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Japan, U.S.A., and Canada Cooperative Survey on Overwintering Salmonids in the North Pacific Ocean: Kaiyo Maru, Cruise Report, 25 November-24 December 1992

by

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Abstract

A Japan, U.S.A., and Canada cooperative survey on overwintering salmonids (Oncorhynchus spp.) in the North Pacific Ocean (157°E-145°W, 38°N-52°N) was conducted by scientists aboard the Japanese research vessel Kaiyo Maru from November 25 to December 24, 1992. This was the first offshore survey of salmonids in the North Pacific Ocean in December. The objectives of the survey were to clarify the winter distribution of salmon, the influence of oceanographic conditions on salmon distribution, and the factors determining the southern limit of salmon distribution in the North Pacific Ocean in winter. This report presents some preliminary results of the survey.

Salmon were caught at only 14 of the 27 stations sampled, and catches were often small (30 or fewer fish at 11 of the 14 stations where salmon were caught). The low catches of salmon were primarily the result of intentional sampling at stations near the southern limit of salmon distribution in the North Pacific Ocean. The surface trawl net used during the survey was effective at catching both juvenile (ocean age .0) and immature (ocean age .1 or older) salmon. In this report, data for juvenile sockeye (O. nerka), chum (O. keta), and pink (O. gorbuscha) salmon caught during the salmon survey were combined into one category, "unidentified juvenile salmon," because of uncertainty about field identifications. Species identifications will be verified in the laboratory. The total catch of salmon during the survey was 702 fish (20 immature sockeye salmon, 388 unidentified juvenile salmon, 239 immature chum salmon, 49 juvenile coho salmon (O. kisutch), 2 juvenile chinook salmon (O. tshawytscha), and 4 immature chinook salmon). No steelhead trout (O. mykiss) were caught. No salmon were caught at stations with sea surface temperatures (SST) above 9.6 °C. Salmon appeared to be distributed primarily in cool (less than 7.5°C SST) waters north of 44°N in the western North Pacific, north of 45°N in the central North Pacific, and north of 49°N in the eastern North Pacific.

After the salmon survey was completed, a large catch of salmon (119 sockeye, 219 chum, 5 pink, and 23 coho salmon) was made in the central Gulf of Alaska (52°06'N, 145°56'W) during testing of the trawl, which had been modified for pollock fishing. This sample included juvenile sockeye, chum, pink, and coho salmon, and is the first information showing that juveniles of all four species are distributed well offshore in the same area of the Gulf of Alaska in December.

Incidental catches of other species of fish and invertebrates during the survey were generally low. Myctophiform fishes, Japanese anchovy (Engraulis japonica), and various species of squid were the predominant bycatch. No marine mammals or birds were caught by the trawl net during the survey.

Introduction

From 1954 to 1991, most of the high-seas research on Pacific salmon (Oncorhynchus spp.) was conducted during the period of operation of the historic Japanese high-seas salmon driftnet fisheries (May-July). As a result, very little is known about the ocean ecology of salmon in winter and the biological and oceanographic factors that affect their distribution, growth, and survival during this critical period. Important new questions about ocean carrying capacity, global warming, and recent changes in abundance, age and growth, and survival of Pacific salmon require the acquisition of new oceanographic and biological data. To this end, a Japan, U.S.A., and Canada cooperative survey of salmon in the North Pacific Ocean was conducted by scientists aboard the Japanese research vessel Kaiyo Maru from November 25 to December 24, 1992. This was the first offshore survey of salmonids in the North Pacific Ocean in December. The objectives of the research, as stated in the cruise plan (Fisheries Agency of Japan 1992), were:

"1. Clarifying the winter distribution of salmon;
2. Clarifying the influence of oceanographic conditions, particularly food (zooplankton, primary production and nutrition); and
3. Clarifying the factors determining the southern limit of salmon in the winter, with respect to global warming."

The purpose of this report is to present information on methods and some preliminary results of the survey.

Methods

The research vessel Kaiyo Maru, built in 1991 and owned by the Fisheries Agency of Japan, Tokyo, is a 93 m stern trawler (gross tonnage, international: 2,942 tons). The vessel left port in Tokyo Bay, Japan, on November 25, 1992. The salmon survey was conducted from November 28 through December 18, 1992. The vessel arrived in port in Seattle, Washington, on December 24, 1992.

The vessel was operated by Captain Hiromi Gomyo and a crew of 45 men. Scientific personnel included: Dr. Kazuya Nagasawa (Chief Scientist), National Research Institute of Far Seas Fisheries (NRIFSF), Shimizu, Japan; Yasuhiro Ueno, NRIFSF; Dr. David W. Welch, Pacific Biological Station (PBS), Nanaimo, British Columbia, Canada; and Katherine W. Myers, Fisheries Research Institute (FRI), University of Washington, Seattle, Washington, U.S.A. Four Japanese students assisted in the collection of data and analysis of samples: Masaaki Nanba, Kagawa University; Kazuhiko Anraku, Kagoshima University; Noriyasu Nagai, Ehime University; and Kunikazu Shimamoto, Tokyo University of Fisheries.

Fishing Operations

The cruise plan called for fishing operations with a spider (surface) trawl along three north-south transects and two diagonal transects (27 stations, Fig. 1, Table 1). On the north-south transects fishing was to be conducted once or twice daily depending on conditions at the stations. On the diagonal surveys, fishing was to be done only once per day.

The spider trawl used in the survey was 208 m long (60-m headrope, 60-m footrope, and approximately 500 m warp; Appendix 1). The cod end was made of 11-mm knotless mesh. The trawl fished from the surface to 40-50 m, and was towed at approximately five knots for about 1 hour.

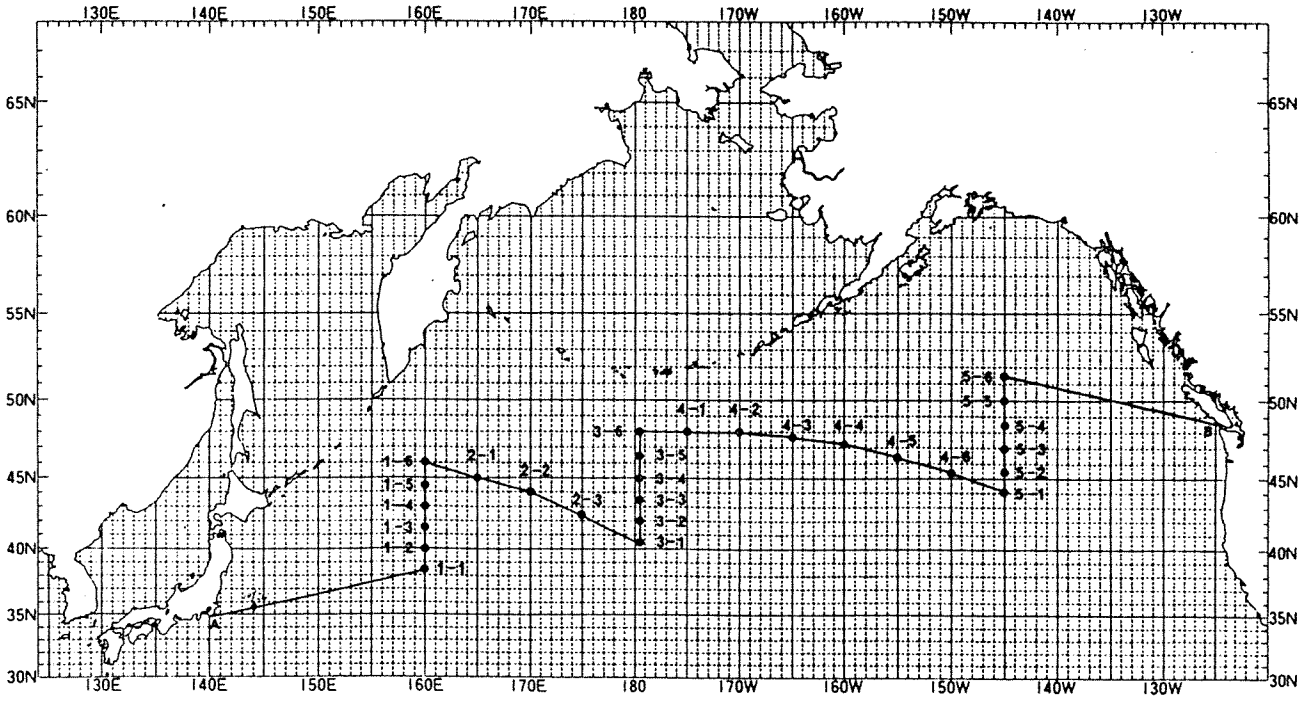


Fig. 1. Planned location of trawl and CTD stations (Fisheries Agency of Japan 1992).

Table 1. Planned location of trawl and CTD stations (Fisheries Agency of Japan 1992).

Station	Location	Scheduled Date	Research
Point A	34-00N, 140-00E	11.25	Leave Tokyo Bay
St. 1-1	38-30N, 160-00E	11.29	Trawl, CTD
St. 1-2	40-00N, 160-00E	11.30	Trawl, CTD
St. 1-3	41-30N, 160-00E	11.30	Trawl, CTD
St. 1-4	43-00N, 160-00E	11.31	Trawl, CTD
St. 1-5	44-30N, 160-00E	11.31	Trawl, CTD
St. 1-6	46-00N, 160-00E	12.01	Trawl, CTD
St. 2-1	45-00N, 165-00E	12.02	Trawl, CTD
St. 2-2	44-00N, 170-00E	12.03	Trawl, CTD
St. 2-3	42-30N, 175-00E	12.04	Trawl, CTD
St. 3-1	40-30N, 179-30W	12.04	Trawl, CTD
St. 3-2	42-00N, 179-30W	12.05	Trawl, CTD
St. 3-3	43-30N, 179-30W	12.06	Trawl, CTD
St. 3-4	45-00N, 179-30W	12.06	Trawl, CTD
St. 3-5	46-30N, 179-30W	12.07	Trawl, CTD
St. 3-6	48-00N, 179-30W	12.07	Trawl, CTD
St. 4-1	48-10N, 175-00W	12.08	Trawl, CTD
St. 4-2	48-00N, 170-00W	12.09	Trawl, CTD
St. 4-3	47-40N, 165-00W	12.10	Trawl, CTD
St. 4-4	47-10N, 160-00W	12.11	Trawl, CTD
St. 4-5	46-20N, 155-00W	12.12	Trawl, CTD
St. 4-6	45-20N, 150-00W	12.13	Trawl, CTD
St. 5-1	44-00N, 145-00W	12.14	Trawl, CTD
St. 5-2	45-30N, 145-00W	12.15	Trawl, CTD
St. 5-3	47-00N, 145-00W	12.15	Trawl, CTD
St. 5-4	48-30N, 145-00W	12.16	Trawl, CTD
St. 5-5	50-00N, 145-00W (P*)	12.17	Trawl, CTD
St. 5-6	51-30N, 145-00W	12.17	Trawl, CTD
Point B	49-00N, 126-00W	12.25	Arrive Seattle

*Ocean Station P

Biological Sampling

After net retrieval, the catch was sorted to species. Numbers and weights of all species in the catch were determined. When individuals were too numerous to count, the entire catch was

weighed and numbers were estimated from a subsample. For Pacific salmon, body weights and fork lengths were recorded for up to 30 fish per species at each station, and scale samples were taken. Because of damage by the trawl net, most of the salmon did not have scales left in the preferred (International North Pacific Fisheries Commission) body area for scale sampling. In these cases, scales were collected from areas adjacent to the preferred area or from under the pectoral fin. After measuring, salmon were numbered with plastic tags and frozen whole (-40°C) in covered aluminum trays. Samples of other species of fish and squid in the catch were also frozen or preserved in 10% Formalin or 70% alcohol for later examination. Samples of whole salmon were frozen for water content analysis at PBS. Samples of mesopelagic fish (myctophiforms) were collected and frozen for studies by the U.S. National Marine Fisheries Service (NMFS; for a reference collection of otoliths to be used for small cetacean food habits studies). A sample of whole salmon (3 chum and 3 sockeye) was frozen for caloric content studies at FRI.

After the Kaiyo Maru returns to Tokyo in late March 1993, the frozen samples of Pacific salmon will be taken to the NRIFSF for further analysis. Species identification will be reconfirmed by morphological counts and measurements. Samples and data collected from Pacific salmon at the NRIFSF shall include:

1. sex
2. liver weight (for energetic studies)
3. gonad weight (for maturation)
4. liver sample (for glycogen content)
5. stomach contents (identification and weight)
6. otoliths (for age and growth studies)
7. heart, muscle, liver, and eye tissue (for genetic stock identification)
8. muscle sample (a small sample for isotope analysis and a large sample for water content analysis)
9. muscle sample for species identification by electrophoresis
10. snouts from salmon lacking the adipose fin for detection of coded-wire tags

Specimens of salmon and squid in good condition will also be examined for parasites at NRIFSF (for stock identification studies).

Oceanographic Sampling

Oceanographic observations were made with a CTD either before or after fishing operations, depending on the weather. A CTD or XBT was used depending on conditions at trawl locations. Sensors on the CTD "octopus" were used to collect data on temperature, conductivity, salinity, and depth from 0-1,000 meters. Water samples were collectd by a bucket at the surface (0 m) and by CTD Rosette sampling (2 liter bottles x 18 depths: 10, 20, 30, 40, 50, 60, 80, 100, 120, 150, 200, 250, 300, 400, 500, 600, 800, and 1,000 meters). In rough seas, a Seabird (Model 19) CTD, referred to in this report as SCTD, was used to collect data on temperature and salinity to a depth of 800 meters. Seawater nutrients (NO_2+NO_3, SiO_2, PO_4) were analyzed with an autoanalyser within a day of sampling. Chlorophyll (0-200 meters) was

determined by fluorometric analysis within 24 hours. Salinities were confirmed by auto-salinometer analysis and dissolved oxygen by an auto-oxygen meter within a day of sampling. In addition, water temperature, salinity, dissolved oxygen, and chlorophyll measurements were determined for surface water.

After trawl sampling or at about 10-12 a.m., while the vessel was underway, primary production was measured by sampling surface seawater with a bucket. The seawater was put into 1 liter polycarbonite bottles, and $_{13}C$-$NaHCO_3$ was added. The bottled seawater was then incubated in a water bath for 2-3 hours on the deck, and filtered. The filter was preserved in the deep freezer (-40°C) for later analysis. Solar radiation was measured using a meteorological radiometer throughout the survey.

Zooplankton collections were taken at the 27 fishing stations after the trawl sampling was completed. A standard NORPAC net with attached flowmeter was used. The net was hauled vertically from 150 meters. Zooplankton were preserved in 10% Formalin (seawater).

A student from the Environmental Chemistry Laboratory, Faculty of Agriculture, Ehime University, collected surface water, air, fish, and squid samples for quantitative analysis of organochlorine pollutants (PCB, DDT, BHC, chlordane, etc.) near the subarctic boundary in winter (N. Nagai, pers. comm.).

While the vessel was underway, temperature, salinity, dissolved oxygen, chlorophyll, and zooplankton were monitored continuously using an EPCS continuous plankton measuring system. Multiple layer ultrasonic current measurements were made with an ADCP system. Vertical thermal structure (0-750 meters) was measured using an XBT at every 1 degree longitude and 30' latitude (starting at 141°E) except at trawl stations. An APT system was used for meteorological monitoring throughout the survey.

Results and Discussion

Date, time, station number, latitude, and longitude of the trawl, CTD, SCTD, XBT, NORPAC net, and primary production stations are shown in Appendix 2. Differences in planned and actual dates and locations of the trawl stations were due primarily to weather conditions and changes in sampling strategy (Figs. 1-2, Tables 1-2, Appendix 2).

The survey started out one day ahead of schedule at stations 1-1 to 1-4, but due to poor weather only one station was sampled on November 30. There was a mistake in the cruise plan in that two stations (1-4 and 1-5) were scheduled for November 31 (Table 1). These stations were sampled on November 30 and December 1, putting us one day behind schedule. The dateline (180°) was crossed on December 6. The first December 6 is referred to as "6a" and the second December 6 is "6b" (Table 2).

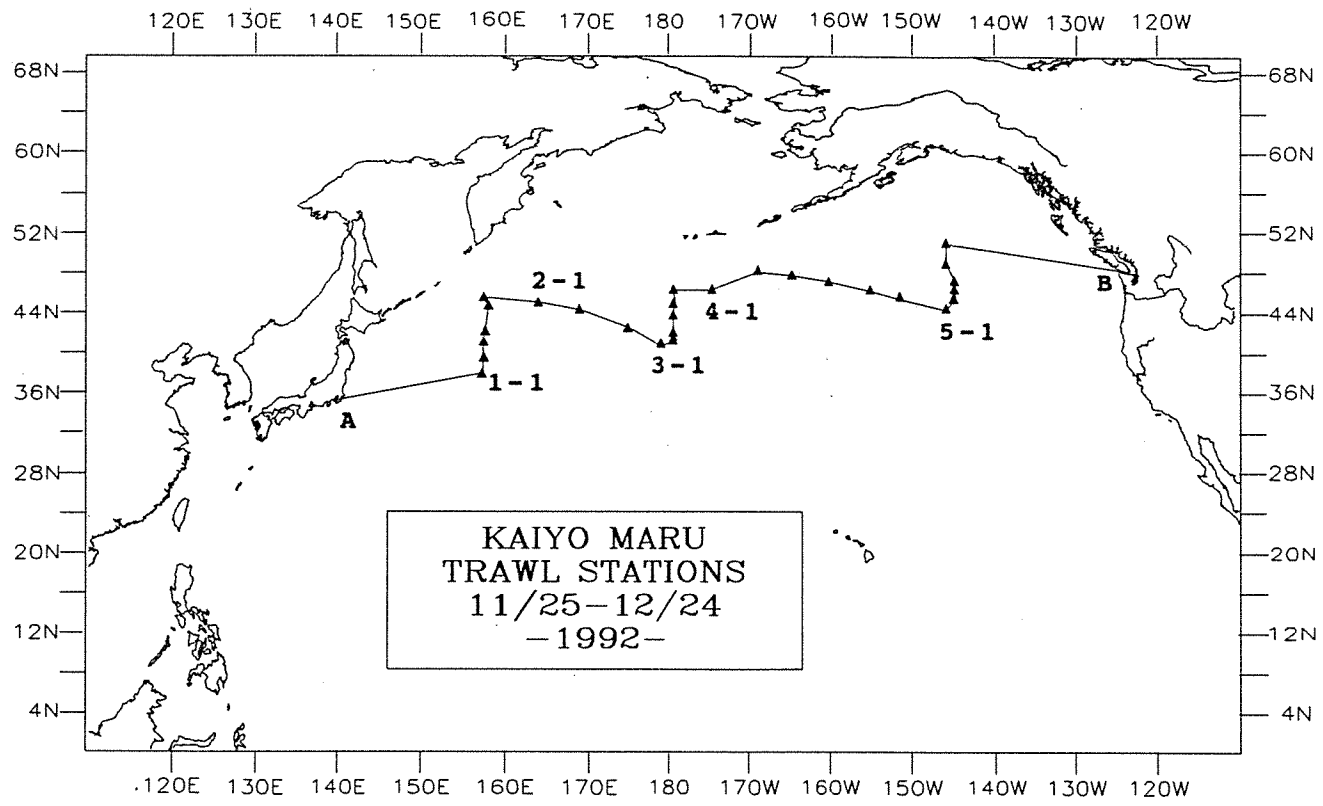


Fig. 2. Location of trawl stations.

Along transect number 3 (179°-30'W), fishing operations at several stations were conducted at specific sea surface temperatures rather than at the scheduled latitudes to investigate the relationship between water temperatures and salmon distribution near the southern limit of their range: 3-2 (approximate SST of 11°C), 3-3 (SST of 10°C), 3-4 (SST of 9°C), 3-5 (SST of 7°C). This same approach was taken at stations 4-6 (SST of 8.5°C) and 5-1 (SST of 10°C).

At station 4-4, the net was towed for 15 hours and 45 minutes (14:56 on December 12 to 06:39 on December 13) because high winds prevented safe retrieval (vessel speed was slowed to 3 knots overnight, so that the trawl was not effectively fishing for salmon during most of this period).

At Station 5-3, sampling was conducted south of the planned station because of delays caused by engine problems. As a result of this delay, stations 5-4 and 5-5 were also south of planned locations.

Table 2. Location of trawl stations.

Station	Location	Date	Research
Point A	34-00N, 140-00E	11.25	Leave Tokyo Bay
St. 1-1	37-57N, 157-20E	11.28	Trawl, CTD
St. 1-2	39-35N, 157-33E	11.29	Trawl, CTD
St. 1-3	41-10N, 157-31E	11.29	Trawl, CTD
St. 1-4	42-14N, 157-42E	11.30	Trawl, CTD
St. 1-5	44-46N, 158-06E	12.01	Trawl, CTD
St. 1-6	45-38N, 157-32E	12.02	Trawl, CTD
St. 2-1	45-06N, 163-51E	12.03	Trawl, CTD
St. 2-2	44-26N, 168-56E	12.04	Trawl, CTD
St. 2-3	42-32N, 174-51E	12.05	Trawl, CTD
St. 3-1	41-00N, 179-02E	12.06a	Trawl, CTD
St. 3-2	41-19N, 179-32W	12.06b	Trawl, CTD
St. 3-3	42-05N, 179-28W	12.06b	Trawl, CTD
St. 3-4	43-49N, 179-28W	12.07	Trawl, CTD
St. 3-5	45-00N, 179-28W	12.07	Trawl, CTD
St. 3-6	46-22N, 179-27W	12.08	Trawl, CTD
St. 4-1	46-24N, 174-42W	12.09	Trawl, CTD
St. 4-2	48-20N, 169-03W	12.10	Trawl, CTD
St. 4-3	47-51N, 164-52W	12.11	Trawl, CTD
St. 4-4	47-12N, 160-24W	12.12-13	Trawl, CTD
St. 4-5	46-23N, 155-18W	12.13	Trawl, CTD
St. 4-6	45-42N, 151-33W	12.14	Trawl, CTD
St. 5-1	44-32N, 145-59W	12.15	Trawl, CTD
St. 5-2	45-31N, 145-03W	12.16	Trawl, CTD
St. 5-3	46-27N, 144-59W	12.16	Trawl, CTD
St. 5-4	47-18N, 144-59W	12.17	Trawl, CTD
St. 5-5	49-03N, 145-00W	12.17	Trawl, CTD
St. 5-6	51-07N, 145-00W	12.18	Trawl, CTD
Point B	49-00N, 126-00W	12.24	Arrive Seattle

Problems With Identification of Juvenile (Ocean Age .0) Salmon

Immature (ocean age .1 or older) chum and sockeye salmon and juvenile (ocean age .0) coho and chinook salmon in the catch were easily identified by standard visual characters, but there were problems with identification of juvenile sockeye, chum, and pink salmon because of their early stage of development and because of physical damage to the fish by the trawl (most

fish were completely scaled). Fish that were identified as juvenile sockeye salmon at stations 2-1, 2-2, 3-5, and 3-6 had blue skin on their backs, no dark blotches or spots on the body or caudal fin, and no silvering on the caudal fin. At Station 4-1, 41 juvenile fish with large dark blotchy spots on their backs (no blotchy spots on their tails) were identified as pink salmon. These fish also had blue skin on their backs and were similar in size to the fish previously identified as juvenile sockeye salmon. The dark blotches on the backs of the fish identified as juvenile pink salmon were sometimes faint, and at subsequent stations there was concern about species identification errors. After sampling at station 4-5, a sample of eight juvenile fish that had been identified as pink salmon (4 fish) and sockeye salmon (4 fish) was examined. Gill raker counts for all of the fish were similar, and counts of lateral line pores and scale characters (from samples taken under the pectoral fin) indicated that all of the fish were pink salmon. Therefore, the presence or absence of large blotchy spots on the backs of the fish could not be used as a character to distinguish juvenile sockeye and pink salmon.

In this report, all of the juvenile fish that were initially identified as pink or sockeye salmon are combined into one category, "unidentified juvenile salmon," because of the problems with species identification. No juvenile chum salmon were identified in the catch, and it is possible that some of the fish in the "unidentified juvenile salmon" category are chum salmon.

After the conclusion of the salmon survey, a sample of juvenile salmon from a catch made during testing of the modified (for the pollock survey) trawl net was examined. Among these fish, juvenile sockeye, pink, and chum salmon could be separated by examination of the texture of the skin and the number and shape of the gill rakers. All three species had blue skin on their backs, but the pink salmon had very smooth skin because of their small scale pockets, and sockeye and chum salmon had rough skin because of their larger scale pockets. The juvenile sockeye salmon had numerous (24-36), long thin gill rakers on the first gill arch, and the juvenile chum salmon had fewer (8-11 +13-15) short, stubby gill rakers on the first gill arch. Scale samples were taken from these fish for comparison with samples taken during the salmon survey.

As noted in the methods section, species identification will be reconfirmed at the NRIFSF by examination of scales and counts of pyloric caeca, gill rakers, lateral line pores, etc. If necessary, muscle tissue samples may be analyzed by electrophoresis to identify species.

Salmonid Catch

Salmon were caught at only 14 of the 27 stations sampled (Fig. 3, Table 3), and catches were often small (30 or fewer fish at 11 of the 14 stations where salmon were caught). This was primarily because of intentional sampling at stations near the southern limit of salmon distribution in the North Pacific Ocean.

The trawl net was effective at catching both juvenile and immature salmon. The total catch of salmon at the 27 stations sampled during the salmon survey was 702 fish (20 immature sockeye salmon, 388 unidentified juvenile salmon, 239 immature chum salmon, 49 juvenile coho salmon, 2 juvenile chinook salmon, and 4 immature chinook salmon; Table 3). No steelhead trout (O. mykiss) were caught during the survey.

After the salmon survey was completed, the trawl was modified (warp shortened to 370 m) for the next (pollock) survey in the Bering Sea. During test fishing with this trawl on December 19, which consisted of a four hour tow at 5 different depths (400m, 300m, 200m, 100m, 0m), a large catch of salmon (366 fish) was taken at 52°06'N, 145°56'W (SST 6.3°C). The species composition of the catch was 219 chum (59.8%), 119 sockeye (32.5%), 23 coho (6.3%), and 5 pink (1.4%) salmon. This sample included juvenile sockeye, chum, pink, and coho salmon, and is the first information showing that juveniles of all four species are distributed well offshore in the same area of the Gulf of Alaska in December. One juvenile coho salmon caught during the test fishing was lacking an adipose fin. This fish was frozen whole for examination at the NRIFSF.

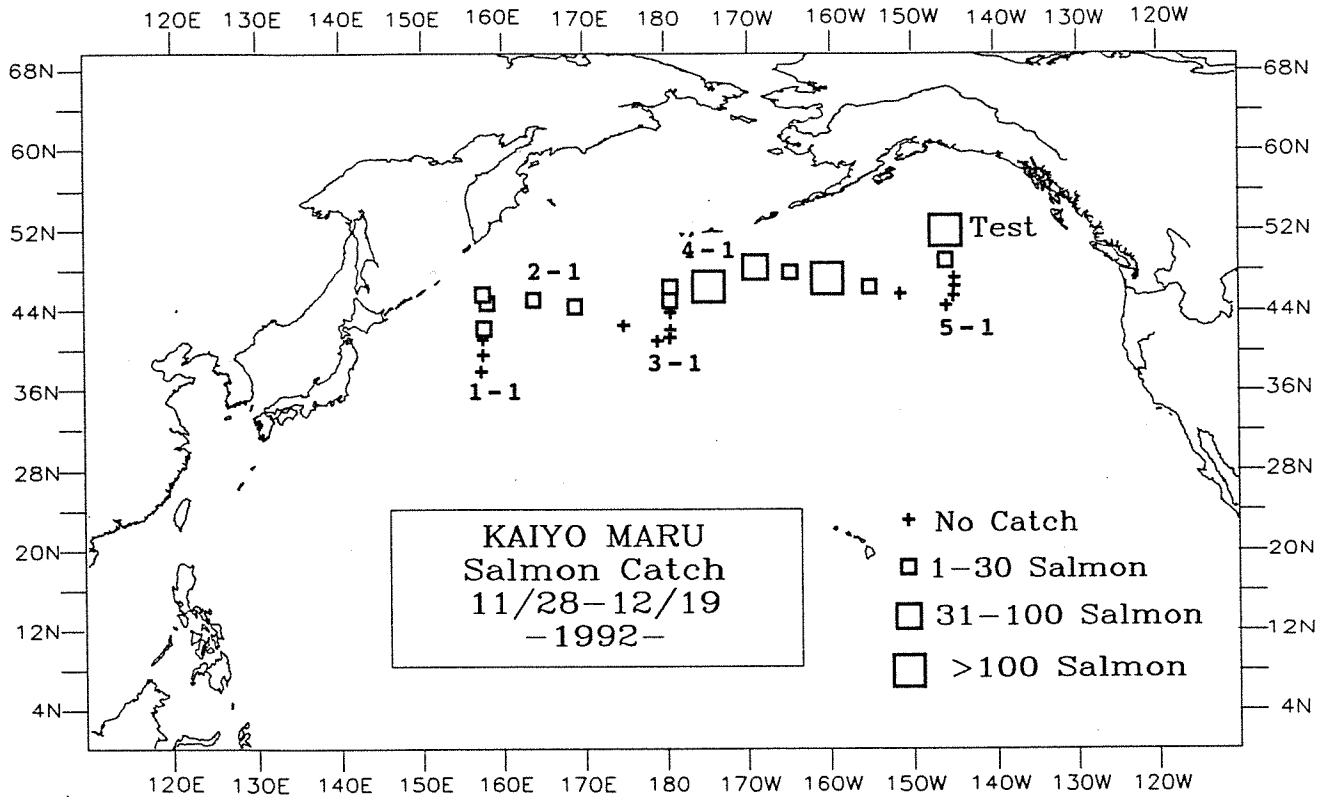


Fig. 3. Salmon catch at 27 stations in the North Pacific Ocean in November and December 1992.

Table 3. Salmon catch (numbers of fish) at 27 stations in the North Pacific Ocean in November and December 1992. Sta.= station number; SMT=ship mean time; Lat.= latitude; Long.=longitude; Crs.=vessel course in degrees; SST=sea surface temperature; Warp = length of net warp during tow; Kt.=speed of vessel in knots during tow; Imm. = immature (ocean age .1 or older); Juv.=juvenile (ocean age .0); Unid.= unidentified species; Red=Oncorhynchus nerka; Chum=O. keta; Coho=O. kisutch; King=O. tshawytscha.

Sta	Date	SMT	Lat.	Long.	Crs	(°C) SST	(m) Warp	Kt.	Imm. Red	Unid. Juv.	Imm. Chum	Juv. Coho	Juv. King	Imm. King	Tot.
1-1	11/28	16:01-17:01	37-57N	157-20E	110	17.9	400	5.0	0	0	0	0	0	0	0
1-2	11/29	08:20-09:20	39-35N	157-33E	85	13.8	450	4.6	0	0	0	0	0	0	0
1-3	11/29	18:20-20:29	41-10N	157-31E	--	10.2	450	4.8	0	0	0	0	0	0	0
1-4	11/30	10:25-11:25	42-14N	157-42E	165	9.6	500	4.7	0	0	1	0	0	0	1
1-5	12/1	10:25-11:26	44-46N	158-06E	140	5.2	500	5.0	3	0	23	0	1	0	27
1-6	12/2	08:06-09:06	45-38N	157-32E	95	4.3	530	5.1	0	0	1	0	1	0	2
2-1	12/3	02:51-03:51	45-06N	163-51E	350	4.6	470	4.9	0	3	4	0	0	0	7
2-2	12/4	14:01-15:01	44-26N	168-56E	120	5.4	520	4.4	0	8	12	6	0	0	26
2-3	12/5	15:30-16:30	42-32N	174-51E	93	9.5	520	3.9	0	0	0	0	0	0	0
3-1	12/6a	12:23-13:23	41-00N	179-02E	30	13.4	570	5.0	0	0	0	0	0	0	0
3-2	12/6b	08:09-09:09	41-19N	179-32W	110	11.3	580	4.4	0	0	0	0	0	0	0
3-3	12/6b	16:04-17:04	42-05N	179-28W	115	9.6	550	4.7	0	0	0	0	0	0	0
3-4	12/7	08:48-09:48	43-49N	179-28W	160	9.0	570	4.8	0	0	0	0	0	0	0
3-5	12/7	18:49-19:50	45-00N	179-28W	122	7.4	520	5.2	0	29	0	0	0	1	30
3-6	12/8	05:51-06:51	46-22N	179-27W	100	4.6	520	5.0	1	22	0	2	0	0	25
4-1	12/9	08:28-09:28	46-24N	174-42W	95	5.4	550	4.5	0	180	47	9	0	0	236
4-2	12/10	08:04-09:57	48-20N	169-03W	55	5.1	550	5.1	7	61	14	2	0	2	86
4-3	12/11	06:59-08:00	47-51N	164-52W	10	5.7	520	5.0	3	1	2	8	0	0	14
4-4	12/12 -13	14:56-06:39	47-12N	160-24W	--	6.6	580	4.6	0	84	134	8	0	1	227
4-5	12/13	19:25-20:25	46-23N	155-18W	103	7.1	520	5.0	0	0	0	2	0	0	2
4-6	12/14	14:14-15:15	45-42N	151-33W	355	8.8	570	4.8	0	0	0	0	0	0	0
5-1	12/15	15:48-16:48	44-32N	145-59W	5	10.0	550	5.2	0	0	0	0	0	0	0
5-2	12/16	08:10-09:10	45-31N	145-03W	183	9.1	560	5.1	0	0	0	0	0	0	0
5-3	12/16	17:25-18:25	46-27N	144-59W	165	9.2	515	5.5	0	0	0	0	0	0	0
5-4	12/17	07:52-08:52	47-18N	144-59W	192	8.3	555	5.2	0	0	0	0	0	0	0
5-5	12/17	18:46-19:46	49-03N	145-00W	345	7.1	510	5.3	1	0	0	8	0	0	9
5-6	12/18	06:12-07:12	51-07N	145-00W	45	6.8	510	5.4	5	0	1	4	0	0	10
Tot.									20	388	239	49	2	4	702

Size of Salmon

Mean fork lengths and weights of the fish in the samples are shown in Table 4. Fish that were originally identified as juvenile pink and sockeye salmon were combined into one category ("unidentified juveniles"). Salmon collected at station 4-4 were not included in the analysis because the fish had been dead a long time (perhaps as long as 14 or 15 hours) before they were measured.

Table 4. Size of immature and juvenile salmon caught during the Japan, U.S.A., and Canada cooperative salmon survey, November-December, 1992. Imm. = immature (ocean age .1 or older); Juv. = juvenile (ocean age .0); Unid. = unidentified species.

Species Category	Sample Size	(cm) Fork Length Mean	95% C.I.	(kg) Weight Mean	95% C.I.
Imm. sockeye	20	42.3	1.33	.828	.095
Imm. chum	88	44.3	1.25	.987	.085
Unid. juv.	170	25.6	.41	.161	.009
Juv. coho	41	33.5	1.16	.459	.051
Juv. chinook	2	25.8	.49	.208	.005
Imm. chinook	3	47.1	6.98	1.297	.649

Immature sockeye salmon ranged in length from 37.0 cm to 50.6 cm and in weight from 0.54 kg to 1.5 kg, and immature chum salmon ranged in length from 33.2 cm to 58.4 cm and in weight from 0.38 kg to 2.35 kg. Length frequency distributions of immature sockeye and chum salmon indicate that several ocean age groups are present in the samples (Figs. 4 and 5).

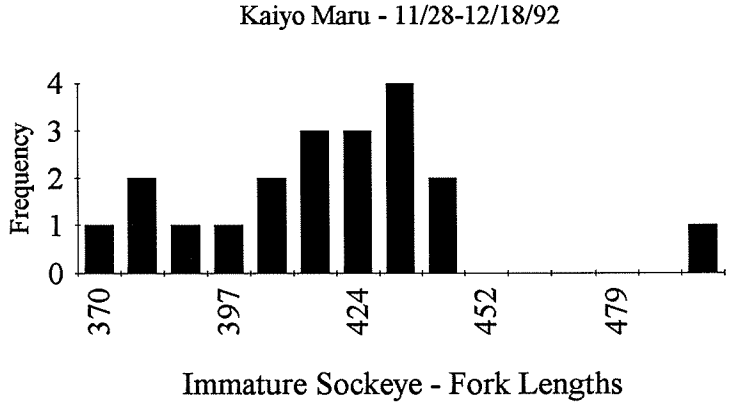


Fig. 4. Length frequency distribution (fork length in mm) of immature sockeye salmon caught in the North Pacific Ocean, December 1992.

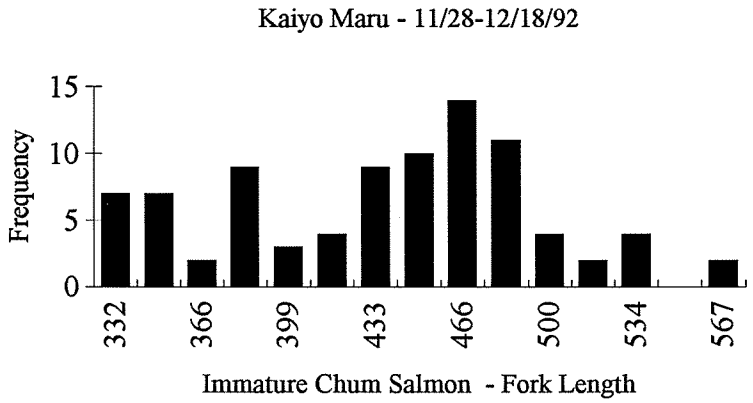


Fig. 5. Length frequency distribution (fork length in mm) of immature chum salmon caught in the North Pacific Ocean, November and December 1992.

The samples were divided into three regional groups: western North Pacific (Sta. 1-1 to 2-2), central North Pacific (Sta. 2-3 to 4-3), eastern North Pacific (Sta. 4-5 to 5-6). The fork lengths and condition factors (weight/length) of juvenile coho salmon in the three regions were significantly different (ANOVA, $p<.01$). The mean size and condition factor of juvenile coho salmon in the eastern North Pacific was larger than that of coho salmon in the western and central North Pacific (Table 4).

Table 4. Mean fork lengths and condition factors of juvenile coho salmon in three regions of the North Pacific in December 1992.

North Pacific Region	Sample size	(g/mm) Condition Factor	(cm) Fork Length
Western	6	1.17	31.2
Central	21	1.16	31.6
Eastern	14	1.66	37.4

The fork lengths of immature sockeye salmon from the three regions were not significantly different (ANOVA, $p=0.23$, $\alpha=.05$; western: n=3, mean F.L. 44.9 cm; central: n=12, 41.6 cm; eastern: n=6, 42.4 cm). The mean fork lengths of immature chum salmon in the eastern and central regions were significantly different (T-test, $p<.01$; eastern: n=41, mean F.L. 48.4 mm; central: n=46, 40.6 cm), perhaps because of the presence of older (possibly maturing) fish in the sample from the eastern region.

The mean fork lengths of immature chum salmon collected in the central Gulf of Alaska (52°N, 145°W) during testing of the pollock trawl averaged 45.8 cm (n=31), immature sockeye salmon averaged 43.4 cm (n=29), and mean fork lengths of juvenile salmon were 24.2 cm (n=2) for sockeye salmon, 25.2 cm for chum salmon (n=2), 27.1 cm for pink salmon (n=5), and 37.1 cm (n=23) for coho salmon.

Oceanographic Data and Salmon Distribution

Oceanographic data collected at each trawl station are summarized in Appendix 3. Calibration information for the Kaiyo Maru CTD and the Seabird CTD (SBCTD) is in Appendix 4. There may be some problems with the surface data collected by the CTD and SBCTD because of failure to properly equilibrate the equipment at the surface. A comparison between the EPCS data and the observed data is in Appendix 5. Dissolved oxygen data from the EPCS system appear to be unreliable, and salinity data need to be corrected. Current speed and direction and profiles of water temperature, salinity, and dissolved oxygen are shown in Appendix 6. Wind speed (m/s) and wave height (m) are shown in Appendix 7.

Salmon appeared to be distributed primarily in cool (less than 7.5° C SST) waters north of 44°N in the western North Pacific, north of 45°N in the central North Pacific, and north of 49°N in the eastern North Pacific (Fig. 3, Table 3). In the western North Pacific, the southern stations (1-1, 1-2, 1-3) were in the Kuroshio Current, based on high water temperatures and salinities. In the central North Pacific, the southernmost station (3-1) was in the Kuroshio Current (high temperature and salinity). Stations 3-2 and 3-3 were on the southern boundary of the transitional region (sub-arctic boundary, salinity 34 ppt vertically). Station 3-4 appeared to be just within the sub-arctic boundary. No salmon were caught at these stations. The largest catch of salmon in the central North Pacific was in 5.4°C (SST) water in the area south of the central Aleutians, Sta. 4-1 (no sampling inside of the U.S. EEZ). In the southern Gulf of Alaska, salmon were not encountered until Station 5-5 (49°03'N, 145°00'W; SST of 7.1°C). The largest catch of salmon (366 fish) in the Gulf of Alaska occurred during testing of the modified trawl net at an SST of 6.3°C. Salmon were not caught at sea surface temperatures above 9.6°C (Sta. 1-4, western North Pacific Ocean; Fig. 6).

Incidental Catch

Incidental catches of other species of fish and invertebrates during the salmon survey were generally low (Appendix 8). In terms of numbers, Myctophiform fishes were the predominant

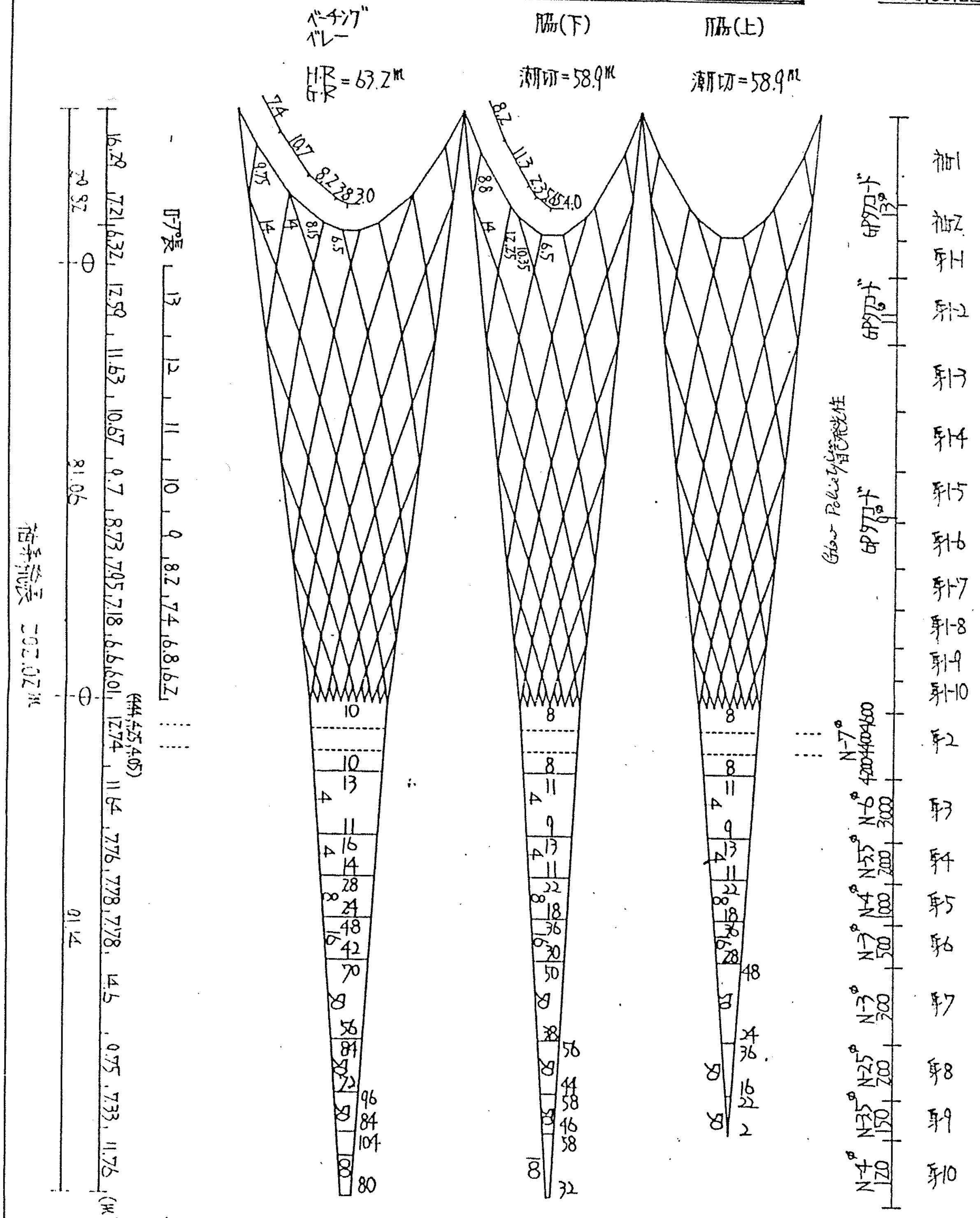
整理番号

水産庁 新船 開洋丸 向

43. 5/27

NICHIMO SPIDER TRAWL NET NST-60-K1

1990.09.22



標色ロープ

ベーチング (上) 青 白 緑 (上)
左脇(下) 橙 黒 黄 (下) 右脇
ベレー

カローブ (29.82m) クロスロープR 22φ テトロン 細 和 交
L.L. (81.06m) GPタフコードクロスロープ 30φ (ブリテン済)
〃 (91.14m) ナイロンクロスロープ 40φ (〃)

H.R G.R クロスロープR 20φ テトロン 和 交

潮切 タフラインクロス C.P.R 36φ (中央部 4.0m STLクロスロープ 40φ)

予備ロープ 11φ ポリエチレン: 2丸
ふくろ ナイロン: 2丸

NICHIMO CO., LTD.

ニチモウ株式会社

漁具構成図

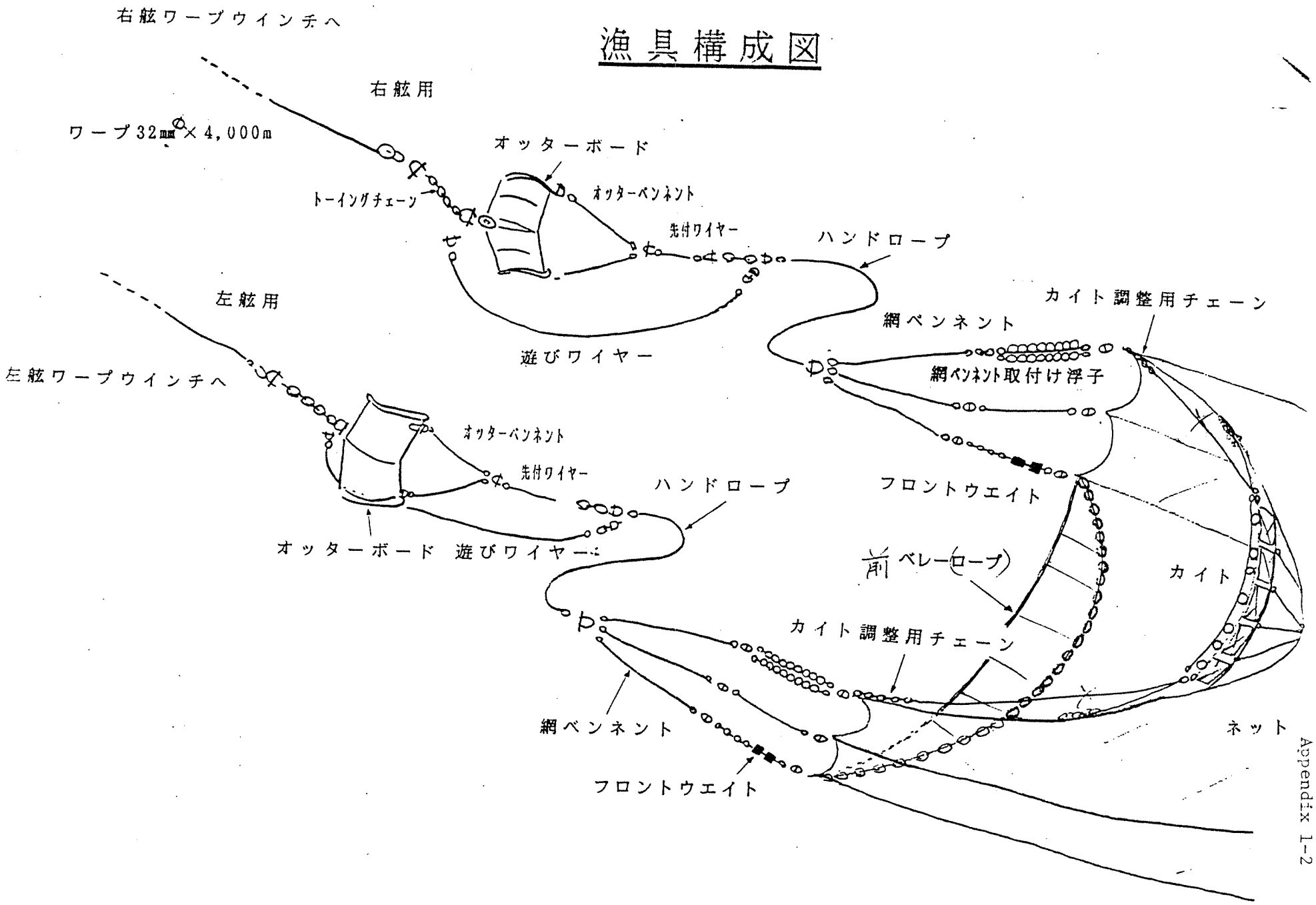

右舷ワープウインチへ
右舷用
ワープ32㎜φ×4,000m
オッターボード
トーイングチェーン
オッターベンネント
先付ワイヤー
ハンドロープ
左舷用
遊びワイヤー
カイト調整用チェーン
網ベンネント
網ベンネント取付け浮子
左舷ワープウインチへ
オッターベンネント
先付ワイヤー
ハンドロープ
フロントウエイト
オッターボード
遊びワイヤー
前ベレーロープ
カイト
カイト調整用チェーン
網ベンネント
ネット
フロントウエイト

図-5

表層トロール漁具向カイト

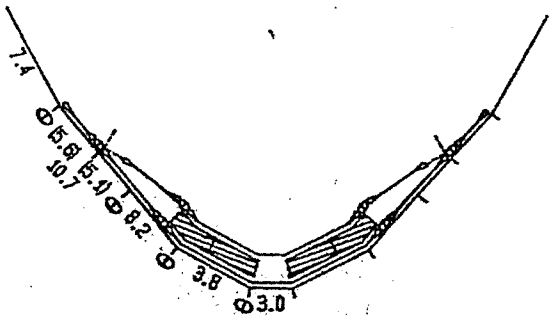
NST-60-K1

表層曳用 {ネットサンネットをテグスロンに替えた時のカイト

ウイング
カイト仕様

取付場所

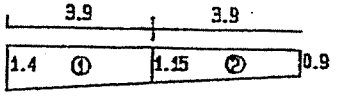
H.R =63.2M



仕様

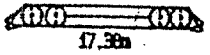
カイト本体

カイト投面積 17.94m² (4枚)



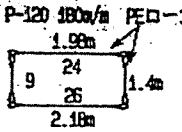
カイト用浮子

カイト前面取付(網地を被せること)
CT-208B (2.7kg/ケ) 計54ケ ≒172.8kg



開口部網地仕様

P-120 180m/m PEロープ-12φ

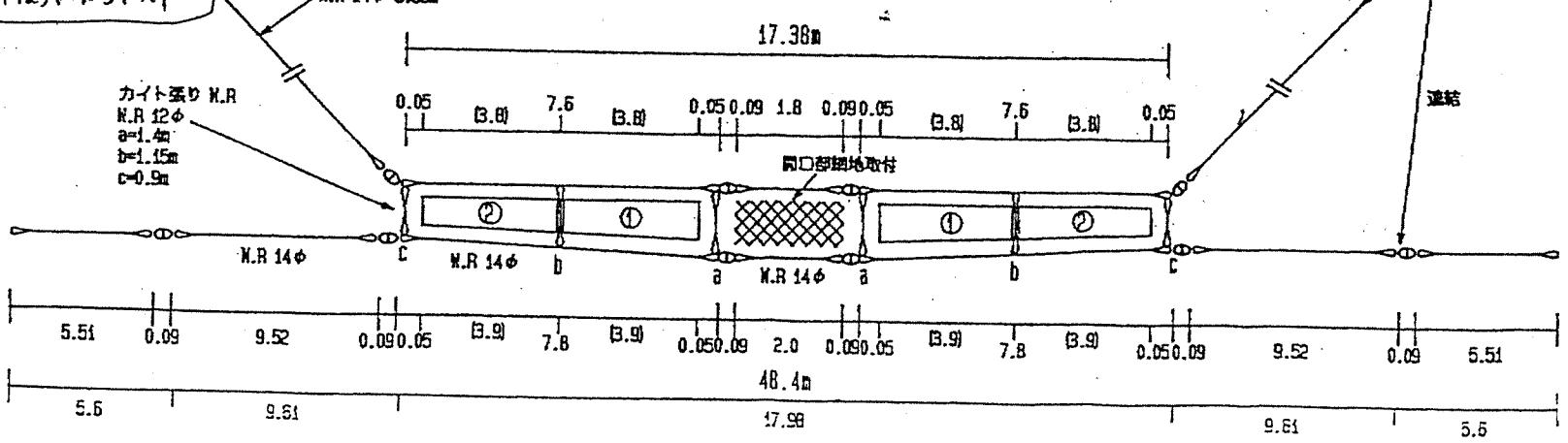


中層曳主体のとき
中間よりブリッ
本体側に取り付け

調整用チェーン
Φ13φ 1.0m
(0.5m部をDP連結とする)

カイトブライドル
M.R 14φ 8.55m

カップリング
θ: DP-13φ



NICHIMO CO., LTD.
MACHINERY & INDUSTRIAL MATERIALS TEAM
RESEARCH & DEVELOPMENT GROUP

NAME OF DRG	NICHIMO SPIDER TRAWL NET - NST-60-K1 ウイング カイト仕様		1992.01.20
DRG NO.	nst_60_k1_3	DISK TITLE	B0
DESIGNED BY	H.KIMURA	DATE	1992.01.26
DRAWING BY	H.TAKUMA	DRG SCALE	S/1000(S/5700)
REMARK	表層トロール用漁具向カイト		
NAME OF VESSEL	水産庁 俊鶻丸		

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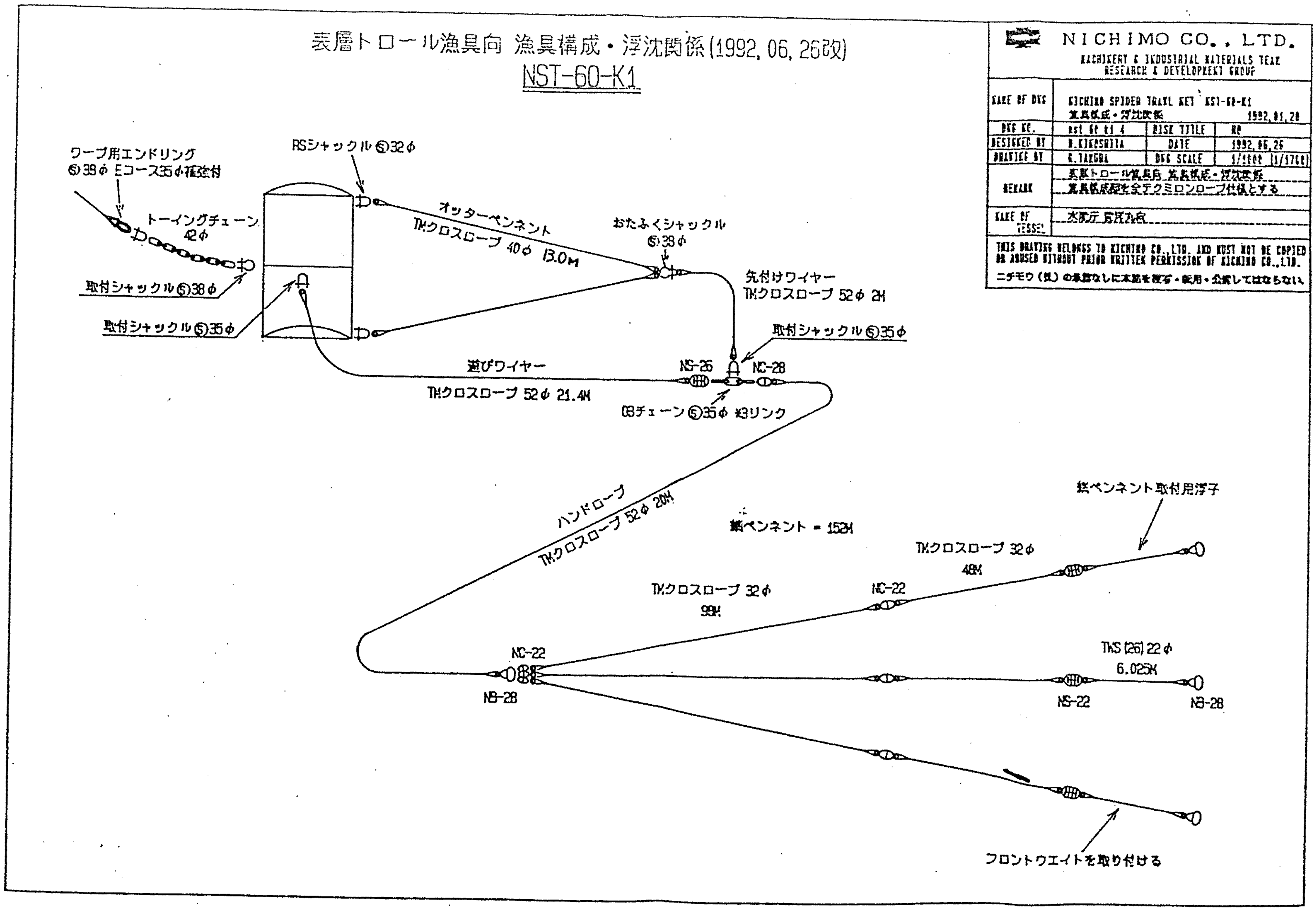
☐ SHOP DRAWING
☐ BID DRAWING


表層トロール漁具向 漁具構成・浮沈関係(1992, 06, 26改)
NST-60-K1
NICHIMO CO., LTD.
ワープ用エンドリング
⑤38φ Eコース35φ補強付
トーイングチェーン
42φ
取付シャックル⑤38φ
取付シャックル⑤35φ
RSシャックル⑤32φ
オッターペンネント
TMクロスロープ 40φ 13.0M
おたふくシャックル
⑤38φ
先付けワイヤー
TMクロスロープ 52φ 2M
取付シャックル⑤35φ
遊びワイヤー
TMクロスロープ 52φ 21.4M
NS-26
NC-28
OBチェーン⑤35φ ×3リンク
ハンドロープ
TMクロスロープ 52φ 20M
ペンネント = 152M
TMクロスロープ 32φ
48M
TMクロスロープ 32φ
99M
NC-22
NC-22
NB-28
TMS (26) 22φ
6.025M
NS-22
NB-28
ペンネント取付用浮子
フロントウエイトを取り付ける
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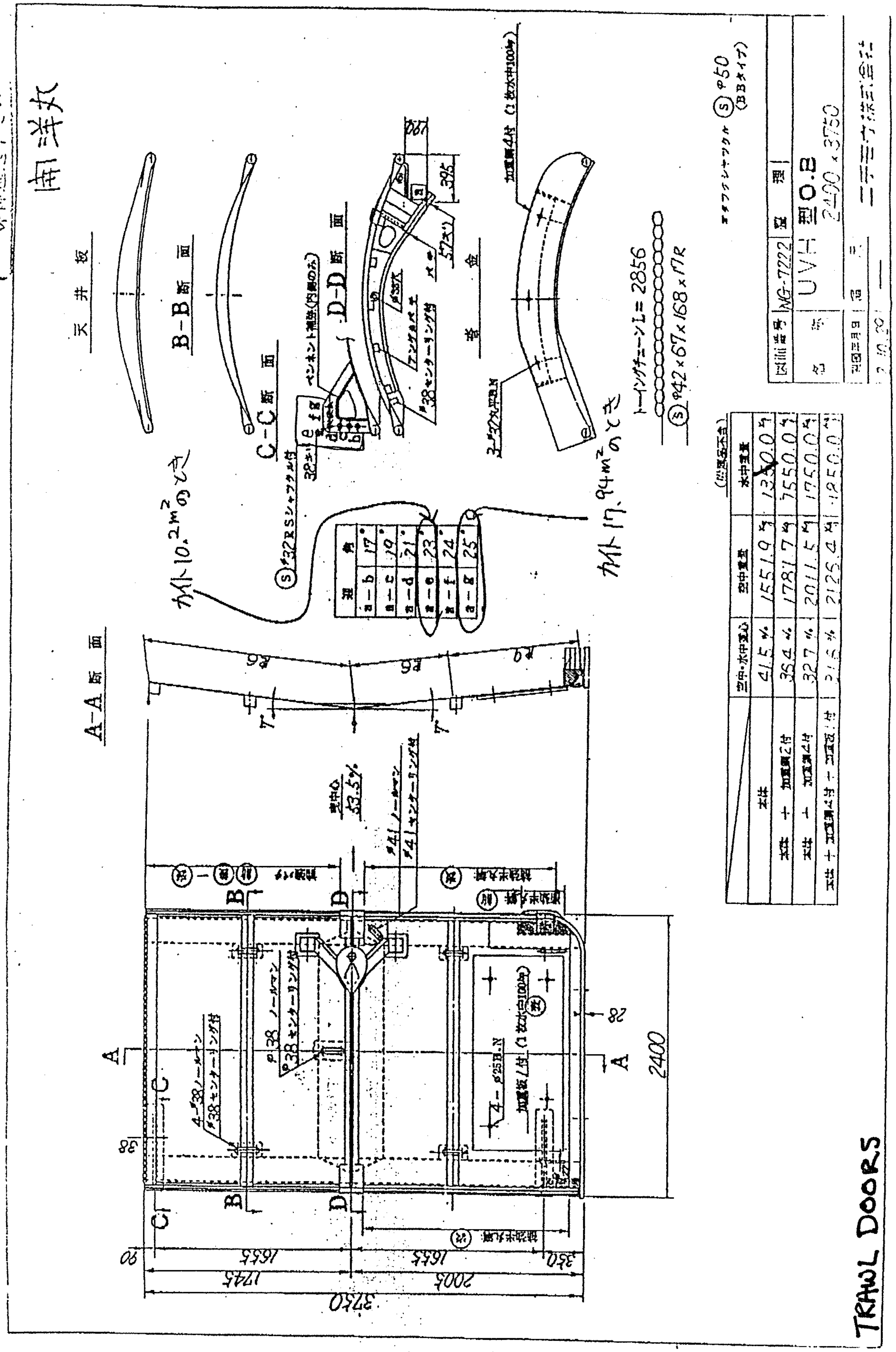
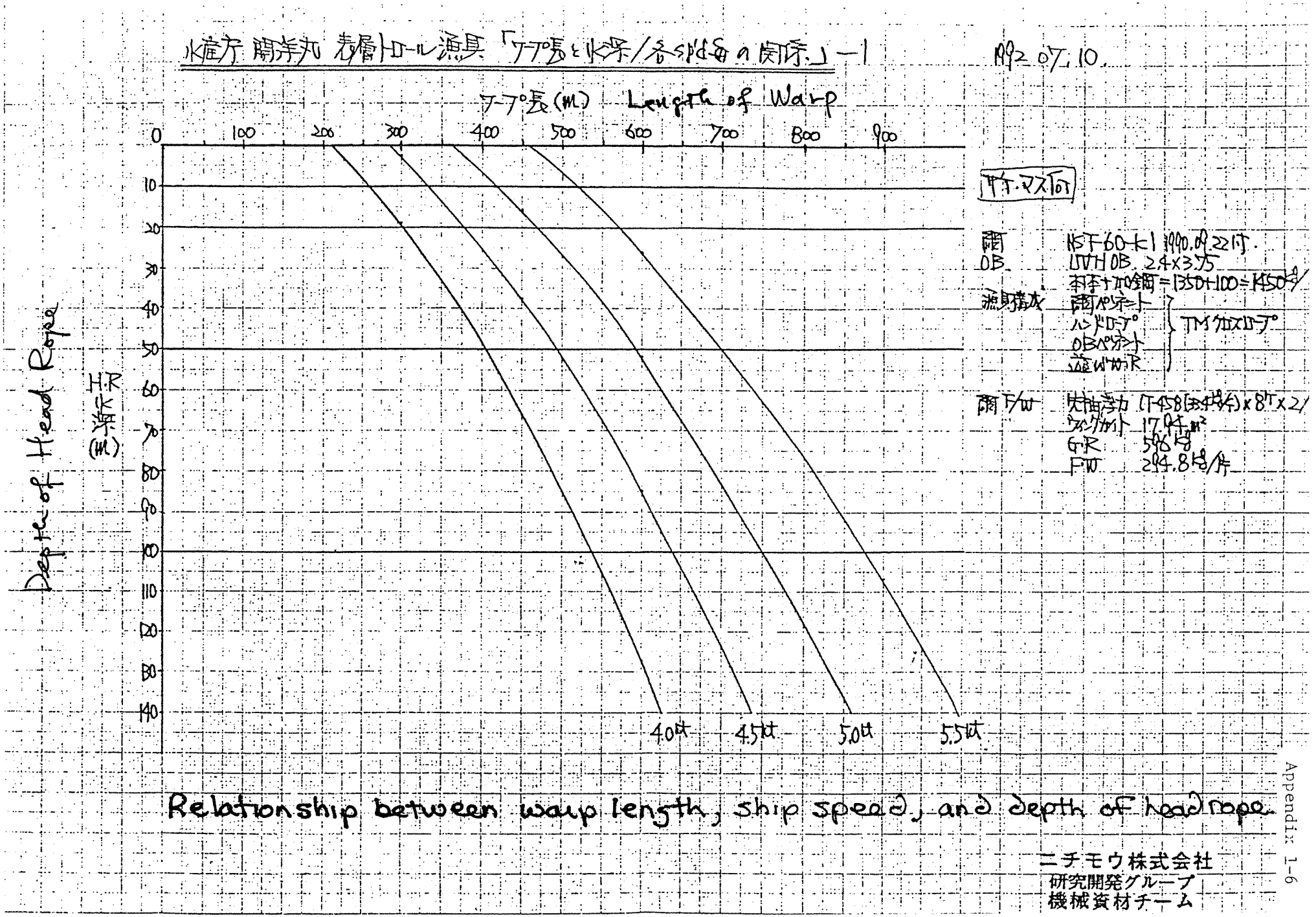

TRAWL DOORS
南洋丸
A-A 断面
B-B 断面
C-C 断面
D-D 断面
天井板
NG-7222
UVH 型 0.8
2400 x 3750
3750
2400



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機械資材チーム

Appendix 2. Date, time, and location of sampling stations.

表 —1、調査一覧

Date SMD	Time SMT	Date GMD	Time GMT	Station	TRAWL	CTD	SCTD	XBT	NORPAC NET	PRIMARY PRODUCTION	Latitude	Longtud
1126	0842	1125	2342	X-1				○			3535N	14358E
	1020	1126	0120	P-1						○	3538N	14423E
	1244		0344	X-2				○			3544N	14500E
	1633		0733	X-3				○			3558N	14600E
	2033		1133	X-4				○			3611N	14700E
1127	0026		1526	X-5				○			3622N	14800E
	0423		1923	X-6				○			3632N	14900E
	0826		2326	X-7				○			3643N	15000E
	1015	1127	0115	P-2						○	3648N	15026E
	1217		0317	X-8				○			3654N	15100E
	1620		0720	X-9				○			3706N	15200E
	2105		1135	X-10				○			3715N	15300E
1128	0102		1532	X-11				○			3728N	15400E
	0455		1925	X-12				○			3739N	15500E
	0902		2332	X-13				○			3749N	15600E
	1020	1128	0050	P-3						○	3751N	15612E
	1506		0536	1-1	○	○			○		3758N	15716E
1129	0051		1451	X-14				○			3830N	15729E
	0315		1715	X-15				○			3900N	15730E
	0614		2014	1-2	○	○			○		3935N	15733E
	1020	1129	0020	P-4						○	3935N	15747E
	1224		0224	X-16				○			4000N	15743E
	1452		0452	X-17				○			4030N	15736E
	1820		0820	1-3	○	○			○		4110N	15731E
	2352		1352	X-18				○			4130N	15741E
1130	0243		1643	X-19				○			4159N	15735E
	0814		2214	1-4	○		○	○	○		4213N	15742E
	0905		2305	P-5						○	4213N	15742E
	1543	1130	0543	X-20				○			4230N	15749E
	1911		0911	X-21				○			4300N	15752E
	2237		1237	X-22				○			4330N	15754E
1201	0158		1558	X-23				○			4400N	15759E
	0528		1928	X-24				○			4430N	15801E
	0805		2205	1-5	○		○		○		4448N	15803E
	0950		2350	P-6						○	4447N	15805E
	1753	1201	0753	X-25				○			4500N	15801E
1202	0215		1545	X-26				○			4530N	15740E
	0610		1940	1-6	○	○			○		4539N	15730E
	0920		2250	P-7						○	4535N	15741E
	1036	1202	0006	X-27				○			4532N	15800E
	1317		0247	X-28				○			4528N	15900E
	1557		0527	X-29				○			4524N	16000E
	1841		0811	X-30				○			4519N	16100E
	2124		1054	X-31				○			4514N	16200E
1203	0004		1334	X-32				○			4510N	16300E
	0228		1558	2-1	○	○			○		4506N	16351E
	0656		2026	X-33				○			4511N	16400E
	1025		2355	X-34				○			4505N	16500E
	1105	1203	0035	P-8						○	4503N	16508E
	1427		0357	X-35				○			4458N	16600E
	1802		0732	X-36				○			4451N	16700E
	2159		1059	X-37				○			4444N	16800E
1204	1045		2345	P-9						○	4425N	16836E

表 — 2 調査一覧

Date SMD	Time SMT	Date GMD	Time GMT	Station	TRAWL	CTD	SCTD	XBT	NORPAC NET	PRIMARY PRODUCTION	Latitude	Longtud
1204	1210	1204	0110	2-2	○		○		○		4426N	16855E
	1853		0753	X-38				○			4407N	17000E
	2248		1118	X-39				○			4346N	17100E
1205	0207		1437	X-40				○			4328N	17200E
	0541		1811	X-41				○			4308N	17300E
	0916		2146	X-42				○			4249N	17400E
	1015		2245	P-10						○	4244N	17411E
	1241	1205	0111	2-3	○	○			○		4231N	17451E
	2117		0917	X-43				○			4159N	17600E
1206 A	0127		1327	X-44				○			4136N	17700E
	0711		1917	X-45				○			4116N	17800E
	1015		2215	P-11						○	4105N	17839E
	1201	1206	0001	3-1	○	○			○		4100N	17902E
1206 B	0336		1536	X-46				○			4115N	18000E
	0604		1804	3-2	○		○		○		4121N	17935W
	0945		2145	P-12						○	4115N	17921W
	1229	1207	0029	X-47				○			4130N	17919W
	1500		0300	X-48				○			4200N	17929W
	1528		0328	3-3	○		○		○		4205N	17928W
	2200		1000	X-49				○			4230N	17921W
1207	0058		1258	X-50				○			4300N	17929W
	0349		1549	X-51				○			4330N	17930W
	0600		1800	3-4	○	○			○		4351N	17930W
	1000		2200	P-13						○	4341N	17923W
	1226	1208	0026	X-52				○			4400N	17927W
	1502		0302	X-53				○			4430N	17930W
	1804		0604	3-5	○	○			○		4500N	17928W
	2237		1037	X-54				○			4500N	17917W
1208	0045		1245	X-55				○			4530N	17920W
	0304		1504	X-56				○			4600N	17925W
	0528		1728	3-6	○		○		○		4622N	17927W
	0959		2159	X-57				○			4621N	17900W
	1015		2215	P-14						○	4620N	17858W
	1359	1209	0159	X-58				○			4622N	17800W
	1810		0610	X-59				○			4625N	17700W
	2358		1128	X-60				○			4627N	17600W
1209	0553		1723	X-61				○			4625N	17500W
	0801		1931	4-1	○	○			○		4624N	17442W
	0940		2110	P-15						○	4622N	17431W
	1345	1210	0115	X-62				○			4634N	17400W
	1703		0433	X-63				○			4655N	17300W
	2059		0759	X-64				○			4717N	17200W
1210	0047		1147	X-65				○			4739N	17100W
	0428		1528	X-66				○			4800N	17000W
	0804		1904	4-2	○	○			○		4820N	16903W
	0940		2040	P-16						○	4823N	16852W
	1435	1211	0135	X-67				○			4816N	16759W
	1553		0453	X-68				○			4808N	16700W
	2321		0950	X-69				○			4759N	16600W
1211	0527		1557	X-70				○			4750N	16500W
	0626		1656	4-3	○		○		○		4751N	16452W
	0925		1955	P-17						○	4758N	16449W
	1216		2246	X-71				○			4759N	16400W

表 —3 調査一覧

Date SMD	Time SMT	Date GMD	Time GMT	Station	TRAWL	CTD	SCTD	XBT	NORPAC NET	PRIMARY PRODUCTION	Latitude	Longtud
1211	1530	1212	0200	X-72				○			4801N	16300W
	1846		0516	X-73				○			4805N	16200W
	2352		0952	X-74				○			4749N	16100W
1212	1000		2000	P-18						○	4714N	16024W
	1433	1213	0033	4-4	○		○		○		4712N	16025W
1213	0854		1854	X-75				○			4655N	15900W
	1020		2020	P-19						○	4650N	15829W
	1148		2148	X-76				○			4646N	15800W
	1427	1214	0027	X-77				○			4638N	15700W
	1707		0307	X-78				○			4629N	15600W
	1902		0502	4-5	○	○			○		4623N	15518W
1214	0111		1111	X-79				○			4620N	15500W
	0432		1432	X-80				○			4608N	15400W
	0744		1744	X-81				○			4556N	15300W
	1015		2015	P-20						○	4546N	15216W
	1114		2114	X-82				○			4543N	15200W
	1303		2303	4-6	○	○			○		4542N	15133W
	1949	1215	0549	X-83				○			4542N	15100W
	2354		0924	X-84				○			4525N	15000W
1215	0328		1258	X-85				○			4508N	14900W
	0658		1628	X-86				○			4451N	14800W
	1015		1945	P-21						○	4434N	14705W
	1039		2009	X-87				○			4433N	14700W
	1408		2338	X-88				○			4416N	14600W
	1527	1216	0057	5-1	○	○			○		4432N	14559W
1216	0017		0917	X-89				○			4500N	14535W
	0614		1514	5-2	○	○			○		4532N	14503W
	0930		1830	P-22						○	4523N	14504W
	1059		1959	X-90				○			4530N	14504W
	1335		2235	X-91				○			4600N	14502W
	1702	1217	0202	5-3	○	○			○		4627N	14459W
	2143		0643	X-92				○			4630N	14458W
1217	0023		0923	X-93				○			4700N	14500W
	0615		1515	5-4	○		○		○		4718N	14459W
	0940		1840	P-23						○	4710N	14500W
	1218		2118	X-94				○			4730N	14500W
	1409		2309	X-95				○			4800N	14500W
	1604	1218	0104	X-96				○			4832N	14500W
	1746		0246	X-97				○			4900N	14500W
	1802		0302	5-5	○	○			○		4903N	14500W
1218	0002		0902	X-98				○			4930N	14500W
	0148		1048	X-99				○			5000N	14500W
	0336		1236	X-100				○			5030N	14500W
	0524		1424	X-101				○			5100N	14500W
	0549		1449	5-6	○	○		○	○		5107N	14500W
	1000		1900	P-24						○	5113N	14448W
1219	0513	1219	1413	X-102				○			5130N	14500W
	1219		2119	X-103				○			5200N	14457W
	1300		2200	TEST1	○						5206N	14456W
	1858	1220	0358	X-104				○			5153N	14412W

Appendix 3. Oceanographic data collected at each trawl station.

Oceanographic data at each trawl station.

Station 1-1
Date(GMT) 1992/11/28
Time 08:59
LAT. 37°52.75' N
LONG. 157°28.43' E
Depth 5699m
memo MK II

Bottle No.	Press. dB	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19 (表層)	0.0	17.2		34.323		5.33	3.1	0.8	0.1
18	11.0	17.75	34.310	34.307	6.47	5.40	3.2	1.0	0.2
17	19.3	17.75	34.313	34.303	6.45	5.36	3.3	0.8	0.1
16	29.6	17.73	34.318	34.314	6.48	5.37	3.4	0.9	0.1
15	41.2	17.67	34.333	34.325	6.49	5.41	3.4	1.0	0.2
14	50.7	17.64	34.344	34.343	6.42	5.37	3.5	1.1	0.2
13	57.7	17.40	34.383	34.348	6.02	5.26	3.8	1.5	0.2
12	79.4	13.83	34.397	34.405	5.77	4.66	13.0	10.5	0.7
11	100.0	12.95	34.395	34.380	5.74	4.64	15.4	12.4	0.8
10	120.9	12.18	34.285	34.305	5.78	4.87	16.8	13.3	0.9
9	149.5	11.21	34.294	34.284	5.75		20.8	14.9	1.0
8	199.0	9.89	34.196	34.192	5.91	4.82	25.4	16.7	1.1
7	251.7	8.77	34.096	34.110	5.82	4.70	31.4	19.2	1.4
6	302.1	7.71	34.041	34.038	5.55	4.43	38.9	21.9	1.6
5	401.0	5.94	34.000	33.984	4.53	3.50	58.1	29.0	2.3
4	501.4	4.84	34.027	34.016	3.34	2.76	76.3	34.2	2.7
3	601.1	4.43	34.124	34.110	2.31	1.99	91.4	37.9	3.0
2	799.9	3.70	34.297	34.281	1.44	1.23	115.1	41.0	3.3
1	1001.9	3.18	34.375	34.361	1.13	1.25	129.3	42.1	3.4

Station 1-2
Date(GMT) 1992/11/28
Time 20:16
LAT. 39°33.63' N
LONG. 157°31.98' E
Depth 5668m
memo MK II

Bottle No.	Press. dB	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19 (表層)	0.0	14.0		34.105		5.17	7.7	3.7	0.4
18	9.8	13.76	34.049	34.063	7.24	5.69	7.8	3.7	0.4
17	18.7	13.75	34.048	34.058	7.41	5.65	7.8	3.7	0.4
16	28.9	13.75	34.048	34.058	7.50	5.66	7.9	3.6	0.4
15	39.7	13.76	34.049	34.064	7.38	5.63	7.8	3.6	0.4
14	52.1	13.75	34.049		7.44	5.67	7.7	3.7	0.4
13	60.3	13.76	34.050	34.056	7.24	5.65	7.7	3.6	0.4
12	78.0	13.42	34.190	34.207	6.39	5.03	11.8	7.8	0.6
11	99.1	11.77	34.317	34.326	6.30	4.78	17.0	12.9	0.9
10	119.7	10.70	34.249	34.241	6.48	4.79	20.4	14.4	1.0
9	147.5	10.17	34.215	34.220	7.01	5.75	19.0	13.7	0.9
8	197.7	7.74	33.919	33.944	7.31	5.46	27.0	17.3	1.3
7	250.3	6.21	33.805	33.804	6.67	3.09	51.7	26.7	2.0
6	299.8	6.10	33.956	33.964	5.26	3.87	51.7	26.7	2.0
5	399.3	4.32	33.900	33.901	4.02	3.06	73.6	33.8	2.6
4	500.9	3.96	33.999	34.017	2.78	2.13	89.4	37.9	3.0
3	601.9	3.71	34.095	34.089	1.91	1.44	103.5	40.7	3.3
2	797.4	3.53	34.298	34.302	1.42	1.14	119.5	41.6	3.4
1	1001.7	3.02	34.387	34.410	1.25	1.00	133.4	42.6	3.5

Station 1-3
Date(GMT) 1992/11/29
Time 10:58
LAT. 041 17.17 N
LONG. 157 40.68 E
Depth 5508m
memo MK II 表層塩検ミス

Bottle No.	Press. dB	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19(表層)	0.0	10.6				滴定ミス	12.6	7.0	0.7
18	9.7	10.20	33.585	33.596	8.41				
17	19.7	10.24	33.593	33.594	8.31		12.6	6.9	0.6
16	30.4	10.11	33.587	33.592	8.37		12.8	7.0	0.6
15	40.7	10.06	33.563	33.562	8.45				
14	49.3	10.06	33.563	33.566	8.48		13.4	7.4	0.7
13	60.9	10.06	33.564	33.561	8.32		13.4	7.4	0.7
12	78.7	8.20	33.731	33.697	8.19		22.6	14.5	1.2
11	99.2	6.98	33.791	33.790	8.10		28.4	18.0	1.4
10	120.5	5.91	33.677	33.697	8.52		29.8	18.2	1.4
9	150.5	5.38	33.660	33.789	8.17		35.0	20.6	1.6
8	200.7	4.95	33.676	33.674	7.77		39.9	22.3	1.8
7	248.4	4.59	33.744	33.744	6.00		54.2	28.0	2.3
6	300.1	4.21	33.830	33.817	4.56		68.7	33.1	2.8
5	399.9	4.00	33.970		3.02				
4	498.8	4.02	34.110	34.101	2.14		97.6	39.3	3.3
3	599.0	3.73	34.211	34.198	1.50		110.2	41.2	3.4
2	800.0	3.26	34.328	34.315	1.16		125.2	42.3	3.6
1	1001.2	2.89	34.403	34.390	1.09		136.8	43.0	3.7

Station 1-4
Date(GMT) 1992/11/30
Time 02:21
LAT. 42°04.4' N
LONG. 157°47.7' E
Depth 5447 m
memo SEA BIRD

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19(表層)	0	9.7		33.732		6.26	14.6	8.9	0.7
18	10	9.62	32.664						
17	20	9.62	33.478						
16	30	9.62	33.473						
15	40	9.63	33.474						
14	50	9.63	33.479						
13	60	9.63	33.483						
12	80	9.60	33.490						
11	100	8.17	33.881						
10	120	6.83	33.787						
9	150	6.29	33.772						
8	200	5.48	33.745						
7	250	4.35	33.708						
6	300								
5	400								
4	500								
3	600								
2	800								
1	1000								

Station 1-5
Date(GMT) 1992/11/30
Time 22:05
LAT. 44°47.8' N
LONG. 158°03.2' E
Depth 5142 m
memo SEA BIRD

Bottle No.	Press. dB	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19(表層)	0	5.2		33.210		7.02	27.3	18.2	2.2
18	10	4.85	32.658						
17	20	4.84	32.816						
16	30	4.84	32.817						
15	40	4.85	32.817						
14	50	4.77	32.801						
13	60	3.00	32.981						
12	80	1.84	33.136						
11	100	1.57	33.194						
10	120	1.85	33.315						
9	150	2.19	33.426						
8	200	2.62	33.636						
7	250	2.96	33.768						
6	300	3.11	33.862						
5	400	3.27	34.026						
4	500	3.10	34.120						
3	600	3.00	34.200						
2	800	2.81	34.323						
1	1000								

Station 1-6
Date(GMT) 1992/12/01
Time 19:30
LAT. 45°39.32' N
LONG. 157°29.78' E
Depth 5003 m
memo MK II

Bottle No.	Press. dB	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19(表層)	0.0	4.5		32.832		7.12	28.8	17.6	1.3
18	10.0	4.27	32.819	32.832	9.96	7.11	29.0	17.8	1.4
17	20.0	4.27	32.820	32.827	10.08	7.12	28.7	18.0	1.4
16	30.0	4.27	32.820	32.832	9.95	7.11	28.9	17.9	1.4
15	40.0	4.27	32.820	32.823	9.94	7.08	28.9	17.6	1.4
14	50.0	4.27	32.821	32.831	9.95	6.83	28.8	18.0	1.4
13	60.0	4.27	32.821	32.825	9.64	6.94	28.8	17.9	1.4
12	80.0	4.24	32.827	32.836	9.87	6.94	29.0	17.8	1.4
11	100.0	1.98	33.097	33.110	9.63	6.78	41.8	25.6	2.0
10	120.0	1.60	33.249	33.266	8.54	6.08	52.6	30.4	2.3
9	150.0	2.11	33.446	33.437	6.51	4.80	64.7	33.7	2.8
8	200.0	2.75	33.690	33.699	3.69	2.81	86.7	38.7	2.5
7	250.0	2.99	33.812	33.821	2.49	1.93	94.9	40.8	3.3
6	300.0	3.01	33.870	33.880	2.11	1.63	99.8	41.2	2.7
5	400.0	3.22	34.058	34.056	1.05	0.96	116.0	43.4	3.0
4	500.0	3.18	34.164	34.160	0.89	0.92	119.2	41.2	2.7
3	600.0	3.07	34.245	34.239	0.86	0.80	114.5	37.1	2.5
2	800.0	2.77	34.351	34.345	0.90	0.81	137.7	41.0	2.5
1	1000.0	2.52	34.434	34.428	1.01	0.99	147.0	40.5	2.6

Station 2-1
Date(GMT) 1992/12/02
Time 18:12
LAT. 45°13.13' N
LONG. 163°50.89' E
Depth 4850 m
memo MK II

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19(表層)	0.0			32.969		6.94	29.0	16.0	1.1
18	9.2	4.57	32.946	32.938	10.08	7.05	29.1	17.0	1.3
17	20.3	4.57	32.946	32.938	10.07	6.92	29.3	17.4	1.3
16	30.2	4.56	32.947	32.939	10.08	6.91	29.2	17.4	1.3
15	40.7	4.56	32.948	32.942	9.99	7.20	29.0	17.3	1.4
14	49.9	4.56	32.947	32.941	9.75	7.00	29.3	17.5	1.4
13	60.6	4.56	32.947	32.941	9.68	6.91	29.0	17.5	1.4
12	79.8	4.52	32.948	32.941	9.46	6.99	29.1	17.4	1.3
11	101.1	2.48	33.268	33.262	9.37	6.53	42.4	25.1	1.9
10	120.2	2.61	33.342	33.338	8.67	6.27	44.0	26.0	2.0
9	148.3	3.12	33.466	33.466	7.61	5.67	46.8	25.9	1.9
8	200.6	2.87	33.582	33.556	6.14	4.52	63.2	30.4	2.0
7	251.2	3.15	33.693	33.686	4.71	3.55	74.9	33.7	2.0
6	300.9	3.29	33.811	33.805	3.41	2.74	80.6	34.9	2.0
5	400.0	3.26	33.941	33.933	1.87	1.43	115.1	47.0	3.1
4	500.7	3.24	34.073	34.056	1.07	0.97	115.6	42.2	2.6
3	601.2	3.30	34.196	34.178	0.54	0.53	121.5	42.2	2.7
2	802.1	2.95	34.315	34.298	0.60	0.59	141.9	43.7	2.9
1	998.6	2.74	34.408	34.388	1.03	0.79	144.6	41.6	2.6

Station 2-2
Date(GMT) 1992/12/04
Time 01:10
LAT. 44°26.4' N
LONG. 168°54.7' E
Depth 5721 m
memo SEA BIRD

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19(表層)	0	5.8		33.002		7.02	26.5	17.4	1.4
18	10	5.62	31.455						
17	20	5.60	32.964						
16	30	5.60	32.936						
15	40	5.60	32.937						
14	50	5.59	32.938						
13	60	5.56	32.932						
12	80	5.02	32.990						
11	100	3.71	33.119						
10	120	3.16	33.312						
9	150	2.97	33.478						
8	200	3.08	33.669						
7	250	3.18	33.783						
6	300	3.28	33.855						
5	400	3.31	33.963						
4	500								
3	600								
2	800								
1	1000								

Station 2-3
Date(GMT) 1992/12/05
Time 01:05
LAT. 42°31.31' N
LONG. 174°50.93' E
Depth 5660 m
memo MK II

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19 (表層)	0.0	9.6		33.769		6.27	13.0	9.7	0.6
18	11.9	9.53	33.763	33.764	8.92	6.36	13.0	9.6	0.6
17	20.6	9.49	33.769	33.772	8.62	6.33	13.1	9.6	0.6
16	30.3	9.47	33.798	33.799	8.66	6.30	13.2	9.8	0.6
15	41.1	9.47	33.799	33.801	8.70	6.26	13.1	9.8	0.7
14	49.2	9.48	33.800	33.800	8.74	6.34	13.1	9.8	0.6
13	59.9	9.48	33.801	33.803	8.60	6.28	13.1	9.8	0.6
12	80.8	9.48	33.805	33.802	8.52	6.28	13.1	9.8	0.6
11	97.0	9.46	33.802	33.799	8.66	6.25	13.1	9.9	0.6
10	119.4	8.34	33.774	33.769	8.46	6.25	16.4	12.3	0.8
9	149.6	7.17	33.769	33.776	8.44	6.10	22.0	16.2	1.0
8	199.9	6.74	33.843	33.841	7.22	5.37	26.3	16.7	0.9
7	248.3	6.08	33.889	33.885	6.10	4.50	43.2	24.3	1.4
6	300.4	5.27	33.886	33.883	5.08	3.81	54.8	28.3	2.0
5	398.6	4.58	33.953	33.945	3.67	2.92	72.2	33.3	1.8
4	499.9	4.20	34.067	34.058	2.39	1.96	89.5	36.9	2.1
3	601.1	3.91	34.170	34.158	1.65	1.44	103.8	39.3	2.3
2	801.7	3.46	34.294	34.279	1.18	1.27	124.4	42.0	3.1
1	1002.4	2.99	34.380	34.363	0.95	1.33	135.4	41.9	2.6

Station 3-1
Date(GMT) 1992/12/06
Time 02:09
LAT. 41°07.00' N
LONG. 179°10.09' E
Depth 5710 m
memo MK II

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19 (表層)		13.2		34.296		5.65	7.2	4.9	0.3
18	8.6	13.56	34.277	34.278	7.80	5.75	7.3	4.7	0.3
17	20.5	13.56	34.276	34.279	7.90	5.72	7.4	4.8	0.3
16	29.9	13.56	34.276	34.275	7.69	5.71	7.4	4.8	0.3
15	40.9	13.53	34.272	34.269	7.61	5.61	7.4	4.7	0.3
14	49.4	13.54	34.273	34.276	7.87	5.72	7.4	4.7	0.3
13	61.8	13.50	34.269	34.265	7.77	5.68	7.6	4.9	0.3
12	78.3	13.48	34.275	34.269	7.55	5.78	7.4	4.9	0.3
11	98.8	12.53	34.412		7.10		11.6	9.8	0.5
10	118.6	12.16	34.388	34.386	7.14	5.26	11.8	10.1	0.5
9	146.6	11.70	34.353	34.351	7.14	5.35	12.1	9.5	0.4
8	198.9	10.98	34.286	34.304	7.17	5.88	10.0	6.7	0.4
7	245.9	10.19	34.212	34.206	7.40	5.45	16.7	12.3	0.5
6	296.9	9.40	34.138	34.136	6.88	5.21	21.8	15.3	0.7
5	397.2	7.72	34.065	34.056	5.74	4.22	56.3	27.9	1.6
4	500.1	6.12	34.011	34.008	4.59	3.55	36.9	22.0	1.2
3	599.8	4.98	34.039	34.033	3.27	2.75	75.5	33.8	2.4
2	801.5	3.95	34.212	34.199	1.51	1.20	108.1	40.1	2.5
1	997.1	3.40	34.319	34.304	0.94	0.87	127.3	42.5	2.7

Station 3-2
Date(GMT) 1992/12/06
Time 18:04
LAT. 41°21.1' N
LONG. 179°34.5' W
Depth 6042 m
memo SEA BIRD

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19 (表層)	0	11.2		34.015		6.01	10.9	7.9	0.5
18	10	11.12	33.486						
17	20	11.13	33.986						
16	30	11.14	33.988						
15	40	11.13	33.986						
14	50	11.13	33.986						
13	60	11.12	33.985						
12	80	11.13	33.984						
11	100	11.11	33.989						
10	120	10.72	34.113						
9	150	9.20	34.042						
8	200	8.11	33.934						
7	250	7.85	33.982						
6	300	6.99	33.963						
5	400	5.51	33.914						
4	500	4.46	33.930						
3	600	4.32	34.049						
2	800	3.73	34.227						
1	1000								

Station 3-3
Date(GMT) 1992/12/07
Time 05:48
LAT. 42°01.3' N
LONG. 179°16.8' W
Depth 5632 m
memo SEA BIRD

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19 (表層)	0	10.3		33.792		6.22	12.9	9.6	0.6
18	10	9.85	30.375						
17	20	9.85	33.755						
16	30	9.85	33.756						
15	40	9.86	33.756						
14	50	9.86	33.757						
13	60	9.86	33.757						
12	80	9.86	33.757						
11	100	9.87	33.758						
10	120	9.85	33.774						
9	150	9.29	34.034						
8	200	7.91	33.900						
7	250	7.76	33.953						
6	300	6.95	33.946						
5	400	5.34	33.903						
4	500	4.67	33.998						
3	600	4.29	34.102						
2	800	3.61	34.239						
1	1000								

Station 3-4
Date(GMT) 1992/12/07
Time 17:56
LAT. 43°51.15' N
LONG. 179°30.16' W
Depth 5508 m
memo SEA BIRD

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19 (表層)	0.0	9.0		33.753		5.41	14.7	10.6	0.7
18	9.3	9.04	33.737	33.739	9.18	5.45	14.8	10.5	0.7
17	20.4	9.04	33.738	33.744	9.11	5.44	15.0	10.6	0.8
16	29.0	9.04	33.738	33.736	9.21	5.44	14.9	10.7	0.7
15	40.4	9.04	33.738	33.738	9.03	5.43	14.9	10.6	0.7
14	50.5	9.04	33.739	33.738	9.11	5.45	15.1	10.7	0.7
13	60.5	9.04	33.738	33.739	8.88	5.41	14.8	10.7	0.8
12	79.7	9.05	33.738	33.739	8.77	5.43	15.1	10.6	0.7
11	101.6	9.06	33.745	33.742	8.79	5.57	15.0	10.7	0.7
10	121.1	9.07	33.754	33.752	8.68	5.47	15.4	10.8	0.7
9	149.2	8.22	33.888	33.875	7.91	5.27	20.1	14.0	0.8
8	200.7	7.85	33.959	33.959	7.53	5.81	25.6	16.4	0.9
7	247.7	6.99	33.957	33.952	6.29	4.10	37.3	22.0	1.2
6	300.1	5.92	33.933	33.928	5.21	3.90	51.7	26.9	1.7
5	400.0	4.70	33.960	33.954	3.78	2.55	72.2	33.1	2.0
4	499.6	4.25	34.026	34.020	2.69	1.85	87.7	37.2	2.9
3	600.8	4.01	34.141	34.133	1.77	1.32	103.4	40.2	2.6
2	803.3	3.54	34.273	34.262	1.15	1.21	122.7	42.5	2.9
1	1004.0	3.06	34.370	34.358	0.89	0.75	139.0	43.7	3.0

Station 3-5
Date(GMT) 1992/12/08
Time 08:34
LAT. 44°54.57' N
LONG. 179°17.95' W
Depth 5746 m
memo MK II

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19 (表層)	0.0	6.8		33.340		5.61	20.6	14.5	1.1
18	10.0	7.13	33.315	33.322	9.00	5.68	21.1	14.8	1.5
17	19.9	7.13	33.314	33.314	9.25	5.64	20.8	14.6	1.2
16	28.4	7.13	33.315	33.315	9.18	5.65	20.8	14.6	1.1
15	39.2	7.13	33.314	33.318	9.31	5.63	21.0	14.7	1.1
14	50.5	7.14	33.319	33.318	9.12	5.67	20.8	14.6	1.1
13	60.1	7.56	33.427	33.410	8.97		20.3	14.4	1.1
12	80.2	8.05	33.729	33.737	8.08	5.17	20.6	14.9	1.0
11	100.7	8.10	33.972	33.976	7.73	4.86	22.6	16.2	1.1
10	120.4	7.91	33.969	33.976	7.68	4.86	23.9	16.7	1.1
9	150.5	7.19	33.913	33.909	7.49	4.73	29.1	18.9	1.1
8	199.2	6.86	33.929		6.77	4.31	34.7	20.9	1.7
7	250.4	5.96	33.910	33.912	5.56	3.57	47.6	26.0	1.7
6	298.9	5.15	33.919	33.915	4.52	2.30	59.9	30.1	2.0
5	399.5	4.58	34.008	34.005	3.27	1.27	78.5	35.6	2.3
4	500.4	4.12	34.108	34.101	2.09	1.12	93.3	38.3	2.3
3	600.5	3.88	34.181	34.171	1.61	0.84	108.0	41.3	2.7
2	800.8	3.44	34.303	34.293	1.14	0.65	123.3	42.8	3.0
1	1000.0	2.96	34.387	34.375	0.91	0.75	139.1	43.9	3.0

Station 3-6
Date(GMT) 1992/12/08
Time 19:14
LAT. 46°18.2' N
LONG. 179°12.6' W
Depth 5044 m
memo SEA BIRD

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19 (表層)	0	4.94		32.956		6.00	30.8	20.2	1.7
18	10	4.74	32.363						
17	20	4.73	32.905						
16	30	4.73	32.904						
15	40	4.73	32.906						
14	50	4.73	32.908						
13	60	4.73	32.909						
12	80	4.70	32.923						
11	100	4.17	33.055						
10	120	3.21	33.362						
9	150	3.39	33.555						
8	200	3.29	33.714						
7	250	3.18	33.784						
6	300	3.32	33.874						
5	400	3.48	34.033						
4	500	3.33	34.124						
3	600	3.29	34.201						
2	800	3.01	34.303						
1	1000								

Station 4-1
Date(GMT) 1992/12/09
Time 21:45
LAT. 46°22.86' N
LONG. 174°29.35' W
Depth 5793 m
memo MK II

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19 (表層)	0.0	5.8		32.982		6.01	27.2	18.6	1.5
18	10.8	5.28	32.957	32.964	10.00	6.03	27.2	18.7	1.5
17	20.9	5.29	32.957	32.959	9.95	5.98	27.2	18.6	1.5
16	32.0	5.29	32.958	32.961	10.23	6.09	27.7	18.8	1.5
15	38.7	5.29	32.958	32.978	9.88	6.07	27.2	18.7	1.5
14	50.8	5.29	32.958	32.962	10.08	6.00	27.2	18.8	1.5
13	58.5	5.29	32.958	32.965	9.74	6.24	27.2	18.7	1.5
12	80.3	5.29	32.958	32.970	9.78	6.12	27.3	18.7	1.5
11	104.0	5.36	32.984	32.981	9.52	6.11	27.2	18.7	1.5
10	120.8	5.08	33.523	33.491	8.48	5.59	30.0	20.2	1.5
9	149.8	4.38	33.600	33.602	6.86	4.59	47.0	26.9	1.8
8	203.8	3.83	33.745	33.745	4.74	3.30	68.8	34.2	2.3
7	249.0	3.69	33.809	33.802	3.90	2.76	78.3	36.9	2.6
6	301.5	3.64	33.877	33.868	3.03	2.28	86.4	38.6	2.5
5	400.9	3.74	34.035	34.026	1.95	1.49	113.2	42.8	2.9
4	501.2	3.57	34.131	34.133	1.29	1.03	103.8	44.2	2.9
3	600.2	3.40	34.213	34.198	1.01	1.40	122.9	43.9	3.3
2	798.6	3.06	34.335	34.319	0.87	0.83	139.0	44.3	3.1
1	998.7	2.75	34.415	34.400	0.86	2.40	151.5	45.0	3.7

Station 4-2
Date(GMT) 1992/12/10
Time 21:11
LAT. 48°23.42' N
LONG. 168°51.05' W
Depth 5070 m
memo MK II

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19 (表層)	0.0	5.4		32.904		5.92	28.2	20.5	1.7
18	11.1	5.03	32.906	32.894	10.24	6.01	27.8	20.1	1.7
17	19.8	5.03	32.908	32.903	10.18	5.97	27.6	20.1	1.7
16	30.8	5.02	32.908	32.903	9.82	5.97	28.0	20.2	1.7
15	40.1	5.02	32.908		9.98	5.97	27.6	20.2	1.7
14	52.1	5.02	32.908		10.51	5.99	27.6	20.2	1.7
13	60.1	5.01	32.909	塩検ミス	9.94	5.90	27.9	20.4	1.7
12	81.5	5.00	32.907		9.77	5.96	27.7	20.3	1.7
11	99.6	4.99	32.908		9.47	5.95	28.0	20.5	1.7
10	117.6	4.33	33.371	33.369	7.53	4.85	40.3	27.0	2.1
9	147.7	4.45	33.755	33.747	5.27	3.33	61.1	34.6	2.3
8	201.1	3.94	33.775	33.769	4.38	2.90	72.0	37.6	2.5
7	248.1	3.76	33.826	33.814	3.63	2.36	81.3	39.4	2.7
6	298.3	3.76	33.905	33.893	2.77	1.84	90.5	42.8	2.9
5	399.7	3.73	34.031	34.018	1.79	1.23	105.5	45.8	3.0
4	498.9	3.58	34.134	34.121	1.18	0.81	118.1	47.1	3.2
3	599.0	3.41	34.220	34.203	0.96	0.67	128.3	47.5	3.2
2	798.0	3.04	34.328	34.312	0.78	0.53	143.0	47.9	3.2
1	997.2	2.77	34.404	34.383	0.81	0.87	155.2	48.6	3.3

Station 4-3
Date(GMT) 1992/12/11
Time 18:47
LAT. 47°58.6' N
LONG. 164°49.1' W
Depth 5168 m
memo SEA BIRD

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19 (表層)	0	5.9		32.835		5.90	25.0	18.8	1.6
18	10	5.51	35.113						
17	20	5.49	32.878						
16	30	5.48	32.876						
15	40	5.47	32.881						
14	50	5.45	32.888						
13	60	5.45	32.888						
12	80	5.45	32.886						
11	100	5.45	32.884						
10	120	5.09	33.035						
9	150	5.25	33.547						
8	200	5.02	33.780						
7	250	4.33	33.802						
6	300	4.03	33.821						
5	400	3.92	33.960						
4	500	3.85	34.079						
3	600	3.62	34.142						
2	800	3.19	34.275						
1	1000								

Station 4-4
Date(GMT) 1992/12/13
Time 17:39
LAT. 46°56.2' N
LONG. 159°04.3' W
Depth 5126 m
memo SEA BIRD

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM
19(表層)	0	6.7		32.999		5.78	19.4	14.6
18	10	6.59	32.641					
17	20	6.59	32.976					
16	30	6.59	32.975					
15	40	6.59	32.975					
14	50	6.60	32.972					
13	60	6.60	32.967					
12	80	6.60	32.962					
11	100	5.69	33.299					
10	120	5.85	33.403					
9	150	6.39	33.753					
8	200	5.93	33.841					
7	250	4.97	33.834					
6	300	4.72	33.875					
5	400	4.21	33.947					
4	500	3.90	34.036					
3	600	3.70	34.122					
2	800	3.33	34.254					
1	1000							

Station 4-5
Date(GMT) 1992/12/14
Time 09:30
LAT. 46°20.08' N
LONG. 155°03.45' W
Depth 5260 m
memo MK II　2番ボトル水漏れの可能性あり、データオミット

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM
19(表層)	0.0	7.5		32.911		6.51	16.4	12.1
18	9.4	7.21	32.901	32.906	9.27	6.61	16.4	12.1
17	20.3	7.22	32.902	32.907	9.11	6.57	16.4	12.1
16	31.6	7.22	32.902	32.907	9.17	6.58	16.7	12.2
15	39.7	7.22	32.902	32.907	9.53	6.56	16.3	12.1
14	51.2	7.23	32.902	32.906	9.40	6.58	16.4	12.1
13	61.3	7.22	32.902	32.909	9.11	6.54	16.4	12.2
12	79.3	7.22	32.903	32.909	9.19	6.56	16.5	12.2
11	98.6	6.31	33.369	33.358	8.98	6.35	19.2	16.2
10	119.8	5.99	33.376	33.387	8.85	5.46	21.4	17.4
9	149.2	6.75	33.679	33.683	7.54	5.43	26.9	20.7
8	203.3	6.79	33.934	33.949	5.96	4.39	39.8	26.1
7	253.3	5.69	33.860	33.888	5.41	3.91	53.3	31.5
6	299.0	4.95	33.872	33.871	4.48	3.33	62.3	34.3
5	402.8	4.48	33.981	33.975	2.99	2.23	82.8	40.5
4	500.6	4.08	34.071	34.066	1.89	1.52	100.5	44.3
3	602.5	3.80	34.147	34.146	4.08	1.17	111.6	45.6
2	799.7	3.40	34.276		0.89			
1	998.8	3.04	34.361	34.356	0.72	0.71	146.6	48.9

Station 4-6
Date(GMT) 1992/12/15
Time 02:13
LAT. 45°51.87' N
LONG. 151°32.16' W
Depth 5291 m
memo MK II

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19(表層)	0.0	8.8		33.133		6.66	13.3	8.2	0.8
18	10.5	8.71	33.108	33.111	8.82	6.77	13.3	8.1	0.7
17	19.6	8.72	33.108	33.110	8.82	6.63	13.3	8.1	0.7
16	30.2	8.72	33.108	33.108	8.77	6.36	13.1	8.2	0.7
15	40.9	8.71	33.107	33.110	9.02	6.33	13.1	8.2	0.7
14	49.9	8.71	33.106	33.114	8.93	6.37	13.0	8.2	0.7
13	60.0	8.72	33.107	33.111	8.86	6.32	13.1	8.2	0.7
12	80.0	8.70	33.105	33.106	8.70	6.33	12.9	8.3	0.7
11	99.8	7.09	33.341	33.343	8.58	6.21	16.4	14.2	1.1
10	120.0	7.27	33.513	33.478	8.24	6.03	17.8	15.2	1.1
9	149.1	7.98	33.906	33.908	6.61	4.89	25.7	20.7	1.2
8	200.7	7.39	33.977	33.918	6.22	4.51	34.1	24.3	1.4
7	250.0	6.34	33.920	33.918	5.71	4.19	43.2	28.0	1.7
6	300.2	5.51	33.886	33.884	5.00	3.71	53.5	32.1	2.0
5	400.4	4.67	33.935	33.929	3.30	2.47	74.6	39.2	2.4
4	500.5	4.26	34.032	34.025	2.11	1.60	93.7	44.0	2.7
3	600.0	4.04	34.111	34.103	3.61	1.16	107.0	47.0	2.9
2	797.6	3.49	34.267	34.256	0.83	0.68	128.5	48.3	3.0
1	1000.4	3.06	34.360	34.347	0.61	0.51	144.2	49.3	3.1

Station 5-1
Date(GMT) 1992/12/16
Time 02:59
LAT. 44°39.19' N
LONG. 146°00.97' W
Depth 4880 m
memo MK II

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19(表層)	0.0	10.3		塩検ミス		6.27	10.3	5.1	0.6
18	10.0	9.75	32.846		9.03	6.43	10.1	5.1	0.6
17	20.4	9.73	32.866		9.16	6.30	10.2	5.1	0.6
16	30.0	9.72	32.869		8.84	6.30	10.1	5.2	0.6
15	39.9	9.69	32.873		9.03	6.28	10.3	5.3	0.6
14	49.7	9.66	32.872		9.36	6.31	10.6	5.4	0.6
13	59.9	9.65	32.874		8.90	6.26	10.5	5.4	0.6
12	79.8	9.48	32.893		8.65	6.29	10.6	5.5	0.6
11	100.5	7.98	33.148		8.52	6.23	14.6	11.1	0.9
10	120.7	7.58	33.199		8.62	6.22	15.7	12.3	1.0
9	149.0	7.67	33.667		7.21	5.29	22.9	19.3	1.8
8	199.6	7.44	33.916		6.59	4.85	30.1	22.4	1.8
7	250.3	6.77	33.932		6.14	4.49	37.6	25.5	2.4
6	300.4	5.80	33.882		5.68	4.14	45.9	29.0	2.3
5	400.3	4.79	33.897		3.69	2.78	67.0	37.5	2.9
4	500.1	4.32	33.984		2.29	1.69	84.5	42.2	3.4
3	599.7	4.10	34.091		3.21	1.22	85.9	41.2	3.4
2	797.3	3.57	34.245		0.73	0.65			
1	1000.6	3.07	34.360		0.38	0.39		測定ミス	

Station 5-2
Date(GMT) 1992/12/16
Time 15:06
LAT. 45°32.30' N
LONG. 145°02.68' W
Depth 4762 m
memo MK II

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19(表層)	0.0	9.2		32.875		6.33	11.7	6.6	0.8
18	10.5	9.14	32.855	32.852	8.78	6.60	11.6	6.5	0.7
17	18.9	9.14	32.855	32.852	9.07	6.36	11.6	6.5	0.7
16	29.8	9.14	32.855	32.856	9.05	6.37	12.3	6.7	0.7
15	40.0	9.14	32.855	32.855	8.90	6.35	11.9	6.6	0.7
14	50.2	9.14	32.856	32.855	9.03	6.38	11.6	6.5	0.7
13	59.3	9.15	32.859	32.858	9.00	6.33	11.7	6.5	0.7
12	79.8	8.88	32.918	32.902	8.78	6.31	12.3	7.3	0.7
11	99.3	7.16	33.150	33.154	8.77	6.29	16.4	13.2	1.1
10	119.7	6.86	33.258	33.247	8.57	6.20	18.1	14.8	1.2
9	149.9	7.50	33.769	33.762	6.89	5.12	25.9	20.5	1.4
8	200.8	6.88	33.927	33.924	6.32	4.60	36.2	24.7	1.7
7	250.2	6.07	33.901	33.892	5.86	4.24	42.8	27.3	2.0
6	299.2	5.37	33.864	33.859	5.13	3.76	51.5	31.0	2.2
5	399.8	4.80	33.933	33.919	3.14	2.37	69.0	37.9	2.7
4	500.8	4.24	34.016	34.003	2.04	1.59	87.3	42.2	3.1
3	601.6	3.96	34.106	34.096	2.95	1.13	97.7	43.2	3.1
2	800.6	3.51	34.258	34.243	0.83	0.73	119.0	45.4	3.3
1	998.6	3.06	34.353	34.339	0.65	0.62	135.1	46.7	3.5

Station 5-3
Date(GMT) 1992/12/17
Time 04:03
LAT. 46°18.89' N
LONG. 144°56.37' W
Depth 4757 m
memo MK II

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19(表層)	0.0	9.2		32.804		6.37	10.7	5.7	0.8
18	9.3	8.96	32.764	32.769	9.02	6.44	10.8	5.8	0.7
17	20.4	8.96	32.764	32.769	9.10	6.40	10.8	5.8	0.7
16	29.7	8.96	32.765	32.768	9.17	6.41	10.8	5.8	0.7
15	40.5	8.96	32.764	32.770	8.97	6.38	10.8	6.0	0.7
14	50.9	8.96	32.765	32.768	9.23	6.42	10.9	5.9	0.7
13	58.9	8.97	32.766	32.768	9.03	6.37	11.0	5.9	0.7
12	79.5	8.19	32.870	32.801	8.85	6.40	11.3	6.5	0.8
11	99.6	6.70	33.128	33.128	8.77	6.32	17.3	12.4	1.1
10	121.2	6.76	33.306	33.289	8.23	6.01	19.5	14.3	1.2
9	150.0	7.25	33.833	33.825	6.88	4.96		NO SAMPLE	
8	198.8	6.35	33.893	33.890	6.18	4.50	39.5	24.9	1.8
7	250.0	5.40	33.858	33.857	5.40	3.94	50.2	28.8	2.3
6	299.3	4.83	33.861	33.859	4.35	3.19	60.4	33.9	2.6
5	401.0	4.39	33.926	33.926	2.93	2.20	76.1	38.7	3.1
4	501.0	4.11	34.035	34.027	1.83	1.41	90.9	42.2	3.4
3	600.0	3.87	34.134	34.126	3.88	1.00	103.0	44.9	3.6
2	799.3	3.42	34.271	34.262	0.75	0.68	121.0	47.5	3.7
1	1000.6	3.02	34.366	34.357	0.48	0.42	134.0	47.4	3.8

Station 5-4
Date(GMT) 1992/12/17
Time 15:15
LAT. 47°18.1' N
LONG. 144°58.8' W
Depth 4711 m
memo SEA BIRD

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19(表層)	0	8.3		33.324		6.57	11.2	6.4	0.9
18	10	8.16	33.782						
17	20	8.16	32.727						
16	30	8.17	32.723						
15	40	8.17	32.719						
14	50	8.17	32.716						
13	60	8.16	32.716						
12	80	8.16	32.712						
11	100	6.36	33.027						
10	120	6.27	33.145						
9	150	7.27	33.827						
8	200	6.45	33.879						
7	250	5.50	33.843						
6	300	4.86	33.844						
5	400	4.38	33.921						
4	500	4.07	34.019						
3	600	3.89	34.111						
2	800	3.42	34.245						
1	1000								

Station 5-5
Date(GMT) 1992/12/18
Time 06:42
LAT. 49°12.31' N
LONG. 145°01.84' W
Depth 4353 m
memo MK II

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19(表層)	0.0	7.2		塩検ミス		6.61	16.6	11.3	1.2
18	10.0	6.97	32.463		9.98	6.70	16.8	11.2	1.1
17	18.6	6.97	32.463		10.18	6.67	16.7	11.3	1.2
16	31.0	6.98	32.464		9.89	6.66	16.7	11.4	1.1
15	41.1	6.98	32.464		9.93	6.63	16.8	11.4	1.1
14	50.1	6.98	32.463		10.04	6.68	16.6	11.6	1.2
13	60.2	6.97	32.464		9.73	6.52	16.9	11.6	1.1
12	81.7	5.93	32.782		9.51	6.50	19.1	13.8	1.3
11	101.5	5.43	33.029		8.95	6.29	23.1	17.5	1.5
10	119.9	5.25	33.356		7.72	5.44	34.5	23.8	1.9
9	150.2	5.56	33.760		6.35	4.55	42.7	28.4	2.1
8	199.0	4.74	33.774		5.40	3.90	54.4	33.5	2.5
7	249.7	4.18	33.811		4.13	3.02	67.5	38.1	3.0
6	300.4	4.07	33.881		3.15	2.36	77.3	42.1	3.2
5	399.8	3.93	33.995		2.00	1.52			
4	500.4	3.75	34.089		1.29	1.00			
3	599.2	3.58	34.183		3.16	0.67		測定ミス	
2	799.0	3.25	34.303		0.73	0.62			
1	1000.8	2.89	34.389		0.62	0.52			

Station 5-6
Date(GMT) 1992/12/18
Time 16:48
LAT. 51°13.29' N
LONG. 144°49.85' W
Depth 4200 m
memo MK II

Bottle No.	Press. dB.	Temp. °C	Sal.(CTD)	Sal.(実測)	DO(CTD) ml/L	DO(実測) ml/L	SiO2 uM	NO2+NO3 uM	PO4 uM
19(表層)	0.0	7.0		塩検ミス		6.59	17.3	12.8	1.2
18	10.2	6.73	32.497		9.35	6.61	17.3	12.9	1.2
17	20.8	6.72	32.496		9.38	6.55	17.4	13.0	1.2
16	32.0	6.72	32.496		9.56	6.61	17.4	13.0	1.2
15	40.4	6.72	32.492		9.34	6.61	17.4	13.1	1.2
14	50.9	6.72	32.496		9.50	6.57	17.3	13.2	1.2
13	60.8	6.72	32.496		9.41	6.59	17.3	13.2	1.2
12	81.1	6.71	32.500		9.45	6.59	17.5	13.2	1.2
11	99.4	5.47	32.955		8.08	5.79	28.7	13.4	1.7
10	119.8	5.01	33.333		6.98	4.99	37.7	22.6	2.1
9	148.8	4.50	33.642		5.50	3.89			
8	198.8	4.22	33.763		4.12	2.96	63.1	35.6	2.9
7	251.9	4.04	33.830		2.89	2.16	73.7	41.1	3.2
6	302.1	3.97	33.900		2.13	1.59	82.4	45.5	3.5
5	399.7	3.90	34.033		1.27	0.74			
4	500.2	3.78	34.130		0.90	0.76			
3	598.5	3.62	34.198		3.35	0.63		測定ミス	
2	800.7	3.25	34.304		0.57	0.53			
1	999.6	2.93	34.382		0.49	0.44			

Appendix 4. Calibration for CTD (Kaiyo Maru) and SBCTD (Seabird CTD).

表　　シーバードとＣＴＤのキャリブレーション(st.calib.1)

PRESS.(db)	Temp(℃)			Salinity		
	CTD	SBCTD	SBCTD-CTD	CTD	SBCTD	SBCTD-CTD
10.0	6.832	6.831	-0.001	32.444	22.169	
15.0	6.835	6.830	-0.005	32.446	27.304	
20.0	6.831	6.829	-0.002	32.448	32.440	-0.008
25.0	6.830	6.829	-0.001	32.449	32.440	-0.009
30.0	6.830	6.830	0.000	32.450	32.440	-0.010
40.0	6.830	6.829	-0.001	32.450	32.441	-0.009
50.0	6.831	6.829	-0.002	32.451	32.441	-0.010
75.0	6.829	6.812	-0.017	32.453	32.454	0.001
100.0	6.779	6.525	-0.254	32.484	32.592	0.108
125.0	5.421	5.110	-0.311	33.021	33.231	0.210
150.0	4.778	4.550	-0.228	33.460	33.586	0.126
200.0	4.261	4.182	-0.079	33.735	33.746	0.011
250.0	4.053	4.039	-0.014	33.814	33.814	0.000
300.0	3.977	3.974	-0.003	33.880	33.869	-0.011
400.0	3.927	3.922	-0.005	33.999	33.986	-0.013
500.0	3.791	3.790	-0.001	34.111	34.097	-0.014
600.0	3.626	3.622	-0.004	34.184	34.171	-0.013
700.0	3.444	3.439	-0.005	34.241	34.226	-0.015
800.0	3.248	3.244	-0.004	34.293	34.278	-0.015
S.E.			0.096			0.060

Calibration for CTD (Kaiyo Maru) and Seabird CTD (SBCTD).

Appendix 5. Comparison between EPCS data and observed data.

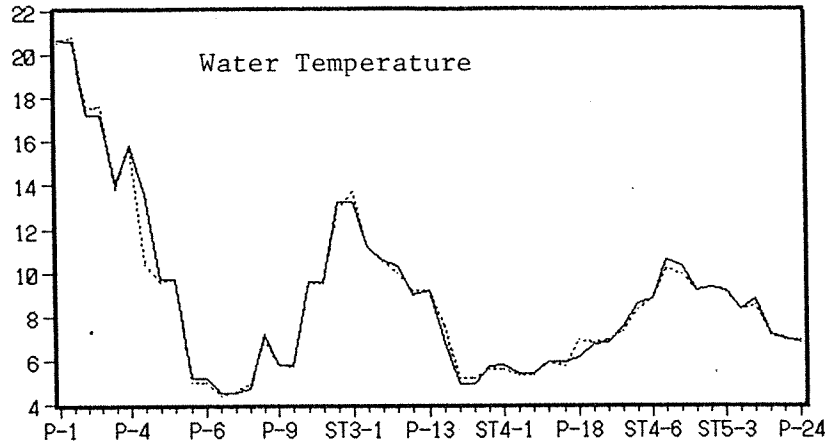
Comparison between EPCS data and observed data.

表　表面採水とＥＰＣＳによる水温、塩分濃度、溶存酸素の比較

STATION	LAT.	LONG.	日付 GMT	時間 GMT	temp. 表面採水	temp. ＥＰＣＳ	temp. 差	sal. 表面採	sal. ＥＰＣＳ	sal. 差	do. 表面採水	do. ＥＰＣＳ	do. 差
P-1	N 035°38	E 144°21	11/26	01:20	20.7	20.6	0.1	34.63	35.42	-0.79			
P-2	N 036°48	E 150°26	11/27	01:15	20.6	20.8	-0.2	34.52	35.22	-0.70			
P-3	N 037°51	E 156°12	11/28	00:50	17.2	17.5	-0.3	34.50	35.19	-0.69			
ST1-1	N 037°52	E 157°28	11/28	08:59	17.2	17.6	-0.4	34.32	35.00	-0.68	5.33	8.41	-3.08
ST1-2	N 039°33	E 157°31	11/28	20:16	14.0	13.8	0.2	34.11	34.69	-0.59	5.17	9.14	-3.97
P-4	N 039°35	E 157°47	11/29	00:20	15.8	15.8	0.0	34.28	34.97	-0.69			
ST1-3	N 041°17	E 157°40	11/29	10:58	10.6	10.4	0.2	33.60	34.14	-0.54		10.10	
P-5	N 042°13	E 157°42	11/29	23:05	9.7	9.6	0.1	33.63	34.18	-0.55			
ST1-4	N 042°04	E 157°47	11/30	02:21	9.7	9.7	0.0	33.73	34.07	-0.34	6.26	10.50	-4.24
ST1-5	N 044°47	E 158°03	11/30	22:05	5.2	5.0	0.2	33.21	33.29	-0.08	7.02	11.98	-4.96
P-6	N 044°47	E 158°05	11/30	23:50	5.2	5.0	0.2	32.86	33.32	-0.46			
ST1-6	N 045°39	E 157°29	12/01	19:30	4.5	4.4	0.1	32.83	33.25	-0.42	7.12	12.09	-4.97
P-7	N 045°35	E 157°41	12/01	22:50	4.5	4.6	-0.1	32.82	33.25	-0.44			
ST2-1	N 045°13	E 163°50	12/02	18:12	4.7	4.9	-0.2	32.97	33.41	-0.44	6.94	12.03	-5.22
P-8	N 045°03	E 165°08	12/03	00:35	7.2	6.9	0.3	33.19	33.69	-0.50			
P-9	N 044°25	E 168°36	12/03	23:45	5.8	5.8	0.0	32.99	33.46	-0.47			
ST2-2	N 044°26	E 168°54	12/04	01:10	5.8	5.7	0.1	33.00	33.44	-0.44	7.02	11.78	-4.76
P-10	N 042°44	E 174°14	12/04	22:45	9.6	9.5	0.1	33.81	34.33	-0.52			
ST2-3	N 042°31	E 174°50	12/05	01:05	9.6	9.5	0.1	33.77	34.34	-0.57	6.27	10.73	-4.46
P-11	N 041°05	E 178°39	12/05	22:15	13.2	12.9	0.3	34.17	34.78	-0.61			
ST3-1	N 041°07	E 179°10	12/06	02:09	13.2	13.7	-0.5	34.30	34.93	-0.63	5.65	9.55	-3.90
ST3-2	N 041°21	E 179°34	12/06	18:04	11.2	11.2	0.0	34.02	34.59	-0.58	6.01	10.34	-4.33
P-12	N 041°15	E 179°21	12/06	21:45	10.6	10.5	0.1	33.85	34.41	-0.56			
ST3-3	N 041°01	E 179°16	12/07	05:48	10.3	10.0	0.3	33.79	34.36	-0.57	6.22	10.78	-4.56
ST3-4	N 043°51	E 179°30	12/07	17:56	9.0	9.2	-0.2	33.75	34.31	-0.56	5.41	11.21	-5.80
P-13	N 043°41	E 179°23	12/07	22:00	9.2	9.2	0.0	33.75	34.29	-0.54			
ST3-5	N 044°54	E 179°18	12/08	08:34	6.8	7.5	-0.7	33.34	33.85	-0.51	5.61	11.20	-5.59
ST3-6	N 046°18	E 179°12	12/08	19:14	4.9	5.2	-0.3	32.96	33.43	-0.47	6.00	12.31	-6.31
P-14	N 046°20	W 178°58	12/08	22:15	4.9	5.2	-0.3	32.95	33.42	-0.47			
P-15	N 046°22	W 174°31	12/09	21:10	5.7	5.6	0.1	32.97	33.44	-0.47			
ST4-1	N 046°22	W 174°29	12/09	21:45	5.8	5.6	0.2	32.98	33.44	-0.46	6.01	12.85	-6.84
P-16	N 048°23	W 168°52	12/10	20:40	5.4	5.3	0.1	32.89	33.38	-0.49			
ST4-2	N 048°23	W 168°51	12/10	21:11	5.4	5.3	0.1	32.90	33.39	-0.49	5.92	12.06	-6.14
ST4-3	N 047°58	W 164°49	12/11	18:47	5.9	5.9	0.0	32.84	33.35	-0.52	5.90	12.02	-6.12
P-17	N 047°58	W 164°49	12/11	19:55	5.9	5.7	0.2	32.84	33.37	-0.53			
P-18	N 047 14	W 160 24	12/12	20:00	6.1	6.9	-0.8	33.00	33.50	-0.50			
ST4-4	N 046°56	W 159°04	12/13	17:39	6.7	6.8	-0.1	33.00	33.48	-0.48	5.78	11.69	-5.91
P-19	N 046°50	W 158°29	12/13	20:20	6.8	6.9	-0.1	32.96	33.47	-0.51			
ST4-5	N 046°20	W 155°03	12/14	09:30	7.5	7.3	0.2	32.91	33.42	-0.51	6.51	11.37	-4.86
P-20	N 045°46	W 152°16	12/14	20:15	8.6	8.3	0.3	33.09	33.59	-0.50			
ST4-6	N 045°51	W 151°32	12/15	02:13	8.8	8.8	0.0	33.13	33.65	-0.52	6.66	10.90	-4.24
P-21	N 044°34	W 147°05	12/15	19:45	10.6	10.2	0.4	32.77	33.35	-0.58			
ST5-1	N 044°39	W 146°01	12/16	02:59	10.3	9.9	0.4	32.82	33.37	-0.55	6.27	10.71	-4.44
ST5-2	N 045°32	W 145°02	12/16	15:06	9.2	9.2	0.0	32.88	33.39	-0.52	6.33	11.57	-5.24
P-22	N 045°23	W 145°04	12/16	18:30	9.3	9.3	0.0	32.87	33.40	-0.53			
ST5-3	N 046°18	W 144°56	12/17	04:03	9.2	9.1	0.1	32.80	33.31	-0.51	6.37	10.99	-4.62
ST5-4	N 047°18	W 144°59	12/17	15:15	8.3	8.3	0.0	32.75	33.25	-0.50	6.57	11.10	-4.53
P-23	N 047°10	W 145°00	12/17	18:40	8.8	8.5	0.3	32.75	33.27	-0.52			
ST5-5	N 049°12	W 145°01	12/18	06:42	7.2	7.1	0.1	32.50	32.98	-0.48	6.61	11.38	-4.77
ST5-6	N 051°13	W 144°56	12/18	16:48	7.0	6.9	0.1	32.51	33.01	-0.50	6.59	12.44	-5.85
P-24	N 051°13	W 144°48	12/18	19:00	6.8	6.9	-0.1	32.51	33.00	-0.49			

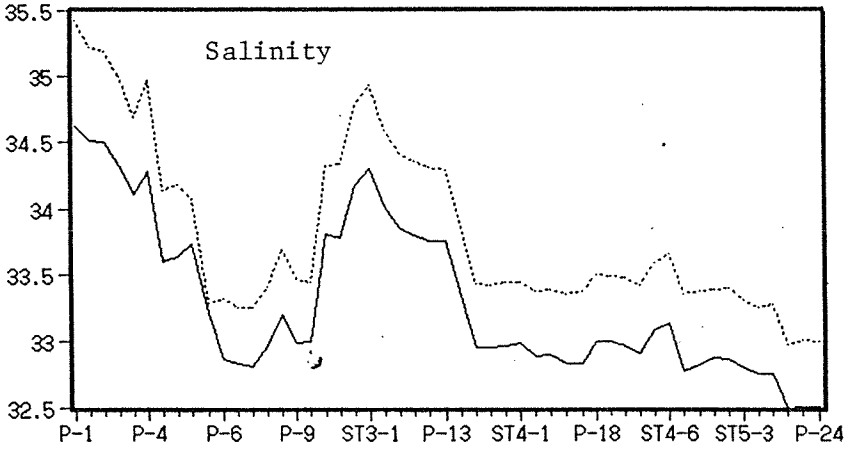
平均	0.01	-0.52	-4.99
標準偏差	0.248	0.100	0.858

水温比較
(ST.P-1****ST.P-24)



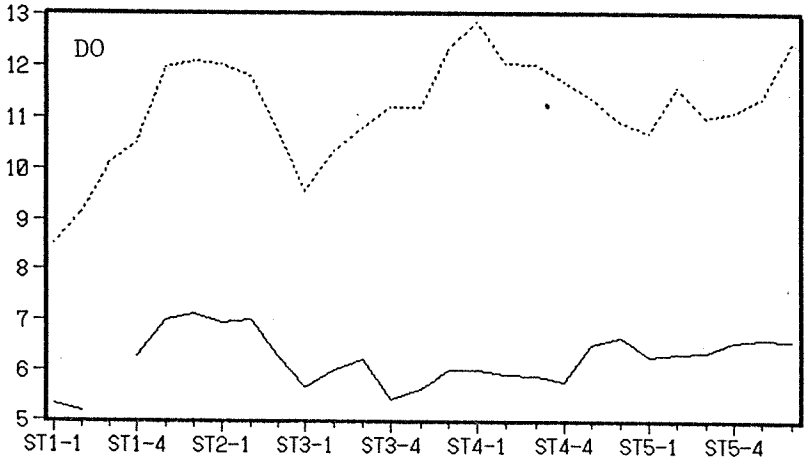
— 実測水温 ···· ＥＰ水温

塩分濃度比較
(ST.P-1****ST.P-24)



— 実測塩分 ···· ＥＰ塩分

酸素比較
(ST.1-1****ST.5-6)



— 実測酸素 ···· ＥＰ酸素
Observed data　　EPCS data

Appendix 6. Current speed and direction and profiles of water temperature, salinity, and dissolved oxygen.

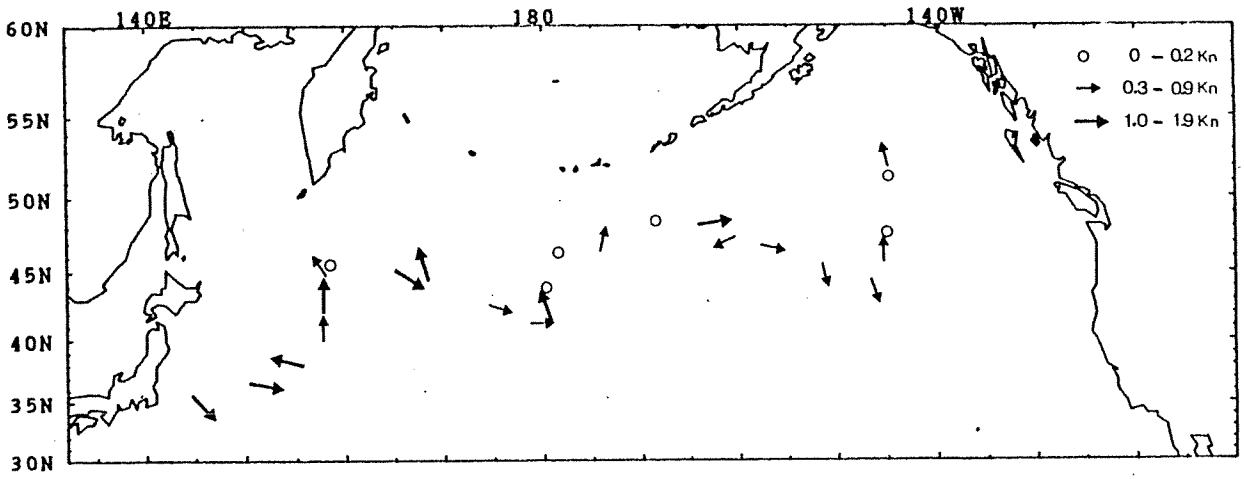


図　　流向流速分布　　Current

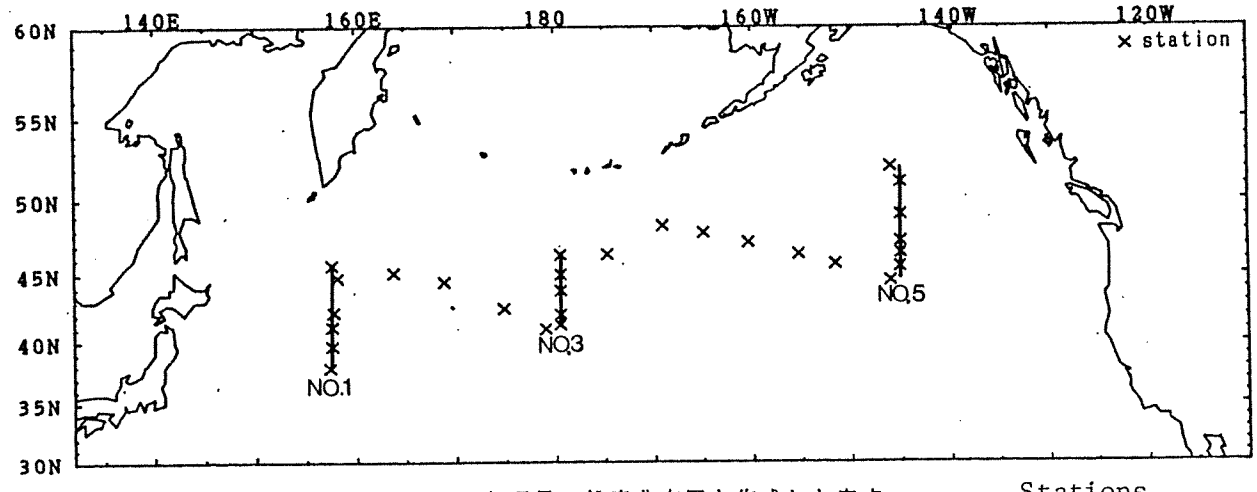
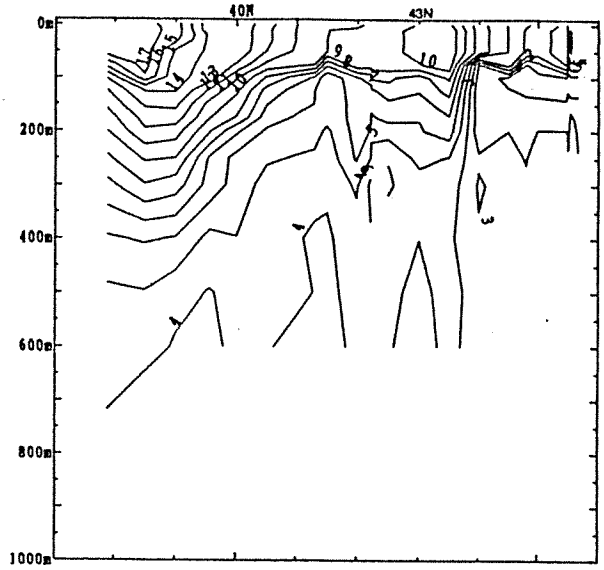
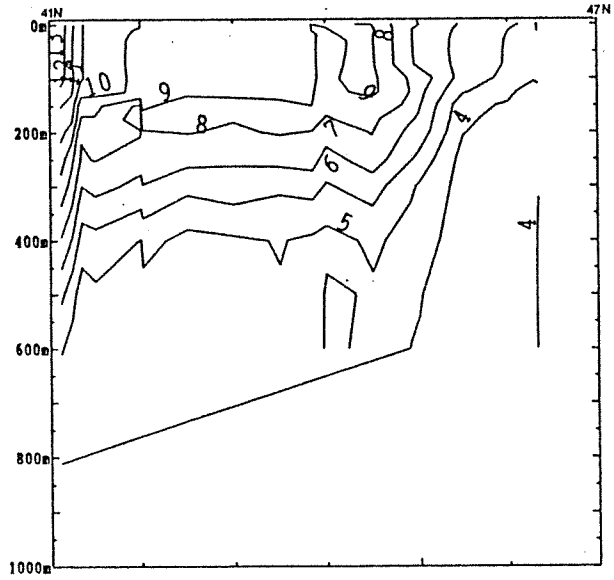


図　　各項目の鉛直分布図を作成した定点　　Stations

定線 1



定線 3



定線5

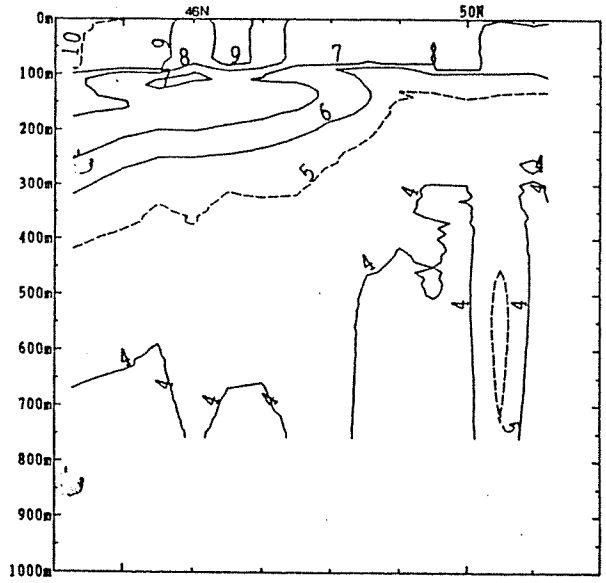
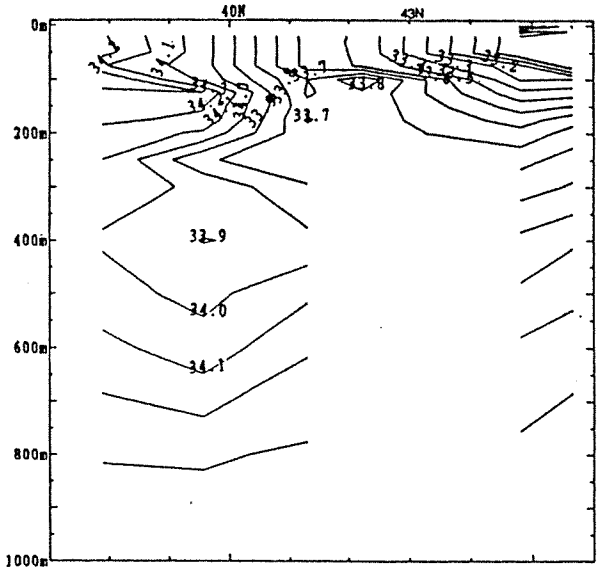
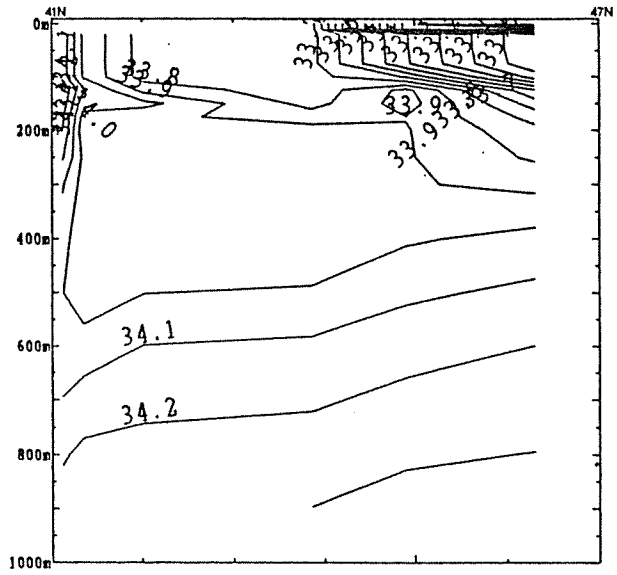


図　　水温の鉛直分布　(℃)
Water Temperature

定線１



定線３



定線５

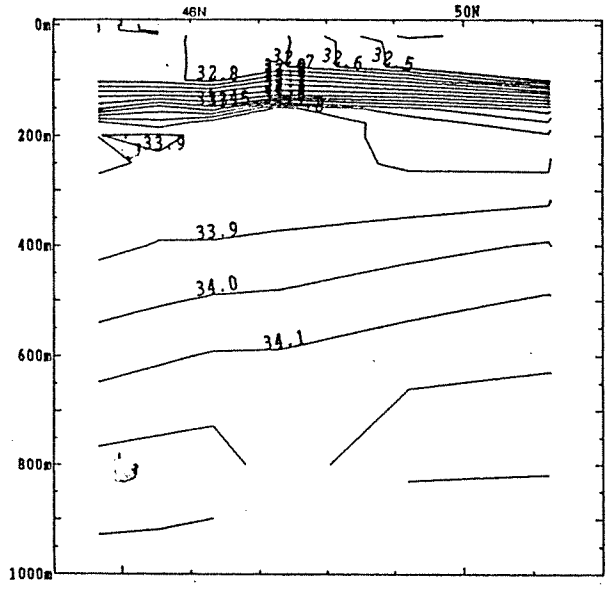
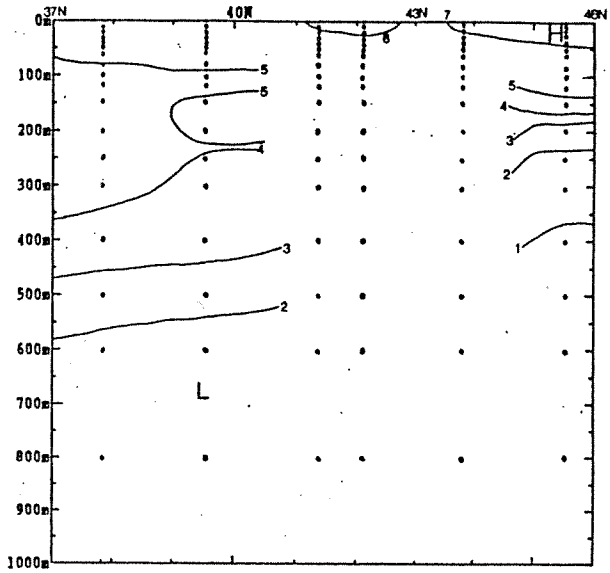
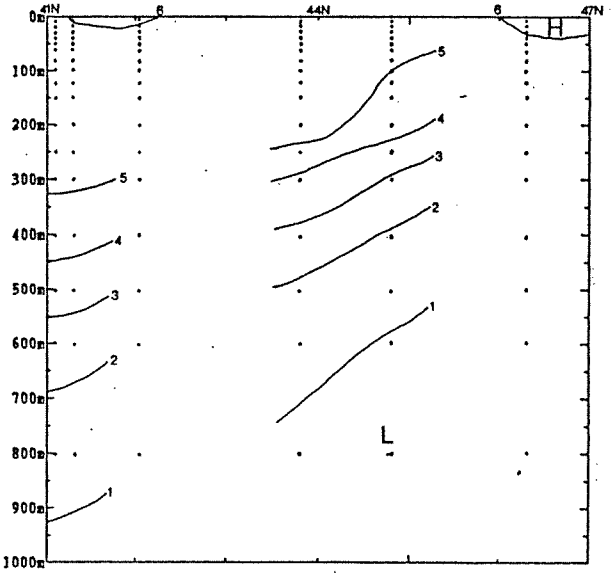


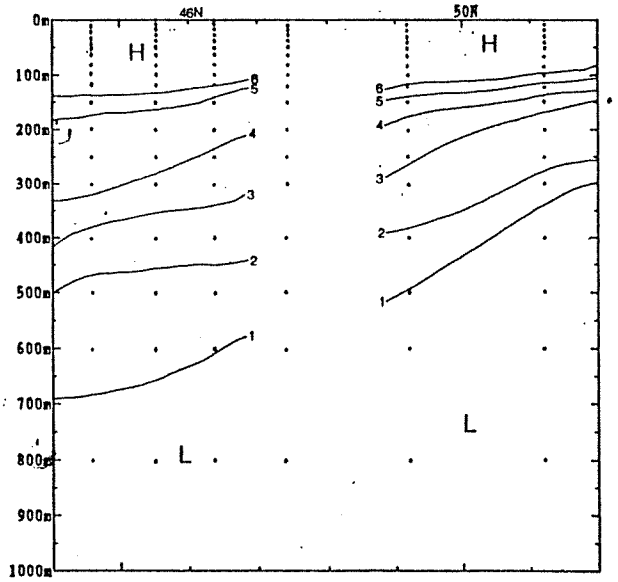
図　　塩分の鉛直分布



定線 1



定線 3



定線 5

図　　溶存酸素（DO）の鉛直分布　　(ml/L)

Dissolved Oxygen

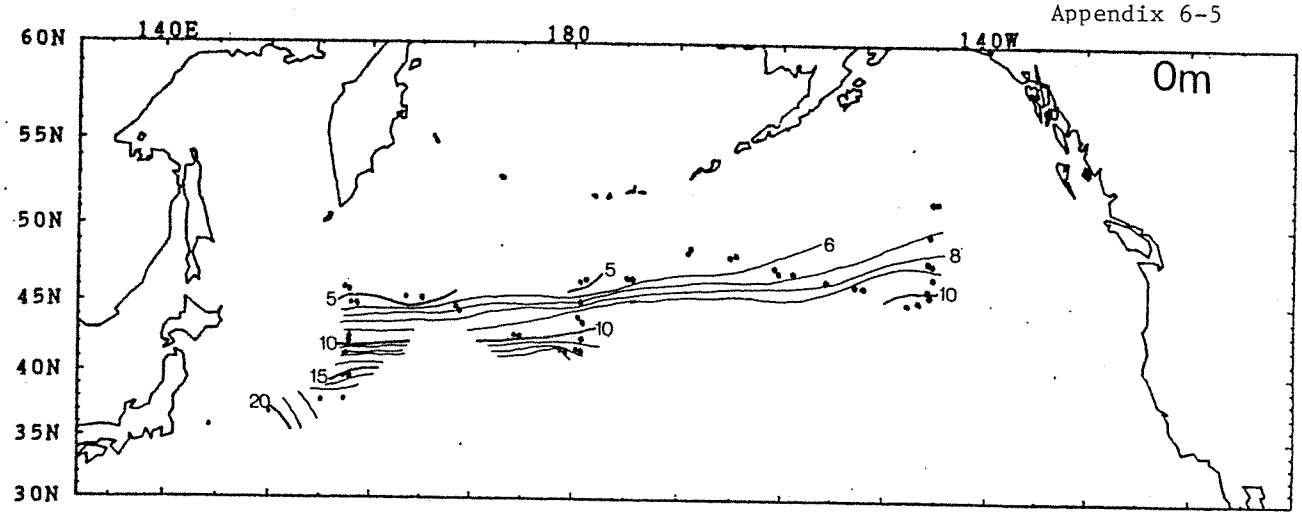


図　水温の水平分布　(℃)

Sea Surface Temperature

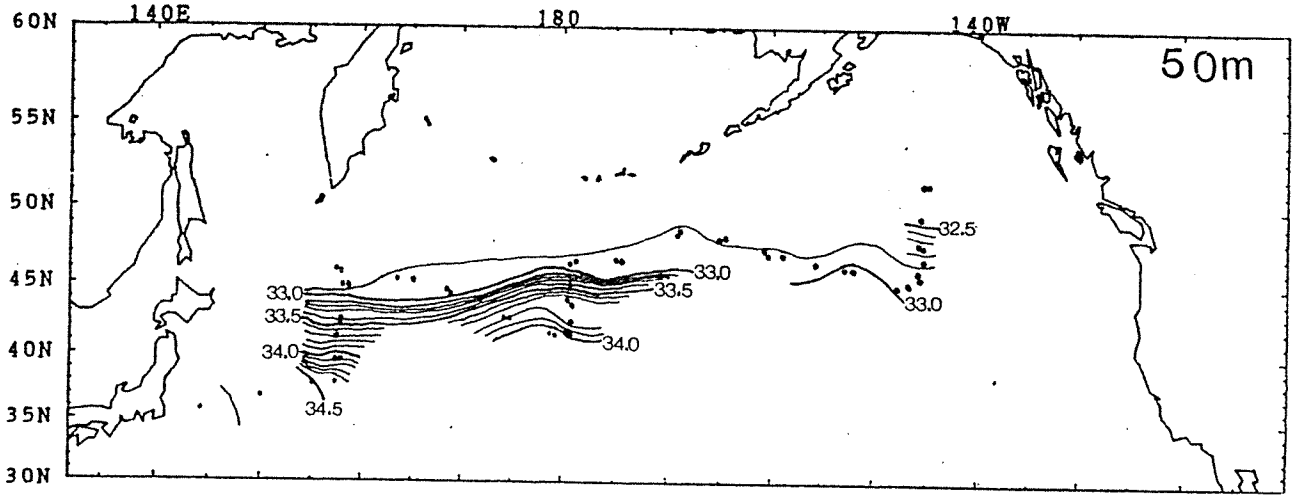


図　塩分（５０ｍ）の水平分布

Salinity (ppt) at 50 meters

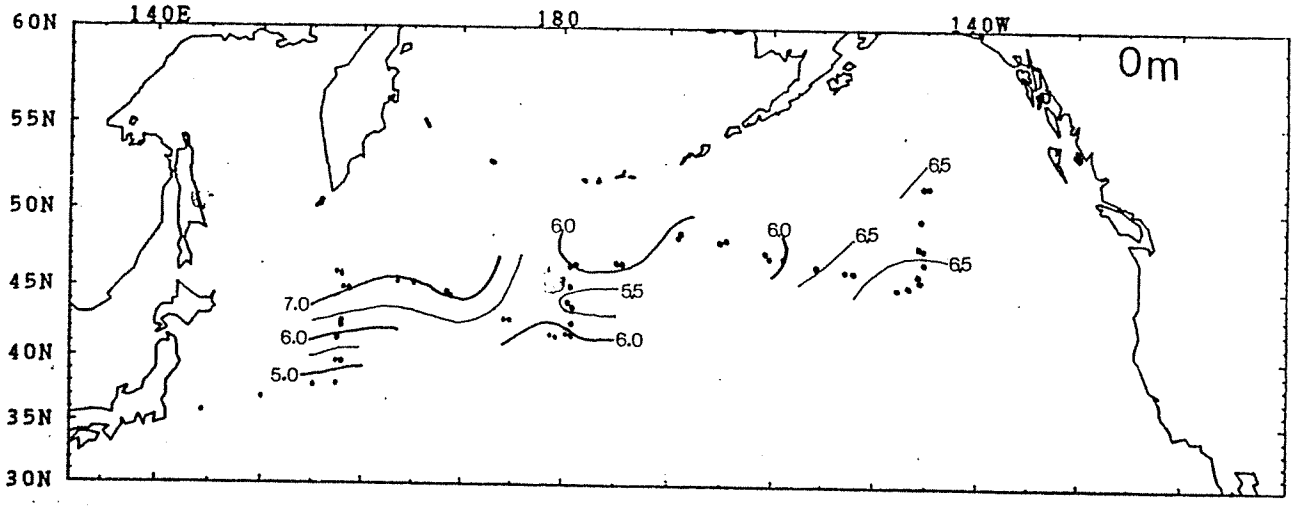


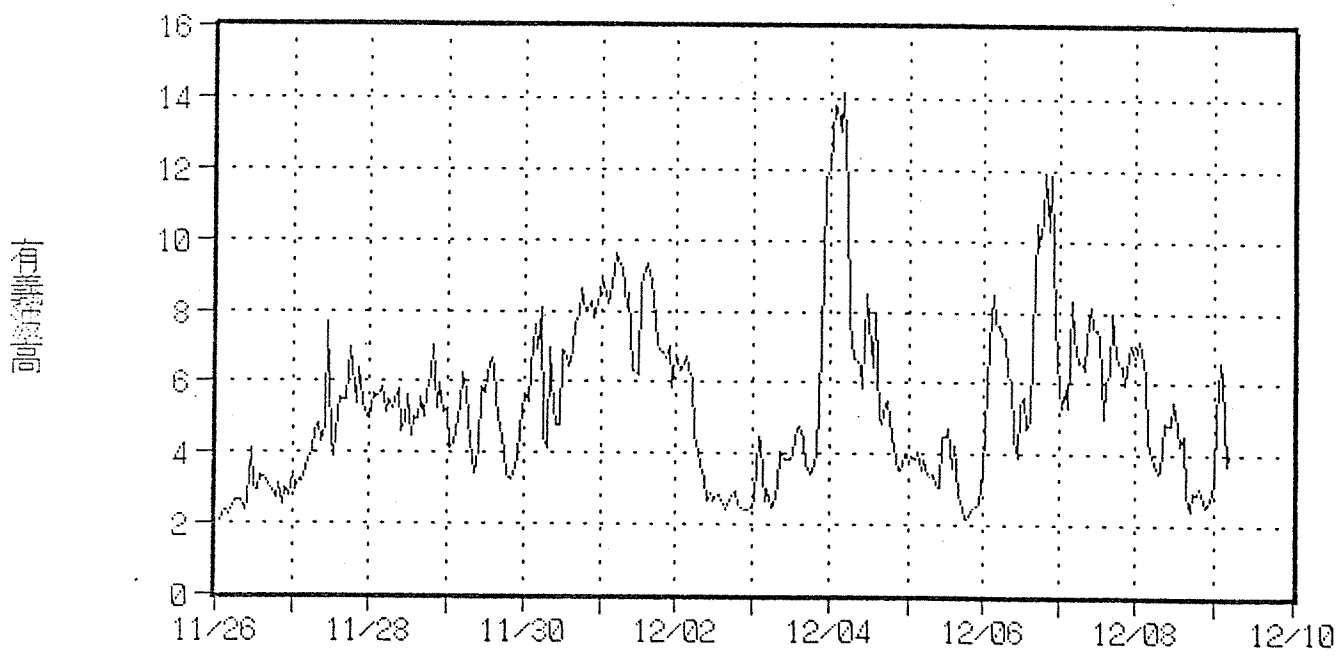
図　溶存酸素（DO）の水平分布　(ml/L)

Surface Dissolved Oxygen

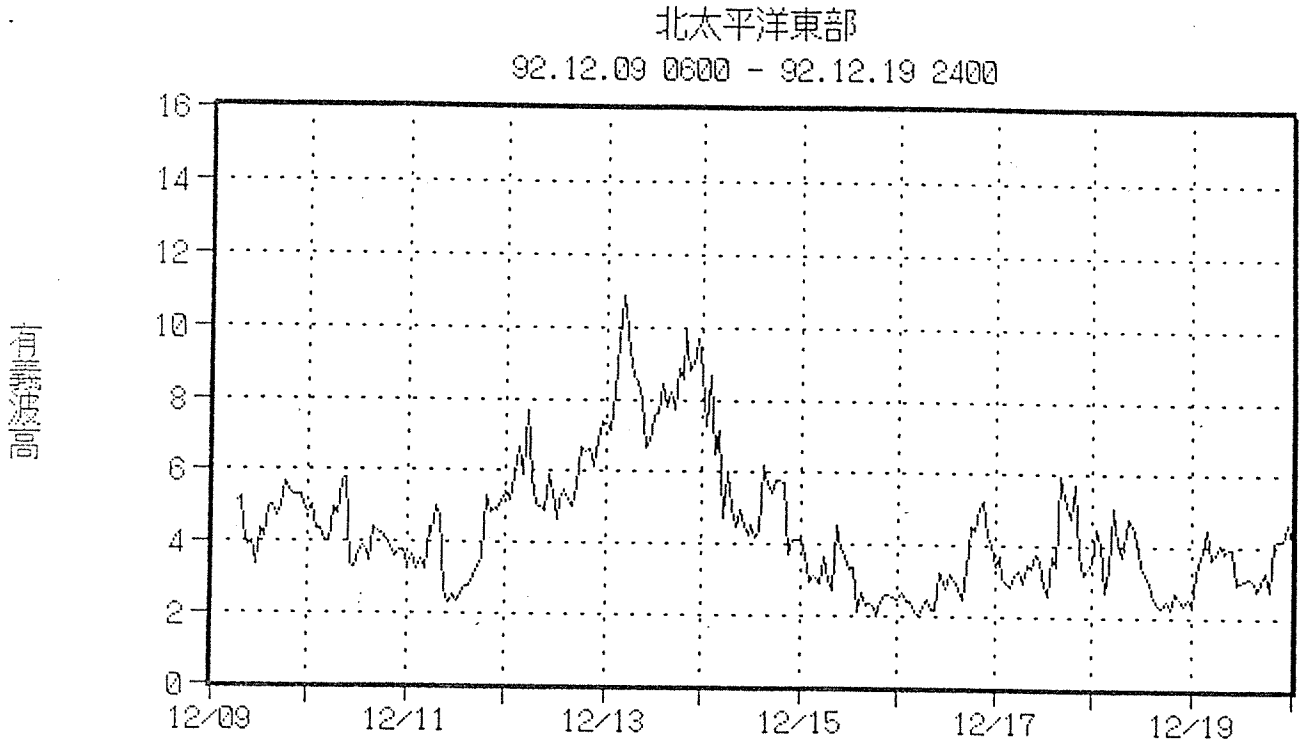
Appendix 7. Wind speed (m/s) and wave height (m).

Wave Height (m)

Western North Pacific Ocean

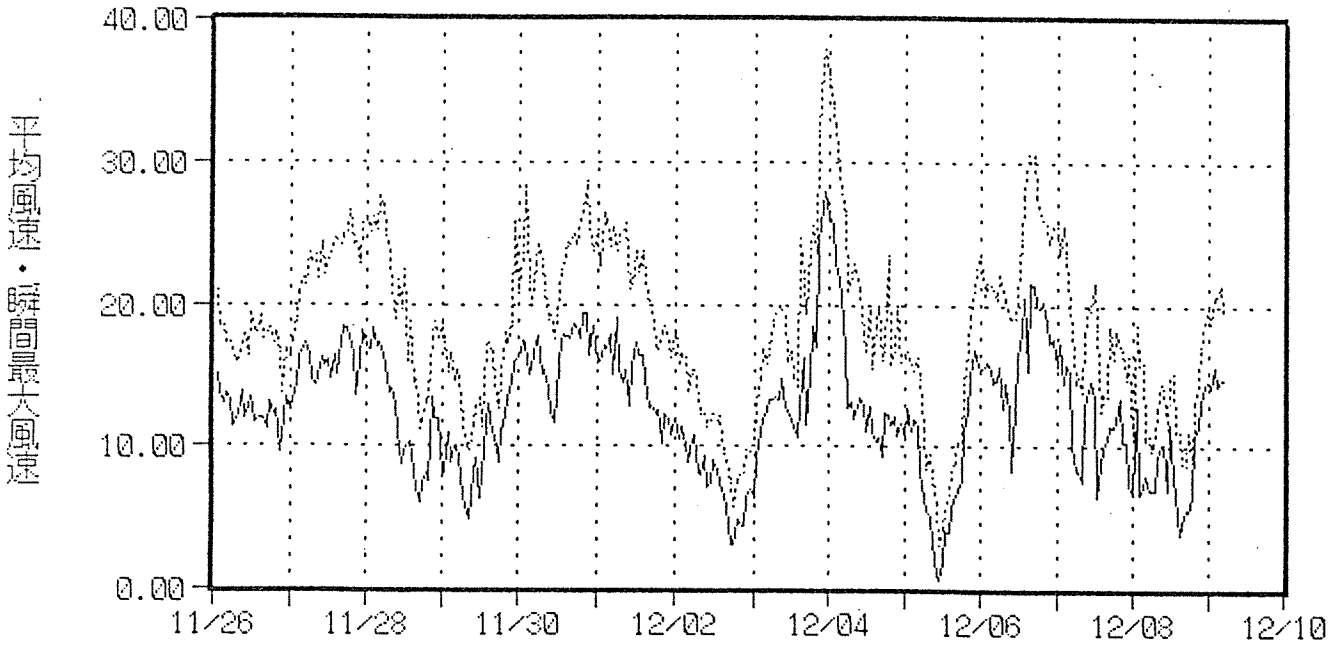


Eastern North Pacific Ocean



Wind Speed (m/s)

Western North Pacific Ocean

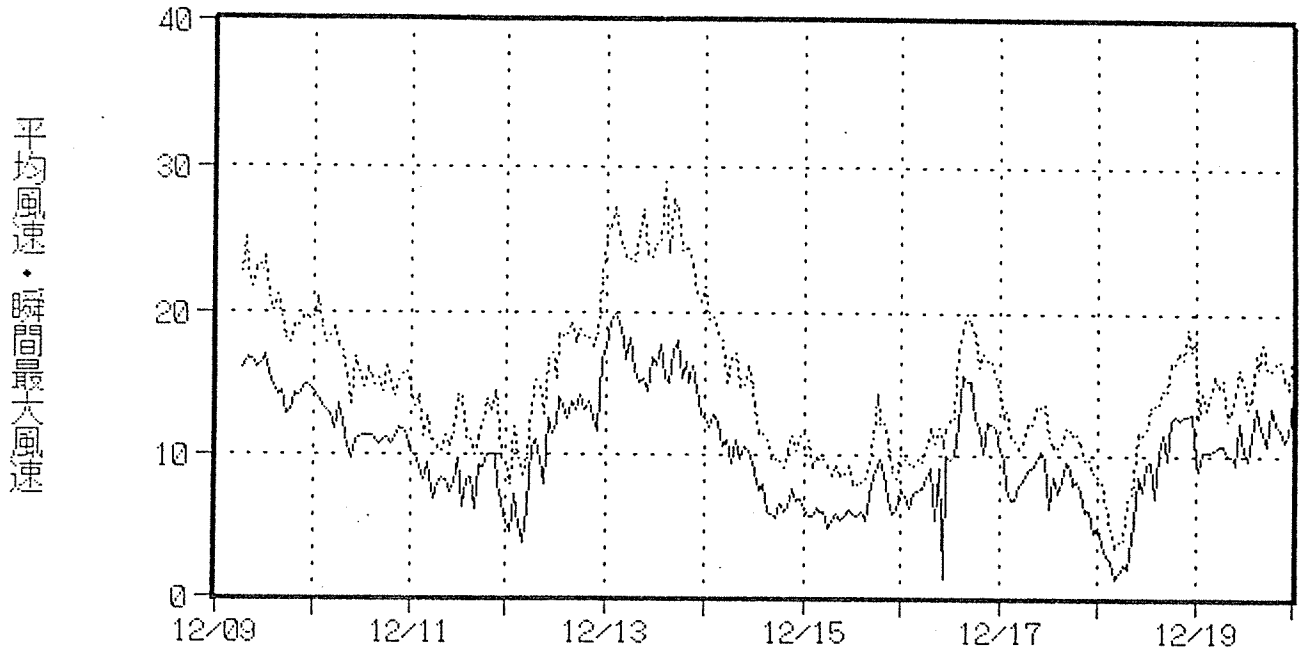


— １０分間平均風速 ····· 瞬間最大風速

Eastern North Pacific Ocean

北太平洋東部

92.12.09 0600 - 92.12.19 2400



— １０分間平均風速 ····· 瞬間最大風速

(mean) (maximum)

Appendix 8. Other species of fish and invertebrates caught during the Japan, U.S.A., and Canada cooperative survey on overwintering salmonids in the North Pacific Ocean in November and December 1992. Dashes (--) indicate count or weight not taken.

St.	Location	(°C) SST	Species	Number	(kg) Weight
1-1	37-57N, 157-20E	17.9	Thunnus alalunga	5	17.20
			Katsuwonus pelamis	5	7.70
			Ocycrius japonicus	2	0.19
			Gempylidae sp.	5	0.12
			Paralepididae sp.	4	0.02
			Myctophiform, other spp.	--	9.60
			Ommastrephes bartrami	1	2.20
			Eucleoteuthis luminosa	9	1.92
			Other squids	23	0.40
			Unid. octopus	3	--
			Others	--	0.16
1-2	39-35N, 157-33E	13.8	Brama raii	1	0.29
			Thunnus sp.	3	3.10
			Unid. squids	17	--
			Unid. octopus	1	--
			Others	--	8.60
1-3	41-10N, 157-31E	10.2	Trachipterus misakiensis	1	0.82
			Trachipterus ishikawai	3	9.23
			Engraulis japonica	118	0.99
			Paralepididae sp.	30	0.13
			Myctophiform, other spp.	--	20.40
			Unid. squids	317	34.95
1-4	42-14N, 157-42E	9.6	Engraulis japonica	15,870	171.40
			Anotopterus pharao	1	0.22
1-6	45-38N, 157-32E	4.3	Unid. squids	2	0.03
			Jelly fish	--	16.5
2-1	45-06N, 163-51E	4.6	Myctophiform, other spp.	--	5.40
			Leptocephalus	3	--
			Gonatopsis borealis	22	0.44
			Unid. squids	51	0.30
			Jelly fish	--	1.90
2-2	44-26N, 168-56E	5.4	Jelly fish	--	3.10
2-3	42-32N, 174-51E	9.5	Engraulis japonica	903	12.71
			Leptocephalus	1	--
			Onychoteuthis boreali-japonica	1	0.61
			Unid. juv. squid	1	--

St.	Location	(°C) SST	Species	Number	(kg) Weight
3-1	41-00, 179-02E	13.4	Jelly fish & others	--	7.80
			Unid. juv. fish	1	--
3-2	41-19N, 179-32W	11.3	Engraulis japonica	2,975	18.80
			Leptocephalus	4	--
3-3	42-05N, 179-28W	9.6	Brama japonica	3	4.09
			Engraulis japonica	5	.04
			Myctophiform, other spp.	333	0.58
			Unid. squid	4	--
3-4	43-49N, 179-28W	9.0	Cololabis saira	13	0.56
			Unid. juv. squid	15	--
3-5	45-00N, 179-28W	7.4	Paralepididae	64	0.13
			Myctophiform, other spp.	--	4.13
			Gonatopsis borealis	2,132	35.39
			Onychoteuthis borealijaponica	38	1.70
			Moroteuthis robusta	3	5.00
			Unid. juv. squid	431	1.19
3-6	46-22N, 179-27W	4.6	Myctophiform, other spp.	--	7.70
			Gonatopsis borealis	102	2.52
			Onychoteuthis borealijaponica	1	0.67
			Unid. juv. squids	69	0.17
			Jelly fish	--	3.85
4-2	48-20N, 169-03W	5.1	Unid. juv. squids	91	1.95
			Jelly fish	86	1.40
4-3	47-51N, 164-52W	5.7	Gonatopsis borealis	5	0.29
			Myctophiform, other spp.	8,296	21.00
4-4	47-12N, 160-24W	6.6	Alepisaurus borealis	1	4.80
			Myctophiform, other spp.	40,003	67.84
			Gonatopsis borealis	13	1.40
			Moroteuthis robusta	2	2.68
			Unid squids	262	0.96
4-5	46-23N, 155-18W	7.1	Myctophiform, other spp.	2,748	5.31
			Gonatopsis borealis	1,978	18.13
			Onychoteuthis borealijaponica	25	1.36
4-6	45-42N, 151-33W	8.8	Myctophiform, other spp.	--	--
			Leptocephalus	--	--
			Gonatopsis borealis	30	0.28
			Berryteuthis anonychus	214	1.61

St.	Location	(°C) SST	Species	Number	(kg) Weight
4-6	(cont'd)		Onychoteuthis borealijaponica	1	0.07
			Unid. juv. squids	6	0.02
			Jelly fish & others	--	0.32
5-1	44-32N, 145-59W	10.0	Leptocephalus	4	0.14
			Onychoteuthis borealijaponica	56	0.30
			Berryteuthis anonychus	36	0.25
			Gonatus sp.	1	0.01
			Unid. juv. squids	3	0.71
5-2	45-31N, 145-03W	9.1	Paralepididae	1	0.007
			Onychoteuthis borealijaponica	2	0.005
5-3	46-27N, 144-59W	9.2	Myctophiform, other spp.	2,155	4.38
			Leptocephalus		
			Gonatopsis borealis	1,170	14.43
			Onychoteuthis borealijaponica	53	4.08
			Chiroteuthis picteti	1	.02
			Unid. juv. squids	389	1.21
5-4	47-18N, 144-59W	8.3	Myctophiform, other spp.	7	.02
			Gonatopsis borealis	31	.28
			Berryteuthis anonychus	1,433	4.64
			Onychoteuthis borealijaponica	3	.12
			Gonatus sp.	2	.05
			Unid. juv. squids	25	.06
			Jelly fish & others	142	.35
5-5	49-03N, 145-00W	7.1	Myctophiform, other spp.	12,081	23.38
			Gonatopsis borealis	5	.12
			Onychoteuthis borealijaponica	20	.07
			Berryteuthis anonychus	120	2.40
			Unid. juv. squids	201	.72
5-6	51-07N, 145-00W	6.8	Myctophiform, other spp.	5,126	8.42
			Berryteuthis anonychus	38	.23
			Unid. juv. squids	57	.20
			Jelly fish	5	.48