772	
56	N 10-59.8 E133-59.4	N 10-56.8 E133-57.4	120607	09:10	10:13	IKMT	0.5	Obl.	929	0-213	1.0~0.3	3.0~2.3	47888	68695	2854	5596~5627	
57	N 15-16.0 E141-58.2	N 15-17.8 E141-57.4	120609	13:43	14:27	ORIBF	0.5	Obl.	490	0-200	1.0~0.3	2.4~2.3	20518	36065	2854	4371~4375	
58	N 15-35.9 E142-07.6	N 15-36.7 E142-10.2	120609	16:40	17:40	ORIBF	0.5	Obl.	584	0-202	1.0~0.2	2.6~2.3	30989	54470	2854	4288~4365	
59	N 15-00.1 E141-59.5	N 15-00.4 E141-57.9	120609	21:45	22:25	ORIBF	0.5	Obl.	458	0-197	1.0~0.3	2.4	19036	33461	2854	4542~4557	
60	N 15-00.6 E141-45.0	N 15-02.4 E141-44.6	120609	23:44	24:26	ORIBF	0.5	Obl.	501	0-198	1.0~0.3	2.3	20100	35330	2854	4586~4595	
61	N 15-00.2 E141-30.4	N 15-01.5 E141-30.2	120610	01:57	02:31	ORIBF	0.5	Obl.	444	0-205	1.0~0.3	2.5~2.0	20489	36015	2854	4411~4491	
62	N 15-00.0 E141-15.0	N 15-00.0 E141-14.0	120610	04:08	04:41	ORIBF	0.5	Obl.	351	0-208	0.5~0.3	2.5	13394	23543	2854	4787~4800	
63	N 14-59.8 E141-00.1	N 14-58.1 E141-00.6	120610	06:11	06:53	ORIBF	0.5	Obl.	521	0-203	0.6~0.3	2.5~2.4	20620	36244	2854	4776~4797	
64	N 14-59.8 E140-30.1	N 14-58.0 E140-30.1	120610	09:36	10:18	ORIBF	0.5	Obl.	483	0-200	1.0~0.3	2.2~1.7	19826	34849	2854	4914~4971	
65	N 14-59.4 E140-00.5	N 14-57.3 E140-01.3	120610	13:47	14:34	ORIBF	0.5	Obl.	555	0-200	1.0~0.3	2.5	18015	31665	2854	4907~4990	
66	N 14-29.6 E139-50.1	N 14-27.5 E139-50.2	120610	17:05	17:50	ORIBF	0.5	Obl.	469	0-195	1.0~0.2	2.5~2.3	21529	37843	2854	3860~3979	

KH-12-2 Net Record (ORIBF, IKMT)

St.	Location		Date	Time		Net Type	Mesh size (mm)	Towing Method	Wire		Reel speed (m/s)	Ship speed (kt)	Filt. volume (m <sup>3</sup> )	Flow-meter Revol.	Flow-meter No.	Sea Depth (m)	
	Net in	Net out		Net in	Net out				(m)	out layer (m)							
67	N 13-59.7 E139-39.8	N 13-57.6 E139-38.8	120610	20:21	21:15	ORIBF	0.5	Obl.	473	0-195	1.0~0.2	2.5	24047	42268	2854	4120~4629	
68	N 13-29.7 E139-24.9	N 13-27.7 E139-23.8	120611	00:33	01:25	ORIBF	0.5	Obl.	464	0-198	1.0~0.2	2.5	24731	43470	2854	3941~4052	
69	N 12-59.8 E139-04.7	N 12-58.6 E139-03.0	120611	04:12	05:12	ORIBF	0.5	Obl.	710	0-366	0.6~0.3	2.5~2.3	24674	43370	2854	4992~5921	
70	N 12-29.6 E138-30.0	N 12-26.3 E138-29.6	120611	08:45	09:53	ORIBF	0.5	Obl.	873	0-307	0.9~0.3	2.5~2.4	36609	64349	2854	4908~5154	
71	N 12-00.0 E137-59.5	N 12-01.1 E138-00.6	120611	13:44	14:30	ORIBF	0.5	Obl.	622	0-313	1.0~0.3	2.5~2.4	20501	36035	2854	4853~5008	
72	N 13-29.8 E142-15.0	N 13-27.9 E142-15.9	120614	19:01	19:47	ORIBF	0.5	Obl.	478	0-205	0.6~0.2	2.5~2.3	21653	38060	2854	3124~3184	
73	N 13-44.9 E142-25.2	N 13-44.3 E142-26.6	120614	21:42	22:23	ORIBF	0.5	Obl.	451	0-209	1.0~0.2	2.6~2.5	17349	30496	2854	2704~2777	
74	N 13-59.9 E142-35.0	N 13-58.8 E142-35.7	120615	00:05	00:39	ORIBF	0.5	Obl.	398	0-210	1.0~0.2	2.6~2.4	15736	27660	2854	2688~2771	
75	N 14-14.9 E142-40.1	N 14-13.8 E142-41.0	120615	02:15	02:54	ORIBF	0.5	Obl.	470	0-216	0.7~0.3	2.5~2.2	19713	34650	2854	2014~2531	
76	N 14-30.0 E142-45.0	N 14-29.3 E142-46.2	120615	04:29	05:11	ORIBF	0.5	Obl.	432	0-206	0.6~0.2	2.5~2.1	18729	32920	2854	2774~2999	
77	N 14-45.0 E142-50.1	N 14-44.4 E142-51.6	120615	06:47	07:30	ORIBF	0.5	Obl.	454	0-209	0.6~0.2	2.5~2.2	20563	36145	2854	2417~3276	
78	N 15-00.1 E142-50.3	N 14-59.8 E142-51.8	120615	09:04	09:47	ORIBF	0.5	Obl.	484	0-206	0.6~0.2	2.5	20153	35423	2854	2953~3106	
79	N 15-15.0 E142-50.2	N 15-14.5 E142-51.6	120615	11:15	11:57	ORIBF	0.5	Obl.	462	0-200	0.6~0.2	2.5~2.4	18529	32570	2854	3476~3542	
80	N 15-04.9 E142-35.2	N 15-04.6 E142-36.7	120615	13:36	14:15	ORIBF	0.5	Obl.	458	0-207	0.3~0.2	2.5	21877	38455	2854	3619~3754	
81	N 14-49.9 E142-35.1	N 14-49.7 E142-37.5	120615	15:39	16:29	ORIBF	0.5	Obl.	557	0-201	0.7~0.2	2.5	25382	44615	2854	3969~4044	
82	N 14-35.0 E142-30.2	N 14-33.7 E142-32.1	120615	18:03	19:52	ORIBF	0.5	Obl.	501	0-188	0.6~0.2	2.5~2.4	23980	42150	2854	2532~2630	



## KH-12-2 Net Record (ORIBF, IKMT)

St.	Location		Date	Time		Net Type	Mesh size (mm)	Towing Method	Wire		Reel speed (m/s)	Ship speed (kt)	Filt. volume (m <sup>3</sup> )	Flow-meter Revol.	Flow-meter No.	Sea Depth (m)	
	Net in	Net out		Net in	Net out				out (m)	layer (m)							
83	N 14-19.8 E142-25.0	N 14-19.0 E142-26.7	120615	20:20	21:05	ORIBF	0.5	Obl.	501	0-188	0.5~0.2	2.6~2.5	20777	36520	2854	3770~3823	
84	N 14-04.8 E142-20.1	N 14-04.3 E142-21.9	120615	22:33	23:18	ORIBF	0.5	Obl.	501	0-184	0.6~0.2	2.5~2.3	20675	36341	2854	3303~3520	
85	N 13-54.8 E142-25.1	N 13-53.7 E142-26.5	120616	00:22	01:07	ORIBF	0.5	Obl.	511	0-205	0.5~0.2	2.4~2.2	21456	37715	2854	2758~2787	
86	N 14-04.9 E142-35.1	N 14-04.1 E142-36.7	120616	02:28	03:15	ORIBF	0.5	Obl.	544	0-204	0.4~0.2	2.5~2.4	22444	39450	2854	2755~2904	
87	N 14-14.9 E142-44.9	N 14-14.2 E142-46.1	120616	04:35	05:21	ORIBF	0.5	Obl.	488	0-206	0.6~0.2	2.6~2.5	21118	37120	2854	1992~2088	
88	N 14-10.0 E142-30.0	N 14-09.0 E142-31.4	120616	06:52	07:41	ORIBF	0.5	Obl.	500	0-253	0.6~0.2	2.5~2.3	21414	37641	2854	2986~3386	
89	N 14-00.0 E142-20.0	N 13-59.4 E142-21.7	120616	09:05	09:50	ORIBF	0.5	Obl.	502	0-246	0.6~0.2	2.5~1.5	18659	32798	2854	2708~3087	
90	N 13-49.9 E142-10.1	N 13-48.6 E142-11.4	120616	11:14	11:59	ORIBF	0.5	Obl.	500	0-222	0.6~0.2	2.5	19206	33760	2854	3550~3680	
91	N 14-00.0 E142-10.1	N 13-59.4 E142-11.9	120616	13:08	13:52	ORIBF	0.5	Obl.	500	0-231	0.4~0.2	2.3	19870	34927	2854	3798~3888	
92	N 14-10.0 E142-20.1	N 14-09.2 E142-21.8	120616	15:07	15:51	ORIBF	0.5	Obl.	491	0-216	0.5~0.2	2.7~2.4	25365	44585	2854	3890~3992	
93	N 14-15.0 E142-35.1	N 14-14.2 E142-37.1	120616	17:12	18:02	ORIBF	0.5	Obl.	507	0-207	0.6~0.2	2.6~2.5	23358	41058	2854	2917~3154	
94	N 14-09.9 E142-40.2	N 14-08.8 E142-42.4	120616	18:55	19:48	ORIBF	0.5	Obl.	558	0-207	0.6~0.2	2.7~2.5	26232	46109	2854	2407~2569	
95	N 13-59.8 E142-30.3	N 13-59.0 E142-31.5	120616	21:14	21:51	ORIBF	0.5	Obl.	451	0-208	0.8~0.2	2.5	15494	27235	2854	2750~2825	
96	N 13-49.7 E142-20.1	N 13-48.9 E142-22.1	120616	23:15	24:05	ORIBF	0.5	Obl.	586	0-210	0.6~0.2	2.5~2.3	24622	43280	2854	3124~3274	
97	N 13-55.0 E142-15.2	N 13-53.9 E142-16.9	120617	01:07	01:53	ORIBF	0.5	Obl.	557	0-209	0.2	2.6~2.0	23745	41737	2854	3628~3736	
98	N 14-05.0 E142-25.1	N 14-04.7 E142-26.9	120617	03:13	04:00	ORIBF	0.5	Obl.	533	0-201	0.6~0.2	2.7~2.4	21836	38383	2854	2791~3220	

KH-12-2 Net Record (ORIBF, IKMT)

St.	Location		Date	Time		Net Type	Mesh size (mm)	Towing Method	Wire		Reel speed (m/s)	Ship speed (kt)	Filt. volume (m <sup>3</sup> )	Flow-meter Revol.	Flow-meter No.	Sea Depth (m)
	Net in	Net out		Net in	Net out				out (m)	layer (m)						
99	N 14-15.0 E142-25.1	N 14-14.6 E142-27.2	120617	05:10	06:00	ORIBF	0.5	Obl.	559	0-208	0.7~0.2	2.7~2.4	24548	43150	2854	3724~3834
100	N 14-04.9 E142-15.2	N 14-04.7 E142-17.2	120617	07:28	08:15	ORIBF	0.5	Obl.	545	0-208	0.8~0.2	2.7~2.4	23999	42185	2854	3312~3667
101	N 13-54.9 E142-05.3	N 13-55.5 E142-07.2	120617	09:43	10:40	ORIBF	0.5	Obl.	600	0-290	0.8~0.2	2.5	22816	40105	2854	4016~4065
102	N 13-59.9 E142-10.0	N 14-00.4 E142-11.4	120617	11:32	12:13	ORIBF	0.5	Obl.	447	0-209	1.0~0.2	2.5~2.3	18137	31880	2854	3837~3899
103	N 14-05.0 E142-10.0	N 14-05.2 E142-11.6	120617	13:01	13:45	ORIBF	0.5	Obl.	497	0-208	0.5~0.2	2.5~2.3	19972	35105	2854	2115~2799
104	N 14-10.0 E142-10.0	N 14-10.1 E142-11.5	120617	14:33	15:14	ORIBF	0.5	Obl.	469	0-207	0.2~0.3	2.6~2.5	18399	32340	2854	4118~4154
105	N 14-10.0 E142-15.1	N 14-09.9 E142-16.8	120617	15:55	16:36	ORIBF	0.5	Obl.	459	0-208	0.6~0.2	2.8~2.5	18779	33009	2854	4077~4108
106	N 14-04.9 E142-15.1	N 14-04.5 E142-17.8	120617	17:27	18:28	ORIBF	0.5	Step	514	0-197	0.6~0.2	2.8~2.3	27146	47715	2854	3303~3691
107	N 13-59.7 E142-15.1	N 13-59.4 E142-17.2	120617	19:25	20:15	ORIBF	0.5	Obl.	550	0-229	0.8~0.2	2.6~1.5	21604	37975	2854	3476~3545
108	N 13-59.9 E142-20.3	N 13-59.9 E142-22.2	120617	20:56	21:44	ORIBF	0.5	Obl.	551	0-199	0.8~0.2	2.5~1.5	21549	37878	2854	2334~3022
109	N 14-05.0 E142-20.0	N 14-04.9 E142-21.6	120617	22:46	23:36	ORIBF	0.5	Obl.	550	0-201	0.8~0.2	2.5~1.5	20968	36857	2854	3434~3578
110	N 14-10.1 E142-20.0	N 14-10.4 E142-21.5	120618	00:30	01:17	ORIBF	0.5	Obl.	550	0-266	0.4~0.2	2.8~2.5	17949	31550	2854	3956~3994
111	N 14-05.0 E142-25.1	N 14-05.3 E142-26.7	120618	02:17	03:05	ORIBF	0.5	Obl.	550	0-245	0.3~0.2	2.4~2.3	21041	36985	2854	2530~3173
112	N 13-54.9 E142-15.0	N 13-54.6 E142-16.5	120618	04:35	05:26	ORIBF	0.5	Obl.	550	0-340	0.6~0.2	2.7~2.4	19792	34790	2854	3690~3738
113	N 13-45.0 E142-05.1	N 13-44.5 E142-06.9	120618	06:53	07:46	ORIBF	0.5	Obl.	550	0-274	0.6~0.2	2.6~2.5	22791	40060	2854	3551~3726
114	N 13-40.0 E142-10.0	N 13-39.9 E142-11.5	120618	08:46	09:36	ORIBF	0.5	Obl.	550	0-302	0.8~0.2	2.5~1.5	18686	32845	2854	3204~3245

KH-12-2 Net Record (ORIBF, IKMT)

St.	Location		Date	Time		Net Type	Mesh size (mm)	Towing Method	Wire out (m)	Sampl. layer (m)	Reel. speed (m/s)	Ship speed (kt)	Filt. volume (m <sup>3</sup> )	Flow-meter Revol.	Flow-meter No.	Sea Depth (m)
	Net in	Net out		Net in	Net out											
115	N 13-49.9 E142-20.1	N 13-49.5 E142-21.5	120618	11:00	11:47	ORIBF	0.5	Obl.	550	0-319	0.8~0.2	2.5~1.5	15341	26965	2854	3156~3308
116	N 14-00.0 E142-30.0	N 13-59.6 E142-31.9	120618	13:04	13:52	ORIBF	0.5	Obl.	550	0-269	0.4~0.2	2.6~2.4	19568	34395	2854	2748~2826
117	N 14-10.0 E142-40.1	N 14-10.3 E142-41.8	120618	15:08	15:53	ORIBF	0.5	Obl.	550	0-261	0.4~0.2	2.5~1.8	18962	33330	2854	2482~2546
118	N 14-15.0 E142-45.0	N 14-15.1 E142-46.9	120618	16:50	17:41	ORIBF	0.5	Obl.	550	0-219	0.6~0.2	2.6~2.4	22767	40018	2854	2076~2212
119	N 14-15.0 E142-35.0	N 14-14.9 E142-36.9	120618	19:00	19:50	ORIBF	0.5	Obl.	550	0-226	0.6~0.2	2.7~2.3	22256	39120	2854	2809~3155
120	N 14-14.9 E142-25.3	N 14-14.3 E142-26.9	120618	21:08	21:53	ORIBF	0.5	Obl.	550	0-216	0.8~0.2	2.5~2.1	19164	33686	2854	3732~3825
121	N 14-10.0 E142-30.0	N 14-09.5 E142-31.5	120618	22:48	23:34	ORIBF	0.5	Obl.	550	0-257	0.8~0.2	2.5~1.5	19580	34417	2854	2892~3379
122	N 14-05.0 E142-35.0	N 14-04.6 E142-36.6	120619	00:29	01:16	ORIBF	0.5	Obl.	550	0-287	0.5~0.2	2.7~2.4	19906	34990	2854	2771~2948
123	N 13-54.9 E142-25.1	N 13-53.9 E142-26.7	120619	02:37	03:24	ORIBF	0.5	Obl.	550	0-222	0.5~0.2	2.5~2.3	23331	41010	2854	2754~2778
124	N 13-45.0 E142-14.6	N 13-44.1 E142-16.5	120619	04:52	05:43	ORIBF	0.5	Obl.	550	0-199	0.6~0.2	2.6~2.5	23390	41113	2854	3113~3177
125	N 13-50.0 E142-09.9	N 13-50.0 E142-11.9	120619	07:03	07:54	ORIBF	0.5	Obl.	550	0-210	0.6~0.2	2.8~2.5	24110	42379	2854	3539~3690
126	N 13-55.0 E142-05.2	N 13-54.5 E142-07.1	120619	09:13	10:00	ORIBF	0.5	Obl.	550	0-217	0.8~0.2	2.5~1.5	19969	35101	2854	3996~4069
127	N 13-49.9 E142-00.3	N 13-49.7 E142-02.3	120619	11:05	11:54	ORIBF	0.5	Obl.	550	0-202	0.7~0.2	2.5~2.2	21274	37395	2854	4094~4134
128	N 13-44.9 E141-55.1	N 13-44.5 E141-56.7	120619	12:52	13:39	ORIBF	0.5	Obl.	550	0-268	0.4~0.2	2.5~2.4	18734	32930	2854	4036~4102
129	N 13-40.0 E142-00.0	N 13-39.8 E142-01.7	120619	14:29	15:15	ORIBF	0.5	Obl.	550	0-256	0.4~0.2	2.5	25692	45160	2854	3647~3829
C-20	N 13-49.9 E142-20.0	N 13-49.8 E142-21.7	120619	19:17	19:58	ORIBF	0.5	Obl.	550	0-208	0.8~0.2	2.4	19577	34412	2854	3173~3318

KH-12-2 Net Record (ORIBF, IKMT)

St.	Location		Date	Time		Net Type	Mesh size (mm)	Towing Method	Wire out (m)	Sampl. layer (m)	Reel. speed (m/s)	Ship speed (kt)	Filt. volume (m <sup>3</sup> )	Flow-meter Revol.	Flow-meter No.	Sea Depth (m)
	Net in	Net out		Net in	Net out											
130	N 12-59.9 E141-25.0	N 12-59.3 E141-26.4	120620	01:38	02:26	ORIBF	0.5	Obl.	550	0-271	0.5~0.2	2.6	26483	46550	2854	3955~4007
131	N 12-49.9 E141-00.0	N 12-48.7 E141-01.2	120620	04:46	05:39	ORIBF	0.5	Obl.	550	0-228	0.6~0.2	2.5~2.3	24094	42352	2854	2612~3237
132	N 12-44.9 E140-45.0	N 12-44.3 E140-46.8	120620	07:21	08:11	ORIBF	0.5	Obl.	550	0-242	0.8~0.2	2.7~2.4	23351	41046	2854	4182~4248
133	N 12-39.9 E140-30.2	N 12-40.2 E140-32.0	120620	09:53	10:42	ORIBF	0.5	Obl.	550	0-260	0.8~0.2	2.6~2.5	20186	35482	2854	4036~4074
134	N 12-30.0 E140-20.1	N 12-28.7 E140-21.3	120620	12:16	13:03	ORIBF	0.5	Obl.	550	0-282	0.4~0.2	2.6~2.3	20384	35830	2854	4032~4215
135	N 12-20.0 E140-10.1	N 12-18.9 E140-11.4	120620	14:26	15:11	ORIBF	0.5	Obl.	550	0-271	0.6~0.2	2.6~2.5	25885	45500	2854	4363~4389
136	N 12-00.0 E140-49.8	N 12-00.7 E140-51.4	120620	21:28	22:16	ORIBF	0.5	Obl.	550	0-209	0.8~0.2	2.7~2.5	22447	39456	2854	3750~3893
137	N 12-10.1 E140-50.2	N 12-11.1 E140-51.6	120620	23:25	24:14	ORIBF	0.5	Obl.	550	0-270	0.6~0.2	2.5~2.4	25857	45450	2854	3453~3662
138	N 12-14.8 E141-05.2	N 12-13.7 E141-06.8	120621	01:34	02:23	ORIBF	0.5	Obl.	550	0-193	0.5~0.2	2.5	22409	39390	2854	4937~5301
139	N 12-20.2 E141-15.0	N 12-22.2 E141-14.9	120621	03:33	04:22	ORIBF	0.5	Obl.	550	0-251	0.5~0.2	2.5~2.4	23976	42144	2854	2660~4302
140	N 12-30.0 E141-19.9	N 12-32.0 E141-20.1	120621	05:41	06:33	ORIBF	0.5	Obl.	550	0-268	0.6~0.2	2.6~2.5	22605	39733	2854	1174~1700
141	N 12-40.0 E141-15.0	N 12-42.0 E141-15.1	120621	07:48	08:39	ORIBF	0.5	Obl.	550	0-281	0.8~0.2	2.5~1.5	21071	37038	2854	3248~3344
142	N 12-50.1 E141-15.0	N 12-51.6 E141-15.8	120621	09:49	10:39	ORIBF	0.5	Obl.	550	0-292	0.8~0.2	2.5~1.5	19600	34452	2854	2499~3382
143	N 13-00.1 E141-24.9	N 13-01.9 E141-24.8	120621	11:56	12:42	ORIBF	0.5	Obl.	550	0-238	0.3~0.2	2.5~2.4	19701	34630	2854	4012~4052
144	N 13-10.2 E141-34.9	N 13-11.6 E141-35.6	120621	14:04	14:50	ORIBF	0.5	Obl.	550	0-257	0.3~0.2	2.4~2.3	21220	37300	2854	3614~3620
145	N 13-20.1 E141-39.9	N 13-21.7 E141-40.7	120621	15:57	16:47	ORIBF	0.5	Obl.	550	0-243	0.6~0.2	2.7~2.4	22456	39472	2854	3636~3924

## KH-12-2 Net Record (ORIBF, IKMT)

St.	Location		Date	Time		Net Type	Mesh size (mm)	Towing Method	Wire		Reel speed (m/s)	Ship speed (kt)	Filt. volume (m <sup>3</sup> )	Flow-meter Revol.	Flow-meter No.	Sea Depth (m)	
	Net in	Net out		Net in	Net out				out (m)	layer (m)							
146	N 13-29.9 E141-44.9	N 13-30.8 E141-46.1	120621	17:57	18:48	ORIBF	0.5	Obl.	550	0-293	0.6~0.2	2.7~2.4	22096	38840	2854	3031~3098	
147	N 13-40.1 E141-49.8	N 13-40.5 E141-50.9	120621	20:07	20:56	ORIBF	0.5	Obl.	550	0-322	0.8~0.2	2.7~2.5	15362	27002	2854	4190~4194	
148	N 13-50.0 E141-54.8	N 13-50.6 E141-56.1	120621	22:14	23:02	ORIBF	0.5	Obl.	550	0-293	0.8~0.2	2.5~2.4	18091	31800	2854	4092~4206	
149	N 14-00.0 E142-00.0	N 14-00.2 E142-01.8	120622	00:15	01:07	ORIBF	0.5	Obl.	550	0-396	0.4~0.2	2.9~2.7	22432	39430	2854	4232~4269	
150	N 14-10.0 E142-05.1	N 14-09.5 E142-06.5	120622	02:19	03:10	ORIBF	0.5	Obl.	550	0-283	0.4~0.2	2.6~2.2	25982	45670	2854	4270~4298	
149-2	N 13-59.9 E142-00.1	N 13-59.0 E142-01.2	120622	05:11	06:01	ORIBF	0.5	Obl.	550	0-355	0.7~0.2	2.6~2.2	17606	30947	2854	4225~4264	
151	N 14-20.2 E142-10.1	N 14-19.9 E142-11.6	120622	08:04	08:54	ORIBF	0.5	Obl.	550	0-291	0.8~0.2	2.7~2.5	18853	33138	2854	4133~4174	
152	N 14-30.0 E142-15.3	N 14-29.3 E142-17.1	120622	10:10	10:59	ORIBF	0.5	Obl.	550	0-222	0.8~0.2	2.8~2.5	22293	39185	2854	4080~4116	
153	N 14-40.1 E142-15.1	N 14-39.8 E142-17.1	120622	12:12	13:02	ORIBF	0.5	Obl.	550	0-218	0.3~0.2	2.7~2.6	17380	30550	2854	4159~4242	
154	N 14-50.0 E142-20.1	N 14-50.0 E142-21.7	120622	14:10	15:01	ORIBF	0.5	Obl.	550	0-238	0.4~0.2	2.5~2.0	20469	35980	2854	4276~4306	
155	N 15-00.2 E142-20.0	N 14-59.6 E142-21.6	120622	16:09	17:00	ORIBF	0.5	Obl.	550	0-212	0.7~0.2	2.5~2.0	19371	34049	2854	4320~4340	
156	N 15-09.9 E142-20.2	N 15-09.5 E142-21.9	120622	18:09	18:59	ORIBF	0.5	Obl.	550	0-210	0.6~0.2	2.7~2.2	21384	37587	2854	4186~4195	
157	N 15-20.1 E142-20.2	N 15-19.6 E142-21.9	120622	20:17	21:04	ORIBF	0.5	Obl.	550	0-193	0.8~0.2	2.5~2.2	21204	37272	2854	4170~4199	
158	N 15-30.2 E142-10.4	N 15-30.0 E142-12.2	120622	22:38	23:27	ORIBF	0.5	Obl.	550	0-204	0.8~0.2	2.5~2.4	22462	39482	2854	4158~4282	
159	N 15-40.1 E142-00.2	N 15-39.5 E142-01.8	120623	01:05	01:50	ORIBF	0.5	Obl.	550	0-218	0.4~0.2	2.4	19992	35140	2854	4428~4440	
160	N 15-50.0 E142-00.2	N 15-49.5 E142-01.8	120623	03:02	03:47	ORIBF	0.5	Obl.	550	0-219	0.5~0.2	2.5	19280	33890	2854	4409~4450	

KH-12-2 Net Record (ORIBF, IKMT)

St.	Location		Date	Time		Net Type	Mesh size (mm)	Towing Method	Wire out (m)	Sampl. layer (m)	Reel. speed (m/s)	Ship speed (kt)	Filt. volume (m <sup>3</sup> )	Flow-meter Revol.	Flow-meter No.	Sea Depth (m)
	Net in	Net out		Net in	Net out											
161	N 16-00.0 E142-00.2	N 15-59.1 E142-01.9	120623	05:00	05:51	ORIBF	0.5	Obl.	550	0-239	0.6~0.2	2.6~2.1	22027	38718	2854	4408~4420
162	N 16-10.1 E142-00.2	N 16-10.7 E142-02.2	120623	07:07	07:58	ORIBF	0.5	Obl.	550	0-236	0.8~0.2	2.5~2.2	21864	38432	2854	4320~4369
163	N 16-19.9 E142-05.1	N 16-19.6 E142-06.8	120623	09:06	09:34	ORIBF	0.5	Obl.	550	0-255	0.8~0.2	2.6~1.5	18656	32792	2854	4213~4279
164	N 16-30.5	N 16-30.7	120623	13:00	13:47	ORIBF	0.5	Obl.	550	0-312	0.8~0.2	2.5	22284	39169	2854	3988~4015

KH-12-2		St. 8-15-1		Depth	4207m	
Date:	2012/5/20			Lat.	15	00.08N
Time:	06:26			Long.	142	29.80E
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.
		db	°C	(psu)	ml/l	ug/l
		Sur.	***	***	***	***
		10	29.475	34.555	4.3232	0.0896
		20	29.478	34.555	4.3252	0.0963
		30	29.480	34.555	4.3172	0.0902
		40	28.951	34.487	4.4446	0.1100
		50	28.613	34.453	4.4769	0.1190
		75	28.124	34.512	4.4704	0.1710
		100	27.662	34.711	4.4461	0.2080
		125	26.586	34.945	4.3324	0.3260
		150	24.786	34.960	4.4726	0.2410
		175	23.192	35.035	4.1883	0.1890
		200	20.958	34.971	4.1418	0.1020
		250	18.387	34.813	3.9746	0.0599
		300	15.288	34.563	3.8990	0.0555
		400	10.097	34.356	2.4151	0.0665
		500	8.038	34.417	1.6970	0.0720
GTD data (BTL)						
BTL	Depth	Pres.	Temp.	Sal	DO	Flu.
No.	m	db	°C	(psu)	ml/l	ug/l
1	198	198.8	20.727	35.045	4.1478	0.1170
2	198	199.2	20.858	35.056	4.1386	0.1300
3	198	199.0	20.848	35.055	4.1447	0.1200
4	198	199.2	20.846	35.056	4.1477	0.1120
5	198	199.7	20.844	35.056	4.1448	0.1110
6	198	199.3	20.844	35.057	4.1426	0.1170
7	198	199.1	20.848	35.057	4.1372	0.1350
8	198	199.4	20.848	35.057	4.1366	0.1200
9	198	199.3	20.848	35.057	4.1376	0.1140
10	198	199.5	20.848	35.058	4.1384	0.1200
11	198	199.4	20.854	35.058	4.1379	0.1280
12	198	199.0	20.859	35.059	4.1412	0.1330
13	198	199.2	20.856	35.059	4.1424	0.1200
14	198	199.3	20.850	35.059	4.1406	0.1180
15	198	199.1	20.849	35.059	4.1466	0.1290
16	198	199.2	20.849	35.059	4.1364	0.1230
17	198	199.3	20.848	35.059	4.1376	0.1180
18	198	199.4	20.851	35.060	4.1379	0.1210
19	198	199.2	20.854	35.061	4.1398	0.1260
20	198	199.3	20.854	35.061	4.1383	0.1190
21	198	199.5	20.854	35.061	4.1425	0.1110
22	198	199.7	20.853	35.061	4.1486	0.1110
23	198	199.5	20.854	35.062	4.1409	0.1220
24	198	199.2	20.859	35.063	4.1378	0.1220

KH-12-2		St. 8-15-2		Depth	4198m	
Date:	2012/5/20			Lat.	15	00.01N
Time:	07:35			Long.	142	30.02E
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.
		db	°C	(psu)	ml/l	ug/l
		Sur.	***	***	***	***
		10	29.350	34.619	4.3327	0.0850
		20	29.351	34.647	4.3274	0.0871
		30	29.234	34.627	4.3756	0.0943
		40	28.594	34.557	4.4808	0.1140
		50	28.385	34.537	4.4931	0.1220
		75	27.898	34.628	4.4771	0.1760
		100	27.429	34.813	4.4598	0.2400
		125	26.453	35.043	4.3357	0.3600
150	24.703	35.053	4.4920	0.3500		
CTD data (BTL)						
BTL	Depth	Pres.	Temp.	Sal	DO	Flu.
No.	m	db	°C	(psu)	ml/l	ug/l
1	150	151.0	24.708	35.053	4.4920	0.2760
2	150	150.6	24.719	35.052	4.4924	0.3680
3	150	150.7	24.719	35.052	4.4818	0.3320
4	150	150.9	24.716	35.053	4.4844	0.3210
5	150	150.7	24.720	35.052	4.4874	0.3270
6	150	151.0	24.704	35.054	4.4902	0.3210
7	150	150.9	24.700	35.055	4.4876	0.3260
8	150	150.9	24.699	35.055	4.4818	0.3270
9	150	150.7	24.708	35.054	4.4902	0.3360
10	150	150.7	24.708	35.053	4.4865	0.3040
11	150	150.7	24.694	35.055	4.4837	0.3320
12	150	150.9	24.676	35.057	4.4839	0.2970
13	150	150.8	24.703	35.054	4.4839	0.2930
14	150	151.0	24.681	35.057	4.4838	0.2760
15	150	151.0	24.690	35.056	4.4810	0.3490
16	150	150.6	24.707	35.054	4.4929	0.2770
17	150	150.7	24.716	35.053	4.4890	0.3490
18	150	150.9	24.705	35.054	4.4882	0.3470
19	150	150.8	24.696	35.055	4.4787	0.3050
20	150	150.7	24.686	35.057	4.4828	0.2960
21	150	150.9	24.683	35.057	4.4860	0.2830
22	150	150.8	24.704	35.054	4.4893	0.3030
23	150	150.9	24.706	35.054	4.4806	0.3150
24	150	150.8	24.693	35.056	4.4875	0.2920



KH-12-2		St. 8-15-3		Depth		4200m		
Date:	2012/5/20			Lat.		15	00.00N	
Time:	08:26			Long.		142	30.03E	
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.		
		db	°C	(psu)	ml/l	ug/l		
		Sur.	29.6	***	***	***	***	
		10	29.348	34.653	4.3332	0.0784		
		20	29.347	34.654	4.3400	0.0832		
		30	28.997	34.606	4.4146	0.0948		
		40	28.514	34.554	4.4761	0.1050		
		50	28.287	34.533	4.4821	0.1170		
		75	27.717	34.675	4.4826	0.1770		
		100	26.970	34.945	4.4345	0.2540		
		125	25.840	35.117	4.2155	0.5240		
		150	24.593	35.066	4.4801	0.3100		
		175	23.470	35.141	4.2656	0.2210		
		200	21.903	35.147	4.0792	0.1310		
		250	18.296	34.922	3.9734	0.0563		
		300	14.573	34.625	3.7944	0.0546		
		400	9.794	34.458	2.3532	0.0661		
		500	7.920	34.508	1.7025	0.0709		
		600	6.637	34.533	1.6680	0.0000		
		700	5.786	34.575	1.6609	0.0745		
800	5.147	34.627	1.7276	0.0741				
900	4.687	34.669	1.8019	0.0743				
1000	4.411	34.699	1.8058	0.0739				
CTD data (BTL)								
BTL	Depth	Pres.	Temp.	Sal	DO	Flu.		
No.	m	db	°C	(psu)	ml/l	ug/l		
1	992	1000.0	4.394	34.727	1.8022	0.0752		
2	942	950.1	4.504	34.721	1.8073	0.0749		
3	893	900.0	4.641	34.711	1.8045	0.0745		
4	844	850.2	4.809	34.700	1.7738	0.0756		
5	794	800.4	5.116	34.679	1.7243	0.0748		
6	744	749.8	5.418	34.658	1.6839	0.0756		
7	695	700.0	5.722	34.637	1.6654	0.0748		
8	646	650.4	6.088	34.614	1.6633	0.0751		
9	596	600.3	6.421	34.597	1.6690	0.0754		
10	546	549.8	7.033	34.596	1.6681	0.0750		
11	496	499.7	7.746	34.592	1.6666	0.0754		
12	447	449.8	8.635	34.536	2.0134	0.0723		
13	397	399.9	9.643	34.526	2.2822	0.0687		
14	348	349.8	12.484	34.580	3.3159	0.0614		
15	298	300.2	14.500	34.701	3.7994	0.0598		
16	249	250.2	18.051	34.982	3.9721	0.0600		
17	209	209.9	20.461	35.141	4.0902	0.1050		
18	149	149.9	24.551	35.133	4.4914	0.2780		
19	99	99.7	27.082	34.967	4.4554	0.3030		
20	49	49.4	27.996	34.640	4.5023	0.1400		
21	4	4.3	29.255	34.722	4.3409	0.0752		
22	377	380.0	11.259	34.515	2.6185	0.0673		
23	158	158.8	24.215	35.152	4.4546	0.2370		
24	130	130.3	25.452	35.183	4.2153	0.4930		

KH-12-2		St. 15-1		Depth	4022m		
Date:	2012/5/21			Lat.	16 29.98N		
Time:	03:34			Long.	142 24.95E		
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.	
		db	°C	(psu)	ml/l	ug/l	
		Sur.	29.0	***	***	***	
		10	28.894	34.867	4.3512	0.0845	
		20	28.898	34.868	4.3468	0.0890	
		30	28.230	34.854	4.4945	0.0955	
		40	27.593	34.869	4.5661	0.1030	
		50	27.084	34.842	4.6234	0.1100	
		75	26.619	34.952	4.5561	0.1250	
		100	25.426	35.046	4.5258	0.2330	
		125	23.961	35.143	4.4488	0.5990	
		150	22.457	35.161	4.3089	0.4330	
		175	20.731	35.066	4.1409	0.2180	
		200	19.144	34.959	4.3091	0.0831	
		250	17.621	34.854	4.4107	0.0535	
		300	15.996	34.765	4.1761	0.0555	
		400	11.660	34.464	3.8042	0.0568	
		500	8.360	34.399	2.2068	0.0682	
		600	6.684	34.465	1.5506	0.0741	
		700	5.781	34.556	1.4480	0.0754	
800	5.117	34.623	1.5472	0.0755			
900	4.598	34.682	1.6047	0.0756			
1000	4.151	34.713	1.7346	0.0745			
CTD data (BTL)							
BTL	Depth	Pres.	Temp.	Sal	DO	Flu.	
No.	m	db	°C	(psu)	ml/l	ug/l	
1	992	1000.6	4.148	34.715	1.7404	0.0739	
2	942	949.6	4.348	34.706	1.7004	0.0758	
3	893	899.8	4.549	34.696	1.6278	0.0757	
4	843	849.6	4.793	34.679	1.5905	0.0773	
5	794	800.2	5.068	34.655	1.5504	0.0771	
6	743	748.9	5.292	34.631	1.5084	0.0770	
7	695	700.5	5.557	34.606	1.4745	0.0768	
8	646	650.8	6.041	34.556	1.4418	0.0763	
9	595	599.8	6.571	34.511	1.5213	0.0760	
10	546	549.9	7.172	34.471	1.7856	0.0747	
11	498	501.5	8.237	34.453	2.1852	0.0729	
12	447	450.1	9.467	34.442	2.7423	0.0669	
13	397	399.7	11.463	34.508	3.7631	0.0624	
14	348	350.4	13.811	34.665	4.1117	0.0585	
15	298	300.3	15.909	34.812	4.1753	0.0572	
16	247	249.0	17.572	34.907	4.4347	0.0573	
17	199	200.6	19.122	35.012	4.3091	0.0947	
18	149	149.8	22.443	35.209	4.3245	0.3930	
19	100	100.3	25.168	35.113	4.5185	0.2490	
20	50	50.3	27.096	34.899	4.6076	0.1260	
21	4	3.9	28.825	34.913	4.3537	0.0892	
22	319	320.9	14.679	34.727	4.1362	0.0583	
23	179	179.9	20.362	35.098	4.1657	0.1430	
24	129	130.3	23.499	35.213	4.4463	0.5040	



KH-12-2		St. 15-2		Depth	4020m	
Date:	2012/5/21			Lat.	16 29.98N	
Time:	05:33			Long.	142 24.99E	
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.
		db	°C	(psu)	ml/l	ug/l
		Sur.	***	***	***	***
		10	28.837	34.900	4.3509	0.0876
		20	28.833	34.900	4.3482	0.0950
		30	28.347	34.892	4.4632	0.0965
		40	27.531	34.903	4.5632	0.1110
		50	26.984	34.889	4.6157	0.1090
		75	26.608	34.984	4.5655	0.1260
		100	25.341	35.095	4.5509	0.2270
		125	24.178	35.169	4.4598	0.5290
		150	22.702	35.224	4.4539	0.3520
		175	21.067	35.148	4.1254	0.2350
200	19.283	35.012	4.2868	0.0911		
CTD data (BTL)						
BTL	Depth	Pres.	Temp.	Sal	DO	Flu.
No.	m	db	°C	(psu)	ml/l	ug/l
1	200	201.1	19.093	34.998	4.3073	0.0957
2	200	200.8	19.111	34.999	4.3107	0.0995
3	200	201.3	19.096	35.000	4.3079	0.0935
4	200	201.1	19.095	34.999	4.3078	0.0946
5	200	200.9	19.102	34.999	4.3128	0.0909
6	199	200.8	19.102	34.999	4.3087	0.0943
7	199	200.6	19.101	34.999	4.3059	0.0889
8	199	200.5	19.104	34.999	4.3101	0.0918
9	199	200.6	19.106	34.999	4.3119	0.0873
10	199	200.7	19.109	35.000	4.3100	0.0922
11	199	200.8	19.112	35.000	4.3111	0.0926
12	200	201.2	19.097	34.999	4.3073	0.0848
13	200	201.2	19.097	34.999	4.3080	0.0931
14	200	201.0	19.080	34.999	4.3106	0.1010
15	199	200.7	19.093	34.999	4.3083	0.0889
16	200	201.3	19.090	34.999	4.3054	0.0851
17	200	201.6	19.095	34.999	4.3053	0.0860
18	200	201.4	19.103	35.000	4.3048	0.0888
19	200	200.9	19.107	35.000	4.3077	0.1040
20	200	201.0	19.091	34.999	4.3117	0.0982
21	200	201.2	19.084	34.998	4.3095	0.0963
22	200	201.2	19.082	34.998	4.3132	0.0968
23	199	200.6	19.111	35.000	4.3057	0.0902
24	200	201.5	19.087	34.999	4.3082	0.0842

KH-12-2		St. 15-3		Depth	4020m	
Date:	2012/5/21			Lat.	16	30.00N
Time:	06:22			Long.	142	25.00E
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.
		db	°C	(psu)	ml/l	ug/l
		Sur.	***	***	***	***
		10	28.837	34.898	4.3647	0.0849
		20	28.832	34.898	4.3531	0.0878
		30	28.439	34.895	4.4625	0.0987
		40	27.505	34.902	4.5741	0.1020
		50	26.968	34.891	4.6095	0.1180
		75	26.607	34.979	4.5616	0.1190
		100	25.190	35.101	4.5141	0.2120
		125	24.072	35.172	4.4448	0.5840
		150	22.534	35.215	4.3839	0.3490
CTD data (BTL)						
BTL	Depth	Pres.	Temp.	Sal	DO	Flu.
No.	m	db	°C	(psu)	ml/l	ug/l
1	149	150.0	22.496	35.212	4.3881	0.3060
2	149	150.2	22.495	35.212	4.3836	0.2790
3	149	150.1	22.497	35.213	4.3769	0.2990
4	149	150.1	22.501	35.213	4.3831	0.3370
5	149	149.7	22.504	35.213	4.3861	0.3220
6	148	149.4	22.511	35.213	4.3891	0.3160
7	149	149.7	22.518	35.214	4.3851	0.3540
8	149	149.8	22.513	35.213	4.3862	0.3280
9	149	149.7	22.531	35.215	4.3900	0.4130
10	149	149.9	22.523	35.214	4.3832	0.3380
11	149	150.2	22.527	35.214	4.3904	0.3310
12	149	149.9	22.524	35.215	4.3907	0.3880
13	149	150.1	22.534	35.215	4.3996	0.3100
14	149	150.2	22.536	35.215	4.3904	0.3790
15	149	149.7	22.528	35.215	4.3978	0.3330
16	149	149.6	22.557	35.216	4.3984	0.3010
17	150	150.9	22.547	35.216	4.3886	0.2750
18	149	150.2	22.541	35.216	4.4053	0.3110
19	149	149.6	22.604	35.218	4.4208	0.3520
20	149	149.7	22.641	35.219	4.4201	0.4300
21	149	149.8	22.677	35.221	4.4390	0.3750
22	149	150.2	22.700	35.222	4.4373	0.3490
23	149	149.9	22.701	35.222	4.4203	0.3410
24	149	149.5	22.667	35.222	4.4413	0.2960

KH-12-2		St.19-1		Depth		4341m		
Date:	2012/5/21			Lat.		14 14.83N		
Time:	19:14			Long.		142 04.88E		
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.		
		db	°C	(psu)	ml/l	ug/l		
		Sur.	29.5	***	***	***	***	
		10	29.373	34.766	4.3300	0.1010		
		20	29.375	34.766	4.3256	0.0937		
		30	29.383	34.765	4.3199	0.0953		
		40	29.186	34.748	4.3783	0.0992		
		50	28.309	34.676	4.5352	0.1160		
		75	27.767	34.745	4.4822	0.1770		
		100	26.787	34.935	4.5456	0.2310		
		125	26.115	34.960	4.5207	0.2920		
		150	25.538	35.039	4.4344	0.3800		
		175	24.595	35.152	4.2906	0.2170		
		200	23.166	35.316	3.9331	0.1590		
		250	18.662	35.002	3.9717	0.0637		
		300	13.184	34.589	3.1492	0.0592		
		400	9.039	34.489	2.0946	0.0672		
		500	7.462	34.569	1.5749	0.0717		
		600	6.454	34.622	1.6155	0.0730		
		700	5.861	34.658	1.6206	0.0738		
		800	5.309	34.682	1.6546	0.0738		
		900	4.816	34.698	1.7288	0.0745		
		1000	4.292	34.734	1.7649	0.0753		
CTD data (BTL)								
BTL	Depth	Pres.	Temp.	Sal	DO	Flu.		
No.	m	db	°C	(psu)	ml/l	ug/l		
1	994	1002.4	4.280	34.735	1.7601	0.0748		
2	942	949.9	4.539	34.726	1.7401	0.0759		
3	893	900.2	4.738	34.719	1.7334	0.0759		
4	843	849.5	4.990	34.713	1.7339	0.0765		
5	794	800.0	5.237	34.707	1.6870	0.0755		
6	745	750.5	5.491	34.699	1.6845	0.0754		
7	695	700.5	5.800	34.687	1.6440	0.0751		
8	646	650.3	6.197	34.665	1.6703	0.0762		
9	596	600.0	6.511	34.651	1.5922	0.0746		
10	546	550.4	6.972	34.634	1.5058	0.0751		
11	497	500.2	7.582	34.593	1.5952	0.0745		
12	447	449.9	8.187	34.540	1.8087	0.0725		
13	397	400.1	9.100	34.523	2.1142	0.0705		
14	347	349.7	10.980	34.536	2.7983	0.0659		
15	298	299.8	12.770	34.609	3.1681	0.0627		
16	248	250.1	17.395	34.925	3.9489	0.0654		
17	199	199.8	20.513	35.195	3.9355	0.1010		
18	149	150.2	25.219	35.086	4.3916	0.3730		
19	100	100.2	27.120	34.927	4.4940	0.2970		
20	50	50.7	29.034	34.772	4.3939	0.1280		
21	4	4.4	29.323	34.801	4.3316	0.0950		
22	358	360.4	10.128	34.518	2.5131	0.0670		
23	189	190.1	22.452	35.323	3.9438	0.1760		
24	159	159.8	24.650	35.169	4.3116	0.2440		

KH-12-2		St. 19-2		Depth	4317m	
Date:	2012/5/21			Lat.	14	15.51N
Time:	21:32			Long.	142	05.47E
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.
		db	°C	(psu)	ml/l	ug/l
		Sur.	29.3	***	***	***
		10	29.353	34.790	4.3223	0.0990
		20	29.357	34.791	4.3208	0.1000
		30	29.351	34.789	4.3223	0.1040
		40	29.355	34.789	4.3214	0.1010
		50	29.313	34.783	4.3422	0.1070
		75	28.104	34.700	4.5202	0.1310
		100	27.550	34.833	4.4876	0.2150
		125	26.559	34.976	4.5387	0.2660
		150	25.773	35.055	4.4492	0.5120
		175	24.472	35.297	4.0627	0.2280
200	22.316	35.297	3.9399	0.1730		
CTD data (BTL)						
BTL	Depth	Pres.	Temp.	Sal	DO	Flu.
No.	m	db	°C	(psu)	ml/l	ug/l
1	202	202.9	21.740	35.257	3.9582	0.1530
2	202	203.1	21.737	35.257	3.9505	0.1350
3	202	203.6	21.672	35.252	3.9541	0.1500
4	203	204.0	21.608	35.249	3.9489	0.1320
5	203	204.0	21.617	35.249	3.9544	0.1420
6	203	204.2	21.535	35.248	3.9467	0.1420
7	203	204.5	21.514	35.246	3.9432	0.1350
8	199	200.5	21.680	35.253	3.9477	0.1470
9	199	200.6	21.892	35.264	3.9493	0.1650
10	199	200.7	21.921	35.270	3.9510	0.1490
11	199	200.8	21.890	35.272	3.9487	0.1410
12	200	200.9	21.877	35.271	3.9446	0.1430
13	200	201.2	21.825	35.268	3.9453	0.1460
14	200	201.0	21.834	35.266	3.9464	0.1370
15	200	200.9	21.911	35.270	3.9481	0.1440
16	199	200.7	21.930	35.273	3.9560	0.1310
17	199	200.5	21.985	35.275	3.9504	0.1480
18	200	201.1	21.877	35.269	3.9528	0.1350
19	200	201.0	21.853	35.267	3.9530	0.1300
20	200	201.1	21.937	35.274	3.9465	0.1280
21	199	200.7	22.067	35.283	3.9450	0.1340
22	200	200.9	22.003	35.278	3.9424	0.1470
23	200	200.8	21.991	35.278	3.9466	0.1400
24	200	201.0	21.931	35.272	3.9503	0.1390

KH-12-2		St.OH-1		Depth	5106m	
Date:	2012/5/24			Lat.	14 00.03N	
Time:	08:00			Long.	137 59.90E	
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.
		db	°C	(psu)	ml/l	ug/l
		Sur.	30.2	***	***	***
		10	29.779	34.637	4.2698	0.0823
		20	29.767	34.637	4.2749	0.0868
		30	29.219	34.612	4.4372	0.1020
		40	28.614	34.593	4.4924	0.1090
		50	28.165	34.615	4.5334	0.1290
		75	27.485	34.759	4.5077	0.1730
		100	27.009	34.873	4.5350	0.2340
		125	26.513	34.965	4.4021	0.3040
		150	25.732	35.081	4.3116	0.4500
		175	23.934	35.276	3.9992	0.2090
		200	22.771	35.263	3.9399	0.1600
		250	17.888	34.918	3.9505	0.0557
		300	14.494	34.653	3.8105	0.0559
		400	9.233	34.384	2.7690	0.0652
		500	7.173	34.476	1.6512	0.0726
CTD data (BTL)						
BTL	Depth	Pres.	Temp.	Sal	DO	Flu.
No.	m	db	°C	(psu)	ml/l	ug/l
1	357	359.9	10.842	34.435	3.2334	0.0623
6	358	360.5	11.076	34.445	3.3295	0.0614
12	358	360.8	11.058	34.448	3.3359	0.0618
18	358	360.3	11.075	34.446	3.3144	0.0612

KH-12-2	St.35-1	Depth	3883m			
Date:	2012/5/25	Lat.	12 00.08N			
Time:	03:15	Long.	140 50.26E			
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.	
	db	°C	(psu)	ml/l	ug/l	
	Sur.	29.5	***	***	***	
	10	29.337	34.551	4.3030	0.1270	
	20	29.334	34.552	4.3009	0.1300	
	30	29.329	34.555	4.3025	0.1260	
	40	28.606	34.617	4.5190	0.1390	
	50	28.392	34.625	4.5124	0.1370	
	75	27.892	34.699	4.4831	0.1550	
	100	26.747	34.985	4.3725	0.2940	
	125	25.315	35.168	4.1755	0.4880	
	150	24.167	35.283	4.0164	0.2490	
	175	21.097	35.182	3.9144	0.1070	
	200	18.689	35.007	3.7635	0.0657	
	250	13.940	34.630	3.1608	0.0614	
	300	11.517	34.493	2.8544	0.0613	
	400	8.424	34.556	1.6882	0.0714	
	500	7.241	34.601	1.6037	0.0733	
	600	6.572	34.639	1.7023	0.0740	
	700	5.907	34.649	1.6946	0.0746	
	800	5.496	34.661	1.7217	0.0766	
	900	4.984	34.673	1.7118	0.0760	
	1000	4.559	34.686	1.7496	0.0764	
CTD data (BTL)						
BTL	Depth	Pres.	Temp.	Sal	DO	Flu.
No.	m	db	°C	(psu)	ml/l	ug/l
1	994	1001.7	4.557	34.687	1.7457	0.0755
2	943	950.1	4.689	34.685	1.7424	0.0767
3	893	900.4	4.951	34.680	1.7299	0.0760
4	843	849.9	5.332	34.667	1.7120	0.0757
5	794	799.8	5.493	34.667	1.7168	0.0760
6	745	750.6	5.585	34.664	1.7012	0.0763
7	695	700.0	5.848	34.658	1.6965	0.0764
8	645	650.0	6.180	34.651	1.6841	0.0762
9	596	600.3	6.502	34.656	1.7015	0.0758
10	546	550.1	6.819	34.629	1.5783	0.0759
11	497	500.1	7.080	34.630	1.5680	0.0760
12	447	450.2	7.735	34.613	1.5913	0.0756
13	398	400.3	8.311	34.573	1.6535	0.0743
14	348	350.0	9.367	34.532	2.0355	0.0707
15	300	302.2	10.662	34.502	2.7079	0.0662
16	249	250.5	13.314	34.615	3.0345	0.0650
17	199	200.3	18.627	35.025	3.7735	0.0782
18	149	150.0	23.280	35.307	3.9431	0.2110
19	100	100.3	27.105	34.919	4.4155	0.2990
20	50	50.3	28.305	34.660	4.5040	0.1510
21	5	5.5	29.280	34.577	4.3025	0.1230
22	358	360.1	8.942	34.538	1.8519	0.0725
23	170	170.7	21.189	35.209	3.9197	0.1160
24	119	120.2	25.709	35.122	4.2552	0.4290

KH-12-2	St. 35-2	Depth	3894m			
Date:	2012/5/25	Lat.	12 00.07N			
Time:	05:06	Long.	140 50.00E			
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.	
	db	°C	(psu)	ml/l	ug/l	
	Sur.	***	***	***	***	
	10	29.287	34.619	4.2761	0.1140	
	20	29.292	34.597	4.3002	0.1260	
	30	29.295	34.597	4.3051	0.1130	
	40	28.680	34.634	4.5220	0.1480	
	50	28.365	34.647	4.5257	0.1270	
	75	27.856	34.720	4.4880	0.1410	
	100	27.443	34.821	4.4088	0.2240	
	121	26.533	35.034	4.3584	0.2840	
CTD data (BTL)						
BTL	Depth	Pres.	Temp.	Sal	DO	Flu.
No.	m	db	°C	(psu)	ml/l	ug/l
1	120	120.4	26.559	35.029	4.3573	0.3470
2	120	120.6	26.558	35.029	4.3558	0.3390
3	120	120.3	26.561	35.029	4.3613	0.3950
4	120	120.6	26.552	35.030	4.3577	0.3760
5	119	120.1	26.563	35.029	4.3564	0.3360
6	119	120.1	26.561	35.029	4.3580	0.3400
7	119	120.2	26.559	35.029	4.3625	0.3860
8	119	120.1	26.558	35.029	4.3487	0.3680
9	120	120.7	26.537	35.034	4.3459	0.4130
10	120	120.8	26.537	35.034	4.3535	0.3510
11	119	120.2	26.547	35.031	4.3546	0.3310
12	120	120.2	26.543	35.032	4.3543	0.4200
13	120	120.3	26.536	35.034	4.3513	0.3610
14	120	120.7	26.534	35.034	4.3549	0.3390
15	120	120.4	26.536	35.034	4.3574	0.3890
16	120	120.6	26.535	35.034	4.3477	0.3920
17	120	120.6	26.533	35.035	4.3512	0.3600
18	120	120.7	26.532	35.035	4.3562	0.3450
19	120	120.4	26.534	35.034	4.3554	0.3980
20	119	120.1	26.539	35.033	4.3479	0.3350
21	120	120.3	26.536	35.034	4.3526	0.4220
22	120	120.3	26.535	35.034	4.3516	0.4290
23	119	120.1	26.538	35.033	4.3480	0.3750
24	100	100.3	27.375	34.851	4.4042	0.3050

KH-12-2		St. 36		Depth		3488m	
Date:	2012/5/25			Lat.		11	00.15N
Time:	19:04			Long.		143	59.95E
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.	
		db	°C	(psu)	ml/l	ug/l	
		Sur.	29.8	***	***	***	
		10	29.492	34.525	4.3064	0.0903	
		20	29.388	34.533	4.3105	0.0973	
		30	29.391	34.549	4.3115	0.0991	
		40	29.205	34.551	4.3762	0.1020	
		50	28.847	34.583	4.4114	0.1360	
		75	28.021	34.749	4.4823	0.1570	
		100	27.744	34.888	4.4394	0.1910	
		125	27.084	35.165	4.3596	0.4960	
		150	25.554	35.317	4.2741	0.5000	
		175	22.969	35.370	3.9987	0.2590	
		200	19.922	35.174	3.6801	0.1880	
		250	14.250	34.709	2.8654	0.0800	
		300	11.530	34.619	2.2506	0.0649	
		400	8.358	34.642	1.3616	0.0722	
		500	7.278	34.677	1.6002	0.0748	

KH-12-2		St. 38		Depth	5630m	
Date:	2012/5/26			Lat.	10	59.97N
Time:	13:17			Long.	148	00.14E
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.
		db	°C	(psu)	ml/l	ug/l
		Sur.	29.4	***	***	***
		10	29.149	34.464	4.3022	0.0899
		20	29.110	34.523	4.3043	0.0936
		30	29.084	34.525	4.3144	0.0991
		40	29.070	34.547	4.3146	0.1140
		50	29.081	34.610	4.3253	0.1270
		75	28.460	34.727	4.4486	0.1710
		100	27.875	34.930	4.4431	0.2030
		125	27.106	35.101	4.3939	0.4260
		150	23.870	35.421	4.0431	0.4120
		175	21.272	35.310	3.9193	0.1750
		200	19.620	35.148	3.9056	0.1020
		250	13.871	34.622	3.8223	0.0561
		300	11.766	34.537	2.7778	0.0606
		400	8.017	34.616	1.3447	0.0722
		500	7.074	34.659	1.5302	0.0738

KH-12-2		St. 41		Depth		4106m	
Date:	2012/5/27			Lat.		4	59.96N
Time:	17:16			Long.		147	59.98E
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.	
		db	°C	(psu)	ml/l	ug/l	
		Sur.	29.9	***	***	***	
		10	29.750	34.395	4.2920	0.0868	
		20	29.628	34.469	4.3073	0.0834	
		30	29.623	34.537	4.3078	0.0900	
		40	29.461	34.646	4.3498	0.1010	
		50	29.313	34.695	4.3352	0.1080	
		75	28.833	34.706	4.2688	0.2240	
		100	27.763	34.843	3.9807	0.8710	
		125	25.991	34.851	3.4439	0.5270	
		150	23.918	35.064	3.3617	0.1910	
		175	17.964	34.897	2.9368	0.0702	
		200	13.136	34.729	2.3602	0.0652	
		250	9.918	34.731	1.5688	0.0682	
		300	9.126	34.772	1.4805	0.0721	
		400	8.047	34.769	1.5329	0.0745	
		500	7.461	34.747	1.6780	0.0745	

KH-12-2		St. 45		Depth	3787m	
Date:	2012/5/29			Lat.	4	59.86N
Time:	05:14			Long.	143	59.82E
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.
		db	°C	(psu)	ml/l	ug/l
		Sur.	29.5	***	***	***
		10	29.382	34.489	4.2910	0.1220
		20	29.481	34.596	4.2823	0.1190
		30	29.511	34.615	4.2892	0.1360
		40	29.520	34.622	4.2831	0.1350
		50	29.546	34.637	4.2888	0.1370
		75	29.434	34.913	4.2894	0.3850
		100	28.888	34.925	4.1017	0.6540
		125	28.130	35.122	3.5967	0.4080
		150	23.372	35.068	3.3136	0.1240
		175	18.568	34.914	2.8971	0.0913
		200	13.336	34.732	2.2851	0.0683
		250	10.360	34.747	1.3330	0.0696
		300	9.368	34.790	1.1592	0.0745
		400	8.307	34.767	1.4493	0.0750
		500	7.433	34.741	1.6096	0.0746

KH-12-2		St.47		Depth	4176m	
Date:	2012/5/29			Lat.	5	00.10N
Time:	23:54			Long.	139	59.91E
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.
		db	°C	(psu)	ml/l	ug/l
		Sur.	29.4	***	***	***
		10	29.387	34.115	4.2926	0.1560
		20	29.553	34.286	4.2881	0.1810
		30	29.607	34.406	4.2863	0.2000
		40	29.602	34.410	4.2878	0.2400
		50	29.605	34.432	4.2932	0.2210
		75	28.499	34.580	4.3400	0.4690
		100	26.755	34.894	3.9276	0.4030
		125	24.093	34.981	3.5013	0.1750
		150	21.807	35.056	3.4934	0.1280
		175	20.851	35.227	3.1515	0.0716
		200	16.815	34.880	2.9237	0.0620
		250	11.079	34.718	1.6575	0.0661
		300	9.658	34.761	1.3158	0.0724
		400	8.379	34.769	1.5798	0.0744
		500	7.427	34.732	1.8281	0.0727



KH-12-2	St. 56	Depth	5604m		
Date:	2012/6/7	Lat.	10	59.93N	
Time:	8:26	Long.	133	59.92E	
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.
	db	°C	(psu)	ml/l	ug/l
	Sur.	30.1	***	***	***
	10	29.732	34.366	4.2305	0.0809
	20	29.738	34.366	4.2342	0.0792
	30	29.690	34.369	4.2274	0.0921
	40	29.331	34.579	4.3727	0.1130
	50	29.204	34.660	4.3454	0.1140
	75	28.383	34.655	4.4119	0.1700
	100	27.964	34.869	4.3755	0.2580
	125	27.187	35.173	4.2851	0.4820
	150	25.037	35.284	4.0530	0.2530
	175	21.534	35.082	3.3963	0.1240
	200	18.768	35.045	3.6045	0.1000
	250	13.346	34.620	3.2425	0.0608
	300	10.968	34.599	2.3121	0.0640
	400	8.623	34.596	1.6907	0.0706
	500	7.133	34.625	1.6167	0.0728

KH-12-2	St. 59	Depth	4558m		
Date:	2012/6/9	Lat.	15	00.02N	
Time:	21:04	Long.	141	59.91E	
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.
	db	°C	(psu)	ml/l	ug/l
	Sur.	29.5	***	***	***
	10	29.207	34.618	4.3076	0.0980
	20	29.113	34.609	4.3188	0.1080
	30	29.054	34.608	4.3279	0.1100
	40	28.914	34.596	4.3463	0.1230
	50	28.702	34.686	4.3793	0.1350
	75	27.852	34.807	4.5193	0.1560
	100	26.693	34.953	4.5369	0.1880
	125	25.718	35.093	4.2395	0.3570
	150	24.320	35.173	4.2062	0.3420
	175	22.743	35.199	4.1611	0.1570
	200	20.927	35.130	4.1768	0.1140
	250	17.672	34.927	4.0639	0.0572
	300	14.775	34.709	3.9683	0.0563
	400	10.209	34.505	2.4844	0.0649
	500	7.906	34.566	1.6987	0.0724

KH-12-2	St. 65	Depth	4920m		
Date:	2012/6/10	Lat.	14	59.89N	
Time:	12:59	Long.	140	00.21E	
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.
	db	°C	(psu)	ml/l	ug/l
	Sur.	30	***	***	***
	10	29.539	34.685	4.2717	0.0735
	20	29.383	34.668	4.2896	0.0825
	30	29.316	34.659	4.3006	0.0916
	40	29.257	34.652	4.3087	0.1050
	50	28.824	34.643	4.4145	0.1170
	75	27.978	34.713	4.4825	0.1560
	100	27.055	34.915	4.5233	0.2320
	125	26.131	35.018	4.5080	0.4280
	150	24.182	35.186	4.1267	0.2290
	175	23.093	35.213	4.0744	0.1380
	200	21.440	35.229	3.9033	0.0905
	250	17.785	34.948	3.8992	0.0579
	300	14.587	34.693	3.6855	0.0578
	400	9.595	34.435	2.8043	0.0633
	500	7.361	34.465	1.7420	0.0738

KH-12-2	St. 68	Depth	4055m		
Date:	2012/6/10	Lat.	13	29.89N	
Time:	23:47	Long.	139	25.05E	
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.
	db	°C	(psu)	ml/l	ug/l
	Sur.	30.5	***	***	***
	10	29.962	34.662	4.2293	0.0806
	20	29.749	34.663	4.2487	0.0928
	30	29.683	34.660	4.2472	0.0987
	40	29.651	34.664	4.2518	0.1090
	50	28.844	34.635	4.4827	0.1330
	75	27.863	34.806	4.3961	0.1570
	100	26.842	34.954	4.4460	0.3090
	125	25.138	35.253	4.0746	0.4460
	150	23.088	35.235	4.0035	0.1940
	175	21.746	35.224	3.9175	0.1220
	200	19.738	35.107	3.9002	0.0681
	250	15.987	34.802	3.7189	0.0566
	300	12.697	34.571	3.7211	0.0581
	400	9.125	34.502	2.2322	0.0690
	500	7.628	34.551	1.7235	0.0724

KH-12-2	St.71	Depth	4964m		
Date:	2012/6/11	Lat.	12	00.01N	
Time:	13:03	Long.	137	59.85E	
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.
	db	°C	(psu)	ml/l	ug/l
	Sur.	30.6	***	***	***
	10	29.631	34.565	4.2585	0.0703
	20	29.553	34.564	4.2639	0.0755
	30	29.447	34.572	4.2731	0.0873
	40	29.266	34.591	4.3463	0.0972
	50	28.307	34.630	4.4925	0.1200
	75	27.787	34.751	4.4761	0.1790
	100	26.973	34.976	4.4002	0.3050
	125	25.857	35.122	4.2170	0.7110
	150	24.205	35.319	3.9614	0.3000
	175	22.128	35.294	3.8797	0.1580
	200	20.359	35.186	3.8200	0.0879
	250	14.642	34.713	3.3587	0.0604
	300	10.985	34.516	2.6876	0.0626
	400	8.437	34.594	1.6060	0.0711
	500	7.182	34.638	1.6006	0.0739

KH-12-2	St. C01	Depth	7112m		
Date:	2012/6/12	Lat.	11	29.97N	
Time:	05:49	Long.	141	59.95E	
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.
	db	°C	(psu)	ml/l	ug/l
	Sur.	29.8	***	***	***
	10	29.664	34.553	4.2518	0.0850
	20	29.545	34.541	4.2559	0.0839
	30	29.384	34.530	4.2766	0.0875
	40	29.255	34.527	4.2813	0.0976
	50	28.886	34.627	4.3945	0.1110
	75	28.090	34.740	4.4427	0.1320
	100	27.854	34.910	4.3975	0.1830
	125	27.106	35.159	4.3173	0.4520
	150	24.629	35.402	4.1413	0.5230
	175	22.424	35.375	3.8873	0.2340
	200	20.263	35.207	3.8606	0.1400
	250	16.398	34.846	3.8460	0.0687
	300	12.076	34.527	3.1249	0.0589
	400	8.401	34.546	1.7204	0.0718
	500	7.179	34.658	1.5826	0.0737

KH-12-2		St. C02		Depth	4173m	
Date:	2012/6/12			Lat.	12 00.06N	
Time:	08:50			Long.	142 10.00E	
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.
		db	°C	(psu)	ml/l	ug/l
		Sur.	29.7	***	***	***
		10	29.549	34.540	4.2503	0.0735
		20	29.549	34.540	4.2464	0.0751
		30	29.510	34.545	4.2504	0.0818
		40	29.377	34.534	4.2710	0.0970
		50	29.312	34.545	4.2814	0.1010
		75	28.420	34.673	4.4514	0.1270
		100	27.945	34.889	4.3965	0.1910
		125	26.606	35.250	4.2919	0.5900
		150	24.767	35.378	4.0890	0.3530
		175	22.803	35.365	3.9277	0.2140
		200	21.122	35.290	3.8507	0.1860
		250	16.251	34.832	3.8238	0.0640
		300	11.408	34.498	2.9307	0.0593
		400	8.329	34.548	1.7091	0.0706
		500	7.030	34.623	1.5990	0.0719

KH-12-2		St. C03		Depth	3078m	
Date:	2012/6/12			Lat.	12	30.10N
Time:	11:53			Long.	142	24.89E
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.
		db	°C	(psu)	ml/l	ug/l
		Sur.	29.7	***	***	***
		10	29.516	34.598	4.2546	0.0681
		20	29.189	34.577	4.2886	0.0792
		30	29.063	34.588	4.3099	0.0872
		40	28.698	34.733	4.3987	0.0967
		50	28.295	34.784	4.4463	0.1080
		75	27.902	34.877	4.4006	0.1610
		100	27.562	34.973	4.3520	0.2670
		125	27.057	35.164	4.3120	0.3730
		150	24.646	35.377	4.0542	0.3850
		175	23.052	35.405	3.9106	0.1840
		200	20.366	35.206	3.8775	0.1080
		250	15.569	34.767	3.7778	0.0574
		300	13.546	34.621	3.2597	0.0580
		400	9.135	34.520	2.0632	0.0670
		500	7.844	34.661	1.5484	0.0735

KH-12-2		St. C04		Depth	3560m	
Date:	2012/6/12			Lat.	13	00.09N
Time:	14:53			Long.	142	39.97E
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.
		db	°C	(psu)	ml/l	ug/l
		Sur.	30.1	***	***	***
		10	29.783	34.601	4.2526	0.0733
		20	29.594	34.587	4.2670	0.0843
		30	29.476	34.580	4.2847	0.0917
		40	29.336	34.587	4.2952	0.1000
		50	29.270	34.596	4.3017	0.1200
		75	28.472	34.720	4.4307	0.1450
		100	27.870	34.834	4.4070	0.2060
		125	27.309	34.974	4.3187	0.3280
		150	26.315	35.212	4.2235	0.4510
		175	24.115	35.371	3.9822	0.2270
		200	21.587	35.299	3.8789	0.1250
		250	18.047	34.990	3.7546	0.0686
		300	13.977	34.653	3.4316	0.0582
		400	9.201	34.528	2.0587	0.0668
		500	7.921	34.608	1.5558	0.0723

KH-12-2		St. C05		Depth	4076m	
Date:	2012/6/12			Lat.	13 29.92N	
Time:	17:54			Long.	142 54.91E	
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.
		db	°C	(psu)	ml/l	ug/l
		Sur.	29.7	***	***	***
		10	29.859	34.603	4.2453	0.0810
		20	29.660	34.589	4.2590	0.0844
		30	29.521	34.583	4.2782	0.0885
		40	29.267	34.567	4.3019	0.1100
		50	28.994	34.622	4.3770	0.1350
		75	28.269	34.686	4.4403	0.1550
		100	27.821	34.786	4.4393	0.1910
		125	27.537	34.885	4.4076	0.2680
		150	26.027	35.207	4.1768	0.3530
		175	23.918	35.383	3.9616	0.1900
		200	20.580	35.192	3.8938	0.0911
		250	15.683	34.773	3.8478	0.0556
		300	12.753	34.586	3.1818	0.0000
		400	10.001	34.509	2.3959	0.0655
		500	7.980	34.560	1.7052	0.0702

KH-12-2		St.C06		Depth	4169m	
Date:	2012/6/12			Lat.	14	00.12N
Time:	20:57			Long.	143	10.01E
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.
		db	°C	(psu)	ml/l	ug/l
		Sur.	29.9	***	***	***
		10	29.757	34.610	4.2482	0.0889
		20	29.672	34.599	4.2603	0.0920
		30	29.395	34.559	4.3020	0.1130
		40	29.288	34.565	4.3057	0.1280
		50	29.043	34.598	4.3649	0.1490
		75	28.518	34.704	4.4461	0.1580
		100	27.866	34.779	4.4119	0.2000
		125	27.527	34.956	4.3579	0.3060
		150	26.561	35.153	4.2147	0.4460
		175	24.252	35.375	3.9926	0.2370
		200	22.632	35.356	3.8853	0.1490
		250	16.513	34.854	3.7008	0.0611
		300	13.169	34.600	3.2434	0.0583
		400	9.484	34.497	2.2721	0.0661
		500	7.466	34.522	1.6714	0.0728

KH-12-2		St. C07		Depth	3894m	
Date:	2012/6/12			Lat.	14	30.01N
Time:	23:53			Long.	143	20.08E
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.
		db	°C	(psu)	ml/l	ug/l
		Sur.	29.5	***	***	***
		10	29.677	34.662	4.2584	0.0913
		20	29.297	34.712	4.3028	0.1090
		30	29.199	34.730	4.3156	0.1350
		40	29.080	34.720	4.3262	0.1390
		50	28.933	34.723	4.3544	0.1400
		75	28.091	34.786	4.4893	0.1640
		100	27.101	34.938	4.4616	0.2430
		125	26.655	35.001	4.4298	0.2660
		150	25.581	35.123	4.3343	0.4730
		175	23.600	35.319	4.0020	0.1910
		200	21.618	35.255	3.9347	0.1080
		250	17.857	34.945	3.9616	0.0577
		300	14.970	34.717	3.8933	0.0563
		400	9.992	34.455	2.9385	0.0606
		500	8.224	34.531	1.7964	0.0689

KH-12-2	St. C08	Depth	3647m		
Date:	2012/6/13	Lat.	15	00.00N	
Time:	02:47	Long.	143	29.96E	
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.
	db	°C	(psu)	ml/l	ug/l
	Sur.	29.9	***	***	***
	10	29.848	34.728	4.2355	0.0909
	20	29.835	34.727	4.2375	0.0914
	30	29.372	34.723	4.3064	0.1250
	40	29.239	34.731	4.3149	0.1470
	50	29.116	34.733	4.3398	0.1330
	75	28.034	34.769	4.4751	0.1620
	100	27.017	34.961	4.3582	0.2330
	125	26.003	35.096	4.2503	0.4500
	150	24.297	35.219	4.1471	0.2530
	175	22.738	35.280	4.0098	0.1470
	200	21.312	35.217	3.9898	0.1140
	250	17.342	34.897	4.0488	0.0551
	300	14.011	34.645	3.9093	0.0561
	400	10.435	34.455	3.1560	0.0626
	500	8.325	34.478	2.0300	0.0692

KH-12-2	St. C09	Depth	4094m		
Date:	2012/6/13	Lat.	15	30.04N	
Time:	05:36	Long.	143	30.01E	
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.
	db	°C	(psu)	ml/l	ug/l
	Sur.	29.9	***	***	***
	10	29.787	34.644	4.2324	0.0912
	20	29.455	34.632	4.2840	0.0933
	30	29.386	34.661	4.2812	0.0980
	40	29.295	34.665	4.2895	0.1010
	50	29.040	34.682	4.3497	0.1130
	75	28.237	34.859	4.4577	0.1380
	100	27.665	34.957	4.3729	0.1750
	125	26.504	35.017	4.3139	0.3840
	150	25.296	35.152	4.1748	0.3540
	175	24.162	35.308	4.0659	0.2280
	200	22.496	35.277	3.9831	0.1400
	250	17.913	34.949	4.0756	0.0572
	300	14.989	34.721	4.0170	0.0556
	400	10.284	34.449	3.1781	0.0624
	500	8.110	34.543	1.7466	0.0704

KH-12-2	St. C10	Depth	3792m		
Date:	2012/6/13	Lat.	16	00.11N	
Time:	08:21	Long.	143	30.00E	
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.
	db	°C	(psu)	ml/l	ug/l
	Sur.	30.1	***	***	***
	10	29.510	34.587	4.2957	0.0834
	20	29.222	34.615	4.3273	0.1000
	30	28.930	34.660	4.3787	0.1130
	40	28.728	34.691	4.4028	0.1200
	50	28.407	34.747	4.4438	0.1300
	75	27.938	34.815	4.4477	0.1640
	100	27.257	34.915	4.4043	0.2460
	125	26.179	35.109	4.2693	0.4520
	150	24.982	35.202	4.1147	0.2550
	175	22.838	35.277	3.9746	0.1360
	200	20.727	35.208	3.9369	0.0826
	250	17.443	34.904	4.1507	0.0536
	300	15.389	34.749	4.0854	0.0527
	400	11.235	34.492	3.3837	0.0601
	500	8.926	34.504	2.0436	0.0662

KH-12-2	St. C11	Depth	4010m		
Date:	2012/6/13	Lat.	17	00.19N	
Time:	14:20	Long.	142	29.86E	
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.
	db	°C	(psu)	ml/l	ug/l
	Sur.	30.1	***	***	***
	10	29.930	34.686	4.2626	0.0805
	20	29.767	34.689	4.2671	0.0872
	30	29.492	34.709	4.2990	0.0954
	40	29.343	34.749	4.3208	0.1030
	50	28.947	34.908	4.3515	0.1160
	75	27.250	34.945	4.5721	0.1490
	100	26.211	35.044	4.5701	0.2030
	125	25.454	35.113	4.5152	0.2360
	150	23.143	35.210	4.2131	0.3680
	175	22.010	35.179	4.1066	0.2550
	200	19.912	35.066	4.1639	0.1040
	250	18.097	34.950	4.1376	0.0569
	300	16.470	34.819	4.2251	0.0543
	400	12.240	34.540	3.8779	0.0570
	500	8.769	34.399	2.6198	0.0666

KH-12-2	St.C12	Depth	3787m		
Date:	2012/6/13	Lat.	16	30.13N	
Time:	17:18	Long.	142	30.15E	
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.
	db	°C	(psu)	ml/l	ug/l
	Sur.	30.1	***	***	***
	10	29.947	34.618	4.2590	0.0888
	20	29.728	34.672	4.2700	0.0934
	30	29.503	34.741	4.3047	0.0998
	40	29.266	34.789	4.3281	0.1050
	50	28.758	34.846	4.4443	0.1230
	75	26.735	34.977	4.5688	0.1860
	100	25.620	35.079	4.5880	0.2130
	125	24.799	35.153	4.4203	0.3020
	150	23.170	35.236	4.1361	0.3160
	175	21.321	35.187	4.0378	0.1870
	200	19.911	35.074	4.1360	0.0949
	250	17.723	34.899	4.3488	0.0562
	300	15.743	34.776	4.1300	0.0544
	400	11.196	34.472	3.6329	0.0586
	500	8.124	34.384	2.4620	0.0668

KH-12-2	St. C13	Depth	3868m		
Date:	2012/6/13	Lat.	16	00.10N	
Time:	20:18	Long.	142	29.99E	
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.
	db	°C	(psu)	ml/l	ug/l
	Sur.	29.9	***	***	***
	10	29.793	34.552	4.2398	0.0907
	20	29.318	34.537	4.3022	0.1010
	30	29.104	34.548	4.3286	0.1220
	40	28.538	34.599	4.4593	0.1370
	50	28.152	34.710	4.5213	0.1400
	75	27.766	34.935	4.3879	0.1640
	100	26.757	35.043	4.3187	0.3160
	125	26.059	35.108	4.2619	0.4650
	150	23.405	35.192	4.1802	0.2120
	175	21.184	35.145	4.1864	0.1400
	200	19.083	35.004	4.1733	0.0727
	250	16.951	34.850	4.2384	0.0538
	300	14.592	34.693	4.0529	0.0557
	400	10.606	34.449	3.1857	0.0604
	500	7.642	34.414	2.0637	0.0699



KH-12-2	St. C14	Depth	4082m		
Date:	2012/6/13	Lat.	15	30.15N	
Time:	23:10	Long.	142	30.09E	
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.
	db	°C	(psu)	ml/l	ug/l
	Sur.	29.9	***	***	***
	10	29.665	34.647	4.2860	0.1090
	20	29.553	34.651	4.2879	0.1190
	30	29.262	34.654	4.3223	0.1660
	40	28.993	34.687	4.3936	0.1540
	50	28.372	34.768	4.4925	0.1560
	75	27.498	34.885	4.4521	0.1850
	100	26.675	35.113	4.3138	0.3840
	125	25.365	35.120	4.2122	0.4180
	150	23.533	35.250	4.0138	0.1710
	175	22.269	35.259	3.9261	0.1250
	200	21.359	35.216	3.9426	0.1060
	250	17.690	34.931	4.0180	0.0563
	300	14.660	34.691	3.8423	0.0568
	400	10.742	34.507	2.6835	0.0625
	500	7.832	34.448	1.9564	0.0694

KH-12-2	St. C15	Depth	4200m		
Date:	2012/6/14	Lat.	15	00.01N	
Time:	02:00	Long.	142	29.97E	
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.
	db	°C	(psu)	ml/l	ug/l
	Sur.	29.8	***	***	***
	10	29.603	34.664	4.2550	0.1160
	20	29.612	34.665	4.2532	0.1190
	30	29.590	34.661	4.2823	0.1120
	40	29.033	34.603	4.3344	0.1710
	50	28.945	34.636	4.3435	0.1740
	75	28.095	34.748	4.4727	0.1780
	100	27.230	34.900	4.4405	0.2590
	125	26.106	35.077	4.3115	0.3220
	150	24.847	35.266	4.0894	0.2590
	175	22.991	35.277	3.9453	0.1740
	200	20.507	35.167	3.9523	0.1040
	250	17.642	34.932	3.9624	0.0562
	300	14.566	34.682	3.8147	0.0550
	400	9.682	34.491	2.3473	0.0649
	500	7.920	34.554	1.6645	0.0711

KH-12-2	St. C16	Depth	3986m		
Date:	2012/6/14	Lat.	14	29.95N	
Time:	04:53	Long.	142	19.86E	
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.
	db	°C	(psu)	ml/l	ug/l
	Sur.	29.8	***	***	***
	10	29.760	34.622	4.2184	0.0994
	20	29.786	34.639	4.2339	0.0987
	30	29.375	34.651	4.3027	0.1250
	40	29.206	34.660	4.2967	0.1400
	50	28.860	34.682	4.4155	0.1760
	75	28.028	34.699	4.5056	0.1760
	100	27.532	34.807	4.4311	0.2190
	125	26.692	35.004	4.3362	0.2900
	150	25.460	35.231	4.1071	0.3180
	175	22.762	35.297	3.9373	0.1400
	200	21.687	35.246	3.9080	0.1080
	250	18.284	34.984	3.8928	0.0579
	300	14.234	34.670	3.8935	0.0553
	400	9.515	34.496	2.3008	0.0646
	500	7.527	34.579	1.5622	0.0724

KH-12-2	St. C17	Depth	3898m		
Date:	2012/6/14	Lat.	13	59.94N	
Time:	07:44	Long.	142	09.95E	
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.
	db	°C	(psu)	ml/l	ug/l
	Sur.	29.8	***	***	***
	10	29.579	34.536	4.2491	0.0930
	20	29.579	34.535	4.2502	0.0953
	30	29.580	34.536	4.2420	0.0983
	40	29.545	34.544	4.2592	0.1030
	50	29.193	34.617	4.3429	0.1360
	75	28.344	34.761	4.4423	0.1680
	100	27.904	34.827	4.4110	0.1880
	125	27.395	35.031	4.3240	0.2980
	150	25.627	35.188	4.1836	0.3400
	175	23.911	35.364	3.9511	0.1860
	200	21.664	35.294	3.8606	0.1220
	250	18.382	34.990	3.9932	0.0572
	300	15.129	34.727	3.7480	0.0530
	400	10.333	34.500	2.5958	0.0626
	500	7.645	34.577	1.5578	0.0712

KH-12-2	St.C18	Depth	3340m		
Date:	2012/6/14	Lat.	13	29.79N	
Time:	10:52	Long.	141	49.89E	
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.
	db	°C	(psu)	ml/l	ug/l
	Sur.	29.4	***	***	***
	10	29.369	34.598	4.2774	0.1010
	20	29.357	34.599	4.2679	0.1100
	30	29.356	34.600	4.2660	0.1200
	40	29.351	34.603	4.2702	0.1270
	50	29.300	34.609	4.3119	0.1390
	75	28.337	34.739	4.4423	0.1940
	100	27.967	34.785	4.4117	0.2170
	125	27.643	34.882	4.3548	0.2740
	150	26.572	35.129	4.2246	0.3590
	175	24.876	35.302	4.0210	0.2120
	200	22.742	35.376	3.9148	0.1670
	250	18.006	34.983	3.7830	0.0644
	300	13.983	34.660	3.4828	0.0572
	400	9.674	34.532	2.0502	0.0650
	500	7.905	34.548	1.6828	0.0708

KH-12-2	St. C19	Depth	3741m		
Date:	2012/6/14	Lat.	13	0.02	
Time:	13:57	Long.	141	29.96E	
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.
	db	°C	(psu)	ml/l	ug/l
	Sur.	29.9	***	***	***
	10	29.546	34.562	4.2516	0.0864
	20	29.507	34.584	4.2523	0.0965
	30	29.442	34.606	4.2683	0.1120
	40	29.163	34.610	4.3207	0.1370
	50	29.032	34.633	4.3427	0.1480
	75	28.172	34.817	4.4110	0.2360
	100	27.710	34.914	4.3909	0.2790
	125	26.813	35.166	4.3003	0.4730
	150	24.424	35.394	4.0202	0.2670
	175	23.677	35.419	3.9675	0.2460
	200	21.460	35.326	3.8744	0.1470
	250	17.468	34.941	3.7437	0.0615
	300	12.616	34.571	3.0732	0.0585
	400	9.443	34.526	2.0392	0.0640
	500	7.765	34.629	1.5773	0.0716

KH-12-2		St. C20-1		Depth		3344m		
Date:	2012/6/19			Lat.		13	49.88N	
Time:	17:05			Long.		142	19.84E	
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.		
		db	°C	(psu)	ml/l	ug/l		
		Sur.	29.9	***	***	***	***	
		10	29.792	34.620	4.2378	0.0845		
		20	29.752	34.622	4.2435	0.0859		
		30	29.676	34.619	4.2519	0.0954		
		40	29.665	34.619	4.2546	0.0966		
		50	29.398	34.644	4.3260	0.1200		
		75	28.349	34.651	4.4922	0.1450		
		100	27.583	34.857	4.5115	0.2350		
		125	26.781	34.997	4.4093	0.3590		
		150	25.416	35.267	4.1283	0.4700		
		175	23.814	35.376	3.9538	0.1900		
		200	21.205	35.255	3.8650	0.1080		
		250	16.526	34.860	3.7262	0.0626		
		300	13.826	34.638	3.7937	0.0000		
		400	9.162	34.503	2.1203	0.0689		
		500	7.702	34.571	1.6239	0.0740		
		600	6.531	34.619	1.6222	0.0752		
		700	5.800	34.654	1.7645	0.0751		
		800	5.278	34.675	1.8411	0.0756		
		900	4.755	34.697	1.7813	0.0755		
		1000	4.453	34.709	1.7981	0.0774		
CTD data (BTL)								
BTL	Depth	Pres.	Temp.	Sal	DO	Flu.		
No.	m	db	°C	(psu)	ml/l	ug/l		
1	992	1000.1	4.448	34.709	1.7995	0.0768		
2	992	1000.1	4.449	34.709	1.7987	0.0767		
3	942	949.8	4.550	34.697	1.8039	0.0769		
4	892	899.6	4.728	34.696	1.7815	0.0764		
5	843	850.0	5.014	34.691	1.7382	0.0782		
6	794	799.9	5.344	34.675	1.7728	0.0764		
7	744	749.8	5.563	34.671	1.6567	0.0768		
8	695	699.8	5.792	34.653	1.7584	0.0771		
9	645	649.8	6.198	34.637	1.7160	0.0763		
10	595	599.7	6.529	34.618	1.6225	0.0767		
11	547	550.8	7.080	34.596	1.5765	0.0771		
12	497	500.1	7.671	34.571	1.6126	0.0770		
13	447	450.3	8.295	34.536	1.7553	0.0757		
14	397	399.9	9.106	34.502	2.0622	0.0725		
15	348	350.0	10.549	34.484	2.9145	0.0671		
16	298	300.2	13.120	34.573	3.5949	0.0629		
17	248	249.8	16.632	34.859	3.7287	0.0679		
18	198	199.5	21.695	35.293	3.8583	0.1370		
19	174	175.3	24.011	35.363	3.9773	0.2440		
20	149	149.6	25.740	35.214	4.1733	0.4720		
21	124	124.6	27.043	34.984	4.3909	0.3400		
22	99	99.7	27.577	34.873	4.4649	0.2580		
23	49	49.6	29.657	34.614	4.2545	0.1080		
24	5	4.9	29.760	34.619	4.2473	0.0923		

KH-12-2		St. C20-2		Depth	3325m	
Date:	2012/6/19			Lat.	13 49.99N	
Time:	18:42			Long.	142 19.98E	
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.
		db	°C	(psu)	ml/l	ug/l
		Sur.	***	***	***	***
		10	29.766	34.619	4.2347	0.0855
		20	29.715	34.619	4.2345	0.0917
		30	29.676	34.619	4.2504	0.0983
		40	29.670	34.617	4.2518	0.0984
		50	29.656	34.617	4.2443	0.1010
		75	28.861	34.620	4.2496	0.1100
		100	27.658	34.685	4.4419	0.1390
		125	26.230	34.884	4.4395	0.2540
		150	25.391	35.038	4.3571	0.4520
		175	23.788	35.265	4.1338	0.3870
200	21.586	35.362	3.9646	0.1860		
CTD data (BTL)						
BTL	Depth	Pres.	Temp.	Sal	DO	Flu.
No.	m	db	°C	(psu)	ml/l	ug/l
1	134	134.8	25.850	35.162	4.2161	0.5300
2	134	134.7	25.848	35.162	4.2200	0.5930
3	134	134.6	25.836	35.161	4.2126	0.6040
4	134	134.9	25.850	35.163	4.2156	0.5780
5	134	134.4	25.831	35.159	4.2223	0.4640
6	134	135.1	25.844	35.161	4.2226	0.4930
7	134	134.8	25.840	35.159	4.2233	0.4930
8	134	134.8	25.833	35.155	4.2187	0.5440
9	134	134.8	25.837	35.158	4.2208	0.5680
10	134	135.0	25.839	35.158	4.2153	0.5810
11	134	134.8	25.830	35.154	4.2236	0.5510
12	134	134.6	25.837	35.146	4.2187	0.5100
13	134	134.9	25.831	35.155	4.2165	0.5470
14	134	134.9	25.830	35.154	4.2220	0.5380
15	134	134.9	25.827	35.151	4.2173	0.5400
16	135	135.4	25.836	35.157	4.2202	0.5190
17	134	135.0	25.829	35.149	4.2371	0.4880
18	134	134.9	25.837	35.145	4.2315	0.5470
19	134	134.7	25.903	35.124	4.2184	0.5250
20	134	135.1	25.864	35.137	4.2133	0.4640
21	134	134.9	25.861	35.137	4.2206	0.5120
22	134	134.8	25.939	35.117	4.2275	0.5800
23	134	135.0	25.898	35.126	4.2208	0.4750
24	134	135.1	25.919	35.122	4.2178	0.4460

KH-12-2		St. 136-1		Depth	3890m	
Date:	2012/6/20			Lat.	12	00.04N
Time:	19:14			Long.	140	49.80E
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.	
	db	°C	(psu)	ml/l	ug/l	
	Sur.	29.8	***	***	***	
	10	29.467	34.528	4.2712	0.0906	
	20	29.450	34.530	4.2620	0.0948	
	30	29.441	34.531	4.2558	0.0999	
	40	29.435	34.541	4.2614	0.1060	
	50	29.427	34.547	4.2637	0.1100	
	75	28.418	34.635	4.4990	0.1510	
	100	28.075	34.703	4.4305	0.1770	
	125	27.881	34.832	4.3671	0.2240	
	150	26.271	35.280	4.2394	0.5060	
	175	23.200	35.399	3.9190	0.2670	
	200	21.067	35.291	3.8927	0.1680	
	250	17.531	34.952	3.8137	0.0732	
	300	12.892	34.594	2.9885	0.0603	
	400	8.929	34.555	1.8103	0.0714	
	500	7.485	34.668	1.6129	0.0740	
	600	6.511	34.681	1.7418	0.0744	
	700	5.835	34.691	1.7349	0.0749	
	800	5.443	34.698	1.7263	0.0757	
	900	5.097	34.706	1.7300	0.0768	
	1000	4.518	34.719	1.7259	0.0748	
CTD data (BTL)						
BTL	Depth	Pres.	Temp.	Sal	DO	Flu.
No.	m	db	°C	(psu)	ml/l	ug/l
1	993	1000.9	4.516	34.719	1.7206	0.0769
2	993	1001.1	4.516	34.719	1.7187	0.0777
3	943	950.1	4.906	34.709	1.7182	0.0778
4	895	902.1	5.102	34.706	1.7240	0.0768
5	844	850.9	5.253	34.702	1.7262	0.0772
6	795	800.9	5.467	34.696	1.7235	0.0772
7	745	750.4	5.612	34.694	1.7306	0.0771
8	695	700.6	5.926	34.689	1.7347	0.0772
9	646	650.3	6.181	34.686	1.7356	0.0773
10	596	600.3	6.628	34.677	1.7291	0.0767
11	547	550.4	6.950	34.673	1.6661	0.0765
12	497	500.4	7.658	34.658	1.5911	0.0779
13	447	449.6	8.183	34.611	1.5512	0.0771
14	398	400.5	9.156	34.546	1.8887	0.0736
15	348	349.9	10.621	34.530	2.3355	0.0687
16	298	300.1	12.553	34.585	2.8740	0.0667
17	249	250.8	16.526	34.820	3.5067	0.0733
18	199	200.1	20.762	35.255	3.8874	0.1420
19	174	175.2	22.958	35.389	3.9033	0.2290
20	149	149.6	26.111	35.290	4.2197	0.5330
21	124	125.2	27.838	34.905	4.3461	0.3070
22	100	100.5	28.069	34.725	4.4277	0.1830
23	50	49.8	29.439	34.543	4.2612	0.1160
24	5	4.7	29.604	34.528	4.2571	0.0927

KH-12-2		St. 136-2		Depth	3889m	
Date:	2012/6/20			Lat.	11	59.93N
Time:	20:57			Long.	140	50.06E
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.
		db	°C	(psu)	ml/l	ug/l
		Sur.	29.9	***	***	***
		10	29.480	34.527	4.2531	0.0974
		20	29.441	34.528	4.2623	0.1060
		30	29.444	34.535	4.2568	0.1090
		40	29.440	34.546	4.2565	0.1100
		50	29.304	34.607	4.3454	0.1390
		75	28.244	34.642	4.4678	0.1610
		100	27.938	34.767	4.3995	0.2260
		125	27.558	35.001	4.3160	0.2880
		150	25.406	35.350	4.1221	0.3710
		175	22.868	35.390	3.9046	0.2380
		200	21.056	35.289	3.8891	0.1850
CTD data (BTL)						
BTL	Depth	Pres.	Temp.	Sal	DO	Flu.
No.	m	db	°C	(psu)	ml/l	ug/l
1	139	140.1	26.761	35.189	4.2478	0.4820
2	139	140.2	26.799	35.184	4.2657	0.5090
3	140	140.6	26.784	35.191	4.2731	0.4920
4	140	140.7	26.778	35.196	4.2744	0.5280
5	140	140.5	26.777	35.195	4.2754	0.6020
6	140	140.7	26.776	35.196	4.2691	0.5280
7	140	140.8	26.762	35.201	4.2760	0.5120
8	140	141.1	26.758	35.203	4.2758	0.6080
9	140	140.8	26.767	35.199	4.2717	0.6060
10	140	140.4	26.767	35.196	4.2709	0.5900
11	140	140.9	26.742	35.204	4.2679	0.5460
12	140	141.2	26.714	35.211	4.2648	0.5190
13	140	140.8	26.760	35.195	4.2740	0.6370
14	140	141.0	26.636	35.230	4.2705	0.6170
15	140	140.7	26.653	35.224	4.2657	0.6600
16	140	140.4	26.709	35.210	4.2610	0.6000
17	140	141.0	26.628	35.231	4.2606	0.6750
18	140	141.0	26.654	35.224	4.2641	0.5470
19	140	140.4	26.752	35.199	4.2724	0.5340
20	140	140.9	26.671	35.221	4.2695	0.5850
21	140	141.0	26.641	35.228	4.2629	0.5280
22	140	140.9	26.613	35.235	4.2719	0.6690
23	140	140.7	26.571	35.244	4.2553	0.6410
24	140	140.4	26.596	35.238	4.2550	0.6040

KH-12-2		St. 164		Depth	4031m		
Date:	2012/6/23			Lat.	16	30.07N	
Time:	11:55			Long.	142	24.64E	
CTD data (LAY)		Pres.	Temp.	Sal	DO	Flu.	
		db	°C	(psu)	ml/l	ug/l	
		Sur.	29.9	***	***	***	
		10	29.540	34.630	4.2503	0.0703	
		20	29.495	34.629	4.2499	0.0763	
		30	29.487	34.630	4.2574	0.0834	
		40	29.479	34.630	4.2603	0.0912	
		50	29.107	34.670	4.3974	0.1160	
		75	27.869	34.779	4.4814	0.1900	
		100	27.128	34.941	4.3757	0.3250	
		125	26.055	35.054	4.3367	0.4370	
		150	24.904	35.236	4.1517	0.3070	
		175	23.728	35.232	4.1146	0.1910	
		200	22.555	35.214	4.0931	0.1390	
		250	19.299	35.023	4.1563	0.0780	
		300	16.504	34.824	4.2212	0.0555	
		400	11.851	34.512	3.5919	0.0595	
		500	8.532	34.408	2.4890	0.0694	
		600	6.621	34.478	1.5729	0.0740	
		700	5.687	34.576	1.4215	0.0755	
		800	4.995	34.643	1.5596	0.0755	
		900	4.415	34.682	1.6823	0.0748	
		1000	3.978	34.703	1.7747	0.0761	
CTD data (BTL)							
BTL	Depth	Pres.	Temp.	Sal	DO	Flu.	
No.	m	db	°C	(psu)	ml/l	ug/l	
1	992	999.8	3.978	34.703	1.7771	0.0759	
2	992	1000.1	3.978	34.703	1.7782	0.0770	
3	942	949.5	4.145	34.694	1.7403	0.0769	
4	892	899.5	4.414	34.680	1.6899	0.0771	

KH-12-2	St. C21-1	Depth	4210m			
Date:	2012/6/23	Lat.	17	21.57N		
Time:	18:15	Long.	142	19.58E		
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.	
	db	°C	(psu)	ml/l	ug/l	
	Sur.	***	***	***	***	
	10	29.532	34.592	4.2678	0.0891	
	20	29.489	34.598	4.2715	0.1060	
	30	29.485	34.613	4.2876	0.1190	
	40	29.022	34.694	4.4395	0.1400	
	50	28.632	34.819	4.4583	0.1570	
	75	27.565	34.888	4.5375	0.2460	
	100	26.763	34.973	4.4849	0.2850	
	125	25.660	35.127	4.3297	0.5130	
CTD data (BTL)	150	24.841	35.226	4.1412	0.3540	
	175	23.813	35.271	4.0819	0.2350	
	200	21.915	35.229	4.0186	0.1100	
BTL	Depth	Pres.	Temp.	Sal	DO	Flu.
No.	m	db	°C	(psu)	ml/l	ug/l
1	123	123.9	25.456	35.118	4.3418	0.6390
2	123	124.2	25.603	35.116	4.3408	0.4660
3	124	124.4	25.609	35.116	4.3309	0.4840
4	123	123.9	25.622	35.120	4.3330	0.5090
5	123	124.1	25.623	35.119	4.3358	0.6200
6	123	124.1	25.619	35.118	4.3364	0.5110
7	123	123.9	25.624	35.120	4.3415	0.5750
8	124	124.4	25.615	35.117	4.3355	0.5570
9	123	124.2	25.625	35.119	4.3248	0.5510
10	123	124.1	25.625	35.120	4.3345	0.5240
11	123	123.9	25.627	35.121	4.3381	0.5350
12	123	124.1	25.626	35.120	4.3302	0.4980
13	123	124.1	25.626	35.120	4.3300	0.6160
14	124	124.4	25.612	35.118	4.3168	0.5040
15	123	124.2	25.630	35.121	4.3249	0.5110
16	123	124.1	25.616	35.118	4.3445	0.6520
17	123	124.1	25.617	35.118	4.3396	0.5070
18	123	124.2	25.617	35.118	4.3444	0.5420
19	123	123.9	25.627	35.120	4.3340	0.5370
20	124	124.6	25.597	35.116	4.3368	0.4980
21	123	124.1	25.613	35.117	4.3356	0.6150
22	123	123.8	25.609	35.117	4.3461	0.5770
23	123	124.0	25.606	35.116	4.3403	0.4930
24	123	123.9	25.611	35.117	4.3431	0.5970

KH-12-2	St. C21-2	Depth	4204m			
Date:	2012/6/23	Lat.	17	21.75N		
Time:	19:02	Long.	142	19.70E		
CTD data (LAY)	Pres.	Temp.	Sal	DO	Flu.	
	db	°C	(psu)	ml/l	ug/l	
	Sur.	29.8	***	***	***	
	10	29.616	34.597	4.2523	0.0948	
	20	29.491	34.593	4.2609	0.0979	
	30	29.491	34.606	4.2772	0.1000	
	40	29.259	34.660	4.3789	0.1260	
	50	28.642	34.823	4.4606	0.1320	
	75	27.703	34.883	4.5338	0.1760	
	100	26.930	34.949	4.5595	0.3220	
	125	25.676	35.094	4.3808	0.5730	
CTD data (BTL)	150	24.845	35.224	4.1350	0.3390	
	175	23.812	35.273	4.0833	0.1800	
	200	21.839	35.228	4.0242	0.1050	
	250	18.831	35.014	4.1135	0.0621	
	300	16.549	34.832	4.1073	0.0542	
	400	12.177	34.534	3.7893	0.0585	
	500	8.696	34.356	3.0563	0.0656	
	600	6.746	34.417	1.8128	0.0730	
	700	5.794	34.507	1.5005	0.0747	
	800	4.735	34.556	1.3990	0.0772	
	900	4.258	34.616	1.5318	0.0763	
	1000	3.783	34.666	1.7058	0.0752	
	BTL	Depth	Pres.	Temp.	Sal	DO
	No.	m	db	°C	(psu)	ml/l
	1	993	1001.3	3.779	34.666	1.7081
	2	993	1001.4	3.779	34.666	1.7117
	3	941	948.7	3.983	34.645	1.6229
	4	892	899.4	4.230	34.619	1.5502
	5	842	849.1	4.457	34.593	1.5099
	6	793	799.1	4.695	34.561	1.3986
	7	743	749.1	5.256	34.514	1.4437
	8	694	699.5	5.789	34.509	1.4967
	9	645	649.4	6.172	34.478	1.5681
	10	595	599.7	6.690	34.418	1.7799
	11	545	549.3	7.548	34.383	2.1826
	12	496	499.6	8.715	34.351	3.0387
	13	447	449.7	10.259	34.420	3.5506
	14	397	399.8	12.062	34.524	3.8185
	15	347	349.4	14.286	34.662	4.0628
	16	298	299.5	16.228	34.806	4.1126
	17	248	249.2	18.539	34.985	4.1341
	18	198	199.2	21.711	35.229	4.0134
	19	174	174.7	23.105	35.274	4.0387
	20	149	149.9	24.637	35.238	4.0848
	21	124	124.6	25.581	35.101	4.3721
	22	99	99.3	26.842	34.956	4.5227
	23	50	50.1	28.615	34.811	4.4707
	24	5	4.6	29.590	34.593	4.2560



KH-12-2		St.X01	
2012/5/16	Lat.	17	00.14N
Time: 09:09	Long.	142	29.97E
XCTD data	Depth	Temp.	Sal
	m	°C	(psu)
	1	29.321	33.310
	3	29.311	34.522
	5	29.300	34.582
	10	29.279	34.603
	20	29.238	34.617
	30	28.264	34.614
	40	27.669	34.671
	50	26.978	34.706
	75	26.453	34.739
	100	25.731	34.823
	125	24.453	34.872
	150	23.034	34.933
	175	21.585	34.853
	200	19.744	34.733
	250	17.723	34.621
	300	16.020	34.528
	400	11.766	34.240
	500	8.486	34.164
	600	6.577	34.247
	700	5.845	34.339
	800	5.188	34.402
	900	4.642	34.460
	1000	4.187	34.495

KH-12-2		St.X02	
2012/5/16	Lat.	16	29.97N
Time: 11:02	Long.	142	30.05E
XCTD data	Depth	Temp.	Sal
	m	°C	(psu)
	1	29.366	33.781
	3	29.324	34.610
	5	29.287	34.622
	10	29.199	34.636
	20	28.760	34.627
	30	27.614	34.666
	40	27.209	34.692
	50	26.970	34.711
	75	26.133	34.765
	100	25.139	34.908
	125	24.043	34.925
	150	22.617	34.952
	175	20.735	34.863
	200	19.440	34.776
	250	17.353	34.643
	300	15.638	34.543
	400	11.438	34.248
	500	8.614	34.188
	600	6.961	34.255
	700	6.070	34.334
	800	5.378	34.408
	900	4.867	34.450
	1000	4.393	34.478

KH-12-2		St.X03	
2012/5/16	Lat.	15	59.95N
Time: 12:52	Long.	142	30.00E
XCTD data	Depth	Temp.	Sal
	m	°C	(psu)
	1	29.871	33.084
	3	29.869	34.465
	5	29.776	34.489
	10	29.598	34.504
	20	29.458	34.488
	30	28.995	34.492
	40	28.602	34.438
	50	28.461	34.458
	75	28.150	34.482
	100	27.367	34.668
	125	26.319	34.860
	150	24.506	35.038
	175	22.329	34.941
	200	20.221	34.826
	250	17.974	34.681
	300	16.311	34.580
	400	11.489	34.251
	500	8.310	34.190
	600	6.579	34.269
	700	5.823	34.341
	800	5.361	34.383
	900	4.929	34.419
	1000	4.544	34.438

KH-12-2		St.X04	
2012/5/16	Lat.	15	29.98N
Time: 14:45	Long.	142	30.00E
XCTD data	Depth	Temp.	Sal
	m	°C	(psu)
	1	29.917	32.848
	3	29.885	34.446
	5	29.796	34.481
	10	29.613	34.502
	20	29.487	34.499
	30	29.089	34.464
	40	28.781	34.439
	50	28.492	34.424
	75	28.101	34.553
	100	27.276	34.820
	125	26.259	34.961
	150	24.916	34.984
	175	23.184	35.005
	200	21.152	34.929
	250	18.308	34.745
	300	16.319	34.603
	400	11.030	34.309
	500	7.945	34.271
	600	6.829	34.330
	700	5.945	34.388
	800	5.319	34.455
	900	4.748	34.496
	1000	4.387	34.511

KH-12-2		St.X05	
2012/5/16	Lat.	14	59.98N
Time: 16:40	Long.	142	30.03E
XCTD data	Depth	Temp.	Sal
	m	°C	(psu)
	1	29.792	33.352
	3	29.769	34.522
	5	29.779	34.539
	10	29.684	34.543
	20	29.611	34.551
	30	29.129	34.513
	40	28.377	34.489
	50	28.140	34.499
	75	27.660	34.589
	100	26.978	34.748
	125	26.086	34.998
	150	24.874	35.124
	175	23.184	35.105
	200	21.492	34.981
	250	18.233	34.748
	300	14.906	34.481
	400	9.981	34.284
	500	7.902	34.364
	600	6.853	34.367
	700	6.054	34.414
	800	5.322	34.453
	900	4.793	34.489
	1000	4.354	34.517

KH-12-2		St.X06	
2012/5/16	Lat.	14	29.88N
Time: 18:34	Long.	142	29.98E
XCTD data	Depth	Temp.	Sal
	m	°C	(psu)
	1	29.633	32.921
	3	29.633	34.508
	5	29.633	34.554
	10	29.633	34.573
	20	29.570	34.581
	30	29.265	34.560
	40	28.780	34.530
	50	28.636	34.515
	75	28.306	34.493
	100	27.715	34.597
	125	27.004	34.756
	150	25.760	34.895
	175	23.371	35.110
	200	21.197	34.994
	250	18.124	34.744
	300	14.126	34.444
	400	9.386	34.298
	500	7.780	34.387
	600	6.802	34.443
	700	6.112	34.474
	800	5.484	34.486
	900	5.065	34.504
	1000	4.575	34.523

KH-12-2		St.X07	
2012/5/16	Lat.	13	59.97N
Time: 20:30	Long.	142	29.99E
XCTD data	Depth	Temp.	Sal
	m	°C	(psu)
	1	29.613	33.182
	3	29.620	34.476
	5	29.630	34.521
	10	29.630	34.543
	20	29.630	34.554
	30	29.439	34.546
	40	28.613	34.498
	50	28.325	34.502
	75	27.881	34.602
	100	26.769	34.787
	125	26.287	34.802
	150	25.533	34.876
	175	24.738	35.032
	200	23.293	35.139
	250	18.715	34.831
	300	13.874	34.432
	400	9.187	34.303
	500	7.447	34.398
	600	6.665	34.440
	700	5.799	34.473
	800	5.372	34.484
	900	5.034	34.493
	1000	4.738	34.503

KH-12-2		St.X08	
2012/5/16	Lat.	13	29.72N
Time: 22:25	Long.	142	30.02E
XCTD data	Depth	Temp.	Sal
	m	°C	(psu)
	1	29.701	33.028
	3	29.711	34.425
	5	29.711	34.467
	10	29.711	34.483
	20	29.691	34.496
	30	29.248	34.578
	40	28.951	34.574
	50	28.571	34.543
	75	28.063	34.470
	100	27.840	34.653
	125	27.168	34.787
	150	25.478	35.074
	175	24.389	35.127
	200	20.756	34.968
	250	15.338	34.532
	300	12.005	34.332
	400	9.064	34.307
	500	7.601	34.382
	600	6.626	34.412
	700	6.157	34.467
	800	5.573	34.480
	900	5.092	34.496
	1000	4.618	34.512

KH-12-2		St.X09	
2012/5/17	Lat.	12	59.98N
Time: 00:22	Long.	142	30.02E
XCTD data	Depth	Temp.	Sal
	m	°C	(psu)
	1	29.623	32.267
	3	29.618	34.410
	5	29.619	34.447
	10	29.619	34.470
	20	29.620	34.488
	30	29.609	34.489
	40	28.984	34.464
	50	28.633	34.443
	75	28.334	34.515
	100	27.904	34.622
	125	26.787	34.937
	150	25.547	35.080
	175	22.974	35.102
	200	20.577	34.961
	250	15.841	34.563
	300	12.029	34.329
	400	9.235	34.346
	500	7.927	34.446
	600	6.760	34.438
	700	6.198	34.461
	800	5.637	34.483
	900	5.308	34.497
	1000	4.716	34.505

KH-12-2		St.X10	
2012/5/17	Lat.	12	29.98N
Time: 02:19	Long.	142	29.94E
XCTD data	Depth	Temp.	Sal
	m	°C	(psu)
	1	29.597	33.163
	3	29.615	34.447
	5	29.615	34.483
	10	29.615	34.497
	20	29.625	34.507
	30	29.592	34.499
	40	28.872	34.452
	50	28.494	34.436
	75	28.114	34.481
	100	27.910	34.571
	125	27.768	34.891
	150	26.171	35.089
	175	23.459	35.197
	200	21.637	35.074
	250	15.469	34.536
	300	12.126	34.322
	400	9.151	34.379
	500	7.844	34.465
	600	6.813	34.453
	700	6.348	34.468
	800	5.773	34.481
	900	5.130	34.501
	1000	4.821	34.511

KH-12-2		St.X11	
2012/5/17	Lat.	11	59.98N
Time: 04:13	Long.	142	30.04E
XCTD data	Depth	Temp.	Sal
	m	°C	(psu)
	1	29.569	32.028
	3	29.570	34.346
	5	29.580	34.452
	10	29.580	34.471
	20	29.580	34.485
	30	29.580	34.489
	40	29.211	34.496
	50	28.831	34.496
	75	28.357	34.553
	100	28.139	34.580
	125	28.060	34.822
	150	27.617	34.952
	175	23.629	35.212
	200	20.625	35.011
	250	14.726	34.477
	300	12.377	34.347
	400	9.146	34.385
	500	7.944	34.452
	600	6.914	34.478
	700	6.340	34.493
	800	5.895	34.502
	900	5.150	34.520
	1000	4.845	34.524

KH-12-2		St.X12	
2012/5/17	Lat.	11	30.01N
Time: 06:07	Long.	142	30.01E
XCTD data	Depth	Temp.	Sal
	m	°C	(psu)
	1	29.690	32.802
	3	29.706	34.451
	5	29.702	34.502
	10	29.707	34.515
	20	29.707	34.528
	30	29.676	34.534
	40	29.247	34.538
	50	28.831	34.496
	75	28.551	34.522
	100	28.108	34.607
	125	27.862	34.900
	150	25.441	35.216
	175	21.354	35.095
	200	19.705	34.970
	250	15.695	34.595
	300	11.408	34.345
	400	8.599	34.380
	500	7.727	34.474
	600	6.917	34.507
	700	6.208	34.522
	800	5.713	34.524
	900	5.217	34.540
	1000	4.825	34.550

KH-12-2		St.X13	
2012/5/17	Lat.	13	00.02N
Time: 13:07	Long.	143	29.99E
XCTD data	Depth	Temp.	Sal
	m	°C	(psu)
	1	29.970	32.746
	3	29.925	34.367
	5	29.892	34.408
	10	29.745	34.420
	20	29.703	34.431
	30	28.990	34.410
	40	28.770	34.543
	50	28.461	34.566
	75	27.868	34.652
	100	27.837	34.892
	125	26.670	34.959
	150	24.871	35.219
	175	21.357	35.104
	200	20.044	35.001
	250	15.152	34.556
	300	12.528	34.366
	400	9.108	34.328
	500	7.596	34.416
	600	6.464	34.451
	700	5.889	34.493
	800	5.436	34.502
	900	5.055	34.516
	1000	4.705	34.526

KH-12-2		St.X14	
2012/5/17	Lat.	13	30.04N
Time: 14:59	Long.	143	30.00E
XCTD data	Depth	Temp.	Sal
	m	°C	(psu)
	1	29.730	32.998
	3	29.749	34.450
	5	29.758	34.505
	10	29.653	34.540
	20	29.580	34.562
	30	28.809	34.570
	40	28.443	34.553
	50	28.406	34.590
	75	28.169	34.582
	100	27.791	34.627
	125	26.401	34.996
	150	24.119	35.154
	175	22.470	35.087
	200	20.030	34.947
	250	16.428	34.649
	300	13.154	34.418
	400	9.144	34.316
	500	7.667	34.420
	600	6.696	34.453
	700	6.073	34.473
	800	5.384	34.505
	900	5.025	34.526
	1000	4.535	34.552

KH-12-2		St.X15	
2012/5/17	Lat.	14	00.03N
Time: 16:50	Long.	143	29.95E
XCTD data	Depth	Temp.	Sal
	m	°C	(psu)
	1	29.822	32.803
	3	29.840	34.513
	5	29.835	34.570
	10	29.829	34.583
	20	29.598	34.586
	30	29.064	34.551
	40	28.548	34.532
	50	28.311	34.528
	75	27.665	34.692
	100	26.631	34.838
	125	25.810	34.893
	150	24.388	34.997
	175	22.440	35.141
	200	21.063	35.034
	250	16.508	34.639
	300	13.098	34.396
	400	9.372	34.331
	500	7.662	34.422
	600	6.493	34.462
	700	5.938	34.493
	800	5.361	34.502
	900	4.971	34.527
	1000	4.503	34.546

KH-12-2		St.X16	
2012/5/17	Lat.	14	30.03N
Time: 18:44	Long.	143	30.04E
XCTD data	Depth	Temp.	Sal
	m	°C	(psu)
	1	29.517	32.292
	3	29.543	34.458
	5	29.547	34.585
	10	29.510	34.598
	20	29.427	34.606
	30	28.780	34.530
	40	28.528	34.523
	50	28.266	34.535
	75	27.907	34.568
	100	27.369	34.774
	125	26.338	34.879
	150	25.246	35.049
	175	22.908	35.096
	200	21.994	35.063
	250	17.490	34.725
	300	13.453	34.425
	400	9.778	34.318
	500	7.851	34.364
	600	6.586	34.424
	700	6.031	34.473
	800	5.306	34.490
	900	4.813	34.519
	1000	4.437	34.539

KH-12-2		St.X17	
2012/5/17	Lat.	15	00.04N
Time: 20:39	Long.	143	30.01E
XCTD data	Depth	Temp.	Sal
	m	°C	(psu)
	1	29.691	33.139
	3	29.709	34.564
	5	29.709	34.597
	10	29.709	34.609
	20	29.445	34.597
	30	28.346	34.618
	40	27.966	34.687
	50	27.710	34.722
	75	27.048	34.816
	100	26.160	34.852
	125	25.550	34.940
	150	24.559	34.971
	175	23.372	35.004
	200	21.844	35.062
	250	18.680	34.807
	300	15.307	34.556
	400	10.504	34.338
	500	8.056	34.394
	600	7.237	34.437
	700	6.033	34.452
	800	5.406	34.486
	900	4.814	34.515
	1000	4.304	34.550

KH-12-2		St.X18	
2012/5/17	Lat.	15	30.00N
Time: 22:36	Long.	143	30.01E
XCTD data	Depth	Temp.	Sal
	m	°C	(psu)
	1	29.470	32.948
	3	29.489	34.651
	5	29.493	34.714
	10	29.498	34.732
	20	29.498	34.741
	30	28.343	34.701
	40	27.845	34.701
	50	27.753	34.701
	75	27.100	34.769
	100	26.447	34.914
	125	24.873	34.948
	150	23.314	35.034
	175	21.803	35.022
	200	20.053	34.891
	250	17.915	34.727
	300	15.594	34.562
	400	10.988	34.336
	500	8.390	34.364
	600	6.668	34.364
	700	5.744	34.428
	800	5.279	34.467
	900	4.722	34.515
	1000	4.350	34.537



KH-12-2		St.X19	
2012/5/18	Lat.	16	00.02N
Time: 00:32	Long.	143	29.91E
XCTD data	Depth	Temp.	Sal
	m	°C	(psu)
	1	29.161	32.907
	3	29.179	34.620
	5	29.179	34.679
	10	29.096	34.691
	20	28.587	34.688
	30	27.550	34.735
	40	27.243	34.768
	50	26.865	34.793
	75	25.898	34.863
	100	25.045	34.973
	125	24.020	34.997
	150	22.831	35.048
	175	21.747	35.000
	200	20.289	34.893
	250	17.925	34.730
	300	15.731	34.593
	400	11.339	34.340
	500	8.068	34.255
	600	6.701	34.340
	700	5.924	34.412
	800	5.332	34.466
	900	4.796	34.499
	1000	4.420	34.520

KH-12-2		St.50	
2012/5/31	Lat.	5	02.35N
Time: 08:44	Long.	133	59.36E
XCTD data	Depth	Temp.	Sal
	m	°C	(psu)
	1	29.492	32.794
	3	29.521	33.574
	5	29.526	33.585
	10	29.531	33.593
	20	29.531	33.603
	30	29.332	33.709
	40	29.364	33.884
	50	29.249	34.065
	75	28.070	34.476
	100	26.056	34.746
	125	22.999	34.946
	150	18.830	34.820
	175	15.814	34.604
	200	11.332	34.396
	250	9.508	34.443
	300	8.585	34.544
	400	7.963	34.572
	500	7.463	34.562
	600	6.981	34.538
	700	6.603	34.523
	800	6.147	34.520
	900	5.335	34.524
	1000	4.744	34.541

# Working log: KH-12-2

Leg 1

Date	Time	Latitude	Longitude	Depth	Station	Comment
120513	957 +09:00	35 37.519N	139 47.743E	—		(LET GO ALL LINES :TOKYO PORT)
120513	1300 +09:00	35 03.057N	139 43.141E	679		(COM'CED LIFEBOAT STATION DRILL )
120513	1330 +09:00	34 55.092N	139 43.566E	83		(FINISHED LIFEBOAT STATION DRILL)
120513	1832 +09:00	33 33.863N	139 58.786E	178		(SUNSET)
120514	443 +09:00	30 50.088N	140 28.165E	2089		(SUNRIZE)
120514	1816 +09:00	27 15.488N	141 05.412E	2858		(SUNSET)
120515	443 +09:00	24 27.841N	141 32.867E	2080		(SUNRIZE)
120515	1623 +09:00	21 22.463N	141 56.764E	3470		(ENTERED EEZ OF U.S).
120515	1802 +09:00	20 56.948N	142 00.264E	3842		(SUNSET)
120516	456 +09:00	18 07.301N	142 21.461E	4140		(SUNRIZE)
120516	909 +09:00	16 59.936N	142 29.969E	3999	ST.X1	LET GO XCTD
120516	1102 +09:00	16 29.981N	142 30.053E	3806	ST.X2	LET GO XCTD
120516	1252 +09:00	15 59.931N	142 29.998E	3867	ST.X3	LET GO XCTD
120516	1445 +09:00	15 29.968N	142 29.999E	4082	ST.X4	LET GO XCTD
120516	1640 +09:00	14 59.954N	142 30.032E	4200	ST.X5	LET GO XCTD
120516	1751 +09:00	14 41.457N	142 30.016E	3998		(SUNSET)
120516	1834 +09:00	14 29.965N	142 29.985E	3499	ST.X6	LET GO XCTD
120516	2030 +09:00	13 59.959N	142 29.990E	2746	ST.X7	LET GO XCTD
120516	2225 +09:00	13 29.948N	142 30.021E	2299	ST.X8	LET GO XCTD
120517	22 +09:00	12 59.958N	142 30.023E	3062	ST.X9	LET GO XCTD
120517	219 +09:00	12 29.960N	142 29.937E	3681	ST.X10	LET GO XCTD
120517	413 +09:00	11 59.963N	142 30.038E	3066	ST.X11	LET GO XCTD
120517	505 +09:00	11 46.596N	142 30.032E	4564		(SUNRIZE)
120517	545 +09:00	11 35.814N	142 30.003E	7169		(CLEARED OUT USA'S EEZ & ENTERED FM'S EEZ)
120517	607 +09:00	11 29.992N	142 30.010E	8321	ST.X12	LET GO XCTD
120517	634 +09:00	11 32.545N	142 32.893E	7635		(CLEARED OUT FM'S EEZ & ENTERED USA'S EEZ )
120517	1307 +09:00	13 00.030N	143 29.990E	3262	ST.X13	LET GO XCTD
120517	1459 +09:00	13 30.054N	143 29.998E	3360	ST.X14	LET GO XCTD
120517	1650 +09:00	14 00.049N	143 29.949E	3268	ST.X15	LET GO XCTD
120517	1747 +09:00	14 14.984N	143 30.016E	4396		(SUNSET)
120517	1844 +09:00	14 30.039N	143 30.036E	3126	ST.X16	LET GO XCTD
120517	2039 +09:00	15 00.046N	143 30.012E	3654	ST.X17	LET GO XCTD
120517	2236 +09:00	15 30.014N	143 30.013E	4107	ST.X18	LET GO XCTD
120518	32 +09:00	16 00.050N	143 29.909E	3825	ST.X19	LET GO XCTD
120518	408 +09:00	15 59.621N	142 40.013E	3610	ST.1	ORI-BF NET STARTED
120518	432 +09:00	15 58.564N	142 40.220E	3626	ST.1	ORI-BF NET DEEPEST
120518	458 +09:00	15 57.384N	142 40.404E	3642	ST.1	(SUNRIZE)
120518	510 +09:00	15 57.030N	142 40.473E	3634	ST.1	ORI-BF NET FINISHED
120518	611 +09:00	15 44.477N	142 40.021E	3530	ST.2	ORI-BF NET STARTED
120518	635 +09:00	15 43.388N	142 39.958E	3476	ST.2	ORI-BF NET DEEPEST
120518	711 +09:00	15 41.982N	142 39.890E	3435	ST.2	ORI-BF NET FINISHED
120518	813 +09:00	15 29.986N	142 40.249E	3771	ST.3	ORI-BF NET STARTED
120518	830 +09:00	15 29.915N	142 41.119E	3730	ST.3	ORI-BF NET DEEPEST
120518	904 +09:00	15 29.765N	142 42.565E	3651	ST.3	ORI-BF NET FINISHED
120518	1020 +09:00	15 15.057N	142 44.753E	3604	ST.4	ORI-BF NET STARTED
120518	1036 +09:00	15 14.966N	142 45.476E	3576	ST.4	ORI-BF NET DEEPEST
120518	1105 +09:00	15 14.738N	142 46.595E	3533	ST.4	ORI-BF NET FINISHED
120518	1226 +09:00	14 59.991N	142 39.917E	3604	ST.5	ORI-BF NET STARTED
120518	1241 +09:00	14 59.774N	142 40.531E	3604	ST.5	ORI-BF NET DEEPEST
120518	1316 +09:00	14 59.325N	142 41.697E	3478	ST.5	ORI-BF NET FINISHED
120518	1432 +09:00	14 44.966N	142 45.076E	3616	ST.6	ORI-BF NET STARTED
120518	1448 +09:00	14 44.677N	142 45.745E	3620	ST.6	ORI-BF NET DEEPEST
120518	1515 +09:00	14 44.207N	142 46.835E	3523	ST.6	ORI-BF NET FINISHED
120518	1630 +09:00	14 50.008N	142 34.819E	4071	ST.7	ORI-BF NET STARTED
120518	1647 +09:00	14 49.719N	142 35.321E	4023	ST.7	ORI-BF NET DEEPEST
120518	1713 +09:00	14 49.256N	142 36.029E	4008	ST.7	ORI-BF NET FINISHED
120518	1751 +09:00	14 55.080N	142 33.456E	4112		(SUNSET)
120518	1839 +09:00	15 05.055N	142 29.915E	4056	ST.7	ORI-BF NET STARTED
120518	1858 +09:00	15 05.017N	142 30.426E	4048	ST.7	ORI-BF NET DEEPEST
120518	1926 +09:00	15 04.873N	142 31.093E	3994	ST.7	ORI-BF NET FINISHED
120518	2048 +09:00	15 19.926N	142 35.101E	4016	ST.9	ORI-BF NET STARTED
120518	2104 +09:00	15 19.959N	142 35.770E	3908	ST.9	ORI-BF NET DEEPEST
120518	2140 +09:00	15 19.819N	142 37.125E	3874	ST.9	ORI-BF NET FINISHED
120518	2300 +09:00	15 05.074N	142 29.945E	4054	ST.8-1	ORI-BF NET STARTED
120518	2313 +09:00	15 05.126N	142 30.360E	4040	ST.8-1	ORI-BF NET DEEPEST
120519	24 +09:00	15 05.219N	142 32.249E	3942	ST.8-1	ORI-BF NET FINISHED
120519	129 +09:00	15 04.859N	142 34.952E	3801	ST.8-2	ORI-BF NET STARTED
120519	144 +09:00	15 04.886N	142 35.342E	3806	ST.8-2	ORI-BF NET DEEPEST
120519	246 +09:00	15 04.662N	142 37.063E	3627	ST.8-2	ORI-BF NET FINISHED
120519	418 +09:00	15 09.913N	142 29.822E	4028	ST.8-3	ORI-BF NET STARTED
120519	445 +09:00	15 10.168N	142 30.552E	3927	ST.8-3	ORI-BF NET DEEPEST

120519	459	+09:00	15 10.307N	142 31.002E	3894	ST.8-3	(SUNRISE)
120519	546	+09:00	15 10.693N	142 32.407E	3825	ST.8-3	ORI-BF NET FINISHED
120519	703	+09:00	15 05.082N	142 24.913E	4202	ST.8-4	ORI-BF NET STARTED
120519	721	+09:00	15 05.159N	142 25.485E	4194	ST.8-4	ORI-BF NET DEEPEST
120519	827	+09:00	15 05.316N	142 27.808E	4139	ST.8-4	ORI-BF NET FINISHED
120519	924	+09:00	14 59.919N	142 29.981E	4203	ST.8-5	ORI-BF NET STARTED
120519	940	+09:00	14 59.888N	142 30.513E	4190	ST.8-5	ORI-BF NET DEEPEST
120519	1046	+09:00	14 59.845N	142 32.740E	4071	ST.8-5	ORI-BF NET FINISHED
120519	1203	+09:00	15 05.136N	142 24.879E	4202	ST.8-6	ORI-BF NET STARTED
120519	1221	+09:00	15 05.199N	142 25.540E	4193	ST.8-6	ORI-BF NET DEEPEST
120519	1245	+09:00	15 05.206N	142 26.278E	4182	ST.8-6	ORI-BF NET FINISHED
120519	1251	+09:00	15 05.207N	142 26.349E	4180	ST.8-7	ORI-BF NET STARTED
120519	1308	+09:00	15 05.151N	142 26.992E	4154	ST.8-7	ORI-BF NET DEEPEST
120519	1331	+09:00	15 05.094N	142 27.713E	4148	ST.8-7	ORI-BF NET FINISHED
120519	1359	+09:00	15 05.039N	142 24.936E	4200	ST.8-8	ORI-BF NET STARTED
120519	1418	+09:00	15 05.084N	142 25.633E	4191	ST.8-8	ORI-BF NET DEEPEST
120519	1526	+09:00	15 05.025N	142 27.878E	4144	ST.8-8	ORI-BF NET FINISHED
120519	1613	+09:00	15 00.083N	142 29.604E	4208	ST.8-9	ORI-BF NET STARTED
120519	1631	+09:00	15 00.116N	142 30.254E	4190	ST.8-9	ORI-BF NET DEEPEST
120519	1743	+09:00	15 00.452N	142 32.535E	4070	ST.8-9	ORI-BF NET FINISHED
120519	1753	+09:00	15 00.622N	142 32.418E	4056		(SUNSET)
120519	1838	+09:00	15 00.040N	142 24.740E	4254	ST.8-10	ORI-BF NET STARTED
120519	1857	+09:00	15 00.114N	142 25.379E	4250	ST.8-10	ORI-BF NET DEEPEST
120519	2009	+09:00	15 00.260N	142 27.790E	4179	ST.8-10	ORI-BF NET FINISHED
120519	2010	+09:00	15 00.258N	142 27.804E	4178	ST.8-11	ORI-BF NET STARTED
120519	2023	+09:00	15 00.267N	142 28.255E	4179	ST.8-11	ORI-BF NET DEEPEST
120519	2140	+09:00	15 00.066N	142 31.002E	4143	ST.8-11	ORI-BF NET FINISHED
120519	2230	+09:00	15 02.656N	142 27.318E	4173	ST.8-12	ORI-BF NET STARTED
120519	2246	+09:00	15 02.736N	142 27.876E	4167	ST.8-12	ORI-BF NET DEEPEST
120519	2356	+09:00	15 03.088N	142 30.143E	4136	ST.8-12	ORI-BF NET FINISHED
120520	58	+09:00	15 04.994N	142 19.884E	4244	ST.8-13	ORI-BF NET STARTED
120520	122	+09:00	15 05.459N	142 20.575E	4234	ST.8-13	ORI-BF NET DEEPEST
120520	227	+09:00	15 06.666N	142 22.492E	4231	ST.8-13	ORI-BF NET FINISHED
120520	343	+09:00	14 59.993N	142 19.898E	4330	ST.8-14	ORI-BF NET STARTED
120520	403	+09:00	15 00.377N	142 20.596E	4328	ST.8-14	ORI-BF NET DEEPEST
120520	500	+09:00	15 01.555N	142 22.385E	4289		(SUNRISE)
120520	517	+09:00	15 01.848N	142 22.663E	4276	ST.8-14	ORI-BF NET FINISHED
120520	622	+09:00	15 00.077N	142 29.821E	4206	ST.8-15	CTD-CMS STARTED
120520	643	+09:00	15 00.216N	142 29.714E	4208	ST.8-15	CTD-CMS DEEPEST
120520	704	+09:00	15 00.241N	142 29.679E	4208	ST.8-15	CTD-CMS FINISHED
120520	731	+09:00	14 59.999N	142 30.024E	4200	ST.8-15	CTD-CMS STARTED
120520	742	+09:00	15 00.040N	142 30.012E	4198	ST.8-15	CTD-CMS DEEPEST
120520	757	+09:00	15 00.065N	142 29.990E	4198	ST.8-15	CTD-CMS FINISHED
120520	821	+09:00	15 00.000N	142 30.034E	4200	ST.8-15	CTD-CMS STARTED
120520	853	+09:00	14 59.948N	142 29.849E	4206	ST.8-15	CTD-CMS DEEPEST
120520	946	+09:00	15 00.011N	142 30.154E	4201	ST.8-15	CTD-CMS FINISHED
120520	1030	+09:00	15 00.025N	142 30.649E	4172	ST.8-15	SETTING OF DRIFTING BUOY STARTED
120520	1034	+09:00	15 00.094N	142 30.513E	4173	ST.8-15	SETTING OF DRIFTING BUOY FINISHED
120520	1039	+09:00	15 00.116N	142 30.366E	4179	ST.8-15	SETTING OF DRIFTING BUOY STARTED
120520	1046	+09:00	15 00.179N	142 30.175E	4191	ST.8-15	SETTING OF DRIFTING BUOY FINISHED
120520	1218	+09:00	15 14.904N	142 20.017E	4232	ST.10	ORI-BF NET STARTED
120520	1239	+09:00	15 14.798N	142 20.822E	4241	ST.10	ORI-BF NET DEEPEST
120520	1317	+09:00	15 14.442N	142 22.329E	4182	ST.10	ORI-BF NET FINISHED
120520	1456	+09:00	15 30.011N	142 09.905E	4152	ST.11	ORI-BF NET STARTED
120520	1514	+09:00	15 29.994N	142 10.520E	4170	ST.11	ORI-BF NET DEEPEST
120520	1545	+09:00	15 29.972N	142 11.584E	4240	ST.11	ORI-BF NET FINISHED
120520	1722	+09:00	15 45.108N	141 59.857E	4454	ST.12	ORI-BF NET STARTED
120520	1749	+09:00	15 45.289N	142 00.888E	4456	ST.12	ORI-BF NET DEEPEST
120520	1756	+09:00	15 45.327N	142 01.160E	4457		(SUNSET)
120520	1831	+09:00	15 45.391N	142 02.440E	4373	ST.12	ORI-BF NET FINISHED
120520	1951	+09:00	15 59.959N	141 59.994E	4409	ST.13	ORI-BF NET STARTED
120520	2010	+09:00	15 59.782N	142 00.835E	4409	ST.13	ORI-BF NET DEEPEST
120520	2050	+09:00	15 59.474N	142 02.437E	4396	ST.13	ORI-BF NET FINISHED
120520	2221	+09:00	16 14.803N	142 00.043E	4341	ST.14	ORI-BF NET STARTED
120520	2237	+09:00	16 14.610N	142 00.589E	4355	ST.14	ORI-BF NET DEEPEST
120520	2312	+09:00	16 14.027N	142 01.853E	4304	ST.14	ORI-BF NET FINISHED
120521	133	+09:00	16 29.905N	142 25.051E	4020	ST.15	ORI-BF NET STARTED
120521	154	+09:00	16 30.067N	142 25.743E	4010	ST.15	ORI-BF NET DEEPEST
120521	229	+09:00	16 30.250N	142 26.909E	3983	ST.15	ORI-BF NET FINISHED
120521	330	+09:00	16 29.998N	142 24.985E	4021	ST.15	CTD-CMS STARTED
120521	405	+09:00	16 29.932N	142 24.844E	4027	ST.15	CTD-CMS DEEPEST
120521	457	+09:00	16 29.822N	142 24.828E	4028		(SUNRISE)
120521	501	+09:00	16 29.806N	142 24.827E	4028	ST.15	CTD-CMS FINISHED
120521	529	+09:00	16 29.990N	142 24.997E	4020	ST.15	CTD-CMS STARTED

120521	541 +09:00	16 29.954N	142 24.971E	4022	ST.15	CTD-CMS DEEPEST
120521	555 +09:00	16 29.894N	142 24.945E	4024	ST.15	CTD-CMS FINISHED
120521	628 +09:00	16 29.989N	142 25.012E	4020	ST.15	CTD-CMS DEEPEST
120521	641 +09:00	16 29.941N	142 25.017E	4020	ST.15	CTD-CMS FINISHED
120521	1225 +09:00	14 59.945N	142 19.992E	4320	ST.16	ORI-BF NET STARTED
120521	1246 +09:00	14 59.730N	142 20.723E	4338	ST.16	ORI-BF NET DEEPEST
120521	1324 +09:00	14 59.535N	142 22.104E	4338	ST.16	ORI-BF NET FINISHED
120521	1458 +09:00	14 44.797N	142 15.023E	4320	ST.17	ORI-BF NET STARTED
120521	1515 +09:00	14 44.678N	142 15.613E	4320	ST.17	ORI-BF NET DEEPEST
120521	1543 +09:00	14 44.502N	142 16.589E	4335	ST.17	ORI-BF NET FINISHED
120521	1704 +09:00	14 29.866N	142 09.900E	4160	ST.18	ORI-BF NET STARTED
120521	1721 +09:00	14 29.702N	142 10.439E	4158	ST.18	ORI-BF NET DEEPEST
120521	1750 +09:00	14 29.394N	142 11.192E	4103	ST.18	ORI-BF NET FINISHED
120521	1758 +09:00	14 29.188N	142 11.404E	4110		(SUNSET)
120521	1910 +09:00	14 14.844N	142 04.915E	4341	ST.19	CTD-CMS STARTED
120521	1940 +09:00	14 14.827N	142 04.685E	4351	ST.19	CTD-CMS DEEPEST
120521	2032 +09:00	14 14.997N	142 04.374E	4346	ST.19	CTD-CMS FINISHED
120521	2037 +09:00	14 15.029N	142 04.370E	4346	ST.19	ORI-BF NET STARTED
120521	2053 +09:00	14 15.210N	142 04.775E	4346	ST.19	ORI-BF NET DEEPEST
120521	2124 +09:00	14 15.491N	142 05.480E	4318	ST.19	ORI-BF NET FINISHED
120521	2128 +09:00	14 15.513N	142 05.496E	4318	ST.19	CTD-CMS STARTED
120521	2142 +09:00	14 15.559N	142 05.297E	4318	ST.19	CTD-CMS DEEPEST
120521	2155 +09:00	14 15.540N	142 05.185E	4320	ST.19	CTD-CMS FINISHED
120521	2324 +09:00	14 00.154N	141 59.818E	4269	ST.20	ORI-BF NET STARTED
120521	2341 +09:00	14 00.443N	142 00.255E	4273	ST.20	ORI-BF NET DEEPEST
120522	15 +09:00	14 01.088N	142 01.076E	4276	ST.20	ORI-BF NET FINISHED
120522	436 +09:00	13 13.468N	141 13.404E	4372		(CLEARED OUT USA'S EEZ)
120522	508 +09:00	13 07.007N	141 06.976E	4462		(SUNRISE)
120522	517 +09:00	13 05.204N	141 05.154E	4415		ENTERED FM'S EEZ
120522	1018 +09:00	12 19.953N	140 09.861E	4364	ST.21	ORI-BF NET STARTED
120522	1036 +09:00	12 20.036N	140 10.452E	4371	ST.21	ORI-BF NET DEEPEST
120522	1111 +09:00	12 20.330N	140 11.604E	4385	ST.21	ORI-BF NET FINISHED
120522	1210 +09:00	12 29.961N	140 14.983E	4361	ST.22	ORI-BF NET STARTED
120522	1230 +09:00	12 30.417N	140 15.368E	4356	ST.22	ORI-BF NET DEEPEST
120522	1303 +09:00	12 31.070N	140 15.947E	4340	ST.22	ORI-BF NET FINISHED
120522	1414 +09:00	12 39.973N	140 24.935E	4137	ST.23	ORI-BF NET STARTED
120522	1434 +09:00	12 40.481N	140 24.336E	4134	ST.23	ORI-BF NET DEEPEST
120522	1510 +09:00	12 41.376N	140 23.495E	4109	ST.23	ORI-BF NET FINISHED
120522	1658 +09:00	12 49.934N	140 44.993E	4280	ST.24	ORI-BF NET STARTED
120522	1719 +09:00	12 50.277N	140 45.495E	4283	ST.24	ORI-BF NET DEEPEST
120522	1754 +09:00	12 50.782N	140 46.145E	4295		(SUNSET)
120522	1755 +09:00	12 50.796N	140 46.161E	4296	ST.24	ORI-BF NET FINISHED
120522	2022 +09:00	13 02.001N	141 15.606E	4241		ENTERED USA'S EEZ
120523	2 +09:00	13 44.893N	141 50.028E	4234	ST.25	ORI-BF NET STARTED
120523	20 +09:00	13 44.297N	141 49.861E	4272	ST.25	ORI-BF NET DEEPEST
120523	51 +09:00	13 43.284N	141 49.645E	4306	ST.25	ORI-BF NET FINISHED
120523	209 +09:00	13 29.954N	141 44.869E	3048	ST.26	ORI-BF NET STARTED
120523	227 +09:00	13 29.516N	141 44.311E	3134	ST.26	ORI-BF NET DEEPEST
120523	256 +09:00	13 28.769N	141 43.439E	3255	ST.26	ORI-BF NET FINISHED
120523	417 +09:00	13 14.960N	141 34.942E	3260	ST.27	ORI-BF NET STARTED
120523	439 +09:00	13 14.598N	141 34.004E	3154	ST.27	ORI-BF NET DEEPEST
120523	506 +09:00	13 14.070N	141 32.924E	3316	ST.27	(SUNRISE)
120523	518 +09:00	13 13.915N	141 32.596E	3366	ST.27	ORI-BF NET FINISHED
120523	639 +09:00	13 00.023N	141 24.974E	4010	ST.28	ORI-BF NET STARTED
120523	700 +09:00	12 59.567N	141 24.429E	4018	ST.28	ORI-BF NET DEEPEST
120523	727 +09:00	12 59.071N	141 23.775E	4029	ST.28	ORI-BF NET FINISHED
120523	757 +09:00	12 55.727N	141 20.636E	3600		(CLEARED OUT USA'S EEZ)
120523	836 +09:00	12 49.799N	141 14.664E	2473	ST.29	ORI-BF NET STARTED
120523	854 +09:00	12 49.555N	141 14.027E	2304	ST.29	ORI-BF NET DEEPEST
120523	928 +09:00	12 49.140N	141 12.817E	2954	ST.29	ORI-BF NET FINISHED
120523	1028 +09:00	12 39.836N	141 15.027E	3250	ST.30	ORI-BF NET STARTED
120523	1046 +09:00	12 39.295N	141 14.919E	3237	ST.30	ORI-BF NET DEEPEST
120523	1120 +09:00	12 38.586N	141 14.506E	3224	ST.30	ORI-BF NET FINISHED
120523	1222 +09:00	12 30.017N	141 20.041E	1678	ST.31	ORI-BF NET STARTED
120523	1242 +09:00	12 29.348N	141 19.808E	2029	ST.31	ORI-BF NET DEEPEST
120523	1312 +09:00	12 28.314N	141 19.503E	2020	ST.31	ORI-BF NET FINISHED
120523	1405 +09:00	12 19.995N	141 14.923E	4403	ST.32	ORI-BF NET STARTED
120523	1427 +09:00	12 19.567N	141 14.278E	4540	ST.32	ORI-BF NET DEEPEST
120523	1503 +09:00	12 18.909N	141 13.135E	4614	ST.32	ORI-BF NET FINISHED
120523	1613 +09:00	12 19.880N	141 00.002E	2140	ST.33	ORI-BF NET STARTED
120523	1634 +09:00	12 19.300N	140 59.392E	2094	ST.33	ORI-BF NET DEEPEST
120523	1711 +09:00	12 18.509N	140 58.322E	2514	ST.33	ORI-BF NET FINISHED
120523	1757 +09:00	12 11.940N	140 51.931E	3580		(SUNSET)
120523	1817 +09:00	12 09.920N	140 50.048E	3443	ST.34	ORI-BF NET STARTED

120523	1838 +09:00	12 09.391N	140 49.520E	3375	ST.34	ORI-BF NET DEEPEST
120523	1913 +09:00	12 08.603N	140 48.699E	3409	ST.34	ORI-BF NET FINISHED
120524	324 +09:00	13 20.946N	139 00.276E	5104		(CLEARED OUT FM's EEZ)
120524	517 +09:00	13 38.032N	138 34.248E	3806		(SUNRISE)
120524	757 +09:00	14 00.038N	137 59.898E	5106	ST.OH-1	CTD-CMS STARTED
120524	819 +09:00	14 00.087N	137 59.920E	5106	ST.OH-1	CTD-CMS DEEPEST
120524	838 +09:00	14 00.126N	137 59.952E	5107	ST.OH-1	CTD-CMS FINISHED
120524	956 +09:00	13 59.934N	137 59.955E	5107	ST.OH-1	SETTING OF UPWELLING SYSTEM STARTED
120524	1346 +09:00	14 01.383N	138 00.947E	4885	ST.OH-1	SETTING OF UPWELLING SYSTEM FINISHED
120524	1806 +09:00	13 21.617N	138 54.278E	3318		(SUNSET)
120524	1815 +09:00	13 20.155N	138 56.329E	4555		(ENTERED FM's EEZ)
120525	313 +09:00	12 00.077N	140 50.251E	3887	ST.35	CTD-CMS STARTED
120525	347 +09:00	12 00.044N	140 50.271E	3888	ST.35	CTD-CMS DEEPEST
120525	440 +09:00	11 59.912N	140 50.370E	3895	ST.35	CTD-CMS FINISHED
120525	503 +09:00	12 00.056N	140 49.992E	3893	ST.35	CTD-CMS STARTED
120525	510 +09:00	12 00.080N	140 50.028E	3894	ST.35	(SUNRISE)
120525	512 +09:00	12 00.086N	140 50.037E	3895	ST.35	CTD-CMS DEEPEST
120525	524 +09:00	12 00.135N	140 50.055E	3897	ST.35	CTD-CMS FINISHED
120525	531 +09:00	12 00.173N	140 50.051E	3894	ST.35	ORI-BF NET STARTED
120525	550 +09:00	11 59.856N	140 49.551E	3903	ST.35	ORI-BF NET DEEPEST
120525	622 +09:00	11 59.359N	140 48.771E	3908	ST.35	ORI-BF NET FINISHED
120525	1335 +09:00	11 25.758N	142 38.715E	9058		(CLEARED OUT FM's EEZ & ENTERED USA'S EEZ)
120525	1749 +09:00	11 04.879N	143 45.013E	5978		(SUNSET)
120525	1826 +09:00	11 01.829N	143 54.431E	4365		(CLEARED OUT USA'S EEZ & ENTERED FM's EEZ)
120525	1900 +09:00	11 00.127N	143 59.964E	3486	ST.36	CTD-CMS STARTED
120525	1920 +09:00	11 00.386N	143 59.888E	3542	ST.36	CTD-CMS DEEPEST
120525	1935 +09:00	11 00.566N	143 59.853E	3679	ST.36	CTD-CMS FINISHED
120525	1942 +09:00	11 00.649N	143 59.859E	3709	ST.36	IKMT NET STARTED
120525	2001 +09:00	11 00.838N	144 00.657E	4108	ST.36	IKMT NET DEEPEST
120525	2044 +09:00	11 00.955N	144 02.526E	4579	ST.36	IKMT NET FINISHED
120526	424 +09:00	11 00.034N	146 00.042E	3043	ST.37	IKMT NET STARTED
120526	440 +09:00	11 00.093N	146 00.686E	3007	ST.37	IKMT NET DEEPEST
120526	452 +09:00	11 00.137N	146 01.155E	3094	ST.37	(SUNRISE)
120526	521 +09:00	11 00.246N	146 02.323E	3273	ST.37	IKMT NET FINISHED
120526	1315 +09:00	10 59.975N	148 00.150E	5630	ST.38	CTD-CMS STARTED
120526	1338 +09:00	10 59.962N	147 59.991E	5628	ST.38	CTD-CMS DEEPEST
120526	1353 +09:00	11 00.011N	147 59.850E	5630	ST.38	CTD-CMS FINISHED
120526	1400 +09:00	11 00.000N	147 59.820E	5629	ST.38	IKMT NET STARTED
120526	1421 +09:00	10 59.903N	148 00.713E	5629	ST.38	IKMT NET DEEPEST
120526	1505 +09:00	10 59.739N	148 02.220E	5622	ST.38	IKMT NET FINISHED
120526	1728 +09:00	10 24.892N	147 56.910E	5410		(SUNSET)
120526	2251 +09:00	08 59.759N	147 50.145E	2856	ST.39	IKMT NET STARTED
120526	2315 +09:00	08 58.971N	147 50.789E	2926	ST.39	IKMT NET DEEPEST
120526	2356 +09:00	08 57.707N	147 52.302E	2963	ST.39	IKMT NET FINISHED
120527	440 +09:00	07 50.429N	148 10.087E	1287		(SUNRISE)
120527	802 +09:00	07 00.257N	148 00.021E	3512	ST.40	IKMT NET STARTED
120527	826 +09:00	07 01.019N	148 00.968E	3467	ST.40	IKMT NET DEEPEST
120527	911 +09:00	07 01.798N	148 03.049E	3252	ST.40	IKMT NET FINISHED
120527	1712 +09:00	04 59.973N	147 59.984E	4106	ST.41	CTD-CMS STARTED
120527	1717 +09:00	04 59.960N	147 59.990E	4107	ST.41	(SUNSET)
120527	1734 +09:00	04 59.983N	147 59.889E	4112	ST.41	CTD-CMS DEEPEST
120527	1749 +09:00	05 00.022N	147 59.785E	4115	ST.41	CTD-CMS FINISHED
120527	1757 +09:00	05 00.024N	147 59.843E	4111	ST.41	IKMT NET STARTED
120527	1814 +09:00	05 00.507N	148 00.428E	3902	ST.41	IKMT NET DEEPEST
120527	1858 +09:00	05 01.706N	148 01.826E	3541	ST.41	IKMT NET FINISHED
120528	241 +09:00	05 00.042N	145 59.967E	4378	ST.42	IKMT NET STARTED
120528	302 +09:00	04 59.651N	146 00.842E	4324	ST.42	IKMT NET DEEPEST
120528	351 +09:00	04 58.801N	146 02.848E	4272	ST.42	IKMT NET FINISHED
120528	501 +09:00	05 14.187N	146 01.031E	4316		(SUNRISE)
120528	1137 +09:00	06 59.988N	145 59.787E	3091	ST.43	IKMT NET STARTED
120528	1153 +09:00	07 00.006N	146 00.365E	3073	ST.43	IKMT NET DEEPEST
120528	1227 +09:00	07 00.085N	146 01.518E	3048	ST.43	IKMT NET FINISHED
120528	1733 +09:00	06 56.096N	144 39.120E	2251		(SUNSET)
120528	2005 +09:00	07 00.210N	143 59.804E	2602	ST.44	IKMT NET STARTED
120528	2025 +09:00	07 01.170N	143 59.639E	2721	ST.44	IKMT NET DEEPEST
120528	2113 +09:00	07 03.723N	143 59.248E	2480	ST.44	IKMT NET FINISHED
120529	511 +09:00	04 59.889N	143 59.839E	3788		(SUNRISE)
120529	511 +09:00	04 59.887N	143 59.838E	3788	ST.45	CTD-CMS STARTED
120529	532 +09:00	04 59.797N	143 59.687E	3785	ST.45	CTD-CMS DEEPEST
120529	548 +09:00	04 59.755N	143 59.586E	3783	ST.45	CTD-CMS FINISHED
120529	554 +09:00	04 59.719N	143 59.567E	3783	ST.45	IKMT NET STARTED
120529	612 +09:00	05 00.445N	143 59.478E	3788	ST.45	IKMT NET DEEPEST
120529	645 +09:00	05 01.811N	143 59.305E	3797	ST.45	IKMT NET FINISHED
120529	1427 +09:00	05 00.011N	142 00.001E	2622	ST.46	IKMT NET STARTED

120529	1449	+09:00	05 00.673N	141 59.569E	2648	ST.46	IKMT NET DEEPEST
120529	1529	+09:00	05 01.872N	141 58.616E	2690	ST.46	IKMT NET FINISHED
120529	1746	+09:00	05 00.063N	141 26.240E	3680		(SUNSET)
120529	2354	+09:00	05 00.108N	139 59.908E	4177	No.47	CTD-CMS STARTED
120530	13	+09:00	05 00.202N	139 59.856E	4178	ST.47	CTD-CMS DEEPEST
120530	28	+09:00	05 00.226N	139 59.829E	4179	ST.47	CTD-CMS FINISHED
120530	32	+09:00	05 00.286N	139 59.794E	4180	ST.47	IKMT NET STARTED
120530	50	+09:00	05 01.210N	139 59.297E	4163	ST.47	IKMT NET DEEPEST
120530	133	+09:00	05 03.243N	139 58.234E	4182	ST.47	IKMT NET FINISHED
120530	451	+09:00	04 59.987N	139 13.769E	4178		(CLEARED OUT FM'S EEZ)
120530	529	+09:00	04 59.913N	139 04.350E	4151		(SUNRISE)
120530	1001	+09:00	04 59.698N	138 00.012E	4352	ST.48	IKMT NET STARTED
120530	1020	+09:00	05 00.261N	138 00.345E	4338	ST.48	IKMT NET DEEPEST
120530	1021	+09:00	05 00.287N	138 00.362E	4337	ST.48	(ENTERED FM'S EEZ)
120530	1100	+09:00	05 01.443N	138 01.015E	4248	ST.48	IKMT NET FINISHED
120530	1545	+09:00	04 59.867N	136 59.241E	4995		(CLEARED OUT FM'S EEZ)
120530	1554	+09:00	04 59.869N	136 57.098E	4802		(ENTERED PW'S EEZ)
120530	1803	+09:00	04 59.942N	136 28.965E	4019		(SUNSET)
120530	2023	+09:00	05 00.018N	136 00.101E	4194	ST.49	IKMT NET STARTED
120530	2043	+09:00	04 59.602N	135 59.578E	4194	ST.49	IKMT NET DEEPEST
120530	2133	+09:00	04 58.763N	135 58.226E	4397	ST.49	IKMT NET FINISHED
120531	543	+09:00	05 00.075N	134 17.442E	4535		(SUNRISE)
120531	718	+09:00	05 00.066N	134 00.151E	3891	ST.50	CTD-CMS STARTED
120531	725	+09:00	05 00.071N	134 00.297E	3958	ST.50	CTD-CMS SUSPENDED
120531	730	+09:00	05 00.086N	134 00.380E	4027	ST.50	IKMT NET STARTED
120531	748	+09:00	05 00.538N	134 00.010E	4000	ST.50	IKMT NET DEEPEST
120531	829	+09:00	05 01.419N	133 59.199E	3869	ST.50	IKMT NET FINISHED
120531	844	+09:00	05 02.166N	133 59.326E	4245	ST.50	LET GO XCTD
120531	1308	+09:00	06 00.086N	134 00.000E	5670	ST.51	IKMT NET STARTED
120531	1331	+09:00	05 59.910N	133 58.884E	5551	ST.51	IKMT NET DEEPEST
120531	1412	+09:00	05 59.569N	133 56.910E	4316	ST.51	IKMT NET FINISHED
120531	1817	+09:00	06 52.851N	133 46.751E	3420		(SUNSET)
120531	1854	+09:00	07 00.079N	133 44.914E	3478	ST.52	IKMT NET STARTED
120531	1917	+09:00	07 00.543N	133 43.788E	3736	ST.52	IKMT NET DEEPEST
120531	2006	+09:00	07 01.447N	133 41.532E	4276	ST.52	IKMT NET FINISHED
120601	544	+09:00	07 35.363N	134 23.213E	1158		(SUNRISE)
120601	1126	+09:00	07 19.823N	134 27.410E	343		(LET GO ALL LINES :PALAU)
120606	952	+09:00	07 19.843N	134 27.469E	343		(LET GO ALL LINES :PALAU)
120606	1300	+09:00	07 48.153N	134 11.682E	4150		(COM'CED LIFEBOAT STATION DRILL)
120606	1325	+09:00	07 52.309N	134 07.659E	4349		(FINISHED LIFEBOAT STATION DRILL)
120606	1330	+09:00	07 53.075N	134 06.924E	4372		(COM'CED FIRE STATION DRILL)
120606	1400	+09:00	07 57.952N	134 02.181E	4407		(FINISHED FIRE STATION DRILL)
120606	1421	+09:00	07 59.920N	133 59.998E	4408	ST.53	IKMT NET STARTED
120606	1438	+09:00	07 59.602N	133 59.369E	4409	ST.53	IKMT NET DEEPEST
120606	1515	+09:00	07 59.041N	133 58.220E	4409	ST.53	IKMT NET FINISHED
120606	1823	+09:00	08 39.568N	134 00.034E	4468		(SUNSET)
120606	2001	+09:00	09 00.125N	133 59.882E	5168	ST.54	IKMT NET STARTED
120606	2020	+09:00	09 01.076N	133 59.425E	5165	ST.54	IKMT NET DEEPEST
120606	2111	+09:00	09 03.362N	133 57.528E	5150	ST.54	IKMT NET FINISHED
120607	146	+09:00	09 59.764N	133 59.803E	4674	ST.55	IKMT NET STARTED
120607	208	+09:00	09 58.857N	133 58.679E	4700	ST.55	IKMT NET DEEPEST
120607	305	+09:00	09 56.535N	133 56.038E	4766	ST.55	IKMT NET FINISHED
120607	541	+09:00	10 28.176N	133 59.285E	5141		(SUNRISE)
120607	822	+09:00	10 59.937N	133 59.967E	5605	ST.56	CTD-CMS STARTED
120607	844	+09:00	10 59.955N	133 59.693E	5603	ST.56	CTD-CMS DEEPEST
120607	901	+09:00	11 00.021N	133 59.567E	5600	ST.56	CTD-CMS FINISHED
120607	906	+09:00	10 59.910N	133 59.468E	5598	ST.56	IKMT NET STARTED
120607	928	+09:00	10 58.856N	133 58.756E	5610	ST.56	IKMT NET DEEPEST
120607	1013	+09:00	10 56.755N	133 57.405E	5628	ST.56	IKMT NET FINISHED
120607	1235	+09:00	11 23.993N	134 15.178E	5212		(CLEARED OUT PW'S EEZ)
120607	1823	+09:00	12 42.609N	135 05.025E	4631		(SUNSET)
120608	521	+09:00	15 11.935N	136 40.815E	5532		(SUNRISE)
120608	1238	+09:00	16 46.141N	137 47.725E	4295	ST.OH2	RETRIEVING OF UPWELLING SYSTEM STARTED
120608	1238	+09:00	16 46.140N	137 47.732E	4276	ST.OH2	RETRIEVING OF UPWELLING SYSTEM FINISHED
120608	1821	+09:00	16 40.830N	137 43.458E	5370		(SUNSET)
120609	506	+09:00	15 51.075N	140 13.046E	4650		(SUNRISE)
120609	1215	+09:00	15 19.736N	141 47.972E	4480		(ENTERED USA'S EEZ)
120609	1317	+09:00	15 15.701N	141 58.290E	4378	ST.57	RETRIEVING OF DRIFTING BUOY STARTED
120609	1324	+09:00	15 15.758N	141 58.261E	4377	ST.57	RETRIEVING OF DRIFTING BUOY FINISHED
120609	1337	+09:00	15 15.850N	141 58.233E	4376	ST.57	ORI-BF NET STARTED
120609	1355	+09:00	15 16.551N	141 57.944E	4371	ST.57	ORI-BF NET DEEPEST
120609	1432	+09:00	15 17.889N	141 57.384E	4376	ST.57	ORI-BF NET FINISHED
120609	1615	+09:00	15 35.490N	142 07.335E	4362	ST.58	RETRIEVING OF DRIFTING BUOY STARTED

120609	1623	+09:00	15 35.662N	142 07.379E	4363	ST.58	RETRIEVING OF DRIFTING BUOY FINISHED
120609	1636	+09:00	15 35.833N	142 07.426E	4365	ST.58	ORI-BF NET STARTED
120609	1659	+09:00	15 36.084N	142 08.469E	4364	ST.58	ORI-BF NET DEEPEST
120609	1745	+09:00	15 36.824N	142 10.337E	4280	ST.58	ORI-BF NET FINISHED
120609	1802	+09:00	15 36.071N	142 10.204E	4278		(SUNSET)
120609	2059	+09:00	15 00.010N	141 59.930E	4558	ST.59	CTD-CMS STARTED
120609	2120	+09:00	15 00.039N	141 59.836E	4558	ST.59	CTD-CMS DEEPEST
120609	2133	+09:00	15 00.030N	141 59.784E	4559	ST.59	CTD-CMS FINISHED
120609	2140	+09:00	15 00.110N	141 59.670E	4559	ST.59	ORI-BF NET STARTED
120609	2159	+09:00	15 00.218N	141 58.875E	4542	ST.59	ORI-BF NET DEEPEST
120609	2229	+09:00	15 00.413N	141 57.718E	4546	ST.59	ORI-BF NET FINISHED
120609	2340	+09:00	15 00.418N	141 45.040E	4596	ST.60	ORI-BF NET STARTED
120609	2358	+09:00	15 01.248N	141 44.859E	4595	ST.60	ORI-BF NET DEEPEST
120610	31	+09:00	15 02.621N	141 44.586E	4587	ST.60	ORI-BF NET FINISHED
120610	119	+09:00	15 00.536N	141 36.504E	4550		(CLEARED OUT USA'S EEZ)
120610	152	+09:00	15 00.098N	141 30.361E	4522	ST.61	ORI-BF NET STARTED
120610	208	+09:00	15 00.643N	141 30.288E	4411	ST.61	ORI-BF NET DEEPEST
120610	237	+09:00	15 01.697N	141 30.233E	4472	ST.61	ORI-BF NET FINISHED
120610	403	+09:00	15 00.029N	141 15.070E	4784	ST.62	ORI-BF NET STARTED
120610	421	+09:00	15 00.063N	141 14.566E	4801	ST.62	ORI-BF NET DEEPEST
120610	446	+09:00	14 59.985N	141 13.883E	4797	ST.62	ORI-BF NET FINISHED
120610	504	+09:00	15 00.006N	141 12.589E	4802		(SUNRISE)
120610	606	+09:00	14 59.936N	141 00.014E	4777	ST.63	ORI-BF NET STARTED
120610	627	+09:00	14 59.056N	141 00.244E	4783	ST.63	ORI-BF NET DEEPEST
120610	659	+09:00	14 57.990N	141 00.648E	4800	ST.63	ORI-BF NET FINISHED
120610	930	+09:00	14 59.896N	140 30.129E	4914	ST.64	ORI-BF NET STARTED
120610	951	+09:00	14 59.055N	140 30.051E	4921	ST.64	ORI-BF NET DEEPEST
120610	1021	+09:00	14 57.822N	140 30.073E	4968	ST.64	ORI-BF NET FINISHED
120610	1254	+09:00	14 59.894N	140 00.200E	4921	ST.65	CTD-CMS STARTED
120610	1315	+09:00	14 59.790N	140 00.321E	4914	ST.65	CTD-CMS DEEPEST
120610	1331	+09:00	14 59.706N	140 00.383E	4914	ST.65	CTD-CMS FINISHED
120610	1341	+09:00	14 59.570N	140 00.428E	4909	ST.65	ORI-BF NET STARTED
120610	1400	+09:00	14 58.753N	140 00.748E	4916	ST.65	ORI-BF NET DEEPEST
120610	1439	+09:00	14 57.187N	140 01.387E	4997	ST.65	ORI-BF NET FINISHED
120610	1659	+09:00	14 29.741N	139 50.094E	3989	ST.66	ORI-BF NET STARTED
120610	1720	+09:00	14 28.836N	139 50.060E	3939	ST.66	ORI-BF NET DEEPEST
120610	1755	+09:00	14 27.258N	139 50.275E	3861	ST.66	ORI-BF NET FINISHED
120610	1813	+09:00	14 26.051N	139 49.929E	4220		(SUNSET)
120610	2017	+09:00	13 59.852N	139 39.803E	4104	ST.67	ORI-BF NET STARTED
120610	2038	+09:00	13 58.970N	139 39.414E	4296	ST.67	ORI-BF NET DEEPEST
120610	2117	+09:00	13 57.438N	139 38.709E	4648	ST.67	ORI-BF NET FINISHED
120610	2344	+09:00	13 29.896N	139 25.051E	4056	ST.68	CTD-CMS STARTED
120611	5	+09:00	13 29.856N	139 25.010E	4047	ST.68	CTD-CMS DEEPEST
120611	20	+09:00	13 29.826N	139 25.002E	4051	ST.68	CTD-CMS FINISHED
120611	29	+09:00	13 29.793N	139 24.982E	4050	ST.68	ORI-BF NET STARTED
120611	48	+09:00	13 29.120N	139 24.644E	3976	ST.68	ORI-BF NET DEEPEST
120611	131	+09:00	13 27.582N	139 23.735E	3926	ST.68	ORI-BF NET FINISHED
120611	155	+09:00	13 25.212N	139 21.842E	4126		(ENTERED FM'S EEZ)
120611	407	+09:00	12 59.948N	139 04.875E	4964	ST.69	ORI-BF NET STARTED
120611	436	+09:00	12 59.346N	139 04.038E	5248	ST.69	ORI-BF NET DEEPEST
120611	516	+09:00	12 58.544N	139 02.883E	5871		(SUNRISE)
120611	520	+09:00	12 58.499N	139 02.797E	5897	ST.69	ORI-BF NET FINISHED
120611	840	+09:00	12 29.731N	138 29.994E	4886	ST.70	ORI-BF NET STARTED
120611	912	+09:00	12 28.165N	138 29.888E	5155	ST.70	ORI-BF NET DEEPEST
120611	956	+09:00	12 26.134N	138 29.616E	5084	ST.70	ORI-BF NET FINISHED
120611	1259	+09:00	12 00.028N	137 59.873E	5021	ST.71	CTD-CMS STARTED
120611	1319	+09:00	11 59.952N	137 59.676E	4891	ST.71	CTD-CMS DEEPEST
120611	1335	+09:00	11 59.943N	137 59.525E	4868	ST.71	CTD-CMS FINISHED
120611	1400	+09:00	12 00.377N	137 59.885E	4978	ST.71	ORI-BF NET DEEPEST
120611	1435	+09:00	12 01.167N	138 00.650E	4983	ST.71	ORI-BF NET FINISHED
120611	1815	+09:00	11 52.932N	138 56.359E	5831		(SUNSET)
120612	507	+09:00	11 30.824N	141 52.585E	7061		(SUNRISE)
120612	545	+09:00	11 29.975N	141 59.979E	7101	ST.C1	CTD-CMS STARTED
120612	606	+09:00	11 30.029N	141 59.792E	7117	ST.C1	CTD-CMS DEEPEST
120612	620	+09:00	11 30.071N	141 59.697E	7124	ST.C1	CTD-CMS FINISHED
120612	834	+09:00	11 59.251N	142 09.716E	4297		(CLEARED OUT FM'S EEZ & ENTERED USA'S EEZ)
120612	846	+09:00	12 00.053N	142 09.999E	4176		CTD-CMS STARTED
120612	911	+09:00	12 00.188N	142 10.066E	4148	ST.C2	CTD DEEPEST
120612	923	+09:00	12 00.229N	142 09.995E	4168	ST.C2	CTD FINISHED
120612	1149	+09:00	12 30.094N	142 24.919E	3074	ST.C3	CTD STARTED
120612	1209	+09:00	12 30.319N	142 24.722E	3140	ST.C3	CTD DEEPEST
120612	1225	+09:00	12 30.470N	142 24.571E	3370	ST.C3	CTD FINISHED
120612	1449	+09:00	13 00.076N	142 39.980E	3553	ST.C4	CTD STARTED
120612	1509	+09:00	13 00.245N	142 39.948E	3575	ST.C4	CTD DEEPEST

120612	1524 +09:00	13 00.352N	142 39.918E	3564	ST.C4	CTD FINISHED
120612	1750 +09:00	13 29.919N	142 54.936E	4061	ST.C5	CTD STARTED
120612	1800 +09:00	13 29.971N	142 54.930E	4076		(SUNSET)
120612	1809 +09:00	13 30.029N	142 54.927E	4108	ST.C5	CTD DEEPEST
120612	1823 +09:00	13 30.046N	142 54.909E	4104	ST.C5	CTD FINISHED
120612	2054 +09:00	14 00.143N	143 09.997E	4168	ST.C6	CTD STARTED
120612	2114 +09:00	14 00.191N	143 09.919E	4164	ST.C6	CTD DEEPEST
120612	2126 +09:00	14 00.161N	143 09.847E	4191	ST.C6	CTD-CMS FINISHED
120612	2348 +09:00	14 30.011N	143 20.082E	3895	ST.C7	CTD STARTED
120613	9 +09:00	14 30.089N	143 20.024E	3883	ST.C7	CTD DEEPEST
120613	24 +09:00	14 30.144N	143 19.962E	3862	ST.C7	CTD FINISHED
120613	244 +09:00	14 59.997N	143 29.979E	3650	ST.C8	CTD STARTED
120613	303 +09:00	15 00.013N	143 29.808E	3627	ST.C8	CTD DEEPEST
120613	318 +09:00	15 00.026N	143 29.692E	3622	ST.C8	CTD FINISHED
120613	452 +09:00	15 21.208N	143 30.024E	3647		(SUNRISE)
120613	532 +09:00	15 30.032N	143 30.020E	4107	ST.C9	CTD STARTED
120613	552 +09:00	15 30.146N	143 29.918E	4114	ST.C9	CTD DEEPEST
120613	606 +09:00	15 30.233N	143 29.831E	4070	ST.C9	CTD FINISHED
120613	817 +09:00	16 00.160N	143 29.994E	3791	ST.C10	CTD STARTED
120613	835 +09:00	16 00.386N	143 29.897E	3809	ST.C10	CTD DEEPEST
120613	848 +09:00	16 00.501N	143 29.849E	3812	ST.C10	CTD FINISHED
120613	1417 +09:00	17 00.143N	142 29.905E	4009	ST.C11	CTD STARTED
120613	1436 +09:00	17 00.621N	142 29.633E	4006	ST.C11	CTD DEEPEST
120613	1452 +09:00	17 00.883N	142 29.581E	4010	ST.C11	CTD FINISHED
120613	1714 +09:00	16 30.088N	142 30.127E	3789	ST.C12	CTD STARTED
120613	1734 +09:00	16 30.516N	142 30.233E	3761	ST.C12	CTD DEEPEST
120613	1750 +09:00	16 30.757N	142 30.369E	3749	ST.C12	CTD FINISHED
120613	1803 +09:00	16 30.175N	142 30.419E	3744		(SUNSET)
120613	2014 +09:00	16 00.115N	142 29.998E	3868	ST.C13	CTD STARTED
120613	2032 +09:00	16 00.232N	142 29.944E	3874	ST.C13	CTD DEEPEST
120613	2045 +09:00	16 00.256N	142 29.909E	3878	ST.C13	CTD FINISHED
120613	2306 +09:00	15 30.131N	142 30.103E	4083	ST.C14	CTD STARTED
120613	2325 +09:00	15 30.374N	142 29.958E	4079	ST.C14	CTD DEEPEST
120613	2336 +09:00	15 30.411N	142 29.925E	4078	ST.C14	CTD FINISHED
120614	156 +09:00	15 00.010N	142 29.983E	4201	ST.C15	CTD STARTED
120614	215 +09:00	15 00.105N	142 29.920E	4201	ST.C15	CTD DEEPEST
120614	230 +09:00	15 00.202N	142 29.859E	4204	ST.C15	CTD FINISHED
120614	450 +09:00	14 29.945N	142 19.873E	3986	ST.C16	CTD STARTED
120614	501 +09:00	14 29.957N	142 19.864E	3985		(SUNRISE)
120614	509 +09:00	14 29.943N	142 19.874E	3986	ST.C16	CTD DEEPEST
120614	521 +09:00	14 29.964N	142 19.885E	3986	ST.C16	CTD FINISHED
120614	741 +09:00	13 59.948N	142 09.959E	3898	ST.C17	CTD STARTED
120614	759 +09:00	13 59.983N	142 09.899E	3898	ST.C17	CTD DEEPEST
120614	812 +09:00	13 59.978N	142 09.809E	3971	ST.C17	CTD FINISHED
120614	1048 +09:00	13 29.793N	141 49.896E	3313	ST.C18	CTD STARTED
120614	1106 +09:00	13 29.867N	141 49.778E	3445	ST.C18	CTD DEEPEST
120614	1119 +09:00	13 29.933N	141 49.756E	3401	ST.C18	CTD FINISHED
120614	1352 +09:00	13 00.014N	141 29.976E	3744	ST.C19	CTD STARTED
120614	1412 +09:00	13 00.088N	141 29.903E	3734	ST.C19	CTD DEEPEST
120614	1427 +09:00	13 00.142N	141 29.836E	3732	ST.C19	CTD FINISHED
120614	1759 +09:00	13 23.396N	142 04.837E	2643		(SUNSET)
120614	1857 +09:00	13 29.856N	142 14.920E	3190	ST.72	ORI-BF NET STARTED
120614	1917 +09:00	13 29.086N	142 15.313E	3158	ST.72	ORI-BF NET DEEPEST
120614	1953 +09:00	13 27.722N	142 15.926E	3111	ST.72	ORI-BF NET FINISHED
120614	2138 +09:00	13 44.984N	142 25.119E	2781	ST.73	ORI-BF NET STARTED
120614	2156 +09:00	13 44.709N	142 25.732E	2728	ST.73	ORI-BF NET DEEPEST
120614	2226 +09:00	13 44.269N	142 26.606E	2697	ST.73	ORI-BF NET FINISHED
120615	0 +09:00	13 59.948N	142 34.970E	2778	ST.74	ORI-BF NET STARTED
120615	17 +09:00	13 59.492N	142 35.257E	2717	ST.74	ORI-BF NET DEEPEST
120615	45 +09:00	13 58.710N	142 35.792E	2682	ST.74	ORI-BF NET FINISHED
120615	211 +09:00	14 14.988N	142 40.020E	1985	ST.75	ORI-BF NET STARTED
120615	227 +09:00	14 14.554N	142 40.373E	2226	ST.75	ORI-BF NET DEEPEST
120615	300 +09:00	14 13.636N	142 41.031E	2570	ST.75	ORI-BF NET FINISHED
120615	424 +09:00	14 30.053N	142 44.903E	3023	ST.76	ORI-BF NET STARTED
120615	445 +09:00	14 29.723N	142 45.445E	2878	ST.76	ORI-BF NET DEEPEST
120615	502 +09:00	14 29.416N	142 46.024E	2794		(SUNRISE)
120615	516 +09:00	14 29.260N	142 46.268E	2790	ST.76	ORI-BF NET FINISHED
120615	641 +09:00	14 45.024N	142 49.978E	3271		ORI-BF NET STARTED
120615	702 +09:00	14 44.742N	142 50.668E	3029	ST.77	ORI-BF NET DEEPEST
120615	735 +09:00	14 44.359N	142 51.716E	2415	ST.77	ORI-BF NET FINISHED
120615	859 +09:00	15 00.142N	142 50.161E	3097	ST.78	ORI-BF NET STARTED
120615	919 +09:00	15 00.077N	142 50.903E	3056	ST.78	ORI-BF NET DEEPEST
120615	949 +09:00	14 59.762N	142 51.861E	2947	ST.78	ORI-BF NET FINISHED
120615	1110 +09:00	15 15.045N	142 50.048E	3537	ST.79	ORI-BF NET STARTED



120615	1130 +09:00	15 14.904N	142 50.745E	3542	ST.79	ORI-BF NET DEEPEST
120615	1202 +09:00	15 14.512N	142 51.745E	3471	ST.79	ORI-BF NET FINISHED
120615	1333 +09:00	15 04.942N	142 35.062E	3773	ST.80	ORI-BF NET STARTED
120615	1348 +09:00	15 04.806N	142 35.636E	3662	ST.80	ORI-BF NET DEEPEST
120615	1420 +09:00	15 04.571N	142 36.816E	3595	ST.80	ORI-BF NET FINISHED
120615	1535 +09:00	14 49.949N	142 35.004E	4055	ST.81	ORI-BF NET STARTED
120615	1554 +09:00	14 49.867N	142 35.839E	4007	ST.81	ORI-BF NET DEEPEST
120615	1635 +09:00	14 49.684N	142 37.619E	3972	ST.81	ORI-BF NET FINISHED
120615	1758 +09:00	14 35.043N	142 30.098E	2642	ST.82	ORI-BF NET STARTED
120615	1801 +09:00	14 34.997N	142 30.144E	2638		(SUNSET)
120615	1819 +09:00	14 34.482N	142 30.859E	2554	ST.82	ORI-BF NET DEEPEST
120615	1856 +09:00	14 33.574N	142 32.143E	2595	ST.82	ORI-BF NET FINISHED
120615	2017 +09:00	14 19.894N	142 24.976E	3829	ST.83	ORI-BF NET STARTED
120615	2037 +09:00	14 19.410N	142 25.686E	3808	ST.83	ORI-BF NET DEEPEST
120615	2109 +09:00	14 18.937N	142 26.782E	3770	ST.83	ORI-BF NET FINISHED
120615	2228 +09:00	14 04.872N	142 20.032E	3539	ST.84	ORI-BF NET STARTED
120615	2248 +09:00	14 04.598N	142 20.816E	3396	ST.84	ORI-BF NET DEEPEST
120615	2321 +09:00	14 04.318N	142 21.934E	3305	ST.84	ORI-BF NET FINISHED
120616	18 +09:00	13 54.903N	142 25.004E	2785	ST.85	ORI-BF NET STARTED
120616	36 +09:00	13 54.487N	142 25.549E	2766	ST.85	ORI-BF NET DEEPEST
120616	113 +09:00	13 53.623N	142 26.590E	2789	ST.85	ORI-BF NET FINISHED
120616	225 +09:00	14 04.950N	142 35.041E	2925	ST.86	ORI-BF NET STARTED
120616	243 +09:00	14 04.620N	142 35.652E	2834	ST.86	ORI-BF NET DEEPEST
120616	320 +09:00	14 04.046N	142 36.769E	2766	ST.86	ORI-BF NET FINISHED
120616	430 +09:00	14 14.978N	142 44.817E	2087	ST.87	ORI-BF NET STARTED
120616	451 +09:00	14 14.663N	142 45.375E	2076	ST.87	ORI-BF NET DEEPEST
120616	500 +09:00	14 14.472N	142 45.643E	1957		(SUNRISE)
120616	525 +09:00	14 14.225N	142 46.183E	2004	ST.87	ORI-BF NET FINISHED
120616	647 +09:00	14 09.966N	142 29.926E	3392	ST.88	ORI-BF NET STARTED
120616	708 +09:00	14 09.676N	142 30.508E	3293	ST.88	ORI-BF NET DEEPEST
120616	745 +09:00	14 08.977N	142 31.473E	2982	ST.88	ORI-BF NET FINISHED
120616	902 +09:00	14 00.005N	142 19.985E	3107	ST.89	ORI-BF NET STARTED
120616	922 +09:00	13 59.772N	142 20.671E	2852	ST.89	ORI-BF NET DEEPEST
120616	954 +09:00	13 59.395N	142 21.790E	2700	ST.89	ORI-BF NET FINISHED
120616	1111 +09:00	13 49.944N	142 10.016E	3679	ST.90	ORI-BF NET STARTED
120616	1130 +09:00	13 49.365N	142 10.574E	3634	ST.90	ORI-BF NET DEEPEST
120616	1204 +09:00	13 48.481N	142 11.426E	3541	ST.90	ORI-BF NET FINISHED
120616	1304 +09:00	14 00.057N	142 10.062E	3892	ST.91	ORI-BF NET STARTED
120616	1322 +09:00	13 59.833N	142 10.711E	3855	ST.91	ORI-BF NET DEEPEST
120616	1358 +09:00	13 59.389N	142 12.008E	3789	ST.91	ORI-BF NET FINISHED
120616	1504 +09:00	14 10.019N	142 20.047E	3994	ST.92	ORI-BF NET STARTED
120616	1521 +09:00	14 09.740N	142 20.717E	3987	ST.92	ORI-BF NET DEEPEST
120616	1556 +09:00	14 09.127N	142 21.910E	3880	ST.92	ORI-BF NET FINISHED
120616	1708 +09:00	14 15.028N	142 35.034E	3152	ST.93	ORI-BF NET STARTED
120616	1731 +09:00	14 14.745N	142 35.932E	3047	ST.93	ORI-BF NET DEEPEST
120616	1759 +09:00	14 14.220N	142 37.020E	2985		(SUNSET)
120616	1850 +09:00	14 09.921N	142 40.100E	2530	ST.94	ORI-BF NET STARTED
120616	1914 +09:00	14 09.510N	142 41.034E	2446	ST.94	ORI-BF NET DEEPEST
120616	1952 +09:00	14 08.780N	142 42.468E	2390	ST.94	ORI-BF NET FINISHED
120616	2110 +09:00	13 59.928N	142 30.164E	2749	ST.95	ORI-BF NET STARTED
120616	2129 +09:00	13 59.468N	142 30.814E	2826	ST.95	ORI-BF NET DEEPEST
120616	2154 +09:00	13 58.937N	142 31.556E	2795	ST.95	ORI-BF NET FINISHED
120616	2311 +09:00	13 49.801N	142 20.016E	3303	ST.96	ORI-BF NET STARTED
120616	2333 +09:00	13 49.348N	142 20.852E	3187	ST.96	ORI-BF NET DEEPEST
120617	11 +09:00	13 48.763N	142 22.244E	3108	ST.96	ORI-BF NET FINISHED
120617	103 +09:00	13 55.009N	142 15.054E	3742	ST.97	ORI-BF NET STARTED
120617	123 +09:00	13 54.600N	142 15.775E	3694	ST.97	ORI-BF NET DEEPEST
120617	159 +09:00	13 53.786N	142 16.998E	3619	ST.97	ORI-BF NET FINISHED
120617	309 +09:00	14 04.970N	142 25.016E	3128	ST.98	ORI-BF NET STARTED
120617	327 +09:00	14 04.875N	142 25.722E	3065	ST.98	ORI-BF NET DEEPEST
120617	405 +09:00	14 04.631N	142 27.062E	2871	ST.98	ORI-BF NET FINISHED
120617	502 +09:00	14 15.006N	142 24.988E	3836		(SUNRISE)
120617	506 +09:00	14 15.041N	142 25.016E	3835	ST.99	ORI-BF NET STARTED
120617	528 +09:00	14 14.896N	142 25.882E	3789	ST.99	ORI-BF NET DEEPEST
120617	605 +09:00	14 14.578N	142 27.303E	3712	ST.99	ORI-BF NET FINISHED
120617	725 +09:00	14 04.858N	142 15.078E	3673	ST.100	ORI-BF NET STARTED
120617	747 +09:00	14 04.781N	142 16.034E	3504	ST.100	ORI-BF NET DEEPEST
120617	820 +09:00	14 04.668N	142 17.379E	3321	ST.100	ORI-BF NET FINISHED
120617	940 +09:00	13 54.881N	142 05.223E	4070	ST101	ORI-BF NET STARTED
120617	1006 +09:00	13 54.964N	142 06.222E	4017	ST101	ORI-BF NET DEEPEST
120617	1043 +09:00	13 55.500N	142 07.211E	4026	ST101	ORI-BF NET FINISHED
120617	1129 +09:00	13 59.907N	142 09.952E	3926	ST102	ORI-BF NET STARTED
120617	1148 +09:00	14 00.123N	142 10.570E	3862	ST102	ORI-BF NET DEEPEST
120617	1218 +09:00	14 00.418N	142 11.516E	3837	ST102	ORI-BF NET FINISHED

120617	1258 +09:00	14 04.955N	142 09.950E	2078	ST103	ORI-BF NET STARTED
120617	1318 +09:00	14 05.053N	142 10.654E	2302	ST103	ORI-BF NET DEEPEST
120617	1350 +09:00	14 05.270N	142 11.731E	2834	ST103	ORI-BF NET FINISHED
120617	1430 +09:00	14 09.994N	142 09.957E	4151	ST104	ORI-BF NET STARTED
120617	1448 +09:00	14 10.059N	142 10.573E	4154	ST104	ORI-BF NET DEEPEST
120617	1520 +09:00	14 10.073N	142 11.620E	4102	ST104	ORI-BF NET FINISHED
120617	1550 +09:00	14 10.006N	142 15.006E	4109	ST105	ORI-BF NET STARTED
120617	1610 +09:00	14 10.005N	142 15.725E	4088	ST105	ORI-BF NET DEEPEST
120617	1641 +09:00	14 09.883N	142 16.907E	4068	ST105	ORI-BF NET FINISHED
120617	1724 +09:00	14 04.962N	142 15.015E	3700	ST106	ORI-BF NET STARTED
120617	1745 +09:00	14 04.808N	142 15.901E	3532	ST.106	ORI-BF NET DEEPEST
120617	1800 +09:00	14 04.736N	142 16.652E	3407		(SUNSET)
120617	1833 +09:00	14 04.444N	142 17.897E	3296	ST.106	ORI-BF NET FINISHED
120617	1921 +09:00	13 59.712N	142 14.961E	3564	ST.107	ORI-BF NET STARTED
120617	1943 +09:00	13 59.595N	142 15.895E	3484	ST.107	ORI-BF NET DEEPEST
120617	2019 +09:00	13 59.366N	142 17.260E	3482	ST.107	ORI-BF NET FINISHED
120617	2053 +09:00	13 59.853N	142 20.175E	3072	ST108	ORI-BF NET STARTED
120617	2113 +09:00	13 59.867N	142 21.025E	2666	ST108	ORI-BF NET DEEPEST
120617	2148 +09:00	13 59.883N	142 22.306E	2294	ST108	ORI-BF NET FINISHED
120617	2242 +09:00	14 04.996N	142 19.947E	3575	ST109	ORI-BF NET STARTED
120617	2307 +09:00	14 04.859N	142 20.760E	3489	ST109	ORI-BF NET DEEPEST
120617	2339 +09:00	14 04.897N	142 21.642E	3443	ST109	ORI-BF NET FINISHED
120618	26 +09:00	14 10.034N	142 19.955E	3994	ST110	ORI-BF NET STARTED
120618	46 +09:00	14 10.195N	142 20.530E	3994	ST110	ORI-BF NET DEEPEST
120618	123 +09:00	14 10.454N	142 21.544E	3950	ST110	ORI-BF NET FINISHED
120618	214 +09:00	14 04.992N	142 25.028E	3200	ST111	ORI-BF NET STARTED
120618	234 +09:00	14 05.086N	142 25.656E	3056	ST111	ORI-BF NET DEEPEST
120618	311 +09:00	14 05.298N	142 26.832E	2544	ST111	ORI-BF NET FINISHED
120618	430 +09:00	13 54.884N	142 14.944E	3742	ST112	ORI-BF NET STARTED
120618	454 +09:00	13 54.743N	142 15.592E	3706	ST.112	ORI-BF NET DEEPEST
120618	503 +09:00	13 54.681N	142 15.876E	3696		(SUNRISE)
120618	530 +09:00	13 54.564N	142 16.518E	3689	ST.112	ORI-BF NET FINISHED
120618	647 +09:00	13 44.989N	142 05.023E	3735	ST.113	ORI-BF NET STARTED
120618	711 +09:00	13 44.909N	142 05.838E	3646	ST.113	ORI-BF NET DEEPEST
120618	749 +09:00	13 44.452N	142 06.893E	3541	ST.113	ORI-BF NET FINISHED
120618	842 +09:00	13 40.016N	142 09.868E	3198	ST.114	ORI-BF NET STARTED
120618	906 +09:00	13 39.970N	142 10.639E	3243	ST.114	ORI-BF NET DEEPEST
120618	939 +09:00	13 39.937N	142 11.602E	3249	ST.114	ORI-BF NET FINISHED
120618	1051 +09:00	13 49.951N	142 19.905E	3333	ST.115	ORI-BF NET STARTED
120618	1119 +09:00	13 49.734N	142 20.669E	3271	ST.115	ORI-BF NET DEEPEST
120618	1150 +09:00	13 49.531N	142 21.554E	3156	ST.115	ORI-BF NET FINISHED
120618	1300 +09:00	13 59.995N	142 29.975E	2749	ST.116	ORI-BF NET STARTED
120618	1320 +09:00	13 59.874N	142 30.670E	2821	ST.116	ORI-BF NET DEEPEST
120618	1356 +09:00	13 59.515N	142 31.955E	2773	ST.116	ORI-BF NET FINISHED
120618	1504 +09:00	14 09.954N	142 40.003E	2627	ST.117	ORI-BF NET STARTED
120618	1521 +09:00	14 10.057N	142 40.607E	2512	ST.117	ORI-BF NET DEEPEST
120618	1557 +09:00	14 10.385N	142 41.878E	2524	ST.117	ORI-BF NET FINISHED
120618	1645 +09:00	14 14.946N	142 44.897E	2084	ST.118	ORI-BF NET STARTED
120618	1707 +09:00	14 15.049N	142 45.737E	2213	ST.118	ORI-BF NET DEEPEST
120618	1746 +09:00	14 15.097N	142 47.007E	2072	ST.118	ORI-BF NET FINISHED
120618	1758 +09:00	14 15.359N	142 46.991E	2127		(SUNSET)
120618	1855 +09:00	14 14.990N	142 34.966E	3156	ST.119	ORI-BF NET STARTED
120618	1917 +09:00	14 14.959N	142 35.737E	3054	ST.119	ORI-BF NET DEEPEST
120618	1955 +09:00	14 14.928N	142 37.021E	2790	ST.119	ORI-BF NET FINISHED
120618	2104 +09:00	14 14.937N	142 25.147E	3831	ST.120	ORI-BF NET STARTED
120618	2126 +09:00	14 14.726N	142 25.993E	3783	ST.120	ORI-BF NET DEEPEST
120618	2159 +09:00	14 14.208N	142 26.934E	3732	ST.120	ORI-BF NET FINISHED
120618	2245 +09:00	14 10.055N	142 29.902E	3392	ST.121	ORI-BF NET STARTED
120618	2306 +09:00	14 09.867N	142 30.645E	3298	ST.121	ORI-BF NET DEEPEST
120618	2338 +09:00	14 09.479N	142 31.552E	2891	ST.121	ORI-BF NET FINISHED
120619	25 +09:00	14 05.033N	142 34.944E	2950	ST122	ORI-BF NET STARTED
120619	46 +09:00	14 04.832N	142 35.560E	2841	ST122	ORI-BF NET DEEPEST
120619	121 +09:00	14 04.538N	142 36.685E	2772	ST122	ORI-BF NET FINISHED
120619	234 +09:00	13 54.943N	142 25.047E	2779	ST123	ORI-BF NET STARTED
120619	253 +09:00	13 54.522N	142 25.666E	2755	ST123	ORI-BF NET DEEPEST
120619	332 +09:00	13 53.741N	142 26.824E	2745	ST123	ORI-BF NET FINISHED
120619	448 +09:00	13 45.026N	142 14.550E	3110	ST.124	ORI-BF NET STARTED
120619	504 +09:00	13 44.746N	142 15.036E	3136		(SUNRISE)
120619	510 +09:00	13 44.634N	142 15.287E	3154	ST.124	ORI-BF NET DEEPEST
120619	547 +09:00	13 44.043N	142 16.594E	3171	ST.124	ORI-BF NET FINISHED
120619	700 +09:00	13 50.078N	142 09.818E	3698	ST.125	ORI-BF NET STARTED
120619	721 +09:00	13 49.962N	142 10.613E	3660	ST.125	ORI-BF NET DEEPEST
120619	759 +09:00	13 49.997N	142 11.964E	3532	ST.125	ORI-BF NET FINISHED
120619	908 +09:00	13 54.973N	142 05.074E	4068	ST126	ORI-BF NET STARTED

120619	931	+09:00	13 54.803N	142 06.047E	4025	ST126	ORI-BF NET DEEPEST
120619	1008	+09:00	13 54.434N	142 07.337E	3996	ST126	ORI-BF NET FINISHED
120619	1101	+09:00	13 49.913N	142 00.143E	4142	ST127	ORI-BF NET STARTED
120619	1124	+09:00	13 49.834N	142 01.116E	4113	ST127	ORI-BF NET DEEPEST
120619	1159	+09:00	13 49.698N	142 02.476E	4083	ST127	ORI-BF NET FINISHED
120619	1248	+09:00	13 44.926N	141 54.998E	4086	ST128	ORI-BF NET STARTED
120619	1308	+09:00	13 44.753N	141 55.664E	4101	ST128	ORI-BF NET DEEPEST
120619	1344	+09:00	13 44.458N	141 56.830E	4032	ST128	ORI-BF NET FINISHED
120619	1426	+09:00	13 40.047N	141 59.978E	3836	ST129	ORI-BF NET STARTED
120619	1445	+09:00	13 39.939N	142 00.632E	3796	ST129	ORI-BF NET DEEPEST
120619	1521	+09:00	13 39.777N	142 01.821E	3635	ST129	ORI-BF NET FINISHED
120619	1701	+09:00	13 49.902N	142 19.854E	3341	ST.C20	CTD-CMS STARTED
120619	1729	+09:00	13 49.896N	142 19.791E	3347	ST.C20	CTD-CMS DEEPEST
120619	1801	+09:00	13 49.929N	142 19.832E	3340		(SUNSET)
120619	1810	+09:00	13 49.924N	142 19.832E	3341	ST.C20	CTD-CMS FINISHED
120619	1840	+09:00	13 50.001N	142 19.987E	3324	ST.C20	CTD-CMS STARTED
120619	1851	+09:00	13 49.952N	142 19.952E	3330	ST.C20	CTD-CMS DEEPEST
120619	1904	+09:00	13 49.936N	142 19.964E	3332	ST.C20	CTD-CMS FINISHED
120619	1912	+09:00	13 49.888N	142 19.955E	3332	ST.C20	ORI-BF NET STARTED
120619	1933	+09:00	13 49.792N	142 20.678E	3267	ST.C20	ORI-BF NET DEEPEST
120619	2003	+09:00	13 49.773N	142 21.837E	3156	ST.C20	ORI-BF NET FINISHED
120619	2018	+09:00	13 49.056N	142 21.389E	3186	ST.C20	SETTING OF DRIFTING BUOY STARTED
120619	2024	+09:00	13 48.900N	142 21.205E	3148	ST.C20	SETTING OF DRIFTING BUOY FINISHED
120620	135	+09:00	12 59.965N	141 24.977E	4008	ST130	ORI-BF NET STARTED
120620	154	+09:00	12 59.717N	141 25.509E	3988	ST130	ORI-BF NET DEEPEST
120620	231	+09:00	12 59.289N	141 26.530E	3952	ST130	ORI-BF NET FINISHED
120620	312	+09:00	12 57.602N	141 18.933E	4076		(CLEARED OUT USA'S EEZ & ENTERED FM'S EEZ)
120620	441	+09:00	12 49.941N	140 59.919E	2549	ST.131	ORI-BF NET STARTED
120620	505	+09:00	12 49.451N	141 00.456E	2624	ST.131	ORI-BF NET DEEPEST
120620	512	+09:00	12 49.294N	141 00.638E	2788		(SUNRISE)
120620	543	+09:00	12 48.696N	141 01.199E	3247	ST.131	ORI-BF NET FINISHED
120620	557	+09:00	12 48.538N	141 01.193E	3283	ST.131	RETRIEVING OF DRIFTING BUOY STARTED
120620	601	+09:00	12 48.539N	141 01.001E	3260	ST.131	SETTING OF DRIFTING BUOY FINISHED
120620	717	+09:00	12 44.916N	140 44.918E	4249	ST.132	ORI-BF NET STARTED
120620	739	+09:00	12 44.577N	140 45.671E	4219	ST.132	ORI-BF NET DEEPEST
120620	815	+09:00	12 44.252N	140 46.923E	4182	ST.132	ORI-BF NET FINISHED
120620	949	+09:00	12 39.875N	140 30.144E	4066	ST133	ORI-BF NET STARTED
120620	1013	+09:00	12 40.024N	140 31.001E	4058	ST133	ORI-BF NET DEEPEST
120620	1046	+09:00	12 40.240N	140 32.078E	3995	ST133	ORI-BF NET FINISHED
120620	1212	+09:00	12 30.007N	140 20.059E	4218	ST134	ORI-BF NET STARTED
120620	1232	+09:00	12 29.509N	140 20.512E	4202	ST134	ORI-BF NET DEEPEST
120620	1308	+09:00	12 28.648N	140 21.328E	4087	ST134	ORI-BF NET FINISHED
120620	1423	+09:00	12 20.010N	140 10.058E	4363	ST135	ORI-BF NET STARTED
120620	1442	+09:00	12 19.629N	140 10.619E	4368	ST135	ORI-BF NET DEEPEST
120620	1515	+09:00	12 18.875N	140 11.499E	4391	ST135	ORI-BF NET FINISHED
120620	1528	+09:00	12 18.372N	140 12.423E	4382		8 SHAPE ROTATION RIGHT TURNING STARTED
120620	1544	+09:00	12 18.422N	140 12.434E	4383		8 SHAPE ROTATION LEFT TURNING STARTED
120620	1558	+09:00	12 18.497N	140 12.429E	4383		8 SHAPE ROTATION TURNING FINISHED
120620	1804	+09:00	12 05.504N	140 39.064E	4046		(SUNSET)
120620	1910	+09:00	12 00.043N	140 49.833E	3890	ST.136	CTD-CMS STARTED
120620	1939	+09:00	12 00.015N	140 49.623E	3900	ST.136	CTD-CMS DEEPEST
120620	2016	+09:00	12 00.058N	140 49.345E	3878	ST.136	CTD-CMS FINISHED
120620	2053	+09:00	11 59.967N	140 50.048E	3889	ST.136	CTD-CMS STARTED
120620	2106	+09:00	11 59.954N	140 49.944E	3888	ST.136	CTD-CMS DEEPEST
120620	2118	+09:00	11 59.896N	140 49.808E	3892	ST.136	CTD-CMS FINISHED
120620	2125	+09:00	11 59.905N	140 49.793E	3892	ST.136	ORI-BF NET STARTED
120620	2147	+09:00	12 00.378N	140 50.480E	3893	ST.136	ORI-BF NET DEEPEST
120620	2220	+09:00	12 00.771N	140 51.509E	3753	ST.136	ORI-BF NET FINISHED
120620	2322	+09:00	12 10.025N	140 50.097E	3444	ST137	ORI-BF NET STARTED
120620	2344	+09:00	12 10.495N	140 50.716E	3478	ST137	ORI-BF NET DEEPEST
120621	21	+09:00	12 11.208N	140 51.739E	3672	ST137	ORI-BF NET FINISHED
120621	131	+09:00	12 14.887N	141 05.062E	4933	ST138	ORI-BF NET STARTED
120621	152	+09:00	12 14.384N	141 05.833E	5188	ST138	ORI-BF NET DEEPEST
120621	228	+09:00	12 13.612N	141 06.906E	5263	ST138	ORI-BF NET FINISHED
120621	329	+09:00	12 20.054N	141 14.981E	4411	ST139	ORI-BF NET STARTED
120621	348	+09:00	12 20.778N	141 14.913E	3817	ST139	ORI-BF NET DEEPEST
120621	428	+09:00	12 22.482N	141 14.862E	2421	ST139	ORI-BF NET FINISHED
120621	510	+09:00	12 27.248N	141 18.105E	1939		(SUNRISE)
120621	537	+09:00	12 29.846N	141 19.916E	1774	ST.140	ORI-BF NET STARTED
120621	559	+09:00	12 30.696N	141 20.025E	1478	ST.140	ORI-BF NET DEEPEST
120621	637	+09:00	12 32.043N	141 20.094E	1296	ST.140	ORI-BF NET FINISHED
120621	744	+09:00	12 39.936N	141 14.984E	3249	ST.141	ORI-BF NET STARTED
120621	809	+09:00	12 40.838N	141 15.064E	3251	ST.141	ORI-BF NET DEEPEST
120621	843	+09:00	12 42.165N	141 15.029E	3350	ST.141	ORI-BF NET FINISHED

120621	944 +09:00	12 49.996N	141 14.898E	2504	ST142	ORI-BF NET STARTED
120621	1010 +09:00	12 50.804N	141 15.334E	2932	ST142	ORI-BF NET DEEPEST
120621	1042 +09:00	12 51.699N	141 15.826E	3412	ST142	ORI-BF NET FINISHED
120621	1119 +09:00	12 55.794N	141 20.435E	3758		(CLEARED OUT FM's EEZ & ENTERED USA's EEZ)
120621	1153 +09:00	13 00.010N	141 24.940E	4009	ST.143	ORI-BF NET STARTED
120621	1213 +09:00	13 00.790N	141 24.848E	4026	ST.143	ORI-BF NET DEEPEST
120621	1247 +09:00	13 02.032N	141 24.754E	0	ST.143	ORI-BF NET FINISHED
120621	1400 +09:00	13 10.057N	141 34.952E	3622	ST.144	ORI-BF NET STARTED
120621	1420 +09:00	13 10.642N	141 35.181E	3614	ST.144	ORI-BF NET DEEPEST
120621	1455 +09:00	13 11.730N	141 35.679E	3616	ST.144	ORI-BF NET FINISHED
120621	1553 +09:00	13 20.029N	141 39.921E	3630	ST.145	ORI-BF NET STARTED
120621	1616 +09:00	13 20.715N	141 40.192E	3836	ST.145	ORI-BF NET DEEPEST
120621	1651 +09:00	13 21.680N	141 40.664E	3898	ST.145	ORI-BF NET FINISHED
120621	1753 +09:00	13 29.928N	141 44.909E	3029	ST.146	ORI-BF NET STARTED
120621	1815 +09:00	13 30.254N	141 45.375E	3045	ST.146	ORI-BF NET DEEPEST
120621	1852 +09:00	13 30.777N	141 46.061E	3172	ST.146	ORI-BF NET FINISHED
120621	2003 +09:00	13 40.020N	141 49.802E	4358	ST.147	ORI-BF NET STARTED
120621	2028 +09:00	13 40.323N	141 50.225E	4194	ST.147	ORI-BF NET DEEPEST
120621	2100 +09:00	13 40.547N	141 50.893E	4191	ST.147	ORI-BF NET FINISHED
120621	2210 +09:00	13 50.008N	141 54.782E	4164	ST148	ORI-BF NET STARTED
120621	2234 +09:00	13 50.297N	141 55.362E	4185	ST148	ORI-BF NET DEEPEST
120621	2306 +09:00	13 50.492N	141 56.170E	—	ST148	ORI-BF NET FINISHED
120622	11 +09:00	14 00.024N	141 59.975E	4269	ST149	ORI-BF NET STARTED
120622	36 +09:00	14 00.085N	142 00.751E	4253	ST149	ORI-BF NET DEEPEST
120622	112 +09:00	14 00.161N	142 01.876E	4230	ST149	ORI-BF NET FINISHED
120622	215 +09:00	14 10.033N	142 05.028E	4299	ST150	ORI-BF NET STARTED
120622	239 +09:00	14 09.772N	142 05.671E	4295	ST150	ORI-BF NET DEEPEST
120622	314 +09:00	14 09.449N	142 06.556E	4267	ST150	ORI-BF NET FINISHED
120622	506 +09:00	13 59.919N	142 00.046E	4266	ST.149-2	ORI-BF NET STARTED
120622	510 +09:00	13 59.871N	142 00.055E	4266		(SUNRISE)
120622	530 +09:00	13 59.521N	142 00.512E	4242	ST.149-2	ORI-BF NET DEEPEST
120622	605 +09:00	13 58.987N	142 01.219E	4223	ST.149-2	ORI-BF NET FINISHED
120622	800 +09:00	14 20.129N	142 10.038E	4178	ST.151	ORI-BF NET STARTED
120622	825 +09:00	14 20.262N	142 10.798E	4133	ST.151	ORI-BF NET DEEPEST
120622	858 +09:00	14 19.823N	142 11.615E	4151	ST.151	ORI-BF NET FINISHED
120622	1004 +09:00	14 29.974N	142 15.098E	4125	ST.152	ORI-BF NET STARTED
120622	1030 +09:00	14 29.843N	142 16.157E	4086	ST.152	ORI-BF NET DEEPEST
120622	1103 +09:00	14 29.186N	142 17.153E	4073	ST.152	ORI-BF NET FINISHED
120622	1208 +09:00	14 40.082N	142 15.009E	4180	ST.153	ORI-BF NET STARTED
120622	1232 +09:00	14 39.928N	142 15.904E	4168	ST.153	ORI-BF NET DEEPEST
120622	1307 +09:00	14 39.810N	142 17.219E	4150	ST.153	ORI-BF NET FINISHED
120622	1407 +09:00	14 50.033N	142 19.992E	4306	ST.154	ORI-BF NET STARTED
120622	1429 +09:00	14 50.027N	142 20.750E	4294	ST.154	ORI-BF NET DEEPEST
120622	1506 +09:00	14 50.056N	142 21.833E	4275	ST.154	ORI-BF NET FINISHED
120622	1605 +09:00	15 00.157N	142 19.989E	4322	ST.155	ORI-BF NET STARTED
120622	1628 +09:00	14 59.980N	142 20.738E	4340	ST.155	ORI-BF NET DEEPEST
120622	1704 +09:00	14 59.621N	142 21.668E	4340	ST.155	ORI-BF NET FINISHED
120622	1803 +09:00	15 09.880N	142 20.066E	4188		(SUNSET)
120622	1804 +09:00	15 09.882N	142 20.080E	4189	ST.156	ORI-BF NET STARTED
120622	1827 +09:00	15 09.793N	142 20.920E	4189	ST.156	ORI-BF NET DEEPEST
120622	1904 +09:00	15 09.488N	142 21.997E	4185	ST.156	ORI-BF NET FINISHED
120622	2014 +09:00	15 20.147N	142 20.067E	4178	ST157	ORI-BF NET STARTED
120622	2036 +09:00	15 19.949N	142 20.908E	4170	ST157	ORI-BF NET DEEPEST
120622	2109 +09:00	15 19.569N	142 21.917E	4199	ST157	ORI-BF NET FINISHED
120622	2233 +09:00	15 30.241N	142 10.319E	4160	ST158	ORI-BF NET STARTED
120622	2258 +09:00	15 30.181N	142 11.215E	4200	ST158	ORI-BF NET DEEPEST
120622	2332 +09:00	15 30.005N	142 12.319E	4275	ST158	ORI-BF NET FINISHED
120623	37 +09:00	15 37.507N	142 02.496E	4456		(CLEARED OUT USA'S EEZ)
120623	59 +09:00	15 40.115N	142 00.029E	4428	ST.159	ORI-BF NET STARTED
120623	121 +09:00	15 39.889N	142 00.818E	4433	ST.159	ORI-BF NET DEEPEST
120623	155 +09:00	15 39.424N	142 01.933E	4442	ST.159	ORI-BF NET FINISHED
120623	258 +09:00	15 50.060N	142 00.063E	4451	ST.160	ORI-BF NET STARTED
120623	318 +09:00	15 49.804N	142 00.793E	4446	ST.160	ORI-BF NET DEEPEST
120623	352 +09:00	15 49.438N	142 01.924E	4408	ST.160	ORI-BF NET FINISHED
120623	456 +09:00	16 00.060N	142 00.140E	4408	ST.161	ORI-BF NET STARTED
120623	501 +09:00	16 00.002N	142 00.232E	4408		(SUNRISE)
120623	518 +09:00	15 59.696N	142 00.867E	4410	ST.161	ORI-BF NET DEEPEST
120623	556 +09:00	15 59.073N	142 02.010E	4415	ST.161	ORI-BF NET FINISHED
120623	703 +09:00	16 10.078N	142 00.100E	4370	ST.162	ORI-BF NET STARTED
120623	725 +09:00	16 10.381N	142 00.958E	4360	ST.162	ORI-BF NET DEEPEST
120623	802 +09:00	16 10.653N	142 02.255E	4318	ST.162	ORI-BF NET FINISHED
120623	903 +09:00	16 19.918N	142 05.064E	4288	ST163	ORI-BF NET STARTED
120623	926 +09:00	16 19.776N	142 05.873E	4217	ST163	ORI-BF NET DEEPEST
120623	958 +09:00	16 19.577N	142 06.847E	4218	ST163	ORI-BF NET FINISHED

120623	1149 +09:00	16 30.045N	142 24.687E	4032	ST164	CTD-CMS STARTED
120623	1217 +09:00	16 30.285N	142 24.573E	4018	ST164	CTD-CMS DEEPEST
120623	1247 +09:00	16 30.461N	142 24.568E	4017	ST164	CTD-CMS FINISHED
120623	1256 +09:00	16 30.525N	142 24.555E	4020	ST164	ORI-BF NET STARTED
120623	1318 +09:00	16 30.580N	142 25.246E	4002	ST164	ORI-BF NET DEEPEST
120623	1351 +09:00	16 30.711N	142 26.295E	3986	ST164	ORI-BF NET FINISHED
120623	1805 +09:00	17 21.479N	142 19.532E	4214		(SUNSET)
120623	1811 +09:00	17 21.546N	142 19.601E	4209	ST.C21	CTD-CMS STARTED
120623	1824 +09:00	17 21.678N	142 19.607E	4209	ST.C21	CTD-CMS DEEPEST
120623	1837 +09:00	17 21.723N	142 19.626E	4208	ST.C21	CTD-CMS FINISHED
120623	1858 +09:00	17 21.746N	142 19.711E	4204	ST.C21	CTD-CMS STARTED
120623	1926 +09:00	17 21.812N	142 19.684E	4208	ST.C21	CTD-CMS DEEPEST
120623	2007 +09:00	17 21.827N	142 19.670E	4208	ST.C21	CTD-CMS FINISHED
120623	2031 +09:00	17 22.068N	142 19.289E	4242	ST.C21	FLOWMETER CALIBRATION STARTED
120623	2043 +09:00	17 22.103N	142 19.287E	4242	ST.C21	FLOWMETER CALIBRATION FINISHED
120623	2046 +09:00	17 22.136N	142 19.275E	4242	ST.C21	FLOWMETER CALIBRATION STARTED
120623	2053 +09:00	17 22.218N	142 19.228E	4241	ST.C21	FLOWMETER CALIBRATION FINISHED
120623	2057 +09:00	17 22.254N	142 19.209E	4240	ST.C21	FLOWMETER CALIBRATION STARTED
120623	2104 +09:00	17 22.304N	142 19.184E	4237	ST.C21	FLOWMETER CALIBRATION FINISHED
120623	2108 +09:00	17 22.349N	142 19.146E	4234	ST.C21	FLOWMETER CALIBRATION STARTED
120623	2115 +09:00	17 22.438N	142 19.091E	4229	ST.C21	FLOWMETER CALIBRATION FINISHED
120623	2120 +09:00	17 22.518N	142 19.035E	4226	ST.C21	FLOWMETER CALIBRATION STARTED
120623	2130 +09:00	17 22.634N	142 18.977E	4222	ST.C21	FLOWMETER CALIBRATION FINISHED
120624	456 +09:00	18 50.253N	142 09.941E	4203		(SUNRISE)
120624	1558 +09:00	21 19.919N	141 53.706E	3832		(CLEARED OUT USA'S EEZ)
120624	1816 +09:00	21 52.758N	141 49.979E	3172		(SUNSET)
120625	1130 +09:00	25 57.298N	141 18.813E	3148		8 SHAPE ROTATION TURNING FINISHED