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## **Results of 2011 Salmon Research by the *Oshoro maru***

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### **Abstract**

In order to accumulate oceanographic and biological data (including salmonids) and to clarify the oceanic structure and marine ecosystem, the T/V *Oshoro maru* conducted oceanographic observations and fishing surveys in the western North Pacific (along the 155°E longitude line). The survey was conducted during the Cruise #228 in May, and the Cruise #229-Leg5 from late July to early August, 2011.

10 oceanographic observations and four drift gillnet surveys were conducted along the 155°E during the Cruise #228 in May. The Polar Front was observed in the vicinity of 44°N. The Subarctic Boundary observed in surface (0-100 db) at nearby 42°-15'N and in more deeper at 40°-30'N. Pink salmon was dominant species at 43°-22.1'N, 43°-57.3'N and 41°-45.0'N, and abundant at 43°-22.1'N. Chum salmon was collected at 43°-22.1'N and 41°-45.0'N. The fork lengths (F.L.) of chum salmon collected by C-gear gillnet ranged between 480-620 mm, and those of pink salmon ranged between 330-470 mm, 76.9% of chum salmon were adult fish.

14 oceanographic observations and four drift gillnet surveys were conducted along the 155°E during the Cruise #229-Leg5 from late July to early August. Seasonal thermocline was observed in 25 m depth and, thereunder the Polar Front was observed in the vicinity of 43°N. The Subarctic Boundary was observed at 41°-15'N, deeper than 140 m at 40°-15'N clearly. Four pink salmon were collected by drift gillnet survey only at 43°-43.4'N. F.L. of pink salmon collected by C-gear gillnet ranged between 430-490 mm.

To collect salmon samples extensively and to collect fresh salmon blood and various tissues, three surface long-line and five hook-and-line gear samplings were conducted during the Cruise #228 and #229-Leg5. A total of 82 chum and 253 pink salmon were collected during the two cruises.

## INTRODUCTION

The *Oshoro maru* has continued to study the oceanic structure and marine biology in the North Pacific Ocean and Bering Sea (infrequently in the Chukuchi Sea) every summer since 1953. Collected data has been published annually since 1957 (Hokkaido University, 1957-2011).

In 2011, salmon researches were conducted during two cruises in May: the Cruise #228 and from late July to early August: the Cruise #229-Leg5 in the western North Pacific.

Primary salmon research objects during two cruises were

1. To collect oceanographic and biological data continuously along 155°E longitude line in May and from late July to early August.
2. To collect salmon samples as extensively as possible during the cruises periods in order to study their food habits, growth and stock identification etc..

This document reports the preliminary results about those researches during the cruises.

## MATERIAL AND METHODS

### Survey Area and Cruise Schedule

The *Oshoro maru* (1,792 gross ton) departed Hakodate on May 12, 2011 and started the Cruise #228. Oceanographic observations, gillnet surveys, surface long-line and hook-and-line samplings were conducted along the 155°E longitude between 44°N and 38°-46'N latitude from May 16 to 22, and returned to Hakodate on May 24. The Cruise #229 was started on June 8 when she left Hakodate. But no salmon research activity was conducted during the Cruise #229-Leg1—Leg4. The Cruise #229-Leg5 was started on July 22 when she left Tokyo for Hakodate. Salmon research activities were conducted from July 27 to Aug 1. Oceanographic observations, gillnet surveys, and hook-and-line samplings were conducted along the 155°E longitude from 37°-14'N to 44°N latitude, and conducted at <43°-42'N, 154°-09'E> on her way back to Hakodate [Fig.1-(1), (2), Table 1].

### *Oceanographic observation*

Ten oceanographic observations were conducted at least 45 nautical miles intervals from 44°N to 38°-46'N along the 155°E, in May. 13 oceanographic observations were conducted along the 155°E from 37°-14'N to 44°N and oceanographic observations were conducted at 43°-42'N, 154°-09'E in July. 24 oceanographic observations were conducted in the western North Pacific Ocean [Fig.1-(1), (2), Table 1]. The temperature and salinity data at each station were collected by using CTD or XCTD. Temperature and salinity data from surface to 500 db pressure along the 155°E were used to plot

temperature and salinity sections about each transect [Fig.2-(1), (2)].

### *Drift Gillnet Research*

A drift gillnet was used to collect salmonids and the other organisms at each four stations along the 155°E in May and July [Figs.1-(1), (2), Table1]. The gillnet configuration at each station is as follows:

Stations	net	A-Gear				C-gear										F-Gear						Total	
	Mesh size (mm)	112	115	118	121	48	55	63	72	82	93	106	121	138	157	19	22	25	29	33	37		42
OSG1101-2	Number of tan	3	3	3	3	3	3	3	6	5	5	3	3	3	3	-	-	-	-	-	-	-	49
OSG1103-8	Number of tan	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	1	1	1	1	1	1	49

The net was total 49 tans which comprised of 30 or 37 tans of C-Gear gillnet (non-selective varied research mesh, Takagi, 1975), 12 tans of A-Gear gillnet (commercial mesh), and non or seven tans of F-Gear gillnet (special mesh). Each tan was 50 m long. Gillnet gear was set in the evening, allowed to soak overnight, and retrieved the following morning. The catch was sorted and counted by mesh size and species. The Catch per Unit Effort (CPUE) values of C-Gear gillnet by species at each station were calculated as catch number per one tan of C-Gear gillnet.

Details about each gillnet operation are shown in Table 2.

### *Surface Long-line Research*

Two surface long-line researches were conducted to collect salmonids in the western North Pacific during the Cruise #228 [Fig.1-(1), Table 1].

The long-line consisted of 20 baskets. One basket (hatchi) was 110.68 m long with 49 hooks baited with salted Japanese anchovy (*Engraulis japonicus*). The catch was sorted by species and counted.

Details about each surface long-line operation are shown in Table 3.

### *Hook-and-Line Sampling*

To collect fresh salmon blood and various tissues, hook-and-line gears were used at five research stations during the Cruise #228 and #229-Leg5 [Fig.1-(1), (2), Table 1].

Three to ten anglers were engaged in the work. Those samplings were conducted mainly around the same time that oceanographic observation was operating. The catch was sorted by species and counted.

### *Fish Examination*

The catch was processed soon after removal from the fishing gear. Biological data were recorded per each sampling gear at every station. Biological data for salmonids consisted of F.L. (mm), body weight (g), sex, and gonad weight (g). Scale samples were collected from the International North Pacific Fisheries Commission (INPFC) preferred body area (Davis et al., 1990) and placed on gummed cards for verification of species

identification, and for age, growth and stock origin studies. For the salmon which had a clipped fin, its snout was removed, salted, and frozen for later potential recovery of the coded-wire tag (CWT) by researchers at NOAA NMFS, Auke Bay Laboratories (ABL).

Additional research activities included collection of salmonids stomachs, muscle and fin tissues, blood samples, and egg samples for studies of food habits, growth, stock identification, and female-specific serum proteins.

Chum salmon (*Oncorhynchus keta*) was classified as mature or immature based on their gonad weight (Takagi, 1961).

Body length and body weight were determined for non-salmonid fish, squid, and other organisms up to a maximum of 30 per species by mesh size. A few were frozen for taxonomic and ecological studies.

## RESULTS AND DISCUSSION

Details of oceanographic data and biological data collected during the cruises will publish in the “*DATA RECORDE OF OCEANOGRAPHIC OBSERVATIONS AND EXPLORATORY FISHING NO.55*” by Hokkaido University in 2012.

### *Along the 155°E Longitude Line: during the Cruise #228 in May, 2011*

#### *Oceanographic Conditions*

Temperature and salinity sections (0-500db) along the 155°E transect are shown in Figure 2-(1).

The geographic positions of the Polar Front, the Transition Domain and the Subarctic Boundary along the 155°E transect (Dodimead et al., 1963, Favorite et al., 1976, Roden, 1991) were observed following locations.

The Polar Front which is indicated by the vertical 4°C isotherm at 100 db observed in the vicinity of 44°N. Small warm core was observed in vicinity of 39°-20'N. The Subarctic Boundary indicated by the vertical 34.0 psu isohaline was observed in surface (0-100 db) at nearby 42°-15'N and in more deeper at 40°-30'N .

#### *Distribution and Abundance of Organisms Caught by Drift Gillnet*

The numbers of organisms caught by drift gillnet and the CPUE values of C-gear gillnet at each station along the 155°E are shown in Table 4.

Four drift gillnet surveys were conducted along the 155°E during the cruise #228 in May, 2011 [Fig.1-(1), Tables 1, 2]. A total of 13 chum salmon, 707 pink salmon (*Oncorhynchus gorbuscha*) were collected at 43°-22.1'N (OSG1101), 43°-57.3'N (OSG1102) and 41°-45.0'N (OSG1103). The C-gear's CPUE value of chum salmon was clearly higher at 43°-22.1'N than at 41°-45.0'N and no salmon at 43°-57.3'N. On the other hand, that of pink salmon was the highest at 43°-22'N, secondarily higher at 41°-45'N, and low at 43°-57'N. Salmonids were account for over 90% of organisms caught by C-gear gillnet at 43°-23'N, at 43°-58'N and at 41°-45'N. Pink salmon was dominant species (over about 90% of C-gear's catch) in those stations. No salmonids were collected only at 39°-30'N (OSG1104). At this point, non-salmonid fish, 21 boreal clubhook squid (*Onychoteuthis borealijaponicus*) and 26 pacific pomfret (*Brama japonica*) were collected. The former were caught at 43°-22'N and 41°-45'N, and each nine squids and 13 squids.

### *Biological Characteristics of Salmonids*

F.L. frequency distributions of chum salmon and pink salmon caught by C-gear gillnet along the 155°E are shown in Fig.3-(a),(b).

A total of 13 chum salmon were collected by C-gear gillnet. Almost all their F.L. ranged between 480-620 mm. Mean  $\pm$  SD of them was  $515.2 \pm 68.1$  mm, and median of them was 514.0 mm. Mature fish occupied 76.9%. From these results, their ocean ages were thought to be almost over three years (Meguro et. al., 2004).

A total of 370 pink salmon were collected by C-gear gillnet. Their F.L. ranged between 330-470 mm. Mean  $\pm$  SD of them was  $388.1 \pm 23.8$  mm, and median was 389.0 mm. Along the 155°E in the western North Pacific: during the Cruise #229-Leg 5 from late July to Early August, 2011.

*Along the 155°E Longitude Line: during the Cruise #229-Leg 5 from Late July to Early August, 2011*

### *Oceanographic Conditions*

Temperature and salinity sections (0-500db) along the 155°E transect are shown in Figure 2-(2).

Seasonal thermocline was observed in 25 db and, thereunder the Polar Front was observed in the vicinity of 43°N. The Subarctic Boundary was observed at 41°-15'N, and deeper than 140 db at 40°-15'N clearly.

### *Distribution and Abundance of Organisms caught by Drift Gillnet*

The numbers of organisms caught by drift gillnet and the CPUE values of C-gear gillnet at each station along the 155°E are shown in Table 5.

Four drift gillnet surveys were conducted along the 155°E during the cruise #229-Leg5 from late July to early August, 2011 [Fig. 1-(2), Tables 1, 2]. A total of four pink salmon were collected at 43°-43.4'N (OSG1108). No salmonids were collected at 40°-15.0'N (OSG1105), 41°-44.7'N (OSG1106) and 43°-14.3'N (OSG1107). Mostly catches of non-salmonids fish, flying squid (*Ommastrephes bartramii*) were dominant species (over 90% of C-gear's catch, 416 individuals) at 40°-15.0'N. 44 flying squid and six boreal clubhook squid (*Onychoteuthis borealijaponicus*) were collected at 41°-44.7'N. 130 Japanese common squid (*Todarodes pacificus*), 90 boreal clubhook squid and 131 Pacific pomfret (*Brama japonica*) were abundant at 43°-14.3'N. 142 Japanese common squid, 43 boreal clubhook squid and 106 Pacific pomfret were collected at 43°-43.4'N.

### *Biological Characteristics of Salmonids*

A total of four pink salmon were collected by C-gear gillnet. Their F.L. ranged between 430-490 mm. Mean  $\pm$  SD of them was  $471 \pm 25.82$  mm, and median was 481.0 mm.

*Surface Long-line Research and Hook-and-Line Samplings*

The catch number of salmonids at each station by hook-and-line gear and surface long-line is shown in Table 6.

A total of 21 chum and 245 pink salmon were collected by hook-and-line gear and surface long-line at 155°E research line during the Cruise #228 (OSHL1101-1103, OSSL1101, 1102). 61 chum salmon and three pink salmon were collected by hook-and-line gear at <43°-42'N, 154°-09'E> during the Cruise #228 (OSHL1104). A total of 10 pink salmon were collected by hook-and-line gear at 155°E research line during the Cruise #229-Leg5 (OSHL1105).

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Table 1. List of salmon research stations, positions and date during the Oshoro maru Cruise #228 and #229, 2011.

Station Name				Position		Date	
Oceanographic	Gillnet	Hook-and-Line	Surface longline	Latitude	Longitude	*S.M.T.	**T.D.
Cruise #228							
OS 11044			OSSL 1101	44-00N	155-02E	May 16	+10h
OS 11045				43-15N	155-00E	May 16	
OS 11046	OSG 1101	OSHL 1101	OSSL 1102	43-23N	155-08E	May16-17	
OS 11047	OSG 1102	OSHL 1102		43-58N	154-59E	May17-18	
OS 11048				42-30N	155-00E	May 18	
OS 11049	OSG 1103	OSHL 1103		41-45N	155-01E	May18-19	
OS 11050				41-01N	155-00E	May 18	
OS 11051				40-15N	155-00E	May 19	
OS 11052	OSG 1104			39-31N	154-59E	May19-20	
OS 11053				38-46N	155-01E	May 20	
		OSHL 1104		39-59N	151-02E	May21-22	
Cruise #229-Leg5							
OS 11299				37-14N	155-00E	Jul 27	+10h
OS 11300				37-15N	155-00E	Jul 27	
OS 11301				38-00N	155-00E	Jul 27	
OS 11302				38-45N	155-02E	Jul 27	
OS 11303				39-30N	155-00E	Jul 28	
OS 11304	OSG 1105			40-15N	155-00E	Jul 28-29	
OS 11305				41-00N	155-00E	Jul 29	
OS 11306	OSG 1106			41-45N	155-00E	Jul 29-30	
OS 11307				42-30N	155-00E	Jul 30	
OS 11308				42-35N	155-00E	Jul 30	
OS 11309				42-44N	154-57E	Jul 30	
OS 11310	OSG 1107			43-15N	155-00E	Jul 30-31	
OS 11311				44-00N	155-00E	Jul 31	
OS 11312	OSG 1108	OSHL 1105		43-42N	154-09E	Jul 31-Aug 1	

\*S.M.T.: Ship's mean time.

\*\*T.D.: Time difference between Greenwich mean time and Ship's mean time.

Table 2. Position and research conditions of surface drift gillnet sampling at each station during the *Oshoro maru* Cruise #228 and #229, 2011.

Station	Date and Time (S.M.T.*1)		T.D.*2	Set Position		D.S.*3	Wr*4	Wind (Force)
	Net set	Net haul		Lat.	Long.			
Cruise #228								
OSG 1101	May 16 17:55-18:22	May 17 04:39-05:30	+10h	43-22.1 N	155-01.3 E	070	bc	West-5
OSG 1102	May 17 17:55-18:25	May 18 04:24-05:02	+10h	43-57.3 N	155-00.2 E	310	o	South-5
OSG 1103	May 18 17:50-18:17	May 19 04:25-05:12	+10h	41-45.0 N	154-59.0 E	090	c	West-5
OSG 1104	May 19 18:00-18:25	May 20 04:30-05:38	+10h	39-30.2 N	154-58.4 E	080	bc	West-6
Cruise #229								
OSG 1105	July 28 19:50-20:15	July 29 04:53-05:43	+10h	40-15.0 N	155-02.9 E	150	c	NNW-5
OSG 1106	July 29 18:28-18:51	July 30 04:37-05:25	+10h	41-44.7 N	154-59.8 E	230	o	WSW-3
OSG 1107	July 30 17:52-18:25	July 31 04:34-05:32	+10h	43-14.3 N	155-01.3 E	270	o	NE-3
OSG 1108	July 31 18:24-18:47	August 1 04:30-05:24	+10h	43-43.4 N	154-06.2 E	130	d	NE-4

\*1 S.M.T. : Ship's Mean Time

\*2 T.D. : Time Difference between Greenwich Mean Time (G.M.T.) and Ship's Mean Time(S.M.T.)

\*3 D.S. : Direction of net set

\*4 Wr : Weather (bc: 25-75% clouded, o: 100% clouded, d: drizzling rain, c: 75-99% clouded)

Table 3. Position and research conditions of surface long-line sampling at each station during the *Oshoro maru* Cruise #228, 2011.

Station	Date and Time (S.M.T.*1)		T.D.*2	Set Position		D.S.*3	Number of baskets	Wr*4	Wind (Force)
	Line set	Line haul		Lat.	Long.				
Cruise #228									
OSSL 1101	May 16 04:55-05:40	May 16 08:39-09:46	+10h	43-59.8N	155-01.0E	080	20	o	West-5
OSSL 1102	May 17 03:55-04:20	May 17 06:25-06:54	+10h	43-22.8N	155-15.3E	253	20	b	WSW-4

\*1 S.M.T. : Ship's Mean Time

\*2 T.D. : Time Difference between Greenwich Mean Time (G.M.T.) and Ship's Mean Time (S.M.T.)

\*3 D.S. : Direction of line set

\*4 Wr : Weather (o: 100% clouded, b: 0-25% clouded)

Table 4. The number of organisms caught by drift gillnet along the 155°E during the Oshoro maru Cruise # 228, in May, 2011. CPUE and (%) indicate numerical catch per one tan and percentage of total catch by C-gear gillnet at each station.

Common name	Scientific name	OSG 1101			OSG 1102			OSG 1103			OSG 1104							
		C		Total	C		Total	C		Total	C		Total					
		CPUE (%)	A		F	A		F	CPUE (%)		A	F		CPUE (%)	A	F		
Sockeye salmon	<i>Oncorhynchus nerka</i>	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0
Chum salmon	<i>Oncorhynchus keta</i>	11	0.3 (2.1)	13	0	24	0	0.0 (0.0)	4	0	4	0	2.1 (1.5)	4	0	6	0	0
Pink salmon	<i>Oncorhynchus gorbuscha</i>	504	13.6 (95.6)	1	0	505	0	88	2.4 (95.7)	0	88	0	3.8 (87.8)	1	0	116	0	0
Coho salmon	<i>Oncorhynchus kisutch</i>	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0
Chinook salmon	<i>Oncorhynchus tshawytscha</i>	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0
Steelhead	<i>Oncorhynchus mykiss</i>	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0
Japanese common squid	<i>Todarodes pacificus</i>	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	4
Boreal clubhook squid	<i>Onychoteuthis boreali-japonicus</i>	9	0.2 (1.7)	0	0	9	0	0.0 (0.0)	0	0	9	0	0.4 (9.9)	0	0	13	21	0.7 (38.9)
Eight-armed squid	<i>Gonatopsis borealis</i>	1	0.0 (0.2)	0	0	1	0	3	0.1 (3.3)	0	3	0	0.0 (0.0)	0	0	0	0	0
Flying squid	<i>Onmmastrephes bartramii</i>	0	0.0 (0.0)	0	0	0	0	0	0.0 (0.0)	0	0	0	0.0 (0.0)	0	0	0	0	1
Salmon shark	<i>Lamna ditropis</i>	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	1	0.0 (1.9)
Spiny dogfish	<i>Squalus acanthias</i>	1	0.0 (0.2)	0	0	1	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)
Longnose lancetfish	<i>Alepisaurus ferrox</i>	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	1	0.0 (0.8)	0	0	1	0.0 (0.0)
Lantern fishes	Myctophidae	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	3	3	0	0.0 (0.0)
Pacific saury	<i>Cololabis saira</i>	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)
Pacific pomfret	<i>Brama japonica</i>	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	26	0.9 (48.1)
Smalleye squaretail	<i>Tetragonurus atlanticus</i>	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	5	0.2 (9.3)
Short-tailed shearwater	<i>Puffinus tenuirostris</i>	0	0.0 (0.0)	0	0	0	0	1	0.0 (1.1)	0	1	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)
Tufted Puffin	<i>Fratrcaula cirrhata</i>	1	0.0 (0.2)	0	0	1	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)
Pacific white-sided dolphin	<i>Lagenorhynchus obliquidens</i>	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	1	0.0 (1.9)

Table 5. The number of organisms caught by drift gillnet during the Oshoro maru Cruise #229 in July-August, 2011. CPUE and (%) indicate numerical catch per tan and percentage of total catch by C-gear gillnet at the station, respectively.

Common name	Scientific name	OSG 1105				OSG 1106				OSG 1107				OSG 1108				
		C		A	F	Total	C		A	F	Total	C		A	F	Total		
		CPUE (%)					CPUE (%)					CPUE (%)						
Sockeye salmon	<i>Oncorhynchus nerka</i>	0	0.0 (0.0)	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0.0 (0.0)		
Chum salmon	<i>Oncorhynchus keta</i>	0	0.0 (0.0)	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0.0 (0.0)		
Pink salmon	<i>Oncorhynchus gorbuscha</i>	0	0.0 (0.0)	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0.0 (0.0)		
Coho salmon	<i>Oncorhynchus kisutch</i>	0	0.0 (0.0)	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0.0 (0.0)		
Chinook salmon	<i>Oncorhynchus tshawytscha</i>	0	0.0 (0.0)	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0.0 (0.0)		
Steelhead	<i>Oncorhynchus mykiss</i>	0	0.0 (0.0)	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0.0 (0.0)		
Japanese common squid	<i>Todarodes pacificus</i>	0	0.0 (0.0)	0	0	0	0.0 (0.0)	0	14	14	130	4.3 (36.4)	0	30	160	142	4.7 (47.8)	
Boreal clubhook squid	<i>Onychoteuthis borealijaponicus</i>	0	0.0 (0.0)	0	1	1	6.0 (10.5)	0	35	41	90	3.0 (25.2)	0	82	172	43	1.4 (14.5)	
Eight-armed squid	<i>Gonatopsis borealis</i>	0	0.0 (0.0)	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	
Flying squid	<i>Ommastrephes bartramii</i>	416	13.9 (91.4)	2	6	424	44	1.5 (77.2)	10	0	54	2	0.1 (0.6)	0	2	0	0.0 (0.0)	
Football octopus	<i>Ocythoe tuberculata</i>	1	0.0 (0.2)	0	0	1	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0.0 (0.0)	
Shortfin mako shark	<i>Isurus paucus</i>	0	0.0 (0.0)	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	
Blue shark	<i>Prionace glauca</i>	4	0.1 (0.9)	2	0	6	1	0.0 (1.8)	0	0	1	1	0.0 (0.3)	1	0	2	0.0 (0.0)	
Salmon shark	<i>Lamna ditropis</i>	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	1	0.0 (0.3)	2	0	3	0.0 (0.0)	
Japanese anchovy	<i>Engraulis japonicus</i>	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	1	1	0.0 (0.0)	
Lantern fishes	Mycetophidae	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	5	5	0	0.0 (0.0)	0	16	16	0.0 (0.0)	
Pacific saury	<i>Cololabis saira</i>	4	0.1 (0.9)	0	44	48	0	0.0 (0.0)	0	13	13	0	0.0 (0.0)	0	35	35	0.0 (0.0)	
Japanese amberjack	<i>Seriola quinqueradiata</i>	8	0.3 (1.8)	0	0	8	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0.0 (0.0)	
Pilofish	<i>Naucrates dactor</i>	1	0.0 (0.2)	0	0	1	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0.0 (0.0)	
Pacific pomfret	<i>Brama japonica</i>	7	0.2 (1.5)	0	0	7	2	0.1 (3.5)	1	0	3	131	4.4 (36.7)	44	5	180	106	3.5 (35.7)
Chub mackerel	<i>Scomber japonicus</i>	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	1	1	0.0 (0.3)	
Smalleye squaretail	<i>Tetraodonurus atlanticus</i>	0	0.0 (0.0)	0	0	0	2	0.1 (3.5)	0	0	2	0	0.0 (0.0)	0	0	0	0.0 (0.0)	
Medusa fish	<i>Ichthyophanes lockingtoni</i>	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	1	0.0 (0.3)
Pacific barrelfish	<i>Hyperosyllipha japonica</i>	14	0.5 (3.1)	1	0	15	2	0.1 (3.5)	0	0	2	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)
Bluefin driftfish	<i>Psenes pellucidus</i>	0	0.0 (0.0)	1	0	1	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)	0	0	0	0	0.0 (0.0)

Table 6. The catch number of each salmonid at each station where salmonids were collected by hook-and-line gear and surface longline in the Oshoro maru Cruise # 228 and #229, 2011.

Station Name	Sampling gear	Species name						Total
		sockeye	Chum	Pink	Coho	Chinook	Stellhead	
Cruise #228								
OSSL1101	Surface longline	0	16	8	0	0	0	24
OSSL 1102	Surface longline	0	2	32	0	0	0	34
OSHL 1101	Hook-and-line	0	1	119	0	0	0	120
OSHL 1102	Hook-and-line	0	1	30	0	0	0	31
OSHL 1103	Hook-and-line	0	1	56	0	0	0	57
OSHL 1104	Hook-and-line	0	61	3	0	0	0	64
Subtotal		0	82	248	0	0	0	330
Cruise #229								
OSHL 1105	Hook-and-line	0	0	5	0	0	0	5
Subtotal		0	0	5	0	0	0	5
Total								
Total		0	82	253	0	0	0	335

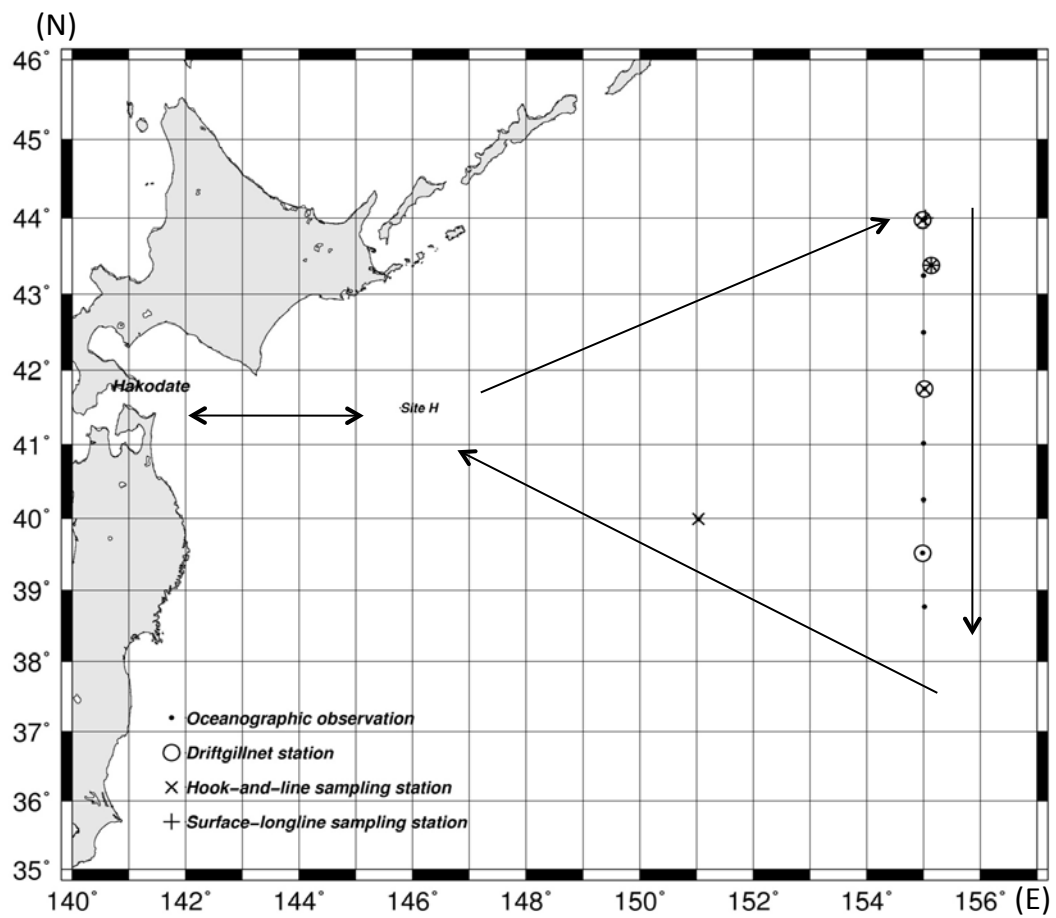


Fig.1-(1). Salmon research stations during the *Oshoro maru* Cruise #228 in May, 2011. Details about each station are shown in Table 1.

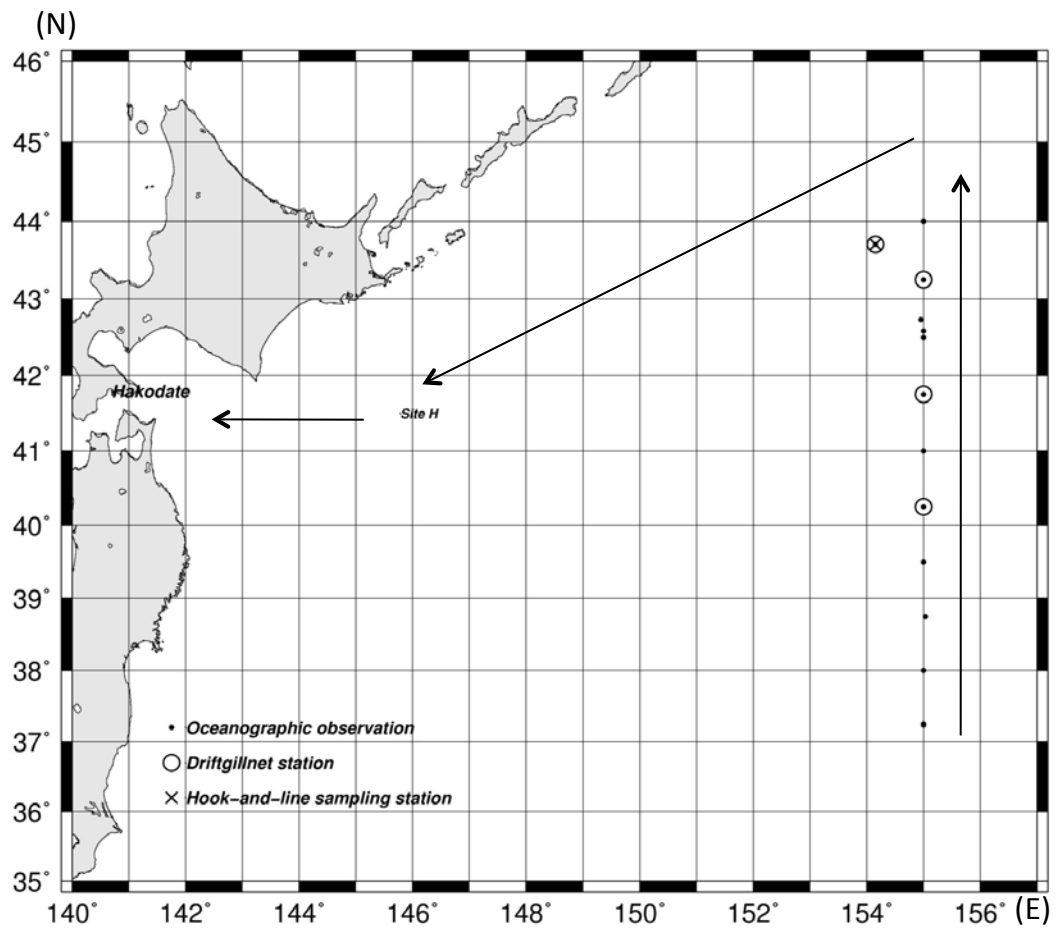


Fig.1-(2). Salmon research stations during the *Oshoro maru* Cruise #229-Leg5 in May, 2011. Details about each station are shown in Table 1.

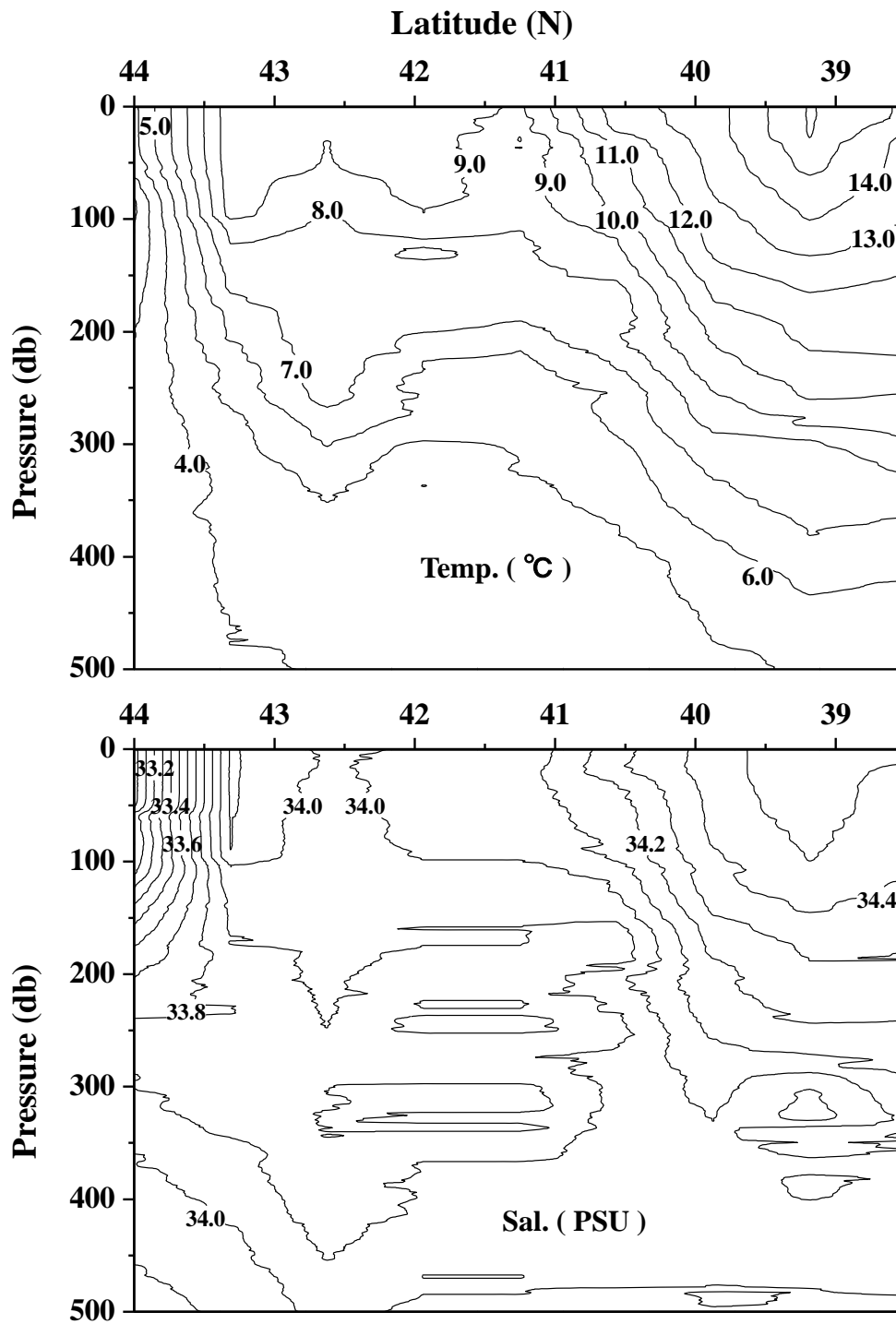


Fig. 2-(1). Temperature and salinity from surface to 500 db pressure along the 155° E transect during the *Oshoro maru* Cruise #228 in May, 2011.



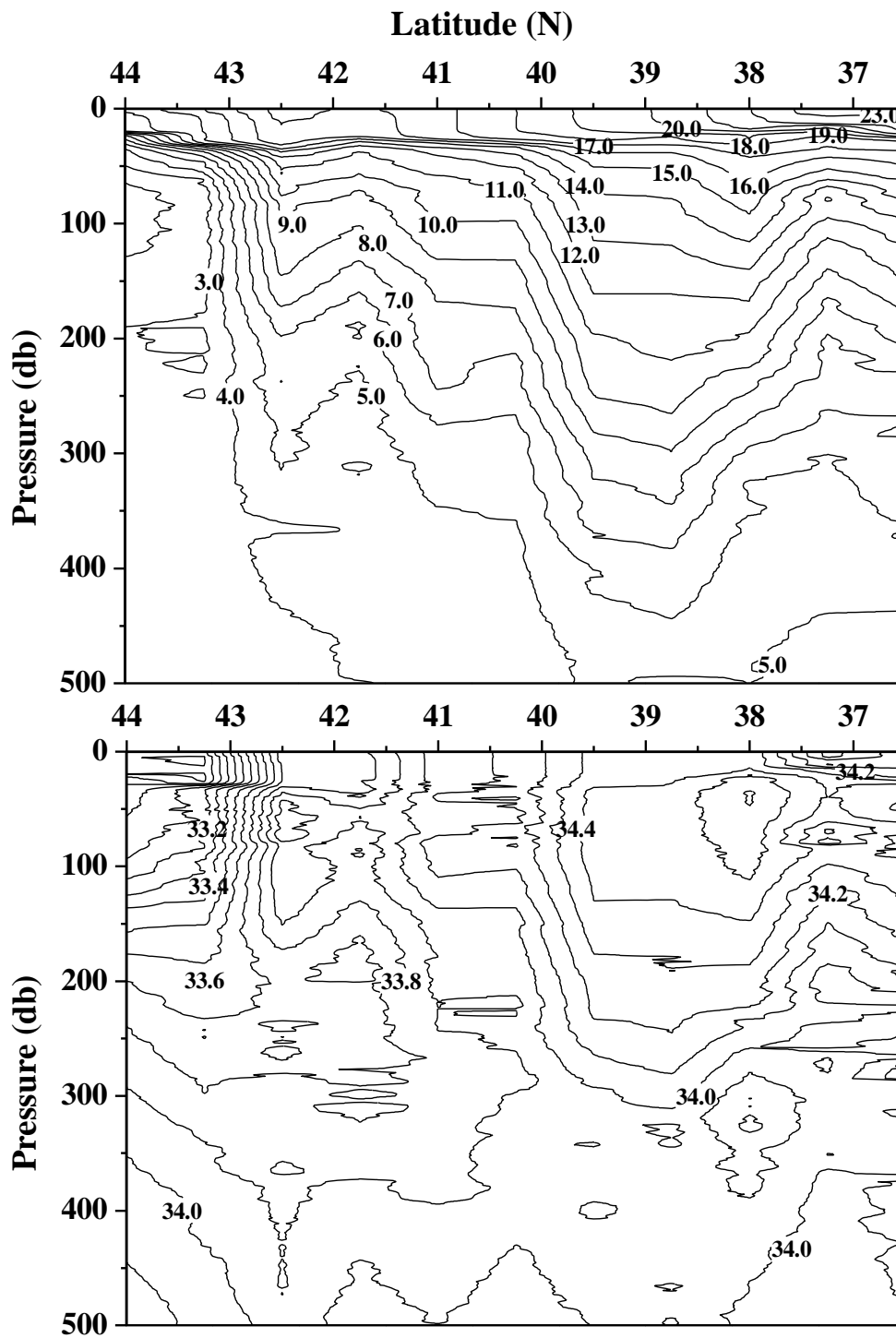


Fig. 2-(2). Temperature and salinity from surface to 500 db pressure along the 155° E transect during the *Oshoro maru* Cruise #229 in July, 2011.

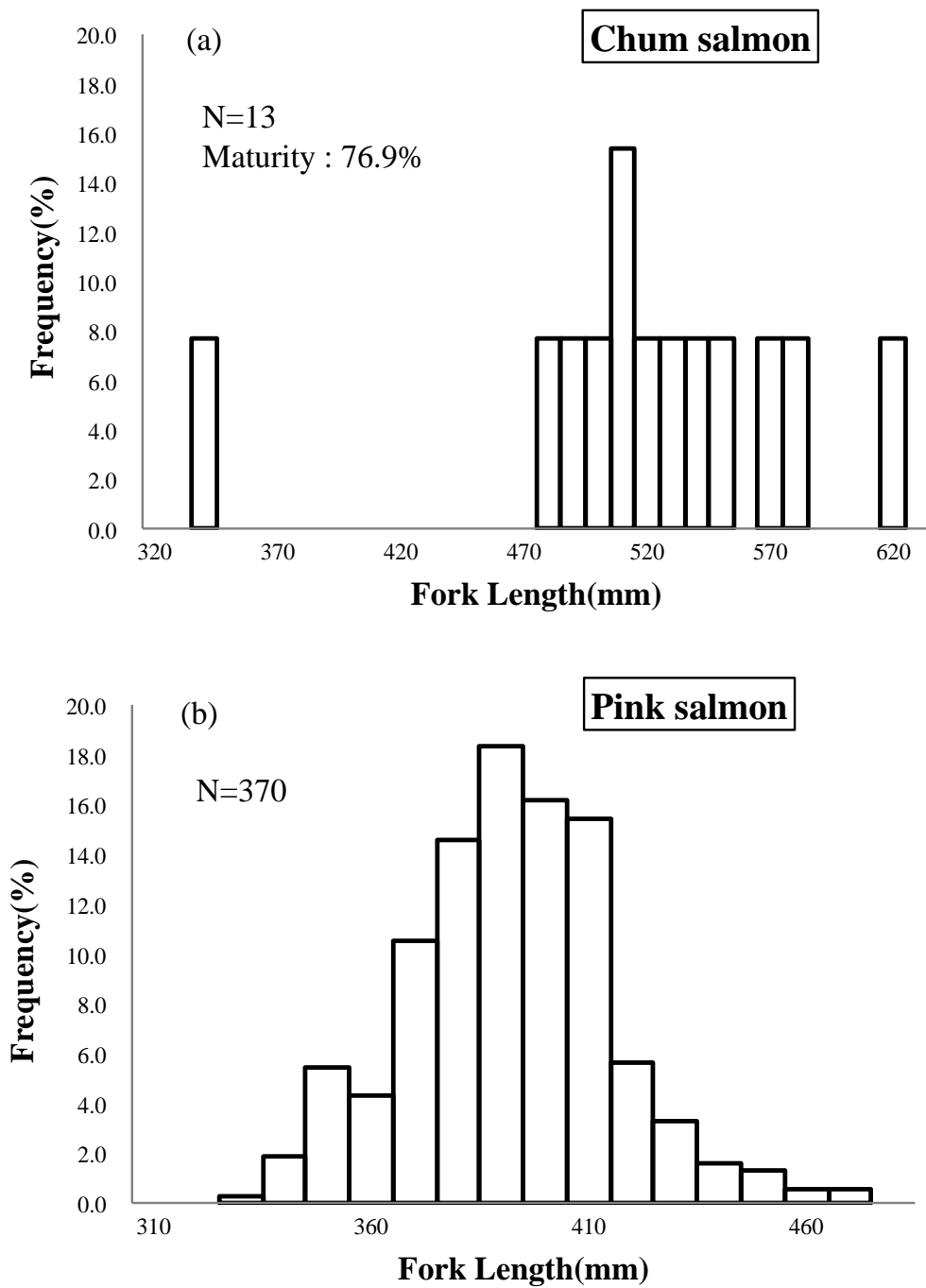


Fig. 3. Fork length frequency of chum salmon (a) and pink salmon (b) caught by C-gear gillnet along the 155°E longitude line during the Oshoro maru Cruise #228 in May 2011.