Salmonid catches and related observations aboard the Japanese research vessel "Hokko Maru", 1-22 June 1987.

by

N.B. Hargreaves
Dept. of Fisheries and Oceans
Biological Sciences Branch
Pacific Biological Station
Nanaimo. B.C. V9R 5K6

Submitted to the

INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION

by the

Canadian National Section

November 1987

This paper may be cited in the following manner:

Hargreaves, N. B. 1987. Salmonid catches and related observations aboard the Japanese research vessel HOKKO MARU, 1-22 June 1987. 14 pp. (Document submitted to the Annual Meeting of the International North Pacific Fisheries Commission, Vancouver, B.C., Canada. November, 1987.) Department of Fisheries and Oceans, Biological Sciences Branch, Pacific Biological Station, Nanaimo, B.C. V9T 5K6.

INTRODUCTION

In accordance with I.N.P.F.C. agreements, Japan annually conducts an extensive ocean research program to collect data for determining the distribution, abundance, migrations, and continent of origin of salmonids captured in the North Pacific Ocean. In 1987 Japan invited one Canadian scientist to participate in these research activities aboard the Japanese research vessel "HOKKO MARU" during 1-24 June, the first of two cruises scheduled for this vessel in 1987. The author participated as the Canadian representative on this cruise.

The primary scientific objective of this cruise was to capture, tag, and release salmonids to obtain data for determining the distribution and country of origin of salmonids captured within the area encompassed by the Japanese land-based salmon fishery. The second objective was to investigate the variability in catches associated with the timing of longline fishing relative to sunrise. This report provides a synopsis of observations on fishing activities, catches, tagging efforts, oceanographic observations, and results of sighting surveys for marine mammals and man-made debris conducted during this cruise.

METHODS

Fishing Gear

All fishing on this cruise was conducted using surface longline gear. No gillnets were used, and there was no angling. A total of 630 hachi were used, of which 600 were commercially manufactured, and an additional 30 hachi were made up by the crew during the cruise, using materials salvaged from the commercial longline. The "baskets" were constructed of plastic, with a ring of straw-like material around the periphery into which the hooks were imbedded to keep them from tangling. Each longline set consisted of 30 hachi or about 3 km total length. Each hachi was 100 m long, and originally equipped with 49 evenly-spaced hooks. However, the first and last hooks were usually removed from each hachi to facilitate handling, resulting in 47 hooks per hachi, or a total of about 1410 hooks per longline set. Several repeated counts by the author (N=15) indicated that the original number of hooks per hachi was usually 49, but occasionally varied between 48 and 51, apparently due to errors made during manufacture. The hooks were "J" shaped, with a single barb, a nominal total length of 5 mm, and a distance of 12 mm between the sharpened tip of the hook and the main stem of the "J". Each hook was tied to the end of a 1 meter length of 15 kg test nylon monofilament fishing line, which in turn was tied to the longline. The main line of each hachi was constructed of four twisted strands of multi-filament nylon. Each hachi also typically had seven (or occasionally six) wooden or styrofoam floats (approximately 16 mm long x 35 mm wide x 21 mm thick) tied with nylon string to the main line at equally spaced intervals, each at a distance of about 200 mm from the main line.

The majority of the longline gear was prepared during the first three days at sea, prior to arriving at the first station. The hooks of each hachi were individually baited by hand, using salted anchovy, during the early part of the cruise. The hachi were then tied into bundles of ten, and stored in the freezer at -35 to -40°C until required. The 30 hachi required for each set were usually brought out of the freezer and stored on deck a few hours prior to the initiation of fishing activity. However, much of the bait was still frozen when the longline went into the water. The longline was always deployed over the stern of the vessel, with the vessel heading into the wind and travelling at approximately 4 knots. The longline was retrieved from the foredeck, over the port side. The captain used both the main propellers and a bow thruster to maneuver the ship while the longline was retrieved, which usually proceeded as quickly as the longline could be manually hauled aboard. A radio buoy, equipped with an orange flag and strobe light on a whip antennae,was attached to each end of the longline to facilitate locating and recovering the long line. Two additional spar buoys, each equipped only with a orange flag, were attached to the long line. The first buoy was tied to the longline between the tenth and eleventh hachi, and the second buoy was attached between the twentieth and twenty-first hachi. Aside from the salvaged materials used to make the 30 non-commercial hachi, all the longline was used for only one set. All the used longline was stored aboard the vessel after each set, and although the longline broke several times in rough seas, virtually all of it was recovered. The crew frequently threw overboard small pieces of monofilament, regardless of whether or not hooks were attached, but to my knowledge none of the main line was discarded at sea. In my opinion the pieces of monofilament that were discarded at sea were too small to represent a hazard to fishes, birds, or marine mammals.

Sampling Activities

Sampling was conducted at 14 stations between 42° and 45°N latitude, and 164° to 177°E longitude (Figure 1). The HOKKO MARU departed from Kushiro, Japan, on the 1 June 1987 at 1400 hrs, arrived at the first station at 1930 hrs on the 4 June, and returned to Kushiro on the 22 June, two days ahead of schedule. A hydrographic cast was conducted immediately after the ship arrived at each station. A PLESSY model 8500 digital display, and model 8700 signal processor were used on deck. An S.T.D. probe was lowered to a maximum depth of 250 m, with the probe halted briefly at 10, 20, 30, 40, 50, 75, 100, 125, 150, 200, 250 m to allow the sensors to stabilize before data was recorded. A bucket sample was used to determine the temperature at the sea surface and a secchi disk was used to determine water transparency (Table 1). Plankton samples were also collected from several depth intervals at each station. Officers and crew kept a continuous watch and recorded all marine mammals and man-made debris sighted from the wheelhouse of the HOKKO MARU throughout the cruise. The author also watched for mammals and debris from either the wheelhouse or the flying deck, but on a more casual basis of an hour or two each day (Table 2).

At each of the seven odd-numbered stations a longline set was conducted at both sunrise and sunset. A longline set was conducted only at sunrise at each of the other seven, even-numbered stations. The speed of the vessel was adjusted such that the longline was typically deployed in 30 minutes and subsequently recovered in 90 minutes. The ship was headed directly into the wind during both deployment and recovery of the longline, which meant that the first hachi deployed was also the first hachi recovered.

The timing of deployment and recovery of the longline gear was precisely varied according to three patterns (denoted as "A", "B", and "C") to obtain data on the catchability of salmon relative to sunrise and sunset. For pattern "A", deployment of the longline commenced 90 minutes before sunrise and was completed 60 minutes before sunrise. The ship then returned to the free end of the first hachi, waited until 30 minutes before sunrise, then hauling of the longline was commenced, and was usually completed by 30 minutes after sunrise. Thus, the longline was set in morning, in the dark, and recovery of the longline spanned the sunrise period. For pattern "B", deployment of the longline commenced 30 minutes before sunrise and was typically completed within a few minutes of sunrise. Recovery of the longline began 30 minutes after sunrise, and was usually completed about 90 minutes after sunrise. Pattern "C" was used only for the evening longline sets, with deployment of the longline beginning 30 minutes before sunset, recovery beginning 30 minutes after sunset, and recovery typically completed by about 90 minutes after sunset. The station locations, time of sunrise and sunset, time of fishing, and type of fishing pattern at each station are summarized in Table 3.

Tagging Procedures

The usual procedure was for each fish to be lifted aboard the vessel with a dipnet as the longline was retrieved. The monofilament line (attaching the hook to the longline) was cut with a knife immediately after each fish was secured in the dipnet. The fish was then lowered or dropped onto a thick foam mattress on the deck. The purpose of the foam was to absorb the impact and reduce injury to the fish, particularly if the fish could not be processed immediately and continued to thrash around on deck. Each fish was then picked up and examined. If the hook was still imbedded in the fish, it was removed, usually with a pair of needle-nosed pliers. If the fish was marked (e.g., missing adipose fin) it was killed and retained for further measurements. If the fish was not marked and was not bleeding extensively after the hook was removed, it was placed in a collapsible canvas holding tank secured to the deck. This tank was approximately 1.5 m square and 1 m deep. A deck hose provided the tank with a continuous supply of fresh seawater at a rate of approximately 40 liters per minute. Fish placed in the holding tank were constantly watched, and any that bled excessively, or that did not right themselves and begin swimming normally within a few minutes, were removed from the tank and killed. When sufficient numbers of "healthy" fish had accumulated in the holding tank, each fish was dipnetted out of the tank, laid in a "V" shaped wooden trough, and a length measurement and scale samples taken. The fish was then tagged with a small (1.7 mm diameter), red and white

plastic disk. These tags were attached to the fish just anterior to the dorsal fin, using a 127 mm long nylon cable tie (model# 08350, available from Dennison Cable Tie Products, Dennison Transoceanic Corporation, Tokyo, Japan), similar to that used by electricians to secure electrical wires. The cable tie was inserted into the fish by using a machined, hollow, stainless steel needle to puncture the flesh and guide the cable tie through the flesh. All tags used on this cruise were individually numbered. One tag was lost at station 8, but otherwise the tags were carefully used in the exact order of the numbers on the tags, beginning with number Y-6001 at station 1 and ending with number Y-6977 at station 14 (Table 3).

All salmonids that were not tagged were retained on the vessel, because either they were missing the adipose fin (11 fish), or were deemed to be unsuitable for tagging due to the condition of the fish. In the latter case, the criterion for retention of fish was apparently the severity of injuries sustained by the fish, as indicated by either excessive bleeding or abnormal behaviour in the holding tank. After tagging was completed, most fish were immediately tossed over the side of the vessel. The fish retained aboard the HOKKO MARU were used to obtain additional biological data and samples, including length, weight, sex, gonad weight, age (from subsequent analyses of scale samples), and a few blood samples for parasite work.

At the author's request, the first 5 salmon tagged at most stations were retained for a short period after tagging to allow observation of their condition and behaviour. These fish were placed in a separate tank, approximately 1.5 meters square by 0.75 meters deep, and supplied with running seawater. After all five fish were placed in the tank, the fish were observed by the author for a variable period of time, ranging from 15 to 90 minutes. Notes were kept regarding the behaviour and condition of these fish, with particular attention paid to their condition just prior to release. These fish were released in the usual manner when all other fish that had been captured had been processed. Thus, the length of time that any particular group of fish was observed was determined primarily by how many fish were captured, and how quickly the tagging began after fish started to be brought aboard.

RESULTS and DISCUSSION

Catches

At all stations the catch consisted almost exclusively of salmonids, with a total catch of 2857 salmon and steelhead trout (Table 4). Pink and chum salmon were captured at all stations and were the most common species. A total of 1347 pink salmon and 1182 chum salmon were captured, with the highest catches of pinks occurring at stations closest to Japan, and the highest catches of chum occurring near the centre of the sampling grid. A total of 267 coho salmon were captured, with the highest catches tending to occur at the more eastern and southern stations. However, at least 1 coho was captured at all but the most western stations (#1, 13, and 14). A total of 15 chinook salmon were captured at 9 different locations, with the highest catches

typically occurring at the most eastern and southern stations. A total of 23 steelhead trout were captured, with the highest catches tending to occur at the most eastern stations, although one steelhead was caught at station #14. The catches of sockeye were consistently low, with most captured at the northern stations closest to Japan. Overall, salmonid catches tended to be highest in light to moderate sea conditions, and somewhat lower under very rough sea conditions. Possibly this may relate to the amount of "action" of the longline and baited hooks, which appeared to be very erratic in heavy seas.

The by-catch and incidental catches were consistently very low. In addition to salmonids, a total of 1 shark, approximately 17 pomfret, 6 squid, and 1 lancet fish were captured on the longline and brought aboard. The only incidental catch was a total of approximately 52 sea birds, consisting primarily of one species, the Black Footed Albatross. Most sea birds had become tangled in the longline rather hooked, and were released alive. Many of these birds sustained minor injuries, such as small cuts, bruises, or lost feathers, but few appeared to be seriously injured, judging from the fact that most flew away from the ship immediately after being released. However, two birds were seriously injured, judging from the loss of blood, and two other birds were released without completely untangling them from the longline. In all four cases these birds repeatedly attempted to fly after release, but did not manage to get airborne. In my opinion, it is unlikely that these four birds survived. No marine mammals were hooked or became tangled in the fishing gear, although porpoise were frequently seen near the ship, and numerous fur seals were also observed taking salmon off the longline or eating salmon still attached to the longline at several stations.

Recovery of Marked Salmonids

The recovery of marked salmonids on this cruise is consistent with previous data for steelhead, but may indicate a substantial extension to the currently accepted ocean range of North American coho. The adipose fin was missing from a total of nine steelhead trout and two coho salmon captured on this cruise (Table 5). After biological measurements were taken, the nose of each of these fish was amputated, frozen, and eventually individually labelled, stored in salt, and shipped to the Far Seas Fisheries Research Laboratory in Shimizu, Japan. These noses were later shipped from Shimizu to the United States, where each nose was checked for the presence or absence of a binary-coded wire tag. The results of the final analyses were not yet available when this report was prepared. However, the amputated adipose fin indicates that these fish probably originated in either Canada or the United States. The adipose-clipped steelhead were captured at stations 5, 6, 7 and 8, locations that are all within the boundaries of the known ocean range of tagged steelhead that have originated in North America. The two coho with missing adipose fins were both captured at station 6. The exact location of this station varied somewhat between the morning and evening longline sets (Table 3), but was approximately 42° 54' N latitude and 174° 50' E longitude. This is substantially further west and south than has previously been reported for any recoveries of coho tagged in either Canada or the United States, or

tagged on the high seas and recovered in North America, and thus may represent a significant extension of the known oceanic range of North American coho. The validity of this interpretation will be easily assessed if the noses of these fish prove to contain a coded wire tag.

Releases of Tagged Fish

A total of 977 salmonids were tagged on this cruise, equivalent to an average of approximately 34% of the total catch of salmonids (Table 6). This is lower than the percentage of salmonids commonly tagged on most North American research vessels. For example, Shepard et al. 1967 tagged an average of 81% of the 6221 salmon caught by longline fishing from Canadian vessels during May 5 to July 26, 1967, and commented that " .. commonly over 90% of the salmon taken in a longline set are judged to be "lively" enough to be tagged and released." More recently, 82% of the salmonids caught by longline during a high seas cruise of the Canadian research vessel W.E. RICKER were tagged and released (LeBrasseur et al. 1987). It is not clear why the percentage of fish tagged tends to be lower on Japanese vessels. Possibly Japanese crews are more critical than North American crews when assessing whether or not each fish is sufficiently healthy to be tagged.

The vast majority of fish recovered quickly when retained for short periods after tagging, and appeared normal and healthy at the time of release (Table 7). The plastic tie holding the tag on one fish opened while the fish was in still in the observation tank and was replaced. One additional pink salmon from the morning longline set at station 3 developed a bloody eye after approximately 15 minutes in the holding tank. This fish was held for approximately 30 minutes after the other 4 fish were released and the bloody eye did not appear to get any worse. However, the behaviour of this fish was abnormal in the tank, including repeatedly running into the side of the tank, and occasional bursts of rapid swimming, followed by periods during which it lay on its side on the bottom of the tank. However, all the other fish appeared to be healthy and active at the time of release. Aside from being held for a short time after tagging, the fish placed in the holding tank for observation apparently were not handled or treated any differently than all of the other fish that were tagged. Thus, in my opinion virtually all of the salmon tagged and released on this cruise should have an excellent chance of survival.

ACKNOWLEDGEMENTS

I thank the Government of Japan for permission to visit the Far Seas Fisheries Laboratory in Shimizu, Japan, and the invitation to participate in the research activities of the HOKKO MARU. I also appreciate the kind assistance provided by Miki Ogura of the Far Seas Fisheries Research Laboratory and chief scientist on this cruise, and Atsushi Takei, of the Resources Division, Fisheries Agency of Japan, who greatly assisted with overcoming language difficulties during the cruise and in Japan. Thanks also to Kakusuke Nakayama, Captain of the HOKKO MARU, and the officers and crew of the HOKKO MARU, who impressed me greatly with their professionalism, friendship, and comradery while aboard the HOKKO MARU and in the port of Kushiro.

REFERENCES

LeBrasseur, R., B. Riddell, and T. Gjernes. 1987. Ocean salmon studies in the Pacific Subartic boundary area. (Document submitted to the annual meeting of the International North Pacific Fisheries Commission, Vancouver, Canada, November, 1987). Department of Fisheries and Oceans, Biological Sciences Branch, Pacific Biological Station, Nanaimo, B.C. V9R 5K6.

Shepard, M. P., C. E. Turner, K. V. Aro, and L. W. Barner. 1967. Results of salmon longline fishing surveys in the Gulf of Alaskan 1966-1967. (Document submitted to the annual meeting of the International North Pacific Salmon Commission, October, 1967. I.N.P.F.C. Doc. No. 1000). 44 pp. Fisheries Research Board of Canada, Biological Station, Nanaimo, B.C.).

Table 1. Summary of oceanographic observations (T=temperature in °C, S=salinity in ppt., secchi=secchi disk depth, *= indicates data not recorded by author). Similar data were collected at station 1 but were not recorded by the author.

	STATION NUMBER											
	2		3		4		5		6		7	
Depth	T	S	T	S	T	S	T	S	T	S	T	S
0m	6.1	33.2	6.0	33.1	10.3	33.9	7.9	33.3	11.0	33.5	10.9	33.7
10m	5.0	33.2	5.8	33.1	10.0	33.9	6.3	33.4	10.6	33.5	10.3	33.7
20m	*	*	5.3	33.1	9.9	33.9	5.6	33.3	9.2	33.5	9.2	33.8
30m	4.3	33.2	4.9	33.2	9.5	33.9	5.5	33.3	8.8	33.5	9.0	33.8
40m	4.2	33.2	4.7	33.2	9.3	33.9	5.2	33.2	8.6	33.5	8.9	33.8
50m	4.1	33.2	4.7	33.2	8.8	34.1	4.8	33.3	8.1	33.6	8.4	33.8
75m	2.8	33.2	3.6	33.2	8.3	34.1	3.8	33.3	6.6	33.8	7.4	33.9
100m	2.4	33.2	2.9	33.3	8.0	34.1	3.5	33.3	6.3	33.8	7.1	33.9
125m	2.5	33.3	2.5	33.3	7.9	34.1	3.3	33.3	6.7	33.9	7.0	33.8
150m	3.1	33.5	3.0	33.5	7.9	34.1	3.3	33.3	6.3	33.8	6.8	33.8
200m	3.5	33.7	3.3	33.8	7.2	34.0	4.0	33.7	6.3	33.9	6.5	33.8
250m	3.4	33.8	3.4	33.9	6.1	33.9	3.8	33.8	6.1	33.9	6.6	33.9
Date:	5 June		6 June		7 June		8 June		9 June		10 June	
Time:	14:50		15:50		14:18		13:28		14:55		14:20	
Secchi:	16 m		*		*		*		14 m		15 m	

	STATION NUMBER													
	8		9		10		11		12		13		14	
Depth	T	S	T	S	T	S	T	S	T	S	T	S	T	S
0m	6.7	33.2	7.0	33.0	6.9	33.2	6.1	33.1	5.8	33.2	6.9	33.3	7.6	33.3
10m	6.6	33.2	6.5	33.1	6.1	33.2	5.6	33.2	5.6	33.2	6.6	33.3	7.2	33.3
20m	6.6	33.2	6.4	33.2	6.1	33.2	4.4	33.2	5.2	33.2	6.4	33.3	6.9	33.3
30m	5.8	33.2	5.5	33.3	5.0	33.2	3.7	33.2	5.1	33.2	5.7	33.4	5.3	33.4
40m	5.6	33.2	5.3	33.3	5.0	33.2	3.4	33.2	3.7	33.2	5.2	33.4	5.2	33.4
50m	5.1	33.3	5.2	33.3	4.6	33.2	2.9	33.2	3.2	33.3	4.8	33.5	4.3	33.4
75m	3.9	33.3	4.4	33.3	3.6	33.3	2.3	33.3	2.0	33.3	4.0	33.5	2.4	33.6
100m	3.8	33.4	3.9	33.4	3.4	33.3	2.1	33.3	1.8	33.3	3.6	33.5	3.0	33.5
125m	3.6	33.4	3.7	33.4	3.2	33.3	1.9	33.3	1.8	33.3	3.6	33.6	3.9	33.6
150m	4.1	33.5	4.3	33.6	3.4	33.4	2.8	33.6	1.9	33.4	3.7	33.6	4.5	33.7
200m	3.8	33.8	4.5	33.8	3.8	33.7	3.4	33.8	2.9	33.7	3.9	33.6	4.1	33.8
250m	3.7	33.8	3.6	33.8	3.6	33.8	3.4	33.9	3.1	33.8	4.3	33.8	3.3	33.8
Date:	11 June		12 June		13 June		14 June		15 June		16 June		17 June	
Time:	17:15		15:35		15:05		14:05		14:20		15:00		14:35	
Secchi:	19 m		17 m		20 m		15 m		8 m		10 m		13 m	

Table 2. Sightings of marine mammals and man-made debris made by the author.

Date	Time of day	Sea conditions	Observations and comments
1 June	14:00 - 16:00	Beaufort 2	near coast of Japan -many gill nets in water
4 June	14:00 - 15:00	Beaufort 3	log or board, approx. 3 meters long
5 June	13:00 - 14:45	Beaufort 3	stick, approx. 2 meters long; small plastic container, approx. 300 mm long.
6 June	14:20 - 15:20	Beaufort 5 light fog	school of porpoise crossed bow of ship, within 100 meters. Approx. 10 animals, but could not determine species due to heavy seas.
7 June	- -	Beaufort 4 heavy fog	visibility too poor for observations
9 June	12:15 - 13:15	Beaufort 4	no mammals or debris sighted
10 June	12:04 - 13:06	Beaufort 4 light fog	no mammals or debris sighted
13 June	13:15 - 14:20	Beaufort 4	no mammals or debris sighted
15 June	13:00 - 14:15	Beaufort 3	approx. 50 porpoise passed within 50 m of ship

Table 3. Ship's position at beginning of longline set, time of sunrise or sunset, time of longline set (start time - finish time), type of fishing pattern, and codes on tags used for tagging salmonids, at each station.

Station	Position	Sunrise	Sunset	Longline set	Type	Tag codes used
1	42°32.7'N 164°30.8'E	03:26		01:54 - 04:08	A	Y-6001 to Y-6051
2	42°35.5'N 166°44.5'E		18:27	17:54 - 20:05	C	Y-6052 to Y-6099
2	42°35.3'N 166°45.8'N	03:16		02:44 - 05:24	B	Y-6100 to Y-6195
3	42°40.0'N 168°45.1'E	03:08		01:39 - 03:57	A	Y-6196 to Y-6239
4	42°44.9'N 170°37.9'E		18:14	17:44 - 18:18	C	Y-6240 to Y-6247
4	42°44.6'N 170°38.3'E	02:59		02:29 - 03:03	B	Y-6248 to Y-6301
5	42°51.7'N 172°27.5'E	02:52		01:19 - 03:45	A	Y-6302 to Y-6360
6	42°54.1'N 174°46.0'E		18:01	17:29 - 19:43	C	Y-6361 to Y-6387
6	42°52.7'N 174°44.5'E	02:44		02:14 - 05:02	B	Y-6388 to Y-6475
7	42°29.4'N 176°33.0'E	02:33		01:04 - 03:24	A	Y-6476 to Y-6493
8	44°38.9'N 176°46.3'E		17:58	17:30 - 19:43	C	Y-6494 to Y-6510[1]
8	44°38.0'N 176°46.5'E	02:28		01:59 - 04:28	B	Y-6511 to Y-6577
9	44°49.4'N 174°14.1'E	02:38		01:09 - 03:34	A	Y-6578 to Y-6634
10	44°50.0'N 172°09.8'E		18:19	17:49 - 20:07	C	Y-6635 to Y-6668
10	44°49.6'N 172°09.4'E	02:44		02:14 - 04:39	B	Y-6669 to Y-6749
11	44°49.8'N 170°09.1'E	02:53		01:24 - 03:59	A	Y-6750 to Y-6810
12	44°45.2'N 168°10.8'E		18:33	18:04 - 20:19	C	Y-6811 to Y-6824
12	44°49.4'N 168°10.2'E	03:00		02:29 - 05:00	B	Y-6825 to Y-6892
13	44°50.8'N 166°51.0'E	03:05		01:34 - 04:15	A	Y-6893 to Y-6929
14	44°48.2'N 164°48.0'E		18:49	18:20 - 20:44	C	Y-6930 to Y-6955
14	44°52.1'N 164°48.9'E	03:13		02:44 - 05:01	B	Y-6956 to Y-6977

[1]tag number Y-6502 was lost.

Table 4. Sea conditions (Beaufort scale), time at beginning of longline set, and catches of salmonids at each station.

Station	Time	Sea conditions	SALMONID CATCH					
			Sockeye	Chum	Pink	Coho	Chinook	Steelhead
1	01:54	Beaufort 3	2	7	204	0	0	0
2	17:54	Beaufort 2-3	0	47	66	5	0	0
2	02:44	Beaufort 4	4	49	172	2	2	0
3	01:39	Beaufort 4	0	57	58	1	2	1
4	17:44	Beaufort 4	0	14	16	6	0	0
4	02:29	Beaufort 3-4	0	148	55	14	2	0
5	01:19	Beaufort 4	0	57	41	47	2	6
6	17:29	Beaufort 4	0	26	3	22	1	1
6	02:14	Beaufort 4-5	0	137	5	64	1	4
7	01:04	Beaufort 5-6	0	13	2	18	0	3
8	17:30	Beaufort 4	0	19	13	8	1	2
8	01:59	Beaufort 2	1	136	46	13	0	0
9	01:09	Beaufort 4	1	51	56	20	1	3
10	17:49	Beaufort 2	0	50	31	7	2	1
10	02:14	Beaufort 3	4	91	113	22	0	0
11	01:24	Beaufort 6-7	0	81	60	4	1	1
12	18:04	Beaufort 3	2	4	11	8	0	0
12	02:29	Beaufort 4	0	160	94	5	0	0
13	01:34	Beaufort 4	4	28	137	0	0	0
14	18:20	Beaufort 4	1	4	84	1	0	1
14	02:44	Beaufort 5	4	3	80	0	0	0

Table 5. Summary of data for all salmonids lacking an adipose fin.

Species	Station number	Location	Date (dd/mm/yy)	Time of set	Sex	Length (mm)	Weight (gm)
steelhead	5	42° 51.72'N 172° 27.49'E	09/06/87	morning	F	698	3600
steelhead	5	42° 51.72'N 172° 27.49'E	09/06/87	morning	M	682	3150
steelhead	6	42° 54.06'N 174° 46.04'E	09/06/87	evening	M	602	2180
coho	6	42° 54.06'N 174° 46.04'E	09/06/87	evening	M	552	1970
steelhead	6	42° 52.72'N 174° 44.54'E	10/06/87	morning	F	822	5850
steelhead	6	42° 52.72'N 174° 44.54'E	10/06/87	morning	F	590	2100
steelhead	6	42° 52.72'N 174° 44.54'E	10/06/87	morning	M	524	1560
steelhead	6	42° 52.72'N 174° 44.54'E	10/06/87	morning	M	570	1980
coho	6	42° 52.72'N 174° 44.54'E	10/06/87	morning	M	570	2050
steelhead	7	42° 29.39'N 176° 33.04'E	11/06/87	morning	F	666	2900
steelhead	8	44° 38.03'N 176° 46.46'E	11/06/87	evening	M	765	3600

Table 6. Number and percentages of catch of each species that were tagged and released.

Species	Total catch	No. tagged	% tagged
Pink salmon	1347	404	30.0
Chum salmon	1182	400	33.8
Coho salmon	267	143	53.6
Chinook salmon	15	10	66.7
Sockeye salmon	23	13	56.5
Steelhead trout	23	7	30.4
All salmonids	2857	977	34.2

Table 7. Summary of observations concerning the condition of salmon held for short periods after tagging (Fishing Time= time of longline set; Observed= number of tagged salmonids observed; Period= number of minutes fish were observed after tagging; Condition= condition of fish at end of observation period).

Station	Fishing time	Observed	Period	Condition
1	morning	5	15	all healthy and active
2	morning	5	20	all healthy and active
3	morning	4	23	all healthy and active
		1	53	pink salmon developed bloody eye, and behaving abnormally
4	evening	5	45	all healthy and active
5	morning	5	60	all healthy and active
6	evening	5	90	all healthy and active
6	morning	5	60	all healthy and active
7	morning	5	39	all healthy and active
8	evening	5	30	all healthy and active
8	morning	5	60	all healthy and active
9	morning	5	54	all healthy and active
10	evening	5	63	all healthy and active
10	morning	5	60	all healthy and active
11	morning	5	56	all healthy and active
12	evening	5	33	all healthy and active
12	morning	5	65	all healthy and active
13	morning	5	41	all healthy and active
14	evening	5	51	all healthy and active
14	morning	5	34	all healthy and active

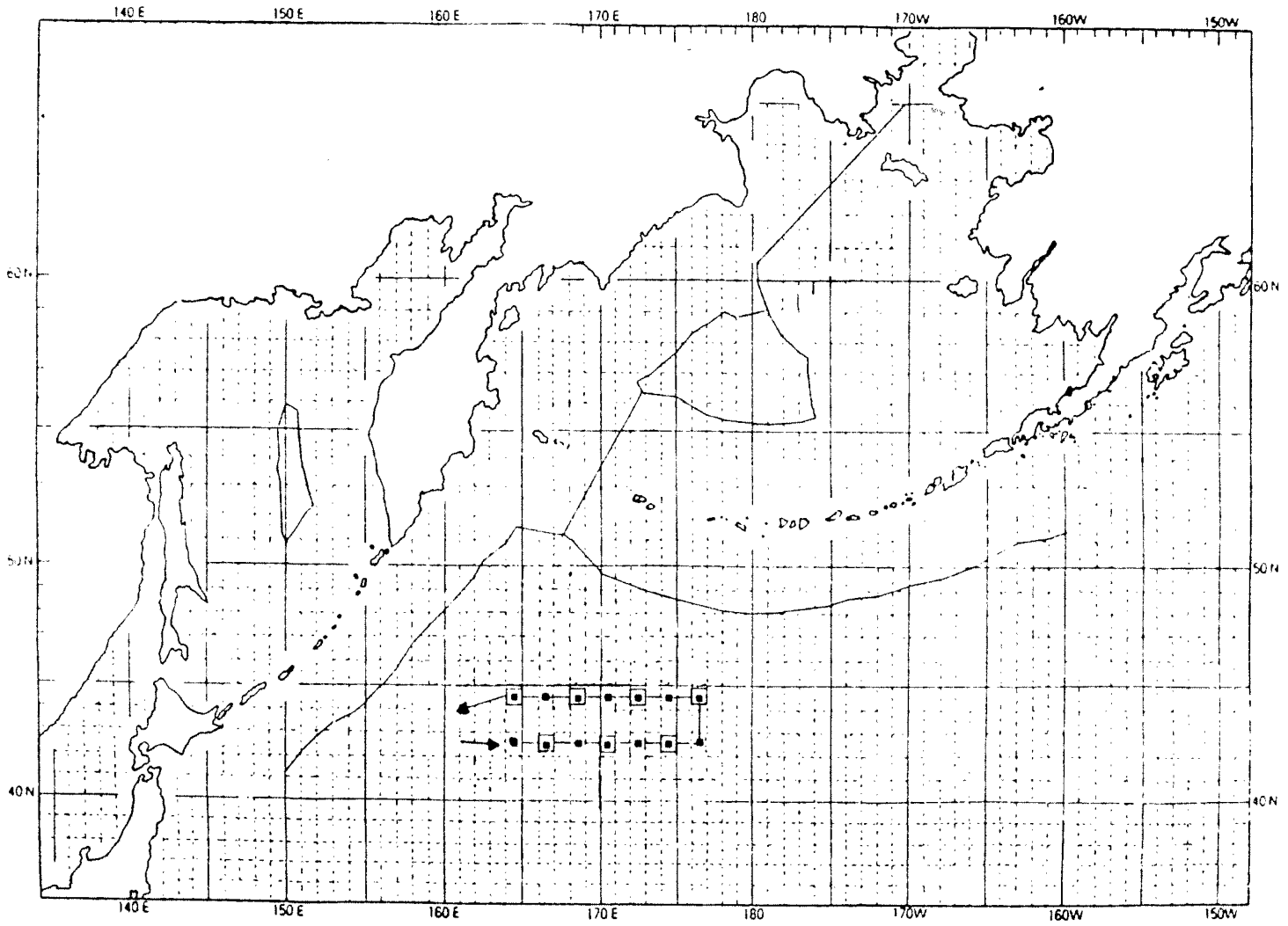

Figure 1: Cruise track and approximate locations of stations. Longline sets were made at both dawn and dusk at seven stations (▣), but only at dawn at the other seven stations (■). (Adapted from figure provided by Miki Ogura, Far Seas Fisheries Research Laboratory, Shimizu, Japan).