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Results of 2021 Salmon Research by T/V *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, T/V *Oshoro maru* set sail for oceanographic observations and fishing surveys in the Western North Pacific Ocean in May 2021. During the cruise "*Oshoro maru* cruise #104, 2021", oceanographic observations and drift gillnet surveys were conducted at several research stations lying on the diagonal line between 42°30'N, 152°00'E to 41°00'N,150°00'E. Typically this survey would be conducted along longitude 155°00'E, however, due to bad weather the survey location had to be moved.

We were able to conduct two gillnet surveys at different stations during the cruise, whereas none of the gillnet survey was made in 2020 due to the COVID-19 pandemic.

A total of 977 salmonids was caught by the survey, including 974 pink, three chum salmons. Other species such as coho, steelhead, and sockeye salmon were not caught during the cruise. The fork lengths (F.L.) of pink salmon collected by C-gear gillnet were all adult fish ranging between 302-466 mm.

To collect salmon samples including fresh salmon blood, otoliths and various tissues extensively two surface long-line samplings and three hook-and-line gear samplings were also conducted during the T/V *Oshoro maru* cruise #104, 2021.

INTRODUCTION

Salmon researches were conducted during the cruise in May 2021: T/V *Oshoro maru* Cruise #104 in the Western North Pacific.

Primary salmon research objectives during the cruise were

1. To collect oceanographic and biological data continuously at each research station.
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 2021 to start the cruise #104. Oceanographic observations, gillnet surveys, surface long-line and hook-and-line samplings were conducted in the area shown in Fig.1 from 13th to 16th, and returned to Hakodate on 19th May.

Oceanographic observation

Oceanographic observations were conducted at 8 stations lying on the diagonal line between 42°30'N, 152°00'E to 41°00'N,150°00'E. [Fig.1]

The temperature and salinity data at each station were collected by CTD. [Table 3]

Drift Gillnet Research

One set of a drift gillnet was used to collect salmonids and the other organisms at the research stations. [Fig.1]

The gillnet configuration at the station was as follows:

Stations	net	A-Gear					C-gear										Total
	Mesh size (mm)	72	82	93	112	115	48	55	63	72	82	93	106	121	138	157	
OSG2101~2	Number of tan	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	49

The net was total 49 tans which comprised of 30 tans of C-Gear gillnet (non-selective varied research mesh, Takagi, 1975) and 19 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 surface long-line researches were conducted to collect salmonids during the *Oshoro maru* cruise #104, 2021. [Fig.1]

The long-line consisted of 10 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 four research stations during the *Oshoro maru* cruise #104, 2021. [Fig.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.

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.

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 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

Oceanographic Conditions

Eight CTD observations were conducted at the stations shown in Fig.1. The results are shown in Fig.2 and Fig.3.

The surface temperature at the northern-most observation point (st.G1) varied between 4-5°C and was the point with the lowest salinity throughout the entire survey. The mid points of the survey (st.G2, C2) had comparatively higher temperature and salinity compared to point st.G1. However, at the southern-most observation point(st.G3) the temperature dropped again.

The data shows that the northern observation points display sub-arctic properties, with the southern observation points appearing to be the transitional domain to a subtropical zone. This suggests that the survey area is a complex water mass distribution with the presence of eddy.

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 *Oshoro maru* cruise #104, 2021 are shown in Table 4.

Two drift gillnet survey was conducted at St.G1and St.G3 [Fig.1, Table 1] and a total of 1 chum salmon (*Oncorhynchus keta*), and 408 pink salmons (*Oncorhynchus gorbuscha*) were collected by C-gear gillnet during the *Oshoro maru* cruise #104, 2021.

Non-salmonid fish 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 during the cruise are shown in Fig.4.

324 pink salmons out of the total 408 by C-gear gillnet were measured. Their F.L. ranged between 302-466 mm. Mean ± SD of them was 384.2 ± 21.6mm, and median was 384 mm.

Surface Long-line Research and Hook-and-Line

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 596 pink salmons were collected during the *Oshoro maru* cruise #104, 2021.

ACKNOWLEDGMENTS

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Table 1. Positions and research conditions of surface drift gillnet sampling at each station during the *Oshoro maru* Cruise #104, 2021.

Station	Date and Time (S.M.T.*1)		T.D.*2	Set Position		D.S.*3	bottom	Wr*4	Wind	S.T.*5
	Net set	Net haul		Lat.	Long.		depth(m)		(Force)	(°C)
OSG 2101	May 13 1757-1815	May 14 0451-0555	+10h	42-28.2N	151-59.9E	025		c	SE-3	5.2
OSG 2102	May 15 1752-1811	May 16 0515-0623	+10h	40-59.3N	150-00.2E	225		f	NNE-4	8.4

Table 2. Positions and research conditions of surface long-line and hook-and-line sampling at each station during the *Oshoro maru* Cruise #104 , 2021.

Station	Date and Time (S.M.T.*1)				T.D.*2	Set Position		D.S.*3	Number of	bottom	Wr*4	Wind	S.T.*5
	Line set		Line haul			Lat.	Long.		baskets	depth(m)		(Force)	(°C)
Cruise #104													
OSSL2101	May 14	0411-0426	May 14	0631-0706	+10h	42-31.9N	152-06.3E	185	10	5100	o	South-4	4.6
OSSL2102	May 16	0421-0440	May 16	0654-0741	+10h	41-01.6N	150-01.5E	135	10	5175	bc	ESE-3	6.1
OSHL2101	May 13	0630	May 14	0330	+10h	42-30.0N	152-00.0E	-	-	-	o	WNW-3	4.4
OSHL2102	May 14	1800	May 14	2330	+10h	41-45.0N	151-00.0E	-	-	-	r	SE-4	10.7
OSHL2103	May 15	2200	May 16	0330	+10h	41-00.4N	150-01.3E	-	-	-	o	North-3	6.3

Table 3. List of oceanographic stations during the *Oshoro maru* Cruise #104, 2021.

Station	Date and Time (S.M.T.*1)		T.D.*2	Set Position		Remark	CTD
				Lat.	Long.	CTD	depth(db)
Cruise #104							
G1	May 13	0755	+10h	42-29.9N	152-00.0E	Sea-Bird SBE 9	5000
G1	May 13	1215	+10h	42-29.9N	152-00.0E	Sea-Bird SBE 9	200
G1	May 13	1830	+10h	42-29.9N	151-59.8E	Sea-Bird SBE 9	2000
C1	May 14	1125	+10h	42-07.5N	151-30.1E	Sea-Bird SBE 9	2000
G2	May 14	1800	+10h	41-45.0N	150-59.9E	Sea-Bird SBE 9	2000
C2	May 15	0800	+10h	41-22.3N	150-30.0E	Sea-Bird SBE 9	2000
G3	May 15	1405	+10h	40-59.9N	150-00.1E	Sea-Bird SBE 9	2000
G3	May 15	1840	+10h	41-00.0N	149-59.9E	Sea-Bird SBE 9	2000

*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 # 104, 2021. CPUE and (%) indicate numerical catch per tan and percentage of total catch by C-gear gillnet at each station.

Common name	Station / Gear / Scientific name	OSG 2101					OSG 2102				
		C			A	Total	C			A	Total
			CPUE	(%)				CPUE	(%)		
Sockeye salmon	*Oncorhynchus nerka*	0	0.0	(0.0)	0	0	0	0.0	(0.0)	0	0
Chum salmon	*Oncorhynchus keta*	1	0.0	(0.6)	2	3	0	0.0	(0.0)	0	0
Pink salmon	*Oncorhynchus gorbuscha*	168	5.6	(93.9)	235	403	240	8.0	(98.4)	331	571
Coho salmon	*Oncorhynchus kisutch*	0	0.0	(0.0)	0	0	0	0.0	(0.0)	0	0
Chinook salmon	*Oncorhynchus tshawytscha*	0	0.0	(0.0)	0	0	0	0.0	(0.0)	0	0
Steelhead	*Oncorhynchus mykiss*	0	0.0	(0.0)	0	0	0	0.0	(0.0)	0	0
Boreopacific armhook squid	*Gonatopsis borealisSasaki*	10	0.3	(5.6)	0	10	4	0.1	(1.6)	0	4
Salmon shark	*Lamna ditropis*	1	0.0	(0.6)	0	1	0	0.0	(0.0)	0	0
Dall's porpoise	*Phocoena dalli*	0	0.0	(0.0)	0	0	0	0.0	(0.0)	1	1
Shearwater	*Puffinus*	3	0.1	(1.7)	1	4	2	0.1	(0.8)	0	2

Table 5. The catch number of each salmonid at each station where the salmonids were collected by hook-and-line gear, surface long-line during the *Oshoro maru* Cruise # 104, 2021.

Station Name	Sampling gear	Species name						Total
		Sockeye	Chum	Pink	Coho	Chinook	Steelhead	
Cruise #104								
OSSL 2101	Surface longline	0	0	12	0	0	0	12
OSSL 2102	Surface longline	0	0	28	0	0	0	28
OSHL 2101	Hook-and-line	0	0	317	0	0	0	317
OSHL 2102	Hook-and-line	0	0	1	0	0	0	1
OSHL 2103	Hook-and-line	0	0	238	0	0	0	238
Total		0	0	596	0	0	0	596

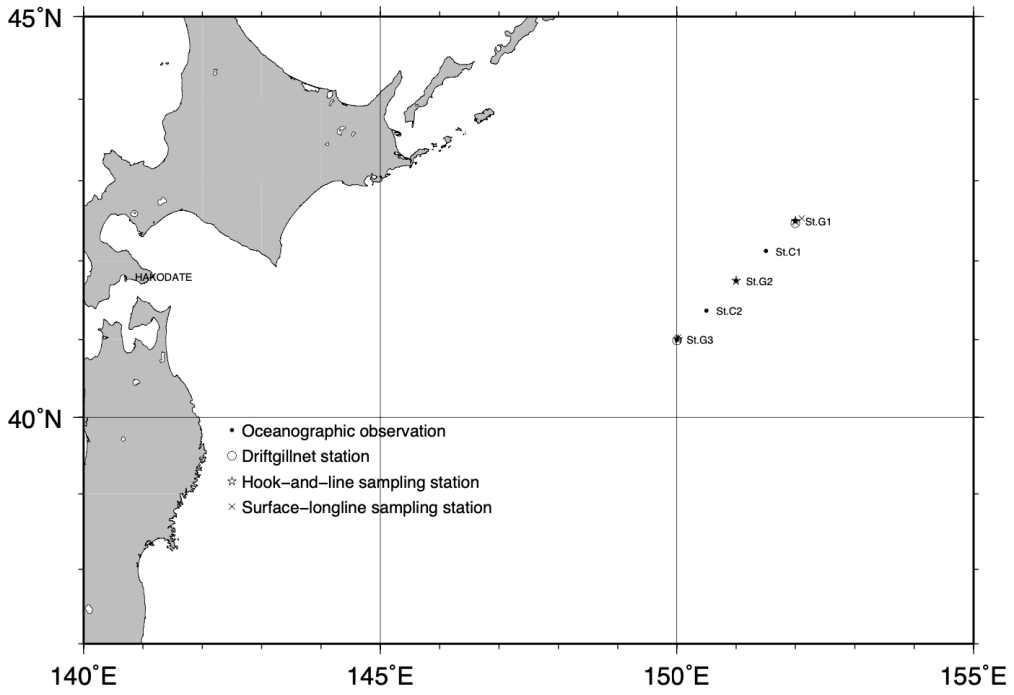

Fig.1 Research stations during the *Oshoro maru* Cruise #104, 2021

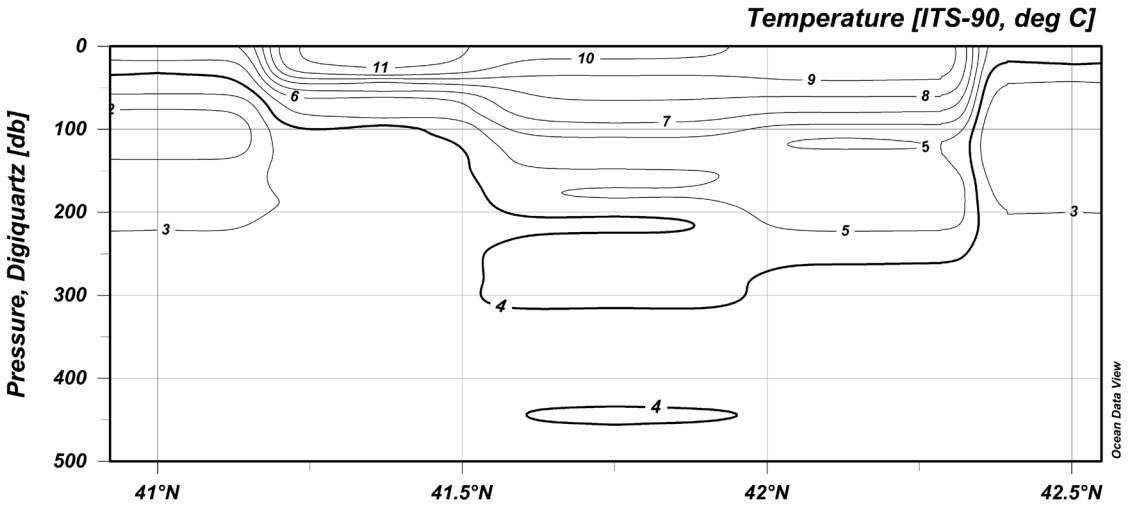

Fig.2 The temperature cross section between St.G1 and G3 covering a depth of 0 to 500m during the *Oshoro maru* Cruise # 104, 2021.

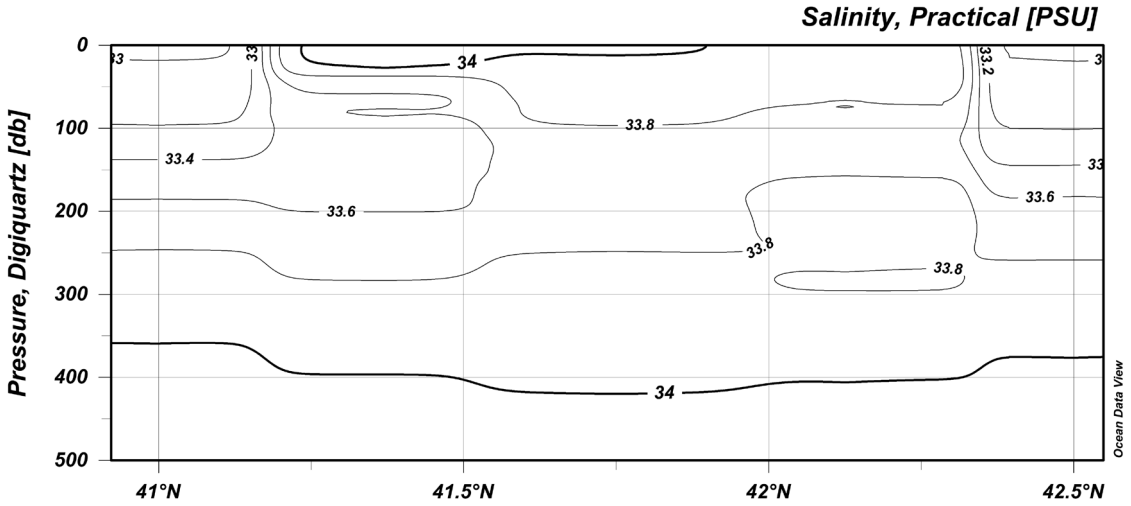

Fig.3 The salinity cross section between St.G1 and G3 covering a depth of 0 to 500m during the *Oshoro maru* Cruise # 104, 2021.

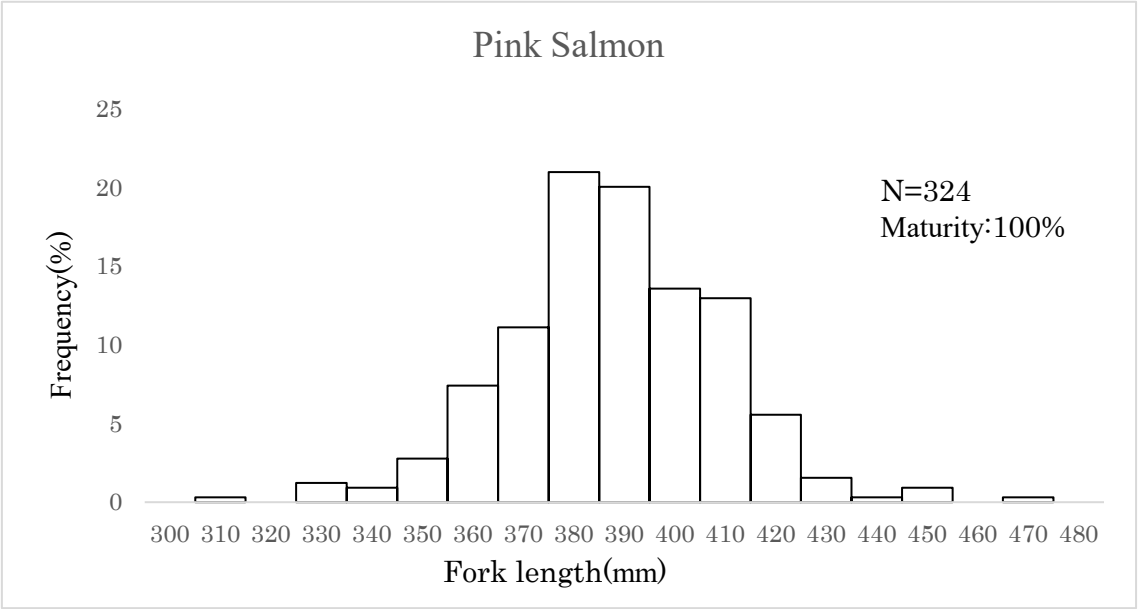

Fig.4 Fork length frequency of pink salmon caught by C-gear gillnet during the *Oshoro maru* Cruise #104, 2021.