NPAFC
Doc. 1820
Rev.

Results of 2018 Salmon Research by the *Oshoro maru*

by

Taichi Sato, Yuta Inagaki, Keiichiro Sakaoka, Keiri Imai,
Maki Ohwada, Kenji Oguma, Kouki Sawada, and Shogo Takagi

T/V *Oshoro maru*
Graduate School of Fisheries Sciences and Faculty of Fisheries, Hokkaido University,
3-1-1 Minato-cho, Hakodate 041-8611, Japan

Submitted to the

NORTH PACIFIC ANADROMOUS FISH COMMISSION

by

Japan

March 2019

THIS PAPER MAY BE CITED IN THE FOLLOWING MANNER:
Sato T., Y. Inagaki, K. Sakaoka, K. Imai, M. Ohwada, K. Oguma, K, Sawada, and S. Takagi. 2019. Results of 2018 salmon research by the *Oshoro maru*. NPAFC Doc. 1820. 11 pp. T/V *Oshoro maru*, Graduate School of Fisheries Sciences and Faculty of Fisheries, Hokkaido University (Available at https://npafc.org).

Keywords: salmon, gillnet, 155°E longitude line

Abstract

In order to accumulate oceanographic and biological data (including salmonids) and to clarify the oceanic structure and marine ecosystem, T/V *Oshoro maru* conducted oceanographic observations and fishing surveys in the western North Pacific (along with the 155°E longitude line) and the Bering Sea. The survey was conducted during the cruise #054 in May, and cruise #056-Leg1 in June 2018.

Oceanographic observations and drift gillnet surveys were conducted along the 155°E during the cruise #054. Due to the unfavorable weather, only one drift gillnet survey was conducted, and no observation or survey was made from 41°45'N southward throughout the cruise this year.

A total of 357 salmonids was caught by gillnet survey, including 355 pink, 2 chum salmon. Other species such as steelhead and sockeye salmon were not caught during the cruise#054. The fork lengths (F.L.) of pink salmon collected by C-gear gillnet were all adult fish ranging between 318–406 mm.

To collect salmon samples including fresh salmon blood, otoliths, and various tissues extensively three hook-and-line gear samplings were conducted during the Cruise #056-Leg1 as well as the cruise #054. The predominant species caught by hook-and-line gear samplings during the cruise #056-Leg-1 were pink salmon (84 pink, 74 sockeye, 60 chum).

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.
Salmon researches were conducted during a cruise in May 2018: the *Oshoro maru* Cruise #054 in the Western North Pacific and in June 2018: the *Oshoro maru* cruise #056-Leg1, in the Bering Sea.
Primary salmon research objectives 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 11th May 2018 and started the cruise #054. Oceanographic observations, gillnet surveys, surface long-line, and hook-and-line samplings were conducted along the 155°E longitude between 44°N and 41°45'N latitude from 14th to 18th and returned to Hakodate on 22nd May.
The cruise #056-Leg1 started on 14th June when she left Tokyo. Salmon research was conducted from 23rd to 25th June and entered the port of Dutch Harbor on 26th. [Table 1, 2, Fig.1.1, Fig.1.2]

Oceanographic observation
Seven oceanographic observations were conducted from 44°N to 41°45'N along the 155°E longitude line. [Table 3, Fig.1.1] The temperature and salinity data at each station were collected by CTD. Temperature and salinity data from a surface to 500db along the 155°E longitude line were used to plot sectioned diagram on temperature and salinity during the Cruise #054. [Fig.2.1, 2.2] Three oceanographic observations at salmon sampling stations were conducted during the cruise #056-Leg1 [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	181	121	48	55	63	72	82	93	106	121	138	157	
OSG1801	Number of tan	3	3	3	3	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 (special mesh) was not used this year. 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 surfaces long-line research was conducted to collect salmonids during Cruise #054. [Fig.1.1, Table 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 #054 and #056-Leg1. [Fig.1.1, Table 2].
Three to ten anglers 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 age, growth, and stock origin studies. Otoliths were also extracted for analysis of the hatch code. Additional research activities included a 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 pink salmon (*Oncorhynchus gorbuscha*) 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 cruise #054 in May 2018

Oceanographic Conditions

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

The Polar Front indicated by the vertical 4°C isotherm appears to sit without conspicuous shift from the last year (Sato, T., K. Sakaoka, Y. Kajiwara, K. Imai, N. Hoshi, M. Ohwada, Y. Inagaki, and S. Takagi., 2018) in the vicinity of 44°30'N [Fig.2.1]. The Subarctic Boundary indicated by the vertical 34.0psu isohaline is also seen with little positional difference from the last year (Sato et al., 2018) [Fig. 2.2].

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 cruise #54 are shown in Table 4.

One drift gillnet survey was conducted along the 155°E in the Subarctic Waters during the cruise #54 in May 2018. [Fig.1.1, Tables 1]. A total of 2 chum salmons (*Oncorhynchus keta*), and 355 pink salmons (*Oncorhynchus gorbuscha*) were collected by C-gear gillnet during the cruise #054. The CPUE value of pink salmon is lower than last year (Sato et al., 2018). 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.

250 pink salmon out of the total 355 by C-gear gillnet were measured. Their F.L. ranged

between 318-406 mm. Mean ± SD of them was 363.9 ± 14.8 mm, and the median was 365 mm. All of these values with regard to the size of Pink salmon were lower than those of last year (Sato et al., 2018).

Surface Long-line Research and Hook-and-Line Samplings (Cruise#054)
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 2 Chum and 228 Pink salmons were collected at 155°E research line during the cruise #054 (OSSL1801, 1802, OSHL1801-04) and 74 Sockeye, 60 Chum, and 84 Pink were collected during the cruise #056.

ACKNOWLEDGMENTS

We thank all of the crew and other staff of the *Oshoro maru* for their outstanding assistance and cooperation in sampling and data collection even when under severe conditions.

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, pp.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, pp.1–195.

Favorite, F., A. J. Dodimead, K. Nasu. 1976: Oceanography of the Subarctic Pacific region. *Int. North Pacific Fish. Comm. Bull.* 33, pp.1–187.

Meguro, T., Kajiwara, Y., Takagi, S., Kamei, Y., Sakaoka, K., and Kimura J. 2004: *Results of 2003 Salmon Research Cruise of the Oshoro maru*. *NPAFC. Doc.* 748, p.15.

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, pp.1–38.

Takagi, K. 1975: A non-selective salmon gillnet for research operation. *Bull. Int. North Pacific. Fish. Comm*., 32, pp.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, pp.17–34.

Sato, T., K. Sakaoka, Y. Kajiwara, K. Imai, N. Hoshi, M. Ohwada, Y. Inagaki, and S. Takagi. 2018: *Results of 2017 salmon research by the Oshoro maru*. NPAFC. Doc. 1760, p.11.

Table 1. Position and research conditions of surface drift gillnet sampling at each station during the *Oshoro maru* Cruise #054, 2018.

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 1801	May 16 1753-1808	May 17 0457-0601	+10h	43-33.7N	154-57.3 E	325	5402	o	NW-6	6.5

Table 2. Position and research conditions of surface long-line and hook-and-line sampling at each station during the *Oshoro maru* Cruise #054 and #056-Leg1, 2018.

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 #054													
OSSL1801	May 17	0422-0432	May 17	0626-0658	+10h	43-40.9N	155-07.9E	350	10	5400	o	West-2	7.0
OSSL1802	May 17	1224-1242	May 17	1455-1555	+10h	43-15.1N	154-58.9E	040	20	5460	f	SW-5	9.5
OSHL1801	May 14	1015	May 14	1620	+10h	44-00.0N	155-00.0E	-	-	-	o	SE-4	3.8
OSHL1802	May 15	1400	May 15	1700	+10h	43-35.9N	154-56.4E	-	-	5400	o	South-5	6.5
OSHL1803	May 16	1840	May 17	0310	+10h	43-35.9N	154-56.4E	-	-	5409	o	NW-5	5.5
OSHL1804	May 17	2000	May 18	0000	+10h	42-51.5N	155-00.1E	-	-	5319	r	SW-5	8.4
Cruise #056-Leg1													
OSHL1805	Jun. 23	2115	Jun. 24	0345	-11h	53-53.7N	174-10.6W	-	-	-	d	SE-4	6.7
OSHL1806	Jun. 24	2115	Jun. 25	0400	-11h, -10h	54-16.8N	170-58.0W	-	-	-	d	ESE-5	7.4
OSHL1807	Jun. 25	2100	Jun. 26	0330	-10h	54-22.3N	166-53.9W	-	-	615	o	SSW-4	6.9

Table 3. List of oceanographic station during the *Oshoro maru* Cruise #054 and #056-Leg1, 2018.

Station	Date and Time (S.M.T.*1)		T.D.*2	Set Position		Remark CTD	CTD depth(db)
				Lat.	Long.		
Cruise #054							
OS 18019	May 14	1019	+10h	43-59.9N	154-59.9E	Sea-Bird SBE 9	5000
OS 18020	May 14	1511	+10h	43-59.7N	154-58.0E	Sea-Bird SBE 9	200
OS 18021	May 17	1844	+10h	43-35.9N	154-56.4E	Sea-Bird SBE 19	550
OS 18022	May 17	1300	+10h	43-17.1N	155-01.2E	Sea-Bird SBE 19	550
OS 18023	May 17	2000	+10h	42-51.5N	155-00.1E	Sea-Bird SBE 19	550
OS 18024	May 18	0310	+10h	42-30.1N	155-00.0E	Sea-Bird SBE 19	570
OS 18025	May 18	0855	+10h	41-45.0N	154-59.7E	Sea-Bird SBE 19	550
Cruise#056-Leg1							
OS 18031	Jun 23	2055	-11h	53-53.7N	174-10.5W	Sea-Bird SBE 19	510
OS 18032	Jun 24	2055	-11h	54-16.9N	170-57.7W	Sea-Bird SBE 19	500
OS 18033	Jun 25	2040	-10h	54-22.1N	166-53.9W	Sea-Bird SBE 19	510

*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 # 054, in May 2018. CPUE and (%) indicate numerical catch per tan and percentage of total catch by C-gear gillnet at the station, respectively.

Common name	Station / Gear / Scientific name	OSG 1801				
		C			A	Total
			CPUE	(%)		
Sockeye salmon	*Oncorhynchus nerka*	0	0.0	(0.0)	0	0
Chum salmon	*Oncorhynchus keta*	2	0.1	(0.5)	0	2
Pink salmon	*Oncorhynchus gorbuscha*	355	11.8	(97.3)	0	355
Coho salmon	*Oncorhynchus kisutch*	0	0.0	(0.0)	0	0
Chinook salmon	*Oncorhynchus tshawytscha*	0	0.0	(0.0)	0	0
Steelhead	*Oncorhynchus mykiss*	0	0.0	(0.0)	0	0
Boreal clubhook squid	*Onychoteuthis borealijaponica*	4	0.1	(1.1)	0	4
Boreopacific gonate squid	*Gonatopsis borealis*	1	0.03	(0.3)	0	1
Salmon shark	*Lamna ditropis*	1	0.03	(0.3)	0	1
Chub mackerel	*Scomber japonicus*	2	0.1	(0.5)	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 # 054 and #056-Leg1, 2018.

Station Name	Sampling gear	Species name						Total
		Sockeye	Chum	Pink	Coho	Chinook	Steelhead	
Cruise #054								
OSSL 1801	Surface longline	0	1	38	0	0	0	39
OSSL 1802	Surface longline	0	0	9	0	0	0	9
OSHL 1801	Hook-and-line	0	0	2	0	0	0	2
OSHL 1802	Hook-and-line	0	0	21	0	0	0	21
OSHL 1803	Hook-and-line	0	0	111	0	0	0	111
OSHL 1804	Hook-and-line	0	1	47	0	0	0	48
Total		0	2	228	0	0	0	230
Cruise #056-Leg1								
OSHL 1805	Hook-and-line	20	10	33	0	0	0	63
OSHL 1806	Hook-and-line	31	42	43	0	0	0	116
OSHL 1807	Hook-and-line	23	8	8	0	0	0	39
Total		74	60	84	0	0	0	218

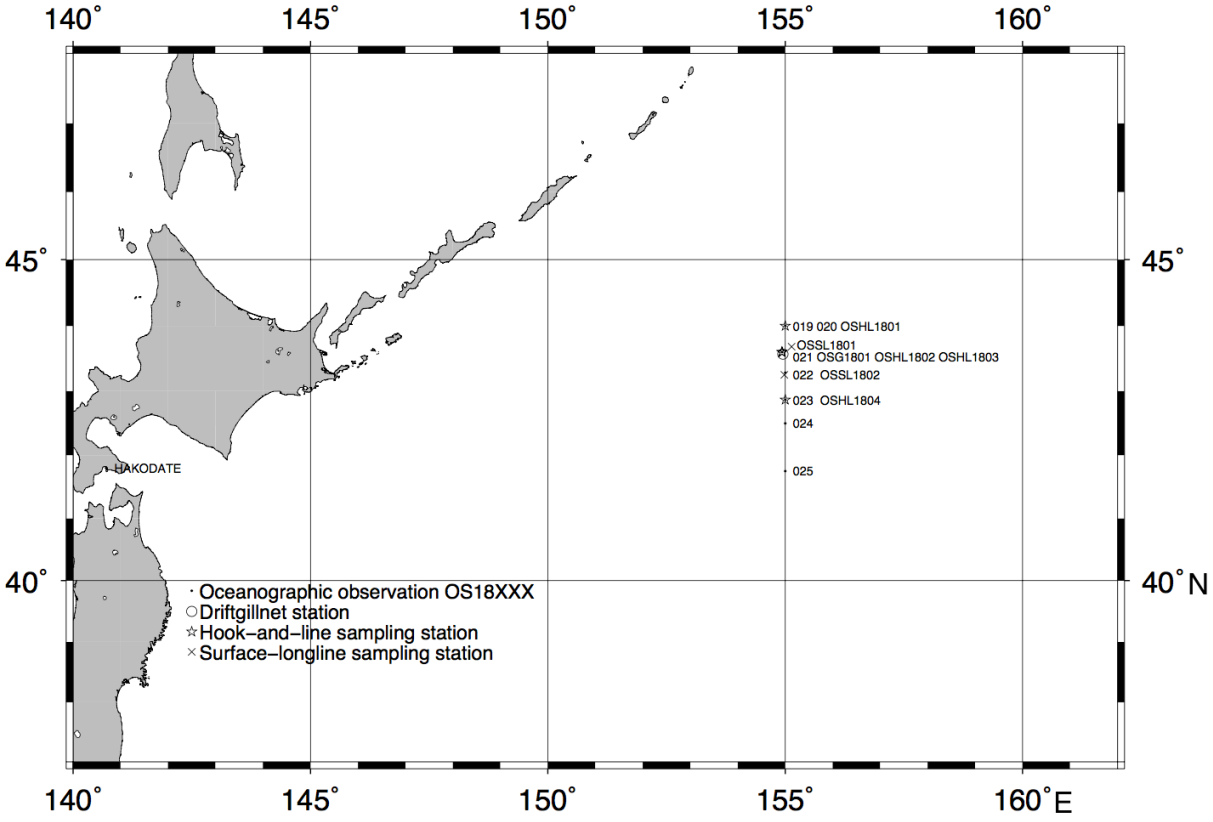

Fig. 1.1. Salmon research stations during the *Oshoro maru* Cruise # 054

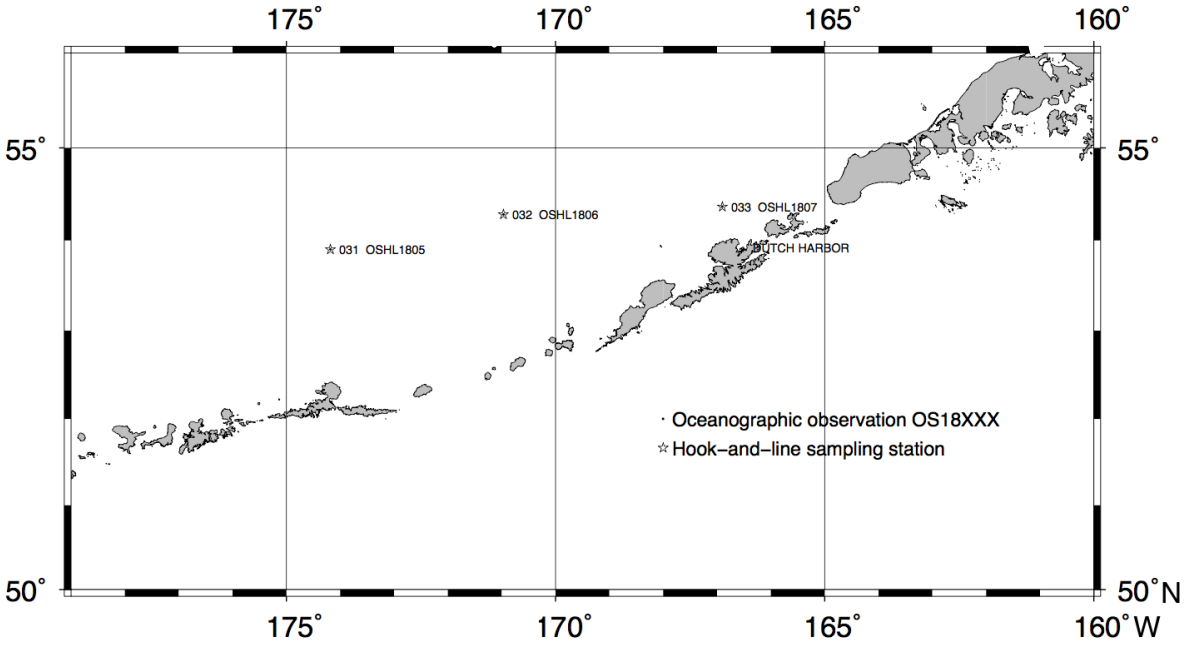

Fig. 1.2. Salmon research stations during the *Oshoro maru* Cruise # 056-Leg1

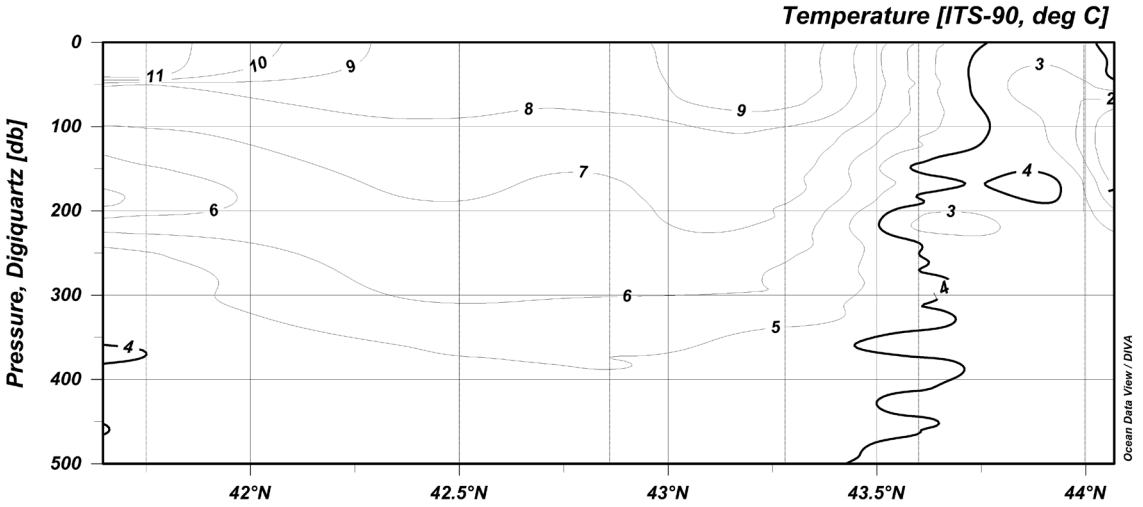

Fig. 2.1. Cross section of temperature from surface to 500 db pressure along the 155°E during the *Oshoro maru* Cruise #054 in May 2018. (Drawn by Ocean Data View ver.4.7.10)

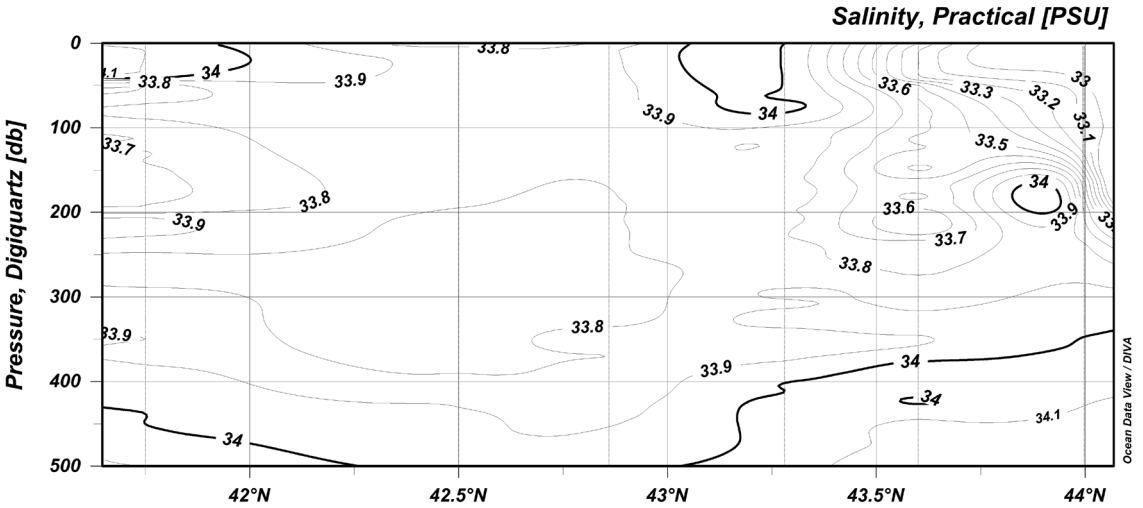

Fig. 2.2. Cross section of salinity from surface to 500 db pressure along the 155°E during the Oshoro maru Cruise #054 in May 2018. (Drawn by Ocean Data View ver.4.7.10)

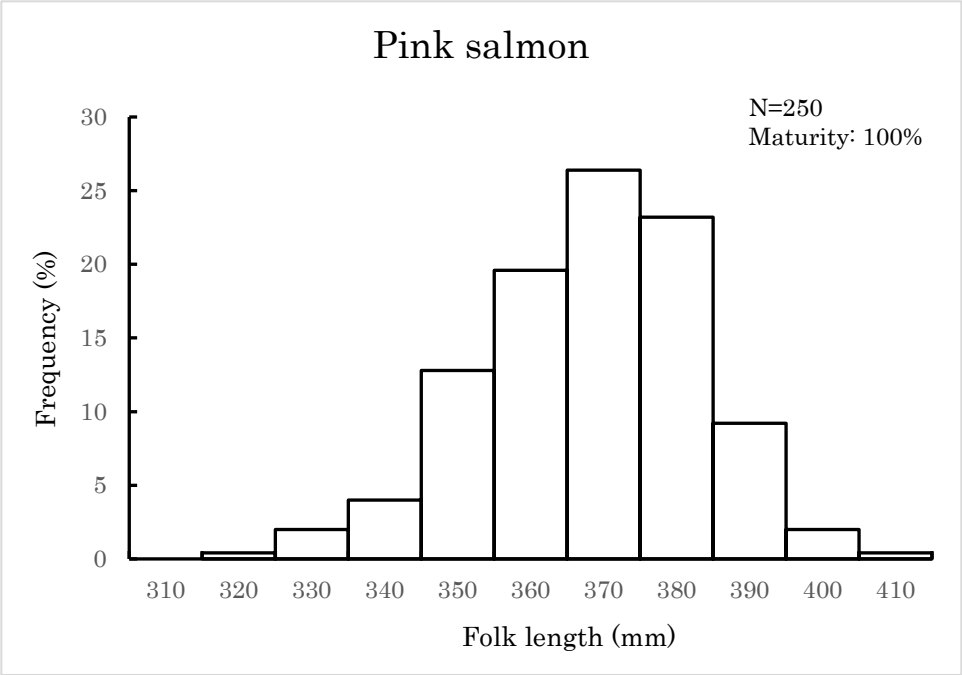

Fig. 3. Fork length frequency of pink salmon caught by C-gear gillnet along the 155°E during the *Oshoro maru* Cruise #054 in May 2018.