

**U.S.-JAPAN COOPERATIVE HIGH SEAS SALMONID  
RESEARCH IN 1990: SUMMARY OF RESEARCH ABOARD  
THE JAPANESE RESEARCH VESSEL *HOKUHO MARU*,  
4 JUNE TO 19 JULY**

by

Nancy D. Davis

FISHERIES RESEARCH INSTITUTE  
School of Fisheries  
College of Ocean and Fishery Sciences  
University of Washington  
Seattle, WA 98195  
U. S. A.

Submitted to the  
International North Pacific Fisheries Commission  
by the  
United States National Section

September 1990

THIS PAPER MAY BE CITED IN THE FOLLOWING MANNER:

Davis, N. D. 1990. U.S.-Japan cooperative high seas salmonid research in 1990: summary of research aboard the Japanese research vessel *Hokuho maru*, 4 June to 19 July. (INPFC Doc.) FRI-UW-9010. Fish. Res. Inst., Univ. Washington, Seattle. 24 pp.

**U.S.-JAPAN COOPERATIVE HIGH SEAS SALMONID  
RESEARCH IN 1990: SUMMARY OF RESEARCH ABOARD  
THE JAPANESE RESEARCH VESSEL *HOKUHO MARU*,  
4 JUNE TO 19 JULY**

**ABSTRACT**

A U. S. scientist participated in the cruise of the Japanese research vessel *Hokuho maru* from 4 June to 19 July, 1990. Morning and evening longline sets (total of 62 sets) were made at 32 stations in the North Pacific Ocean southwest of 47°N latitude, 180° longitude, and the catch was 5,071 salmonids (*Oncorhynchus* spp.). Pink (*O. gorbuscha*; 44% of total catch), chum (*O. keta*; 38%), and coho salmon (*O. kisutch*; 17%) were abundant in the catch, but chinook salmon (*O. tshawytscha*) and steelhead (*O. mykiss*) were infrequent in the catch (each equaled 1% of the catch). No sockeye salmon (*O. nerka*) were caught. An overall average of 71% of the salmonids caught were tagged and released. Stomach contents from 322 chum, 267 pink, 251 coho, and 8 chinook salmon and 9 steelhead were identified to major taxonomic groups. The stomachs of chum salmon most often contained unidentifiable, heavily-digested material, but gelatinous zooplankton, such as ctenophores were also common. Copepods, amphipods, chaetognaths, and pteropods were common in the stomachs of pink salmon. Coho salmon consumed predominantly fish and squid. Thirty-five percent of all salmon stomachs collected from morning longline sets were empty, compared with only four percent of stomachs collected from evening sets. Recommendations for future high seas salmonid tagging operations include taking extra scales from coho, sockeye, and chinook salmon, releasing live-caught steelhead missing adipose fins found east of 165° E longitude, and releasing all salmonids that are alive at the time they are tagged, despite their condition.

**INTRODUCTION**

In accordance with the 1986 Memorandum of Understanding on salmon research of the International North Pacific Fisheries Commission (INPFC), in 1990 a U.S. scientist participated in salmon research aboard the Japanese research vessel *Hokuho maru*. The primary objective of the INPFC-related research conducted by this vessel was to live-

capture salmon for the purposes of biological sampling and tagging in the area south of 46° N latitude. This report summarizes the results of the sampling and tagging operations and my observations on the stomach contents of salmonids caught on surface longlines. The investigation of salmonid stomach contents was made with two objectives: first, to describe the major prey categories found in the stomachs, and second, to describe the differences in prey taxa among the several species of salmonid predators.

## METHODS

### BIOLOGICAL SAMPLING AND TAGGING OPERATIONS

Sixty-two longline operations were made at 32 stations between 11 June and 14 July, 1990, in the area southwest of 47° N latitude and 180° longitude (Fig. 1). The longline was set approximately 30 minutes before sunrise or sunset and allowed to fish for 60 minutes before the crew commenced to haul it aboard. Thirty zaru (plastic trays used to hold units of longline; each zaru contains 120 m of longline and 49 hooks) were fished at all morning and evening sets until 22 June when effort changed to fishing 40 zaru in the morning and 30 zaru in the evening. This regime was followed except in several cases when fewer zaru were set (see 25 June and 10-11 July; Table 1).

At each of the 32 longline stations, oceanographic data including temperature and salinity were recorded to a depth of 260 m, or more, using an Alec Memory S. T. D. sensor (model AST-1000; Alec Electronics Co. Ltd., Japan). These data were collected as part of the routine oceanographic sampling procedures of the *Hokuho maru*. I grouped the oceanographic data into eight north-south transects from 165°30' E to 179°30' E longitude at intervals of 2° of longitude. Each transect was composed of four stations located at one degree intervals from 43°30' N to 46°30' N latitude (Fig. 1). Temperature and salinity data recorded at 10 m depth intervals are shown in Appendix 1 through Appendix 8.

The procedure used by the crew to sample live-caught fish included measuring fork length, scale sampling, and applying disk tags. Scales were removed from the INPFC preferred area (area A) either above or below the lateral line. One scale per fish was removed from each of chum salmon, pink salmon, and steelhead, and one scale from each side of the fish was sampled from coho and chinook salmon. These scales were placed on gummed cards. Additional scales were collected (scrape samples from area A) from coho

and chinook salmon. The scrape samples were placed in individual packets. The tag was applied just anterior to the dorsal fin, and was attached to the fish using a plastic cinch strap. If the fish was injured, e.g., a slash due to a predator, this condition was noted. If the hook was swallowed by the fish, it was removed using one of several hook-removing tools (the "hook-out" tool, pliers, tools made by the crew, or forceps). If the hook was so deeply swallowed that it could not be removed in several attempts, it was left in the fish, and this was also noted. Fish were examined for missing adipose fins. Live steelhead caught east of 165° E longitude that were found to have missing adipose fins were noted, tagged, and released.

Fish that died while on the longline, or that died in the live tank (stopped opercular movements), or that were bleeding profusely from the gills were set aside for biological sampling. Scales were sampled by the same procedure used with fish that had been tagged, except that more scales were removed in the scrape samples from coho and chinook salmon. Body length, body weight, and gonad weight were measured; the heads of chinook salmon were retained (for later examination for *Myxobolus* spp. parasites in the laboratory); and snouts of dead steelhead missing adipose fins were removed.

#### COLLECTION OF SALMONID STOMACHS

Stomachs were collected from salmonids caught in morning and evening longline sets that died before they could be tagged or that were bleeding very heavily from the gills. Usually these fish were numerically sufficient to provide stomach samples (up to 16 fish per species). Rarely, an additional fish would be sacrificed if it was unusually large, in order to provide data from a wide range of fish sizes.

After the crew's collection of biological data, I removed the stomach from the esophagus to the pyloric valve. Each stomach was weighed to the nearest gram; the contents were removed and the stomach was rinsed with water, blotted, and weighed again. Weight of stomach contents was determined by subtraction. Stomach contents were examined visually without magnification and identified to major prey categories that included the following: fishes, squids, copepods, euphausiids, amphipods, other, and unidentified mush. "Other" included the following groups: polychaetes, chaetognaths, shrimp, pteropods, ostracods, isopods, and gelatinous zooplankton. "Unidentified mush" was composed of indistinguishable material that was heavily digested. This material could

not be identified confidently to taxonomic group without magnification. Occasionally, to verify identification of prey categories and to develop a more detailed list of prey organisms, subsamples of stomach contents were examined with a binocular dissecting microscope. For each stomach, the percent volume of each prey category was estimated by eye.

Fish were caught on longlines baited with salted anchovy (*Engraulis japonicus*). Bait found in the stomachs was easy to separate from anchovy eaten as fresh prey. Salted anchovies have green skin and flesh color, whereas fresh anchovies have blue skin and white flesh color. Presence of bait in the stomach was noted, and the weight of bait was measured and subtracted from the weight of stomach contents. Because bait was not considered as prey, it was not included in the estimate of percent volume of prey. Likewise, a stomach containing only bait was considered empty.

To summarize the results of the stomach content analysis, the percent occurrence of each major prey category was calculated and combined into four groups according to capture location in degrees latitude for chum, pink, and coho salmon. Too few chinook and steelhead stomachs were collected to summarize the results in this manner.

## RESULTS AND DISCUSSION

### FISHING AND TAGGING OPERATIONS

In total, 5,071 salmonids were caught and 3,591 fish were disk-tagged and released (Tables 1 and 2). Pink salmon was the most abundant species (44% of the catch) followed by chum (38%) and coho salmon (17%). Chinook salmon and steelhead were the least abundant species (each equaled 1% of the catch), and no sockeye salmon were caught. A total of 1,480 salmon either died before being tagged or were required for experiments, so an overall average of 71% of the salmonids caught were tagged and released.

Several steelhead missing adipose fins were captured alive and released. One steelhead missing an adipose fin died, so its snout was removed for later inspection for the presence of a coded-wire tag. No other salmonids with missing adipose fins were identified.

## SALMONID STOMACH CONTENTS

Most of the stomachs examined were from chum (n=322), pink (n=267), and coho salmon (n=251) (Table 3). Few chinook salmon (n=8) and steelhead (n=9) stomachs were examined. Thirty-five percent of stomachs collected from morning longline sets were empty, compared with only four percent of stomachs collected from evening sets (Table 3).

At all latitudes, "unidentified mush" and the "other" category were the most common prey categories in chum salmon (Table 4). These two groups together ranged from 64% to 87% of the total prey occurrences across the latitudinal gradient. One type of organism commonly found in the stomachs of chum was the ctenophore *Beroe* sp. (Appendix 9). It is quite possible that the unidentified mush common in chum stomachs are the digested remains of ctenophores. Black and Low (1983) found that digested ctenophores in the gut of juvenile chum and chinook salmon caught in purse seines in coastal British Columbia appeared as a granular, white mush that was difficult to identify.

Fish and squid were infrequently found in the stomachs of chum (Table 4). The frequency of occurrence of these two groups added together ranged from 1% to 9% among the four groups. Fish found in chum stomachs were lanternfishes (Myctophidae) and the same anchovy species that was used as bait (*E. japonicus*; Appendix 9). This pattern in the frequency of occurrence of the prey categories was constant across the latitudinal gradient (Table 4). The index of stomach content weight (stomach content weight X 100/body weight) is approximately twice the value in samples from evening longline sets than the value in samples from morning longline sets. This indicates that not only was there a higher percentage of chum salmon with empty stomachs in the morning, but also the weight of stomach contents of fish containing food was less in fish caught during morning longline sets (Table 4).

Results of stomach examinations of pink salmon were quite different than those of chum salmon (Table 5). At all latitudes, copepods and amphipods (predominantly hyperiids) were the predominant prey categories, together representing from 46% to 63% of the total occurrences of prey categories. The "other" category was also important but decreased in frequency from south (24%) to north (6%). A common organism found in the "other" category was chaetognaths. At the most northerly latitude (46° 30' N), copepods, euphausiids, and squids found in stomachs increased in frequency. For pink salmon, the fish and squid categories together represented roughly twice the percentage found in the

stomachs of chum salmon, ranging from 10% to 20%. Pink salmon were found to feed on the same fishes as chum salmon, namely, myctophids and *E. japonicus* (Appendix 9). The index of stomach content weight also showed the same trend as the chum salmon, that is, that the index was larger from stomachs collected in evening longline sets than from stomachs collected in the morning. The evening sets produced stomachs with three to five times the index value in the evening than in the morning (Table 5). The percentage of empty stomachs in morning samples was higher for pink salmon (58%) than for chum salmon (15%).

Results of stomach examinations of coho salmon were quite different than those of both chum and pink salmon (Table 6). Fishes and squids were important prey categories at all latitudes, together representing from 54% to 92% of occurrences of all prey categories. All other categories were relatively infrequently encountered (<14%) except at the most southerly latitude (43° 30' N) where amphipods were relatively common in the stomachs (26%). Coho salmon were found to feed on all types of fish that were encountered during the study (Appendix 9). These fishes included myctophids, pacific saury (*Cololabis saira*), three-spine stickleback (*Gasterosteus aculeatus*), juvenile Atka mackerel (*Pleurogrammus monopterygius*), and anchovy (*E. japonicus*). Three-spine sticklebacks have been recorded in the stomachs of high seas steelhead (Pearcy et al. 1988, Quinn and Light 1989), but this is the first report of three-spine sticklebacks in the stomachs of high seas salmon. The squids found in the stomachs of coho salmon included the gonatids: *Gonatus* sp., *Gonatopsis borealis*, and *Berrytheuthis magister* (Appendix 9). The index of stomach content weights for coho salmon indicated that the stomach contents of fish caught in the morning sets and containing food weighed less than those of fish caught in evening sets in three out of the four groups. At 45°30' N, stomachs collected in the morning had slightly greater weight in proportion to body weight than stomachs collected in the evening (Table 6). This case is different than the results found for the other species, and indicates either that there is more variability in the time of day that coho feed or, perhaps, that this case was unusual. The evening sample was small (n=8), and may, therefore, not be representative. Overall, there was a higher percentage of empty stomachs for coho collected in the evening than for chum and pink salmon stomachs.

Using percent frequency of occurrence to summarize data on stomach contents may carry the risk of overestimating the importance of small organisms that may be eaten frequently in small quantity and underestimating the importance of large organisms that may be eaten less frequently in large quantity. Keeping this in mind, however, these

results provide a useful index from which several generalizations may be made. Differences in the prey eaten by chum, pink, and coho salmon were obvious, but did not seem to vary significantly with latitude within the study area (43°30' N to 46°30' N latitude and 165°30' E to 179°30' N longitude). Chum salmon were found to feed largely on gelatinous zooplankton, namely the ctenophore *Beroe*, and seem to digest their prey quickly producing a whitish unidentifiable mush that was common in their stomachs. Pink salmon were commonly found to feed extensively on copepods, (hyperiid) amphipods, and chaetognaths and occasionally on fish and squid. Coho salmon were feeding on a wide variety of fish and squid species. Too few chinook salmon and steelhead were sampled to adequately characterize their food habits.

### RECOMMENDATIONS FOR BIOLOGICAL SAMPLING AND TAGGING IN 1991

One of the recommendations of the 1989 Sub-Committee on Salmon was to collect extra scales from individual fish including chinook, coho, and sockeye salmon. On this cruise, no sockeye salmon were caught, but additional scales were sampled from chinook and coho salmon. Considering the number of scales that were removed in the scrape samples, it is likely that at least one scale from each fish sampled would be suitable for ageing and for scale pattern analyses.

Another recommendation by the Sub-Committee on Salmon was the tagging and release of live-caught steelhead missing adipose fins caught east of 165° E longitude. Several live steelhead missing adipose fins were disk-tagged and released on this cruise, and one dead steelhead had the snout removed for later examination for the presence of a coded-wire tag. No other salmonids with missing adipose fins were caught. The release of steelhead with missing adipose fins caught in areas east of the 165° E longitude results in the tagging and release of fish that would have otherwise been sacrificed. Because few steelhead with missing adipose fins actually carry coded-wire tags (Light et al. 1988), this policy results in more steelhead being tagged and released.

Last year, guidelines to Japanese salmon research vessels regarding the condition of fish judged suitable for tagging included only releasing fish in "good" condition, that is, fish not showing the following characteristics: swimming upside down, bleeding from the gill or mouth, having blood-shot eyes, having scars on the body or damaged fins (Davis

1989). However, the guidelines this year were different: release all living fish, despite their condition. As a result of this change, a large number of tagged salmonids (approximately 11,000 fish) and up to 90% of the fish caught by some Japanese research vessels were released (M. Ogura, personal communication). In the absence of reliable information on mortality rates of tagged salmonids released in various states of health, tagging all live fish seems to be an effective approach to increasing potential returns.

I recommend high seas salmonid tagging procedures include the following for 1991: taking extra scales from coho, sockeye, and chinook salmon to maximize the number of scales available for scale analyses; releasing live-caught steelhead missing adipose fins found east of 165° E longitude to increase the number of steelhead released with high seas tags; and releasing all salmonids that are alive at the time they are tagged, despite their condition, to possibly increase the number of tagged fish that might be recaptured.

### ACKNOWLEDGEMENTS

I am grateful to Dr. Yukimasa Ishida of the Fisheries Agency of Japan (Government of Japan) for providing me the opportunity to participate in the research cruise of the *Hokuho maru*. I thank Captain Hayasaka and all the officers, crew, teachers, and students of the *Hokuho maru* for generously giving of their time and experience in assisting me in my research, and for their kind hospitality while aboard the vessel. I also thank Mr. Masayuki Shoji of the Otaru Fisheries High School for his tireless support of my research needs on the vessel and for facilitating logistical arrangements. The staffs of the Management Bureau for Training Ships and the the Akkeshi Fisheries High School were gracious hosts in Hakodate and Akkeshi, respectively. Dr. Richard Brodeur provided many helpful suggestions on background material, species identification, and sampling techniques. Funding for this project was provided by the U. S. National Oceanic and Atmospheric Administration (NOAA, Contract No. 50-ABNF-7-00002).

### REFERENCES

- Black, E. A. and C. J. Low. 1983. Ctenophores in salmon diets. *Trans. Amer. Fish Soc.* 112:728.

- Davis, N. D. 1989. U.S.-Japan cooperative high seas salmonid research in 1989: summary of research aboard the Japanese research vessel *Shin Riasu maru*, 1 June to 20 July. (INPFC Doc.) FRI-UW-8910. Fish. Res. Inst., Univ. Washington, Seattle. 14 pp.
- Light, J. T., S. Fowler, and M. L. Dahlberg. 1988. High seas distribution of North American steelhead as evidenced by recoveries of marked or tagged fish. (INPFC Doc.) FRI-UW-8816. Fish. Res. Inst., Univ. Washington, Seattle. 21 pp.
- Pearcy, W. G., R. D. Brodeur, J. M. Shenker, W. W. Smoker, and Y. Endo. 1988. Food habits of Pacific salmon and steelhead trout, midwater trawl catches and oceanographic conditions in the Gulf of Alaska, 1980-1985. Bull. Ocean. Res. Inst. 26(II):29-78.
- Quinn, T. P., and J. T. Light. 1989. Occurrence of threespine sticklebacks (*Gasterosteus aculeatus*) in the open North Pacific Ocean: migration or drift? Can. J. Zool. 67:2850-2852.

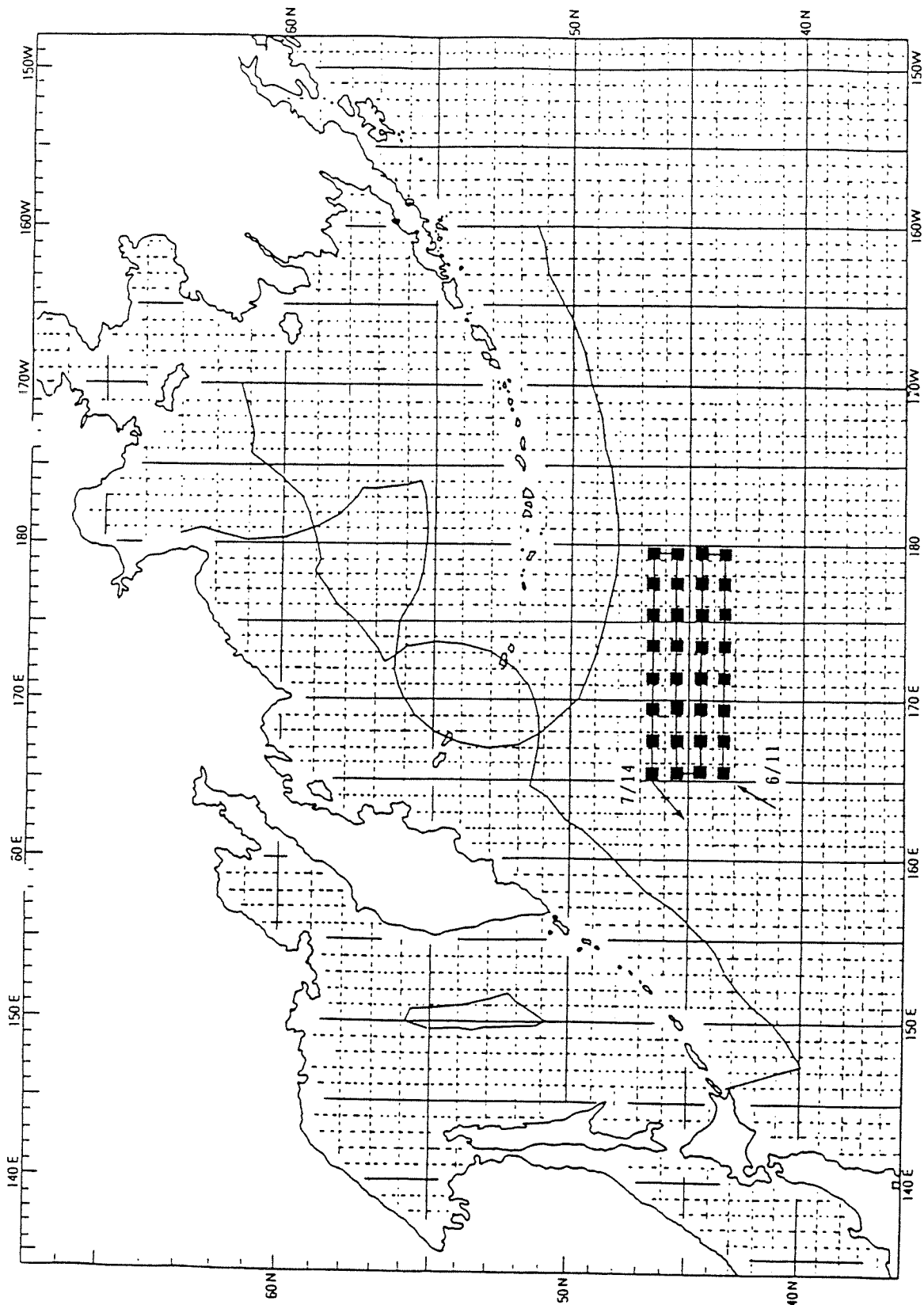


Figure 1. Location of longline stations for the summer 1990 salmon research cruise of the *Hokuho maru*. Longlines are set at sunrise and sunset.

Table 1. Salmonid catch for each fishing operation and number of salmonids tagged and released.

Date	Time	Location	Number of zaru fished*	Total Catch	Number of Fish Tagged and Released						
					Chum	Pink	Coho	Chinook	Steelhead	Total	
6-11	p. m.	43°30'N 165°30'E	30	47	8	25	1	0	0	0	34
6-12	a. m.	43°30'N 165°30'E	30	71	16	34	3	0	0	0	53
6-12	p. m.	43°30'N 167°30'E	30	63	14	19	12	0	1	1	46
6-13	a. m.	43°30'N 167°30'E	30	177	59	53	1	0	0	0	113
6-13	p. m.	43°30'N 169°30'E	30	229	40	99	0	1	0	0	140
6-14	a. m.	43°30'N 169°30'E	30	253	78	93	5	0	0	0	176
6-14	p. m.	43°30'N 171°30'E	30	33	11	7	3	0	0	0	21
6-15	a. m.	43°30'N 171°30'E	30	36	11	10	8	0	0	0	29
6-15	p. m.	43°30'N 173°30'E	30	41	13	16	0	0	0	0	29
6-16	a. m.	43°30'N 173°30'E	30	87	32	22	3	1	1	1	59
6-16	p. m.	43°30'N 175°30'E	30	11	7	1	0	0	0	0	8
6-17	a. m.	43°40'N 175°40'E	30	101	66	12	5	0	1	1	84
6-17	p. m.	43°30'N 177°30'E	30	14	12	1	0	0	0	0	13
6-18	a. m.	43°43'N 177°40'E	30	47	21	10	3	1	2	2	37
6-18	p. m.	43°31'N 179°29'E	30	25	13	0	3	1	0	0	17
6-19	a. m.	43°35'N 179°34'E	30	28	12	1	4	0	1	1	18
6-19	p. m.	44°30'N 179°30'E	30	28	5	3	9	0	1	1	18
6-20	a. m.	44°31'N 179°30'E	30	51	17	5	15	0	1	1	39
6-20	p. m.	44°31'N 177°30'E	30	25	12	3	5	1	0	0	21
6-21	a. m.	44°34'N 177°25'E	30	81	28	10	13	0	2	2	53
6-21	p. m.	44°30'N 175°30'E	30	27	10	2	5	0	2	2	22
6-22	a. m.	44°34'N 175°28'E	30	44	15	5	13	0	3	3	36
6-22	p. m.	44°30'N 173°30'E	30	38	11	7	6	1	2	2	27
6-23	a. m.	44°40'N 173°20'E	40	113	49	26	14	0	0	0	89
6-23	p. m.	44°29'N 171°30'E	30	77	31	15	5	0	0	0	51
6-24	a. m.	44°30'N 171°30'E	40	33	16	11	2	0	1	1	30

Table 1. Continued.

Date	Time	Location	Number of zaru fished*	Total Catch	Number of Fish Tagged and Released						
					Chum	Pink	Coho	Chinook	Steelhead	Total	
6-24	p. m.	44°30'N 169°30'E	30	82	41	8	2	1	1	0	52
6-25	a. m.	44°32'N 169°28'E	39	263	135	20	4	1	1	1	161
6-25	p. m.	44°29'N 167°31'E	30	212	23	109	18	2	0	0	152
6-26	a. m.	44°33'N 167°27'E	40	196	15	84	39	0	0	0	138
6-26	p. m.	44°30'N 165°30'E	30	157	29	72	15	0	0	0	116
6-27	a. m.	44°34'N 165°31'E	40	469	28	285	17	0	0	0	330
6-27	p. m.	45°30'N 165°30'E	30	102	36	28	7	0	0	0	71
6-28	a. m.	45°20'N 165°30'E	40	433	98	205	13	0	0	0	316
6-28	p. m.	45°30'N 167°30'E	30	66	6	26	11	2	0	0	45
6-29	a. m.	45°20'N 167°30'E	40	102	21	35	6	1	0	0	63
6-30	p. m.	45°30'N 169°30'E	30	7	2	1	1	0	1	1	5
7-1	a. m.	45°20'N 169°40'E	40	112	25	49	6	1	0	0	81
7-1	p. m.	45°31'N 171°31'E	30	26	12	2	1	1	0	0	16
7-2	a. m.	45°40'N 171°30'E	40	83	52	5	5	0	0	0	62
7-2	p. m.	45°30'N 173°30'E	30	33	10	1	15	3	0	0	29
7-3	a. m.	45°32'N 173°36'E	40	83	23	9	25	3	1	1	61
7-3	p. m.	45°30'N 175°30'E	30	8	3	0	4	0	1	1	8
7-4	a. m.	45°40'N 175°30'E	40	43	21	2	7	0	1	1	31
7-4	p. m.	45°31'N 177°31'E	30	16	8	0	5	0	2	2	15
7-5	a. m.	45°40'N 177°45'E	40	52	6	0	29	0	3	3	38
7-5	p. m.	45°30'N 179°30'E	30	12	0	1	7	0	0	0	8
7-6	a. m.	45°40'N 179°35'E	40	20	1	1	17	0	1	1	20
7-6	p. m.	46°30'N 179°31'E	30	17	0	1	11	1	0	0	13
7-7	a. m.	46°40'N 179°20'E	40	18	1	0	11	0	0	0	12
7-7	p. m.	46°30'N 177°30'E	30	48	0	0	34	0	3	3	37
7-8	a. m.	46°29'N 177°28'E	40	49	7	6	21	0	2	2	36
7-8	p. m.	46°30'N 175°30'E	30	35	4	2	19	1	1	1	27

Table 1. Continued.

Date	Time	Location	Number of zaru fished*	Total Catch	Number of Fish Tagged and Released					
					Chum	Pink	Coho	Chinook	Steelhead	Total
7-9	a. m.	46°29'N 175°30'E	40	70	14	4	34	1	0	53
7-10	a. m.	46°30'N 173°30'E	20	13	7	0	4	0	0	11
7-11	a. m.	46°30'N 171°30'E	20	37	22	4	7	0	0	33
7-11	p. m.	46°30'N 169°25'E	20	43	13	14	2	0	1	30
7-12	a. m.	46°30'N 169°28'E	40	122	49	25	9	0	0	83
7-12	p. m.	46°32'N 167°27'E	30	46	14	2	13	2	1	32
7-13	a. m.	46°42'N 167°20'E	40	123	39	16	24	2	0	81
7-13	p. m.	46°33'N 165°28'E	30	21	4	0	11	0	0	15
7-14	a. m.	46°48'N 165°25'E	40	72	1	30	15	1	0	47
<b>TOTAL</b>			<b>2,019</b>	<b>5,071</b>	<b>1,377</b>	<b>1,537</b>	<b>608</b>	<b>32</b>	<b>37</b>	<b>3,591</b>

\*Zaru are plastic trays used to hold units of longline. Each zaru contains 120 m of longline and 49 hooks.

Table 2. Total number of salmonids listed by species that were caught and tagged in longline operations.

Species	Total Catch	Number Tagged
Chum	1,906	1,377
Pink	2,209	1,537
Coho	870	608
Chinook	40	32
Steelhead	46	37
Total	5,071	3,591

Table 3. Summary of the number (and percent) of stomachs examined and the number found to be empty for each species by period of day when longlining was conducted.

Species	Total Number of Stomachs Examined	Number of Empty Stomachs (%)	Number of Stomachs found to Contain Prey (%)
<u>Chum</u>			
a. m.	190	29 (15)	161 (85)
p. m.	132	1 (1)	131 (99)
Total	322	30 (9)	292 (91)
<u>Pink</u>			
a. m.	182	106 (58)	76 (42)
p. m.	85	1 (1)	84 (99)
Total	267	107 (40)	160 (60)
<u>Coho</u>			
a. m.	170	52 (31)	118 (69)
p. m.	81	10 (12)	71 (88)
Total	251	62 (25)	189 (75)
<u>Chinook</u>			
a. m.	4	0	4 (100)
p. m.	4	0	4 (100)
Total	8	0	8 (100)
<u>Steelhead</u>			
a. m.	6	4 (67)	2 (33)
p. m.	3	1 (33)	2 (67)
Total	9	5 (56)	4 (44)
Grand Total (%)	857	204 (24)	653 (76)

Table 4. The percent occurrence of major prey categories found in the stomachs of chum salmon. Data are grouped by capture location in degrees latitude.

Prey Category	43° 30'N	44° 30'N	45° 30'N	46° 30'N
Fishes	2	5	8	0
Squids	0	0	1	1
Copepods	9	12	8	7
Euphausiids	0	1	9	1
Amphipods	16	16	10	4
Other <sup>1</sup>	24	26	28	43
Unidentified Mush <sup>2</sup>	49	40	36	44

Chum Salmon Biological Data:	
Number of stomachs	100
Number of empty stomachs	12
Mean length (mm; ± S.D.)	441.3 (±45.1)
Range in length (mm)	324-610
Index of stomach content weight <sup>3</sup> mean (± S.D.)	
a. m.:	0.61 (±0.37) n=49
p. m.:	1.51 (±0.53) n=39
	100
	13
	447.5 (±61.5)
	316-670
	0.65 (±0.44) n=37
	1.76 (±0.88) n=50
	69
	3
	480.1 (±75.8)
	356-720
	1.05 (±0.86) n=44
	2.01 (±0.53) n=22
	53
	2
	501.3 (±67.3)
	367-680
	0.87 (±0.53) n=31
	1.79 (±0.60) n=20

<sup>1</sup> Includes polychaetes, chaetognaths, shrimp, pteropods, ostracods, isopods, and gelatinous zooplankton.

<sup>2</sup> Heavily digested material with an overall whitish appearance.

<sup>3</sup> Stomach content weight X 100/body weight.

Table 5. The percent occurrence of major prey categories found in the stomachs of pink salmon. Data are grouped by capture location in degrees latitude.

Prey Category	43° 30'N	44° 30'N	45° 30'N	46° 30'N
Fishes	7	10	11	5
Squids	3	10	8	12
Copepods	27	23	24	38
Euphausiids	7	14	8	13
Amphipods	29	23	32	25
Other <sup>1</sup>	24	20	16	6
Unidentified Mush <sup>2</sup>	3	0	1	1

17

Pink Salmon Biological Data:

Number of stomachs	69	82	62	54
Number of empty stomachs	33	41	20	13
Mean length (mm; $\pm$ S.D.)	456.8 ( $\pm$ 23.2)	462.9 ( $\pm$ 25.7)	477.2 ( $\pm$ 20.3)	490.2 ( $\pm$ 17.6)
Range in length (mm)	400-528	352-512	426-514	460-524
Index of stomach content weight <sup>3</sup> mean ( $\pm$ S.D.)				
a. m.:	0.43 ( $\pm$ 0.34) n=12	0.38 ( $\pm$ 0.18) n=8	0.58 ( $\pm$ 0.71) n=25	0.49 ( $\pm$ 1.07) n=31
p. m.:	1.53 ( $\pm$ 0.67) n=24	2.21 ( $\pm$ 1.25) n=33	1.74 ( $\pm$ 0.90) n=17	2.08 ( $\pm$ 1.32) n=10

<sup>1</sup> Includes polychaetes, chaetognaths, shrimp, pteropods, ostracods, isopods, and gelatinous zooplankton.

<sup>2</sup> Heavily digested material.

<sup>3</sup> Stomach content weight X 100/body weight.

Table 6. The percent occurrence of major prey categories found in the stomachs of coho salmon. Data are grouped by capture location in degrees latitude.

Prey Category	43° 30'N	44° 30'N	45° 30'N	46° 30'N
Fishes	28	56	41	40
Squids	26	32	51	47
Copepods	6	0	3	4
Euphausiids	0	0	1	6
Amphipods	26	8	4	1
Other <sup>1</sup>	14	4	0	2
Unidentified Mush <sup>2</sup>	0	0	0	0

18

Coho Salmon Biological Data:

Number of stomachs	28	88	58	77
Number of empty stomachs	7	24	13	18
Mean length (mm; ± S.D.)	546.3 (±23.5)	544.8 (±29.8)	546.8 (±39.1)	548.5 (±34.8)
Range in length (mm)	500-596	478-611	422-630	453-608
Index of stomach content weight <sup>3</sup> mean (± S.D.)				
a. m.:	0.65 (±0.60) n=6	1.02 (±0.97) n=41	2.46 (±1.73) n=37	1.58 (±1.35) n=34
p. m.:	1.52 (±1.59) n=15	1.69 (±1.52) n=23	2.30 (±1.76) n=8	2.02 (±1.54) n=25

1 Includes polychaetes, chaetognaths, shrimp, pteropods, ostracods, isopods, and gelatinous zooplankton.

2 Heavily digested material.

3 Stomach content weight X 100/body weight.

Appendix 1. Temperature (°C) and salinity (0/00) recorded at 10 m depth intervals along a north-south transect at 165°30'E longitude between 43°30'N and 46°30'N latitude.								
Depth	T 43°30'N	S 43°30'N	T 44°30'N	S 44°30'N	T 45°30'N	S 45°30'N	T 46°30'N	S 46°30'N
0	7.12	33.14	8.95	33.32	7.49	33.08	8.87	33.10
10	7.04	33.23	8.88	33.35	7.29	33.10	8.70	33.08
20	6.79	33.19	8.43	33.36	6.60	33.09	8.26	33.11
30	5.48	33.26	7.68	33.39	4.97	33.12	8.14	33.09
40	5.01	33.28	5.95	33.38	3.95	33.15	5.00	33.18
50	4.78	33.35	4.72	33.34	3.83	33.14	4.42	33.17
60	4.57	33.29	5.50	33.53	3.69	33.13	4.34	33.23
70	4.44	33.29	5.61	33.60	3.38	33.17	4.29	33.21
80	4.33	33.29	5.37	33.63	2.92	33.17	3.74	33.19
90	4.11	33.34	5.04	33.60	2.34	33.20	3.46	33.22
100	3.57	33.32	4.76	33.62	2.26	33.25	2.92	33.25
110	3.44	33.43	5.14	33.76	2.41	33.32	2.70	33.32
120	3.65	33.43	5.30	33.80	2.62	33.40	3.05	33.40
130	3.77	33.51	5.52	33.88	2.79	33.48	3.40	33.60
140	3.86	33.59	5.61	33.87	3.03	33.55	3.43	33.67
150	4.05	33.67	5.49	33.86	2.95	33.64	3.32	33.69
160	3.88	33.73	5.27	33.85	2.92	33.68	3.14	33.71
170	3.75	33.75	5.07	33.84	2.69	33.69	3.03	33.76
180	3.77	33.81	4.88	33.88	2.74	33.71	2.88	33.74
190	3.65	33.80	4.66	33.85	2.74	33.77	2.90	33.75
200	3.63	33.82	4.41	33.87	2.79	33.80	2.97	33.81
210	3.62	33.82	4.30	33.87	2.81	33.81	2.93	33.82
220	3.55	33.84	4.11	33.86	2.81	33.83	3.05	33.85
230	3.82	33.91	3.98	33.89	2.82	33.83	3.03	33.88
240	3.78	33.89	3.88	33.88	2.84	33.86	3.09	33.88
250	3.57	33.89	3.83	33.89	2.88	33.90	3.13	33.92
260	3.47	33.88	3.67	33.89	3.01	33.91	3.17	33.92

Appendix 2. Temperature (°C) and salinity (0/00) recorded at 10 m depth intervals along a north-south transect at 167°30'E longitude between 43°30'N and 46°30'N latitude.								
Depth	T 43°30'N	S 43°30'N	T 44°30'N	S 44°30'N	T 45°30'N	S 45°30'N	T 46°30'N	S 46°30'N
0	7.20	33.18	8.19	33.18	8.46	32.93	8.40	33.25
10	7.02	33.17	7.66	33.25	7.95	33.08	8.36	33.16
20	6.72	33.18	6.96	33.22	6.25	33.03	7.99	33.14
30	5.62	33.20	5.62	33.32	4.49	33.16	7.82	33.14
40	5.62	33.19	5.10	33.31	4.13	33.15	4.86	33.12
50	5.55	33.21	4.88	33.40	3.91	33.13	4.51	33.19
60	5.43	33.20	4.88	33.44	3.97	33.18	4.37	33.18
70	5.34	33.20	4.35	33.40	3.91	33.16	4.17	33.16
80	4.89	33.19	3.77	33.45	3.54	33.19	3.83	33.14
90	4.65	33.24	4.15	33.54	3.13	33.08	3.41	33.17
100	3.94	33.28	4.53	33.65	2.80	33.31	3.00	33.21
110	3.41	33.25	4.55	33.68	2.77	33.32	2.73	33.25
120	3.12	33.30	4.53	33.72	2.73	33.38	2.56	33.26
130	3.43	33.50	4.51	33.74	2.89	33.44	3.02	33.46
140	3.47	33.60	4.32	33.76	2.81	33.54	3.46	33.59
150	3.55	33.71	4.21	33.78	2.57	33.61	3.56	33.70
160	3.32	33.75	4.12	33.78	2.60	33.66	3.63	33.73
170	3.30	33.76	3.82	33.77	2.66	33.69	3.62	33.78
180	3.10	33.79	3.67	33.76	2.64	33.72	3.52	33.79
190	3.09	33.80	3.54	33.78	2.68	33.74	3.50	33.83
200	3.12	33.82	3.47	33.78	2.76	33.79	3.44	33.86
210	3.16	33.85	3.38	33.82	2.80	33.82	3.42	33.88
220	3.23	33.87	3.28	33.80	2.87	33.84	3.43	33.88
230	3.32	33.91	3.24	33.83	2.93	33.87	3.33	33.89
240	3.33	33.91	3.23	33.84	2.96	33.89	3.36	33.90
250	3.32	33.94	3.21	33.83	2.89	33.91	3.40	33.92
260	3.30	33.96	3.14	33.85	2.90	33.91	3.43	33.95

Appendix 3. Temperature (C°) and salinity (0/00) recorded at 10 m depth intervals along a north-south transect at 169°30'E longitude between 43°30'N and 46°30'N latitude.								
Depth	T 43°30'N	S 43°30'N	T 44°30'N	S 44°30'N	T 45°30'N	S 45°30'N	T 46°30'N	S 46°30'N
0	7.12	33.12	8.50	33.08	7.59	33.10	7.85	33.08
10	7.01	33.18	8.27	33.07	7.58	33.12	7.75	33.09
20	6.48	33.15	7.60	33.14	7.56	33.12	7.71	33.07
30	5.99	33.20	7.04	33.14	6.41	33.19	7.59	33.08
40	5.47	33.18	6.42	33.17	5.43	33.23	7.45	33.04
50	5.12	33.22	5.37	33.19	5.40	33.24	5.18	33.09
60	4.86	33.23	4.92	33.24	4.61	33.19	4.22	33.16
70	4.75	33.23	4.61	33.25	4.17	33.21	3.79	33.20
80	4.63	33.26	4.42	33.24	3.86	33.21	3.44	33.21
90	4.40	33.26	4.05	33.25	3.72	33.20	3.11	33.22
100	4.29	33.28	3.29	33.23	3.50	33.27	2.66	33.24
110	3.72	33.32	3.05	33.30	3.13	33.27	2.46	33.26
120	3.41	33.42	3.36	33.42	2.98	33.34	2.46	33.34
130	3.38	33.49	3.58	33.53	3.28	33.42	2.85	33.49
140	3.28	33.61	3.67	33.61	3.45	33.53	2.99	33.56
150	3.20	33.68	3.61	33.69	3.77	33.68	3.31	33.76
160	3.13	33.75	3.51	33.73	3.68	33.72	3.38	33.86
170	3.11	33.76	3.36	33.74	3.64	33.76	3.50	33.93
180	3.10	33.79	3.27	33.77	3.61	33.81	3.57	33.94
190	3.13	33.82	3.24	33.77	3.39	33.79	3.53	33.97
200	3.13	33.83	3.22	33.81	3.42	33.82	3.49	33.99
210	3.17	33.86	3.27	33.84	3.24	33.82	3.50	34.01
220	3.19	33.90	3.35	33.83	3.34	33.87	3.50	34.03
230	3.20	33.90	3.46	33.89	3.27	33.85	3.52	34.05
240	3.28	33.92	3.51	33.90	3.31	33.87	3.54	34.08
250	3.30	33.94	3.55	33.94	3.34	33.89	3.53	34.09
260	3.36	33.97	3.56	33.94	3.35	33.92	3.52	34.12

Appendix 4. Temperature (C°) and salinity recorded at 10 m depth intervals along a north-south transect at 171°30'E longitude between 43°30'N and 46°30'N latitude.								
Depth	T 43°30'N	S 43°30'N	T 44°30'N	S 44°30'N	T 45°30'N	S 45°30'N	T 46°30'N	S 46°30'N
0	7.36	33.20	8.73	33.28	7.35	33.13	7.91	32.97
10	7.34	33.18	8.66	33.29	7.34	33.08	7.90	32.96
20	7.33	33.20	8.33	33.30	7.27	33.10	7.90	32.95
30	6.29	33.27	8.16	33.31	5.65	33.20	7.68	32.96
40	6.18	33.31	6.85	33.38	5.84	33.32	4.88	33.09
50	5.51	33.23	6.50	33.39	5.69	33.35	4.26	33.17
60	5.28	33.25	6.43	33.43	5.56	33.36	4.10	33.15
70	5.26	33.27	6.16	33.44	5.28	33.35	3.72	33.17
80	5.09	33.26	6.05	33.44	4.86	33.33	3.09	33.20
90	5.20	33.33	6.06	33.46	3.83	33.26	2.79	33.24
100	5.34	33.37	5.96	33.48	3.14	33.24	2.57	33.26
110	5.09	33.35	5.98	33.53	3.13	33.25	2.57	33.34
120	4.65	33.60	6.06	33.57	3.14	33.38	2.74	33.46
130	4.09	33.36	6.13	33.62	3.22	33.41	2.95	33.58
140	4.13	33.44	6.22	33.62	3.31	33.55	3.01	33.69
150	5.22	33.63	5.92	33.66	3.43	33.66	3.21	33.82
160	5.10	33.71	5.62	33.64	3.44	33.73	3.35	33.87
170	5.11	33.75	5.49	33.71	3.40	33.77	3.53	33.92
180	5.01	33.85	5.51	33.72	3.33	33.79	3.58	33.98
190	5.01	33.84	5.55	33.75	3.25	33.80	3.58	34.00
200	4.81	33.84	5.47	33.82	3.35	33.84	3.54	34.02
210	4.90	33.90	5.28	33.86	3.27	33.84	3.47	34.02
220	4.67	33.90	4.99	33.89	3.23	33.87	3.41	34.04
230	4.57	33.89	4.82	33.90	3.23	33.87	3.51	34.06
240	4.45	33.91	4.63	33.90	3.25	33.90	3.38	34.06
250	4.38	33.90	4.40	33.89	3.30	33.94	3.36	34.07
260	4.28	33.91	4.29	33.90	3.33	33.94	3.41	34.10

Appendix 5. Temperature (C°) and salinity (0/00) recorded at 10 m depth intervals along a north-south transect at 173°30'E longitude between 43°30'N and 46°30'N latitude.								
Depth	T 43°30'N	S 43°30'N	T 44°30'N	S 44°30'N	T 45°30'N	S 45°30'N	T 46°30'N	S 46°30'N
0	7.59	33.16	8.73	33.26	7.67	32.99	7.68	33.09
10	7.58	33.14	7.89	33.30	7.42	33.04	7.67	33.06
20	7.58	33.14	7.80	33.30	7.27	33.06	7.61	33.03
30	6.63	33.18	7.06	33.28	5.01	33.14	5.63	33.02
40	6.13	33.26	6.62	33.26	4.20	33.15	4.37	33.15
50	5.59	33.24	6.19	33.38	4.00	33.17	4.35	33.16
60	5.43	33.26	6.15	33.39	3.76	33.18	4.29	33.17
70	5.31	33.28	5.88	33.43	3.19	33.19	4.18	33.15
80	5.21	33.29	5.88	33.44	2.87	33.21	3.88	33.17
90	5.15	33.30	5.53	33.44	2.73	33.26	3.38	33.18
100	5.09	33.33	5.39	33.47	2.57	33.31	2.89	33.20
110	5.07	33.37	5.12	33.52	2.99	33.42	2.60	33.24
120	5.06	33.40	5.19	33.58	3.12	33.49	2.58	33.28
130	4.92	33.43	5.01	33.52	3.21	33.57	2.62	33.35
140	4.94	33.47	4.79	33.61	3.30	33.65	2.69	33.47
150	5.07	33.56	4.76	33.72	3.20	33.75	2.80	33.63
160	5.06	33.63	4.77	33.79	3.07	33.75	2.85	33.72
170	4.99	33.75	4.77	33.85	3.03	33.78	2.95	33.80
180	4.81	33.79	4.71	33.85	2.98	33.74	3.06	33.84
190	4.60	33.81	4.62	33.89	2.87	33.81	3.09	33.86
200	4.28	33.81	4.45	33.89	2.90	33.81	3.16	33.90
210	4.02	33.83	4.34	33.89	2.93	33.84	3.20	33.90
220	3.94	33.85	4.41	33.92	2.92	33.87	3.24	33.97
230	3.90	33.88	4.37	33.94	2.96	33.87	3.28	33.99
240	3.88	33.90	4.33	33.92	2.97	33.90	3.33	34.02
250	3.85	33.91	4.30	33.95	3.02	33.92	3.35	34.06
260	3.84	33.91	4.24	33.96	3.05	33.94	3.38	34.07
270	3.75	33.93	4.13	33.96	3.11	33.95	3.38	34.09
280	3.76	33.96	3.99	33.98	3.16	33.99	3.38	34.10
290	3.75	33.97	3.97	33.97	3.23	34.01	3.39	34.11
300	3.86	34.02	3.82	33.98	3.24	34.03	3.40	34.13
310	3.93	34.03	3.79	33.97	3.29	34.03	3.39	34.14

Appendix 6. Temperature (°C) and salinity (0/00) recorded at 10 m depth intervals along a north-south transect at 175°30'E between 43°30'N and 46°30'N latitude.								
Depth	T 43°30'N	S 43°30'N	T 44°30'N	S 44°30'N	T 45°30'N	S 45°30'N	T 46°30'N	S 46°30'N
0	8.19	33.33	8.36	33.12	8.08	33.11	8.27	32.98
10	8.19	33.33	8.13	33.35	7.95	33.23	8.26	33.13
20	8.17	33.33	8.05	33.35	7.80	33.20	7.52	33.15
30	7.89	33.31	7.73	33.38	6.18	33.32	6.36	33.24
40	7.18	33.39	7.44	33.38	5.95	33.38	5.59	33.29
50	7.03	33.40	7.16	33.35	5.88	33.35	5.21	33.26
60	6.76	33.41	6.60	33.43	5.75	33.36	5.31	33.32
70	6.53	33.45	6.51	33.43	5.34	33.32	4.68	33.24
80	6.24	33.44	6.49	33.43	5.70	33.38	4.04	33.27
90	6.37	33.48	6.47	33.43	5.06	33.29	3.58	33.25
100	6.27	33.46	6.33	33.39	4.74	33.37	3.21	33.31
110	5.72	33.45	6.04	33.44	4.55	33.41	2.96	33.34
120	5.50	33.48	5.92	33.47	4.88	33.53	2.92	33.37
130	5.58	33.56	5.58	33.48	4.53	33.49	3.09	33.55
140	5.55	33.62	5.61	33.52	5.07	33.69	3.32	33.65
150	5.21	33.68	5.80	33.61	5.14	33.74	3.33	33.72
160	5.04	33.73	5.83	33.68	5.04	33.75	3.40	33.75
170	4.76	33.78	5.84	33.70	4.82	33.80	3.16	33.76
180	4.60	33.79	5.62	33.80	4.64	33.81	3.16	33.78
190	4.43	33.83	5.67	33.86	4.63	33.86	3.29	33.83
200	4.27	33.84	5.51	33.88	4.50	33.88	3.42	33.84
210	4.18	33.84	5.08	33.89	4.39	33.88	3.40	33.86
220	4.07	33.87	4.89	33.89	4.40	33.91	3.39	33.89
230	4.01	33.88	4.72	33.89	4.05	33.88	3.45	33.90
240	3.99	33.87	4.67	33.89	3.95	33.90	3.50	33.93
250	3.86	33.90	4.57	33.90	3.90	33.91	3.58	33.97
260	3.84	33.93	4.46	33.91	3.90	33.93	3.62	33.99
270	3.82	33.93	4.34	33.92	3.95	33.94	3.60	33.99

Appendix 7. Temperature (°C) and salinity (0/00) recorded at 10 m depth intervals along a north-south transect at 177°30'E longitude between 43°30'N and 46°30'N latitude.								
Depth	T 43°30'N	S 43°30'N	T 44°30'N	S 44°30'N	T 45°30'N	S 45°30'N	T 46°30'N	S 46°30'N
0	8.47	33.30	8.77	33.52	7.85	33.12	7.92	33.15
10	8.27	33.37	8.63	33.52	7.81	33.08	7.36	33.04
20	8.24	33.40	8.65	33.51	7.63	33.09	7.29	33.04
30	8.24	33.38	8.52	33.50	7.44	33.06	7.26	33.05
40	9.00	33.75	8.21	33.52	4.98	33.14	6.27	33.02
50	6.74	33.44	7.78	33.69	4.41	33.18	4.95	33.15
60	6.25	33.42	7.67	33.74	4.32	33.18	4.78	33.18
70	6.73	33.54	8.19	33.92	4.32	33.18	4.41	33.11
80	6.37	33.51	8.46	34.02	4.24	33.19	3.85	33.16
90	6.08	33.54	8.58	34.05	4.15	33.18	3.58	33.17
100	5.88	33.51	8.60	34.06	3.94	33.21	3.49	33.20
110	5.55	33.51	8.52	34.06	3.54	33.27	3.39	33.18
120	5.58	33.56	8.43	34.05	4.43	33.49	3.27	33.22
130	5.59	33.63	8.37	34.04	4.04	33.50	3.28	33.33
140	5.40	33.69	8.25	34.04	4.05	33.51	3.30	33.48
150	5.25	33.71	8.15	34.08	4.01	33.62	3.30	33.64
160	4.96	33.75	7.97	34.01	4.29	33.69	3.28	33.73
170	4.76	33.78	7.68	33.98	4.46	33.76	3.28	33.79
180	4.68	33.79	7.46	34.00	4.66	33.83	3.27	33.82
190	4.43	33.83	7.18	34.05	4.19	33.84	3.27	33.83
200	4.28	33.83	6.90	34.05	4.20	33.85	3.28	33.86
210	4.17	33.86	6.59	34.03	4.04	33.86	3.29	33.86
220	4.10	33.85	6.15	34.00	3.98	33.85	3.31	33.88
230	4.02	33.86	5.94	33.98	3.91	33.89	3.32	33.91
240	3.95	33.87	5.50	33.95	3.80	33.87	3.34	33.94
250	3.94	33.88	5.27	33.95	3.77	33.90	3.36	33.96
260	4.10	33.92	5.11	33.96	3.74	33.91	3.41	33.97

Appendix 8. Temperature (°C) and salinity (0/00) recorded at 10 m depth intervals along a north-south transect at 179°30'E longitude between 43°30'N and 46°30'N latitude.								
Depth	T 43°30'N	S 43°30'N	T 44°30'N	S 44°30'N	T 45°30'N	S 45°30'N	T 46°30'N	S 46°30'N
0	9.70	33.65	7.67	33.32	7.74	32.91	8.06	32.98
10	9.58	33.68	7.41	33.32	7.60	33.03	7.40	33.00
20	9.46	33.70	7.11	33.34	7.55	33.01	7.35	32.99
30	9.44	33.70	7.06	33.34	7.23	33.04	6.81	32.97
40	9.34	33.69	6.87	33.33	7.08	33.03	5.55	33.11
50	8.91	33.72	6.42	33.35	6.69	33.07	4.94	33.16
60	8.62	33.91	6.33	33.39	5.53	33.06	4.85	33.18
70	8.70	34.04	6.33	33.41	4.90	33.12	4.46	33.18
80	8.73	34.06	6.25	33.41	4.68	33.17	3.97	33.17
90	8.66	34.07	6.10	33.40	4.54	33.16	3.72	33.18
100	8.61	34.07	5.63	33.44	4.09	33.16	3.46	33.18
110	8.57	34.07	5.44	33.45	3.58	33.20	3.36	33.23
120	8.55	34.09	5.41	33.44	3.49	33.23	3.33	33.28
130	8.54	34.08	5.37	33.46	3.11	33.26	3.39	33.48
140	8.44	34.09	5.41	33.49	3.08	33.35	3.34	33.58
150	8.29	34.07	5.62	33.59	3.20	33.51	3.40	33.72
160	8.18	34.06	5.55	33.61	3.31	33.58	3.36	33.77
170	8.18	34.09	5.28	33.65	3.16	33.70	3.31	33.78
180	8.10	34.09	5.62	33.78	3.13	33.73	3.29	33.79
190	7.94	34.09	5.58	33.83	3.11	33.77	3.25	33.82
200	7.50	34.06	5.48	33.89	3.19	33.82	3.25	33.84
210	7.34	34.04	5.60	33.95	3.22	33.82	3.25	33.88
220	7.13	34.07	5.55	33.94	3.24	33.84	3.27	33.90
230	6.94	34.07	5.39	33.94	3.22	33.86	3.29	33.92
240	6.69	34.06	5.01	33.92	3.28	33.88	3.34	33.94
250	6.51	34.05	4.88	33.93	3.24	33.89	3.38	33.97

Appendix 9. Prey organisms identified from the stomachs of salmonids.

Prey Organism	Chum	Pink	Coho	Chinook	Steelhead
Ctenophora <i>Beroe</i> sp.	X X				
Polychaeta Alciopidae	X X				X
Pteropoda <i>Limacina</i> sp. Clionidae	X X X	X X X	X X		
Cephalopoda (Teuthoidea) Gonatidae <i>Gonatus</i> sp. <i>Gonatopsis borealis</i> <i>Berrytheuthis magister</i>	X	X	X X X X X	X X	X
Ostracoda	X	X			
Isopoda	X	X			
Decapoda (Natantia)	X	X			
Euphausiacea <i>Thysanoessa</i> sp.	X X	X X	X		X
Copepoda <i>Neocalanus cristatus</i>	X	X X	X X		

## Appendix 9. Continued.

Prey Organism	Chum	Pink	Coho	Chinook	Steelhead
Amphipoda	X	X	X		X
Gammaridae	X				
Hyperiidae	X	X	X		
Chaetognatha	X	X			
Osteichthyes	X	X	X		X
Myctophidae	X	X	X		
<i>Colobis saira</i>			X		
<i>Gasterosteus aculeatus</i>			X		X
<i>Pleurogrammus monopterygius</i>			X		
<i>Engraulis japonicus</i>	X	X	X		