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Results of 2017 Salmon Research by the *Oshoro maru*

by

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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) and Bering Sea. The survey was conducted during the Cruise #039 in May, and the Cruise #040-Leg2, 4 from June to July 2017.

Oceanographic observations and drift gillnet surveys were conducted along the 155°E during the Cruise #039. No significant shift from the last year was confirmed for the Polar Front observed in the vicinity of 44°N.

A total of 1945 salmonids was caught by gillnet surveys, including 1896 Pink, 49 Chum salmon. Other species such as Steelhead and Sockeye salmon were not caught this year by the gillnet surveys. The fork lengths (F.L.) of chum salmon collected by C-gear gillnet ranged between 272-551 mm F.L., and those of pink salmon ranged between 322-495 mm F.L., 100% of Pink salmon caught along 155°E were adult fish.

To collect salmon samples extensively and to collect fresh salmon blood, otoliths and various tissues, three hook-and-line gear samplings and a surface long-line sampling were conducted during the Cruise #040-Leg2, 4 as well as the Cruise #039. The dominant species caught by these gears during the Cruise #040 were Pink salmon (61 Pink, 18 Sockeye, 6 Chum, 3 Coho and 1 Chinook salmon).

Keywords: salmon, gillnet, 155°E longitude line

INTRODUCTION

The *Oshoro maru* has continued to study the oceanic structure and marine biology in the North Pacific Ocean every summer and Bering Sea (infrequently in the Chukchi Sea) almost every summer since 1953. Collected data has been published annually since 1957 (Hokkaido University, 1957-2017).

Salmon researches were conducted during a cruise in May 2017: the *Oshoro maru* Cruise #039 in the Western North Pacific and in June to July 2017: the *Oshoro maru* Cruise #040-Leg2, 4 in Bering Sea.

Primary salmon research objects during two cruises were

1. To collect oceanographic and biological data continuously along 155°E longitude line in May.
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 cruise.

MATERIAL AND METHODS

Survey Area and Cruise Schedule

The *Oshoro maru* (1,998 gross ton) departed Hakodate on 12th May 2017 and started the Cruise #039. Oceanographic observations, gillnet surveys, surface long-line and hook-and-line samplings were conducted along the 155°E longitude between 44°N and 40°15'N latitude from 15th to 19th, and returned to Hakodate on 22nd May.

The Cruise #040-Leg2 was started on 18th June when she left Tokyo. Salmon researches were conducted from 29th June to 2nd July, and entered the port of Dutch Harbor on 3rd July. #040-Leg4 was started on 16th July when she left Nome. A salmon research was conducted on 21st July and returned to Hakodate on 1st August. Oceanographic observations and hook-and-line samplings were conducted. [Table 1, 2, Fig.1.1, Fig.1.2]

Oceanographic observation

Seven oceanographic observations were conducted from 44°N to 40°15'N along the 155°E longitude line. [Table 3, Fig.1.1] The temperature and salinity data at stations OS17020, 17022, 17024, 17027 were collected by CTD and OS17023, 17025, 17026 were by XCTD. Temperature and salinity data from surface to 500db along the 155°E longitude line were used to plot temperature and salinity sections about each transect during the Cruise #039. [Fig.2.1, 2.2] Three oceanographic observations at salmon sampling stations were conducted during the Cruise #040-Leg2, 4 [Table 3, Fig.1.2]

Drift Gillnet Research

One set of a drift gillnet was used to collect salmonids and the other organisms at the station along the 155°E longitude line. [Fig.1.1, Table1] The gillnet configuration at the station was as follows:

Stations	net	A-Gear		C-gear										Total
	Mesh size (mm)	112	115	48	55	63	72	82	93	106	121	138	157	
OSG1701	Number of tan	6	6	3	3	3	5	6	5	3	3	3	3	49
OSG1702	Number of tan	6	6	3	3	3	5	6	5	3	3	3	3	49
OSG1703	Number of tan	6	6	3	3	3	5	6	5	3	3	3	3	49
OSG1704	Number of tan	6	6	3	3	3	5	6	5	3	3	3	3	49

The net was total 49 tans which comprised of 37 tans of C-Gear gillnet (non-selective varied research mesh, Takagi, 1975) and 12 tans of A-Gear gillnet (commercial mesh). F-Gear gillnet was not used this year (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 was calculated as catch number per one tan of C-Gear gillnet.

Details about each gillnet operation are shown in Table 1.

Surface Long-line Research

Two surface long-line researches were conducted to collect salmonids during the Cruise #039 and #040-Leg4. [Fig.1.1, 1.2]

The long-line consisted of 20 or 30 baskets (hachi). One basket was 110.68 m long with 49 hooks baited with Japanese common squid (*Todarodes pacificus*). The catch was sorted by species and counted.

Details about each surface long-line operation are shown in Table 2.

Hook-and-Line Sampling

To collect fresh salmon blood, otoliths and various tissues, hook-and-line gears were used at seven research stations during the Cruise #039 and #040-Leg2, 4 [Fig.1.1, 1.2].

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.

Details about each hook-and-line operation are shown in Table 2.

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. Otoliths were also extracted for analysis of the hatch code. For the salmonids that had clipped fins, their snouts were 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.

Sockeye salmon (*Oncorhynchus nerka*), chum salmon (*Oncorhynchus keta*) and steelhead (*Oncorhynchus mykiss*) were 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

Along the 155°E Longitude Line: during the Cruise #039 in May 2017

Oceanographic Conditions

Temperature and salinity sections (0-500db) along the 155°E longitude line transect are shown in Figure 2.1, 2.2.

The Polar Front which is indicated by the vertical 4°C isotherm was observed in the vicinity of south of 44°N, nearly the same position of the last year [Fig.2.1]. The Subarctic Boundary which is indicated by the vertical 34.0 psu isohaline could not be determined as it appeared vaguely [Figure 2.2] while it was clearly found in the north of 41°N the last year.

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 the stations during the cruise #39 are shown in Table 4.

Four drift gillnets survey were conducted along the 155°E in the Subarctic Waters during the cruise #39 in May 2017. [Fig.1.1, Tables 1]. A total of 33 chum salmon (*Oncorhynchus keta*), and 1888 pink salmon (*Oncorhynchus gorbuscha*) were collected by C-gear gillnet during the cruise #039. The CPUE value of pink salmon was high throughout the survey. Non-salmonid fishes caught by C-gear gillnet

were also shown in Table 4.

Biological Characteristics of Salmonids

F.L. frequency distributions of pink salmon caught by C-gear gillnet along the 155°E are shown in Fig.3.

684 Pink salmon out of the total 1888 by C-gear gillnet were measured. Their F.L. ranged between 322-495 mm. Mean \pm SD of them was 399.9 ± 20.7 mm, and median was 399 mm. All of these values with regard to the size of Pink salmon were higher than these of last year.

Surface Long-line Research and Hook-and-Line Samplings (Cruise#039 and #040)

The catch number of salmonids at each station by hook-and-line gear and surface long-line is shown in Table 5.

By surface long-line and hook-and-line gear, a total of 19 Chum and 403 Pink salmon were collected at 155°E research line during the Cruise #039 (OSSL1701, OSHL1601-04) and 18 Sockeye, 6 Chum, 61 Pink, 3 Coho and 1 Chinook salmon were collected during the Cruise #040

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REFERENCES

- Davis, N. D., K. W. Myers, R. V. Walker, and C. Harris. 1990: The Fisheries Research Institute's high-seas salmonids tagging program and methodology for scale pattern analysis. *Am. Fish. Soc. Symp.*, 7: 863-879.
- Dodimead, A. J., F. Favorite, T. Hirano. 1963: Salmon of the North Pacific Ocean. Part II. Review of oceanography of the subarctic Pacific region. *Int. North Pacific Fish. Comm. Bull.* 13: 1-195.
- Favorite, F., A. J. Dodimead, K. Nasu. 1976: Oceanography of the Subarctic Pacific region. *Int. North Pacific Fish. Comm. Bull.* 33: 1-187.
- Hokkaido University. 1957-2010. *Data Record of Oceanographic and Exploratory Fishing Numbers 1-55(1957-2012)*. Faculty of Fisheries, Hokkaido University, Hakodate, Japan.
- Meguro, T., Kajiwarra, Y., Takagi, S., Kamei, Y., Sakaoka, K., and Kimura J. 2004: Results of 2003 Salmon Research Cruise of the *Oshoro maru*. *NPAFC. Doc.* 748: 15p

- Roden, G. I. 1991: Subarctic-Subtropical Transition Zone of the North Pacific: Large-Scale Aspects and Mesoscale Structure. In *Biology Oceanography and Fisheries of the North Pacific Transition Zone and Subarctic Frontal Zone*, ed. by J.A. Wetherall, *NOAA Tech. Rep.*, 105:1-38.
- Takagi, K. 1975: A non-selective salmon gillnet for research operation. *Bull. Int. North Pacific. Fish. Comm.*, 32, 13-41.
- Takagi, K. 1961: The seasonal change of gonad weight of sockeye and chum salmon in the North Pacific Ocean, especially with reference to mature and immature fish. *Bull. Hokkaido Reg. Fish. Res. Lab.* 23, 17-34.

Table 1. Position and research conditions of surface drift gillnet sampling at each station during the *Oshoro maru* Cruise #039, 2017.

Station	Date and Time (S.M.T.*1)				T.D.*2	Set Position		D.S.*3	bottom depth(m)	Wr*4	Wind (Force)	S.T.*5 (°C)
	Net set		Net haul			Lat.	Long.					
OSG 1701	May 15	1750-1812	May 16	0457-0601	+10h	43-56.0N	155-00.0 E	300	5329	o	NE-4	5.6
OSG 1702	May 16	1755-1820	May 17	0500-0627	+10h	43-15.0N	155-00.4 E	030	5465	o	SE-6	7.0
OSG 1703	May 17	1800-1823	May 18	0458-0609	+10h	42-00.3N	155-00.1 E	140	5407	o	WNW-5	6.9
OSG 1704	May 18	1752-1813	May 19	0456-0552	+10h	40-14.2N	155-00.2 E	115	5545	o	WNW-4	12.9

Table 2. Position and research conditions of surface long-line and hook-and-line sampling at each station during the *Oshoro maru* Cruise #039 and #040, 2017.

Station	Date and Time (S.M.T.*1)				T.D.*2	Set Position		D.S.*3	Number of baskets	bottom depth(m)	Wr*4	Wind (Force)	S.T.*5 (°C)
	Line set		Line haul			Lat.	Long.						
Cruise #039													
OSSL1701	May 18	0400-0430	May 18	0632-0746	+10h	41-55.0N	155-01.6E	310	20	5425	o	NW-5	6.8
OSHL1701	May 15	2000	May 16	0300	+10h	44-00.0N	155-00.0E	-	-	5285	o	ESE-2	4.0
OSHL1702	May 16	2055	May 17	0400	+10h	43-14.7N	155-00.3E	-	-	5469	r	ESE-6	7.1
OSHL1703	May 17	2200	May 18	0300	+10h	42-02.8N	154-59.2E	-	-	5507	o	WNW-5	6.8
OSHL1704	May 18	2000	May 19	0400	+10h	40-14.2N	155-00.4E	-	-	-	o	NW-4	13.0
Cruise #040													
OSSL1702	Jul. 21	0350-0420	Jul. 21	0550-0715	-11h	62-09.9N	170-31.3W	110	30	47	f	West-2	9.7
OSHL1705	Jun. 29	2230	Jun. 30	0230	-12h, -11h	51-56.1N	171-45.9W	-	-	-	d	South-2	6.7
OSHL1706	Jul. 02	0100	Jul. 02	0505	-10h	52-25.1N	169-53.9W	-	-	-	o	SW-4	8.9
OSHL1707	Jul. 21	0000	Jul. 21	0300	-11h	62-10.0N	170-30.2W	-	-	47	f	West-2	9.7

Table 3. List of oceanographic station during the *Oshoro maru* Cruise #039 and #040 2017.

Station	Date and Time (S.M.T.*1)			T.D.*2	Set Position		Remark CTD	CTD depth(db)
					Lat.	Long.		
C039								
OS 17020	May 15	1848		+10h	44-00.0N	155-00.1E	Sea-Bird SBE 9	5300
OS 17022	May 16	1507		+10h	43-15.0N	155-00.0E	Sea-Bird SBE 9	5500
OS 17023	Mar 17	1415		+10h	42-29.9N	154-59.9E	Tsurumi-Seiki XCTD4	-
OS 17024	May 17	1856		+10h	42-00.7N	155-00.6E	Sea-Bird SBE 9	5400
OS 17025	May 18	0851		+10h	41-45.1N	154-59.9E	Tsurumi-Seiki XCTD4	-
OS 17026	May 18	1330		+10h	40-59.9N	154-59.9E	Tsurumi-Seiki XCTD4	-
OS 17027	May 18	1856		+10h	40-14.8N	155-00.0E	Sea-Bird SBE 9	5500
C040								
OS 17070	Jun 30	2235		-12h	51-56.2N	171-45.9W	Sea-Bird SBE 9	800
OS 17193	Jul 02	0355		-10h	52-23.2N	169-54.0W	Sea-Bird SBE 9	800
OS 17272	Jul 21	0942		-11h	62-11.0N	170-30.0E	Sea-Bird SBE 9	1500

Note: For all the observations conducted by XCTD4 the depth is measured based on the speed of the probe in free fall.

*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 or line set.

*4 Wr. : Weather (bc:25-74%clouded, c: 75-99% clouded, o: 100% clouded, f: fog, r: rain, d: drizzle).

*5 S.T. : Surface temperature

Table 4. The number of organisms caught by drift gillnet during the *Oshoro maru* Cruise # 039, in May, 2017. CPUE and (%) indicate numerical catch per tan and percentage of total catch by C-gear gillnet at the station, respectively.

Common name	Scientific name	Station				OSG 1701				OSG 1702				OSG 1703				OSG 1704			
		Gear		A	Total	C		A	Total	C		A	Total	C		A	Total	C		A	Total
		CPUE	(%)			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	0	0	0.0 (0.0)	0	0
Chum salmon	<i>Oncorhynchus keta</i>	12	0.4 (1.6)	3	15	8	0.3 (1.5)	5	13	12	0.4 (1.9)	5	17	1	0.0 (0.3)	3	4	1	0.0 (0.3)	3	4
Pink salmon	<i>Oncorhynchus gorbuscha</i>	736	24.5 (97.9)	6	742	541	18.0 (98.2)	1	542	611	20.4 (97.4)	1	612	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	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	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	0	0	0.0 (0.0)	0	0
Tufted Puffin	<i>Fratercula cirrhata</i>	0	0.0 (0.0)	1	1	1	0.0 (0.2)	0	1	2	0.1 (0.3)	0	2	0	0.0 (0.0)	0	0	0	0.0 (0.0)	0	0
Boreal clubhook squid	<i>Orychoteuthis borealijaponica</i>	0	0.0 (0.0)	0	0	1	0.0 (0.2)	0	1	0	0.0 (0.0)	0	0	23	0.8 (7.7)	0	23	0	0.0 (0.0)	0	23
Boreopacific gonate squid	<i>Gonatopsis borealis</i>	4	0.133 (0.5)	0	4	0	0.0 (0.0)	0	0	0	0.0 (0.0)	0	0	2	0.1 (0.7)	0	2	0	0.0 (0.0)	0	2
Neon flying squid	<i>Ommastrephes 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 (0.0)	0	0	0	0.0 (0.0)	1	1
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	29	0.967 (9.7)	2	31	0	0.0 (0.0)	0	31
Albacore tuna	<i>Thunnus alalunga</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	0.0 (0.0)	0	0
Blue shark	<i>Prionace glauca</i>	0	0.0 (0.0)	0	0	0	0.0 (0.0)	0	0	0	0.0 (0.0)	0	0	1	0.033 (0.3)	0	1	0	0.0 (0.0)	0	1
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	0	0.0 (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	0.0 (0.0)	0	0	0	0.0 (0.0)	0	0	0	0.0 (0.0)	1	1
Club mackerel	<i>Scomber japonicus</i>	0	0.0 (0.0)	0	0	0	0.0 (0.0)	0	0	2	0.067 (0.3)	0	2	240	8.0 (80.5)	5	245	0	0.0 (0.0)	0	245
Spotline sardine	<i>Sardinops melanostictus</i>	0	0.0 (0.0)	0	0	0	0.0 (0.0)	0	0	0	0.0 (0.0)	0	0	2	0.067 (0.7)	0	2	0	0.0 (0.0)	0	2

Table 5. The catch number of each salmonid at each station where salmonids were collected by hook-and-line gear, surface long-line in the *Oshoro maru* Cruise # 039 and #040, 2017.

Station Name	Sampling gear	Species name						Total
		Sockeye	Chum	Pink	Coho	Chinook	Stellhead	
Cruise #039								
OSSL 1701	Surface longline	0	4	77	0	0	0	81
OSHL 1701	Hook-and-line	0	1	12	0	0	0	13
OSHL 1702	Hook-and-line	0	0	29	0	0	0	29
OSHL 1703	Hook-and-line	0	9	285	0	0	0	294
OSHL 1704	Hook-and-line	0	5	0	0	0	0	5
Total		0	19	403	0	0	0	422
Cruise #040								
OSSL 1702	Surface longline	9	3	13	2	1	0	28
OSHL 1705	Hook-and-line	0	0	16	0	0	0	16
OSHL 1706	Hook-and-line	9	3	28	1	0	0	41
OSHL 1707	Hook-and-line	0	0	4	0	0	0	4
Total		18	6	61	3	1	0	89

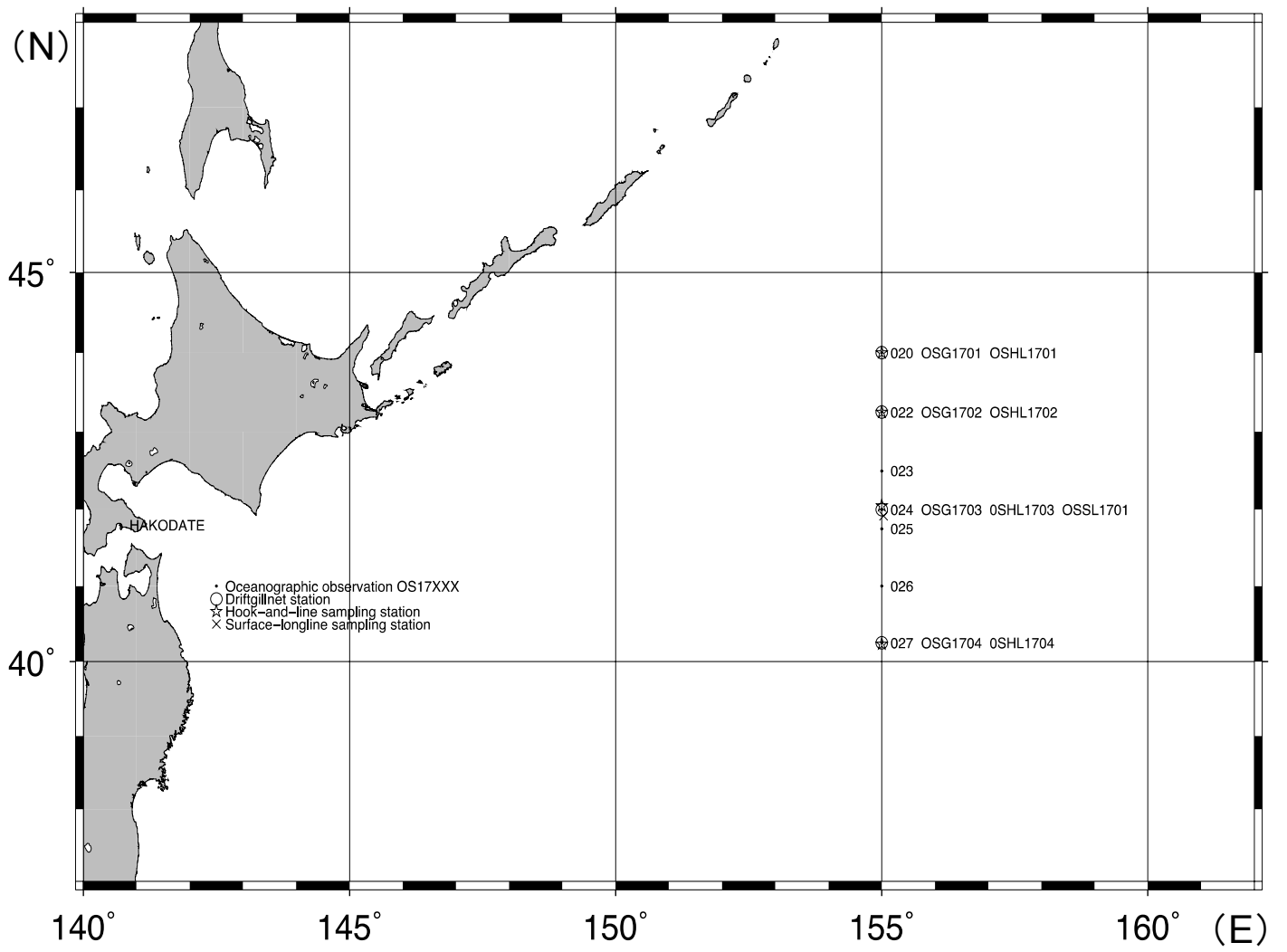


Fig.1.1 Salmon research stations during the *Oshoro maru* Cruise # 039

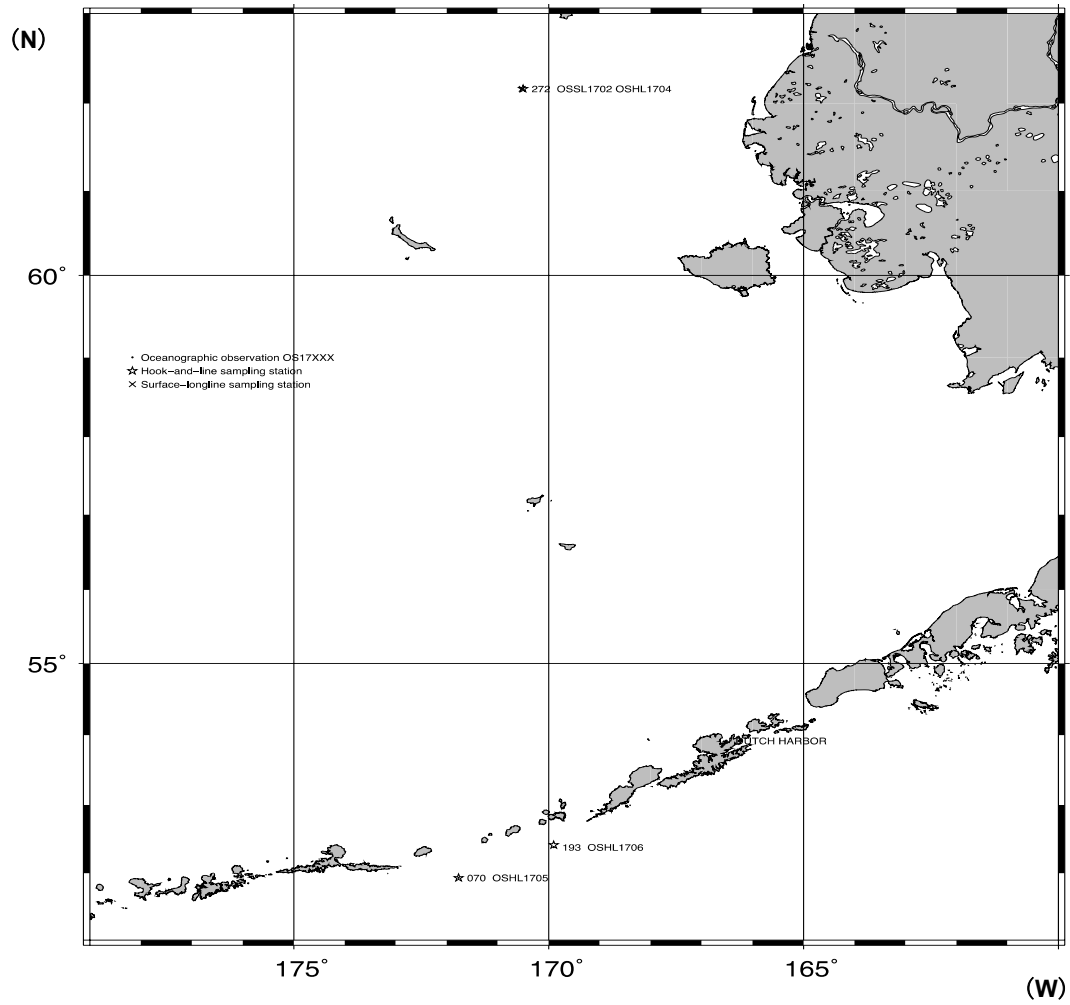


Fig.1.2 Salmon research stations during the *Oshoro maru* Cruise # 040

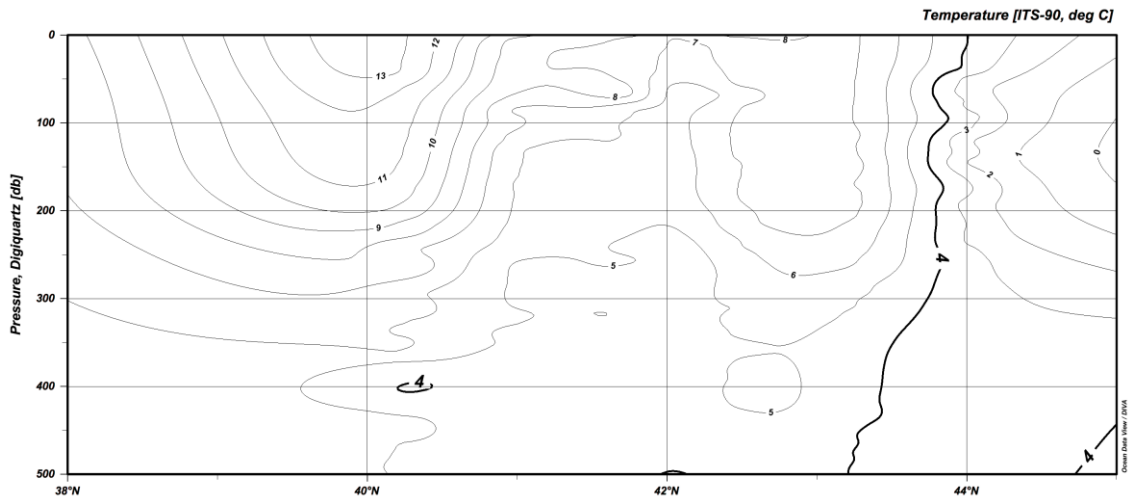


Fig.2.1 Temperature from surface to 500 db pressure along the 155°E transect during the *Oshoro maru* Cruise #039 in May, 2017.

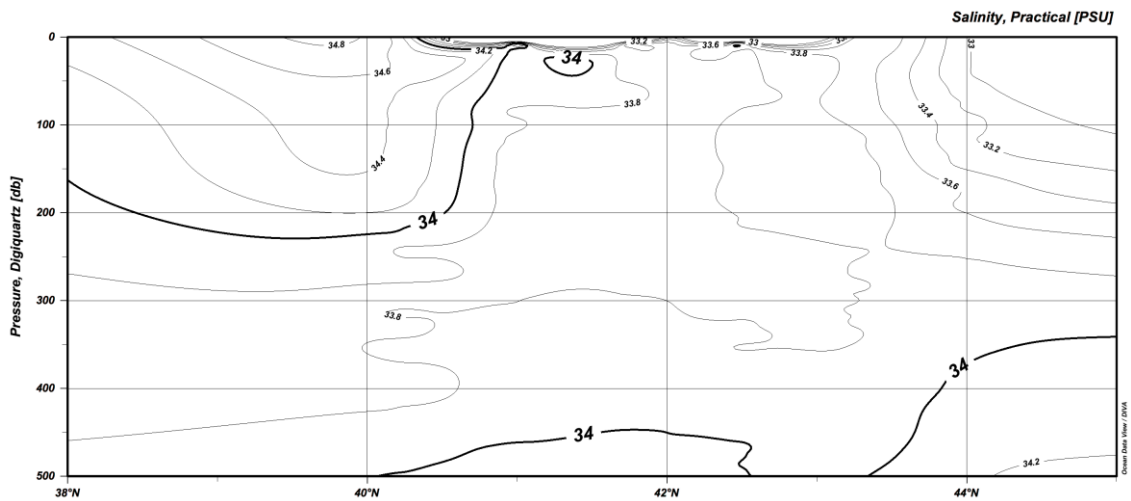


Fig.2.2 Salinity from surface to 500 db pressure along the 155°E transect during the *Oshoro maru* Cruise #039 in May, 2017.

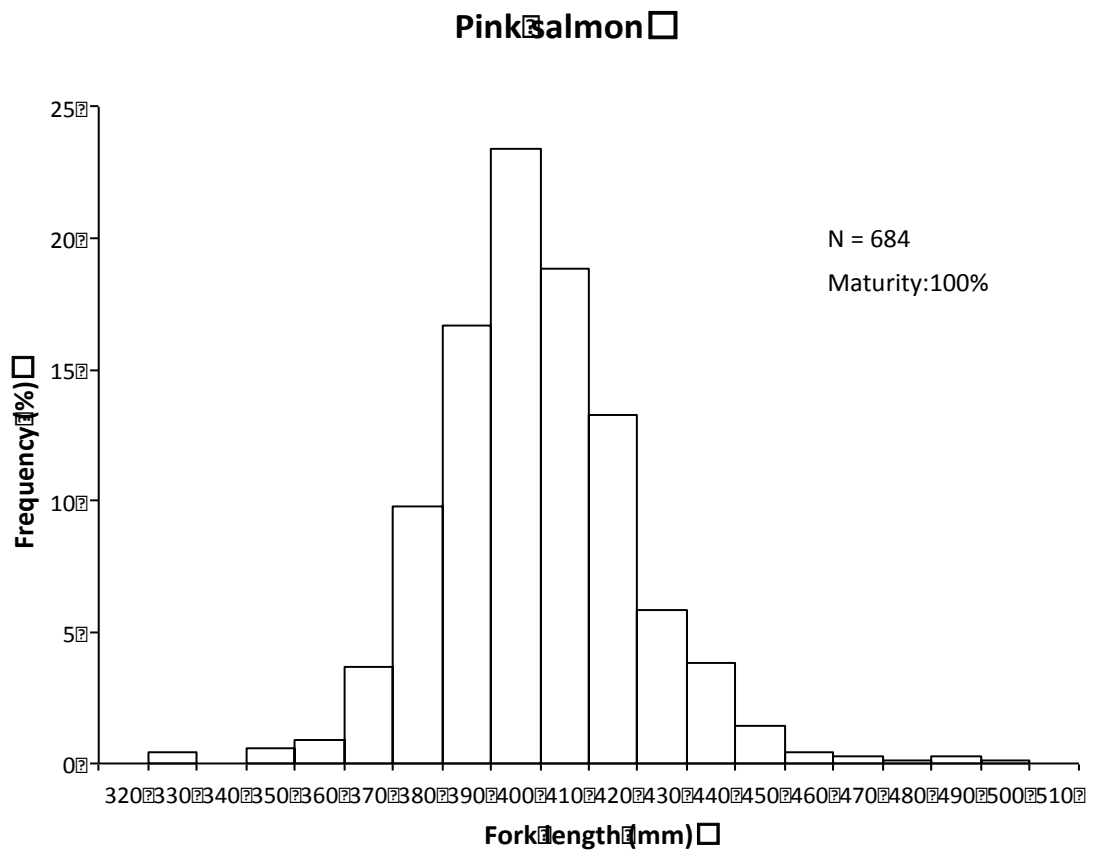


Fig.3 Fork length frequency of pink salmon caught by C-gear gillnet along the 155°E during the *Oshoro maru* Cruise #039 in May, 2017.