Preliminary Report
of
The Hakuho Maru Cruise
KH-09-5 Leg 7

Mar. 1, 2009 - Mar. 19, 2009
(Eel Cruise Indonesia)

Atmosphere and Ocean Research Institute
The University of Tokyo
2012

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By
The Scientific Members of the Expeditions

Edited by
Shun Watanabe, Kazuki Yokouchi
and Katsumi Tsukamoto

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Preface

The research cruise of the HAKUHO-Maru (KH-09-5 leg 7) entitled "A study on the spawning migration and reproductive ecology of the freshwater eels around Sulawesi Island, Indonesia" that was started from Benoa on 2 March has been finished by entering Bitung on 19 March 2010. The main objective of this research cruise was to study the spawning migration behavior of the tropical freshwater eels (*Anguilla celebesensis, A. marmorata and A. bicolor*) and to define their actual spawning sites using the updated biotelemetric devices and traditional net samplings. Other marine creatures such as anguilliform leptocephali, phyllosoma larvae of lobsters, oceanic sea skater of *Halobates* as well as many fish larvae were also intensively sampled to study the marine biodiversity in Indonesian waters.

During a total of 17 days, net samplings with the IKMT at a total of 48 stations successfully yielded 28 anguillid leptocephali (including 9.7 mm TL larvae up to fully grown stage larvae) and 2,126 marine eel leptocephali. Although the detailed analyses will be carried out after the cruise in collaboration with the Indonesian Scientists, the tentative morphological species identification on board clearly suggested that some anguillid species spawn in Tomini Bay and Celebes Sea, contrasting to their temperate counter parts such as the Japanese and European eels. Further, preliminary tracking on the tropical anguillid eels suggested the future possibility to completely reveal the spawning behavior of these species. We also succeeded to get a considerable amount of biological specimens. I deeply expect that future analyses of these samples or data will provide a new insight into the marine biodiversity in Indonesian waters.

This cruise was organized under the JSPS Multilateral Core University Program "Coastal Oceanography" to provide an opportunity for Indonesian young scientists to experience the actual oceanographic measurements and biological samplings. A total of 9 Indonesian scientists from three different institutions (Research Center for Oceanography, Research Center for Limnology and University of Tadulako) were invited for this cruise. Although the cruise was confronted with many difficulties, such as the documentations for research permit, contact with the local government and sample sharing on board etc., the Indonesian Team leaders, Drs. Wouthuyzen and Syahailatua as well as Bapak Djoko made considerable efforts to solve these problems and finally led the cruise successfully. I want to express my sincere thank for the Indonesian Team leaders for their kind and very good coordination during the cruise. This cruise could be a good starting point for further collaborative research between Indonesia and Japan.

Lastly, I want to express my sincere thank for the Captain Ushio FUJITA and the officers and crew of HAKUHO-MARU for their cooperation.

In the cabin of Hakuho-Maru, 25 March 2010

Chief scientists : Jun Aoyama

Scientists on board HAKUHO-MARU (KH-09-5 Leg 7)

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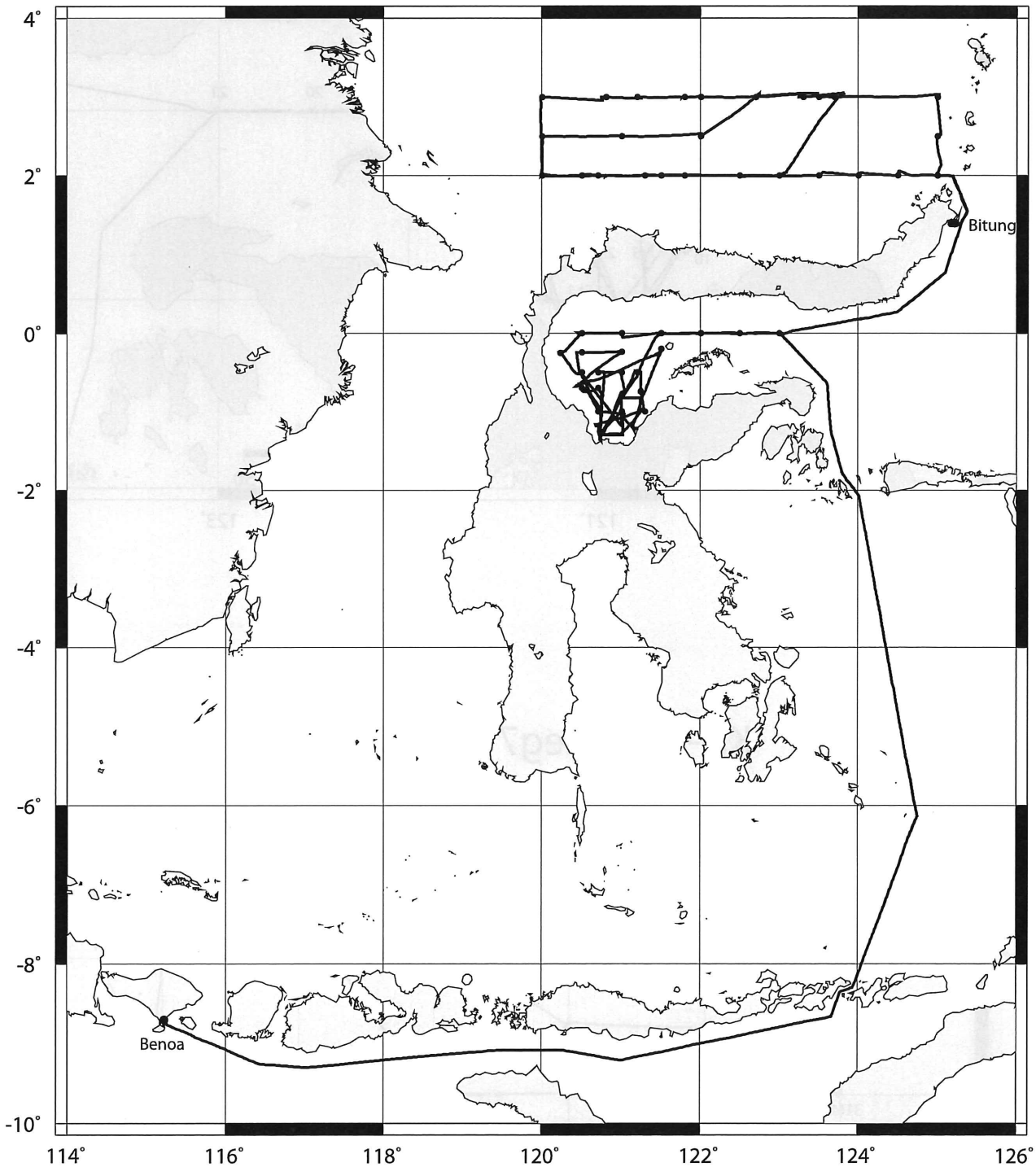
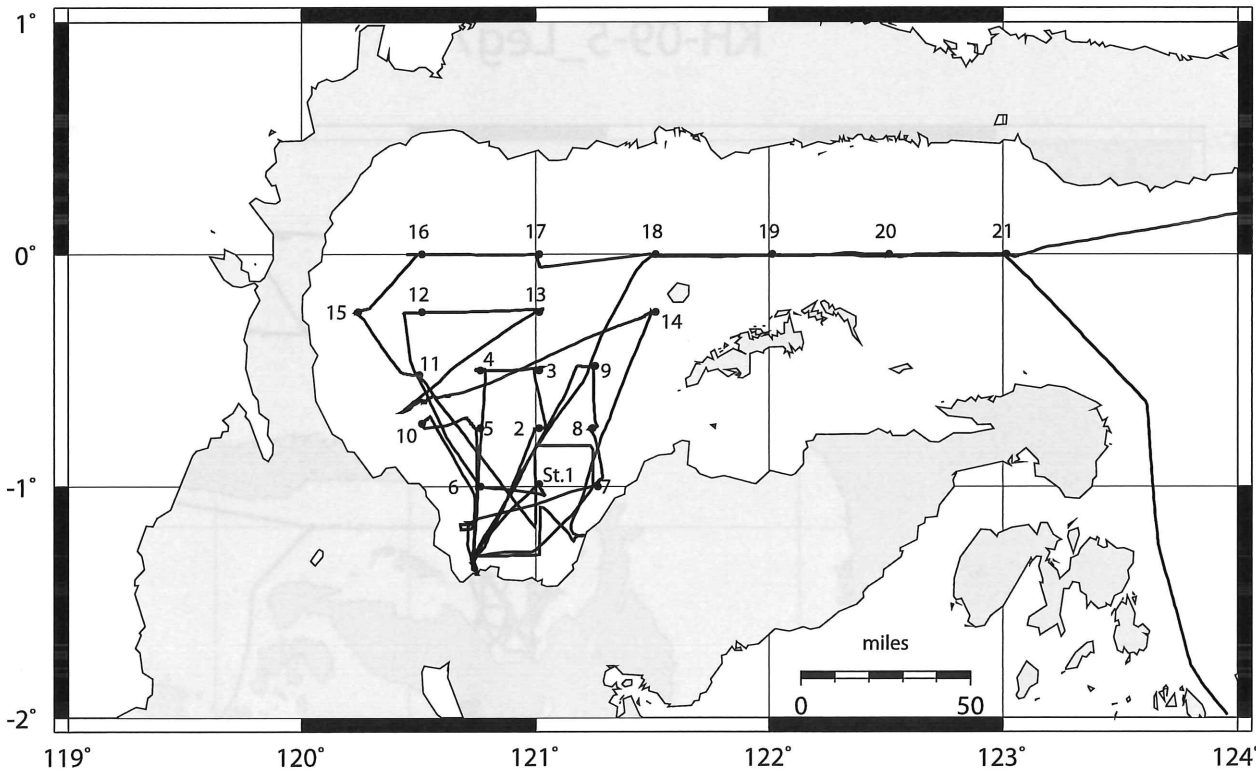
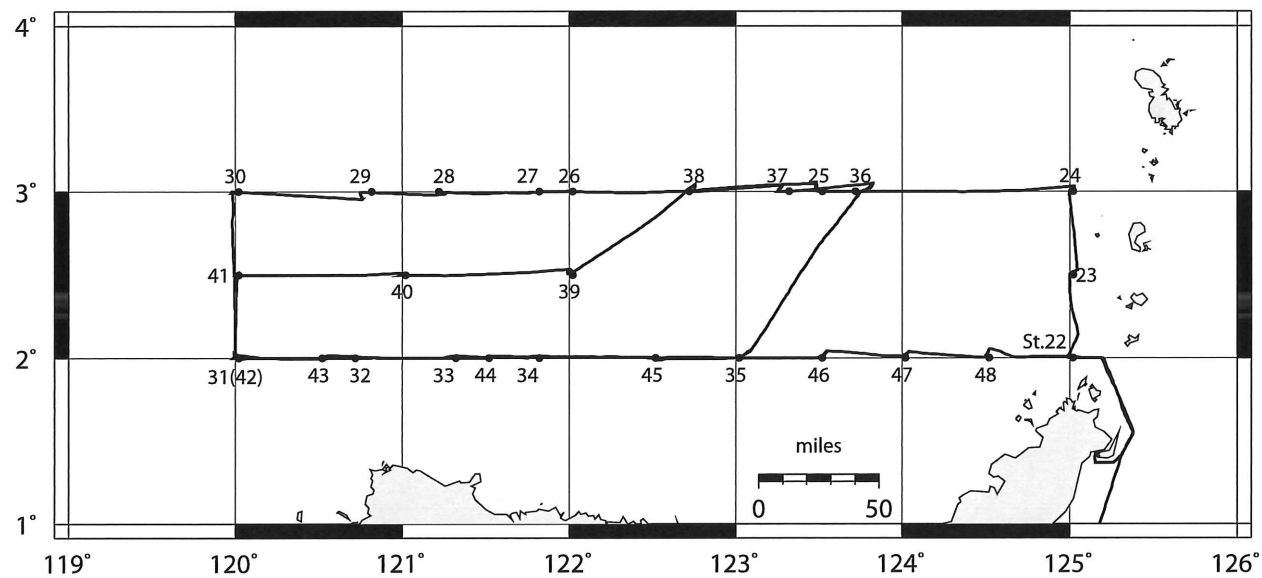
KH-09-5_Leg7



KH-09-5_Leg7 (Tomini Bay)



KH-09-5_Leg7 (Selebes Sea)



Sample Distributions for KH-09-5 Leg 7

(The details must be referred "Sample Shipping Invoice" hold by the Chief and Co-Chief scientists)

1. Anguillid leptocephali

All specimens were divided into the head and tail parts for preserving in ethanol to bring to Japan and Indonesia, respectively. Further analyses will be conducted with a tight collaboration between members of the two groups.

2. Anguilliform leptocephali except moray eels

All specimens were basically divided equally into two to be preserved in formalin and ethanol, and both groups brought back a pair of formalin and ethanol samples (a few tentatively frozen on board).

3. Others (Larvae of Tunas, Gobies and Other species, Gelatinous creatures)

the specimens preserved adequately during the cruise for the Japanese and Indonesian groups were brought to each country, respectively.

4. Oceanic insects (Halobates)

Most of specimens were basically brought by the Japanese group. But representative specimens remained in Indonesia.

5. Phyllosoma and Moray eel larvae

As these specimens are important for the Ph.D students on board, so all specimens but a representative specimen were brought to Japan for their analyses in the Ph.D. theses. Total DNA will be obtained in Japan and transferred to Indonesia soon after extracted. After finishing of their PhDs, all the remaining specimens will be finally sent back to Indonesia with their dissertations.

6. NORPAC and Water samples

Indonesian group brought all the NORPAC samples as they preserved during the cruise. Samples relating to the water filtered were brought separately as they were filtered or preserved during the cruise by the responsible members of each subject.

7. Mother bottles

Mother bottles of the stations that targeted eel eggs and preleptocephali in the southern part of Tomini Bay were equally divided into two parts for Indonesia and Japan. For other stations in Tomini Bay and the Celebes Sea, the mother bottles that include whole fish samples (St. 17, 19, 20, 22, 23, 25, 26, 27, 29, 30, 32, 34, 35, 36, 37, 39, 40, 41, 43, 44, 46, 47) were remain in Indonesia, and the stations at which fish larvae were sorted out on board (St. 15, 16, 18, 21, 24, 28, 31, 33, 38, 42, 45, 48) went to Japan.

The property of specimens and genetic resources.

For future study and monitoring the biodiversity in the area, the property of specimens remains in Indonesia. Based on this concept, at least half of the volume of total DNA extract of any kind of creatures obtained from this cruise will be finally back and deposited in Indonesia, regardless of the place where the extraction was conducted.
All scientists on board will have a right of free access to any kind of specimens and data obtained from this cruise. All scientists who got specimens from this cruise will be fully responsible to keep them in good condition for future study, e.g., temperature control or change the medium etc. Research subjects printed in the Cruise Report will have the priority to use the specimens.

Authorship of the paper

Dr. Sam Wouthuyzen will be included as a co-author in the major scientific papers published from Japanese side, and Dr. Jun Aoyama for Indonesian side, as the responsible leaders of the cruise. Any kind of publication of the data obtained from the cruise must be informed to the chief and co-chief scientists. The other members will be carefully considered depending on their scientific contribution. Co-authors are required to collaborate in further sampling, analyses or constructive discussion in each research subjects. The research leader will finally define the authorship of the paper.

Anguillid Leptocephali in Tomini Bay and the Celebes Sea during the Collaborative Leg 7 Cruise of KH-09-5 Between Indonesia and Japan

All Scientists onboard

The Leg 7 collaborative cruise between scientists from Indonesia sampled for leptocephali in both the Celebes (Sulawesi) Sea and in Tomini Bay because both these regions are known to be spawning areas of tropical freshwater eels of the genus *Anguilla* (Aoyama et al. 2003; Wouthuyzen et al. 2009). Tomini Bay has a local spawning area of *Anguilla celebesensis*, but that species may typically only spawn there during some parts of the year in relation to the tropical monsoon cycle (Wouthuyzen et al. 2009). Small leptocephali of both *A. celebesensis* and *A. borneensis* have also been collected in the Celebes Sea (Aoyama et al. 2003). However, the more widely distributed anguillid species *A. marmorata* (Miller et al. 2002; Kuroki et al. 2009) and *A. bicolor pacifica* (Kuroki et al. 2006) appear to only spawn outside of the Indonesian Seas.

During the Leg 7 cruise, 28 anguillid leptocephali were collected at 12 different stations (Fig. 1) with leptocephali of 2 general size classes being caught (Fig. 2). The anguillid larvae were widely distributed geographically in the Celebes Sea, but were only caught in the southern portion of Tomini Bay. More were leptocephali were collected in the Celebes Sea than in Tomini Bay during this survey. These leptocephali had the typical morphological features of anguillid leptocephali (Fig. 3-5) so they could be identified to the genus level onboard during the cruise.

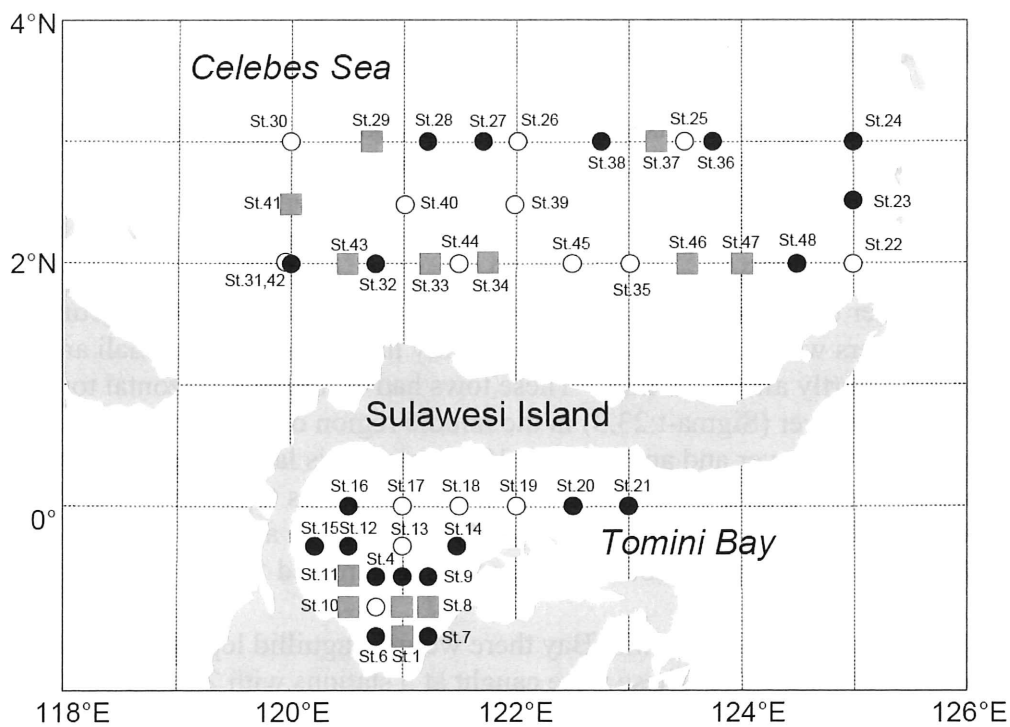


Figure 1. Map showing the stations where anguillid leptocephali were collected (red squares) during Leg 7 of the KH-09-5 cruise. Black circles show night stations, white circles show day stations.

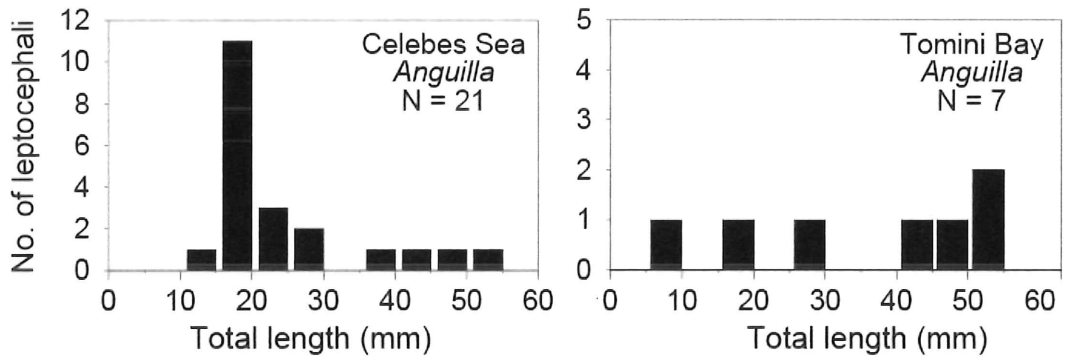


Figure 2. Length frequency distribution of the anguillid leptocephali collected in the two sampling areas during the Leg 7 survey of KH-09-5.

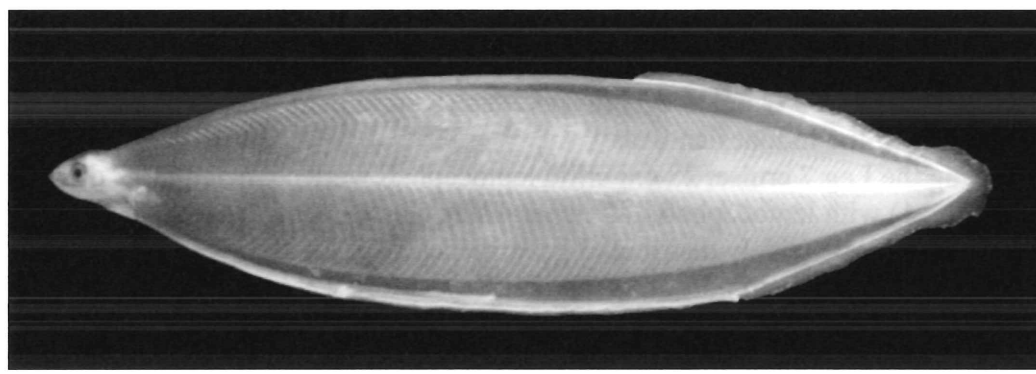


Figure 3. A 54.8 longfin anguillid leptocephalus collected at Stn. 8 in Tomini Bay. This specimen (No. 222) shows a deep-body and long dorsal fin that is typical of longfin leptocephali. Its species identity will be determined using DNA analysis.

Sampling during Leg 7 was conducted at 48 stations using an Isaacs Kidd Midwater trawl (IKMT) with an 8.7 m^2 mouth opening and 0.5 mm mesh during both day and night (Fig. 1). At night in Tomini Bay 2 different types of step tows were conducted with one type being a standardized step tow also used in Leg 5 and Leg 6 that sampled at 5 different layers (120, 90, 70, 50, 30 m, for 10 min at each depth layer). The other type of night tow used in Tomini Bay were step tows targeting the thermocline layers were anguillid eggs and recently hatched preleptocephali are likely to accumulate shortly after spawning. These tows had 10 min of horizontal towing at a specific density layer (Sigma-t:23.3) in the middle region of the thermocline and one step 10 m above this layer and another step 10 m below this layer, also for 10 min. Then finally a single step at 30 m was made at the end of this type of tow. During the day in both Tomini Bay and the Celebes Sea, oblique tows to a depth of about 500 m were made. At night in the Celebes Sea only the standardized 5 layer step tow was used.

During the sampling in Tomini Bay there were 7 anguillid leptocephali collected at sizes of 9.6–45.8 mm TL. These were caught at 5 stations with 2 being collected at both Stn 8 and Stn. 10. All the anguillid leptocephali were collected in the southern portion of the bay (Fig. 1,6). The smallest anguillid leptocephalus collected during the Leg 7 cruise was collected at Stn. 2 near the seamount area (Pasir Laut) in the southern part of the bay. The angullid leptocephali collected in Tomini Bay all had from 104 to 106 total myomeres (TM), and may have been longfin eels (Jespersen

1942), except for one 43.5 larva caught at Stn. 11 on the western side of the bay that may have been *Anguilla bicolor pacifica*.

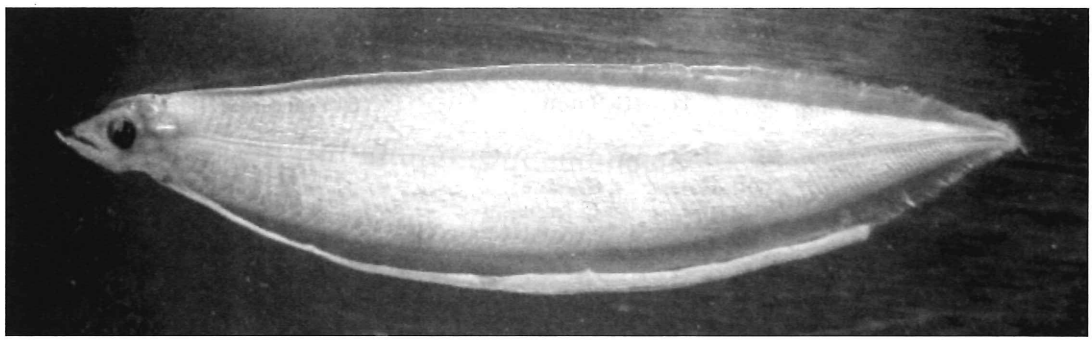


Figure 4. A 16.0 mm apparently longfin anguillid leptocephalus collected at Stn. 46 in the Celebes Sea. This specimen (No. 2001) will be identified to the species level in the laboratory later using DNA analysis.

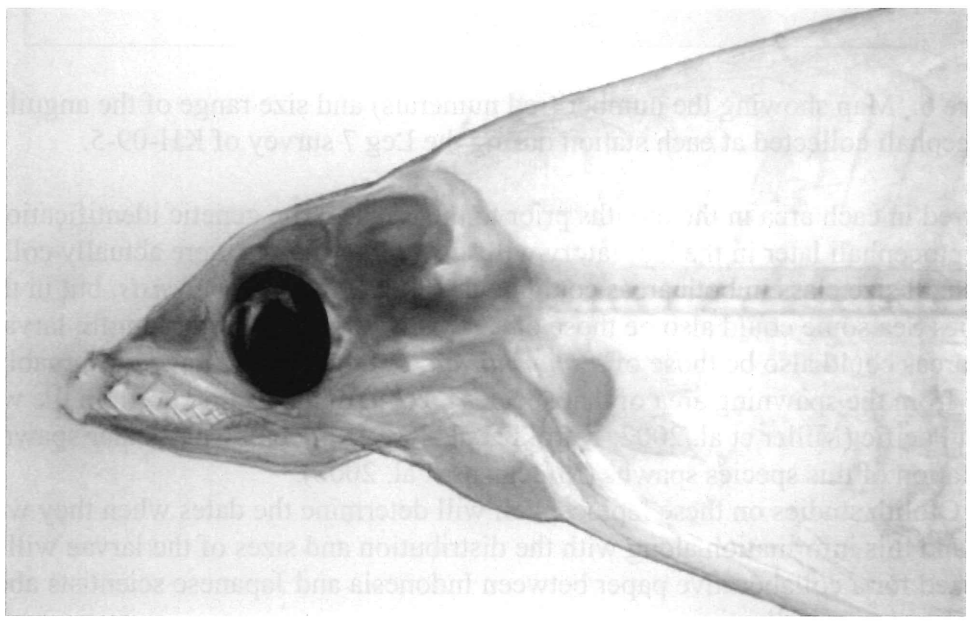


Figure 5. The head region of a 36.8 mm longfin anguillid leptocephalus (No. 2002) collected at Stn. 46 in the Celebes Sea.

In the Celebes Sea anguillid leptocephali were seemingly more abundant and a total of 21 were collected at 8 stations with 2–6 specimens being collected at 5 of the stations and single specimens being caught at the other positive stations. The catches were clearly more abundant at the southern stations closer to the northern arm of Sulawesi Island (Fig. 6). Ten were collected at Stn. 33 and Stn. 34 combined at sizes of 16.6–21.0, plus 1 at 52.1 mm TL. Three were also caught at both Stn. 46 and Stn. 47 at size ranges from 16.0 to 48.9 mm. The leptocephali collected in the Celebes Sea had a TM range of 102–109. Although the dorsal fin was not fully formed in the smaller leptocephali, both the large and small sizes all appeared to be longfin eels.

The results of these two surveys for leptocephali in different ocean areas show that tropical anguillid eels had been spawning in both areas before the cruise. The two size classes present in both areas show that more than one spawning event had

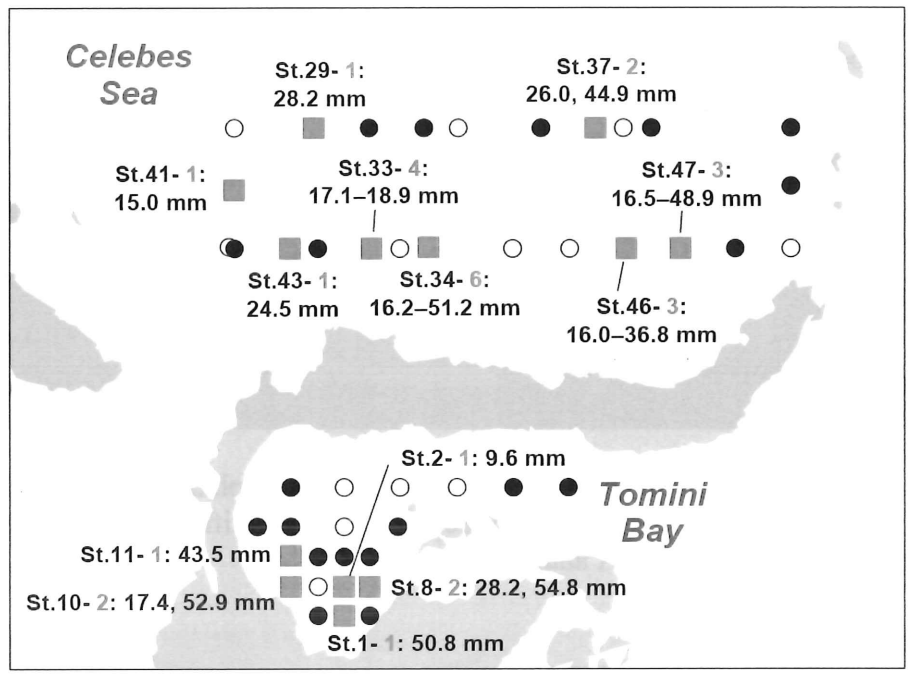


Figure 6. Map showing the number (red numerals) and size range of the anguillid leptocephali collected at each station during the Leg 7 survey of KH-09-5.

occurred in each area in the months prior to the cruise. The genetic identification of the leptocephali later in the laboratory will show what species were actually collected. The small size class in both areas could be the larvae of *A. celebesensis*, but in the Celebes Sea some could also be those of *A. borneensis*. The larger longfin larvae in both areas could also be those of *A. marmorata*, but they would have presumably come from the spawning area of that species located much further north in the western North Pacific (Miller et al. 2002; Kuroki et al. 2009) where one particular spawning population of this species spawns (Minegishi et al. 2008).

Otolith studies on these leptocephali will determine the dates when they were born and this information along with the distribution and sizes of the larvae will be analyzed for a collaborative paper between Indonesia and Japanese scientists about these interesting collections.

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Leptocephali Collected in Tomini Bay and the Celebes Sea during Leg 7 of KH-09-5

All Scientists onboard

The sampling survey of Leg 7 of the KH-09-5 collaborative cruise between scientists from Indonesia and Japan sampled in two very different areas, which were the semi-enclosed but fairly deep (1000–2000 m) Tomini Bay and the very deep Celebes Sea (4000–5000 m). The Celebes Sea (also referred to as the Sulawesi Sea) receives a constant inflow of water from the western North Pacific from the Mindanao Current (Lukas et al. 1991). This water then circulates around the deep basin of the Celebes Sea in large eddies, and then some of this water then flows southward into Makasar Strait as the main part of the Indonesian Throughflow (Gordon 2005). Some water also flows back out of the Celebes Sea into the western North Pacific (Miyama et al. 1995). This could result in leptocephali being widely transported around the basin. In contrast, Tomini Bay may only have limited exchange of water with the adjacent Molucca Sea, probably mostly through tidal currents (Hatayama et al. 1996).

The biodiversity (Wouthuyzen et al. 2005), life history characteristics (Miller et al. 2006), and assemblage structure (Minagawa et al. 2004) of leptocephali have begun to be studied in the central Indonesian Seas around Sulawesi Island using data collected during collaborative cruises between scientists at the Ocean Research Institute and at the Research Center for Oceanography, of LIPI in Indonesia on the Indonesian vessel *Baruna Jaya* VII. Cruises sampling for leptocephali were conducted in both 2001 and 2002 at many locations around Sulawesi Island, including Tomini Bay and the Celebes Sea, but the *Hakuho Maru* survey of Leg 7 of the KH-09-5 cruise, was generally more intensive with more stations in the two areas that were sampled for a total of 48 stations (Figure 1).

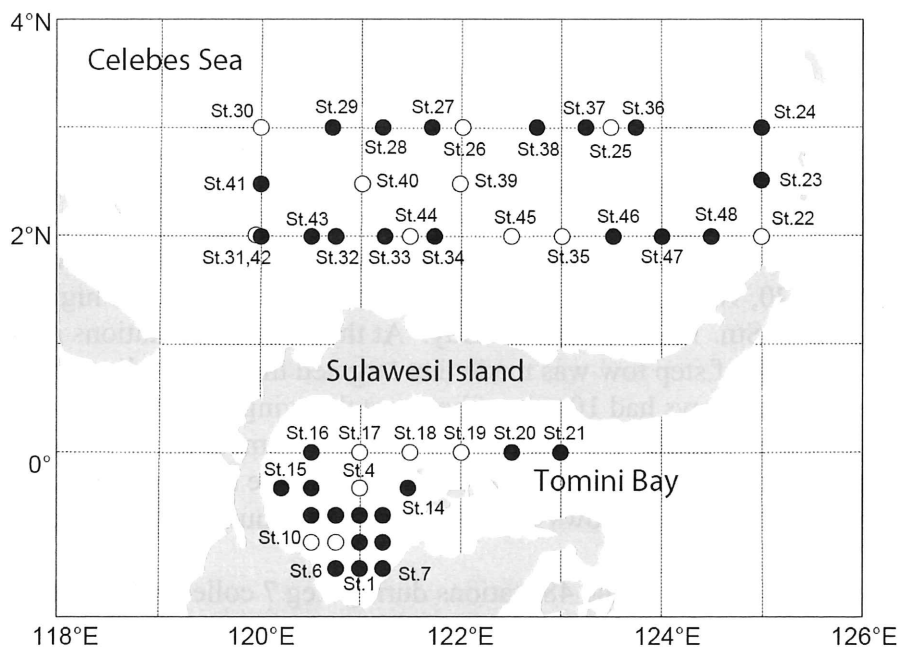

Figure 1. Map showing night (black) and day (white) stations during Leg 7 of KH-09-5, with station numbers shown except in the south-central part of Tomini Bay.
Table 1. Catches of the leptocephali collected during the Leg 7 collaborative cruise of KH-09-5 conducted in Tomini Bay and the Celebes Sea.

Family / taxa	Celebes Sea	Tomini Bay	Total		Family / taxa	Celebes Sea	Tomini Bay	Total
Anguillidae					**Muraenidae**			
Anguilla spp.	21	6	27		Muareninae	181	143	324
A. bicolor pacifica		1	1		Uropterigiinae	15	54	69
Congridae					sp.	14	10	24
Ariosoma scheelei	107	45	152		**Nettastomatidae**			
Ariosoma spp.	151	68	219		*Nettenchelys*	1	4	5
Conger	33	26	59		*Saurenchelys*	6	2	8
Gnathophis types	19	5	24		*Nettastoma*		1	1
Gnathophis sp. G	3	6	9		**Synaphobranchidae**			
Congrinae 1row	42	54	96		Illyophinae	2	7	9
Bathycongrus spp.	5	32	37		Synaphobranchinae	9	5	14
Gorgasia	2	7	9		**Derichthyidae**	5		5
Heteroconger hassi		7	7		**Nemichthyidae**			
Heteroconger	1	9	10		*Nemichthys*	63	60	123
spp.	1	4	5		*Avocettina*	12	14	26
Chlopsidae					Nemichthys Juv.	5	2	7
Kaupichthys	14	159	173		**Serrivomeridae**			
Kaupichthys LB		4	4		spp.	23	113	136
Chlopsis types	6	28	34		Juvenile	1		1
Robinsia caterinae	2	2	4		**Eurypharyngidae**			
spp.	18	83	101		*Eurypharynx*	1	3	4
Ophichthidae					***Thallassenchelys***	1		1
Ophichthinae	12	12	24		***Ascomina***		2	2
Myrophinae	4	6	10		**Albuliformes**			
Neenchelys spp.	161	44	205		*Albula*		1	1
Neench. microretus	4		4		Notacanths	1	3	4
Juv/Adult		1	1		**Elopiformes**			
Moringuidae					Elopidae	1	1	2
Moringua	38	57	95		**Unidentified**	6	5	11
					Total	991	1096	2087

During the Leg 7 survey, an Isaacs Kidd Midwater trawl (IKMT) with an 8.7 m^2 mouth opening and 0.5 mm mesh was used to conduct grid surveys in both of the two areas that were sampled (Figure 1). Stations were sampled during both day and night, with step tows that fished to a maximum depth of 150 m and then horizontally at depths of about 120, 90, 70, 50, 30 m for 10 min at each depth layer at night in the Celebes Sea and at Stn. 15–21 in Tomini Bay. At the other night stations in Tomini Bay, a different type of step tow was made that targeted the thermocline layer and one shallow layer. These tows had 10 min of horizontal towing at a specific density layer (23.3) in the middle region of the thermocline and one 10 min step at 10 m above this layer and another step 10 m below this layer. Then a single shallow step was made at 30 m. During the day, oblique tows that fished to a maximum depth of about 500 m were conducted.

These 3 types of tows at the 48 stations during Leg 7 collected a total of 2,076 leptocephali and 9 juveniles/adults of 12 anguilliform families, 2 family-unknown taxa (*Thalassenchelys* and *Ascomina*). More analysis is needed, but perhaps more than 80 anguilliform species were present, plus 4 of other orders (see Table 1).

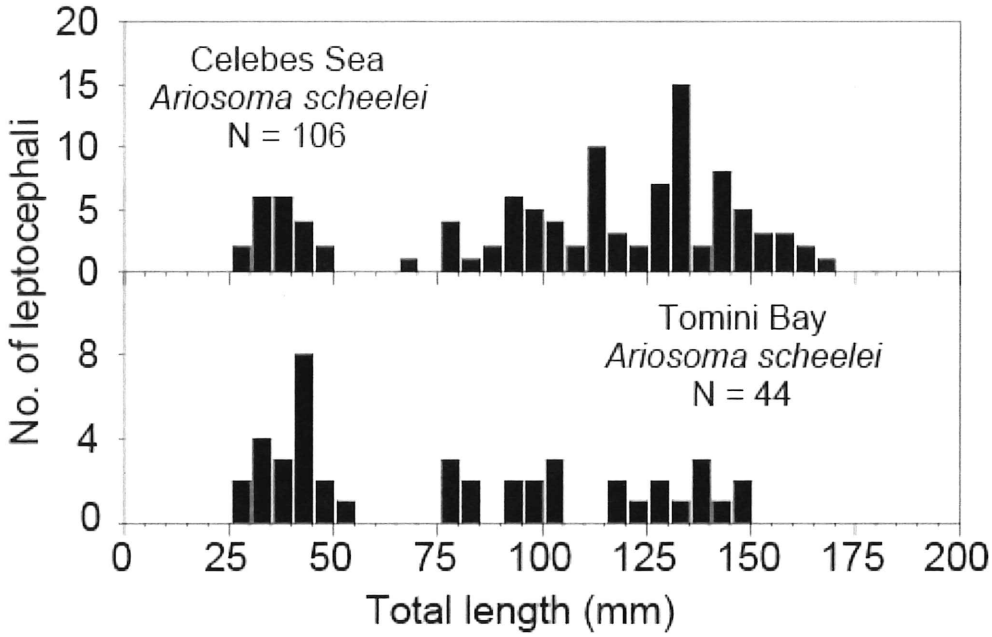

Figure 2. Length frequency distributions of the *Ariosoma* leptocephali distinguished during Leg 7 of KH-09-5 as being *Ariosoma scheelei*, which is an abundant species of leptocephali in some areas of the Indonesian Seas (Miller et al. 2006).

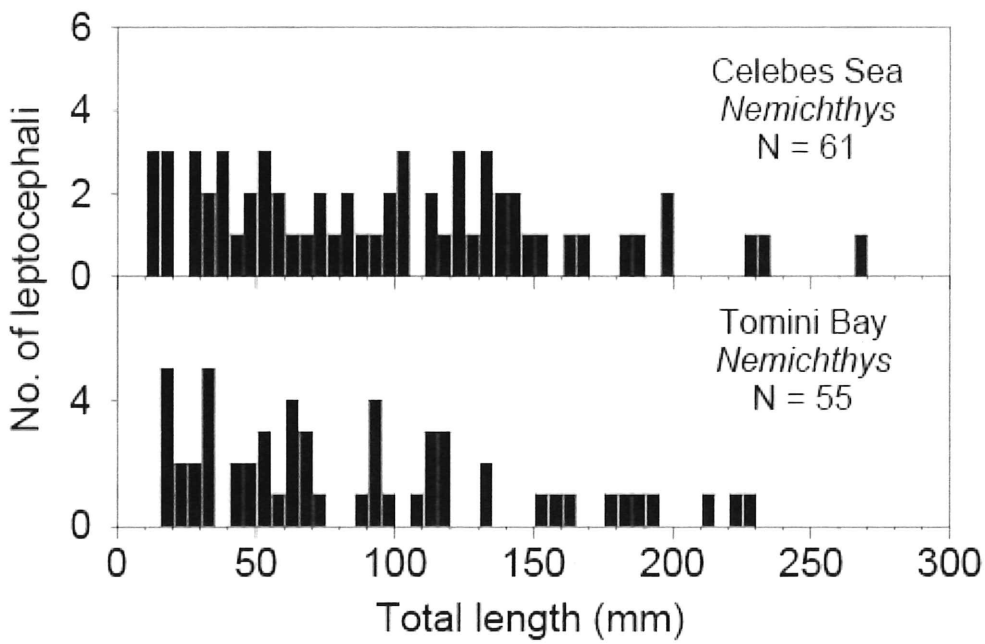

Figure 3. Length frequency distributions of the *Nemichthys* leptocephali collected during Leg 7 of KH-09-5. These are the larvae of mesopelagic eels that live in the upper 2,000 m of the ocean (Miller and Tsukamoto 2004).

Preliminary examination of the data revealed that the family Congridae (N = 627) was the most abundant, partly due to the 371 leptocephali of the Ariosoma-type, which also included the abundant larvae of the shallow water tropical eel *Ariosoma scheelei* (Figure 2). The larval distributional ecology of this species was studied after the 2001 Indonesia/Japan collaborative *Baruna Jaya* VII cruise (Miller et al. 2006).

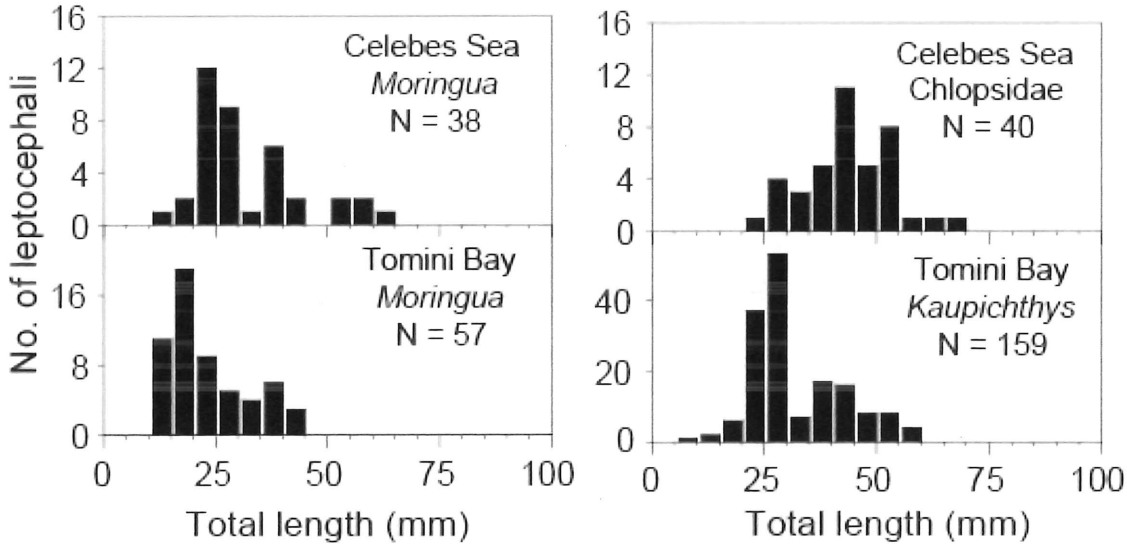

Figure 4. Length frequency distributions of the leptocephali of shallow water eels of the family Moringuidae (left panels) and Chlopsidae (right panels) collected during Leg 7 of KH-09-5. Other species of the Chlopsidae in Tomini Bay are not shown, but *Kaupichthys* was the most abundant taxa of that family, as also was observed in the 2002 *Baruna Jaya* VII survey (see Lee et al. 2008).

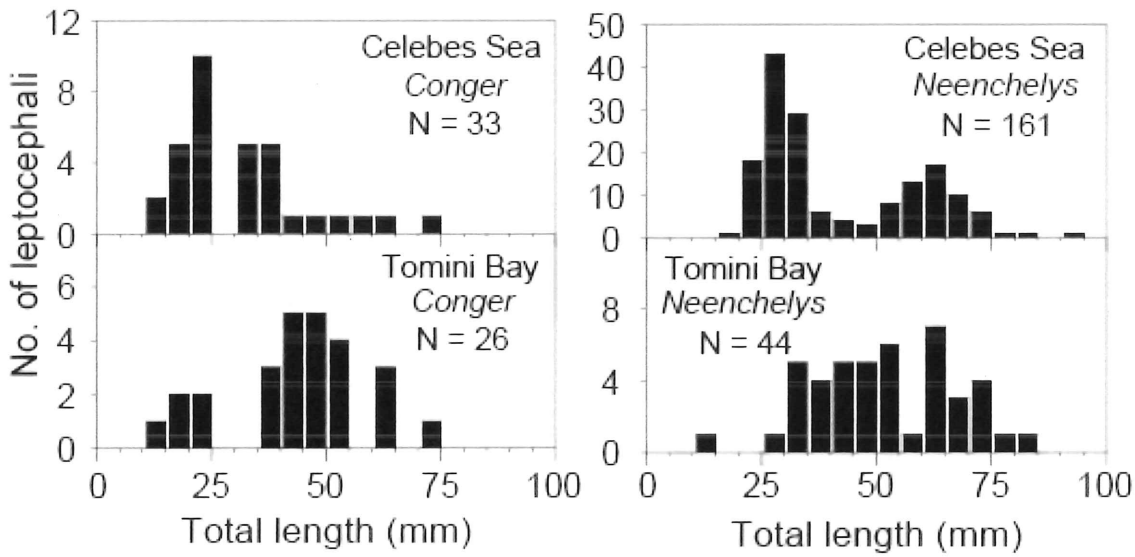

Figure 5. Length frequency distributions of the leptocephali of shallow water eels of the genus *Conger* (family Congridae) and the genus *Neenchelys* (family Ophichthidae) collected during Leg 7 of KH-09-5.

The family Congridae was also diverse in number of taxa, since this family includes many genera with diverse species in the Indo-Pacific. Some differences were observed in the abundances and size between congrids in Tomini Bay and the Celebes Sea however, even though there may have been some sampling bias between the two areas, with slightly more fishing effort at night in the Celebes Sea. For example *Ariosoma*- and *Gnathophis*- types with pointed heads (see Figure 6) were more abundant in the Celebes Sea, but *Bathycongrus* and the garden eel leptocephali of *Gorgasia* and *Heteroconger* were more abundant in Tomini Bay. One clear example, was that the only 7 *Heteroconger hassi* collected all were in Tomini Bay.

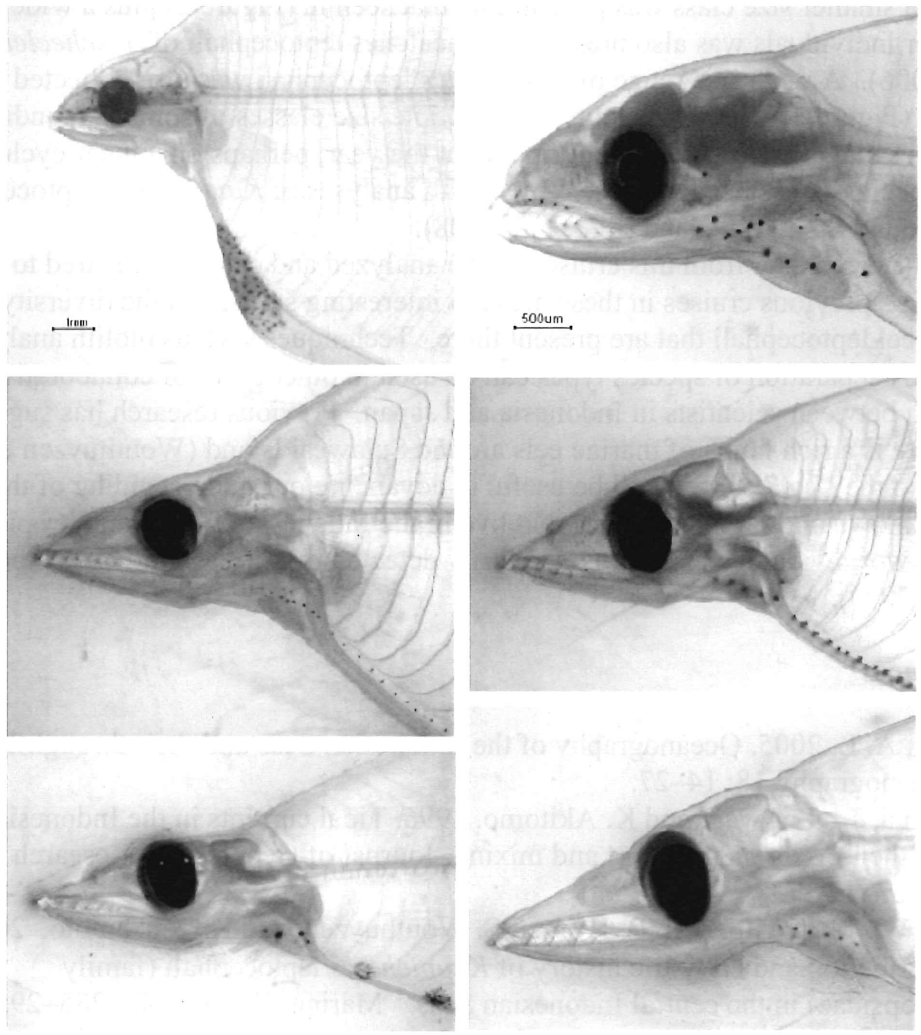

Figure 6. Photographs of the head region of two species of the Chlopsidae (top two panels) and 4 congrid species with very pointed head shapes that were collected during Leg 7 of KH-09-5 in Indonesian waters.

Various taxa of leptocephali of other families of eels were also abundant in some areas during the Leg 7 survey. For example, leptocephali of the Chlopsidae (see Figure 6) were abundant in Tomini Bay (N = 276), and in particular, those of the genus *Kaupichthys* (N = 159) were very abundant there, at a range of sizes (Figure 4). In contrast, only 40 specimens of all species of chlopsid leptocephali were collected in the Celebes Sea. The larvae of the muraenid subfamily Uropterigiinae, and serrivomerids (mesopelagic eels), and the Moringuidae were also more abundant in Tomini Bay than in the Celebes Sea. Other taxa were more abundant in the Celebes Sea however, such as the ophichthid genus *Neenchelys*, which was present in large numbers with two size classes being collected (Figure 5).

Comparisons of the length frequency distributions of the same taxa between the two sampling regions will also be useful to help understand the reproductive ecology of eels in this tropical region. For example, it is clear that similar size class structure was present in both Tomini Bay than in the Celebes Sea for species such as *Ariosoma scheelei* (Figure 2) and *Conger* (Figure 5), which both showed at least two similar size classes. Interestingly, during the 2001 survey around Sulawesi Island, an almost

identical smaller size class was present like that seen in (Figure 2) plus a wide range of larger individuals was also present in the catches leptocephali of *A. scheelei* (Miller et al. 2006). A wide size range of *Nemichthys* leptocephali was also collected in both regions (Figure 3). The bimodality and multiple size classes of some taxa indicate spawning may occur periodically throughout the year, perhaps on a lunar cycle for some species as has been suggested by otolith analyses of *Kaupichthys* leptocephali from around Sulawesi Island (Lee et al. 2008).

The catch data from this cruise will be analyzed and can be compared to the data from the 2 previous cruises in these areas in interesting studies on the diversity of marine eel leptocephali that are present there. Techniques such as otolith analyses and DNA separation of species types can be used in other types of collaborative research between scientists in Indonesia and Japan. Previous research has suggested that there is a rich fauna of marine eels around Sulawesi Island (Wouthuyzen et al. 2005), so the Leg 7 survey will be useful in advancing our understanding of these poorly known and rarely seen eels that live in the Indonesian Seas and in tropical regions worldwide that are often only easily detected by surveys of their leptocephali (Miller 2009).

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First Trial for Tracking Silver Eel Migration in Tomini Bay

Tracking Team

HAKUHO-MARU: (Jun Aoyama, Katsumi Tsukamoto, Seishi Hagihara, Triyanto, Fadly F. Tantu)

POSO ESTUARY: (Ryotaro Manabe, Katsufumi Sato)

Catadromous eels of the genus *Anguilla* are known to make long distance spawning migrations such as those made by the European and American eels to spawn in Sargasso Sea (Schmidt 1922, McCleave and Kleckner 1887) and by the Japanese eel that spawns near the West Mariana Ridge (Tsukamoto 2006). However, the finding of the spawning areas of *A. celebesensis* in Tomini Bay and the Sulawesi Sea (Celebes Sea) and *A. borneensis* in the Sulawesi Sea suggested that the tropical anguillids have their spawning sites near their freshwater growth habitats and make short distance spawning migrations, clearly contrasting to their counterparts in temperate regions (Kuroki et al. 2006).

Recent developments of archival tags and the other biotemetric devices has enabled biologists to track the migration of silver eels for which the routes and swimming depth are entirely not known. Jellyman and Tsukamoto (2002, 2005) were the first to apply satellite pop-up tags to study the spawning migration of *A. dieffenbachii*, and recently Aarestrup et al. (2009) reported the data obtained by the satellite pop-up tags of about 4 months of the migration of European silver eels released from Ireland in the North Atlantic Ocean. These studies successfully showed considerable data about the swimming depth, speed and temperature experienced by migrating silver eels. However, no study could achieve to track silver eel migrations to the spawning areas presumably because they are located so far from the releasing points, and their migrations take a long time making them technically difficult to follow entirely.

Ecological traits of the tropical anguillids that make small scale spawning migrations and generally have large body sizes may possibly facilitate the ability of a study to track their whole spawning migrations. We conducted the first tracking experiments in Tomini Bay using acoustic pingers, archival radio data loggers and satellite pop-up tags for *A. celebesensis* and *A. marmorata* silver eels to know their entire spawning migration behaviors. This study was also to make the first methodological evaluations of these telemetric devices for the tropical anguillids.

Acoustic Tags

A silver eel of *A. celebesensis* in the S2 stage was surgically tagged with an acoustic pinger (VEMCO V16TP-1H, 51KHz) and released just outside of the Poso estuary at 16:08 on 8 Mar. 2010 during the KH-09-5 Leg 7. The eel was followed by a tracking boat equipped with the acoustic receiver (VEMCO VR100) (see Appendix Fig. 1). The swimming depth and temperature experienced by the eel, as well as the GPS position of the tracking boat were automatically logged in the receiver. After the release, the eel showed a horizontal movement towards the northwest making frequent

brief stops of about 10-30 min (Fig. 1). The swimming depth recorded during the tracking ranged from 3-201 m (mean 106.7 m) and temperature experienced, 32.3 – 16.9°C (mean 24.7°C) (Fig.2). The tracking had been successfully conducted until 20:00 on 8 Mar., however, due a fuel shortage of the tracking boat, we needed to return back to Poso. When we came again the position of the last contact with the eel, the signal was already lost. Thereafter we continued a grid survey covering wide areas at around until 4:00 on 9 Mar., but the signal could be found again.

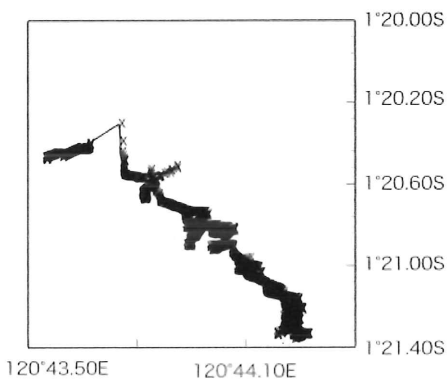

Fig.1. Horizontal movement of the eel tracked in this study.

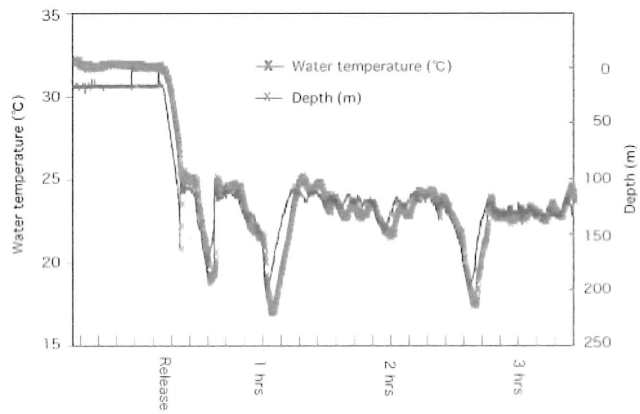

Fig.2. Swimming depth (blue) and temperature experienced (red) of the eel in this study.

Radio archival data logger

A radio archival data logger to measure the two dimensional accelerations with the depth and temperature (Little Leonard D2GT) was attached to a silver eel of *A. celebesensis* and released prior to the arrival of Hakuho-Maru off Poso estuary (see Appendix Fig. 1). The tag was preprogrammed to detach from the eel after 12 hours of the release. On 6 Mar., we detected a VHF signal from the logger in the region near the Poso statuary (01°26.46.7S, 120°44.52.3E). This indicated that the logger was successfully detached from the eel and surfaced within a range of our VHF receiver (c.a. 15 km) from the Hakuho-Maru. The next day, 7 Mar., we started a survey to recover the logger and finally got it using an inflatable boat launched from the HAKUHO-MARU. The next data logger was released on 8 Mar. with a silver *A. celebesensis* and was preprogrammed to detach from the eel 24 hours after. We surveyed widely covering almost 1 degree around off Poso estuary during the day times of 9 and 10 Mar. However, the signal was never detected by the receiver suggesting that the logger was detached under rocks or in some obstacle such as a hole etc. and was stuck there. Data obtained from the first logger needs to be down loaded in the laboratory after the cruise.

Satellite pop-up tag

A satellite pop-up tag is a device for tracking the large-scale movements and behavior of fish and other animals, which do not spend enough time at the surface to allow the use of real-time Argos satellite tags. The results provide the migration path taken by the

study animal, depth and temperature preferences of the study animal, as well as oceanographic data in the form of depth-temperature profiles. We used the satellite pop-up tag for the first time to study the spawning migrations of the tropical anguillids. A total of 3 *A. celebesensis* and 2 *A. marmorata* were tagged by pop-up tags (Wildlife Computer - new type of Mk10-PAT), which were preprogrammed to detach from the eels at about two weeks and 5 months, respectively. Although the summary data will be transmitted via Argos satellite, we tried to recover the tags from the *A. celebesensis* that will surface during the cruise to have more detailed information. The tags are though to appear near "Pasir Laut" in Tomini Bay, which is an estimated spawning site of this species.

All 3 tags attached to *A. celebesensis* were confirmed to surface and transmitted the data to Argos satellite at 8 – 9 March through an internet connection from the laboratory in Japan. Two of them were found near Pasir Laut, but one was the west of Poso estuary (Fig.3). We tried to recover a tag near Pasir Laut following the position sent from Japan that has a time lag of about 1-3 hours. The HAKUHO-MARU could successfully approach to the estimated position informed from Japan, but we could not find the tag because it was difficult to find visually such a small tag in that area. Some other devices to detect radio signal from the tag etc. is surely needed to recover the small tag on the ocean.

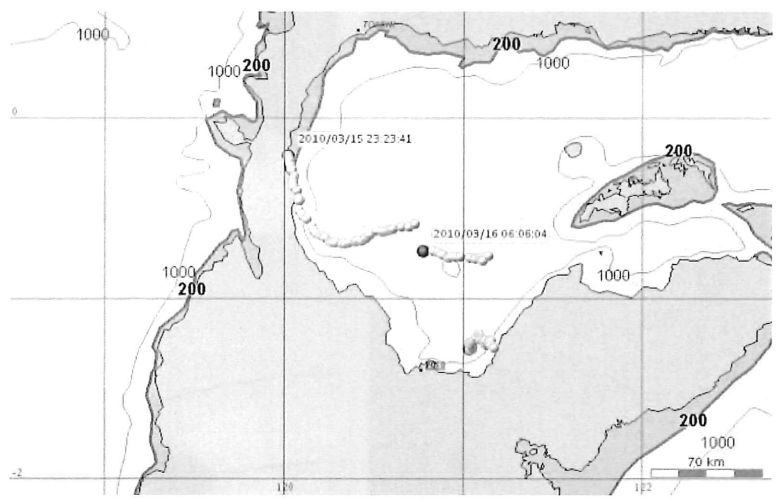

Fig. 3. Positions and traces of 3 satellite tags surfaced in the Tomini

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Appendix Figure 1. Scenes from the releasing of A. celebesensis on 8 March during Leg 7 of KH-09-5 (upper and left). The eel is being released into Tomini Bay after being tagged with the data logger. The bottom right panel shows 5 satellite transmitting pop-up tags of the type attached to 5 eels released into Tomini Bay during this study.

Analysis of total suspended material (TSM) and its relationship to the abundance of leptocephali in the Tomini Bay dan Celebes Sea

Sam Wouthuyzen

It is believe that many marine and freshwater eels larva feed on the marine debris call as "marine snow". It is consisted of the decay of dead zoo- and phytoplankton that those materials can be expressed as Total Suspended Material (TSM). Thus on this cruise (KH-09-5 lag 7) I am interested to know whether there is any correlation of TSM and the abundance of leptocephali in the Tomini Bay and Celebes Sea. For that purposes I collected water samples from about 15 stations at depth 5 m, 50 m, chl-a max (mostly at 75 m depth), 100 m and 200 m. One liter of seawater collected at each depth was filtered on 25 mm glass fiber filter Whatman GF/F. Filters were keep in the freezer and will be weighed in the lab after out from the Hakiko Maru. The total numbers of leptocephali catch at each station were recorded. Simple regression analysis will be conducted to see if there any relationship between the TSM and the abundance of each station. Since the TSM data are not available now, thus the result could not be reported here. I will report later. However, since the fluorescence chlorophyll-a concentration parameter recorded on the CTD cast, then it is assume that the chlorophyll-a concentration is also can be expressed as TSM. Thus, it is possible to know whether there is relationship between chlorophyll-a and the abundance of leptocephali. Figure 1 shows Plot of Chlorophyll-a concentration VS the catch of leptocephali. The abundance of leptocephali is correlated well with Chlorophyll-a max (at depth around 75 m; R^2 =0.861), while weak correlation with chlorophyll-a at surface (5 m depth, R^2=0.226), and there is no correlation at all at depth 200 m. Further analysis must be conducted in the near future.

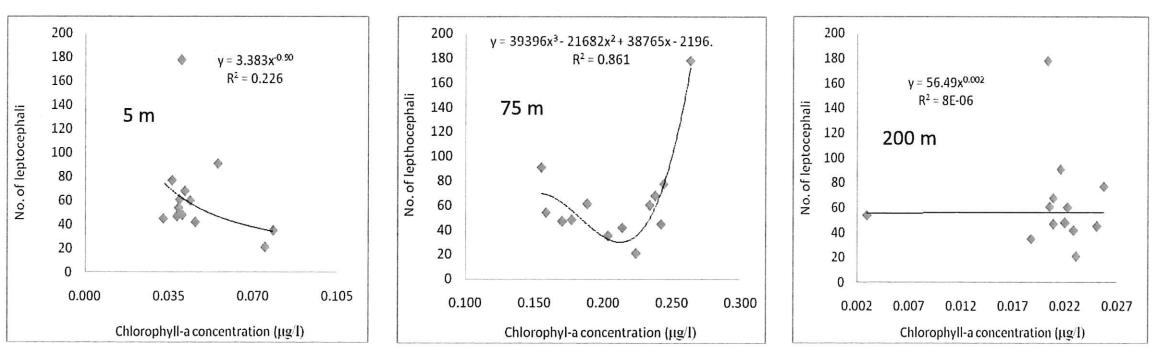

Fig. 1. Plot of chlorophyll-a concentration at depth 5 m, 75 m and 200 m VS the abundance of leptocrphali.

The dynamics of bacterial productivity in the Tomini Bay and Sulawesi Sea

Djoko Hadi Kunarso

The marine microorganisms is play an important role in the marine ecosystems as decomposer on the nutrients resources of trophic level in food webs. In order to understand the ecological role of trophic level, it is necessary to establish their distribution and to determine the abundance of components mainly bacteria and phytoplankton. Therefore, in the cooperation research on the marine science between ORI, UT and RCO LIPI were investigate the dynamics of bacterial productivity in the Tomini bay and Sulawesi sea. The observation had been conducted during the RV Hakuho Maru cruise (KH-09-5) in leg 7 from Bali to Bitung on the period 2 – 19 March 2010. The objective of this study is to find out the concentration and pattern of distribution the bacterial productivity and related with waters fertility.

The sea water samples fo bacteriological examination were taken from 14 stations by using the Rosette sampler from the surface to the bottom layers up to 100 m in Tomini bay and Sulawesi sea. The samples were collected immediately transfer from the bottle sample with volume 500 ml taken about 10 ml were carefully placed into sterilized screw cup tube and preserved into 10% formalin. Analysis to determine of bacteria productivity based on the total bacteria cells with Acridine Orange Direct Counting (AODC) method (ZIMMERMAN & MEYER REIL, 1974 and HOBBIE *et al.,* 1977). For the find out of bacterial productivity in the marine environment based on the calculation of conversion from total bacteria cells to the bacteria biomass into the Carbon unit (VAN ES & MEYER REIL, 1982) and MORIARTY *et al.*, (1990).

During the Hakuho Maru cruise KH-09-5 in leg 7 the total samples were collected 24 samples from Tomini bay and 21 samples from Sulawesi sea, and all sample were preserved in 10 % formalin than analyzed in RCO LIPI, Jakarta. To enumerate the total bacterial cells abundance on 10 ml samples filtered onto black polycarbonate filters (0.2 μm pore size) and examined with an epiflourescence microscope at 1250x magnification.

The preliminary results based on the larva diversity seem to indicate that in Tomini bay more divers than Sulawesi sea. This condition due to waters fertility in Tomini

bay more higher than Sulawesi sea,besides by influenced of marine ecosystems itself and also factor the monsoon and environment. In general the pattern of distribution of bacterial productivity at the surface layers tends to highest numbers compared with bottom layers. The most important cause different of dynamics numbers was nutrient factor particularly organic materials resources in the marine ecosystem.

Sea water sampling

Tomini bay

St 4	7 March 2010	3 samples (5 meter; 50 meter and 100 meter)
St 9	8 March 2010	3 samples
St 10	10 March 2010	3 samples
St 14	10 March 2010	3 samples
St 17	12 March 2010	4 samples (5 meter; 50 meter; 100 meter and 200 meter)
St 19	12 March 2010	4 samples
St 21	12 March 2010	4 samples

Sulawesi Sea

St 22	13 March 2010	3 samples (5 meter; 50 meter and 100 meter)
St 24	14 March 2010	3 samples
St 25	14 March 2010	3 samples
St 26	14 March 2010	3 samples
St 30	15 March 2010	3 samples
St 31	15 March 2010	3 samples
St 35	16 March 2010	3 samples

Acknowledgment: We would like to thanks Pro. Dr Katsumi Tsukamoto, Dr. Jun Aoyama, Dr. Shun Watanabe and Captain and Crew of Hakuho Maru (KH-09-5 Leg 7) for their kindness to participate in this cruise from Bali to Bitung.

Tuna larvae in central Indonesia region

Augy Syahailatua and Shun Watanabe

Objectives:

To know the spawning location of tuna in central Indonesia region.

Subjects:

1. To understand the taxonomic composition and distribution of tuna larvae.

2. To study the age and growth of tuna larvae.

Methods:

Tuna larvae together with other ichthyoplankton species (Figure 1) were sampled using the IKMT net at 21 stations in Tomini Bay and 27 stations in Sulawesi Sea. The net was towed obliquely from 500 m to the surface at daytime stations or step obliquely at night stations from the surface to 150 m and then towed horizontally at 5 layers for 10 minutes each.

Tuna larvae were sorted immediately after towing and preserved in 10% formalin (mostly for morphology and meristic analyses) and also in absolute ethanol (for genetic and age studies). Further analyses will be taken at ORI, Tokyo (Japan) and LIPI Ambon (Indonesia).

Temporary Results:

1. Tuna larvae were caught in quite large numbers from the Sulawesi Sea compared to in Tomini Bay. Also, the east side of the Sulawesi Sea showed higher abundances than the west side.

2. Samples of tuna larvae are required to be identified in detail for genus or species level. However, from quick observation of the samples, we could find that beside tuna larvae from the genus of *Thunnus* (Figure 1) other genera of the Scombridae were also collected.

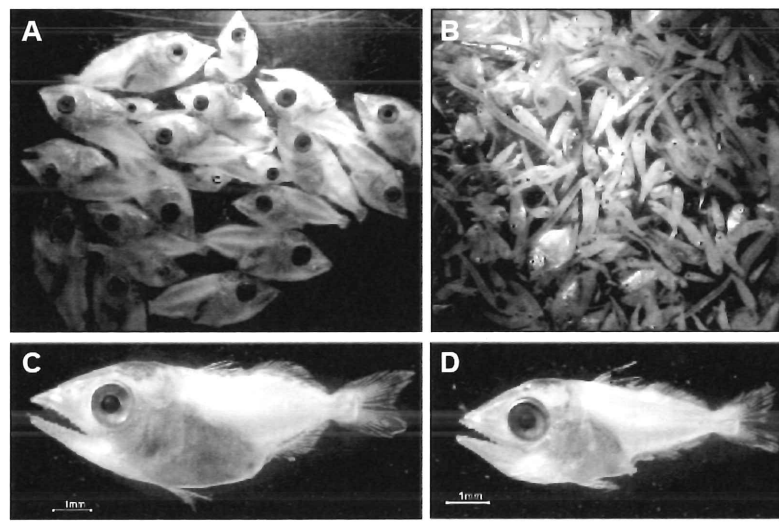

Figure 1. Photographs of tuna larvae from Stn. 23 (A) and other fish larvae from the same station (B), and tuna larvae from Stn. 32M (C, D) collected during Leg 7 of KH-09-5 in the Indonesian Seas.

Distribution and Larval Dispersal of Sicydiinae Gobies in Tomini Bay and the Celebes Sea, Indonesia revealed by mitochondrial DNA and Otolith Analysis

Shun Watanabe, Hanung Agus Mulyadi, Augy Syahailatua, Katsumi Tsukamoto, Sam Wouthuyzen, and Jun Aoyama

The species of the Sicydiinae (Gobiidae) are widespread mainly in tropical and subtropical oceanic islands from the western Indian Ocean through Indonesia, the eastern Pacific Ocean, and the Caribbean Sea to western Africa (Keith 2003). There have been many biological and ecological studies on these amphidromous species of the Gobiidae in the Indo-Pacific and the Caribbean regions (Keith 2003). However, only a few attempts have so far been made to directly study their marine life stages and no studies have examined the relationship among the marine life stages and the distributions of the Sicydiinae species. The objectives of this study are as follows: 1) to identify the marine larvae of Sicydiinae species in Tomini Bay and the Celebes Sea, Indonesia, using molecular genetic techniques, 2) to describe the morphology of the marine larvae of these species, and 3) to determine their oceanic larval duration by counting of daily growth increments from the core to the edge in the larval otoliths.

During the sorting activity on board Leg 7 of KH-09-5, particular attention was given to the Sicydiinae larvae, and we attempted to identify them based on morphological criteria such as red pigmentation on the head, base of the second dorsal fin and on the caudal fin. The existence of the pelvien fin, which is an important character in the adults stage of Gobiidae, was more difficult to find in the small larvae that were observed. A total of 521 ethanol preserved possible Sicydiinae larvae from 29 stations were obtained (Tomini Bay: St. 2, 3, 5, 6, 8, 9, 11, 12, 14, 17, 21 and the Celebes Sea: St. 23, 25, 27, 28, 41, 44, 46, 47). There were more individuals collected from Tomini Bay (N=413) than those collected from the Celebes Sea (N=108). Their standard length ranged widely (6 - 27 mm). All individuals have been preserved in 99% ethanol for further molecular genetic and otoliths analyses. After being preserved by ethanol, their red pigmentation disappeared. However, these larvae were divided into at least five groups based on the sequence of black pigmentation spots on their bodies.

According to these criteria, some larvae have been identified as Sicydiinae larvae, but this has to be confirmed for all specimens using mitochondrial DNA (COI and 16S ribosomal RNA) once back in the laboratory. We will try to determine the oceanic larval duration of Sicydiinae larvae when we examine all individuals that are identified as Sicydiinae and exclude other goby larvae. Furthermore, we will also describe the morphological characters of the Sicydiinae larvae from Tomini Bay and the Celebes Sea in detail to help their identification in future surveys.

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Fish larvae and juveniles collected around Sulawesi Island, Indonesia

Mari Kuroki[1], Michael J. Miller[2], and Jun Aoyama[2]

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[2]*Ocean Research Institute, The University of Tokyo, Japan*

Previous sampling surveys using the IKMT around Sulawesi Island, Indonesia have been conducted in 2001 (BJ-01-1) and 2002 (BJ-02-4) in the same areas as the present cruise, but the specimens examined during those surveys were mostly restricted to anguilliform larvae. In the KH-09-5 Leg 7 cruise, fish larvae and juveniles and a few invertebrate specimens were sorted out of some samples (Fig. 1) in Tomini Bay and the Celebes Sea during 12-19 March 2010. During the present cruise all the other fish larvae (non-anguilliforms) were systematically sorted out of the plankton from a total of 12 tows (step tows in the day and oblique tows at night of IKMT) both in Tomini Bay (St. 15-21) and Celebes Sea (St. 22- 48). Fish larvae were sorted out of about 20 other tows and these larvae were taken to Indonesia by Indonesian scientists on the cruise. High-resolution digital pictures were taken of some fish specimens from these 12 tows with a stereo microscope aboard (SMZ-1500, Nikon).

Figure 1. Fishes sorted out of one tow of the IKMT during Leg 7 of KH-09-5.

All fish larvae collected were preserved individually in 99% ethanol or in 10% formalin. The number of fishes collected (excluding anguilliform leptocephali) in these tows is estimated to be up to 3,000. Tomini Bay and the Celebes Sea have different oceanographic characters and the fish species collected and the biomass also varied between these two areas. The collected fish larvae in this cruise will be identified to the lowest possible taxonomic level in the laboratory as fish and invertebrate collections and educational materials at the University of Tokyo. Moreover, the applied studies such as morphological analysis, life history, food web structures, and molecular analyses will be investigated using these samples. The fish biomass, assemblages, and species composition collected around Sulawesi Island will be used to compare to the same kind of samples collected during the previous legs of the KH-09-5 cruise that were collected mostly to the west of the Mascarene Ridge in the southwestern Indian Ocean.

Taxonomical Identification of Muraenid Leptocephali Collected During the KH-09-5 Leg 7 Cruise using Morphology and DNA Barcoding

Atsushi Tawa

Moray eels (family: Muraenidae) are one of the most diverse families of eels and more than at least 100 species have been reported in the Indo-Pacific Ocean (Smith 1962, Chen et al. 1993, Randall et al. 1995, Böhlke et al. 2000, Hatooka 2002). However, only a few species or types of leptocephali have been described scientifically (D'Ancona 1928, Nair et al. 1949,1960, Jones and Pantalu 1952, Castle 1965, Tabeta and Mochioka 1988). The Muraenidae is a fairly homogeneous group whose leptocephali show little fundamental variation. Genera and species groups are characterized mainly by pigmentation and fin position (Smith 1989).

A total of 421 specimens of muraenid leptocephali were collected during the KH-09-5 Leg 7 cruise. These specimens were divided into 327 Muraeninae and 70 Uropterygiinae, and 24 unidentified using fin position and pigmentation patterns onboard. Four specimens belonging to Muraeninae were sent to the Research Center for Oceanography LIPI. The other specimens will be taken to ORI or Kyushu University temporarily before they are returned to Indonesia.

These may include more than at least 30 species, because of the various pigmentation patterns (Figure 1) and wide range of total myomeres. However, it is very difficult to identify muraenid leptocephali to the species level morphologically, so DNA will be used.

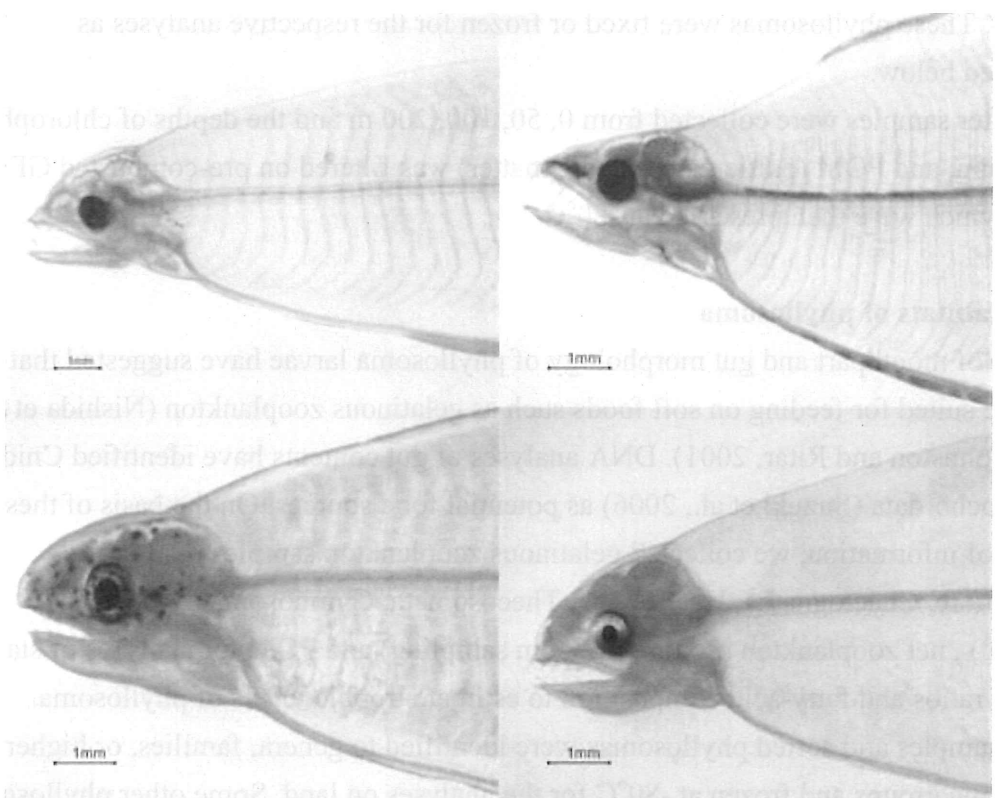

Figure 1. Various pigmentation patterns of muraenid leptocephali collected during the KH-09-5 Leg 7 cruise.

Studies on feeding ecology of phyllosoma larvae of palinurid and scyllarid lobsters

Masamichi MACHIDA and Shuhei NISHIDA

Introduction

The larvae of palinurid and scyllarid lobsters are called "phyllosoma", with their transparent and flattened bodies. Phyllosoma larvae are distributed in open ocean、with long planktonic period for over 6 months. Their prey items in national environment have been mostly unknown because their low natural density has made wild specimens difficult to be captured for experimental observations. The main purpose of the present cruise is to collect phyllosoma larvae for analyses of stable isotope ratios, fatty acid composition and gut contents, and for species identification using genetic markers.

Phyllosoma, plankton and POM sampling

A total of 27 phyllosomas was corrected using an Isaacs-Kidd Midwater Trawl (IKMT, 0.5mm mesh aperture) towed obliquely , horizontally or step-wise during Leg.7 (Table 1). Phyllosomas were sorted from the original zooplankton samples immediately after capture. These phyllosomas were fixed or frozen for the respective analyses as described below.

Sea-water samples were collected from 0, 50, 100, 200 m and the depths of chlorophyll maximum, and POM (particulate organic matter) was filtered on pre-combusted GF/F filters which were then preserved at -80°C.

Food habitats of phyllosoma

Studies of mouthpart and gut morphology of phyllosoma larvae have suggested that they are suited for feeding on soft foods such as gelatinous zooplankton (Nishida et al., 1990; Johnston and Ritar, 2001). DNA analyses of gut contents have identified Cnidaria and Urochordata (Suzuki et al., 2006) as potential food sources. On the basis of these bodies of information, we collected gelatinous zooplankton samples (Cnidaria, Ctenophore, Chaetognatha, Heteropoda, Thecosomata, Gymnosomata, Thaliacea, Salpida) , net zooplankton mixture (random sampling) and POM for analyses of stable isotope ratios and fatty-acid composition to estimate trophic levels of phyllosoma. These samples and sorted phyllosomas were identified to genera, families, or higher taxonomic groups and frozen at -80°C for the analyses on land. Some other phyllosomas were frozen or fixed in 100% alcohol for genetic identification of gut-contents, or fixed

in 2% formaldehyde or in Karnovsky's fixative for light/electron microscopic observation on feeding structure and gut contents.

Species identification of phyllosoma with genetic markers

It is difficult to identify the species of scyllarid phyllosomas , due to the limited morphological information that are available only for the final stage larvae in most species. Identification at the genus level is also difficult, particularly between *Parribacus* and *Scyllarides*, by morphological characteristics. Genetic species identification of invertebrate is often possible on the basis of mitochondrial cytochrome oxidase subunit I (COI) and/or 16S rDNA genes, coupled with a GenBank homology search. However, COI and 16S rDNA references of scyllarid lobsters are still very incomplete. With this circumstance, we aimed at obtaining sequence references and morphological characteristics of the scyllarid lobsters. Some of the sorted scyllarid phyllosomas were identified to possible lowest levels and preserved in 100% alcohol for genetic analysis, while some other specimens were fixed and preserved in formaldehyde as references for morphological analysis.

Table 1. Number of phyllosoma larvae collected during Leg 7 of KH-09-5 cruise.

	KH-09-5, Leg7
Panulirus spp.	2
Justitia spp.	5
Synaxidae spp.	5
Scyllarinae spp.	12
Scyllarides or *Parribacus* spp.	3
Total	27

Distribution and tolerance to brackish and fresh water bodies as habitat in oceanic sea skater of *Halobates* (Heteroptera: Gerridae) inhabiting Celebes Sea and Tomini bay

Tetsuo Harada & Takero Sekimoto

INTRODUCTION

Many great voyages were launched to explore the oceans and what lies beyond, because they have always held a great fascination to us. A great variety of marine organisms were collected and describe during these voyages, but insects appear to have received little attention (Andersen & Chen, 2004). Although they are the most abundant animals on land, insects are relatively rare in marine environments (Cheng, 1985). However, a few thousand insect species belonging to more than 20 orders are considered to be marine (Cheng & Frank, 1993; Cheng, 2003). The majority of marine insects belong to the Coleoptera, Hemiptera, and Diptera, and they can be found in various marine habitats. However, the only insects to live in the open ocean are members of the genus *Halobates*, commonly known as sea-skaters. They belong to the family Gerridae (Heteroptera), which comprises the common pond-skaters or water-striders. Unlike most of its freshwater relatives, the genus *Halobates* is almost exclusively marine. Adults are small, measuring only about 0.5 cm in body length, but they have rather long legs and may have a leg span of 1.5 cm or more except for a new species, *Halobates megamoomario*. This new species which has very long boy length of 0.9 cm and large mid-leg span of 3.2 cm has been newly and recently collected in the tropical Pacific Ocean during the cruise, MR-06-05-Leg 3, and described (Harada *et al.,* submitted). They are totally wingless at all stages of their life cycle and are confined to the air-sea interface, being an integral member of the pleuston community (Cheng, 1985). One may wonder how much tiny insects have managed to live in the open sea, battling waves and storms. In life, sea-skaters appear silvery. On calm days ocean-going scientists have probably seen them as shiny spiders skating over the sea surface. It is not known whether ancient mariners ever saw them, and no mention of their presence has been found in the logs of Christopher Columbus'S (1451-1506) ships or other ships that sailed to and from the New World (Andersen & Cheng, 2004).

Forty-seven species of *Halobates* are now known (Andersen & Cheng, 2004; Harada *et al.*, submitted). Six are oceanic and are widely distributed in the Pacific, Atlantic and the Indian Oceans. The remaining species occur in near-shore areas of the tropical seas associated with mangrove or other marine plants. Many are endemic to islands or island groups (Cheng, 1989).

The only insects that inhabit the open sea area are six species of sea skaters: *Halobates micans, H. sericeus, H. germanus, H. splendens, H. sobrinus* (Cheng, 1985) and *H. megamoomario* newly described (Harada *et al.*, submitted). Three species, *Halobates sericeus*, *H. micans* and *H. germanus* inhabit tropical and temperate areas of the Pacific Ocean in the northern hemisphere, including The Kuroshio Current and the East China Sea (Andersen & Polhemus, 1976, Cheng, 1985). *Halobates sericeus, H. micans and H*

germanus are reported from latitudes of 13°N-40°N, 0°N-35°Nand 0°N-37°N, respectively, in the Pacific Ocean (Miyamoto & Senta,,1960; Andersen & Polhemus, 1976; Ikawa *et al.*, 2002). However, this information was collected on different cruises and in different times of the years. There have been several ecological studies based on samples collected in a specific area in a particular season during the six cruises of R/V HAKUHO-MARU: KH-02-01, KH-06-02, KH-07-04-Leg 1 (Harada *et al.*, 2008) TANSEI-MARU: KT-07-19, KT-08-23 and R/V MIRAI: MR-06-05-Leg 3 (Harada *et al.*, 2007), MR-08-02, MR-09-04 (Harada *et al.*, 2009)

During one cruise, KH-02-01, one sea skater species, *Halobates sericeus,* was collected at 18 locations in the East China Sea area (27°10' N- 33°24' N, 124°57' E - 129°30' E) (Harada, 2005), and *H. micans* and/or *H. germanus* at only 8 locations in the area south of 29° 47'N, where water temperatures were more than 25℃. At three locations, where the water temperature was less than 23℃, neither *H. micans* nor *H. germanus* were caught.

During another cruise, KH-06-02, in the latitude area of 12°N to 14°30' N, *Halobates micans* were caught at 6 of 7 locations, while *H.germanus* and *H. sericeus* were caught at only 3 and 1 location(s), respectively (Harada *et al,* 2006). However, at 15°00' N or northern area, *H. germanus* were caught at 14 of 19 locations, whereas *H. micans* and *H. cericeus* were caught at only 8 and 6 locations, respectively (Harada *et al*, 2006).

In the cruise, MR-06-05-Leg 3, larvae of both *H. micans* and *H. germanus* were very abundant at 6° N, whereas adults of *H. germanus* alone were completely dominant at 2° N on the longitudinal line of 130°E. On the longitudinal line of 138°E, larvae and adults of *H. micans* alone were dominant at points of 5 ° and 8°N, while adults of *H. germanus* were abundant between 0° and 2°N. At the two stations of St. 37 (6° N, 130° E) and St. 52 (5° N, 138° E), relatively great number of larvae of *H. sericeus* were collected. This species has been known to be distributed in the northern area of the Pacific Ocean. At St. 52 (6° N, 138° E), it was heavily raining around the ship while trailed.

In the cruise, KT-07-19 on the northern edge of Kuroshio Current, *H. sericeus* was mainly collected in the northern-eastern area of 135°-140°E, 34°-35°N whereas *H. germanus and H. micans* were mainly collected in the relatively southern-western area of 131°-133°E., 31°-33°N. Only *H. sericeus* can be transferred by the Kuroshio Current onto the relatively northern-eastern area and to do reproduce at least in the summer season. In the cruise of KT-08-23, Most of "domestic" specimen collected in the area northern to Kuroshio current and near to Kyushu and Shikoku islands in September were *H. germanus* (Harada *et al.*, unpublished).

All samplings of *Halobates* have been performed at different geographical positions in any cruise in the Pacific Ocean so far. However, there has been no information on the dynamics in species and individual compositions in relatively eastern area of 145-160°E, 0-10°N of tropical Pacific Ocean. This study aims, first, to perform samplings in this area of the Western Pacific Ocean and examine dynamics of the species composition and reproductive and growth activity and compare these data to the data in the past which were got in more western area of 130-137°E, 0-10°N in the cruise, MR-06-05- Leg 3.

During the cruise, MR-08-02, on the longitudinal line of 130°E, larvae of both *H. micans* and *H. germanus* were very abundant at 5-12° N, whereas adults of *H. sericeus* alone were dominant at 17° N. In the lower latitude area of 5-8 ° N, all the three described species, *H. micans, H. germanus* and *H. sericeus* and un-described species, *Halobates moomario* (Harada *et al.,* unbublished) were collected. At a fixed point located at 12°N, 135°E, *H. micans* was dominant through the sampling period of 20 days, whereas *H. sericeus* was collected mainly in the latter half of the period. Higher number of *Halobates* (593) was collected in the first half of the sampling period (8th – 17th June, 2008) when the weather was very fine than that (427) in the second half (18th – 27th June, 2008) when the typhoon No 6 was born and developed near the fixed sampling point.

During the cruise, MR-09-04, *H. germanus* was abundant through the sampling points in the area of 147°E-156°E with low latitude of 0-10°E of the tropical pacific ocean, except for the two points of 0°N, 156°E and 2°N, 156°E where *H. sericeus* was most abundant.

In this cruise of KH-09-05-Leg 7, the samplings are performed in relatively inner sea of tropical area, Celebes Sea and Domini Gulf located 3°'N-1°S, 120E-125E. This study aims, first, to examine how species composition of sea skaters are different between Celebes sea which is open to the Pacific Ocean from which Indonesian Through Current come in and Tomini Gulf which is completely surrounded by Sulawesi island and several ones and with little influence from the Pacific Ocean.

Insects which have chance to be exposed to sea water or brackish water are known to adopt one of two strategies to survive an stress as higher osmotic pressure, "osmoregulating" and "osmoconforming" (Bradley, 1987). In the former strategy, insect maintains the osmotic pressure in haemolymph relatively lower level against high salinity environment. For example, dipteran larvae including saline-water mosquitoss of the genus *Aedes* and chironomids (Neumann, 1976; Kokkin, 1986) constantly lose water in saline water. To prevent water loss, larvae drink the external medium and at the same time excrete a concentrated "urine" to keep lower osmotic pressure in the haemolymph. In the latter strategy, osmoconforming, insects of other genera of mosquitoes (Bradley, 1987, 1994) and euryhaline species of other order genera (for example a dragon fly nymph, *Enallagma clausam*: Stobbart & Shaw, 1974) equilibrate the osmotic pressure of the haemolymph with that of the saline environment.

A semi-aquatic bug, *Aquarius paludum,* a fresh water and semi-cosmopolitan species in Palearctic area response to the exposure to the brackish water: the limit for nymph growth was 0.9% of NaCl, and even in 0.45% of salinity can depress the reproductive activity (down up to 2/3 of fecundity) in the population inhabiting fresh water habitat (Kishi *et al.*, 2006, 2007, 2009). How do oceanic sea skaters adapt to the brackish and fresh water environment? In the open ocean, some heavy rain can make the sea water file leading to rapid decreasing of osmotic pressure. There have been no studies on this question so far.

In this study, a pilot experiment is performed on oceanic sea skaters, *Halobates* to know how their behavior is in some disorder, for example, some possibility of "a kind of paralysis due to lower osmotic

pressure" and how long they can live under double pressures, lower NaCl concentration and starvation.

MATERIALS AND METHODS

Samplings

Samplings were performed in 6th – 19th March, 2010 with a IKMT-NET (10 m long and with width of the opening: about 3 m.). The IKMT-NET was trailed for 1 min. on the sea surface at 44 stations located 3°'N-1°S, 120E-125E. in the Celebes Sea and the Domini Gulf on the back of R/V HAKUHOMARU (3991t) which is owned by JAMSTEC (Japan Agency for Marine-earth Science and TECHnology) during the science cruise, KH-09-05-Leg 7 organized by Ocean Research Institute, The University of Tokyo. The trailing on the water surface was performed for 1 min with the ship speed of 2.0-2.5 knot to the sea water. Surface area which was swept by IKMT-NET was evaluated as a expression of [(2.25knot × 1800m/h + 0.3m/sec × 3600) × 1/60 × 3]. The area which was swept by the IKMT-NET during the trailing of 1 min on the water surface can be estimated as the value of 256.5m^2 per one sweeping on average.

Rearing Experiment

1) Samplings for rearing experiment

At St 2 (0°44'S, 121° 00'E), St 3 (0°30'S, 121° 00'E), St 12 (0°15'S, 121° 30'E), St 13(0°15'S, 120° 00'E), a round shaped net with 30cm in diameter fixed to wooden stick (517cm long and 2.5-4cm in diameter) was swept from the right deck side under the bright light for CTD examination about 30 times each at St 2 (estimated surface area where it was swept: 30 x 0.3m x 1m long= 9m^2) and at St 3 (9m^2), 50 times at St 13 (15m^2) and 10 times at St 12 (3m^2). The round-shaped hand net was swept on the area of 36 m^2 in total at the four stations.

At St 2, 30 individuals of *Halobates sp 1* (proposed name *H. moomario*: Harada, submitted) (adult females: 15, adult males: 13, 3rd instar nymphs: 2), at St 3, 13 individuals of *H. sp. 1* (adult females: 9, adult males: 2, 5th instar nymphs: 1, 3rd instar: 1), at St 12, 196 individuals of *H. sp. 1* (adult females: 70, adult males: 126) and at St 13, 74 individuals of *H. sp. 1* (adult females: 29, adult males: 39, 5th instar nymphs: 3, 4th instar: 1, 3rd instar: 2) were collected in the Domini Gulf and all adult individuals collected were used for the salinity experiments (specimens collected at St 2 and St 3 for Experiment 1; ones at St 13 for Experiment 2; ones at St 12 for Experiment 3). Surface water temperature and air temperature were 32.0°C and 33.0°C at St 2, 32.3°C and 33.5°C at St 3, 30.3°C and 29.0°C at St 12 and 29.8 °C and 29.2°C at St 13, respectively.

2) Salinity experiment

All specimen (mostly adults) for Experiment 1-3 were moved on the sea water in the aquaria set in the CTD-preservation room on the deck of R/V Hakuhomaru (temperature and relative humidity are very stable within 28.5±1C and more than 90%, respectively) except for the upper

deck of R/V Hakuhomaru which was used for the first 30 hours of Experiment 1 as a pilot study under low individual density. White cube aquaria with 30cm X 30cm X 40cm) (Photo 1) were used for the experiments. Experimental specimens were moved to one of the 4 salinity conditions (A: sea water, B: sea water : fresh water (supplied in R/V Hakuhomaru)= 2 : 1, C: sea water : fresh water = 1 : 2, D=fresh water) at low (8-10 specimen / one aquarium: Experiment 1), medium (17 specimen / one aquarium: Experiment 2) and high (48-51 specimen / one aquarium: Experiment 3) density, 8-12hours (Experiment 1), 13 hours (Experiment 2) and 8 hours (Experiment 3) after the collection. After the transfer, whether the specimen were living was checked and the water film where sea skaters were skating was recorded by digital camera (the movie-mode of Fine Pix A-800, Fuji Film Corporation) 10-15sec every 2 hours continuously till all the adults were dead.

RESULTS

Samplings (Table 1)

At 8 stations of 21 ones in total in the Tomini Bay , *Halobates sp. 1* (proposed name, *H. moomario*) was collected. On the other hand, *H. germanus* and *H. micans* were collected at only one station (St. 29 For *H. germanus*, St 32 for *H. micans*) of 13 stations in the Celebes Sea. Water and air temperatures were similar and both 31±2°C at Stations in Tomini Bay and 28±2°C in the Celebes Sea.

Salinity experiment (Table 2)

1) Experiment 1 (at low individual density)

The movements of mid- and/or hind legs of all the specimen on the fresh water were paralyzed with unusual back position and quick fluctuating and all ones were dead within 2 hours after the occurrence of such so called "paralysis due to fresh-water shock" The paralysis and death after that occurred only on the fresh water 19-31hrs and 21-33 hrs, respectively. Heavy storm attacked the four aquaria 13-15h after the start of Experiment 1 and quick decrease of water and air temperatures down to 27°C. All the specimens in all four conditions are temporarily (2-3hours) paralyzed by the temperature decrease but all were recovered, because all four aquaria were quickly moved to the CTD preservation room where temperature was stable around 29°C. Period in survival on sea water bodies was 45 hrs on average and significantly shorter than those on 2/3 and 1/3 concentration of sea water (each 100hrs on average) (Table 3).

2) Experiment 2 (at medium individual density)

So called the paralysis due to fresh water shock occurred on all specimens on the fresh water bodies from 10-44 hrs and all specimen were dead within 2 hours after the occurrence of the paralysis (12-46hrs). Period in survival of the specimen on 2/3 concentration of sea water was 107 hrs on average and tended to be slightly longer than those on sea water or 1/3 concentration of sea water

(90 hrs and 85 hrs, respectively) (Table 3), although there was no significant difference (Mann-Whitney U-test: z=-0.357, p=0.719).

3) Experiment 3 (at high individual density)

So called the paralysis due to fresh water shock occurred on all specimens on the fresh water bodies from 6-38 hrs and all specimen were dead within 2 hours after the occurrence of the paralysis (8-40 hrs). Period in survival of the specimen on 2/3 concentration sea water and 1/3 concentration were 92 hrs and 91 hrs on average, respectively and were similar to that on 100% sea water (86hrs) (Table 3) (Fig. 1).

In total data from Experiments 1-3, females showed significantly longer hours of 27 hrs in survival on average than males only on the fresh (Table 3) (Fig 1). Individuals on 2/3 sea water tended to be in survival longer than those on 100% sea water in Experiments 1-3 (Wilcoxon test on average value: z= -1.604, p=0.109).

Additional analysis

The data on field samplings in this study and environmental data on the oceanography and also the biological productivity by phyto-plankton and zoo-plankton during the cruise can be compared to the sampling data and related oceanography data in the area of 0-8 ° N, 130-138 ° E, in the Pacific Ocean at the cruise, MR-06-05-Leg 3 in the western tropical Pacific Ocean, as well as those in the area of 8 ° N to 6 ° S in the Indian Ocean at the cruise, KH-07-04-Leg1 (Harada *et al.*, 2008), those in the area of 30-35 ° N along the Kuroshio Current at the cruise, KT-07-19, KT-08-23, KT-09-20 in the future.

Analysis on the relationship between the extent of reproductive maturation and hours in survival on the fresh water which means the tolerance to "fresh water shock" will be done in near future. The video camera data which was taken every 2 hrs during the salinity experiment will be analyzed after the cruise to examine the frequency and speed of skating on one of four salinity conditions in this study.

DISCUSSION

Distribution of oceanic Halobates and oceanic dynamics in Tomini-Bay and Celebes Sea

Extremely high density of individuals of *Halobates sp. 1* (proposed name: *Halobates moomario)* can be estimated to inhabit Tomini-Bay (Table 4). Because samplings by IKMT-NET lead to be under-estimated of the density due to the disturbance by the ship body during the sweeping in the back of the ship, at least several hundred-thousand or more individuals of *H. moo.* per 1km^2 seems to be on Tomini-Bay which is more than 10-100 or more times of individual density in the western Tropical Pacific Ocean (Table 4) and also more than 2 times of density of *H. micans* on that (208 thousands individual on the tropical Atlantic Ocean (Andersen & Chen, 2004). Probably extremely smooth water surface in Tomini-Bay can be related to the high abundance of this species and also extremely high reproductive ability

can be speculated to link to such complete and high density occupation without other oceanic *Halobates* species. From the evolutional point of view, Tomini-Bay and related inside seas in Eastern-Western Asian Area can be speculated to be the original area for a newly recruitment of the originally "costal" species into the oceanic life to mean the change to another oceanic species.

In the Celebes Sea, cosmopolitan oceanic sepecies, *H. micans and H. germanus* were collected by IKMT-NET with low density less than 1/10 or 1/100 times of that in the Tropical Pacific Ocean (Table 4). However, this seems to be under estimated in comparison with the real density due to the back trailing of the IKMT-NET. These two species of *H. micans* and *H. germanus* could be speculated to be transferred from the Pacific Ocean on the Indonesian Through Current to the Celebes Sea.

"Fresh water shock" and longest hours in survival under starvation on 2/3 concentration of sea water

Behavioral paralysis which occurred especially in the movements of mid and hind legs were induced by only fresh water condition in salinity experiment. This paralysis which can be called "fresh water shock" occurred from 6-30hrs and all specimen were dead within the 2 hours of this paralysis. Rapid transferring of fresh water from femur and tarsus segments of the leg in which part water surface is attached into the haemolymph of the body of sea skaters. Some kind of disorder of motor neuron in the legs can be speculated to occur due to the rapid decrease in osmotic pressure.

Hours in survival under starvation on 2/3 concentration of sea water were longer than those under the other three salinity conditions. Due to the CTD data during this cruise, sea water was taken from the bottom of the ship (5-6m depth) in the automatic sea water supplying system in this ship has salinity value of around 35. Two thirds conc. sea water and one third conc. sea water can be estimated to have salinity value of around 23 and 11.5, respectively. On to surface water in the ocean, heavy rain falls occasionally and it can be causes of lower salinity level. The result of this study implies that their appropriate salinity value of their habitat is not "100% sea water" but around 2/3 concentration of sea water. Highest fitness on 2/3 sea water might be an adaptation to occasional rain fall on to the water film as habitat of oceanic sea skaters.

Threshold level for triggering " the fresh water shock" and which strategy of "osmoregulating" and "osmoconforming" (Bradley, 1987) is chosen by the oceanic sea skaters are unknown and remained to be studied in the near future.

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Table 1. Number of *Halobates* collected at 11 stations among 44 stations where IKMT-NET was trailed in the Celebes Sea and Tomini Gulf of Indonesia in Mar 6, 2010 to Mar 19, 2010. (*H.m.: Halobates micans; H.g.: Halobates germanus*; *H.moo.*:undescribed *Halobates moomario (Halobates sp. 1: new species)*; EX: N of exuviae; Date: sampling date; DN: day or night when sampling was performed; Sampling was performed for 1min. EG: eggs on some substrates like as polystyrene form thousands of eggs laid on the substrate. Surface area which was swept by IKMT-NET was evaluated as a expression of [(2.25knot × 1800m/h + 0.3m/sec × 3600) × 1/60 × 3]. The area which was swept by the IKMT-NET during the trailing of 1 min on the water surface can be estimated as the value of 256.5m^2 per one sweeping on average.

Lati. Longi. Date	*H. moo.*							*H.m.*							*H.g.*							EX	St.	DN
	1st	2nd	3rd	4th	5th	F	M	1st	2nd	3rd	4th	5th	F	M	1st	2nd	3rd	4th	5th	F	M			
0°45'S 121°E Mar 6	0	0	0	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	St 2	N
1°S 120°45'E Mar8	0	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	St 6	N
1°S 121°15'E Mar7	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1#	St 7	N
0°45'S 121°15'E Mar8	0	0	0	0	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	St 8	N
0°30'S 120°30'E Mar11	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	St 11	N
0°15'S 120°15'E Mar12	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	St 15	N
0°15'S 120°00'E Mar10	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	St 13	N
0°00'S 122°30'E Mar12	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	St 20	N
3°00'N 121°45'E Mar15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	St 29	N
2°00'N 120°45'E Mar15	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	St 32	N
3°00'N 121°45'E Mar16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1#	St 33	N
Total (Full total: 31)	0	1	0	0	4	11	10	0	0	1	0	0	0	1	0	0	0	0	0	1	0	2		

#: ***H. moo.*** In the Tomini Bay, IKMT-NET was swept one time at night at 15 stations (St. 2, 3, 4, 7, 1, 6, 5, 14, 13, 12, 11, 15, 19, 20 and 21 in this order, and it was also swept one time in daytime at 5 stations (St 5, 10 16, 17, 18) in this order in the Tomini Bay. In the Celebes Sea, IKMT-NET was swept one time at night at 17 stations (St. 23, 24, 26, 27, 28, 29, 32, 33, 34, 37, 38, 41, 42, 43, 46, 47, 48) in this order, and it was also swept one time in daytime at 10 stations(St 22, 25, 30, 31, 35, 36, 39, 40, 44, 45) in this order in the Celebes sea.

Table 2-Sheet 1. Results of salinity experiment performed on larvae and adults of *un-described new species Halobates moomario* (H. moo.) proposed name) HS: hours in survival under starvation on one of four sea (brackish or fresh) waters with four salinity concentrations (A: sea water, B: sea water : fresh water= 2 : 1, C: sea water : fresh water = 1 : 2,
D=distilled water) ; "Date and Time of day" when experiments were performed. (KH-09-05-Leg 7: Mar 7-Mar 12, 2010) TD: Time of day; Increase in temp. at SCP shown in the parenthesis after SCP

St.No . conc..	Latitude(N)	Longitude(E)	Exp.No.	HS	Species	Stage (sex)	Date	TD	Salinity
St. 2,3	0°30-45'S	121°E	1	29	H. moo.	Adult (female)	Mar 7	12:00~	A
St. 2,3	0°30-45'S	121°E	1	43	H. moo.	Adult (female)	Mar 7	12:00~	A
St. 2,3	0°30-45'S	121°E	1	45	H. moo.	Adult (female)	Mar 7	12:00~	A
St. 2,3	0°30-45'S	121°E	1	45	H. moo.	Adult (female)	Mar 7	12:00~	A
St. 2,3	0°30-45'S	121°E	1	59	H. moo.	Adult (female)	Mar 7	12:00~	A
St. 2,3	0°30-45'S	121°E	1	47	H. moo.	Adult (female)	Mar 7	12:00~	A
St. 2,3	0°30-45'S	121°E	1	41	H. moo.	Adult (male)	Mar 7	12:00~	A
St. 2,3	0°30-45'S	121°E	1	45	H. moo.	Adult (male)	Mar 7	12:00~	A
St. 2,3	0°30-45'S	121°E	1	71	H. moo.	Adult (male)	Mar 7	12:00~	A
St. 2,3	0°30-45'S	121°E	1	43	H. moo.	5th instar	Mar 7	12:00~	A
St. 2,3	0°30-45'S	121°E	1	39	H. moo.	3rd instar	Mar 7	12:00~	A
St. 2,3	0°30-45'S	121°E	1	43	H. moo.	3rd instar	Mar 7	12:00~	A
St. 2,3	0°30-45'S	121°E	1	37	H. moo.	Adult (female)	Mar 7	12:00~	B
St. 2,3	0°30-45'S	121°E	1	59	H. moo.	Adult (female)	Mar 7	12:00~	B
St. 2,3	0°30-45'S	121°E	1	81	H. moo.	Adult (female)	Mar 7	12:00~	B
St. 2,3	0°30-45'S	121°E	1	109	H. moo.	Adult (female)	Mar 7	12:00~	B
St. 2,3	0°30-45'S	121°E	1	131	H. moo.	Adult (female)	Mar 7	12:00~	B
St. 2,3	0°30-45'S	121°E	1	133	H. moo.	Adult (female)	Mar 7	12:00~	B
St. 2,3	0°30-45'S	121°E	1	141	H. moo.	Adult (female)	Mar 7	12:00~	B
St. 2,3	0°30-45'S	121°E	1	81	H. moo.	Adult (male)	Mar 7	12:00~	B
St. 2,3	0°30-45'S	121°E	1	111	H. moo.	Adult (male)	Mar 7	12:00~	B
St. 2,3	0°30-45'S	121°E	1	135	H. moo.	Adult (male)	Mar 7	12:00~	B
St. 2,3	0°30-45'S	121°E	1	169	H. moo.	Adult (male)	Mar 7	12:00~	B
St. 2,3	0°30-45'S	121°E	1	29	H. moo.	3rd instar	Mar 7	12:00~	B
St. 2,3	0°30-45'S	121°E	1	53	H. moo.	Adult (female)	Mar 7	12:00~	C
St. 2,3	0°30-45'S	121°E	1	61	H. moo.	Adult (female)	Mar 7	12:00~	C
St. 2,3	0°30-45'S	121°E	1	107	H. moo.	Adult (female)	Mar 7	12:00~	C
St. 2,3	0°30-45'S	121°E	1	137	H. moo.	Adult (female)	Mar 7	12:00~	C

Table 2-Sheet 2. Results of salinity experiment performed on larvae and adults of *un-described new species Halobates moomario* (H. moo.) proposed name) HS: hours in survival under starvation on one of four sea (brackish or fresh) waters with four salinity concentrations (A: sea water, B: sea water : distilled water= 2 : 1, C: sea water : distilled water = 1 : 2, D=distilled water) ; "Date and Time of day" when experiments were performed. (KH-09-05-Leg 7: Mar 7-Mar 12, 2010) TD: Time of day; Increase in temp. at SCP shown in the parenthesis after SCP

St.No .	Latitude(N)	Longitude(E)	Exp.No.	HS	Species	Stage (sex)	Date	TD	Salinity conc..
St. 2,3	0°30-45'S	121°E	1	87	H. moo.	Adult (male)	Mar 7	12:00~	C
St. 2,3	0°30-45'S	121°E	1	99	H. moo.	Adult (male)	Mar 7	12:00~	C
St. 2,3	0°30-45'S	121°E	1	121	H. moo.	Adult (male)	Mar 7	12:00~	C
St. 2,3	0°30-45'S	121°E	1	137	H. moo.	Adult (male)	Mar 7	12:00~	C
St. 2,3	0°30-45'S	121°E	1	25	H. moo.	Adult (female)	Mar 7	12:00~	D
St. 2,3	0°30-45'S	121°E	1	25	H. moo.	Adult (female)	Mar 7	12:00~	D
St. 2,3	0°30-45'S	121°E	1	33	H. moo.	Adult (female)	Mar 7	12:00~	D
St. 2,3	0°30-45'S	121°E	1	31	H. moo.	Adult (female)	Mar 7	12:00~	D
St. 2,3	0°30-45'S	121°E	1	31	H. moo.	Adult (female)	Mar 7	12:00~	D
St. 2,3	0°30-45'S	121°E	1	21	H. moo.	Adult (female)	Mar 7	12:00~	D
St. 2,3	0°30-45'S	121°E	1	23	H. moo.	Adult (male)	Mar 7	12:00~	D
St. 2,3	0°30-45'S	121°E	1	23	H. moo.	Adult (male)	Mar 7	12:00~	D
St. 2,3	0°30-45'S	121°E	1	21	H. moo.	Adult (male)	Mar 7	12:00~	D

Table 2-Sheet 3. Results of salinity experiment performed on larvae and adults of *un-described new species Halobates moomario* (H. moo.) proposed name) HS: hours in survival under starvation on one of four sea (brackish or fresh) waters with four salinity concentrations (A: sea water, B: sea water : distilled water= 2 : 1, C: sea water : distilled water = 1 : 2, D=distilled water) ; "Date and Time of day" when experiments were performed. (KH-09-05-Leg 7: Mar 7-Mar 12, 2010) TD: Time of day; Increase in temp. at SCP shown in the parenthesis after SCP.

St.No .	Latitude(N)	Longitude(E)	Exp.No.	HS	Species	Stage (sex)	Date	TD	Salinity conc..
St. 13	0°15'S	120°00'E	2	40	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 13	0°15'S	120°00'E	2	68	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 13	0°15'S	120°00'E	2	70	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 13	0°15'S	120°00'E	2	98	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	2	120	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	2	128	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	2	148	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 13	0°15'S	120°00'E	2	24	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 13	0°15'S	120°00'E	2	28	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 13	0°15'S	120°00'E	2	68	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 13	0°15'S	120°00'E	2	84	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 13	0°15'S	120°00'E	2	86	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 13	0°15'S	120°00'E	2	104	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 13	0°15'S	120°00'E	2	104	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 13	0°15'S	120°00'E	2	158	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 13	0°15'S	120°00'E	2	174	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 13	0°15'S	120°00'E	2	80	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 13	0°15'S	120°00'E	2	90	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 13	0°15'S	120°00'E	2	104	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 13	0°15'S	120°00'E	2	124	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 13	0°15'S	120°00'E	2	54	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 13	0°15'S	120°00'E	2	62	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 13	0°15'S	120°00'E	2	78	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 13	0°15'S	120°00'E	2	80	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 13	0°15'S	120°00'E	2	106	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 13	0°15'S	120°00'E	2	140	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 13	0°15'S	120°00'E	2	150	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 13	0°15'S	120°00'E	2	156	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 13	0°15'S	120°00'E	2	168	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 13	0°15'S	120°00'E	2	32	H. moo.	Adult (female)	Mar 11	11:00~	C

Table 2-Sheet 4. Results of salinity experiment performed on larvae and adults of *un-described new species Halobates moomario* (H. moo.) proposed name) HS: hours in survival under starvation on one of four sea (brackish or fresh) waters with four salinity concentrations (A: sea water, B: sea water : distilled water= 2 : 1, C: sea water : distilled water = 1 : 2, D=distilled water) ; "Date and Time of day" when experiments were performed. (KH-09-05-Leg 7: Mar 7-Mar 12, 2010) TD: Time of day; Increase in temp. at SCP shown in the parenthesis after SCP.

St.No .	Latitude(N)	Longitude(E)	Exp.No.	HS	Species	Stage (sex)	Date	TD	Salinity conc..
St. 13	0°15'S	120°00'E	2	54	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 13	0°15'S	120°00'E	2	58	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 13	0°15'S	120°00'E	2	78	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 13	0°15'S	120°00'E	2	80	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 13	0°15'S	120°00'E	2	92	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 13	0°15'S	120°00'E	2	142	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 13	0°15'S	120°00'E	2	38	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 13	0°15'S	120°00'E	2	60	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 13	0°15'S	120°00'E	2	72	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 13	0°15'S	120°00'E	2	88	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 13	0°15'S	120°00'E	2	100	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 13	0°15'S	120°00'E	2	104	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 13	0°15'S	120°00'E	2	104	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 13	0°15'S	120°00'E	2	126	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 13	0°15'S	120°00'E	2	140	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 13	0°15'S	120°00'E	2	16	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 13	0°15'S	120°00'E	2	16	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 13	0°15'S	120°00'E	2	18	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 13	0°15'S	120°00'E	2	24	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 13	0°15'S	120°00'E	2	28	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 13	0°15'S	120°00'E	2	34	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 13	0°15'S	120°00'E	2	46	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 13	0°15'S	120°00'E	2	46	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 13	0°15'S	120°00'E	2	12	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 13	0°15'S	120°00'E	2	14	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 13	0°15'S	120°00'E	2	14	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 13	0°15'S	120°00'E	2	14	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 13	0°15'S	120°00'E	2	16	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 13	0°15'S	120°00'E	2	20	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 13	0°15'S	120°00'E	2	26	H. moo.	Adult (male)	Mar 11	11:00~	D

Table 2-Sheet 5. Results of salinity experiment performed on larvae and adults of *un-described new species Halobates moomario* (H. moo.) proposed name) HS: hours in survival under starvation on one of four sea (brackish or fresh) waters with four salinity concentrations (A: sea water, B: sea water : distilled water= 2 : 1, C: sea water : distilled water = 1 : 2, D=distilled water) ; "Date and Time of day" when experiments were performed. (KH-09-05-Leg 7: Mar 7-Mar 12, 2010) TD: Time of day; Increase in temp. at SCP shown in the parenthesis after SCP.

St.No .	Latitude(N)	Longitude(E)	Exp.No.	HS	Species	Stage (sex)	Date	TD	Salinity conc..
St. 13	0°15'S	120°00'E	2	34	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 13	0°15'S	120°00'E	2	42	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	42	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	48	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	54	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	56	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	60	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	68	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	74	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	74	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	78	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	90	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	96	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	96	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	104	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	108	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	112	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	114	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	114	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	118	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	148	H. moo.	Adult (female)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	38	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	56	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	60	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	62	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	64	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	64	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	70	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	70	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	72	H. moo.	Adult (male)	Mar 11	11:00~	A

Table 2-Sheet 6. Results of salinity experiment performed on larvae and adults of *un-described new species Halobates moomario* (H. moo.) proposed name) HS: hours in survival under starvation on one of four sea (brackish or fresh) waters with four salinity concentrations (A: sea water, B: sea water : distilled water= 2 : 1, C: sea water : distilled water = 1 : 2, D=distilled water) ; "Date and Time of day" when experiments were performed. (KH-09-05-Leg 7: Mar 7-Mar 12, 2010) TD: Time of day; Increase in temp. at SCP shown in the parenthesis after SCP.

St.No .	Latitude(N)	Longitude(E)	Exp.No.	HS	Species	Stage (sex)	Date	TD	Salinity conc..
St. 12	0°15'S	120°30'E	3	74	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	74	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	76	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	80	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	82	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	84	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	88	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	88	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	88	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	90	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	90	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	92	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	96	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	96	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	96	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	104	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	104	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	106	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	106	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	108	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	108	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	126	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	132	H. moo.	Adult (male)	Mar 11	11:00~	A
St. 12	0°15'S	120°30'E	3	40	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	54	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	56	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	62	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	68	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	74	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	80	H. moo.	Adult (female)	Mar 11	11:00~	B

Table 2-Sheet 7. Results of salinity experiment performed on larvae and adults of *un-described new species Halobates moomario* (H. moo.) proposed name) HS: hours in survival under starvation on one of four sea (brackish or fresh) waters with four salinity concentrations (A: sea water, B: sea water : distilled water= 2 : 1, C: sea water : distilled water = 1 : 2, D=distilled water) ; "Date and Time of day" when experiments were performed. (KH-09-05-Leg 7: Mar 7-Mar 12, 2010) TD: Time of day; Increase in temp. at SCP shown in the parenthesis after SCP.

St.No .	Latitude(N)	Longitude(E)	Exp.No.	HS	Species	Stage (sex)	Date	TD	Salinity conc..
St. 12	0°15'S	120°30'E	3	88	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	90	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	92	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	96	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	98	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	98	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	100	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	104	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	110	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	114	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	136	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	144	H. moo.	Adult (female)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	38	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	42	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	50	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	56	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	58	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	66	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	70	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	70	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	72	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	76	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	80	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	86	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	86	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	90	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	90	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	92	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	92	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	96	H. moo.	Adult (male)	Mar 11	11:00~	B

Table 2-Sheet 5. Results of salinity experiment performed on larvae and adults of *un-described new species Halobates moomario* (H. moo.) proposed name) HS: hours in survival under starvation on one of four sea (brackish or fresh) waters with four salinity concentrations (A: sea water, B: sea water : distilled water= 2 : 1, C: sea water : distilled water = 1 : 2, D=distilled water) ; "Date and Time of day" when experiments were performed. (KH-09-05-Leg 7: Mar 7-Mar 12, 2010) TD: Time of day; Increase in temp. at SCP shown in the parenthesis after SCP.

St.No .	Latitude(N)	Longitude(E)	Exp.No.	HS	Species	Stage (sex)	Date	TD	Salinity conc..
St. 12	0°15'S	120°30'E	3	96	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	98	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	98	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	100	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	104	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	104	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	106	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	114	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	114	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	120	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	120	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	136	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	142	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	150	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	184	H. moo.	Adult (male)	Mar 11	11:00~	B
St. 12	0°15'S	120°30'E	3	28	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	52	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	58	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	62	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	64	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	68	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	78	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	82	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	94	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	94	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	96	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	100	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	106	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	108	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	116	H. moo.	Adult (female)	Mar 11	11:00~	C

Table 2-Sheet 9. Results of salinity experiment performed on larvae and adults of *un-described new species Halobates moomario* (H. moo.) proposed name) HS: hours in survival under starvation on one of four sea (brackish or fresh) waters with four salinity concentrations (A: sea water, B: sea water : distilled water= 2 : 1, C: sea water : distilled water = 1 : 2, D=distilled water) ; "Date and Time of day" when experiments were performed. (KH-09-05-Leg 7: Mar 7-Mar 12, 2010) TD: Time of day; Increase in temp. at SCP shown in the parenthesis after SCP.

St.No .	Latitude(N)	Longitude(E)	Exp.No.	HS	Species	Stage (sex)	Date	TD	Salinity conc..
St. 12	0°15'S	120°30'E	3	124	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	126	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	178	H. moo.	Adult (female)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	12	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	26	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	44	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	54	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	62	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	64	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	70	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	70	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	72	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	76	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	78	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	80	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	80	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	88	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	90	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	92	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	94	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	96	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	96	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	98	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	98	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	98	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	98	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	100	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	104	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	106	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	108	H. moo.	Adult (male)	Mar 11	11:00~	C

Table 2-Sheet 10. Results of salinity experiment performed on larvae and adults of *un-described new species Halobates moomario* (H. moo.) proposed name) HS: hours in survival under starvation on one of four sea (brackish or fresh) waters with four salinity concentrations (A: sea water, B: sea water : distilled water= 2 : 1, C: sea water : distilled water = 1 : 2, D=distilled water) ; "Date and Time of day" when experiments were performed. (KH-09-05-Leg 7: Mar 7-Mar 12, 2010) TD: Time of day; Increase in temp. at SCP shown in the parenthesis after SCP.

St.No .	Latitude(N)	Longitude(E)	Exp.No.	HS	Species	Stage (sex)	Date	TD	Salinity conc..
St. 12	0°15'S	120°30'E	3	112	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	124	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	132	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	144	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	144	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	188	H. moo.	Adult (male)	Mar 11	11:00~	C
St. 12	0°15'S	120°30'E	3	8	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	8	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	16	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	22	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	22	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	24	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	26	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	26	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	28	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	30	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	32	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	34	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	34	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	40	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	40	H. moo.	Adult (female)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	10	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	10	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	12	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	12	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	12	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	16	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	16	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	16	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	16	H. moo.	Adult (male)	Mar 11	11:00~	D

Table 2-Sheet 11. Results of salinity experiment performed on larvae and adults of *un-described new species Halobates moomario* (H. moo.) proposed name) HS: hours in survival under starvation on one of four sea (brackish or fresh) waters with four salinity concentrations (A: sea water, B: sea water : distilled water= 2 : 1, C: sea water : distilled water = 1 : 2, D=distilled water) ; "Date and Time of day" when experiments were performed. (KH-09-05-Leg 7: Mar 7-Mar 12, 2010) TD: Time of day; Increase in temp. at SCP shown in the parenthesis after SCP.

St.No .	Latitude(N)	Longitude(E)	Exp.No.	HS	Species	Stage (sex)	Date	TD	Salinity conc..
St. 12	0°15'S	120°30'E	3	16	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	16	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	16	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	16	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	18	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	20	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	20	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	20	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	22	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	22	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	22	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	26	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	28	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	28	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	28	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	28	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	30	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	32	H. moo.	Adult (male)	Mar 11	11:00~	D
St. 12	0°15'S	120°30'E	3	34	H. moo.	Adult (male)	Mar 11	11:00~	D

Table 3: Effects of salinity condition on hours in survival under starvation in the oceanic sea skaters, Halobates sp. 1 (proposed name: *H. moomario,* Harada *et al.*, unpublished) collected in the Domini Gulf during the science cruise, KH-09-05-Leg 7. *H.moo.=Halobates moomario* (un-described new species: Harada *et al.*, submitted)

.	Hours in survival under										
	Sea water (SW)			2/3 conc. of SW			1 /3 conc. of SW			Fresh water	
	Mean	SD	n	Mean	SD	n	Mean	SD	n	Mean	SD
Experiment 1	45.8	10.4	12	101.3	44.0	12	100.3	31.9	8	25.9	4.6
(low density)	*Kruskal-Wallis test: χ^2-value=27.2, df=3, P<0.001*										
Experiment 2	90.3	43.6	15	107.1	37.4	13	85.5	33.2	16	24.7	11.7
(medium density)	*Kruskal-Wallis test: χ^2-value=33.1, df=3, P<0.001*										
Experiment 3	86.2	23.6	51	92.3	29.6	52	90.8	33.7	51	22.1	8.4
(high density)	*Kruskal-Wallis -test: χ^2-value=96.8, df=3, P<0.001*										
Females	81.1	33.3	32	93.1	29.1	30	87.2	34.4	29	27.0	9.6
Males	84.8	29.8	44	99.7	35.1	46	92.9	32.6	46	20.5	7.5
Total	81.6	31.6	79	96.2	33.5	77	90.7	33.2	75	23.3	9.0
(high density)	*Kruskal-Wallis -test: χ^2-value=153.3, df=3, P<0.001*										
	Mann-Whitney U-test on the difference in hours in survival between females and males										
	Sea water (SW)			2/3 conc.of SW			1 /3 conc. of SW			Fresh water	
	Z	*P*		*Z*	*P*		*Z*	*P*		*Z*	*P*
	-0.51	*0.613*		*-0.57*	*0.566*		*-0.96*	*0.335*		*-3.03*	*0.002*

Table 4. Comparison of individual density of oceanic sea skaters Halobates among several tropical area in the Pacific Ocean, the Indian Ocean, Tomini-bay and Celebes Sea based on the sampling data during the five cruises organized in MR-06-05-Leg 3 (**A**. sampling period: Dec 15, 2006 to Jan 8, 2007:ORI-NET), KH-07-04-Leg 1 (**B**.sampling period: Dec 24-30, 2007:Neuston-NET 1 & ORI-NET), MR-08-02 (**C.** sampling period: Jun 1-7, 2008; **D**. sampling period: Jun 8-27, 2008: ORI-NET), MR-09-04 (**E.** sampling period: Nov 12 to Dec 4, 2009: Neuston-NET 2) and KH-09-05-Leg 7 (**F**. period of night sampling: Mar 6-13, 2010 in Tomini Bay: IKMT-NET; **G.** period of night sampling: Mar 13-19, 2010 in Celebes Sea: IKMT-NET; **H**. period of night sampling: Mar 6-11, 2010 in Tomini Bay: a round-shaped hand NET) *H.m.= Halobates micans, H.g.= Halobates germanus, H.s.= Halobates sericeus, H.moo.=Halobates moomario* (un-described new species: Harada *et al.*, submitted),

	Total		*H. m.*	*H. g.*	*H. s.*	*H. moo.*	
AS#	Nymphs	Adults					
A. (MR-06-05-Leg3: 0°N-8°N, 130°N-138°E, ORI-NET, side of the ship, Western Tropical Pacific Ocean)							
Number of individual	**2292**	**1510**	**1678**	**1738**	**208**	**178**	
0.0293303							
Individual density (N per 1km^2)	**78144.4**	**51482.6**	**57210.5**	**59256.1**	**7091.6**	**6068.8**	**-**
B. (KH-07-04-Leg 1: 8°N-6°35'S, 86°E- 76°36'E, NEUSTON-NET 1 or ORI-NET, side of the ship, Eastern Tropical Indian Ocean)							
Number of individual	**1291**	**706**	**1886**	**111**	**0**	**0**	
0.044292							
Individual density (N per 1km^2)	**29147.5**	**15939.7**	**42581.1**	**2506.1**	**0**	**0**	
-							
C. (MR-08-02: 5°N-17°30'N, 130°E-134°E, ORI-NET, side of the ship, Western Tropical Pacific Ocean)							
Number of individual	**1223**	**266**	**>443**	**>388**	**>63**	**>88**	
0.0293303							
Individual density (N per 1km^2)	**41697.5**	**9069.1**	**>15103.8**	**>13228**	**>2147.9**	**>3000.3**	**-**
D. (MR-08-02: 12°N, 135°E,							
E. ORI-NET, side of the ship, a fixed station in Western Tropical Pacific Ocean)							
Number of individual	**800**	**222**	**825**	**4**	**193**	**2**	
0.0838009							
Individual density (N per 1km^2)	**9546.4**	**2649.1**	**9844.8**	**47.7**	**2303.1**	**23.9**	**-**
E. (MR-09-04: 0°N-10°N, 147°N-156°30'E, NEUSTON-NET 2, side of the ship)							
Number of individual	**443**	**464**	**150**	**561**	**169**	**27**	
0.0335203							
Individual density (N per 1km^2)	**13215.9**	**13842.4**	**4474.9**	**16736.1**	**5041.7**	**805.5**	**-**

F. (KH-09-05-Leg 7: 1°S – 0°S, 120°15'E – 123°E, IKMT-NET, back of the ship, Tomini Bay)

Number of individual	**5**	**21**	**0**	**0**	**0**	**26**	
0.003847							
Individual density (N per 1km^2)	**1299.7**	**5458.8**	**0**	**0**	**0**	**6758.5**	**-**

G. (KH-09-05-Leg 7: 2°N-3°N, 120°E-124°E, IKMT-NET, back of the ship, Celebes Sea)

Number of individual	**1**	**2**	**2**	**1**	**0**	**0**	
0.0043605							
Individual density (N per 1km^2)	**229.3**	**458.7**	**458.7**	**229.3**	**0**	**0**	**-**

H. (KH-09-05-Leg 7: 00°15'S – 00°45'S, 120°30'E – 120°00'E, A handy round-shaped NET, side of the ship, Tomini Bay)

Number of individual	**10**	**203**	**0**	**0**	**0**	**213**	
0.000036							
Individual density (N per 1km^2)	**277.8×10^3**	**5.639×10^6**	**0**	**0**	**0**	**5.917×10^6**	**-**

#AS: area where net was swept (km^2)

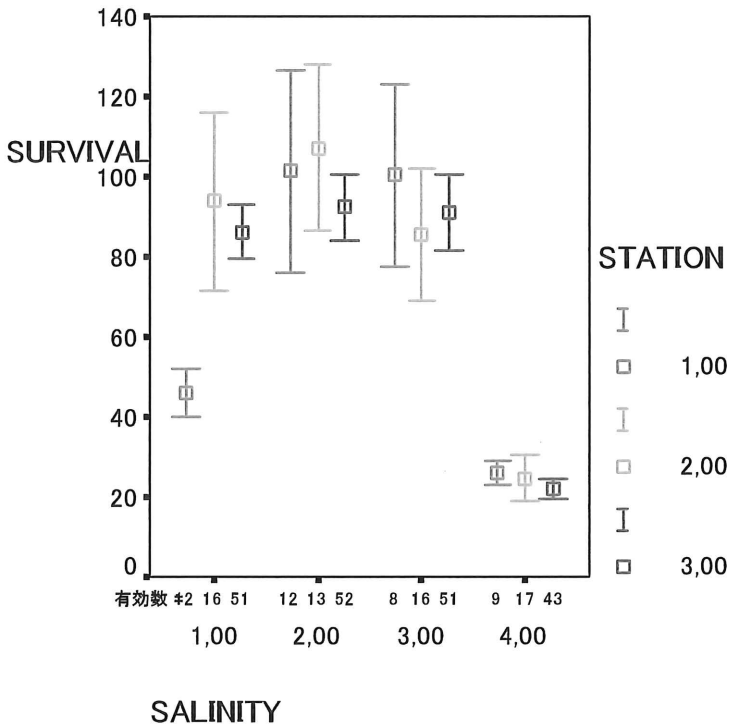

Fig.1. Effect of salinity on hours in survival under starvation and under one of three individual densities (1: low density, 9-12 indivi./ 0.009m^2; 2: medium density, 13-16 indivi./ 0.009m^2; 3: high density, 48-52 indivi. / 0.009m^2). Salinity conditions were sea water (1), two thirds ratio of sea water (2), one third ratio of sea water (3) and fresh water (4).

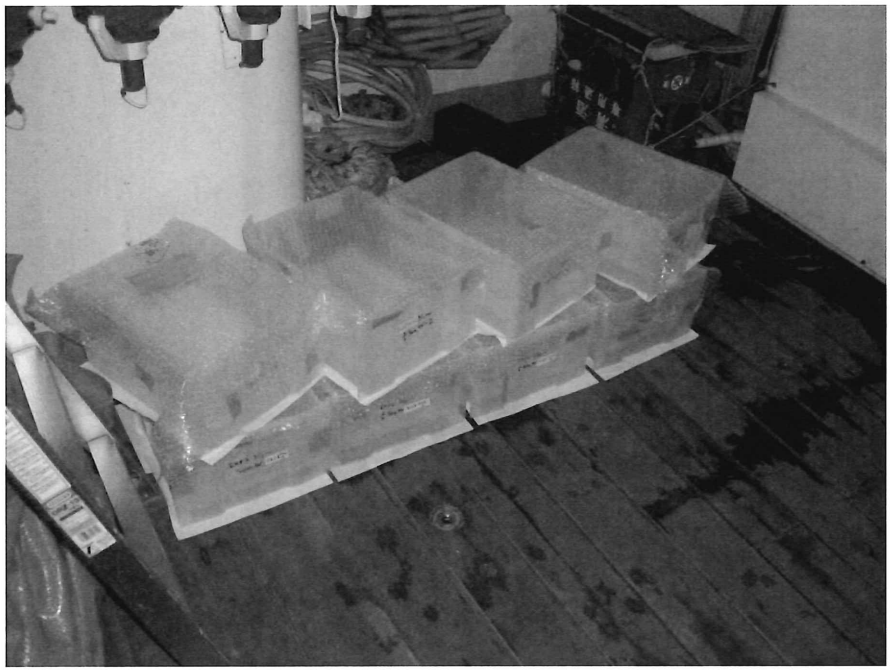

Photo 1: Scene of salinity experiment in preservation room for CTD of the R/V Hakuhomaru during the cruise, KH-09-05-Leg 7. In each aquarium, adults of Halobates sp 1 (proposed name *Halobates moomario*) at one of four kinds of salinity conditions.

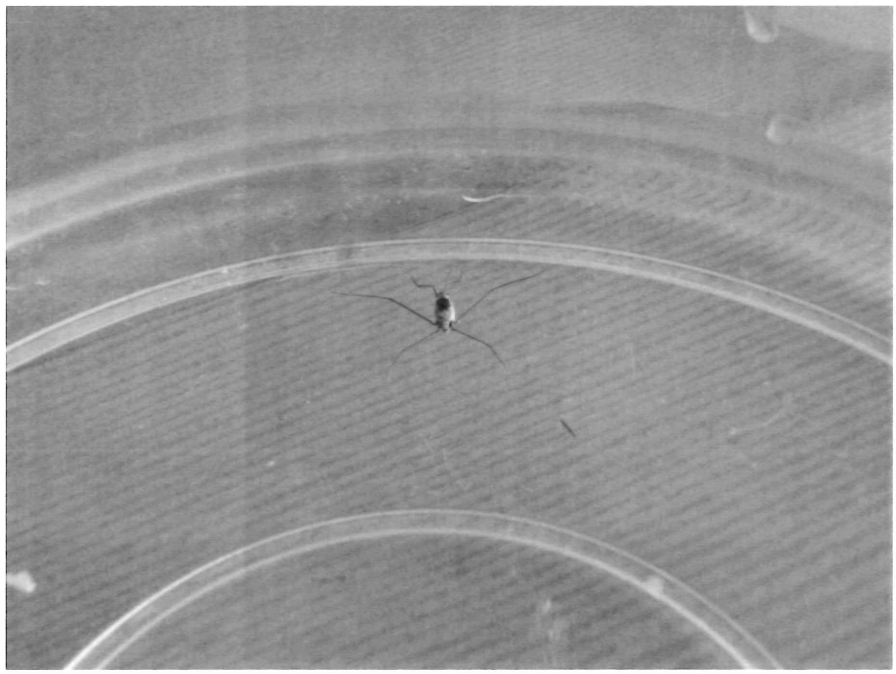

Photo 2: A female adult of *Halobates sp 2* (proposed name, *Halobates megamoomario:* Harada et al., submitted) collected by handy net (30 cm in diameter) with 5m stick From the back of R/V HAKUHOMARU in Benoa harbor (photo taken by Dr. Michael J Miller, 5th March 2010)

KH09-5 Leg 7 Net Record

St.	Location		Date	Time		Net	Mesh	Towing	Wire	Sampl.	Reel.	Ship	Sea
	Net in	Net out		Net in	Net out	Type	size (mm)	Method	out (m)	layer (m)	speed (m/s)	speed (kt)	Depth (m)
1	S 00-59.8 E 121-00.8	S 01-02.3 E 121-02.3	100308	21:17	22:42	IKMT	0.5	Step	511	0-149	0.2	1.4-2.6	1738-1811
2	S 00-45.2 E 120-59.8	S 00-44.8 E 121-02.6	100307	0:27	1:59	IKMT	0.5	Step	349	0-148	0.3-1.0	1.8-2.7	617-768
3	S 00-29.7 E 120-59.7	S 00-29.2 E 121-01.7	100307	4:25	5:39	IKMT	0.5	Step	426	0-149	0.2-0.4	1.5-2.2	1889-1900
4	S 00-29.7 E 120-44.9	S 00-29.6 E 120-47.0	100307	8:21	9:40	IKMT	0.5	Step	388	0-152	0.3-1.0	2.0-2.5	1976-1994
5	S 00-44.8 E 120-44.4	S 00-42.4 E 120-42.4	100309	5:29	6:51	IKMT	0.5	Step	453	0-146	0.3-1.0	2.1-2.5	1423-1609
6	S 01-00.1 E 120-44.9	S 01-02.6 E 120-45.2	100309	0:25	1:47	IKMT	0.5	Step	436	0-151	0.3	1.6-2.3	1155-1392
7	S 00-59.7 E 121-15.0	S 00-57.9 E 121-17.2	100307	21:24	22:51	IKMT	0.5	Step	486	0-147	0.5	1.3-2.8	1503-1674
8	S 00-44.8 E 121-13.9	S 00-44.6 E 121-15.8	100308	1:28	2:44	IKMT	0.5	Step	339	0-147	0.3-0.5	1.9-2.4	1760-1782
9	S 00-29.1 E 121-14.3	S 00-28.9 E 121-11.0	100308	5:46	7:14	IKMT	0.5	Step	665	0-149	0.3-1.0	2.0-2.5	1834-1889
10	S 00-43.7 E 120-31.0	S 00-42.1 E 120-32.9	100309	9:19	10:36	IKMT	0.5	Step	456	0-151	0.3-1.0	2.2-2.5	1647-1738
11	S 00-31.2 E 120-29.3	S 00-30.3 E 120-26.0	100311	18:44	20:13	IKMT	0.5	Step	585	0-149	0.3-1.0	1.5-2.5	1870-1880
12	S 00-15.0 E 120-29.6	S 00-15.1 E 120-26.5	100311	3:08	4:35	IKMT	0.5	Step	586	0-150	0.3-1.0	2.3-2.5	1830-1849
13	S 00-14.6 E 121-00.0	S 00-14.2 E 121-01.8	100310	10:22	11:36	IKMT	0.5	Step	393	0-149	0.3-0.5	2.0-2.5	2018-2019
14	S 00-14.9 E 121-29.7	S 00-16.6 E 121-26.8	100310	0:16	1:49	IKMT	0.5	Step	636	0-153	0.3	1.9-2.3	1659-1846
15	S 00-14.8 E 121-14.3	S 00-14.0 E 121-17.3	100311	22:38	0:06	IKMT	0.5	Step	580	0-150	0.3-1.0	2.0-2.5	1702-1777
16	S 00-00.0 E 120-29.7	N 00-00.1 E 120-27.1	100312	2:29	3:58	IKMT	0.5	Step	463	0-158	0.3-1.0	2.0-2.5	1193-1392
17	S 00-00.1 E 121-00.1	S 00-03.1 E 121-01.1	100312	7:22	8:46	IKMT	0.5	Obl.	1636	0-558	0.5-1.0	2.0-2.3	1956-2003
18	S 00-00.0 E 121-30.4	S 00-00.3 E 121-33.1	100312	11:41	12:58	IKMT	0.5	Obl.	1479	0-510	0.5-1.0	2.0-2.5	1761-1854
19	S 00-00.1 E 122-00.2	S 00-00.2 E 122-03.5	100312	15:53	17:17	IKMT	0.5	Obl.	1605	0-502	0.5-1.0	1.5-2.2	1723-1735
20	S 00-00.2 E 122-30.5	S 00-01.0 E 122-34.1	100312	20:03	21:33	IKMT	0.5	Step	645	0-158	0.3-1.0	1.6-2.5	2636-2753

KH09-5 Leg 7 Net Record

St.	Location		Date	Time		Net	Mesh	Towing	Wire	Sampl.	Reel.	Ship	Sea
	Net in	Net out		Net in	Net out	Type	size (mm)	Method	out (m)	layer (m)	speed (m/s)	speed (kt)	Depth (m)
21	S 00-00.2 E 123-00.2	S 00-01.0 E 123-02.9	100313	0:26	1:56	IKMT	0.5	Step	612	0-158	0.3-1.0	2.0-2.5	3380-3451
22	N 02-00.1 E 124-58.8	N 02-01.4 E 125-00.0	100313	17:14		IKMT	0.5	Obl.	1254	0-524	0.3-1.0	1.8-2.3	1469-1561
23	N 02-30.1 E 125-00.2	N 02-31.7 E 125-01.6	100313	20:31	21:51	IKMT	0.5	Step	382	0-145	0.3-1.0	1.3-2.5	3176-3320
24	N 02-59.7 E 124-59.8	N 03-01.9 E 125-01.5	100314	0:53	2:21	IKMT	0.5	Step	562	0-153	0.3-1.0	2.0-2.5	4121-4141
25	N 03-01.6 E 123-28.8	N 03-02.5 E 123-29.3	100314	9:54	10:47	IKMT	0.5	Obl.	795	0-534	0.5-1.0	1.5-2.5	4904-4914
26	N 03-00.3 E 121-59.2	N 03-00.4 E 121-00.4	100314	17:02	17:56	IKMT	0.5	Obl.	1127	0-530	0.5-1.0	1.5-2.5	5089-5093
27	N 02-59.9 E 121-45.2	N 02-59.7 E 121-46.1	100314	19:17	20:41	IKMT	0.5	Step	437	0-168	0.3-1.0	1.2-2.8	5044-5046
28	N 02-59.8 E 121-15.0	N 02-59.4 E 121-15.9	100314	22:49	0:11	IKMT	0.5	Step	421	0-167	0.3-1.0	2.3-2.7	5058-5065
29	N 02-59.7 E 120-45.0	N 02-57.5 E 120-45.9	100315	2:21	3:57	IKMT	0.5	Step	568	0-154	0.5-1.0	2.0-2.5	4956-4987
30	N 02-59.8 E 119-58.7	N 02-59.9 E 119-59.3	100315	8:11	10:16	IKMT	0.5	Obl.	1128	0-624	0.5-1.0	1.8-2.5	4425-4439
31	N 02-00.0 E 119-59.1	N 02-01.3 E 120-00.7	100315	14:12	15:13	IKMT	0.5	Obl.	1063	0-498	0.5-1.0	2.3-3.0	4902-5048
32-M	N 01-59.9 E 120-44.9	N 02-00.1 E 120-46.0	100315	18:46	19:16	IKMT	0.5	Hori.	159	0-34.2	0.3-1.0	1.4-2.5	3971-4072
32	N 01-59.9 E 120-46.3	N 02-00.6 E 120-49.6	100315	19:35	20:59	IKMT	0.5	Step	396	0-164	0.3-1.0	1.6-2.8	3794-4185
33	N 02-00.1 E 121-15.2	N 02-00.8 E 121-19.0	100315	22:58	0:15	IKMT	0.5	Step	354	0-155	0.3-1.0	1.5-2.6	3680-3807
34	N 02-00.1 E 121-45.2	N 02-00.7 E 121-48.5	100316	2:16	3:38	IKMT	0.5	Step	351	0-155	0.5-1.0	2.3-2.6	3992-4096
35	N 02-00.5 E 123-00.9	N 02-02.5 E 123-05.1	100316	9:54	11:44	IKMT	0.5	Obl.	2078	0-546	0.5-1.0	1.2-2.5	5420-5424
36-M1	N 02-59.9 E 123-44.9	N 03-00.7 E 123-46.5	100316	16:42	17:45	IKMT	0.5	Obl.	264	0-96.3	1.0	1.4-2.6	4847-4861
36-M2	N 03-00.6 E 123-46.7	N 03-01.3 E 123-48.1	100316	17:53		IKMT	0.5	Obl.	200	0-36.4	1.0	1.5-2.6	4829-4846
36	N 03-01.4 E 123-48.3	N 03-02.9 E 123-49.6	100316	18:46	20:16	IKMT	0.5	Step	441	0-167	0.3-1.0	1.6-2.7	4801-4827
37	N 03-00.3 E 123-15.0	N 03-02.1 E 123-16.7	100316	22:47	0:14	IKMT	0.5	Step	441	0-169	0.3-1.0	1.8-2.6	4972-4984

KH09-5 Leg 7 Net Record

St.	Date	Time Net in	Net Type	Mesh size (mm)	Towing Method	Wire out (m)	Sampl. layer (m)	Reel. speed (m/s)	Flow-meter Revol.	Flow-meter No.
17	100312	6:50	NORPAC	0.03	VER.	200+0	0-200	1.0	2028	1234
				0.1					1982	1526
20	100312	19:30	NORPAC	0.03	VER.	200+0	0-200	1.0	2003	1234
				0.1					1873	1526
22	100313	16:42	NORPAC	0.03	VER.	200+140	0-200	1.0	6637	1234
				0.1					5078	1526
25	100314	9:27	NORPAC	0.03	VER.	200+8	0-200	1.0	3242	1234
				0.1					3248	1526
30	100315	7:48	NORPAC	0.03	VER.	200+8	0-200	1.0	2562	1234
				0.1					2488	1526
35	100316	9:30	NORPAC	0.03	VER.	200+0	0-200	1.0	2640	1234
				0.1					2415	1526
39	100317	8:40	NORPAC	0.03	VER.		0-200	1.0	2660	1234
				0.1					2640	1526

KH09-5 Leg 7 Net Record

St.	Location		Date	Time		Net Type	Mesh size (mm)	Towing Method	Wire out (m)	Sampl. layer (m)	Reel. speed (m/s)	Ship speed (kt)	Sea Depth (m)
	Net in	Net out		Net in	Net out								
38	N 03-00.2 E 122-44.9	N 03-02.5 E 122-45.3	100317	2:30	3:59	IKMT	0.5	Step	331	0-161	0.3-1.0	1.5-3.0	5043-5063
39	N 02-31.0 E 121-59.5	N 02-31.8 E 122-00.8	100317	9:26	10:25	IKMT	0.5	Obl.	990	0-505	0.5-1.0	2.0-2.7	5393-5397
40	N 02-29.9 E 121-00.2	N 02-30.5 E 121-01.7	100317	14:31	15:35	IKMT	0.5	Obl.	1196	0-498	0.5-1.0	2.0-3.0	5391-5393
41	N 02-30.0 E 120-00.1	N 02-30.1 E 120-01.0	100317	19:30	20:47	IKMT	0.5	Step	304	0-158	0.3-1.0	1.9-3.3	4981-4994
42	N 02-00.0 E 120-00.1	N 01-59.8 E 120-02.2	100317	23:00	0:24	IKMT	0.5	Step	491	0-168	0.3-1.0	1.7-2.7	4687-4813
43	N 02-00.0 E 120-29.8	N 02-00.9 E 120-33.4	100318	2:32	4:06	IKMT	0.5	Step	452	0-159	0.3-1.0	1.6-2.5	4075-4432
44	N 02-00.0 E 121-29.9	N 02-00.7 E 121-33.3	100318	7:55	9:15	IKMT	0.5	Obl.	1448	0-515	0.5-1.0	1.6-2.5	4084-4300
45	N 02-00.1 E 122-29.8	N 01-59.3 E 122-32.5	100318	13:05	14:24	IKMT	0.5	Obl.	1453	0-505	0.5-1.0	1.7-3.0	4966-4999
46	N 02-00.1 E 123-29.9	N 02-02.2 E 123-32.8	100318	18:18	19:43	IKMT	0.5	Step	377	0-151	0.5-1.0	1.4-2.5	5388-5402
47	N 02-00.7 E 123-59.8	N 02-02.2 E 124-02.5	100318	21:47	23:08	IKMT	0.5	Step	295	0-150	0.3-1.0	1.3-2.7	5018-5053
48	N 02-00.2 E 124-29.8	N 02-03.1 E 124-31.2	100319	1:17	2:37	IKMT	0.5	Step	456	0-154	0.3-1.0	1.5-2.5	4388-4442

KH-09-5_Leg7	St.1	Depth	1808m
Date:	2010.3.8	Lat.	0 59.68S
Time:	11:54	Long.	121 00.45E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
5	30.674	34.050	4.43	0.04
10	30.493	34.121	4.45	0.04
20	30.076	34.150	4.48	0.05
30	29.289	34.206	4.44	0.07
40	28.541	34.226	4.34	0.11
50	27.896	34.251	4.04	0.28
75	26.664	34.300	3.38	0.17
100	24.720	34.354	2.69	0.09
125	20.979	34.512	2.57	0.04
150	18.706	34.560	2.49	0.02
175	16.566	34.580	2.48	0.02
200	15.367	34.586	2.42	0.02
250	11.985	34.588	2.28	0.02
300	10.830	34.594	2.23	0.02
400	8.850	34.590	2.15	0.02
500	7.831	34.580	2.12	0.03
600	6.797	34.571	2.13	0.03
700	6.192	34.573	2.12	0.03
800	5.635	34.575	2.12	0.02
900	5.066	34.580	2.14	0.03
1000	4.656	34.585	2.15	0.03
1250	3.829	34.598	2.20	0.03
1500	3.211	34.610	2.25	0.03

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
Sur.	0	***	31.0	***	***	***
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KH-09-5_Leg7	St.2	Depth	646m
Date:	2010.3.6	Lat.	0 45.23S
Time:	15:43	Long.	120 59.80E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
10	30.508	34.067	4.42	0.04
20	30.369	34.128	4.45	0.05
30	29.552	34.196	4.43	0.05
40	28.909	34.213	4.41	0.07
50	28.618	34.225	4.38	0.12
75	27.788	34.259	3.97	0.24
100	25.677	34.314	2.86	0.13
125	22.266	34.459	2.51	0.05
150	19.640	34.538	2.49	0.02
175	17.039	34.576	2.48	0.02
200	15.073	34.584	2.43	0.02
250	12.714	34.584	2.33	0.02
300	10.746	34.594	2.22	0.03
400	9.053	34.590	2.18	0.03
500	7.841	34.578	2.14	0.02
600	6.839	34.571	2.13	0.03

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
Sur.	0	***	30.4	***	***	***
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KH-09-5_Leg7	St.3	Depth	1888m
Date:	2010.3.6	Lat.	0 29.91S
Time:	19:28	Long.	120 59.79E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml・l⁻¹	FLC μg/l
5	30.543	34.088	4.35	0.04
10	30.523	34.087	4.38	0.04
20	30.353	34.111	4.44	0.04
30	29.717	34.189	4.44	0.05
40	29.141	34.209	4.40	0.05
50	28.821	34.219	4.42	0.07
75	26.621	34.296	3.32	0.19
100	24.521	34.364	2.64	0.10
125	21.733	34.492	2.78	0.04
150	19.246	34.561	2.59	0.02
175	16.722	34.577	2.46	0.02
200	15.593	34.582	2.44	0.02
250	12.327	34.589	2.30	0.03
300	10.921	34.591	2.25	0.03
400	9.179	34.591	2.17	0.03
500	7.925	34.580	2.17	0.03
600	6.931	34.570	2.14	0.03
700	6.244	34.572	2.12	0.03
800	5.585	34.575	2.13	0.02
900	5.103	34.579	2.13	0.02
1000	4.618	34.585	2.16	0.03

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml・l⁻¹	FLC μg/l
Sur.	0	***	30.5	***	***	***
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KH-09-5_Leg7	St.4	Depth	1974m
Date:	2010.3.6	Lat.	0 29.95S
Time:	23:15	Long.	120 44.89E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml・l⁻¹	FLC μg/l
5	30.675	34.064	4.33	0.04
10	30.642	34.092	4.35	0.04
20	30.331	34.109	4.41	0.05
30	29.520	34.175	4.46	0.05
40	29.165	34.212	4.41	0.07
50	28.639	34.215	4.31	0.10
75	27.327	34.273	3.62	0.27
100	24.205	34.385	2.71	0.08
125	21.096	34.508	2.57	0.04
150	19.074	34.572	2.66	0.02
175	16.734	34.578	2.49	0.02
200	14.992	34.582	2.42	0.02
250	12.221	34.587	2.31	0.03
300	10.813	34.594	2.24	0.03
400	9.217	34.592	2.15	0.03
500	8.004	34.581	2.13	0.03
600	6.778	34.571	2.13	0.02
700	6.155	34.571	2.14	0.02
800	5.616	34.575	2.13	0.02
900	5.046	34.581	2.15	0.02
1000	4.627	34.585	2.15	0.02

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml・l⁻¹	FLC μg/l
Sur.	0	***	30.8	***	***	***
1	199	200	15.383	34.582	2.42	0.02
2	199	201	15.378	34.583	2.42	0.02
3	199	201	15.376	34.583	2.42	0.02
4	199	201	15.375	34.584	2.42	0.02
5	99	99	25.446	34.285	2.82	0.10
6	99	99	25.540	34.332	2.88	0.12
7	99	100	25.547	34.334	2.89	0.11
8	99	100	25.551	34.335	2.90	0.11
9	99	100	25.548	34.337	2.89	0.11
10	69	70	27.326	34.267	3.61	0.26
11	69	70	27.328	34.269	3.61	0.26
12	69	70	27.329	34.269	3.61	0.26
13	69	70	27.326	34.270	3.60	0.26
14	69	70	27.328	34.270	3.61	0.26
15	49	50	28.471	34.217	4.29	0.11
16	50	50	28.483	34.223	4.30	0.11
17	50	50	28.483	34.224	4.30	0.11
18	50	50	28.481	34.225	4.30	0.11
19	50	50	28.479	34.226	4.31	0.11
20	5	5	30.531	34.095	4.36	0.06
21	5	5	30.554	34.095	4.36	0.05
22	5	5	30.579	34.092	4.36	0.04
23	5	5	30.606	34.091	4.35	0.04
24	5	5	30.602	34.093	4.36	0.04

KH-09-5_Leg7	St.5	Depth	1400m
Date:	2010.3.8	Lat.	0 44.99S
Time:	20:25	Long.	120 44.84E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
5	30.708	33.917	4.34	0.04
10	30.672	34.051	4.38	0.03
20	30.467	34.126	4.43	0.04
30	29.474	34.204	4.43	0.05
40	29.021	34.215	4.41	0.08
50	28.370	34.228	4.25	0.09
75	26.672	34.302	3.35	0.18
100	24.726	34.342	2.62	0.10
125	21.858	34.476	2.52	0.05
150	19.868	34.564	2.64	0.03
175	17.428	34.573	2.50	0.02
200	15.387	34.586	2.44	0.02
250	11.800	34.592	2.28	0.03
300	10.746	34.594	2.22	0.03
400	9.035	34.592	2.15	0.03
500	8.120	34.583	2.12	0.03
600	7.069	34.573	2.12	0.02
700	6.328	34.572	2.12	0.02
800	5.627	34.575	2.13	0.02
900	5.037	34.581	2.15	0.02
1000	4.715	34.584	2.14	0.03

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
Sur.	0	***	30.5	***	***	***
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KH-09-5_Leg7	St.6	Depth	1178m
Date:	2010.3.8	Lat.	1 02.79S
Time:	18:03	Long.	120 45.25E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
5	30.560	33.928	4.38	0.07
10	30.591	33.968	4.37	0.07
20	30.221	34.127	4.43	0.06
30	29.912	34.125	4.39	0.12
40	29.006	34.191	4.28	0.23
50	28.377	34.225	4.28	0.17
75	26.862	34.283	3.36	0.15
100	25.494	34.311	2.78	0.11
125	22.170	34.471	2.63	0.05
150	18.898	34.550	2.50	0.02
175	16.846	34.577	2.46	0.02
200	15.270	34.585	2.43	0.02
250	12.558	34.589	2.31	0.03
300	10.902	34.593	2.24	0.02
400	9.501	34.592	2.16	0.03
500	7.960	34.581	2.13	0.02
600	6.792	34.572	2.12	0.03
700	6.222	34.573	2.12	0.03
800	5.556	34.576	2.13	0.03
900	5.067	34.581	2.13	0.03
1000	4.685	34.585	2.14	0.03

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
Sur.	0	***	30.4	***	***	***
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KH-09-5_Leg7	St.7	Depth	1677m
Date:	2010.3.7	Lat.	0 59.97S
Time:	12:08	Long.	121 14.98E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
5	31.348	33.954	4.28	0.04
10	31.310	33.977	4.28	0.04
20	30.301	34.147	4.54	0.05
30	29.363	34.194	4.41	0.06
40	28.935	34.206	4.44	0.10
50	28.604	34.226	4.28	0.14
75	26.789	34.292	3.42	0.23
100	25.200	34.340	2.78	0.09
125	21.610	34.487	2.65	0.04
150	18.850	34.558	2.47	0.02
175	16.821	34.577	2.50	0.02
200	15.239	34.582	2.44	0.02
250	12.534	34.587	2.32	0.02
300	11.287	34.592	2.25	0.03
400	9.245	34.591	2.16	0.03
500	7.963	34.581	2.13	0.03
600	6.808	34.572	2.12	0.02
700	6.190	34.572	2.12	0.03
800	5.699	34.575	2.13	0.02
900	5.149	34.579	2.14	0.03
1000	4.682	34.585	2.15	0.02
1250	3.814	34.599	2.24	0.03
1500	3.060	34.613	2.28	0.02

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
Sur.	0	***	31.4	***	***	***
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KH-09-5_Leg7	St.8	Depth	1771m
Date:	2010.3.7	Lat.	0 45.18S
Time:	16:14	Long.	121 13.95E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
5	30.819	33.865	4.30	0.03
10	30.570	33.998	4.42	0.04
20	29.954	34.160	4.47	0.05
30	29.103	34.211	4.39	0.06
40	28.897	34.219	4.37	0.08
50	28.443	34.226	4.27	0.10
75	26.518	34.305	3.22	0.17
100	23.811	34.427	2.62	0.08
125	21.171	34.506	2.54	0.04
150	17.913	34.569	2.47	0.02
175	16.358	34.579	2.49	0.02
200	14.796	34.581	2.48	0.02
250	12.004	34.585	2.32	0.03
300	10.759	34.591	2.28	0.02
400	9.014	34.591	2.15	0.03
500	7.874	34.580	2.13	0.03
600	6.768	34.571	2.15	0.03
700	6.271	34.572	2.12	0.03
800	5.533	34.576	2.13	0.02
900	5.064	34.580	2.14	0.02
1000	4.623	34.585	2.16	0.02
1250	3.786	34.598	2.22	0.03
1500	3.084	34.612	2.28	0.02

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
Sur.	0	***	30.6	***	***	***
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KH-09-5_Leg7	St.9	Depth	1834m
Date:	2010.3.7	Lat.	0 29.06S
Time:	20:18	Long.	121 14.23E

CTD data (LAY)

Pres. db	Temp. °C	Sal (psu)	DO ml·l⁻¹	FLC μg/l
5	30.479	34.119	4.40	0.03
10	30.513	34.120	4.38	0.04
20	30.464	34.120	4.42	0.04
30	29.594	34.195	4.45	0.06
40	29.459	34.197	4.43	0.05
50	28.762	34.223	4.35	0.07
75	26.975	34.284	3.48	0.19
100	24.796	34.360	2.79	0.11
125	22.231	34.465	2.70	0.05
150	18.607	34.557	2.53	0.02
175	16.622	34.582	2.52	0.02
200	15.197	34.578	2.53	0.02
250	12.280	34.586	2.32	0.03
300	11.213	34.590	2.27	0.03
400	9.340	34.592	2.18	0.03
500	7.913	34.580	2.13	0.02
600	6.841	34.571	2.13	0.03
700	6.161	34.572	2.13	0.03
800	5.515	34.576	2.15	0.02
900	5.033	34.581	2.16	0.02
1000	4.559	34.586	2.16	0.02
1250	3.791	34.599	2.25	0.03
1500	3.035	34.613	2.31	0.02

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. °C	Sal (psu)	DO ml·l⁻¹	FLC μg/l
Sur.	0	***	30.1	***	***	***
1	66	66	28.190	34.230	4.15	0.19
2	66	66	28.205	34.232	4.17	0.20
3	66	66	28.202	34.234	4.17	0.20
4	66	66	28.206	34.233	4.17	0.19
5	66	66	28.201	34.233	4.17	0.19
6	66	66	28.197	34.233	4.17	0.20
7	66	66	28.203	34.233	4.17	0.20
8	66	66	28.202	34.233	4.16	0.20
9	66	66	28.200	34.233	4.17	0.20
10	66	66	28.202	34.233	4.17	0.22
11	66	66	28.199	34.233	4.17	0.21
12	66	66	28.197	34.233	4.17	0.21
13	66	66	28.197	34.233	4.17	0.22
14	66	66	28.205	34.233	4.17	0.21
15	66	66	28.200	34.234	4.17	0.21
16	66	66	28.196	34.234	4.17	0.21
17	66	66	28.193	34.234	4.17	0.23
18	66	66	28.192	34.234	4.16	0.23
19	66	66	28.190	34.234	4.15	0.22
20	66	66	28.190	34.234	4.17	0.38
21	66	66	28.190	34.234	4.16	0.22
22	66	66	28.189	34.234	4.16	0.22
23	66	66	28.187	34.234	4.16	0.22
24	66	66	28.186	34.234	4.16	0.21

KH-09-5_Leg7	St.10	Depth	1631m
Date:	2010.3.9	Lat.	0 44.02S
Time:	0:05	Long.	120 30.87E

CTD data (LAY)

Pres. db	Temp. °C	Sal (psu)	DO ml·l⁻¹	FLC μg/l
5	30.670	33.833	4.32	0.05
10	30.708	33.882	4.33	0.04
20	30.585	34.074	4.37	0.04
30	30.524	34.115	4.40	0.05
40	29.546	34.200	4.44	0.06
50	28.881	34.218	4.37	0.08
75	27.436	34.271	3.66	0.21
100	26.282	34.320	3.22	0.13
125	21.236	34.503	2.54	0.03
150	19.180	34.558	2.60	0.02
175	16.802	34.579	2.49	0.02
200	15.080	34.586	2.43	0.02
250	12.264	34.590	2.28	0.03
300	11.025	34.596	2.21	0.02
400	9.093	34.591	2.15	0.03
500	7.845	34.579	2.12	0.03
600	6.743	34.572	2.13	0.03
700	6.104	34.571	2.18	0.03
800	5.482	34.577	2.13	0.03
900	5.065	34.580	2.14	0.03
1000	4.723	34.584	2.13	0.03
1200	4.005	34.595	2.20	0.02

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. °C	Sal (psu)	DO ml·l⁻¹	FLC μg/l
Sur.	0	***	30.5	***	***	***
1	198	199	15.031	34.582	2.39	0.02
2	75	75	27.436	34.267	3.65	0.19
3	75	75	27.424	34.269	3.64	0.19
4	75	75	27.421	34.269	3.65	0.19
5	75	75	27.419	34.270	3.64	0.18
6	75	75	27.414	34.270	3.64	0.19
7	75	75	27.392	34.271	3.63	0.19
8	75	75	27.384	34.272	3.63	0.18
9	75	75	27.385	34.271	3.63	0.19
10	75	75	27.389	34.271	3.63	0.18
11	75	75	27.374	34.272	3.63	0.19
12	75	75	27.372	34.272	3.62	0.18
13	75	75	27.369	34.272	3.62	0.19
14	75	75	27.375	34.272	3.62	0.19
15	75	75	27.377	34.272	3.62	0.19
16	75	75	27.372	34.272	3.63	0.19
17	75	75	27.374	34.272	3.62	0.19
18	75	75	27.364	34.273	3.62	0.19
19	75	75	27.357	34.273	3.62	0.19
20	75	75	27.352	34.273	3.61	0.19
21	75	75	27.340	34.273	3.61	0.19
22	75	75	27.335	34.274	3.61	0.18
23	75	75	27.332	34.274	3.61	0.19
24	5	5	30.659	33.835	4.31	0.05

KH-09-5_Leg7	St.11	Depth	1878m
Date:	2010.3.11	Lat.	0 31.15S
Time:	9:28	Long.	120 29.45E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml・l⁻¹	FLC μg/l
5	30.599	33.872	4.34	0.04
10	30.673	33.975	4.35	0.04
20	30.647	34.009	4.36	0.04
30	30.437	34.128	4.46	0.06
40	29.300	34.199	4.47	0.08
50	28.322	34.235	4.27	0.16
75	26.681	34.303	3.33	0.16
100	23.650	34.418	2.60	0.07
125	21.260	34.506	2.58	0.03
150	18.020	34.572	2.52	0.02
175	16.117	34.582	2.47	0.02
200	14.412	34.586	2.40	0.02
250	11.789	34.592	2.26	0.03
300	10.790	34.594	2.23	0.02
400	9.225	34.592	2.16	0.03
500	7.692	34.578	2.13	0.03
600	6.702	34.572	2.12	0.02
700	6.014	34.573	2.13	0.02
800	5.500	34.575	2.15	0.02
900	5.041	34.580	2.13	0.03
1000	4.743	34.584	2.14	0.02
1250	3.883	34.597	2.21	0.03
1500	3.094	34.612	2.31	0.03

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml・l⁻¹	FLC μg/l
Sur.	0	***	30.3	***	***	***
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KH-09-5_Leg7	St.12	Depth	1849m
Date:	2010.3.10	Lat.	0 15.02S
Time:	18:14	Long.	120 29.79E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml・l⁻¹	FLC μg/l
5	30.770	33.951	4.30	0.04
10	30.791	33.977	4.31	0.03
20	30.421	34.116	4.44	0.05
30	29.822	34.185	4.48	0.07
40	29.116	34.202	4.44	0.08
50	28.231	34.237	4.21	0.13
75	27.306	34.273	3.52	0.23
100	25.054	34.353	2.75	0.10
125	22.404	34.461	2.63	0.05
150	19.778	34.547	2.60	0.03
175	16.644	34.581	2.49	0.02
200	14.982	34.587	2.40	0.02
250	12.427	34.587	2.31	0.02
300	10.759	34.591	2.26	0.03
400	9.014	34.591	2.15	0.03
500	7.756	34.579	2.12	0.02
600	6.847	34.570	2.14	0.03
700	6.003	34.573	2.13	0.02
800	5.518	34.576	2.15	0.03
900	5.116	34.580	2.15	0.02
1000	4.670	34.585	2.15	0.02

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml・l⁻¹	FLC μg/l
Sur.	0	***	30.8	***	***	***
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KH-09-5_Leg7	St.13	Depth	2019m
Date:	2010.3.10	Lat.	0 14.93S
Time:	13:06	Long.	120 59.88E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
5	30.573	34.014	4.33	0.04
10	30.572	34.014	4.33	0.04
20	30.474	34.059	4.34	0.05
30	29.871	34.167	4.49	0.07
40	29.110	34.207	4.42	0.08
50	28.736	34.221	4.36	0.12
75	26.912	34.291	3.40	0.18
100	25.519	34.336	2.88	0.13
125	21.840	34.484	2.65	0.04
150	19.383	34.570	2.69	0.02
175	16.820	34.578	2.47	0.02
200	14.681	34.581	2.39	0.02
250	12.055	34.590	2.28	0.02
300	10.720	34.590	2.31	0.03
400	8.751	34.589	2.13	0.03
500	7.688	34.578	2.13	0.03
600	6.750	34.570	2.14	0.03
700	6.059	34.572	2.13	0.03
800	5.540	34.575	2.17	0.03
900	5.103	34.581	2.16	0.03
1000	4.600	34.587	2.18	0.03
1250	3.848	34.598	2.21	0.03
1500	3.058	34.613	2.32	0.03

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
Sur.	0	***	30.6	***	***	***
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KH-09-5_Leg7	St.14	Depth	1651m
Date:	2010.3.9	Lat.	0 14.92S
Time:	14:49	Long.	121 29.79E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
10	30.491	34.136	4.35	0.04
20	30.355	34.106	4.38	0.04
30	30.022	34.165	4.47	0.07
40	29.733	34.189	4.43	0.10
50	29.258	34.203	4.41	0.11
75	26.859	34.285	3.40	0.19
100	24.747	34.369	2.91	0.08
125	21.903	34.475	2.68	0.04
150	19.137	34.557	2.56	0.02
175	16.332	34.581	2.51	0.02
200	14.380	34.584	2.42	0.02
250	12.018	34.587	2.32	0.02
300	10.521	34.592	2.33	0.03
400	9.282	34.591	2.19	0.02
500	7.904	34.580	2.13	0.03
600	7.008	34.571	2.16	0.03
700	6.197	34.572	2.14	0.02
800	5.772	34.574	2.14	0.03
900	5.143	34.579	2.15	0.02
1000	4.771	34.584	2.18	0.03
1250	3.824	34.599	2.26	0.02
1500	3.145	34.610	2.28	0.02

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
Sur.	0	***	29.4	***	***	***
1	201	202	14.077	34.583	2.37	0.02
2	62	62	27.514	34.248	3.73	0.19
3	62	62	27.518	34.260	3.75	0.20
4	62	62	27.517	34.258	3.74	0.19
5	62	62	27.510	34.260	3.75	0.20
6	62	62	27.506	34.262	3.75	0.22
7	62	62	27.495	34.262	3.74	0.19
8	62	62	27.494	34.263	3.74	0.19
9	62	62	27.487	34.263	3.74	0.19
10	62	62	27.487	34.263	3.74	0.19
11	62	62	27.482	34.264	3.74	0.21
12	62	62	27.483	34.264	3.74	0.23
13	62	62	27.488	34.263	3.75	0.19
14	62	62	27.489	34.263	3.74	0.20
15	62	62	27.486	34.263	3.74	0.19
16	62	62	27.485	34.263	3.74	0.19
17	62	62	27.486	34.263	3.73	0.20
18	62	62	27.487	34.264	3.74	0.19
19	62	62	27.490	34.263	3.75	0.20
20	62	62	27.480	34.264	3.75	0.19
21	62	62	27.482	34.264	3.74	0.19
22	62	62	27.474	34.264	3.74	0.20
23	62	62	27.466	34.265	3.73	0.19
24	5	6	30.493	34.135	4.34	0.04

KH-09-5_Leg7	St.15	Depth	1703m
Date:	2010.3.11	Lat.	0 14.92S
Time:	13:57	Long.	120 13.95E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml・l⁻¹	FLC μg/l
5	30.657	33.856	4.31	0.06
10	30.870	33.983	4.37	0.06
20	30.473	34.124	4.49	0.09
30	29.544	34.203	4.46	0.12
40	28.824	34.217	4.35	0.13
50	27.939	34.246	3.96	0.27
75	26.991	34.289	3.36	0.15
100	24.882	34.359	2.70	0.09
125	21.856	34.473	2.47	0.04
150	19.492	34.552	2.61	0.02
175	16.167	34.580	2.46	0.02
200	14.403	34.587	2.39	0.02
250	12.157	34.590	2.27	0.02
300	10.613	34.595	2.22	0.02
400	8.904	34.588	2.18	0.03
500	7.728	34.578	2.14	0.03

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml・l⁻¹	FLC μg/l
Sur.	0	***	30.9	***	***	***
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KH-09-5_Leg7	St.16	Depth	1413m
Date:	2010.3.11	Lat.	0 00.05S
Time:	17:52	Long.	120 29.80E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml・l⁻¹	FLC μg/l
5	30.784	33.961	4.29	0.04
10	30.784	33.966	4.30	0.04
20	30.370	34.131	4.50	0.05
30	29.830	34.197	4.49	0.07
40	29.015	34.209	4.44	0.09
50	28.242	34.234	4.22	0.15
75	27.340	34.277	3.61	0.24
100	24.885	34.352	2.67	0.10
125	22.504	34.446	2.50	0.05
150	20.016	34.545	2.56	0.03
175	17.572	34.577	2.55	0.02
200	15.340	34.587	2.42	0.02
250	11.948	34.594	2.25	0.03
300	10.687	34.591	2.27	0.03
400	9.050	34.590	2.17	0.03
500	7.710	34.580	2.19	0.03

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml・l⁻¹	FLC μg/l
Sur.	0	***	30.5	***	***	***
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KH-09-5_Leg7	St.17	Depth	1952m
Date:	2010.3.11	Lat.	0 00.00N
Time:	22:34	Long.	120 59.97E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
5	30.585	33.958	4.32	0.04
10	30.590	33.966	4.33	0.05
20	30.603	34.087	4.39	0.05
30	30.304	34.144	4.48	0.06
40	29.368	34.199	4.48	0.07
50	28.632	34.221	4.32	0.10
75	27.241	34.279	3.58	0.20
100	25.231	34.353	3.00	0.10
125	22.787	34.446	2.65	0.05
150	19.595	34.557	2.60	0.02
175	16.967	34.579	2.50	0.02
200	15.151	34.586	2.41	0.02
250	12.049	34.592	2.27	0.03
300	10.689	34.592	2.31	0.03
400	8.932	34.590	2.17	0.03
500	7.771	34.581	2.19	0.02

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
Sur.	0	***	30.4	***	***	***
1	201	202	14.844	34.580	2.41	0.02
2	201	202	14.846	34.581	2.41	0.02
3	201	202	14.860	34.582	2.41	0.02
4	201	202	14.864	34.582	2.41	0.02
5	101	101	24.984	34.339	2.92	0.08
6	101	101	24.996	34.350	2.93	0.08
7	101	101	24.989	34.355	2.93	0.08
8	101	101	24.993	34.356	2.93	0.08
9	101	101	24.992	34.356	2.93	0.08
10	66	66	27.836	34.246	3.96	0.23
11	66	66	27.835	34.248	3.98	0.25
12	66	66	27.842	34.248	3.99	0.25
13	66	66	27.842	34.248	3.99	0.25
14	66	66	27.842	34.249	3.98	0.26
15	51	52	28.526	34.227	4.29	0.11
16	51	52	28.526	34.227	4.29	0.11
17	51	52	28.527	34.227	4.29	0.11
18	51	52	28.527	34.227	4.29	0.12
19	51	52	28.527	34.228	4.29	0.11
20	6	6	30.619	33.993	4.34	0.04
21	6	6	30.612	33.986	4.33	0.04
22	6	6	30.607	33.978	4.33	0.05
23	6	6	30.599	33.967	4.33	0.04
24	6	6	30.596	33.963	4.33	0.04

KH-09-5_Leg7	St.18	Depth	1859m
Date:	2010.3.12	Lat.	0 00.00S
Time:	2:59	Long.	121 30.10E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
5	30.859	34.102	4.33	0.03
10	30.807	34.100	4.33	0.04
20	30.478	34.128	4.44	0.04
30	29.543	34.191	4.48	0.08
40	29.271	34.195	4.40	0.09
50	28.463	34.233	4.33	0.11
75	27.136	34.289	3.42	0.22
100	24.476	34.375	3.26	0.08
125	22.091	34.473	2.82	0.04
150	20.442	34.536	2.62	0.03
175	17.666	34.573	2.50	0.02
200	15.540	34.583	2.47	0.03
250	12.860	34.586	2.33	0.03
300	11.112	34.591	2.29	0.02
400	8.981	34.590	2.20	0.03
500	7.583	34.583	2.24	0.03

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
Sur.	0	***	31.1	***	***	***
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KH-09-5_Leg7	St.19	Depth	1738m
Date:	2010.3.12	Lat.	0 00.04S
Time:	7:08	Long.	121 59.99E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml・l^{-1}	FLC μg/l
5	30.822	34.089	4.34	0.03
10	30.729	34.108	4.35	0.04
20	30.317	34.149	4.37	0.04
30	29.896	34.166	4.39	0.06
40	29.325	34.201	4.43	0.09
50	29.059	34.211	4.42	0.12
75	26.911	34.290	3.49	0.24
100	25.377	34.347	3.16	0.11
125	22.454	34.458	2.91	0.04
150	19.308	34.553	2.58	0.03
175	15.507	34.581	2.52	0.02
200	13.948	34.584	2.39	0.02
250	11.952	34.584	2.32	0.03
300	10.857	34.595	2.42	0.03
400	9.246	34.590	2.18	0.03
500	7.906	34.582	2.19	0.03

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml・l^{-1}	FLC μg/l
Sur.	0	***	31.5	***	***	***
1	199	200	13.987	34.579	2.38	0.02
2	199	200	13.988	34.581	2.37	0.02
3	199	200	13.972	34.582	2.38	0.02
4	199	200	13.970	34.583	2.37	0.02
5	99	100	24.958	34.355	3.20	0.08
6	99	100	24.953	34.357	3.19	0.08
7	99	99	24.957	34.359	3.20	0.08
8	99	99	24.949	34.360	3.21	0.08
9	99	100	24.935	34.361	3.21	0.08
10	64	65	27.597	34.242	3.82	0.29
11	64	65	27.615	34.257	3.88	0.33
12	64	65	27.614	34.258	3.88	0.33
13	65	65	27.615	34.259	3.88	0.33
14	65	65	27.613	34.259	3.86	0.33
15	49	50	28.681	34.220	4.35	0.14
16	49	49	28.719	34.220	4.36	0.13
17	50	50	29.039	34.208	4.37	0.12
18	49	50	28.997	34.212	4.41	0.12
19	49	50	29.012	34.212	4.42	0.12
20	5	5	30.542	34.130	4.37	0.04
21	5	5	30.616	34.120	4.37	0.04
22	5	5	30.621	34.122	4.36	0.04
23	5	5	30.646	34.119	4.37	0.04
24	5	5	30.679	34.112	4.36	0.04

KH-09-5_Leg7	St.20	Depth	2586m
Date:	2010.3.12	Lat.	0 00.04S
Time:	11:22	Long.	122 30.07E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml・l^{-1}	FLC μg/l
5	30.242	34.181	4.38	0.04
10	30.208	34.184	4.37	0.05
20	30.182	34.193	4.36	0.05
30	30.085	34.185	4.36	0.06
40	29.758	34.190	4.48	0.08
50	29.195	34.212	4.39	0.09
75	26.875	34.284	3.64	0.26
100	25.378	34.333	3.33	0.10
125	22.381	34.462	2.96	0.04
150	18.933	34.557	2.56	0.02
175	15.413	34.579	2.53	0.02
200	14.056	34.584	2.44	0.02
250	12.405	34.586	2.33	0.03
300	11.112	34.587	2.41	0.03
400	8.973	34.590	2.20	0.03
500	7.867	34.588	2.31	0.03

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml・l^{-1}	FLC μg/l
Sur.	0	***	30.2	***	***	***
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KH-09-5_Leg7	St.21	Depth	3388m
Date:	2010.3.12	Lat.	0 00.02N
Time:	15:40	Long.	123 00.10E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
5	30.287	34.182	4.33	0.04
10	30.277	34.177	4.33	0.04
20	29.801	34.202	4.43	0.05
30	29.674	34.227	4.39	0.05
40	29.512	34.211	4.38	0.06
50	29.133	34.182	4.36	0.10
75	26.669	34.286	3.66	0.24
100	24.561	34.377	3.28	0.07
125	22.339	34.453	3.05	0.04
150	19.489	34.558	2.65	0.03
175	16.981	34.582	2.63	0.02
200	14.996	34.581	2.54	0.03
250	12.505	34.574	2.46	0.02
300	11.224	34.587	2.44	0.03
400	8.919	34.589	2.25	0.03
500	7.919	34.583	2.24	0.03

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
Sur.	0	***	30.2	***	***	***
1	200	201	14.976	34.576	2.53	0.02
2	200	201	14.971	34.577	2.53	0.02
3	200	201	14.970	34.578	2.53	0.03
4	200	201	14.967	34.578	2.52	0.02
5	101	101	24.610	34.364	3.27	0.07
6	101	101	24.608	34.366	3.28	0.07
7	101	102	24.606	34.368	3.28	0.07
8	101	102	24.606	34.368	3.28	0.07
9	101	102	24.595	34.368	3.28	0.07
10	69	69	27.550	34.256	3.80	0.25
11	69	69	27.548	34.257	3.81	0.27
12	69	69	27.544	34.257	3.81	0.26
13	69	69	27.533	34.257	3.82	0.26
14	69	69	27.515	34.258	3.82	0.26
15	51	51	29.118	34.180	4.33	0.12
16	51	51	29.111	34.181	4.35	0.12
17	51	51	29.094	34.183	4.34	0.12
18	51	51	29.078	34.182	4.35	0.13
19	51	51	29.063	34.184	4.34	0.13
20	6	6	30.244	34.190	4.33	0.04
21	6	6	30.247	34.190	4.33	0.04
22	6	6	30.261	34.187	4.32	0.04
23	6	6	30.272	34.184	4.32	0.04
24	6	6	30.278	34.184	4.33	0.04

KH-09-5_Leg7	St.22	Depth	1426m
Date:	2010.3.12	Lat.	2 00.00N
Time:	7:59	Long.	124 59.76E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
5	27.391	34.422	4.60	0.25
10	27.308	34.421	4.58	0.38
20	27.214	34.459	4.45	0.47
30	27.180	34.510	4.40	0.30
40	27.129	34.549	4.37	0.35
50	27.032	34.619	4.33	0.20
75	25.557	34.610	4.03	0.21
100	24.266	34.679	3.82	0.12
125	22.396	34.711	3.65	0.07
150	21.481	34.708	3.60	0.06
175	18.773	34.669	3.46	0.03
200	16.344	34.604	3.40	0.02
250	13.020	34.475	3.10	0.02
300	11.779	34.450	2.85	0.02
400	8.860	34.484	2.30	0.03
500	7.116	34.537	2.28	0.03

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
Sur.	0	***	28.1	***	***	***
1	198	200	15.326	34.565	3.33	0.02
2	199	200	15.823	34.584	3.40	0.02
3	198	199	15.910	34.582	3.36	0.02
4	198	199	15.958	34.585	3.37	0.02
5	99	99	24.481	34.668	3.85	0.13
6	99	99	24.515	34.668	3.85	0.12
7	99	99	24.532	34.669	3.85	0.13
8	99	99	24.548	34.669	3.86	0.12
9	98	99	24.555	34.669	3.86	0.12
10	75	76	25.886	34.601	4.09	0.22
11	75	75	25.893	34.602	4.09	0.23
12	75	76	25.899	34.603	4.09	0.24
13	75	75	25.889	34.602	4.10	0.23
14	75	76	25.873	34.600	4.09	0.24
15	25	25	27.175	34.499	4.39	0.33
16	25	25	27.182	34.494	4.41	0.38
17	25	25	27.185	34.491	4.41	0.45
18	25	25	27.190	34.487	4.42	0.42
19	25	25	27.193	34.485	4.42	0.50
20	5	5	27.808	34.389	4.66	0.36
21	5	5	27.922	34.376	4.67	0.21
22	5	5	27.917	34.375	4.67	0.28
23	5	5	28.075	34.363	4.65	0.20
24	5	5	28.013	34.368	4.65	0.29

KH-09-5_Leg7	St.24	Depth	4124m
Date:	2010.3.13	Lat.	2 59.77N
Time:	16:06	Long.	124 59.83E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
5	28.988	34.406	4.46	0.08
10	28.758	34.395	4.50	0.09
20	28.646	34.399	4.50	0.09
30	28.317	34.394	4.43	0.07
40	28.116	34.405	4.42	0.10
50	27.432	34.525	4.34	0.14
75	26.094	34.646	4.01	0.20
100	22.418	34.806	3.72	0.10
125	18.850	34.692	3.53	0.04
150	17.298	34.639	3.46	0.03
175	15.746	34.582	3.37	0.02
200	14.213	34.524	3.23	0.02
250	11.887	34.438	2.92	0.02
300	10.302	34.440	2.52	0.02
400	8.905	34.492	2.43	0.03
500	7.875	34.531	2.32	0.03

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
Sur.	0	***	29.0	***	***	***
1	200	201	13.913	34.506	3.18	0.02
2	200	201	13.910	34.509	3.18	0.02
3	200	201	13.918	34.509	3.18	0.02
4	200	201	13.917	34.509	3.18	0.02
5	100	101	24.597	34.819	3.87	0.12
6	101	101	24.626	34.820	3.89	0.12
7	101	101	24.636	34.822	3.90	0.12
8	101	101	24.644	34.823	3.90	0.12
9	101	101	24.653	34.824	3.91	0.11
10	67	68	26.295	34.621	4.04	0.19
11	68	68	26.297	34.626	4.04	0.20
12	68	68	26.296	34.626	4.04	0.20
13	67	68	26.295	34.626	4.04	0.19
14	67	68	26.295	34.626	4.04	0.19
15	51	51	27.264	34.550	4.30	0.15
16	51	51	27.256	34.553	4.31	0.15
17	51	51	27.267	34.553	4.31	0.14
18	51	51	27.253	34.554	4.31	0.15
19	50	51	27.235	34.555	4.31	0.15
20	6	6	29.107	34.415	4.44	0.08
21	6	6	29.106	34.415	4.45	0.08
22	6	6	29.105	34.415	4.44	0.08
23	6	6	29.100	34.415	4.45	0.08
24	6	6	29.101	34.415	4.44	0.13

KH-09-5_Leg7	St.25	Depth	4916m
Date:	2010.3.14	Lat.	3 00.24N
Time:	0:27	Long.	123 29.70E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
5	28.677	34.420	4.44	0.06
10	28.679	34.420	4.46	0.06
20	28.676	34.420	4.45	0.07
30	28.667	34.421	4.44	0.07
40	28.270	34.492	4.43	0.09
50	27.905	34.594	4.42	0.07
75	26.991	34.687	4.27	0.13
100	23.924	34.796	3.73	0.12
125	21.331	34.786	3.62	0.06
150	16.021	34.608	3.41	0.03
175	14.632	34.549	3.30	0.02
200	12.874	34.474	3.05	0.02
250	11.486	34.439	2.79	0.02
300	10.646	34.410	2.65	0.03
400	8.522	34.469	2.14	0.03
500	7.407	34.552	2.58	0.02

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
Sur.	0	***	28.9	***	***	***
1	199	200	12.725	34.469	3.02	0.02
2	99	100	25.414	34.666	3.80	0.14
3	86	86	26.495	34.652	4.21	0.22
4	86	87	26.339	34.636	4.18	0.22
5	86	87	26.298	34.628	4.17	0.22
6	86	87	26.304	34.628	4.14	0.23
7	86	87	26.225	34.630	4.13	0.25
8	86	87	26.227	34.631	4.12	0.22
9	86	87	26.221	34.631	4.13	0.23
10	86	87	26.215	34.633	4.13	0.24
11	86	87	26.157	34.649	4.11	0.22
12	86	87	26.153	34.648	4.10	0.21
13	87	87	26.160	34.647	4.10	0.22
14	86	87	26.139	34.652	4.10	0.22
15	86	87	26.134	34.654	4.09	0.21
16	87	87	26.127	34.657	4.08	0.23
17	86	87	26.130	34.656	4.09	0.22
18	86	87	26.129	34.658	4.09	0.21
19	87	87	26.130	34.659	4.09	0.21
20	86	87	26.131	34.660	4.09	0.20
21	87	87	26.122	34.662	4.09	0.20
22	86	87	26.115	34.662	4.09	0.20
23	50	50	27.886	34.598	4.41	0.07
24	5	5	28.692	34.420	4.44	0.05

KH-09-5_Leg7	St.26	Depth	5092m
Date:	2010.3.14	Lat.	3 00.09N
Time:	8:14	Long.	121 59.85E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml·l^{-1}	FLC μg/l
5	29.085	34.399	4.44	0.05
10	29.039	34.396	4.45	0.07
20	28.896	34.392	4.46	0.07
30	28.874	34.390	4.46	0.09
40	28.531	34.409	4.44	0.10
50	28.015	34.535	4.42	0.10
75	26.882	34.676	4.28	0.18
100	24.173	34.796	3.83	0.10
125	21.584	34.798	3.70	0.07
150	18.063	34.686	3.49	0.03
175	14.811	34.553	3.38	0.02
200	12.888	34.469	3.11	0.02
250	10.300	34.412	2.54	0.02
300	8.979	34.394	2.38	0.03
400	8.111	34.486	2.11	0.03
500	7.607	34.546	2.36	0.02

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml·l^{-1}	FLC μg/l
Sur.	0	***	29.1	***	***	***
1	200	201	13.005	34.467	3.17	0.02
2	201	202	12.994	34.467	3.17	0.02
3	199	200	13.177	34.475	3.22	0.02
4	199	200	13.145	34.475	3.25	0.02
5	100	100	24.246	34.780	3.80	0.09
6	100	101	24.245	34.782	3.80	0.09
7	100	101	24.253	34.781	3.80	0.09
8	101	101	24.224	34.784	3.80	0.09
9	100	101	24.276	34.779	3.81	0.09
10	79	79	26.734	34.676	4.22	0.16
11	79	79	26.806	34.671	4.26	0.17
12	79	79	26.820	34.665	4.26	0.16
13	79	79	26.862	34.657	4.26	0.17
14	79	79	26.903	34.664	4.28	0.16
15	50	50	28.201	34.493	4.42	0.08
16	50	50	28.220	34.488	4.43	0.09
17	50	50	28.219	34.486	4.43	0.08
18	50	50	28.205	34.490	4.43	0.08
19	50	50	28.209	34.490	4.44	0.09
20	5	5	28.999	34.395	4.45	0.07
21	5	5	29.060	34.398	4.45	0.06
22	5	5	29.063	34.398	4.45	0.06
23	4	5	29.055	34.399	4.45	0.06
24	5	5	29.060	34.399	4.44	0.05

KH-09-5_Leg7	St.30	Depth	4454m
Date:	2010.3.14	Lat.	2 59.84N
Time:	22:59	Long.	119 59.85E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml·l^{-1}	FLC μg/l
5	29.085	34.324	4.40	0.05
10	28.924	34.339	4.41	0.06
20	28.317	34.418	4.40	0.08
30	28.200	34.435	4.39	0.10
40	28.122	34.444	4.37	0.13
50	28.014	34.461	4.35	0.15
75	27.700	34.549	4.31	0.13
100	26.620	34.571	3.99	0.07
125	25.129	34.643	3.87	0.06
150	21.103	34.854	3.73	0.05
175	16.881	34.654	3.50	0.03
200	15.088	34.581	3.45	0.03
250	11.203	34.418	2.80	0.02
300	9.900	34.387	2.52	0.02
400	8.479	34.446	2.10	0.03
500	7.638	34.502	2.09	0.03

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml·l^{-1}	FLC μg/l
Sur.	0	***	29.0	***	***	***
1	198	200	14.214	34.517	3.40	0.02
2	101	101	27.430	34.585	4.25	0.08
3	68	68	27.741	34.529	4.30	0.13
4	68	69	27.732	34.533	4.31	0.13
5	68	69	27.730	34.534	4.31	0.13
6	68	69	27.730	34.534	4.31	0.13
7	68	69	27.729	34.533	4.31	0.12
8	68	69	27.725	34.535	4.31	0.12
9	68	69	27.721	34.535	4.30	0.14
10	68	69	27.713	34.537	4.30	0.13
11	68	69	27.710	34.537	4.30	0.12
12	68	69	27.712	34.537	4.30	0.12
13	68	69	27.718	34.535	4.30	0.13
14	68	69	27.716	34.536	4.30	0.12
15	68	69	27.724	34.533	4.30	0.13
16	68	68	27.727	34.532	4.30	0.13
17	68	69	27.721	34.535	4.31	0.13
18	68	69	27.728	34.533	4.30	0.13
19	68	68	27.732	34.533	4.30	0.13
20	68	68	27.736	34.532	4.30	0.14
21	68	68	27.741	34.531	4.31	0.14
22	68	69	27.745	34.529	4.31	0.14
23	50	50	28.071	34.441	4.36	0.14
24	5	5	28.929	34.338	4.41	0.05

KH-09-5_Leg7	St.31	Depth	4812m
Date:	2010.3.15	Lat.	1 59.99N
Time:	5:26	Long.	119 59.51E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
10	29.191	34.290	4.42	0.04
20	28.868	34.340	4.45	0.05
30	28.067	34.432	4.47	0.06
40	27.859	34.499	4.40	0.08
50	27.602	34.504	4.32	0.32
75	27.325	34.547	4.17	0.23
100	24.063	34.211	3.32	0.08
125	20.619	34.334	2.93	0.04
150	18.596	34.406	2.73	0.04
175	16.005	34.497	2.85	0.03
200	14.918	34.562	3.52	0.02
250	12.478	34.428	3.18	0.02
300	10.960	34.369	3.01	0.02
400	8.327	34.460	2.08	0.03
500	7.052	34.526	2.14	0.03

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
Sur.	0	***	30.0	***	***	***
1	198	199	15.000	34.562	3.51	0.02
2	197	199	15.002	34.562	3.51	0.02
3	197	198	15.001	34.562	3.51	0.02
4	197	198	14.995	34.563	3.51	0.02
5	100	101	24.204	34.202	3.34	0.06
6	101	102	23.989	34.212	3.32	0.06
7	102	102	23.807	34.228	3.33	0.06
8	103	103	23.682	34.228	3.28	0.06
9	103	104	23.643	34.226	3.28	0.06
10	49	50	27.602	34.499	4.30	0.30
11	49	50	27.602	34.500	4.30	0.29
12	49	50	27.602	34.500	4.31	0.29
13	49	50	27.603	34.500	4.31	0.30
14	49	49	27.602	34.500	4.30	0.34
15	25	25	28.357	34.417	4.46	0.06
16	25	25	28.284	34.422	4.47	0.06
17	25	25	28.763	34.347	4.45	0.06
18	25	25	28.835	34.339	4.45	0.05
19	25	25	28.839	34.344	4.45	0.06
20	5	5	29.267	34.297	4.40	0.03
21	5	5	29.273	34.298	4.41	0.04
22	5	5	29.272	34.298	4.41	0.04
23	5	5	29.275	34.298	4.41	0.03
24	5	5	29.274	34.298	4.40	0.03

KH-09-5_Leg7	St.35	Depth	5420m
Date:	2010.3.16	Lat.	2 00.08N
Time:	0:29	Long.	123 00.15E

CTD data (LAY)

Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
5	28.472	34.524	4.39	0.03
10	28.471	34.525	4.39	0.03
20	28.468	34.525	4.40	0.03
30	28.323	34.547	4.40	0.04
40	27.630	34.649	4.41	0.04
50	26.781	34.726	4.29	0.18
75	25.087	34.610	3.84	0.21
100	23.657	34.766	3.72	0.08
125	18.261	34.605	3.21	0.04
150	16.496	34.590	3.29	0.03
175	15.848	34.576	3.31	0.03
200	14.569	34.531	3.22	0.02
250	11.336	34.426	2.79	0.02
300	10.317	34.422	2.51	0.02
400	8.981	34.487	2.24	0.03
500	7.431	34.531	2.27	0.03

CTD data (BTL)

BTL No.	Depth m	Pres. db	Temp. ℃	Sal (psu)	DO ml·l⁻¹	FLC μg/l
Sur.	0	***	28.9	***	***	***
1	200	201	14.245	34.519	3.17	0.02
2	199	200	14.332	34.522	3.17	0.02
3	199	201	14.300	34.521	3.17	0.02
4	200	201	14.316	34.522	3.18	0.02
5	100	100	23.312	34.749	3.66	0.06
6	99	100	23.685	34.759	3.72	0.07
7	99	100	23.654	34.760	3.74	0.07
8	100	100	23.815	34.761	3.74	0.07
9	100	100	23.809	34.763	3.74	0.07
10	58	58	26.026	34.669	4.07	0.30
11	57	58	26.107	34.690	4.11	0.32
12	57	58	26.181	34.710	4.16	0.31
13	57	58	26.165	34.704	4.13	0.32
14	58	58	26.086	34.689	4.13	0.31
15	50	50	26.827	34.728	4.31	0.16
16	50	50	26.841	34.732	4.32	0.15
17	50	51	26.841	34.731	4.31	0.15
18	50	50	26.849	34.733	4.32	0.15
19	50	51	26.844	34.732	4.31	0.15
20	5	5	28.478	34.524	4.39	0.03
21	5	5	28.479	34.524	4.39	0.04
22	5	5	28.512	34.525	4.39	0.03
23	5	5	28.514	34.525	4.39	0.03
24	5	5	28.517	34.525	4.39	0.03

KH-09-5_Leg7	St.39	Depth	5400m
Date:	2010.3.16	Lat.	2 30.09N
Time:	23:45	Long.	122 00.09E

CTD data (LAY)

Pres.	Temp.	Sal	DO	FLC
db	℃	(psu)	ml・l^{-1}	μg/l
5	29.048	34.423	4.38	0.05
10	29.048	34.423	4.38	0.07
20	29.045	34.425	4.38	0.07
30	28.831	34.489	4.39	0.07
40	27.646	34.697	4.42	0.05
50	27.380	34.712	4.40	0.06
75	26.601	34.706	4.25	0.22
100	25.149	34.799	3.96	0.16
125	21.094	34.833	3.72	0.06
150	15.681	34.592	3.42	0.02
175	12.834	34.463	3.26	0.02
200	11.931	34.426	3.09	0.02
250	11.198	34.434	2.71	0.02
300	9.718	34.405	2.40	0.02
400	8.196	34.478	2.08	0.03
500	7.387	34.534	2.33	0.03

CTD data (BTL)

BTL	Depth	Pres.	Temp.	Sal	DO	FLC
No.	m	db	℃	(psu)	ml・l^{-1}	μg/l
Sur.	0	***	29.9	***	***	***
1	199	201	11.366	34.421	2.82	0.02
2	99	100	24.400	34.790	3.85	0.12
3	75	75	26.380	34.741	4.20	0.19
4	75	75	26.358	34.744	4.20	0.19
5	75	76	26.338	34.747	4.19	0.19
6	75	75	26.347	34.746	4.18	0.19
7	75	75	26.330	34.746	4.19	0.20
8	75	75	26.338	34.746	4.19	0.20
9	75	75	26.331	34.746	4.18	0.19
10	75	76	26.319	34.746	4.18	0.19
11	75	76	26.316	34.747	4.19	0.19
12	75	76	26.308	34.747	4.18	0.19
13	75	76	26.302	34.747	4.18	0.20
14	75	76	26.301	34.747	4.18	0.21
15	75	76	26.308	34.747	4.18	0.21
16	75	76	26.300	34.748	4.18	0.20
17	75	76	26.301	34.747	4.18	0.21
18	75	76	26.303	34.748	4.18	0.20
19	75	76	26.309	34.747	4.19	0.20
20	75	76	26.304	34.748	4.19	0.20
21	75	76	26.309	34.747	4.19	0.22
22	75	76	26.308	34.748	4.18	0.21
23	50	50	27.253	34.737	4.38	0.07
24	5	5	29.041	34.425	4.38	0.09

Date (YYMMDD)	Time (hhmm)	Time Difference between Ship Time and UTC	Latitude	Longitude	Water Depth (m)	Station Name	Heading (deg.)	Log Speed (knot)	System Course (deg.)	System Speed (knot)	Current Direction (deg.)	Current Speed (knot)	Distance (mile)	Comment
100302	733	+08:00	08 44.559S	115 12.749E	0		15	0.1	43	0.1			0	PILOT CAME ON BOARD
100302	825	+08:00	08 45.369S	115 13.946E	0		78	3.2	79	1.8			1.7	PILOT LEFT HER
100302	846	+08:00	08 45.315S	115 15.081E	0		109	0.2	301	1.2			2.9	LET GO ANCHOR
100302	1855	+08:00	08 45.343S	115 15.017E	0		34	1.5	130	0.7			0	S/B ENG'S
100302	1900	+08:00	08 45.342S	115 15.017E	0		37	1.5	40	0.1			0.1	COM'CED HEAVE IN ANCHOR
100302	1914	+08:00	08 45.348S	115 15.048E	0		40	1.3	64	0.4			0	UP & DOWN ANCHOR
100302	1920	+08:00	08 45.362S	115 15.067E	0		84	1.8	134	1.4			0.1	SLOW AHEAD ENG'S
100302	1923	+08:00	08 45.434S	115 15.141E	0		112	4.3	137	4.3	216	1.1	0.2	S/CO ON 113°
100302	1934	+08:00	08 46.432S	115 17.039E	0		105	16.3	116	16.4	188	2.9	2.3	R/UP ENG'S
100303	0	+08:00	09 15.368S	116 25.307E	2388		111	17.3	115	16.1	245	1	75.8	A/CO TO 094°
100303	212	+08:00	09 18.073S	117 01.020E	2094		86	16.8	85	15.8	263	1.4	111.4	A/CO TO 085°
100303	613	+08:00	09 11.901S	118 05.162E	2546		85	16.6	83	16.2	277	0.6	175	SUNRISE & TURNED OFF REGULATION LIGHTS
100303	1110	+08:00	09 05.263S	119 23.071E	1175		85	16.6	89	16.1	225	1.5	252.4	A/CO TO 090°
100303	1300	+08:00	09 05.086S	119 51.862E	974		90	17.1	90	15.6	271	1.7	280.9	COM'CED LIFEBOAT STATION DRILL
100303	1320	+08:00	09 05.047S	119 57.142E	939		91	17.1	91	15.7	274	1.5	286.1	FINISHED LIFEBOAT STATION DRILL
100303	1434	+08:00	09 05.117S	120 17.040E	829		101	16.2	101	16.2	314	0.1	305.9	A/CO TO 100°
100303	1714	+08:00	09 12.622S	120 59.653E	2098		98	16.9	98	15.6	284	0.9	348.5	A/CO TO 078°
100303	1800	+08:00	09 09.975S	121 11.804E	2426		78	16.8	78	16.7	242	0.3	360.9	TURNED OFF AIS AGAINST PIRATES
100303	1815	+08:00	09 09.191S	121 15.862E	2430		79	16.8	79	16.3	263	0.3	365	SUNSET & PUT ON REGULATION LIGHTS
100303	2000	+08:00	09 03.426S	121 44.119E	2613		78	16.9	77	16.6	301	0.5	393.5	S/B ENG'S
100304	401	+08:00	08 39.391S	123 40.137E	3082		22	13.3	27	14.2	65	2	510.8	A/CO TO 020°
100304	515	+08:00	08 21.203S	123 46.695E	278		26	14.6	24	16	355	1	530.2	A/CO TO 070°
100304	550	+08:00	08 17.811S	123 56.094E	456		64	17.5	70	15.6	193	1.3	540.1	SUNRISE & TURNED OFF REGULATION LIGHTS
100304	550	+08:00	08 17.788S	123 56.150E	457		58	17.8	64	14.9	194	1.5	540.1	A/CO TO 021°
100304	630	+08:00	08 09.396S	123 59.646E	879		23	16.6	21	15	227	1.7	549.2	R/UP ENG'S
100304	1407	+08:00	06 08.049S	124 45.100E	1110		20	17.1	21	16.1	179	0.8	678	A/CO TO 350°
100304	1759	+08:00	05 07.372S	124 33.966E	5362		350	16.3	350	16.3	205	0.3	739.2	SUNSET & PUT ON REGULATION LIGHTS
100305	520	+08:00	02 06.042S	124 01.334E	826		354	16.3	354	15.7	168	0.5	922.6	S/B ENG'S
100305	527	+08:00	02 04.250S	124 01.071E	899		324	16.3	324	15.5	161	1.4	924.4	A/CO TO 324°
100305	551	+08:00	01 59.082S	123 57.143E	596		323	16.2	323	16.9	319	1	930.9	SUNSET & PUT ON REGULATION LIGHTS
100305	651	+08:00	01 46.210S	123 48.020E	390		344	16.1	344	15.8	70	0.1	946.7	A/CO TO 345°
100305	848	+08:00	01 15.525S	123 39.850E	1470		352	15.9	352	15.8	291	0.5	978.4	A/CO TO 355°
100305	854	+08:00	01 13.971S	123 39.669E	1502		355	16.2	352	15.5	254	0.5	980	R/UP ENG'S
100305	1109	+08:00	00 38.023S	123 36.436E	1539		320	16.2	317	15.8	183	0.9	1015.9	A/CO TO 316°
100305	1420	+08:00	00 00.277S	123 00.310E	3381		270	15.9	269	15.8	109	0.7	1068	A/CO TO 270°
100305	1807	+08:00	00 00.262S	121 58.141E	1765		270	16.8	270	16.8	119	0.2	1130.4	SUNSET & PUT ON REGULATION LIGHTS
100305	1950	+08:00	00 00.519S	121 29.733E	1858		235	16.3	234	16	90	0.7	1158.9	A/CO TO 211°
100305	2331	+08:00	00 52.896S	120 58.405E	1710		212	16.8	212	16.5	0	0.4	1220.2	S/B ENG'S
100306	220	+08:00	01 18.193S	120 43.815E	736		179	1.6	195	1.1			1249.4	USED HELM VAR'LY
100306	221	+08:00	01 18.200S	120 43.813E	732		161	0.4	256	0.1			1249.4	STOPPED ENG'S
100306	224	+08:00	01 18.193S	120 43.815E	734		126	0.2	13	0.3			1249.4	CHANGED ENG'S TO E/M
100306	608	+08:00	01 18.057S	120 43.815E	708		207	1.9	201	1.8			1251.2	SUNRISE & TURNED OFF REGULATION LIGHTS
100306	754	+08:00	01 18.808S	120 43.753E	830		210	0.1	46	0.3			1252.9	COMCED CONTACTING LAND SUPPORT TEAM
100306	1001	+08:00	01 18.747S	120 43.668E	801		212	0.2	268	0.2			1253.3	CHANGED ENG'S TO S/M
100306	1040	+08:00	01 20.111S	120 43.853E	906		138	0.2	290	0.6			1254.7	FINISHED MEETING OF LAND SUPPORT TEAM
100306	1122	+08:00	01 20.034S	120 43.894E	920		81	0.6	61	0.4			1255	CHANGED ENG'S TO E/M
100306	1350	+08:00	01 21.615S	120 44.885E	484		0	3.2	358	3.2	341	0.3	1259.4	CHANGED ENG'S TO T/M
100306	1351	+08:00	01 21.558S	120 44.882E	499		359	3.4	357	3.4	294	0.1	1259.5	CHANGED ENG'S TO S/M
100306	1352	+08:00	01 21.551S	120 44.882E	501		359	3.5	357	3.4	274	0.2	1259.5	SLOW AHEAD ENG'S
100306	1532	+08:00	01 22.293S	120 44.734E	328		159	2.8	163	2.6	295	0.3	1272.4	STOPPED ENG'S
100306	1533	+08:00	01 22.355S	120 44.754E	350		156	2.1	160	2			1272.5	CHANGED ENG'S TO E/M
100306	1742	+08:00	01 22.057S	120 44.733E	355		349	3.3	346	3.4	322	0.2	1274.1	CHANGED ENG'S TO T/M
100306	1742	+08:00	01 22.053S	120 44.732E	355		349	3.3	346	3.5	313	0.1	1274.1	SLOW AHEAD ENG'S
100306	1812	+08:00	01 18.613S	120 43.626E	769		206	0.1	34	1.2			1277.9	CHANGED ENG'S TO S/M
100306	1813	+08:00	01 18.605S	120 43.632E	0		205	0.1	35	1.3			1277.9	SUNSET & PUT ON REGULATION LIGHTS
100306	1852	+08:00	01 18.322S	120 44.879E	968		29	6.2	30	5.7	191	0.4	1280.1	CHANGED ENG'S TO T/M
100306	1911	+08:00	01 15.741S	120 46.997E	990		20	10.3	24	10	146	0.7	1283.4	CHANGED ENG'S TO S/M
100306	2034	+08:00	00 59.494S	120 54.303E	1799		20	11.7	22	11.4	152	0.4	1301.1	CHANGED ENG'S TO T/M
100306	2154	+08:00	00 45.255S	120 59.889E	627		41	2.8	28	2.6	281	0.5	1316.4	CHANGED ENG'S TO E/M
100306	2338	+08:00	00 45.266S	120 59.824E	641	St2	121	0.1	290	0.3			1317	CTD STARTED
100307	0	+08:00	00 45.242S	120 59.756E	655	St2	120	0.2	230	0.3			1317.1	CTD DEEPEST
100307	17	+08:00	00 45.229S	120 59.700E	656	St2	90	0.2	301	0.2			1317.2	CTD FINISHED
100307	23	+08:00	00 45.217S	120 59.674E	627	St2	90	0.3	79	0.6			1317.2	IKMT NET STARTED
100307	38	+08:00	00 45.180S	121 00.180E	618	St2	91	2.5	86	2.1	301	0.5	1317.7	IKMT NET DEEPEST
100307	202	+08:00	00 44.823S	121 02.675E	646	St2	91	1.8	80	1.6			1320.3	IKMT NET FINISHED
100307	213	+08:00	00 44.173S	121 02.647E	646		346	2.9	344	3.3	325	0.4	1321	CHANGED ENG'S TO T/M
100307	213	+08:00	00 44.167S	121 02.645E	649		346	3	344	3.4	321	0.4	1321	SLOW AHEAD ENG'S
100307	213	+08:00	00 44.166S	121 02.645E	649		346	3	344	3.4	329	0.5	1321	S/CO ON 000°
100307	319	+08:00	00 29.947S	120 59.825E	1887		63	0.7	3	0.3			1335.4	USED HELM VAR'LY
100307	319	+08:00	00 29.947S	120 59.825E	1887		63	0.7	349	0.3			1335.4	STOPPED ENG'S
100307	321	+08:00	00 29.936S	120 59.817E	1887		65	0.2	353	0.3			1335.5	CHANGED ENG'S TO E/M
100307	324	+08:00	00 29.924S	120 59.809E	1888	St3	44	0.1	319	0.3			1335.5	CTD STARTED
100307	350	+08:00	00 29.807S	120 59.692E	1896	St3	60	0.5	332	0.4			1335.7	CTD DEEPEST
100307	412	+08:00	00 29.761S	120 59.591E	1907	St3	60	0.1	285	0.4			1335.8	CTD FINISHED
100307	420	+08:00	00 29.734S	120 59.604E	1906	St3	80	1.9	72	1.6			1335.9	IKMT NET STARTED
100307	433	+08:00	00 29.605S	121 00.017E	1898	St3	80	2.3	72	2.2	313	0.4	1336.3	IKMT NET DEEPEST
100307	540	+08:00	00 29.156S	121 01.657E	1889	St3	80	1.4	81	0.8			1338	IKMT NET FINISHED
100307	551	+08:00	00 29.328S	121 01.353E	1892		269	2.9	267	3.2	259	0.3	1338.6	CHANGED ENG'S TO T/M
100307	607	+08:00	00 29.571S	120 58.760E	1912		264	15.5	264	15.8	256	0.3	1341.1	SUNRISE & TURNED OFF REGULATION LIGHTS
100307	701	+08:00	00 30.002S	120 45.051E	1976		276	0.5	283	0.7			1354.9	STOPPED ENG'S
100307	704	+08:00	00 29.998S	120 45.015E	1975		249	0.1	232	0.4			1355	CHANGED ENG'S TO E/M
100307	709	+08:00	00 29.973S	120 44.971E	1974	St4	100	0.1	281	0.9			1355	CTD-CMS STARTED
100307	737	+08:00	00 29.869S	120 44.803E	1976	St4	90	0.6	6	0.2			1355.3	CTD-CMS DEEPEST
100307	808	+08:00	00 29.773S	120 44.668E	1976	St4	90	0.2	297	0.5			1355.5	CTD-CMS FINISHED
100307	816	+08:00	00 29.723S	120 44.701E	1976	St4	90	2.6	85	2.2	305	12	1355.6	IKMT NET STARTED
100307	832	+08:00	00 29.690S	120 45.217E	1978	St4	90	2.4	88	2			1356.1	IKMT NET DEEPEST
100307	943	+08:00	00 29.650S	120 47.018E	1995	St4	90	1.5	95	1			1357.9	IKMT NET FINISHED
100307	954	+08:00	00 30.290S	120 47.213E	1994		169	4.9	175	4.7	281	0.5	1358.6	CHANGED ENG'S TO T/M
100307	1301	+08:00	01 19.015S	120 44.045E	903		183	6.3	183	5.8	6	0.4	1407.2	CHANGED ENG'S TO S/M
100307	1333	+08:00	01 21.617S	120 45.072E	437		340	5.8	340	5.9	36	0.1	1411.4	CHANGED ENG'S TO T/M
100307	1554	+08:00	01 09.417S	120 42.982E	918		139	0.8	153	0.9			1442.5	CHANGED ENG'S TO E/M
100307	1723	+08:00	01 10.018S	120 42.950E	888		55	0.1	182	0.4			1443.2	FOUND!
100307	1742	+08:00	01 10.130S	120 42.985E	892		62	1.8	77	1.9			1443.3	CHANGED ENG'S TO T/M
100307	1823	+08:00	01 06.916S	120 51.492E	1595		75	16.8	77	16.6	193	0.5	1452.7	SUNSET & PUT ON REGULATION LIGHTS
100307	1957	+08:00	01 00.015S	121 14.872E	1679		69	2.2	78	2.2	139	0.3	1477	CHANGED ENG'S TO E/M
100307	2004	+08:00	00 59.977S	121 14.979E	1678	St7	40	0.5	84	0.3			1477.2	CTD STARTED
100307	2039	+08:00	01 00.018S	121 14.865E	1678	St7	29	0.2	290	0.2			1477.3	CTD DEEPEST
100307	2111	+08:00	00 59.884S	121 14.781E	1678	St7	50	0.4	357	0.3			1477.5	CTD FINISHED
100307	2120	+08:00	00 59.723S	121 14.914E	1675	St7	50	2.6	45	2.5	324	0.2	1477.7	IKMT NET STARTED
100307	2136	+08:00	00 59.294S	121 15.381E	1668	St7	55	2.5	52	2.3	259	0.3	1478.3	IKMT NET DEEPEST
100307	2253	+08:00	00 57.828S	121 17.189E	1591	St7	60	1.4	45	1.7			1480.7	IKMT NET FINISHED
100307	2305	+08:00	00 57.097S	121 17.195E	1589		352	4.5	350	4.8	321	0.2	1481.5	CHANGED ENG'S TO T/M
100308	4	+08:00	00 45.255S	121 14.077E	1775		60	0.4	297	0.9			1493.8	STOPPED ENG'S
100308	6	+08:00	00 45.241S	121 14.046E	1772		49	0.2	288	1.1			1493.8	CHANGED ENG'S TO E/M
100308	11	+08:00	00 45.211S	121 13.979E	1772	St8	59	0.2	311	0.8			1493.9	CTD STARTED
100308	46	+08:00	00 44.973S	121 13.898E	1772	St8	80	0.8	347	0.3			1494.2	CTD DEEPEST
100308	118	+08:00	00 44.877S	121 13.851E	1771	St8	80	0.6	344	0.3			1494.3	CTD FINISHED

KH-09-5 Leg7

Date (YYMMDD)	Time (hhmm)	Time Difference between Ship Time and UTC	Latitude	Longitude	Water Depth (m)	Station Name	Heading (deg.)	Log Speed (knot)	System Course (deg.)	System Speed (knot)	Current Direction (deg.)	Current Speed (knot)	Distance (mile)	Comment
100308	124	+08:00	00 44.846S	121 13.875E	1772	St8	80	1.4	64	0.9			1494.4	IKMT NET STARTED
100308	138	+08:00	00 44.710S	121 14.267E	1780	St8	78	2.1	65	1.6			1494.8	IKMT NET DEEPEST
100308	245	+08:00	00 44.566S	121 15.807E	1781	St8	118	1.5	101	1			1496.4	IKMT NET FINISHED
100308	300	+08:00	00 43.832S	121 15.616E	1789		341	2.8	337	3.2	309	0.5	1497.3	CHANGED ENG'S TO T/M
100308	300	+08:00	00 43.827S	121 15.614E	1788		341	2.7	337	3.3	305	0.5	1497.3	SLOW AHEAD ENG'S
100308	409	+08:00	00 29.093S	121 14.238E	1836		293	0.9	332	0.8			1512.3	STOPPED ENG'S
100308	415	+08:00	00 29.059S	121 14.232E	1835		239	0.4	55	0.1			1512.3	CHANGED ENG'S TO E/M
100308	419	+08:00	00 29.073S	121 14.242E	1834	St9	239	0.2	162	0.3			1512.3	CTD-CMS STARTED
100308	454	+08:00	00 29.199S	121 14.328E	1835	St9	240	0.5	252	0.6			1512.6	CTD-CMS DEEPEST
100308	535	+08:00	00 29.180S	121 14.399E	1834	St9	240	0	44	0.2			1512.8	CTD-CMS FINISHED
100308	544	+08:00	00 29.150S	121 14.339E	1835	St9	270	1.5	272	1.7			1512.9	IKMT NET STARTED
100308	601	+08:00	00 29.125S	121 13.643E	1840	St9	270	2.2	271	2.5	299	0.2	1513.6	IKMT NET DEEPEST
100308	618	+08:00	00 29.092S	121 12.991E	1848	St9	270	2.2	274	2.3	332	0.2	1514.2	SUNRISE & TURNED OFF REGULATION LIGHTS
100308	717	+08:00	00 28.878S	121 10.922E	1889	St9	270	1.5	276	1.8			1516.3	IKMT NET FINISHED
100308	730	+08:00	00 29.249S	121 10.514E	1890		200	3	209	3.3	272	0.5	1516.9	CHANGED ENG'S TO T/M
100308	1109	+08:00	01 18.333S	120 44.082E	866		212	2.9	212	2.6	48	0.6	1572.5	CHANGED ENG'S TO E/M
100308	1758	+08:00	01 18.446S	120 44.382E	924		160	0	343	0.6			1574.3	CHANGED ENG'S TO T/M
100308	1816	+08:00	01 16.783S	120 45.364E	764		30	15.4	31	14.5	179	0.6	1576.3	SUNSET & PUT ON REGULATION LIGHTS
100308	1948	+08:00	00 59.682S	121 00.433E	1809		158	0.2	104	0.3			1599.2	CHANGED ENG'S TO E/M
100308	1951	+08:00	00 59.680S	121 00.449E	1808	St1	160	0.1	80	0.2			1599.2	CTD STARTED
100308	2029	+08:00	00 59.683S	121 00.580E	1808	St1	160	0.1	57	0.2			1599.4	CTD DEEPEST
100308	2105	+08:00	00 59.646S	121 00.621E	1808	St1	160	0.4	109	0.2			1599.5	CTD FINISHED
100308	2113	+08:00	00 59.767S	121 00.705E	1810	St1	150	2.6	145	2.5	333	0.5	1599.6	IKMT NET STARTED
100308	2129	+08:00	01 00.347S	121 01.099E	1812	St1	150	2.3	145	2.4	46	0.2	1600.3	IKMT NET DEEPEST
100308	2244	+08:00	01 02.297S	121 02.359E	1738	St1	160	1.5	151	1.3			1602.7	IKMT NET FINISHED
100308	2255	+08:00	01 02.280S	121 01.864E	1744		290	4.4	293	4.7	9	0.2	1603.3	CHANGED ENG'S TO T/M
100309	11	+08:00	01 00.069S	120 44.942E	1380		201	0.9	285	0.1			1620.4	STOPPED ENG'S
100309	14	+08:00	01 00.062S	120 44.937E	1381		188	0.2	334	0.2			1620.5	CHANGED ENG'S TO E/M
100309	22	+08:00	01 00.063S	120 44.940E	1381		180	0.6	184	0.6			1620.5	IKMT NET STARTED
100309	37	+08:00	01 00.588S	120 44.977E	1382	St6	180	2.4	174	2.3	48	0.3	1621	IKMT NET DEEPEST
100309	150	+08:00	01 02.697S	120 45.196E	1157	St6	180	1.9	170	1.8			1623.1	IKMT NET FINISHED
100309	200	+08:00	01 02.798S	120 45.245E	1161	St6	180	0.1	81	0.3			1623.2	CTD STARTED
100309	226	+08:00	01 02.831S	120 45.311E	1204	St6	180	0.2	14	0.2			1623.4	CTD DEEPEST
100309	248	+08:00	01 02.742S	120 45.338E	1212	St6	180	0.1	32	0.2			1623.5	CTD FINISHED
100309	300	+08:00	01 02.592S	120 45.222E	1181		355	3	359	2.6	155	0.1	1623.9	CHANGED ENG'S TO T/M
100309	300	+08:00	01 02.591S	120 45.222E	1197		355	3	0	2.7	150	0.1	1623.9	SLOW AHEAD ENG'S
100309	419	+08:00	00 45.023S	120 44.889E	1397		118	0.1	267	0.6			1641.4	CHANGED ENG'S TO E/M
100309	422	+08:00	00 45.017S	120 44.866E	1399	St5	190	0.1	322	0.5			1641.4	CTD STARTED
100309	451	+08:00	00 44.925S	120 44.798E	1405	St5	100	0.2	278	0.5			1641.6	CTD DEEPEST
100309	519	+08:00	00 44.916S	120 44.571E	1415	St5	80	0.2	257	0.7			1641.9	CTD FINISHED
100309	527	+08:00	00 44.881S	120 44.458E	1419	St5	341	1.5	320	1.7			1642	IKMT NET STARTED
100309	540	+08:00	00 44.444S	120 44.149E	1447	St5	341	2.3	323	2.3	250	0.7	1642.5	IKMT NET DEEPEST
100309	604	+08:00	00 43.743S	120 43.600E	1498	St5	340	2.3	324	2.3	248	0.7	1643.4	SUNRISE & TURNED OFF REGULATION LIGHTS
100309	656	+08:00	00 42.351S	120 42.314E	1616	St5	332	1.5	291	1.9	288	12	1645.4	IKMT NET FINISHED
100309	707	+08:00	00 42.415S	120 41.739E	1634		246	4.3	249	4.7	262	0.7	1646	CHANGED ENG'S TO T/M
100309	758	+08:00	00 44.115S	120 30.912E	1628		9	2.1	348	2.1	280	0.7	1657.6	CHANGED ENG'S TO E/M
100309	802	+08:00	00 44.043S	120 30.894E	1630	St10	50	0.4	311	0.6			1657.7	CTD-CMS STARTED
100309	833	+08:00	00 43.944S	120 30.767E	1629	St10	50	0.5	34	0.2			1657.9	CTD-CMS DEEPEST
100309	907	+08:00	00 43.892S	120 30.710E	1624	St10	29	0.5	315	0.5			1658	CTD-CMS FINISHED
100309	917	+08:00	00 43.712S	120 30.871E	1641	St10	50	2.9	51	2.6	220	0.2	1658.3	IKMT NET STARTED
100309	934	+08:00	00 43.322S	120 31.339E	1685	St10	50	2.5	50	2.2	236	0.2	1658.9	IKMT NET DEEPEST
100309	1040	+08:00	00 42.054S	120 32.997E	1735	St10	50	1.2	58	1			1661	IKMT NET FINISHED
100309	1052	+08:00	00 42.534S	120 33.377E	1748		149	4.9	153	4.9	261	0.4	1661.7	CHANGED ENG'S TO T/M
100309	1327	+08:00	01 18.394S	120 44.158E	892		100	1	51	0.1			1700.4	STOPPED ENG'S
100309	1328	+08:00	01 18.394S	120 44.160E	892		91	0.4	108	0.1			1700.4	CHANGED ENG'S TO E/M
100309	1355	+08:00	01 18.320S	120 44.157E	885		130	0.2	328	0.3			1700.5	CHANGED ENG'S TO T/M
100309	1403	+08:00	01 18.195S	120 44.105E	846		168	0.1	350	1.6			1700.6	SLOW AHEAD ENG'S
100309	1653	+08:00	01 14.102S	121 09.905E	974		328	1.2	341	1.2			1743.2	CHANGED ENG'S TO E/M
100309	1839	+08:00	01 12.946S	121 12.043E	502		270	0.4	254	0.8			1746.8	CHANGED ENG'S TO T/M
100309	2241	+08:00	00 14.993S	121 29.866E	1645		326	2.1	331	2.2	6	0.2	1810.4	CHANGED ENG'S TO E/M
100309	2246	+08:00	00 14.942S	121 29.804E	1650	St14	230	0.3	303	0.6			1810.4	CTD-CMS STARTED
100309	2322	+08:00	00 14.857S	121 29.838E	1645	St14	229	0	340	0.3			1810.7	CTD-CMS DEEPEST
100309	2359	+08:00	00 14.840S	121 29.867E	1642	St14	229	0.1	333	0.1			1810.8	CTD-CMS FINISHED
100310	13	+08:00	00 14.813S	121 29.751E	1651	St14	224	1.9	240	1.9			1811	IKMT NET STARTED
100310	31	+08:00	00 15.247S	121 29.149E	1712	St14	224	2.2	235	2.3	292	0.3	1811.7	IKMT NET DEEPEST
100310	153	+08:00	00 16.633S	121 26.686E	1849	St14	234	2	250	2.2	308	0.6	1814.6	IKMT NET FINISHED
100310	207	+08:00	00 16.934S	121 25.774E	1872		248	3.5	254	3.5	282	0.2	1815.5	CHANGED ENG'S TO T/M
100310	207	+08:00	00 16.935S	121 25.773E	1872		248	3.5	254	3.5	298	0.2	1815.5	SLOW AHEAD ENG'S
100310	231	+08:00	00 18.467S	121 21.341E	1981		249	16.9	250	16.6	78	0.2	1820.2	R/UP ENG'S
100310	524	+08:00	00 36.446S	120 37.914E	1840		272	0.4	258	1.4			1867.3	CHANGED ENG'S TO E/M
100310	610	+08:00	00 36.488S	120 37.281E	1833		209	0.2	270	0.9			1868	SUNRISE & TURNED OFF REGULATION LIGHTS
100310	1803	+08:00	00 40.876S	120 25.718E	1700		279	0.6	274	1.3			1892.2	CHANGED ENG'S TO T/M
100310	1814	+08:00	00 40.242S	120 26.390E	1693		53	11	53	10.4	226	0.3	1893.2	SUNSET & PUT ON REGULATION LIGHTS
100310	2102	+08:00	00 14.959S	120 59.907E	2020		45	0.5	311	0.6			1935.3	CHANGED ENG'S TO E/M
100310	2103	+08:00	00 14.957S	120 59.906E	2020	St13	45	0.5	310	0.7			1935.3	CTD STARTED
100310	2137	+08:00	00 14.780S	120 59.813E	2020	St13	85	0.7	357	0.3			1935.6	CTD DEEPEST
100310	2211	+08:00	00 14.644S	120 59.752E	2020	St13	85	0.5	298	0.4			1935.8	CTD FINISHED
100310	2219	+08:00	00 14.609S	120 59.859E	2020	St13	85	2.5	78	1.8			1935.9	IKMT NET STARTED
100310	2236	+08:00	00 14.517S	121 00.349E	2019	St13	85	2.3	80	1.7			1936.5	IKMT NET DEEPEST
100310	2339	+08:00	00 14.151S	121 01.830E	2018	St13	84	1.5	78	0.9			1938	IKMT NET FINISHED
100310	2350	+08:00	00 14.260S	121 01.534E	2018		269	4.6	272	4.8	320	0.3	1938.5	CHANGED ENG'S TO T/M
100311	156	+08:00	00 15.011S	120 29.935E	1850		282	1.1	278	0.6			1970.2	STOPPED ENG'S
100311	159	+08:00	00 15.007S	120 29.897E	1850		310	0.2	282	0.7			1970.3	CHANGED ENG'S TO E/M
100311	211	+08:00	00 15.026S	120 29.810E	1850	St12	239	0.2	249	0.3			1970.4	CTD STARTED
100311	237	+08:00	00 15.043S	120 29.742E	1850	St12	270	0	321	0.2			1970.5	CTD DEEPEST
100311	259	+08:00	00 15.029S	120 29.698E	1850	St12	270	0.2	303	0.2			1970.5	CTD FINISHED
100311	306	+08:00	00 15.026S	120 29.666E	1850	St12	270	0.6	270	0.9			1970.6	IKMT NET STARTED
100311	322	+08:00	00 15.024S	120 29.002E	1845	St12	271	2.5	270	2.6	280	0.2	1971.2	IKMT NET DEEPEST
100311	436	+08:00	00 15.087S	120 26.495E	1834	St12	271	1.5	267	1.3			1973.8	IKMT NET FINISHED
100311	448	+08:00	00 15.449S	120 26.357E	1835		171	2.7	172	2.7	342	0.2	1974.3	CHANGED ENG'S TO T/M
100311	1719	+08:00	00 31.170S	120 29.525E	1881		325	0.7	308	0.8			2175	STOPPED ENG'S
100311	1720	+08:00	00 31.156S	120 29.509E	1880		339	0.6	312	0.7			2175	CHANGED ENG'S TO E/M
100311	1725	+08:00	00 31.147S	120 29.470E	1878	St11	270	0.4	264	0.4			2175	CTD STARTED
100311	1803	+08:00	00 31.198S	120 29.443E	1878	St11	270	0.1	249	0.1			2175.2	CTD DEEPEST
100311	1813	+08:00	00 31.212S	120 29.421E	1877		270	0.1	237	0.1			2175.2	SUNSET & PUT ON REGULATION LIGHTS
100311	1835	+08:00	00 31.235S	120 29.408E	1878	St11	270	0	171	0.1			2175.3	CTD FINISHED
100311	1841	+08:00	00 31.231S	120 29.365E	1876	St11	278	1.6	277	1.8			2175.3	IKMT NET STARTED
100311	1857	+08:00	00 31.153S	120 28.656E	1878	St11	279	2.5	275	2.6	237	0.2	2176	IKMT NET DEEPEST
100311	2017	+08:00	00 30.705S	120 25.965E	1875	St11	285	1.6	280	1.7			2178.8	IKMT NET FINISHED
100311	2029	+08:00	00 30.236S	120 25.279E	1883		326	4.9	322	5.2	272	0.5	2179.6	CHANGED ENG'S TO T/M
100311	2149	+08:00	00 15.000S	120 14.020E	1705		303	2.3	315	2.2	60	0.5	2198.6	CHANGED ENG'S TO E/M
100311	2153	+08:00	00 14.946S	120 13.965E	1704	St15	270	0.7	334	0.6			2198.7	CTD STARTED
100311	2212	+08:00	00 14.833S	120 13.981E	1703	St15	230	0.3	11	0.2			2198.8	CTD DEEPEST
100311	2228	+08:00	00 14.834S	120 13.975E	1703	St15	230	0.4	66	0.3			2198.8	CTD FINISHED
100311	2235	+08:00	00 14.817S	120 14.075E	1705	St15	74	2.3	71	2.5	14	12	2198.9	IKMT NET STARTED
100311	2251	+08:00	00 14.587S	120 14.766E	1721	St15	80	2.6	75	2.6	2	0.2	2199.7	IKMT NET DEEPEST
100312	8	+08:00	00 14.037S	120 17.359E	1778	St15	80	1.3	76	1.5			2202.3	IKMT NET FINISHED

KH-09-5 Leg7

Date (YYMMDD)	Time (hhmm)	Time Difference between Ship Time and UTC	Latitude	Longitude	Water Depth (m)	Station Name	Heading (deg.)	Log Speed (knot)	System Course (deg.)	System Speed (knot)	Current Direction (deg.)	Current Speed (knot)	Distance (mile)	Comment
100312	20	+08:00	00 13.581S	120 17.899E	1779		41	3.6	43	3.6	177	0.1	2203	CHANGED ENG'S TO T/M
100312	20	+08:00	00 13.581S	120 17.899E	1779		41	3.6	41	3.5	177	0.1	2203	SLOW AHEAD ENG'S
100312	139	+08:00	00 00.090S	120 29.771E	1415		274	0.5	28	0.4			2221	STOPPED ENG'S
100312	141	+08:00	00 00.082S	120 29.780E	1412		268	0.4	28	0.5			2221	CHANGED ENG'S TO E/M
100312	149	+08:00	00 00.058S	120 29.796E	1407	St16	270	0.1	46	0.2			2221.1	CTD STARTED
100312	205	+08:00	00 00.047S	120 29.821E	1404	St16	209	0.2	148	0.1			2221.1	CTD DEEPEST
100312	219	+08:00	00 00.042S	120 29.836E	1403	St16	209	0.2	73	0.1			2221.1	CTD FINISHED
100312	226	+08:00	00 00.043S	120 29.803E	1402	St16	270	1.2	272	1.3			2221.2	IKMT NET STARTED
100312	241	+08:00	00 00.014S	120 29.279E	1437	St16	270	2.2	271	2			2221.7	IKMT NET DEEPEST
100312	401	+08:00	00 00.111N	120 26.992E	1360	St16	270	1.5	275	1.2			2224	IKMT NET FINISHED
100312	413	+08:00	00 00.024S	120 27.170E	1145		91	2.6	88	2.5	33	0.2	2224.5	CHANGED ENG'S TO T/M
100312	606	+08:00	00 00.095S	120 56.306E	1938		88	16.8	88	16.7	141	0.2	2253.7	SUNRISE & TURNED OFF REGULATION LIGHTS
100312	627	+08:00	00 00.005N	120 59.920E	1952		103	0.2	84	0.6			2257.3	CHANGED ENG'S TO E/M
100312	632	+08:00	00 00.008N	120 59.958E	1952	St17	120	0.2	78	0.4			2257.4	CTD-CMS STARTED
100312	648	+08:00	00 00.020N	121 00.022E	1953	St17	120	0.1	48	0.2			2257.5	NORPAC NET STARTED
100312	649	+08:00	00 00.021N	121 00.022E	1953	St17	121	0.1	23	0.2			2257.5	CTD-CMS DEEPEST
100312	701	+08:00	00 00.039N	121 00.049E	1953	St17	120	0.1	73	0.3			2257.5	NORPAC NET FINISHED
100312	711	+08:00	00 00.045N	121 00.081E	1954	St17	120	0.2	90	0.2			2257.5	CTD-CMS FINISHED
100312	718	+08:00	00 00.005N	121 00.110E	1955	St17	170	1.8	166	1.8			2257.6	IKMT NET STARTED
100312	751	+08:00	00 01.302S	121 00.494E	1987	St17	170	1.9	162	2	127	0.6	2259	IKMT NET DEEPEST
100312	848	+08:00	00 03.127S	121 01.111E	2004	St17	170	1.5	161	1.7			2260.9	IKMT NET FINISHED
100312	858	+08:00	00 03.235S	121 01.711E	2005		85	5	87	5.1	208	0.1	2261.6	CHANGED ENG'S TO T/M
100312	1052	+08:00	00 00.027N	121 30.017E	1861		111	2.1	110	2.2	94	0.2	2290.1	CHANGED ENG'S TO E/M
100312	1056	+08:00	00 00.008N	121 30.071E	1859	St18	100	0.5	108	0.6			2290.1	CTD STARTED
100312	1113	+08:00	00 00.013N	121 30.123E	1859	St18	100	0	310	0.1			2290.3	CTD DEEPEST
100312	1131	+08:00	00 00.009N	121 30.142E	1858	St18	100	0.1	287	0.2			2290.3	CTD FINISHED
100312	1138	+08:00	00 00.000N	121 30.282E	1856	St18	95	2.8	96	2.8	82	0.1	2290.5	IKMT NET STARTED
100312	1209	+08:00	00 00.106S	121 31.549E	1824	St18	95	2.3	96	2.3	99	0	2291.8	IKMT NET DEEPEST
100312	1259	+08:00	00 00.332S	121 33.114E	1759	St18	95	1.6	101	1.7			2293.3	IKMT NET FINISHED
100312	1312	+08:00	00 00.429S	121 33.988E	1722		90	3.7	95	3.8	175	0.3	2294.2	CHANGED ENG'S TO T/M
100312	1312	+08:00	00 00.429S	121 33.989E	1722		90	3.7	95	3.7	175	0.3	2294.2	SLOW AHEAD ENG'S
100312	1459	+08:00	00 00.059S	121 59.989E	1737		350	0.6	17	0.4			2320.3	STOPPED ENG'S
100312	1501	+08:00	00 00.051S	121 59.992E	1738		335	0.5	15	0.3			2320.3	CHANGED ENG'S TO E/M
100312	1505	+08:00	00 00.040S	121 59.994E	1739	St19	360	0.3	249	0.3			2320.4	CTD-CMS STARTED
100312	1521	+08:00	00 00.062S	121 59.993E	1737	St19	0	0.3	156	0.3			2320.4	CTD-CMS DEEPEST
100312	1542	+08:00	00 00.078S	122 00.029E	1735	St19	20	0.2	108	0.2			2320.5	CTD-CMS FINISHED
100312	1548	+08:00	00 00.088S	122 00.069E	1733	St19	90	0.9	94	1.1			2320.5	IKMT NET STARTED
100312	1623	+08:00	00 00.159S	122 01.575E	1734	St19	90	2	93	2.4	111	0.4	2322.1	IKMT NET DEEPEST
100312	1718	+08:00	00 00.237S	122 03.541E	1724	St19	90	1.6	92	1.8			2324	IKMT NET FINISHED
100312	1729	+08:00	00 00.259S	122 04.441E	1732		94	3.4	94	3.8	90	0.4	2324.9	CHANGED ENG'S TO T/M
100312	1917	+08:00	00 00.032S	122 30.054E	2586		349	0.4	221	0.4			2350.6	CHANGED ENG'S TO E/M
100312	1918	+08:00	00 00.036S	122 30.060E	2590	St20	330	0.4	112	0.5			2350.6	CTD STARTED
100312	1930	+08:00	00 00.116S	122 30.112E	2589	St20	311	0.3	151	0.4			2350.7	NORPAC NET STARTED
100312	1936	+08:00	00 00.140S	122 30.120E	2592	St20	311	0.6	183	0.2			2350.8	CTD DEEPEST
100312	1940	+08:00	00 00.153S	122 30.113E	2593	St20	310	0.6	232	0.2			2350.8	NORPAC NET FINISHED
100312	1951	+08:00	00 00.216S	122 30.146E	2601	St20	310	0.3	154	0.4			2350.8	CTD FINISHED
100312	2000	+08:00	00 00.198S	122 30.325E	2618	St20	90	2.6	95	2.9	35	0.6	2351	IKMT NET STARTED
100312	2017	+08:00	00 00.302S	122 31.092E	2665	St20	90	2.2	98	2.4	182	0.5	2351.9	IKMT NET DEEPEST
100312	2136	+08:00	00 00.601S	122 34.177E	2755	St20	90	1.4	94	1.8			2354.9	IKMT NET FINISHED
100312	2148	+08:00	00 00.492S	122 34.998E	2789		80	5.1	81	5.4	152	0.1	2355.8	CHANGED ENG'S TO T/M
100312	2332	+08:00	00 00.015N	122 59.954E	3378		98	2.4	93	2.5	45	0.3	2380.8	CHANGED ENG'S TO E/M
100312	2338	+08:00	00 00.021N	123 00.067E	3384	St21	100	0.6	78	0.8			2380.9	CTD-CMS STARTED
100312	2356	+08:00	00 00.086N	123 00.163E	3386	St21	110	0.1	321	0.5			2381.1	CTD-CMS DEEPEST
100313	18	+08:00	00 00.162N	123 00.170E	3382	St21	111	0.1	338	0.5			2381.2	CTD-CMS FINISHED
100313	23	+08:00	00 00.186N	123 00.164E	3378	St21	110	0.6	89	0.8			2381.2	IKMT NET STARTED
100313	40	+08:00	00 00.045N	123 00.757E	3388	St21	111	2.4	105	2.3	24	0.3	2381.8	IKMT NET DEEPEST
100313	159	+08:00	00 00.571S	123 02.955E	3438	St21	111	1.5	108	1.4			2384.1	IKMT NET FINISHED
100313	211	+08:00	00 00.433S	123 03.733E	3444		76	3.1	76	3.1	277	0.2	2385	CHANGED ENG'S TO T/M
100313	211	+08:00	00 00.433S	123 03.734E	3441		76	3.1	76	3.2	277	0.2	2385	SLOW AHEAD ENG'S
100313	212	+08:00	00 00.431S	123 03.740E	3441		76	3.1	76	3.1	278	0.1	2385	S/CO ON 080°
100313	236	+08:00	00 00.923N	123 08.267E	3463		71	16.6	71	16.3	251	0.4	2389.6	R/UP ENG'S
100313	554	+08:00	00 10.788N	124 02.490E	2956		83	16.9	83	17.1	57	0.4	2444.9	SUNRISE & TURNED OFF REGULATION LIGHTS
100313	733	+08:00	00 16.182N	124 30.182E	2636		51	16.2	54	16.9	107	0.5	2473.3	A/CO TO 050°
100313	1020	+08:00	00 46.181N	125 06.191E	1718		18	16.2	18	15.8	207	0.7	2520	A/CO TO 017°
100313	1249	+08:00	01 25.565N	125 18.963E	672		30	15.2	30	17.4	35	1.8	2561.3	A/CO TO 030°
100313	1317	+08:00	01 32.718N	125 22.923E	1040		25	16.5	25	17.5	13	1.4	2569.4	A/CO TO 338°
100313	1458	+08:00	01 59.923N	125 11.332E	2074		274	15.8	277	16.8	309	0.5	2599.1	A/CO TO 270°
100313	1530	+08:00	02 00.006N	125 01.732E	1131		269	16.6	268	17.7	255	1.2	2608.5	S/B ENG'S
100313	1531	+08:00	02 00.005N	125 01.683E	1138		270	16.6	269	17.5	255	1.1	2608.5	USED HELM VAR'LY
100313	1543	+08:00	02 00.039N	124 59.962E	1368		9	0.8	272	0.8			2610.4	STOPPED ENG'S
100313	1546	+08:00	02 00.036N	124 59.910E	1380		5	0.2	265	1.2			2610.4	CHANGED ENG'S TO E/M
100313	1555	+08:00	02 00.020N	124 59.812E	1411	St22	0	0	243	0.5			2610.5	CTD-CMS STARTED
100313	1613	+08:00	02 00.060N	124 59.637E	1470	St22	51	0.9	331	0.4			2610.8	CTD-CMS DEEPEST
100313	1634	+08:00	02 00.089N	124 59.401E	1502	St22	10	0.5	266	0.9			2611	CTD-CMS FINISHED
100313	1642	+08:00	02 00.119N	124 59.265E	1518	St22	350	0.5	282	1.5			2611.2	NORPAC NET STARTED
100313	1701	+08:00	02 00.085N	124 58.839E	1554	St22	359	0.1	268	1.4			2611.6	NORPAC NET FINISHED
100313	1709	+08:00	02 00.096N	124 58.756E	1577	St22	60	1.6	46	1			2611.8	IKMT NET STARTED
100313	1737	+08:00	02 00.591N	124 59.432E	1469	St22	60	2.1	48	1.4			2612.6	IKMT NET DEEPEST
100313	1754	+08:00	02 00.905N	124 59.714E	1506	St22	60	2.5	40	1.8			2613.1	SUNSET & PUT ON REGULATION LIGHTS
100313	1820	+08:00	02 01.401N	125 00.007E	1516	St22	40	1.9	18	1.7			2613.7	IKMT NET FINISHED
100313	1833	+08:00	02 02.055N	125 00.188E	1666	St22	30	3.5	17	3.7	301	0.9	2614.4	CHANGED ENG'S TO T/M
100313	2025	+08:00	02 29.980N	125 00.020E	3318		45	2.5	31	2.6	296	0.6	2643.1	CHANGED ENG'S TO S/M
100313	2028	+08:00	02 30.056N	125 00.084E	3316	St23	55	2.5	54	2.3	297	0.4	2643.2	IKMT NET STARTED
100313	2045	+08:00	02 30.490N	125 00.550E	3310	St23	54	2.1	56	1.8			2643.8	IKMT NET DEEPEST
100313	2153	+08:00	02 31.717N	125 02.612E	3174	St23	55	1.3	66	1.8			2646.4	IKMT NET FINISHED
100313	2159	+08:00	02 31.907N	125 02.683E	3168		353	4.1	352	4	316	0.4	2646.6	CHANGED ENG'S TO T/M
100313	2359	+08:00	02 59.835N	124 59.932E	4126		105	0.2	211	1			2674.7	CHANGED ENG'S TO E/M
100314	4	+08:00	02 59.805N	124 59.871E	4124	St24	19	0.3	307	1.1			2674.7	CTD-CMS STARTED
100314	21	+08:00	02 59.776N	124 59.773E	4127	St24	61	0.5	213	0.2			2675	CTD-CMS DEEPEST
100314	43	+08:00	02 59.693N	124 59.781E	4120	St24	30	0.2	242	0.5			2675.2	CTD-CMS FINISHED
100314	49	+08:00	02 59.641N	124 59.755E	4120	St24	30	0.1	108	0.3			2675.2	IKMT NET STARTED
100314	108	+08:00	03 00.235N	125 00.046E	4138	St24	41	2.4	43	2.5	266	0.1	2675.9	IKMT NET DEEPEST
100314	223	+08:00	03 01.901N	125 01.588E	4139	St24	39	1.2	32	1.1			2678.3	IKMT NET FINISHED
100314	235	+08:00	03 02.042N	125 01.251E	4151		264	2.6	254	3	194	0.7	2678.8	CHANGED ENG'S TO T/M
100314	235	+08:00	03 02.041N	125 01.249E	4151		264	2.6	246	3.1	194	0.7	2678.8	SLOW AHEAD ENG'S
100314	235	+08:00	03 02.041N	125 01.245E	4151		263	2.8	266	3.1	204	0.6	2678.8	S/CO ON 270°
100314	300	+08:00	03 01.578N	124 56.441E	4246		265	16.2	264	16.3	165	0.1	2683.7	R/UP ENG'S
100314	548	+08:00	03 00.126N	124 10.362E	4678		270	16.2	272	17.2	313	0.7	2729.9	SUNRISE & TURNED OFF REGULATION LIGHTS
100314	802	+08:00	03 00.045N	123 31.949E	4908		266	16.9	268	17.3	316	0.9	2768.1	S/B ENG'S
100314	813	+08:00	03 00.099N	123 29.968E	4915		339	1.3	311	2.2	277	1.4	2770.2	CHANGED ENG'S TO E/M
100314	822	+08:00	03 00.204N	123 29.745E	4916	St25	70	0.1	300	1.2			2770.5	CTD-CMS STARTED
100314	844	+08:00	03 00.499N	123 29.598E	4915	St25	91	1.1	13	0.9			2770.9	CTD-CMS DEEPEST
100314	912	+08:00	03 00.876N	123 29.484E	4914	St25	71	0.5	318	1.2			2771.3	CTD-CMS FINISHED
100314	925	+08:00	03 01.041N	123 29.251E	4914	St25	60	0.4	306	1.8			2771.6	NORPAC NET STARTED
100314	941	+08:00	03 01.347N	123 28.921E	4919	St25	60	0.4	303	1.8			2772.1	NORPAC NET FINISHED
100314	951	+08:00	03 01.539N	123 28.766E	4915	St25	80	1.9	27	1.1			2772.3	IKMT NET STARTED
100314	1018	+08:00	03 02.065N	123 29.158E	4909	St25	79	1.9	18	1.3			2773	IKMT NET DEEPEST

Date (YYMMDD)	Time (hhmm)	Time Difference between Ship Time and UTC	Latitude	Longitude	Water Depth (m)	Station Name	Heading (deg.)	Log Speed (knot)	System Course (deg.)	System Speed (knot)	Current Direction (deg.)	Current Speed (knot)	Distance (mile)	Comment
100314	1047	+08:00	03 02.545N	123 29.314E	4909	St25	80	1.6	349	0.8			2773.6	IKMT NET FINISHED
100314	1058	+08:00	03 02.789N	123 28.820E	4913		266	4.2	273	5.8	295	1.6	2774.2	CHANGED ENG'S TO T/M
100314	1120	+08:00	03 02.788N	123 24.052E	4941		265	15.6	268	17.4	299	1.7	2778.9	R/UP ENG'S
100314	1555	+08:00	03 00.020N	122 01.546E	5109		268	16.8	268	17.8	272	1.4	2861.7	S/B ENG'S
100314	1606	+08:00	03 00.078N	122 00.148E	5096		335	0.2	268	2.2	260	2.2	2863	CHANGED ENG'S TO E/M
100314	1611	+08:00	03 00.090N	121 59.967E	5095	St26	59	0.4	276	2.2	269	2.5	2863.2	CTD-CMS STARTED
100314	1629	+08:00	03 00.183N	121 59.616E	5095	St26	70	1.6	340	0.7			2863.5	CTD-CMS DEEPEST
100314	1650	+08:00	03 00.299N	121 59.303E	5088	St26	59	0.3	273	1.8			2863.9	CTD-CMS FINISHED
100314	1657	+08:00	03 00.301N	121 59.176E	5089	St26	80	2.1	84	0.4			2864.1	IKMT NET STARTED
100314	1723	+08:00	03 00.320N	121 59.707E	5094	St26	84	2.8	86	1.2			2864.6	IKMT NET DEEPEST
100314	1802	+08:00	03 00.392N	122 00.372E	5095	St26	86	1.3	173	0.3			2865.3	IKMT NET FINISHED
100314	1806	+08:00	03 00.318N	122 00.371E	5097		178	2.5	210	3.1	247	1.6	2865.4	SUNSET & PUT ON REGULATION LIGHTS
100314	1813	+08:00	03 00.221N	121 59.900E	5092		265	3.4	265	5.2	261	1.6	2865.9	CHANGED ENG'S TO T/M
100314	1910	+08:00	02 59.781N	121 45.217E	5044		332	2.8	295	3.8	240	1.8	2880.6	CHANGED ENG'S TO S/M
100314	1914	+08:00	02 59.848N	121 45.162E	5045	St27	78	2.3	81	0.7			2880.7	IKMT NET STARTED
100314	1953	+08:00	02 59.827N	121 45.801E	5044	St27	83	2.3	103	0.8			2881.4	IKMT NET DEEPEST
100314	2041	+08:00	02 59.690N	121 46.112E	5044	St27	85	1.3	254	0.8			2881.8	IKMT NET FINISHED
100314	2050	+08:00	02 59.740N	121 45.676E	5046		271	4.7	267	6.7	258	1.8	2882.3	CHANGED ENG'S TO T/M
100314	2240	+08:00	02 59.965N	121 15.091E	5059		244	3.5	253	5.2	265	1.6	2912.9	CHANGED ENG'S TO S/M
100314	2246	+08:00	02 59.837N	121 14.927E	5061	St28	99	2.6	156	1.1			2913.1	IKMT NET STARTED
100314	2259	+08:00	02 59.647N	121 15.055E	5062	St28	100	2.5	149	0.8			2913.4	IKMT NET DEEPEST
100315	14	+08:00	02 59.345N	121 15.921E	5067	St28	90	1.8	144	0.7			2914.5	IKMT NET FINISHED
100315	25	+08:00	02 59.284N	121 15.273E	5063		270	6	260	7	219	1.6	2915.2	CHANGED ENG'S TO T/M
100315	214	+08:00	02 59.938N	120 45.207E	4954		270	6.6	269	7.1	240	1	2945.3	CHANGED ENG'S TO S/M
100315	219	+08:00	02 59.761N	120 45.042E	4953	St29	124	1.5	189	1.6			2945.5	IKMT NET STARTED
100315	236	+08:00	02 59.266N	120 45.209E	4963	St29	120	2.5	150	1.9			2946.1	IKMT NET DEEPEST
100315	359	+08:00	02 57.485N	120 45.887E	4988	St29	110	1.9	154	1.1			2948	IKMT NET FINISHED
100315	408	+08:00	02 57.337N	120 45.444E	4982		275	5.1	273	6.1	261	1.1	2948.6	CHANGED ENG'S TO T/M
100315	604	+08:00	02 59.404N	120 12.563E	4593		274	16.8	274	18.1	271	1.5	2981.5	SUNRISE & TURNED OFF REGULATION LIGHTS
100315	653	+08:00	02 59.887N	120 00.022E	4454		11	0.3	257	1.6			2994.1	CHANGED ENG'S TO E/M
100315	655	+08:00	02 59.864N	119 59.953E	4457	St30	80	0.4	266	1.8			2994.2	CTD-CMS STARTED
100315	713	+08:00	02 59.850N	119 59.657E	4451	St30	91	1.4	255	0.4			2994.5	CTD-CMS DEEPEST
100315	733	+08:00	02 59.847N	119 59.398E	4435	St30	80	0.2	254	1.5			2994.8	CTD-CMS FINISHED
100315	742	+08:00	02 59.798N	119 59.184E	4433	St30	80	0.5	257	1.3			2995	NORPAC NET STARTED
100315	758	+08:00	02 59.749N	119 58.929E	4432	St30	80	0.8	262	1.2			2995.3	NORPAC NET FINISHED
100315	809	+08:00	02 59.739N	119 58.715E	4422	St30	70	2.2	30	0.7			2995.5	IKMT NET STARTED
100315	837	+08:00	03 00.040N	119 59.010E	4426	St30	70	2.2	26	0.9			2995.9	IKMT NET DEEPEST
100315	919	+08:00	02 59.892N	119 59.323E	4438	St30	100	1.9	177	0.6			2996.4	IKMT NET FINISHED
100315	930	+08:00	02 59.313N	119 59.148E	4445		179	4.7	201	5.1	266	1.8	2997	CHANGED ENG'S TO T/M
100315	1000	+08:00	02 53.257N	119 59.393E	4491		177	16.8	182	16.2	290	1.6	3003	R/UP ENG'S
100315	1305	+08:00	02 01.345N	119 59.919E	5074		176	16.5	181	16.1	281	1.6	3054.8	S/B ENG'S
100315	1315	+08:00	02 00.046N	119 59.826E	4784		80	0.8	265	1.6			3056.1	STOPPED ENG'S
100315	1317	+08:00	02 00.031N	119 59.768E	4789		94	0.2	262	1.9	246	7.9	3056.1	CHANGED ENG'S TO E/M
100315	1322	+08:00	02 00.002N	119 59.579E	4807	St31	81	0.1	265	1.6			3056.3	CTD-CMS STARTED
100315	1340	+08:00	02 00.028N	119 59.401E	4842	St31	90	1.8	143	0.6			3056.6	CTD-CMS DEEPEST
100315	1400	+08:00	01 59.976N	119 59.323E	4907	St31	80	0.4	261	1.4			3056.8	CTD-CMS FINISHED
100315	1408	+08:00	01 59.964N	119 59.126E	4901	St31	71	0.5	294	0.8			3057	IKMT NET STARTED
100315	1435	+08:00	02 00.483N	119 59.676E	4913	St31	70	2.9	40	1.9			3057.8	IKMT NET DEEPEST
100315	1518	+08:00	02 01.342N	119 59.588E	5064	St31	12	1.5	323	1.9	281	2.6	3059.1	IKMT NET FINISHED
100315	1534	+08:00	02 01.365N	120 00.048E	5039		94	2.6	108	1.4			3059.9	CHANGED ENG'S TO T/M
100315	1534	+08:00	02 01.365N	120 00.049E	5039		95	2.6	109	1.4			3059.9	SLOW AHEAD ENG'S
100315	1543	+08:00	02 01.188N	120 00.936E	5005		96	9.7	101	8.9	243	0.9	3060.8	S/CO ON 090°
100315	1811	+08:00	01 59.997N	120 37.664E	4094		88	16.5	91	15.6	226	0.8	3097.8	SUNSET & PUT ON REGULATION LIGHTS
100315	1842	+08:00	01 59.960N	120 44.784E	4051		82	2.5	97	2.4	239	0.4	3104.9	CHANGED ENG'S TO S/M
100315	1843	+08:00	01 59.950N	120 44.850E	4057	St32	79	2.4	100	2	155	0.7	3104.9	IKMT NET STARTED
100315	1853	+08:00	01 59.955N	120 45.186E	4072	St32	71	2.3	74	2.4	204	0.4	3105.3	IKMT NET DEEPEST
100315	1917	+08:00	02 00.007N	120 46.012E	3958	St32	74	1.6	112	1.6			3106.1	IKMT NET FINISHED
100315	1933	+08:00	01 59.892N	120 46.197E	3960	St32	74	1.5	105	1.7			3106.5	IKMT NET STARTED
100315	1944	+08:00	01 59.903N	120 46.671E	4131	St32	74	2.6	83	2.4	160	0.6	3106.9	IKMT NET DEEPEST
100315	2102	+08:00	02 00.133N	120 49.621E	3807	St32	81	1.2	88	1.3			3110	IKMT NET FINISHED
100315	2111	+08:00	02 00.111N	120 50.066E	3844		88	4.1	91	4.5	93	0.4	3110.4	CHANGED ENG'S TO T/M
100315	2252	+08:00	01 59.997N	121 14.904E	3820		84	3.3	84	3.8	115	0.6	3135.3	CHANGED ENG'S TO S/M
100315	2256	+08:00	02 00.009N	121 15.062E	3815	St33	58	2.2	73	2.6	99	0.9	3135.5	IKMT NET STARTED
100315	2310	+08:00	02 00.292N	121 15.709E	3777	St33	60	2.1	66	2.9	90	0.7	3136.2	IKMT NET DEEPEST
100316	19	+08:00	02 00.834N	121 19.083E	3746	St33	70	1.2	72	1.8			3139.7	IKMT NET FINISHED
100316	26	+08:00	02 00.801N	121 19.694E	3807		92	5.9	95	6.2	128	0.7	3140.3	CHANGED ENG'S TO T/M
100316	208	+08:00	01 59.976N	121 44.962E	4067		88	5.6	84	4.8	323	0.3	3165.6	CHANGED ENG'S TO S/M
100316	212	+08:00	02 00.055N	121 45.124E	4066	St34	76	1.6	63	2	45	1.1	3165.8	IKMT NET STARTED
100316	228	+08:00	02 00.306N	121 45.735E	4090	St34	68	2.5	64	2.5	131	0.2	3166.5	IKMT NET DEEPEST
100316	340	+08:00	02 00.704N	121 48.603E	4044	St34	85	1.3	113	1.5			3169.5	IKMT NET FINISHED
100316	348	+08:00	02 00.677N	121 49.230E	4051		90	5.9	90	6.3	167	0.4	3170.1	CHANGED ENG'S TO T/M
100316	405	+08:00	02 00.570N	121 52.405E	4201		92	16.2	92	15.9	188	0.5	3173.3	R/UP ENG'S
100316	557	+08:00	02 00.230N	122 22.320E	4804		93	16.3	90	16.1	351	0.7	3203.2	SUNRISE & TURNED OFF REGULATION LIGHTS
100316	808	+08:00	02 00.003N	122 58.096E	5417		91	16.3	91	16.6	18	0.4	3239.1	S/B ENG'S
100316	820	+08:00	02 00.041N	123 00.053E	5420		60	0.9	75	1.2			3241.1	CHANGED ENG'S TO E/M
100316	825	+08:00	02 00.074N	123 00.127E	5420	St35	60	0.5	65	1.2			3241.2	CTD-CMS STARTED
100316	848	+08:00	02 00.182N	123 00.245E	5420	St35	131	0.1	318	1			3241.5	CTD-CMS DEEPEST
100316	914	+08:00	02 00.363N	123 00.331E	5423	St35	126	0.6	122	0.9			3241.8	CTD-CMS FINISHED
100316	928	+08:00	02 00.342N	123 00.461E	5422	St35	50	0.1	87	0.9			3242	NORPAC NET STARTED
100316	943	+08:00	02 00.444N	123 00.546E	5424	St35	50	0.1	64	0.3			3242.2	NORPAC NET FINISHED
100316	952	+08:00	02 00.459N	123 00.713E	5421	St35	90	2.5	96	2.8	101	0.8	3242.4	IKMT NET STARTED
100316	1036	+08:00	02 01.161N	123 02.882E	5424	St35	59	1.9	55	2.5	64	0.7	3244.8	IKMT NET DEEPEST
100316	1147	+08:00	02 02.493N	123 05.149E	5421	St35	60	1.3	61	1.3			3247.5	IKMT NET FINISHED
100316	1200	+08:00	02 02.947N	123 05.562E	5420		34	2.5	30	2.8	8	0.5	3248.1	CHANGED ENG'S TO T/M
100316	1247	+08:00	02 11.990N	123 11.644E	5391		35	15.9	32	15.7	277	0.7	3259	R/UP ENG'S
100316	1630	+08:00	02 58.957N	123 44.246E	4883		36	15.6	34	14.8	259	0.7	3316.1	S/B ENG'S
100316	1639	+08:00	02 59.859N	123 44.830E	4860		49	2.2	60	1.9			3317.2	CHANGED ENG'S TO S/M
100316	1640	+08:00	02 59.876N	123 44.844E	4862	St36	50	2.3	44	2.1			3317.2	IKMT NET STARTED
100316	1652	+08:00	03 00.091N	123 45.143E	4859	St36	60	2	51	1.2			3317.6	IKMT NET DEEPEST
100316	1747	+08:00	03 00.652N	123 46.545E	4849	St36	56	1.5	94	1.1			3319.2	IKMT NET FINISHED
100316	1751	+08:00	03 00.666N	123 46.641E	4850	St36	50	1.6	82	1.5			3319.3	IKMT NET STARTED
100316	1757	+08:00	03 00.754N	123 46.818E	4846	St36	50	2.4	64	2.6	102	0.9	3319.5	SUNSET & PUT ON REGULATION LIGHTS
100316	1812	+08:00	03 00.998N	123 47.311E	4836	St36	50	2.5	62	2.4	159	0.7	3320.1	IKMT NET DEEPEST
100316	1838	+08:00	03 01.327N	123 48.105E	4828	St36	51	1.7	83	1.4			3321	IKMT NET FINISHED
100316	1843	+08:00	03 01.356N	123 48.187E	4829	St36	39	1.7	40	1.6			3321.1	IKMT NET STARTED
100316	1858	+08:00	03 01.737N	123 48.527E	4824	St36	40	2.4	32	1.7	42	5.4	3321.6	IKMT NET DEEPEST
100316	2019	+08:00	03 02.984N	123 49.584E	4802	St36	45	1.8	35	0.8			3323.4	IKMT NET FINISHED
100316	2032	+08:00	03 03.109N	123 49.312E	4801		264	4.6	261	5.8	244	1.3	3324	CHANGED ENG'S TO T/M
100316	2240	+08:00	03 00.032N	123 15.032E	4987		325	3.7	313	4.8	231	0.8	3358.4	CHANGED ENG'S TO S/M
100316	2244	+08:00	03 00.162N	123 14.977E	4985	St37	46	2.3	26	2.2	341	2.5	3358.6	IKMT NET STARTED
100316	2300	+08:00	03 00.706N	123 15.282E	4983	St37	45	2.5	31	2.3	295	0.7	3359.2	IKMT NET DEEPEST
100317	17	+08:00	03 02.152N	123 16.740E	4973	St37	60	1.5	26	1.2			3361.4	IKMT NET FINISHED
100317	25	+08:00	03 02.278N	123 16.298E	4973		266	6.3	267	7	286	1.3	3362	CHANGED ENG'S TO T/M
100317	220	+08:00	03 00.147N	122 45.058E	5062		229	4.5	249	5.9	291	1.6	3393.3	CHANGED ENG'S TO S/M
100317	227	+08:00	03 00.127N	122 44.944E	5063	St38	47	1.8	330	2	312	4.6	3393.6	IKMT NET STARTED
100317	241	+08:00	03 00.516N	122 44.902E	5060	St38	60	2.4	5	1.6			3394	IKMT NET DEEPEST
100317	401	+08:00	03 02.590N	122 45.323E	5042	St38	65	1.6	340	1.4			3396.2	IKMT NET FINISHED

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Date (YYMMDD)	Time (hhmm)	Time Difference between Ship Time and UTC	Latitude	Longitude	Water Depth (m)	Station Name	Heading (deg.)	Log Speed (knot)	System Course (deg.)	System Speed (knot)	Current Direction (deg.)	Current Speed (knot)	Distance (mile)	Comment
100317	411	+08:00	03 02.396N	122 44.938E	5044		229	4.9	244	5.9	292	1.7	3396.7	CHANGED ENG'S TO T/M
100317	428	+08:00	03 00.345N	122 42.321E	5061		225	16.5	231	17.2	277	1.8	3400	R/UP ENG'S
100317	555	+08:00	02 44.827N	122 22.469E	5222		234	16.9	236	17.2	295	1	3425.1	SUNRISE & TURNED OFF REGULATION LIGHTS
100317	726	+08:00	02 30.772N	122 01.156E	5397		237	16.8	238	16.8	281	0.4	3450.7	S/B ENG'S
100317	738	+08:00	02 30.085N	122 00.174E	5401		150	0.2	262	0.7			3452	CHANGED ENG'S TO E/M
100317	742	+08:00	02 30.093N	122 00.121E	5400	St39	60	0.2	268	0.9			3452	CTD-CMS STARTED
100317	801	+08:00	02 30.217N	121 59.980E	5400	St39	71	1.1	34	0.7			3452.3	CTD-CMS DEEPEST
100317	829	+08:00	02 30.420N	121 59.952E	5399	St39	60	0.4	274	0.6			3452.5	CTD-CMS FINISHED
100317	839	+08:00	02 30.423N	121 59.770E	5400	St39	49	0.1	275	1.5			3452.7	NORPAC NET STARTED
100317	853	+08:00	02 30.601N	121 59.607E	5399	St39	50	0.8	323	1.1			3453	NORPAC NET FINISHED
100317	856	+08:00	02 30.649N	121 59.570E	5400	St39	59	0.6	316	0.9			3453.1	CALIBRATION STARTEFD NORPAC NET
100317	916	+08:00	02 30.891N	121 59.387E	5398	St39	59	0.6	318	1.1			3453.4	CARIBRATION FINISHED NORPAC NET
100317	923	+08:00	02 30.994N	121 59.367E	5404	St39	69	2.5	51	2.2			3453.5	IKMT NET STARTED
100317	952	+08:00	02 31.546N	122 00.125E	5396	St39	69	2	41	1.6			3454.5	IKMT NET DEEPEST
100317	1028	+08:00	02 31.813N	122 00.849E	5392	St39	90	1.5	64	0.5			3455.3	IKMT NET FINISHED
100317	1040	+08:00	02 31.982N	122 00.532E	5392		265	4.6	272	5.2	301	1.1	3455.8	CHANGED ENG'S TO T/M
100317	1100	+08:00	02 31.818N	121 56.622E	5398		264	16.1	265	16.4	330	0.6	3459.7	R/UP ENG'S
100317	1418	+08:00	02 30.047N	121 01.352E	5391		271	16.1	272	17.1	273	1	3515.1	S/B ENG'S
100317	1425	+08:00	02 29.954N	121 00.151E	5395		141	2.3	197	2.3	277	1.9	3516.3	CHANGED ENG'S TO S/M
100317	1428	+08:00	02 29.921N	121 00.146E	5393	St40	79	1.2	350	0.3			3516.4	IKMT NET STARTED
100317	1456	+08:00	02 30.125N	121 00.851E	5392	St40	80	2.4	72	1.6			3517.1	IKMT NET DEEPEST
100317	1536	+08:00	02 30.513N	121 01.691E	5394	St40	80	1.8	76	0.8			3518	IKMT NET FINISHED
100317	1545	+08:00	02 30.658N	121 01.347E	5392		267	6.3	270	7.5	278	1	3518.6	CHANGED ENG'S TO T/M
100317	1600	+08:00	02 30.547N	120 58.281E	5390		267	16.5	269	17.2	277	1	3521.7	R/UP ENG'S
100317	1812	+08:00	02 29.874N	120 20.702E	5062		273	16.2	270	17.2	226	1.4	3559.3	SUNSET & PUT ON REGULATION LIGHTS
100317	1918	+08:00	02 29.921N	120 01.421E	5006		275	16.2	271	17.6	240	2.4	3578.7	S/B ENG'S
100317	1925	+08:00	02 29.964N	120 00.121E	4995		0	2.9	299	2.4	256	2.4	3579.9	CHANGED ENG'S TO S/M
100317	1928	+08:00	02 29.997N	120 00.089E	4992	St41	51	2.7	8	0.7			3579.9	IKMT NET STARTED
100317	1940	+08:00	02 30.022N	120 00.131E	4994	St41	60	2.8	71	0.6			3580	IKMT NET DEEPEST
100317	2050	+08:00	02 30.293N	120 01.005E	4985	St41	65	2.1	89	0.2			3581.1	IKMT NET FINISHED
100317	2100	+08:00	02 29.872N	120 00.936E	5003		178	4.9	197	6.4	236	2.3	3581.6	CHANGED ENG'S TO T/M
100317	2254	+08:00	02 00.102N	119 59.978E	4789		150	4.2	167	4.8	234	1.3	3611.2	CHANGED ENG'S TO S/M
100317	2257	+08:00	01 59.989N	120 00.052E	4776	St42	68	2.5	87	1.6			3611.4	IKMT NET STARTED
100317	2314	+08:00	02 00.032N	120 00.531E	4796	St42	70	2.6	91	2.1			3611.9	IKMT NET DEEPEST
100318	27	+08:00	01 59.771N	120 02.228E	4673	St42	85	1.5	126	1.2			3613.7	IKMT NET FINISHED
100318	34	+08:00	01 59.748N	120 02.670E	4658		85	6.2	89	5.1	245	1.2	3614.2	CHANGED ENG'S TO T/M
100318	228	+08:00	01 59.933N	120 29.711E	4433		69	2.4	79	2.6	178	0.3	3641.2	CHANGED ENG'S TO S/M
100318	229	+08:00	01 59.946N	120 29.769E	4432	St43	75	1.8	78	1.9			3641.3	IKMT NET STARTED
100318	245	+08:00	02 00.073N	120 30.401E	4322	St43	69	2.8	78	2.6	116	0.5	3641.9	IKMT NET DEEPEST
100318	409	+08:00	02 00.969N	120 33.430E	4080	St43	65	1.7	66	1.8			3645.1	IKMT NET FINISHED
100318	417	+08:00	02 00.952N	120 33.921E	4127		90	4.5	97	4.6	145	0.7	3645.6	CHANGED ENG'S TO T/M
100318	434	+08:00	02 00.815N	120 36.860E	4338		91	16.3	92	16	158	0.2	3648.5	R/UP ENG'S
100318	601	+08:00	01 59.947N	121 00.249E	3740		90	16.5	89	16.3	321	0.3	3672	SUNRISE & TURNED OFF REGULATION LIGHTS
100318	744	+08:00	02 00.020N	121 28.605E	4023		92	16.3	90	16	41	0.1	3700.4	S/B ENG'S
100318	750	+08:00	02 00.007N	121 29.687E	4080		92	4.9	92	5.1	59	0.4	3701.4	CHANGED ENG'S TO S/M
100318	753	+08:00	02 00.015N	121 29.838E	4084	St44	78	2.6	82	3.1	82	0.5	3701.6	IKMT NET STARTED
100318	827	+08:00	02 00.361N	121 31.362E	4116	St44	77	2.4	74	2.3	278	0.1	3703.2	IKMT NET DEEPEST
100318	917	+08:00	02 00.721N	121 33.360E	4302	St44	80	1.5	79	1.6			3705.3	IKMT NET FINISHED
100318	928	+08:00	02 00.712N	121 33.886E	4312		89	4.9	93	4.8	165	0.3	3705.8	CHANGED ENG'S TO T/M
100318	950	+08:00	02 00.579N	121 37.822E	4307		91	16.1	91	15.9	247	0.2	3709.7	R/UP ENG'S
100318	1253	+08:00	02 00.125N	122 28.550E	4967		96	16.2	93	16.1	17	0.9	3760.5	S/B ENG'S
100318	1259	+08:00	02 00.098N	122 29.608E	4962		96	6	88	6	19	0.8	3761.6	CHANGED ENG'S TO S/M
100318	1303	+08:00	02 00.059N	122 29.769E	4963	St45	132	1.8	99	1.6			3761.8	IKMT NET STARTED
100318	1336	+08:00	01 59.694N	122 31.017E	4998	St45	129	2.6	107	2.4	8	0.8	3763.1	IKMT NET DEEPEST
100318	1426	+08:00	01 59.262N	122 32.527E	4994	St45	120	1.6	90	1.7			3764.8	IKMT NET FINISHED
100318	1434	+08:00	01 59.355N	122 33.212E	5011		89	6.3	78	7	41	1.3	3765.5	CHANGED ENG'S TO T/M
100318	1500	+08:00	01 59.738N	122 38.792E	5036		93	16.3	90	16.5	24	0.8	3771.1	R/UP ENG'S
100318	1758	+08:00	02 00.011N	123 27.287E	5408		93	16.3	90	16	318	0.6	3819.6	SUNSET & PUT ON REGULATION LIGHTS
100318	1804	+08:00	01 59.986N	123 28.685E	5405		93	16.2	92	15.5	318	0.6	3821.2	S/B ENG'S
100318	1810	+08:00	02 00.011N	123 29.710E	5406		92	3.6	94	3.2	302	0.7	3822.1	CHANGED ENG'S TO S/M
100318	1814	+08:00	02 00.055N	123 29.834E	5404	St46	64	2.5	53	2.3	317	0.4	3822.3	IKMT NET STARTED
100318	1829	+08:00	02 00.413N	123 30.377E	5400	St46	69	2.5	65	2.8	12	0.2	3822.9	IKMT NET DEEPEST
100318	1945	+08:00	02 02.288N	123 32.831E	5390	St46	50	1.6	43	2.1	18	0.9	3826.1	IKMT NET FINISHED
100318	1953	+08:00	02 02.409N	123 33.197E	5388		94	3.8	85	3.9	37	0.6	3826.5	CHANGED ENG'S TO T/M
100318	2141	+08:00	02 00.714N	123 59.583E	5064		82	4.7	91	4.2	215	0.7	3853	CHANGED ENG'S TO S/M
100318	2145	+08:00	02 00.721N	123 59.744E	5059	St47	79	2.5	76	2.7	207	0.6	3853.2	IKMT NET STARTED
100318	2201	+08:00	02 00.764N	124 00.327E	5032	St47	76	2.5	71	2.3	270	0.3	3853.8	IKMT NET DEEPEST
100318	2310	+08:00	02 02.176N	124 02.508E	5032	St47	55	1.1	44	1			3856.5	IKMT NET FINISHED
100318	2321	+08:00	02 02.189N	124 02.964E	5017		95	5.1	100	5.1	229	0.3	3857	CHANGED ENG'S TO T/M
100319	110	+08:00	02 00.082N	124 29.651E	4425		93	5.2	86	4.7	309	0.7	3883.7	CHANGED ENG'S TO S/M
100319	115	+08:00	02 00.167N	124 29.812E	4439	St48	29	1.3	7	2			3883.9	IKMT NET STARTED
100319	129	+08:00	02 00.732N	124 29.975E	4408	St48	25	2.2	6	2.7	329	0.5	3884.5	IKMT NET DEEPEST
100319	239	+08:00	02 03.171N	124 31.265E	4392	St48	30	1.3	12	1.9			3887.3	IKMT NET FINISHED
100319	248	+08:00	02 03.267N	124 31.835E	4367		105	6.5	98	5.9	348	0.7	3887.9	CHANGED ENG'S TO T/M
100319	248	+08:00	02 03.267N	124 31.836E	4366		105	6.4	96	6	353	0.6	3887.9	S/CO ON 090°
100319	310	+08:00	02 01.959N	124 35.810E	4037		116	16.5	114	16.3	27	0.7	3892.1	R/UP ENG'S
100319	528	+08:00	01 59.954N	125 11.803E	2033		96	16.3	94	15.9	340	0.7	3928.6	A/CO TO 158°
100319	545	+08:00	01 55.996N	125 13.647E	1763		156	16.9	159	15.7	331	0.4	3933	SUNRISE & TURNED OFF REGULATION LIGHTS
100319	600	+08:00	01 52.267N	125 15.207E	1174		157	16.6	154	15.7	340	1	3937	S/B ENG'S
100319	607	+08:00	01 51.130N	125 15.690E	1156		160	5.3	165	4.3	347	1	3938.2	CHANGED ENG'S TO S/M
100319	759	+08:00	01 33.250N	125 22.741E	991		161	12	156	10.8	23	1.7	3957.5	A/CO TO 210°
100319	1201	+08:00	01 26.303N	125 11.500E	151		101	0.3	342	0.2			3983.4	SENT OUT 1ST SHORE LINE