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The 1999 Salmon Research Cruise of the *Hokko maru*

by

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Abstract

The salmon research cruise of the R/V *Hokko maru* of the Hokkaido National Fisheries Research Institute (HNFRI) was conducted along 165° E from 51° to 41° N in June 21 - July 14, 1999, for stock assessment and carrying capacity estimation in the western North Pacific. Survey included oceanographic observation, sampling of sea surface water to estimate primary production, sampling of zooplankton, fishing of salmon and other fishes by drift gillnet. Number of salmon caught by 10 operations of drift net was 2,332 and less than in the last year. It includes 1,674 pink, 349 coho, 157 chum, 143 sockeye, 7 chinook, and 2 steelhead. Fish size of pink, coho, chum, and sockeye salmon was larger than in 1998. 484 stomachs of salmon were collected to study feeding habit. Samples of heart, liver, pectoral fin, and muscle from 149 chum salmon were collected for genetic stock identification. 149 and 188 pairs of otolith (sagittae) were collected from chum and pink salmon, respectively, to recognize thermal marks. In addition to Pacific salmon, 130 flying squid, 128 smalleye squaretail, 120 blue shark, 115 Pacific pomfret, and other organisms were caught by drift gill nets. Samples and data will be analyzed in HNFRI, National Salmon Resources Center, National Fisheries Research Institute for Far Sea Fisheries, Japan Meteorological Agency, and Hokkaido Tokai University.

Introduction

The R/V *Hokko maru* of the Hokkaido National Fisheries Research Institute (HNFRI) continues the salmon research cruise in summer in the western North Pacific from 1992. The objectives of the cruises of the *Hokko maru*, *Wakatake maru*, *Oshoro maru*, and *Hokusei maru* in summer in the North Pacific are to assess the condition of Pacific salmon stocks and to determine the ocean distribution of Japanese chum salmon stocks. All of these surveys by Japanese salmon research vessels include fishing of salmon using non-selective research gillnet, oceanographic observation, and zooplankton sampling. Another major objective of the *Hokko maru* survey is to estimate carrying capacity of salmon in the western North Pacific.

Methods

1. Period and area of the *Hokko maru* salmon survey

The salmon research cruise of the *Hokko maru* was conducted in June 21 – July 14, 1999. Survey period was in June 26 - July 10.

The survey area was along 165° E from 51° N to 41° N in the western North Pacific

(Fig. 1). 11 stations were set at 1°-latitude intervals. The station 11 was moved to the point 41° N 164° 30’ E.

2. Oceanographic observation

Sea surface temperature and transparency were measured using a mercury thermometer and a Secchi disk. Salinity and temperature from 0 to 1500 m were measured using a CTD probe. Surface water was sampled to measure salinity using AUTOSAL. At the midpoints between survey stations, salinity, and temperature from 0 to 1000 m were measured by an XCTD probe.

3. Primary production and zooplankton samplings

At the 11 stations, surface water was sampled to measure chlorophyll-a and CO_2 concentrations. Samples will be examined in HNFRI and Japan Meteorology Agency.

At St. 2-11, zooplankton was sampled at 2 hour after the sunset by vertical towing of a remodeled NORPAC net from 150 m depth and by horizontal towing (10 min at 1 knot) of an ORI net (0.69 mm mesh) under the sea surface. Bongo net was used to compare with ORI net. Zooplankton samples will be examined in the laboratory.

4. Fishing of salmon and other fishes

At St. 2-11, drift gillnet was used to catch salmon and other fishes. The net was consisted of 30 tan of non-selective research gillnet (48, 55, 72, 82, 93, 106, 121, 138, and 157 mm mesh size; 3 tans of each mesh size; 1 tan is 50 m long), 17 tans of commercial gillnet (115 mm mesh size) and 2 tans of small-mesh gillnet (29 and 37 mm mesh size). The net was set at 16:00 and retrieved at 04:00 in Japan Standard Time.

Number of organisms caught by drift gillnet was counted by species and mesh sizes. Catch per unit effort (CPUE) was calculated as number of fish caught by 30 tan of research gillnets. Fork length, body weight, and gonad weight of maximum 60 fish by salmon species were measured. Scales were collected from the INPFC preferred area. Fork, total, or mantle length of maximum 30 non-salmonids was measured.

5. Sampling of tissues or whole salmon

To study food habit of salmon, 484 stomachs from salmon caught by research gillnet were fixed and preserved in 10% buffered formalin. The stomach contents will be examined in HNFRI and Hokkaido Tokai University. To measure carbon and nitrogen stable isotope concentrations, 10 pink salmon were frozen.

To measure fat contents of salmon, we froze a part of muscle collected from dorsal area posterior to the head from 50 chum salmon and whole body of 49 pink salmon. Samples will be examined in National Salmon Resources Center (NSRC).

For genetic stock identification of chum salmon, 149 sets of tissues (heart, liver,

muscle, and pectoral fin) were collected and frozen. From the same fish, 149 pairs of otolith (sagittae) were collected to recognize thermal marks. For pink salmon, 188 pairs of otolith were collected for thermal mark examination by NSRC.

Results and Discussion

1. Oceanographic environment

Mean sea surface temperature was 8.8 (5.1-16.3) °C in 51-41° N along 165° E in June-July, 1999. The value was similar to SST in 1997 (8.4°C) and 1998 (8.8°C) (Ishida et al. In print).

2. Abundance of salmon

Number of salmon caught by 10 operations of drift gillnet was 2,332. It include 1,674 pink, 349 coho, 157 chum, 143 sockeye, 7 chinook, and 2 steelhead (Table 1). No fin-clipped fish were caught.

CPUEs of sockeye, chum, pink, chinook, and steelhead in 1999 were less than mean CPUEs in 1992-1998 (Table 2). Especially, CPUE of chum salmon in 1999 was 9.3 and 42.0% of mean CPUE in 1992-1998.

3. Body size of salmon

Mean fork length and body weight of salmon in 1999 was similar to the values in 1992-1998 (Table 3). Mean fork length and body weight of sockeye, chum, pink, and coho salmon were larger than in 1998.

4. Non-salmonids

During 10 gillnet operations in 1999, 3 cephalopods, 3 sharks, 6 teleosts, and 4 birds were caught. Number of frying squid (*Ommastrephes bartrami*: 130) was largest in non-salmonids, followed by smalleye squaretail (*Tetragonurus cuvieri*: 128), blue shark (*Prionace glauca*: 120), Pacific pomfret (*Brama japonica*: 115), and others. Number of Pacific saury (*Cololabis saira*: 10) was less than mean of 1992-1998 (Ishida et al. In print). Number of smalleye squaretail was larger than the past.

References

Ishida, Y., T. Azumaya, and M. Fukuwaka. In print. Summer distribution of fishes and squids in the western North Pacific Ocean. Bull. Hokkaido Natl. Fish. Res. Inst. No. 62

Table 1. Number of salmon and other organisms caught during the *Hokko maru* salmon research cruise in 1999. C: research gillnet (30 tans; 48-157 mm), A: commercial gillnet (17 tans; 115 mm), F: small-mesh gillnet (2 tans; 29-37 mm).

St	Date	Lat.	Long.	SST	Gear	Tan	Sock-eye	Chum	Pink	Coho	Chi-nook	Steelhead	Flying sq.	Gonate sq.	Club-hook sq	Pomfret	Salmon shark	Spiny dogfish	Blue shark	Pacific saury	Other fishes	Shear-waters	Other birds
2	990629	5000	16500	E	5.0	C	30	41	34	146	1	1	0	0	1	0	0	0	0	0	0	0	2	0
						A	17	43	37	110													20	
						F	2																	
3	990630	4858	16500	E	6.1	C	27	34	12	118	1	0	0	0	0	0	0	0	0	0	0	0	6	1
						A	17	15	8	86	0	0											3	2
						F	2																	
4	990701	4759	16500	E	6.5	C	30	3	14	168	10	0	0	0	1	0	0	0	0	0	0	0	2	2
						A	17	6	8	234	9	1											1	1
						F	2																	
5	990702	4659	16502	E	7.0	C	30	0	15	239	59	1	0	0	8	0	0	0	0	0	0	0	0	0
						A	17		6	248	69	1							1			1		
						F	2																	
6	990703	4558	16502	E	8.9	C	30	0	5	43	31	0	0	0	2	2	0	0	0	0	0	0	0	0
						A	17		2	21	64	3												
						F	2																	
7	990704	4457	16504	E	9.5	C	30	1	10	43	14	0	0	0	1	1	0	0	0	0	0	0	0	0
						A	17		3	26	13		1											1
						F	2																	
8	990707	4357	16457	E	9.7	C	30	0	0	80	25	0	0	0	5	1	0	0	0	1	0	0	0	0
						A	17			58	23		1				1			2				
						F	2																	
9	990708	4300	16500	E	9.4	C	30	0	2	27	16	0	0	0	4	1	7	0	0	0	1	0	0	0
						A	17			26	14			1			3			1			2	
						F	2																	
10	990709	4202	16502	E	12.3	C	30	0	0	1	0	0	0	6	30	29	29	1	0	2	6	69	0	0
						A	17		1					15			16	1						
						F	2																	
11	990710	4101	16430	E	16.3	C	30	0	0	0	0	0	0	27	1	12	45	3	0	40	1	64	0	0
						A	17							81			14			74				
						F	2														3			
	Total					C	297	79	92	865	157	2	0	33	53	46	81	4	0	43	7	133	10	3
						A	170	64	65	809	192	5	2	97	0	0	34	1	1	77	0	1	26	4
						F	20	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
						Total	487	143	157	1674	349	7	2	130	53	46	115	5	1	120	10	134	36	7

Table 2. Number of salmon per 30 tans of research gillnets during the *Hokko maru* salmon research cruise in the western North Pacific.

Year	Sockeye	Chum	Pink	Coho	Chinook	Steelhead	Total
1992	22	18	63	12	0.9	0.3	116.2
1993	7	36	10	9	1	0.2	63.2
1994	11	8	238	9	0	0.4	266.4
1995	11	18	45	12	0.4	0.1	86.5
1996	23	23	147	7	0.1	0.6	200.7
1997	3	18	113	8	1	1	144.0
1998	23	34	132	13	0.4	1	203.4
92-98	14.3	22.1	106.9	10	0.5	0.5	154.3
1999	8.0	9.3	87.4	15.9	0.2	0	120.7

Table 3. Mean fork length (FL; mm) and body weight (BW; g) of salmon caught by research gillnets during the *Hokko maru* salmon research cruise in the western North Pacific. Standard deviations are in parentheses. N: number of measured fish.

	Sockeye			Chum			Pink			Coho			Chinook			Steelhead		
Year	FL	BW	N	FL	BW	N	FL	BW	N	FL	BW	N	FL	BW	N	FL	BW	N
1992	493 (79)	1662 (822)	214	438 (56)	1015 (443)	190	457 (28)	1066 (507)	638	544 (37)	1973 (451)	153	619 (30)	3025 (509)	12	669 (83)	3108 (886)	4
1993	484 (64)	1476 (694)	102	516 (89)	1961 (990)	451	479 (33)	1408 (379)	128	561 (40)	2359 (559)	104	631 (28)	3296 (453)	13	694 (14)	3250 (227)	3
1994	520 (74)	1956 (884)	174	508 (78)	1719 (747)	132	451 (25)	1133 (218)	1379	541 (34)	1920 (406)	102	–	–	0	700 (81)	3520 (953)	5
1995	497 (73)	1686 (771)	206	480 (96)	1547 (890)	244	484 (32)	1464 (285)	557	558 (36)	2360 (457)	127	652 (88)	3834 (1651)	5	744	4750	1
1996	525 (64)	1984 (914)	366	485 (96)	1574 (870)	263	471 (28)	1351 (292)	1315	554 (67)	2109 (496)	79	640	3400	1	610 (95)	2250 (794)	5
1997	441 (55)	1103 (520)	28	423 (91)	1079 (881)	184	446 (29)	1160 (232)	937	532 (43)	1918 (518)	93	614 (39)	2889 (447)	10	621 (114)	2623 (1353)	12
1998	497 (73)	1716 (830)	288	468 (84)	1302 (849)	429	439 (23)	986 (191)	1120	527 (33)	1792 (366)	134	649 (79)	3863 (1797)	4	674 (118)	3519 (2086)	10
1999	503 (59)	1761 (727)	79	487 (81)	1574 (868)	86	446 (26)	1166 (235)	793	549 (34)	2108 (411)	154	630 (20)	3550 (450)	2	–	–	0

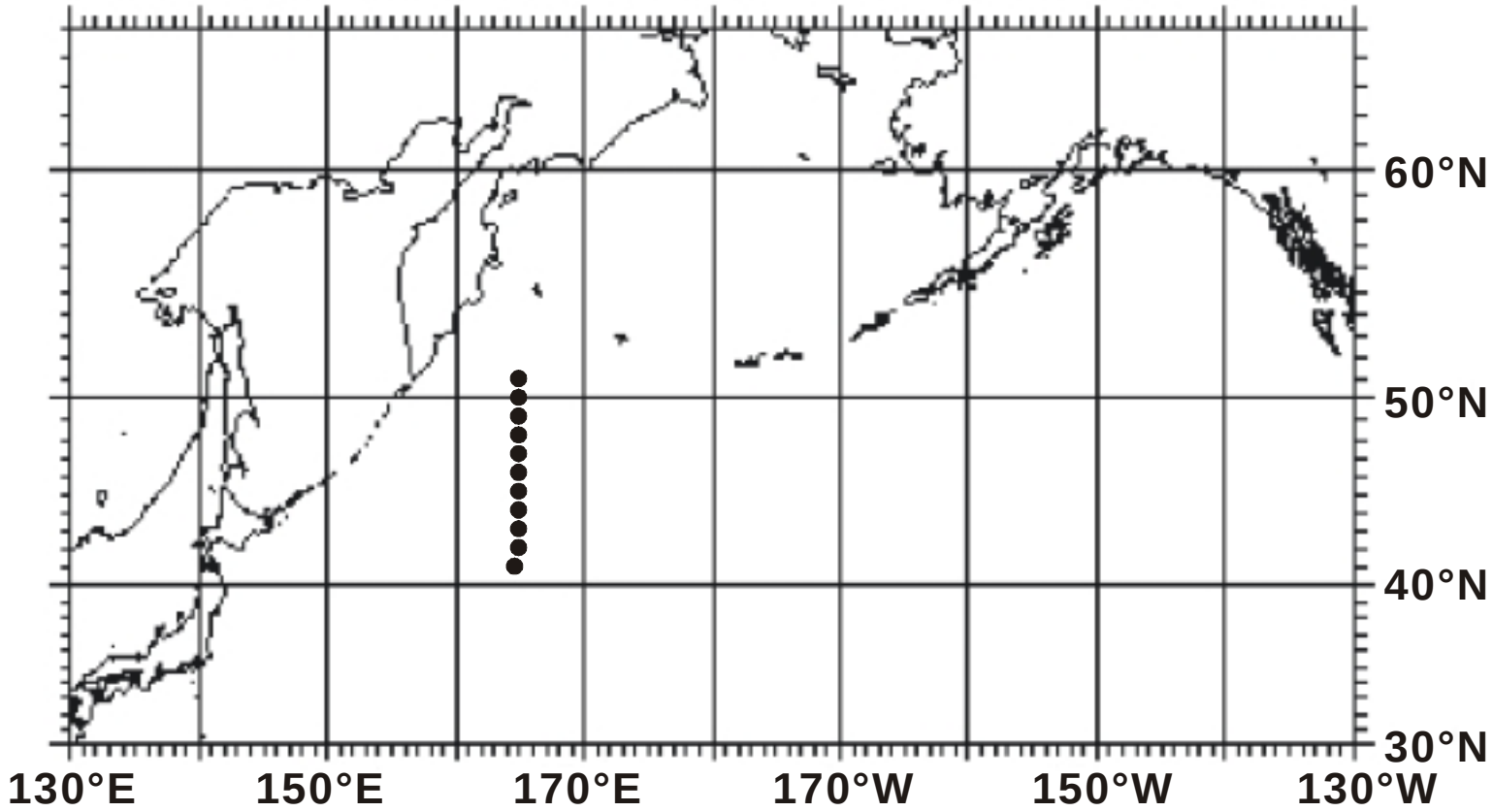

Fig. 1. Map showing observation and sampling stations for the salmon research cruise of the *Hokko maru* in June-July 1999.