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**Canadian High Seas Salmon Research, 1992.**

by

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## ABSTRACT

Two Canadian research cruises were conducted in 1992 as part of a co-operative research program with Japan to examine the relationship between oceanographic factors controlling the distribution of Pacific salmon on the high seas, and the potential impact of climatic change on oceanic salmon production. Surveys were conducted in the eastern North Pacific using a rope trawl, surface gillnets, and longlines from February 27 to March 25, 1992, and from July 5-23 using surface gillnets and longline. Salmonids were caught only at sea surface temperatures less than 10.5°C during the spring cruise, and at temperatures of less than 14°C during the summer cruise.

### 1. CRUISE TRACK AND FISHING STATIONS

Figure 1 shows the Spring cruise track, CTD stations, and fishing stations completed by the R.V. W.E. Ricker. A total of 10 rope trawl tows, 9 gillnet sets, 2 longline sets, 5 bongo tows, and 67 CTD casts were completed. Eight rope trawl tows were made on the outbound leg to station "P", one just south of ocean station "P", and one along the western edge of LaPerouse Bank on the return leg. The nine gillnet sets began at ocean station "P". Six were then made at or close to 140° longitude, one just off Cobb's Seamount, and 1 approximately 60 km northwest of Cobb's Seamount. The two longline sets were made at 46° 21.3'N and 43° 48.6'N at 140°W longitude.

Figure 2 shows the summer cruise track and the CTD, XBT, bongo net, surface gillnet, and surface longline stations completed by the R.V. W.E. Ricker. A total of 44 CTD casts, 44 XBT casts, 20 bongo tows, 10 gillnet sets, and 2 longline sets were completed. A medical emergency mid-way through the cruise caused significant changes to the cruise plan, and reduced the number of fishing stations.

## 2. FISHING GEAR AND SAMPLING PROTOCOL

### 2.1. Rope trawl

During the spring cruise salmon were sampled with a Polish mid-water rope trawl, model 368/338, leased from Cantrawl Pacific Fishing Services in Richmond, B.C., Canada. The rope trawl measured 112 m along the head rope, 103 m along the side rope, and approximately 120 m in length. The body of the net consisted of a 90 m tapered web section, a 30 m intermediate section constructed from 75 mm stretch mesh polypropylene web, and a 40 mm stretched mesh knotted nylon codend. The rope trawl was fitted with a standard Diamond VII rig that included 45 m bridles and 5 m trawl doors. The mouth opening of the rope trawl when towed at 5 knots was 10 m in height by 40 m in width, as measured by a Simrad model FS3300 echosounder mounted on the head-rope.

Normal sampling protocol was to tow the rope trawl at 5 knots for one hour, fishing at a depth of 40 m from the surface to the head-rope for the first 30 minutes and at 20 m for the second 30 minutes. The tow at station #8, just northeast of ocean station "P", differed from this normal procedure in that we towed for 3 hours, sampling for 20 minutes at 100 m, 90 m, 80 m, 70 m, 60 m, 50 m, 40 m, 30 m, and 20 m. All sampling was conducted during daylight hours. No salmon were caught at any offshore station using this gear.

### 2.2. Gillnet

The surface gillnet was made up of 20 to 26 50 m tans of 115 mm stretched mesh monofilament, yielding a total length of 1 to 1.3 km. The gillnet was normally set between 18:00 and 20:30 hours in the evening, and hauled it in after 8:00 the next morning. However, there were two daytime sets of approximately 5 and 6 hours duration at stations #17 and #19, respectively, during the spring cruise.

### 2.3 Longline

The floating longline was fished twice during both spring and summer cruises in an effort to capture live salmon for an experiment to assess their daily food ration. During the spring cruise a longline was deployed using 14 and 20 hachi at stations #12 and #18, respectively. During the summer cruise a longline was deployed using 6 and 21 hachi at stations #1 and #2, respectively. Salted anchovies were used as bait during both cruises.

## 3. BIOLOGICAL SAMPLING

For all salmon caught, fork length, body weight, gonad weight, liver weight, and stomach content weight were measured; and scale samples were collected. During the spring cruise principal diet items were recorded as well while at sea. During the summer cruise, salmon stomachs were frozen intact for later laboratory analysis. Chum salmon (*O. keta*) tissue samples were collected and stored frozen for subsequent electrophoretic analysis to determine continent of origin.

Neon flying squid were measured for mantle length and the sex was recorded.

## 4. OCEANOGRAPHIC DATABASES

Detailed oceanographic data from the cruise included a series of CTD casts to 800 metres (spring) and 1,000 metres (summer) and a continuous record of sea surface temperatures and salinities that was provided by the SAIL system. The CTD and SAIL datasets can be accessed by contacting Robin Brown, Oceanographic Data Management, Institute of Ocean Sciences (IOS), P.O. Box 6000, 9860 West Saanich Road, Sidney, B.C., Canada, V8L 4B2. The CTD dataset for the spring cruise is identified by the cruise number "92-03" and the SAIL dataset by the vessel name "W.E. Ricker", year "1992", and start date "Julian day, 58". The CTD dataset for the summer cruise is identified by the cruise number "OP92-17" and the SAIL dataset by the vessel name "W.E. Ricker", year "1992", and start date "Julian day, 188".

## 5. CATCH RESULTS

Table 1 presents the Pacific salmon catch by rope trawl at each station. The rope trawl was intended to be our primary sampling gear on the spring cruise. However, no salmon were caught during the nine one-hour tows along the out-bound leg to station "P", or during the three-hour tow just south of station "P". We therefore switched over to surface gillnet. A limited test of our rope trawl's ability to catch salmon was made with a one-hour tow on LaPerouse Bank on the return leg of the cruise (station #21, see Figure 1). Seven juvenile coho (Oncorhynchus kisutch) and one juvenile chinook salmon (O. tshawytscha), all under 40 cm in fork length, were caught. We believe that the mouth area of the rope trawl was too small for use in the clear waters of the offshore.

Table 2 presents the catches by surface gillnet of salmon and neon flying squid at each station during the spring cruise. Salmonids were caught by surface gillnet only at sea surface temperatures less than 10.5°C; 11 sockeye salmon (O. nerka) at station #9, 31 chum salmon (O. keta) and 2 steelhead trout (O. mykiss) at station #11, 3 chum salmon at station #13, 1 steelhead trout at station #19, and 22 chum salmon and 4 steelhead trout at station #20. Neon flying squid were caught in relatively warm waters; 34 at station #14 and 7 at station #16, where the sea surface temperatures were 13.5°C and 11.3°C, respectively.

Table 3 presents the surface gillnet catches in summer of salmon and neon flying squid at each station. A total of 425 Pacific salmon were caught by surface gillnet; 50.6% pink salmon, 25.9% sockeye salmon (O. nerka), 10.8% chum salmon, 9.2% coho salmon (O. kisutch), and 3.5% steelhead trout (O. mykiss). No chinook salmon (O. tshawytscha) were caught.

In summer the distribution of Pacific salmon was again strongly dependent on sea surface temperature (Table 3). Pink, chum, coho, sockeye salmon, and steelhead trout were caught at the one station on the outbound leg and at the three most northerly stations along 145°W at or below 12.1°C. They were also caught at the two stations on the 138°W transect, where the sea surface temperatures were 12.7°C and 13.3°C, respectively. No salmon were caught at stations

#5 and #6 at the southern extreme of the 145°W transect or at the two stations on the 142° 30'W transect, where sea surface temperatures ranged from 13.3°C to 14°C. These catch results indicate that the upper thermal limits to the southern distributions of pink, chum, coho, sockeye salmon, and steelhead trout in the mid-summer are between 13°C and 14°C.

Tables 4 and 5 presents the spring and summer salmonid catches by longline for two stations. Four chum salmon, 1 chinook salmon, and 3 steelhead trout were caught in the spring at station #12, where the sea surface temperature was 8.55°C; and none at station #18, where the sea surface temperature was 10.44°C. In the summer, 15 pink salmon, 3 sockeye salmon, and 1 steelhead trout were caught at station #2, where the sea surface temperature was 12.7°C; while no salmon were caught at station #1 at the southern extreme of the 145°W transect, where the sea surface temperature was 13.7°C.

#### ACKNOWLEDGEMENTS

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Table 1. Rope trawl catches on the W.E. Ricker cruise to the eastern North Pacific, February 27-March 25, 1992.

STN#	DATE	TIME	START LOCATION	DIR	KM	DEPTH(m)	SST	SSS	PK	CM	CO	SK	CN	ST
1	92/02/29	9:42-10:42	48 26.6N 127 26.0W	267	10.0	20,40	9.16	32.24	0	0	0	0	0	0
2	92/02/29	14:53-15:53	48 25.6N 128 18.6W	254	10.0	20,40	9.41	32.29	0	0	0	0	0	0
3	92/03/01	9:20-10:20	48 27.0N 131 29.9W	211	9.4	20,40	9.13	32.31	0	0	0	0	0	0
4	92/03/01	14:48-15:48	48 37.1N 132 06.3W	210	11.3	20,40	8.97	32.29	0	0	0	0	0	0
5	92/03/02	8:27- 9:27	49 53.8N 134 52.1W	228	10.2	20,40	7.56	32.36	0	0	0	0	0	0
6	92/03/02	15:07-16:07	50 17.2N 135 44.8W	261	8.0	20,40	7.61	32.36	0	0	0	0	0	0
7	92/03/03	8:28- 9:28	51 50.3N 138 31.8W	248	10.0	20,40	6.53	32.40	0	0	0	0	0	0
8	92/03/04	8:55-11:55	50 30.8N 143 41.5W	242	27.8	20-100	5.71	32.47	0	0	0	0	0	0
10	92/03/05	13:43-14:43	49 37.2N 145 02.8W	350	10.0	20,40	6.04	32.44	0	0	0	0	0	0
21	92/03/23	13:12-14:43	48 33.3N 125 05.6W	132	8.7	20,40	9.47	31.71	0	0	8	0	1	0

Table 2. Gillnet catches on the W.E. Ricker cruise to the eastern North Pacific, February 27-March 25, 1992.

STN#	DATE	SET TIME	HAUL TIME	LOCATION	DIR	TANS	SST	SSS	PK	CM	CO	SK	CN	ST	FS
9	92/03/05	18:00-18:10	8:26- 9:25	50 00.0N 144 59.9W	63	20	5.98	32.45	0	0	0	11	0	0	0
11	92/03/10	18:14-18:26	8:15- 9:10	45 18.2N 140 55.6W	231	20	9.07	32.12	0	31	0	0	0	2	0
13	92/03/12	17:15-17:39	19:01-19:40	46 20.7N 140 05.3W	126	20	8.55	32.54	0	3	0	0	0	0	0
14	92/03/14	18:29-18:45	9:00- 9:38	39 58.3N 139 50.7W	342	26	13.54	33.48	0	0	0	0	0	0	34
15	92/03/15	19:50-20:18	8:16- 9:06	41 29.5N 140 00.4W	40	26	11.91	33.05	0	0	0	0	0	0	0
16	92/03/16	20:10-20:23	8:20- 9:30	43 10.1N 140 00.7W	211	26	11.35	32.95	0	0	0	0	0	0	7
17	92/03/18	5:10- 5:35	12:25-13:00	43 50.0N 140 00.6W	225	24	10.44	32.70	0	0	0	0	0	0	0
19	92/03/21	11:00-11:18	15:00-15:48	46 45.1N 130 47.8W	300	24	10.05	32.39	0	0	0	0	0	1	0
20	92/03/21	19:15-19:35	8:19- 9:19	47 04.5N 131 26.3W	174	24	10.47	32.46	0	22	0	0	0	4	0

Species abbreviations: PK, pink salmon; CM, chum salmon; CO, coho salmon; SK, sockeye salmon; CN, chinook salmon; ST, steelhead trout; FS, neon flying squid.

Table 3. Summary of surface gillnet catches on the W.E. Ricker cruise to the eastern North Pacific, July 5-23, 1992.

SET#	DATE	LOCATION	DIR	SET TIME	HAUL TIME	TANS	MESH	WINDS km/hr	SST	SSS	PK	CM	CO	SO	ST	PF	FS
1	92/07/09	51 36.9N 142 59.5W	245	22:00-22:12	8:23-10:00	25	115	SW 28	11.164	32.284	60	4	24	25	1	2	0
2	92/07/10	51 29.9N 145 00.2W	265	20:00-20:11	8:12- 9:43	25	115	SW 33	11.138	32.369	38	20	7	16	0	0	0
3	92/07/11	50 00.0N 145 00.3W	270	20:51-21:01	8:35- 9:40	25	115	W 30	11.278	32.401	29	17	2	23	2	0	0
4	92/07/12	48 30.0N 145 00.3W	260	20:15-20:26	8:10- 9:17	25	115	SW 22	12.084	32.521	15	1	1	16	2	1	0
5	92/07/13	47 00.1N 145 00.0W	262	20:05-20:16	8:15- 9:19	25	115	SW 13	13.275	32.722	0	0	0	0	0	11	0
6	92/07/14	46 00.0N 145 00.0W	270	20:03-20:16	8:12- 9:06	25	115	SW 26	13.733	32.776	0	0	0	0	0	17	0
7	92/07/15	46 29.9N 142 29.9W	270	20:47-20:58	8:15- 9:43	25	115	NE 15	14.032	32.634	0	0	0	0	0	2	77
8	92/07/16	48 20.6N 142 29.9W	180	21:08-21:19	6:42- 7:30	25	115	S 15	13.457	32.482	0	0	0	0	0	21	1
9	92/07/18	51 24.9N 137 56.6W	50	21:13-21:35	8:31- 9:34	25	115	W 22	12.698	32.347	38	5	4	28	6	14	0
10	92/07/19	50 41.6N 138 00.1W	330	19:07-19:17	8:23- 9:18	25	115	NW 15	13.290	32.358	35	0	1	2	4	2	0

Table 4. Longline catches on the W.E. Ricker cruise to the eastern North Pacific, February 27-March 25, 1992.

STN#	DATE	SET TIME	HAUL TIME	LOCATION	DIR	HACHI	SST	SSS	PK	CM	CO	SK	CN	ST
12	92/03/12	12:56-13:26	15:00-17:35	46 21.3N 140 05.7W	270	14	8.55	32.54	0	4	0	0	1	3
18	92/03/18	6:30- 7:12	7:53- 9:50	43 48.6N 140 02.9W	352	20	10.44	32.70	0	0	0	0	0	0

Table 5. Summary of longline catches on the W.E. Ricker cruise to the eastern North Pacific, July 5-23, 1992.

SET#	DATE	SET TIME	HAUL TIME	LOCATION	DIR	HACHI	SST	SSS	PK	CM	CO	SO	ST	PF
1	92/07/15	5:00- 5:15	5:30- 6:00	46 00.0N 145 00.0W	270	6	13.733	32.776	0	0	0	0	0	0
2	92/07/20	5:04- 5:38	6:20- 7:43	51 27.7N 137 53.8W	235	21	12.698	32.347	15	0	0	3	1	1

## Species abbreviations:

PK, pink salmon; CM, chum salmon; SO, sockeye salmon; CO, coho salmon; ST, steelhead salmon;  
 PF, Pacific pomfret; FS, neon flying squid.



Figure 1.



