

NPAFC
Doc. 1635
Rev.

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Submitted to the

NORTH PACIFIC ANADROMOUS FISH COMMISSION

by

Japan

April 2016

THIS PAPER MAY BE CITED IN THE FOLLOWING MANNER:

Iida, T., K. Sakaoka, Y. Kajiwara, N. Hoshi, M. Ohwada, K. Imai, and S. Takagi. 2016. Results of 2015 salmon research by the *Oshoro-maru*. NPAFC Doc. 1635. 10 pp. T/V “*Oshoro maru*”, Graduate School of Fisheries Sciences and Faculty of Fisheries, Hokkaido University (Available at www.npafc.org).

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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 #012 in May 2015. Nine oceanographic observations, three drift gillnet surveys, four line and hock surveys and one surface long-line survey were conducted along the 155°E line. A total of 75 salmonids including 72 pink and 3 chum salmon was caught by gillnet and hock-line surveys. Pink salmon was the dominant species in this region. The fork length (FL) of pink salmon collected by C-gear gillnet ranged between 356-472 mm.

To collect salmon samples extensively and to collect fresh salmon blood and various tissues, one surface long-line and four hook-and-line gear samplings were conducted during the Cruise #012. Almost all of caught by these gears were pink salmon. A total of one chum and 12 pink salmon were collected during the Cruise #012.

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 the Bering Sea (infrequently in the Chukuchi Sea) almost every summer since 1953. Collected data has been published annually since 1957 (Hokkaido University, 1957-2014).

Salmon researches were conducted during a cruise in May 2015: the *Oshoro maru* Cruise #012 in the western North Pacific.

Primary salmon research objects during a cruise 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 May 8, 2015 and started the Cruise #012. Oceanographic observations, gillnet surveys, surface long-line and hook-and-line samplings were conducted along the 155°E longitude between 43°05'N and 35°31'N latitude from May 11 to 17, and returned to Hakodate on May 19 (Tables 1 & 2, Fig. 1).

Oceanographic observation

Twelve oceanographic observations were conducted from 44°N to 37°15'N along the 155°E longitude line (Fig. 1, Table 3). The temperature and salinity data at each station were collected by using CTD or 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 #012 (Fig. 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, Table 1). The gillnet configuration at the station was as follows:

Stations	net	A-Gear				C-gear										Total
	Mesh size (mm)	112	115	118	121	48	55	63	72	82	93	106	121	138	157	
OSG1501	Number of tan	3	3	3	3	3	3	3	5	6	5	3	3	3	3	49
OSG1502	Number of tan	3	3	6	7	3	3	3	3	3	3	3	3	3	3	49
OSG1503	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). The net set did not include F-Gear gillnet in this year. Each tan was 50 m long. Gillnet gear was set in the evening, allowed to soak overnight, and retrieved in 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

One surface long-line research was conducted to collect salmonids at a station (39°23'N, 146°08'E) during the Cruise #012 (Fig. 1).

The long-line consisted of 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 and various tissues, hook-and-line gears were used at three research stations during the Cruise #012 (Fig. 1).

Three to ten anglers were engage 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 FL (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

Along the 155°E Longitude Line: during the Cruise #012 in May 2015

Oceanographic Conditions

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

The geographic positions of the Polar Front and the Subarctic Boundary along the 155°E longitude line transect (Dodimead et al., 1963.; Favorite et al., 1976.; Roden, 1991) were observed following locations in May 2015.

The Polar Front which might be indicated by the vertical 4°C isotherm at 100 db observed in the vicinity of 41°30'N. The Subarctic Boundary indicated by the vertical 34.0 PSU isohaline was observed in the vicinity of 40°30'N.

Distribution and Abundance of Organisms caught by Drift Gillnets

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

A drift gillnet survey was conducted along the 155°E during the cruise #012 in May 2015 (Fig. 1, Table 1). Two chum salmon and 60 pink salmon (*Oncorhynchus gorbuscha*) were collected at 43°-05.4'N (OSG1501). The CPUE value of pink salmon was high at this position. One Tufted Puffin (*Fratercula cirrhata*), one auk (*Alcidae spp.*) and two Short-tailed Shearwater (*Puffinus tenuirostris*) were incidentally caught during the gillnet operation (Table 4).

Biological Characteristics of Salmonids

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

A total of 55 pink salmon was collected by C-gear gillnet. Their FL ranged between 356-472 mm. Mean \pm SD of them was 412.4 ± 17.4 mm, and median was 411.5 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 5. One chum and twelve pink salmon were collected by surface long-line and hook-and-line gear during the Cruise #012 (OSSL1501, OSHL1501-04).

ACKNOWLEDGMENTS

We thank the other officers, crew, graduate students, and cadets of the *Oshoro Maru* for their outstanding assistance and cooperation in sampling and data collection even if sometimes were under severe conditions.

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Table 1. Position and research conditions of surface drift gillnet sampling at each station during the *Oshoro maru* Cruise #012, 2015.

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.					
OSG1501	May 11	1840-1907	May 12	0455-0605	+10h	43-05.4N	155-01.4E	90	5388	bc	North-3	5.6
OSG1502	May 14	1750-1810	May 15	0458-0605	+10h	35-30.6N	151-30.0E	240	6078	b	SW-4	17.4
OSG1503	May 16	1750-1806	May 17	0508-0612	+10h	39-14.9N	146-11.3E	310	5265	o	NW-5	12.3

Table 2. Position and research conditions of surface long-line and hook-and-line sampling at each station during the *Oshoro maru* Cruise #012, 2015.

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.						
C269													
OSSL1501	May 17	0355-0427	May 17	0636-0752	+10h	39-22.6N	146-08.4E	300	30	5210	bc	NW-3	11.9
OSHL1501	May 11	0600	May 11	1000	+10h	43-59.9N	155-00.0E	-	-	5300	c	NNE-4	4.5
OSHL1502	May 11	2250	May 12	0400	+10h	43-03.3N	155-08.0E	-	-	5324	bc	West-3	5.1
OSHL1503	May 12	2005	May 13	0135	+10h	40-15.0N	155-00.0E	-	-	5542	bc	West-4	11.1
OSHL1504	May 14	1830	May 15	0000	+10h	35-30.0N	151-30.0E	-	-	5542	bc	SW-4	17.4

Table 3. List of oceanographic stations during the *Oshoro maru* Cruise #012, 2015.

Station	Date and Time (G.M.T.*1)			T.D.*2	Set Position		Remark	CTD(XCTD) depth(db)
					Lat.	Long.		
C269								
OS15022	May 11	19:46	+10h	43-59.9N	155-00.0E	Sea-Bird SBE 9	3003	
OS15024	May 12	7:35	+10h	43-15.0N	155-00.0E	XCTD	1100	
OS15025	May 12	9:27	+10h	43-05.0N	155-05.1E	Sea-Bird SBE 9	1503	
OS15026	May 12	2:29	+10h	41-45.0N	154-59.9E	XCTD	2000	
OS15027	May 12	10:09	+10h	40-14.9N	155-00.0E	Sea-Bird SBE 9	3001	
OS15029	May 12	22:59	+10h	38-45.0N	155-00.0E	XCTD	2000	
OS15030	May 13	6:39	+10h	37-15.0N	154-59.9E	XCTD	1886	
OS15031	May 14	8:38	+10h	35-30.7N	151-31.2E	Sea-Bird SBE 9	3002	
OS15034	May 16	6:02	+10h	39-15.6N	146-11.2E	Sea-Bird SBE 9	3001	

*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 (b: 0-24% clouded, bc: 25-75% clouded, c: 75-99% clouded, o: 100% clouded).

*5 S.T. : Surface temperature

Table 4. The number of organisms caught by drift gillnet during the *Oshoro maru* Cruise # 012, in May 2015. CPUE and (%) indicate catch per tan and percentage of total catch by C-gear gillnet at the station, respectively.

		Station		OSG1501				OSG1502				OSG1503					
Common name	Scientific name	Gear	C		A	Total	C		A	Total	C		A	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
Chum salmon	<i>Oncorhynchus keta</i>		2	0.1	(3.3)	0	2	0	0.0	-	0	0	0	0.0	(0.0)	0	0
Pink salmon	<i>Oncorhynchus gorbuscha</i>		55	1.8	(90.2)	5	60	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
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
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	
Tufted Puffin	<i>Fratercula cirrhata</i>		1	0.0	(1.6)	0	1	0	0.0	-	0	0	0	0.0	(0.0)	0	0
Auks	<i>Alcidae spp.</i>		1	0.0	(1.6)	0	1	0	0.0		0	0	0	0.0	(0.0)	0	0
Short-tailed Shearwater	<i>Puffinus tenuirostris</i>		2	0.1	(3.3)	0	2	0	0.0	-	1	1	1	0.0	(100.0)	0	1

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 # 012, 2015.

Station Name	Sampling gear	Species name						Total
		Sockeye	Chum	Pink	Coho	Chinook	Stellhead	
C012								
OSSL 1401	Surface longline	0	0	0	0	0	0	0
OSHL 1401	Hook-and-line	0	0	3	0	0	0	3
OSHL 1402	Hook-and-line	0	1	8	0	0	0	9
OSHL 1403	Hook-and-line	0	0	1	0	0	0	1
OSHL 1404	Hook-and-line	0	0	0	0	0	0	0
Total		0	1	12	0	0	0	13

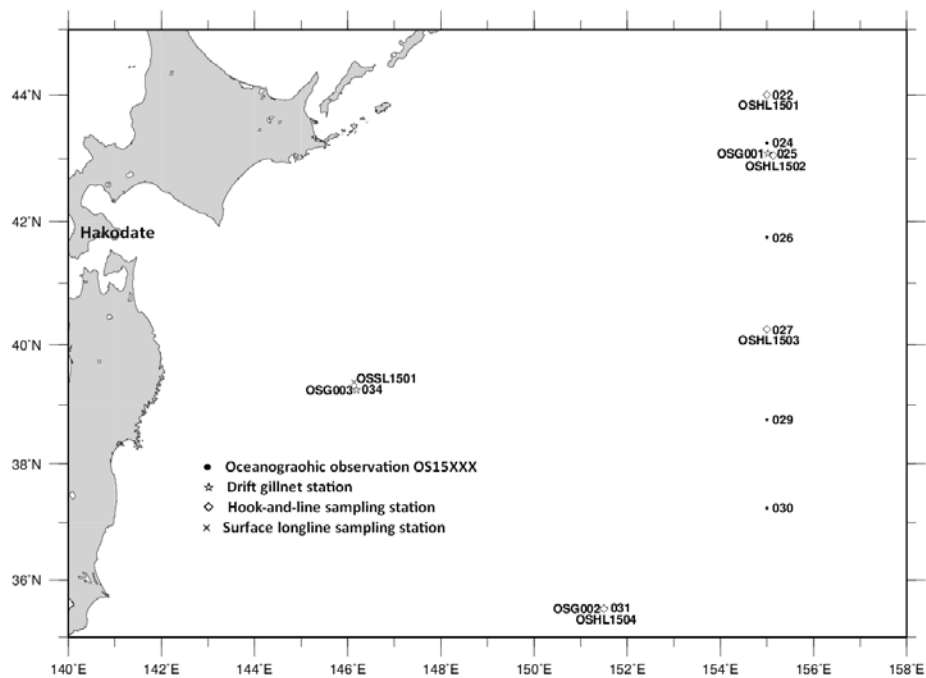


Fig. 1. Research stations during the *Oshoro maru* Cruise #012 in May 2015. Position and weather are shown in Tables 1-3.

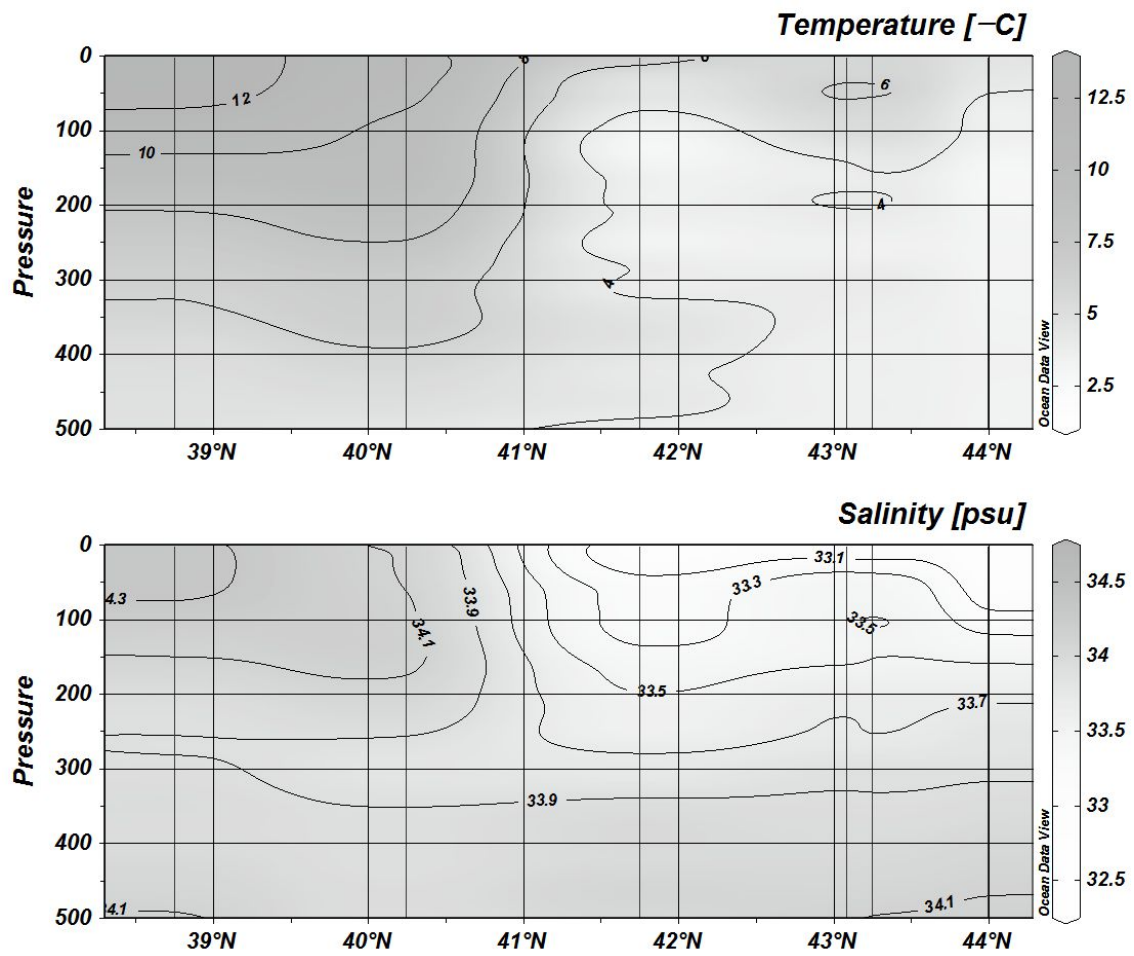


Fig. 2. Temperature and salinity from surface to 500 db pressure along the 155°E transect during the *Oshoro maru* Cruise #012 in May 2015.

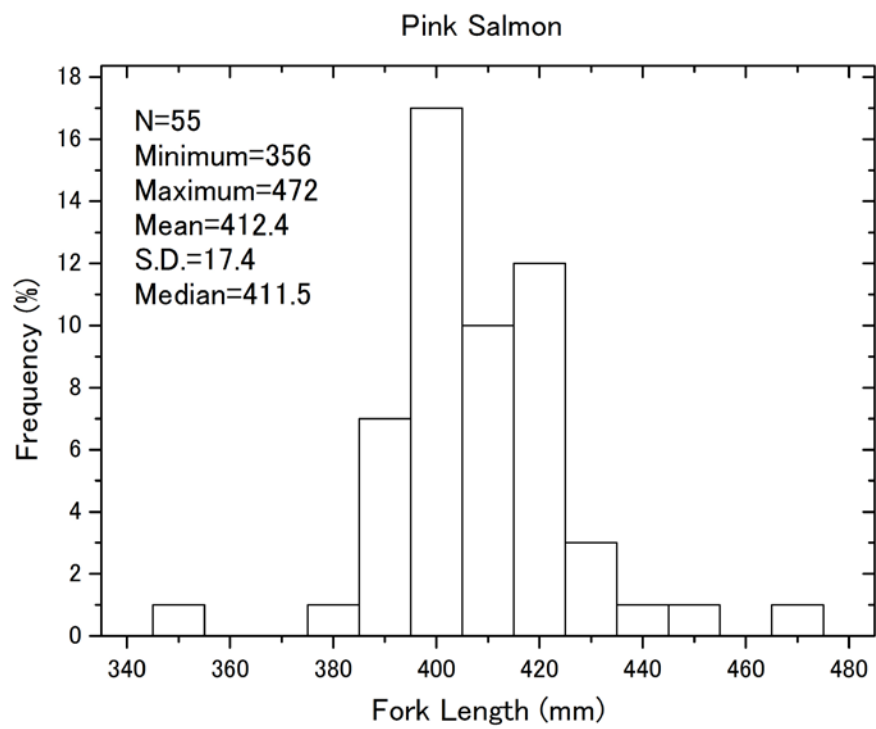


Fig. 3. Fork length frequency of pink salmon caught by C-gear gillnet along the 155°E line during the *Oshoro maru* Cruise #012 in May 2015.