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JAPAN-U.S. COOPERATIVE HIGH SEAS SALMONID RESEARCH IN 1994: SUMMARY OF RESEARCH ABOARD THE JAPANESE RESEARCH VESSEL *WAKATAKE MARU*, 10 JUNE TO 24 JULY

by

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Abstract

An annual cooperative Japan-U.S. survey, initiated in 1991, to investigate the ocean carrying capacity of salmonids in the North Pacific Ocean was continued. Japanese and U.S. scientists aboard the R/V *Wakatake maru* conducted fishing operations and collected data on oceanographic conditions, phytoplankton, and zooplankton in the North Pacific Ocean and Bering Sea. Fishing operations were conducted along a south-to-north transect at 179°30'W longitude between 38°30'N and 58°30'N latitude with additional stations in the central Bering Sea. Sea surface temperatures were cooler in 1994 than in 1993, often by as much as 1°C. The catch included 10,626 salmonids (*Oncorhynchus* spp. and *Salvelinus malma*). Chum salmon (*O. keta*) were the most abundant species (76% of the salmonid catch) followed by sockeye (*O. nerka*, 12%), pink (*0. gorbuscha*, 6%), and coho (*O. kisutch*, 4%) salmon . Chinook salmon (*O. tshawytscha*) and steelhead trout (*O. mykiss*) were in low abundance (1%), and two Dolly Varden (*S. malma*) were caught. Fifty-five percent of the 120 steelhead trout caught were lacking the adipose or a ventral fin, which indicates that these fish were of North American hatchery origin. A total of 331 neon flying squid (*Ommastrephes bartramii*) was caught by gillnet. Ninety-seven percent of the neon flying squid were caught south of salmonid distributions, but salmonid and squid distributions overlapped at 42°30'N latitude, where 11 squid and 14 salmonids were caught (4 chum, 1 pink, and 9 coho salmon). In the Bering Sea, an unusually large number of walleye pollock (*Theragra chalcogramma*, N=255) was caught by longline (N=124) and gillnet (N=131). Examination of salmonid stomach contents indicated that sockeye had a varied diet including copepods (27% mean volume of stomach contents), small squid (25%), amphipods (20%), and euphausiids (17%). Small squid (47%), euphausiids (17%), and copepods (14%) were also common prey of pink salmon. Chum salmon preyed upon euphausiids (14%) and amphipods (12%), but coelenterates (28%) were found in large volume. Squid was commonly found in the stomachs of coho salmon (92%), chinook salmon (66%), and steelhead trout (80%). The mean percent volume of crustaceous zooplankton found in the stomachs of chum salmon increased from 11% in 1993, a year of high pink salmon abundance, to 32% in 1994, a year of low pink salmon abundance.

Introduction

Each summer beginning in 1991, the Fisheries Agency of Japan (FAJ) has chartered the R/V *Wakatake maru* to conduct studies on salmonids (*Oncorhynchus* spp; abundance and distribution, food habits, and age and growth), primary productivity, and zooplankton abundance in the central North Pacific Ocean and Bering Sea. The objectives of these cruises are to investigate the carrying capacity of salmonids in the ocean, and to develop a time series of oceanographic and biological data by sampling the same locations year after year. These studies are also of interest to U. S. salmon researchers, and each year the FAJ graciously invites a U. S. scientist to join its research staff aboard the *Wakatake maru.* In this report, we briefly describe the sampling methods used to collect fish and plankton; summarize the oceanographic conditions, catch, and results of salmonid stomach examinations; and compare these results with those of earlier years.

The salmon research cruise of the *Wakatake maru* provided an opportunity to make collections of study materials for other salmonid studies including diurnal variation in salmonid food habits; caloric value of salmonid prey organisms, chum salmon (*O. keta*) tissue samples to determine stock origins by means of gel electrophoresis; fat and protein content and RNA/DNA ratios found in the muscle of chum, pink (*O. gorbuscha*), and sockeye salmon (*O. nerka*) to determine growth rates; abundance and distribution of the salmon louse, *Lepeophtheirus salmonis* ; appearance of slash-marks on salmonids; round specimens of salmonid predators (e.g., salmon shark, *Lamna ditropis*, and daggertooth, *Anotopterus pharao*); and collection of Dolly Varden char (*Salvelinus malma*) for genetic and morphometric studies. In addition, round samples of Pacific pomfret (*Brama japonica*) and Pacific saury (*Cololabis saira*) were collected for studies of their biology and ecology. The details of these studies will be reported elsewhere.

Methods

The cruise track and sampling plan have changed little since this research program began in 1991 (Ishida et al. 1991, 1992; Nagasawa et al. 1994a). The cruise track included 28 fishing stations along a transect at 179°30'W longitude from 38°30'N to 58°30'N latitude with additional stations in the central Bering Sea (see Table 1 for positions of fishing stations) and 56 transit stations, where oceanographic data and abbreviated water and zooplankton samples were collected (Fig. 1). At each fishing station a surface longline (30 hachi, 3.33 km) was set 30 minutes before sunset and retrieved 30 minutes after sunset. A gillnet was set in the afternoon and retrieved the following morning (49 tans, 2.45 km; Table 2). Noon-hour observations included salinity and temperature measurements (1-meter intervals) and water sampling for chlorophyll-a and nutrient analysis (seven depths; Table 2). Zooplankton samples were collected at midnight using Norpac, Bongo, ORI (Ocean Research Institute), and a fish larval net (Table 2). A detailed description of the towing method for each of these nets is given in Table 3.

Since 1992 zooplankton sampling has gradually intensified on the *Wakatake maru* salmonid cruises. In 1991 and 1992 only the Norpac and fish larval net were used (Ishida et al. 1991, 1992). In 1993 use of the ORI net began because the large net opening, fast towing speed, and large mesh enabled this net to collect mobile mega-zooplankton that the Norpac net does not sample adequately (Nagasawa et al. 1994a; Table 3). In 1994 use of the bongo net was begun because it is capable of catching large zooplankton, and this net is more commonly used for zooplankton collections than the ORI net.

Transit stations were located along a direct route going to and returning from the fishing area (Fig. 1). Water temperature, salinity, and depth data were collected using CTD and XBT, and water samples for chlorophyll-a and nutrient analysis were collected at the surface. A vertical tow of the Norpac net (0-150 meters) was used to collect zooplankton (Table 2). These activities were not conducted at any particular time of day, but whenever the ship arrived on station.

Method of fish examination, collection of scales and otoliths, and salmonid stomach content analysis are as described by Davis (1990), Ishida et al. (1991, 1992), and Nagasawa et al. (1994a). Salmonid stomach contents and index of stomach content weight (SCI; stomach contents X 100/body weight) were grouped according to oceanographic region as suggested by Nagasawa et al. (1994a) and Tadokoro et al. (1994).

Ishida et al. (1992) and Tadokoro et al. (in prep.) suggested that when pink salmon abundance was low more euphausiids, copepods, and squids were found in chum salmon diets than when pink salmon abundance was high. To determine if there was a change in the diet of salmonids between 1993 and 1994, the prey types found in the stomachs of salmonids were summarized in three categories: micro-nekton (fish and squid), crustaceous, and non-crustaceous zooplankton, and the percentage of each prey category found in the stomach contents was compared between years.

Results and Discussion

OCEANOGRAPHY

Water temperature and salinity profiles were plotted for the south-to north transect at 179°30'W longitude from 38°30'N to 58°30'N latitude (Fig. 2). Location of oceanographic regions are approximate because the sampling locations are widely separated (1° of latitude or longitude) and the salinity values used to produce the vertical profiles have not been calibrated with water samples analyzed in the laboratory. The Transition Zone, south of the Subarctic Boundary, was located between 38°30'N and 40°30'N (Stations 1-3; Roden 1991). The location of the Subarctic Boundary, denoted as a vertical 34.0 psu (practical salinity units) isohaline, was found in the vicinity between 40°30'N and 41°30'N (between Stations 3 and 4; Dodimead et al. 1963, Favorite et al. 1976). The Transition Domain defined by the presence of cold water less than 4°C below 100 m extended from approximately 41°30'N to 45°30'N (Stations 4-8). Between 46°30'N and 50°30'N, temperature and salinity had a homogeneous component indicating the eastward flowing Subarctic Current (Stations 9-13). The Alaska Current, indicated by slightly warmer surface waters where the 4°C isotherm dips below 100 m, was found at 51°30'N (Station 14). The Bering Current was found in the vicinity between 52°30'N and 53°30 N (Stations 15 and 16), south of the Bering Sea Gyre that is characterized by a cold core of water less than 2°C at 75-200 m depth (54°30'N to 58°30' N, Stations 17-21).

We have included the temperature and salinity profiles for the east-to-west series of fishing stations at 56°30'N latitude on Figure 3. Conditions across the central Bering Sea appear quite homogeneous, and from 178°30'W to 177°30'E (Stations 25-28) the cold core of water less than 2° C is found at less than 200 m, indicating these stations are within the Bering Sea Gyre. This cold core was not found at the most easterly station, 177°30'W, indicating that this location was within the Bering Current (Station 24).

In 1994, sea surface temperatures north of 39°30'N in the North Pacific Ocean and Bering Sea were generally cooler than in 1993, often by as much as 1° C (Fig. 4). The sea surface temperatures in the vicinity of the Subarctic Current (45°30'N-49°30'N latitude) were cooler in 1994 than in the previous three years. The approximate June location of the Subarctic Boundary at its intersection with the 179°30'W longitude transect has moved progressively northwards from 1991 (40°30'N), reaching a northernmost location in 1993 (between 42°30'N and 43°30'N), but shifted to a more southerly position in 1994 (between 40°30'N and 41°30'N latitude; Fig. 4).

DISTRIBUTION AND ABUNDANCE OF SALMONIDS

A total of 10,626 salmonids was caught by longline and gillnet (Table 1). Chum salmon were the most abundant species caught (76% of the salmonid catch), followed by sockeye (12%), pink (6%), coho (*O. kisutch*, 4%), and chinook (*O. tshawytscha*, 1%)

salmon, and steelhead trout (*O. mykiss*, 1%). Two Dolly Varden char (*Salvelinus malma)* were caught. The Subarctic Boundary is believed to be the southern limit of salmonid distribution. The most southerly station where salmonids were caught was 42°30'N latitude, which was north of the Subarctic Boundary (four chum, one pink, nine coho; Table 1). This is unlike 1993, when 93 chum and 2 coho were found in the transition zone south of the Subarctic Boundary (Nagasawa et al. 1994b).

Sockeye salmon were caught northward from 47°30'N (SST=6.1° C), and were abundant in the Bering Sea (Table 1). Longline catches and gillnet catch per unit of effort (CPUE; number of fish caught per tan) have been quite variable from 1991 to 1994 (Figs. 5, 6, and 7). In 1991, sockeye were abundant in the southern area of the donut hole sampled by the *Wakatake maru.* In 1992 and 1993, sockeye appear to have been abundant in the eastern area of the central Bering Sea. In 1994, we observed more sockeye salmon that appeared to be maturing fish than we encountered in 1993. Males and females with gonad weights greater than 50 g were caught from June 29 through July 16, northward from 49°30'N to 58°30'N, and in the Donut Hole area.

Chum salmon were caught at all stations northwards of 42°30'N (SST=10.5° C), and were abundant northwards of 49°30' N (SST=6.2° C; Table 1). Longline catch and gillnet CPUEs were greater in 1994 than in the previous three years, and the gillnet CPUEs indicate that abundance in even-numbered years (1992 and 1994) is greater than abundance in odd-numbered years in the Bering Sea (1991 and 1993; Figs. 5, 6, and 7).

Pink salmon were caught in small numbers northwards of 42°30'N (SST=10.5° C), but this species was not abundant in the catch in 1994 (Table 1, Figs. 5, 6, and 7). Longline catches and gillnet CPUEs indicate that in the survey area pink salmon are more abundant in odd-numbered years than in even-numbered years. Recoveries of high seas tags indicate that odd-year Asian pink salmon are abundant in this area of the central North Pacific Ocean and Bering Sea (Myers et al. 1990). The abundance of pink salmon was greater in 1991 than in the last three years. In 1991, the *Wakatake maru* began sampling approximately 6 days earlier (June 12) than in 1992-1994 (June 17 or 18). By the middle of June, many of the maturing pink salmon have begun their spawning migration, thereby reducing their number in our catches (Nagasawa et al. 1994a).

Ninety-eight percent of the coho salmon catch was between 42°30'N and 47°30' N (SST=6.1°-10.5° C), but a few coho were caught in the Bering Sea (N=4; Table 1). Longline catch and gillnet CPUEs indicate that coho salmon were more abundant in 1991 than in 1992-1994 (Figs. 5, 6, and 7).

Chinook salmon were caught between 46°30'N (SST=6.6 ° C) and 49°30'N (SST=6.2° C) in the North Pacific Ocean and in the central Bering Sea northward of 54°30'N (SST=6.3-7.7° C; Table 1). Longline catches indicate chinook salmon abundance is low in the area straddling the Aleutians Islands between approximately 48°30'N and 53°30'N latitude (Figs. 5, 6, and 7). The *Wakatake maru* does not conduct any gillnet fishing in this area because it is within the U. S. 200-mile zone, so it is not possible to corroborate this observation with gillnet CPUEs.

Steelhead trout were caught between 44°30' N (SST=10.0° C) and 50°30'N (SST=6.9° C), but they were not caught in the Bering Sea (Table 1). As indicated by longline catches and gillnet CPUEs, steelhead trout were more abundant in 1991 and 1994 than in 1992 and 1993 (Figs. 5, 6, and 7). Fifty-five percent of the steelhead trout caught in 1994 were lacking either the adipose or a ventral fin indicating these fish are likely to be of North American hatchery origin (Table 4). We observed one steelhead trout that was lacking one of its ventral fins, but the fish still had an adipose fin, so we did not collect the snout. However, the Columbia Basin steelhead policy states that a left ventral fin clip (with or without other fin clips) is reserved for coded-wire tags placed in Columbia River steelhead and may not be used without a coded-wire tag (Johnson and Longwill 1993; see footnote on Table 4). In future salmonid research, we will examine all steelhead for ventral fin clips in addition to adipose fin clips and collect snouts from all steelhead that are lacking the adipose fin or lacking the left ventral fin. From the steelhead snouts that we collected, three coded-wire tags were recovered: one steelhead originated from the North Fork of the Salmon River, ID, and the other two were from the Hoh River, WA (Dahlberg et al. 1994).

Two Dolly Varden char were caught in the research-mesh gillnet on July 9 at the northernmost station (58°30'N latitude). The sea surface temperature at this station was the minimum temperature encountered during the survey (SST=5.5° C; Tables 1 and 5).

CATCHES OF NON-SALMONIDS

A total of 331 neon flying squid (*Ommastrephes bartramii*) was caught by gillnet. Ninety-seven percent of the flying squid caught were found south of salmonid distributions (south of 42°30'N latitude). At 42°30' N (SST=10.5°), where salmonid and squid distributions overlapped, 11 neon flying squid were caught coincidentally with 14 salmonids (four chum, one pink, and nine coho salmon; Table 1). The abundance of neon flying squid was greater in 1994 than in the previous three years (Figs. 5, 6, and 7).

Common non-salmonid fishes caught in operations included Pacific pomfret (*Brama japonica*), Atka mackerel (*Pleurogrammus monopterygius*), and walleye pollock (*Theragra chalcogramma*). A total of 237 pomfret was caught at the southern end of the transect southwards from 44°30'N (SST=10.0-15.9°C) and mainly on longline gear (67% of the total catch; Table 1). In the Bering Sea, Atka mackerel and walleye pollock were commonly caught on salmon gear. A total of 117 Atka mackerel was caught almost exclusively in research-mesh gillnet (N=116). Two hundred and fifty-five walleye pollock were caught. This total is dramatically larger than catches in any of the previous three years (six fish in 1991, two fish in 1992 and 1993). Forty-nine percent of the pollock were caught on surface longline gear (mean fork length=466 mm), 34% in research-mesh gillnet (mean fork length 488 mm), and the remaining 17% in commercial-mesh gillnet (mean fork length=557 mm). Perhaps the moratorium on pollock fishing in the international waters of the central Bering Sea has led to a recent increase in the abundance of pollock in the Donut Hole area.

SALMONID FOOD HABITS

Stomachs from 724 salmonids [141 sockeye (19%), 402 chum (56%), 89 pink (12%), 45 coho (6%), 29 chinook (4%) and 18 steelhead (2%)] were examined from the longline catch at 28 fishing stations (Table 6). In the Subarctic Current, sockeye salmon fed primarily on squid, but in the Alaska Current their diet included amphipods, mysids, and pteropods. In the Bering Current, sockeye salmon consumed many amphipods and euphausiids, but in the Bering Sea Gyre, sockeye salmon fed chiefly on copepods and squid. The index of stomach content weight (SCI; prey weight X 100/body weight) was greater in the Bering Sea Gyre (0.99) than in the Bering Current (0.45). The SCI for sockeye salmon was approximately equal for the two regions of the North Pacific Ocean (0.83-0.87; Table 6).

The major prey components found in the stomachs of chum salmon were ctenophores and chaetognaths in the Transition Domain, and many pteropods, coelenterates, and unidentified material were found in the stomachs of chum salmon caught in the Subarctic Current (Table 6). Squid, euphausiids, and amphipods were abundant in the stomachs of chum salmon caught in the Alaska Current. Amphipods and coelenterates were important in the diets of chum salmon caught in the Bering Current, and coelenterates and euphausiids were important in the Bering Sea Gyre. The SCI for chum salmon ranged from a low of 0.83 in the Bering Current to a high of 1.23 in the Alaska Current.

Pink salmon fed chiefly on copepods and chaetognaths in the Transition Domain and fed on large numbers of squid in the Subarctic Current (Table 6). Mysids, amphipods, and pteropods were commonly found in the stomachs of pink salmon caught in the Alaska Current. The stomachs of pink salmon contained large quantities of squids and amphipods in the Bering Current and contained fish and euphausiids in the Bering Sea Gyre. When pink salmon fed on squid in the Subarctic Current, the SCI value was larger than the value found in other regions (2.34; Table 6).

In the Subarctic Current, coho salmon fed exclusively on squid, but their diets included some fish in the Transition Domain (Table 6). Stomach content weight relative to body weight was heavier for coho and pink salmon than the other salmonids. Heavy feeding activity of coho and pink salmon may be related to the large growth these two species commonly show in the summer before they return to their natal streams to spawn.

Chinook salmon fed on squid in the Subarctic Current, squid and fish in the Bering Current, and squid and euphausiids in the Bering Sea Gyre (Table 6). The SCI ranged from a low of 0.28 in the Subarctic Current to 1.13 in the Bering Sea Gyre (Table 6).

Steelhead trout preyed on squid and fish in the Transition Domain and in the Subarctic Current (Table 6). The SCI was higher in the Subarctic Current than in the Transition Domain (0.78-1.28).

The percentage of crustaceous zooplankton (euphausiids, copepods, amphipods, ostracods, and decapods) found in the stomach of chum salmon increased from 11% in 1993, year of high pink salmon abundance, to 32% in 1994, a year of low pink salmon abundance in the study area (Fig. 8). The proportion of non-crustaceous zooplankton (pteropods, gelatinous zooplankton, appendicularians, polychaetes, chaetognaths, and salps) decreased from 75% in 1993 to 61% in 1994. The percentage of crustaceous zooplankton found in other salmonid stomachs has also increased in 1994. Pink, sockeye, and chinook salmon all exhibited a reduction from previous years in the percentage of micro-nekton in the diet and an increase in the percentage of crustaceous zooplankton (Fig. 8).

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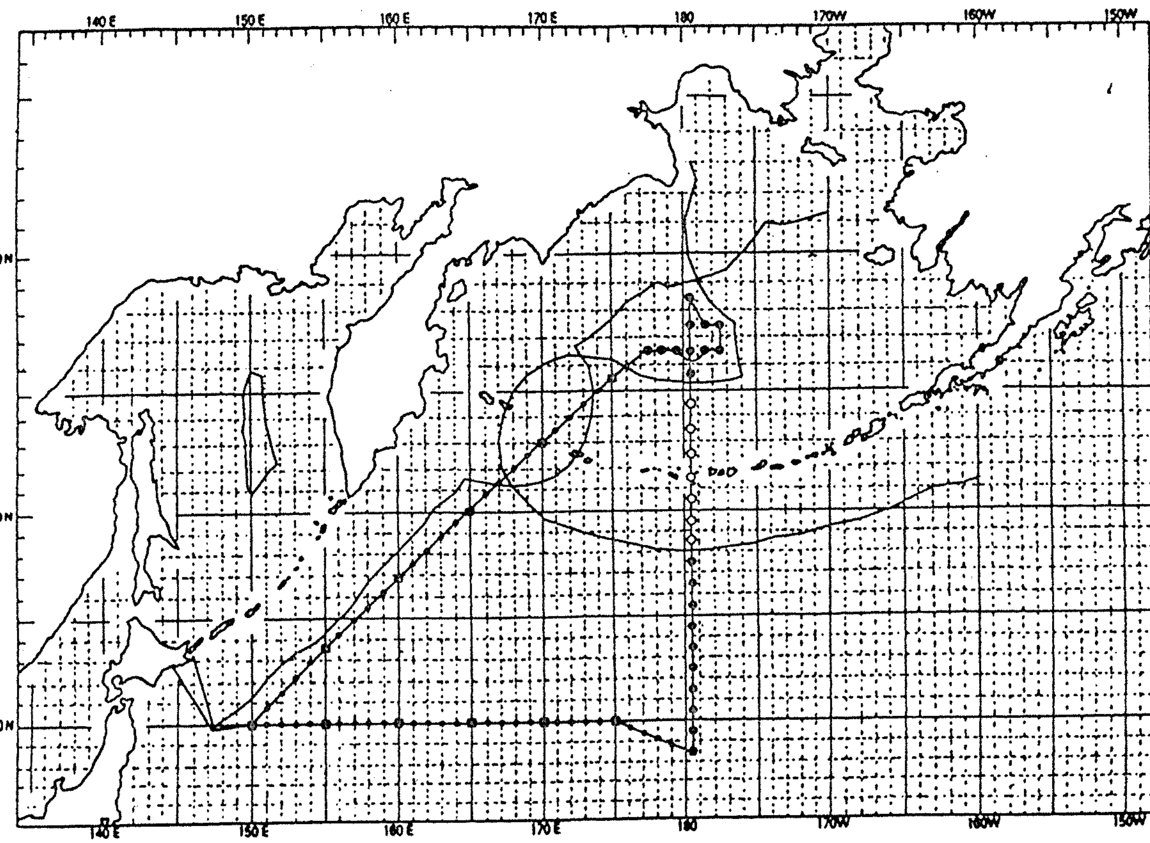
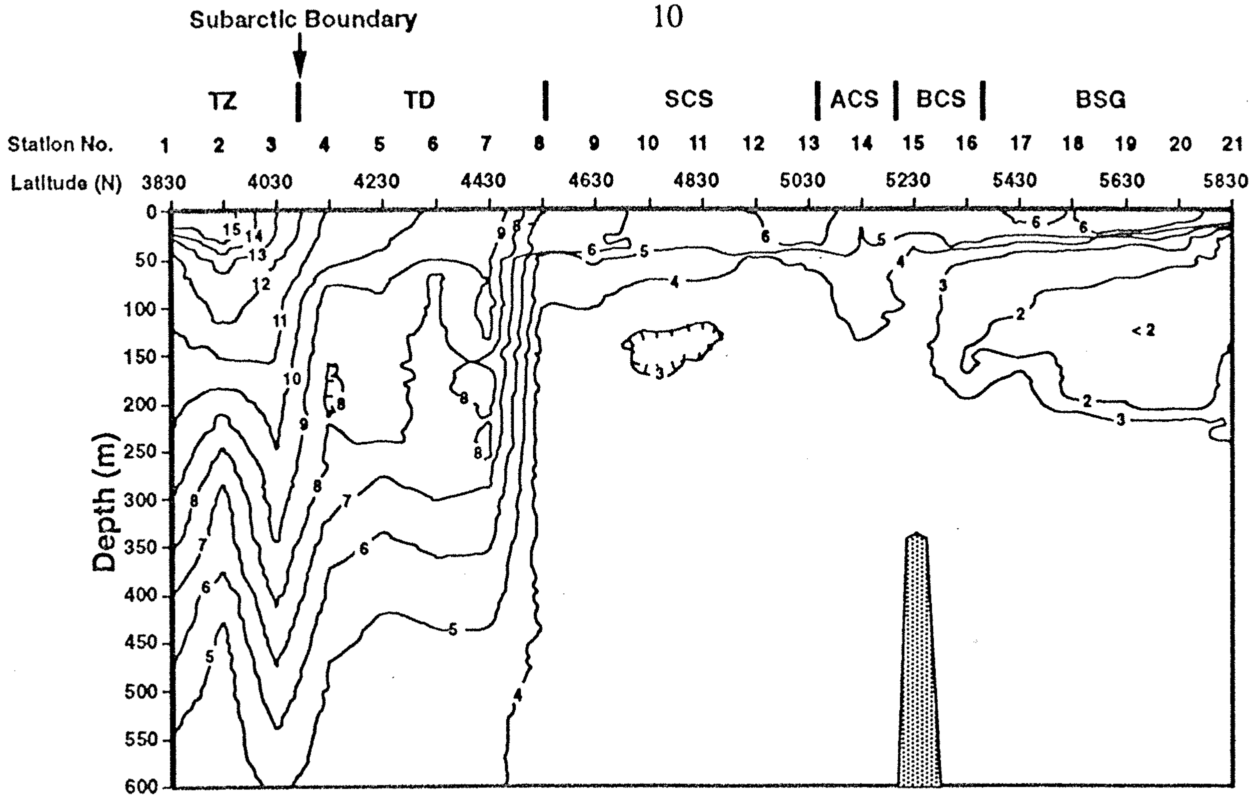


Figure 1. Station locations for the summer 1994 salmon research cruise of the *Wakatake maru*. The cruise track included 28 F (fishing) stations along a north-south transect at 179°30'W longitude and an east-west transect at 56°30'N latitude in the central Bering sea, and 56 T (transit) stations enroute and returning from the fishing research area. ● =longline and gillnet fishing operations, ○ =longline fishing operations, ■ =STD operations, • =XBT operations.



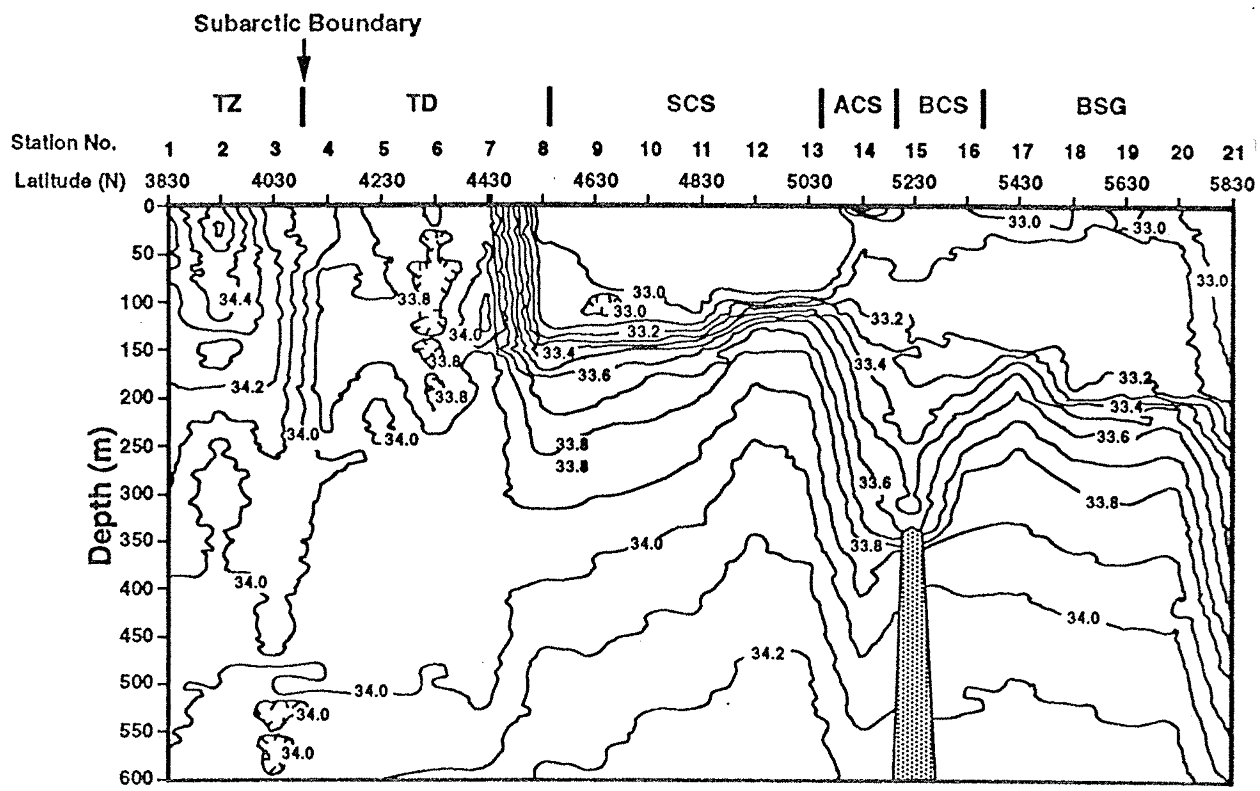
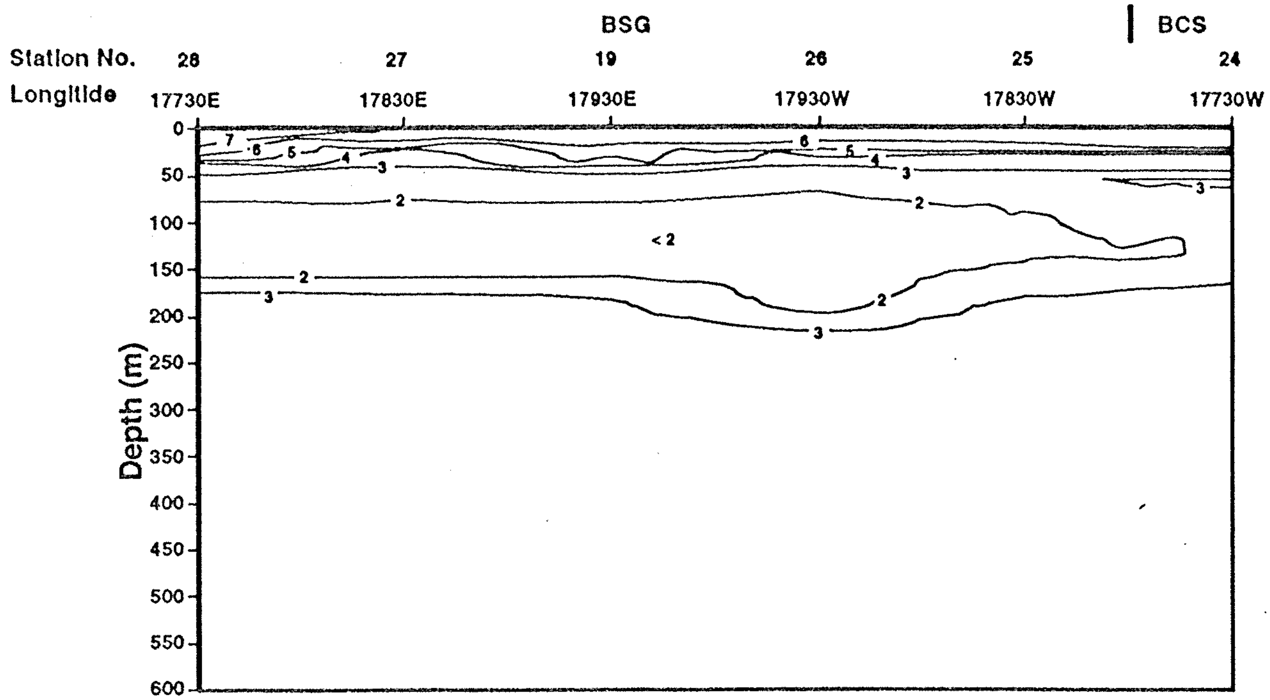


Figure 2. Vertical profile of water temperature (top, °C) and salinity (bottom, psu, practical salinity units) found in surface waters along a north-south transect at 179°30'W longitude. The subarctic boundary is denoted by the vertical 34.0 psu isohaline. TZ=Transition Zone, TD=Transition Domain, SCS=Subarctic Current System, ACS=Alaska Current System, BCS=Bering Current System, and BSG=Bering Sea Gyre. Stippled area is the sea bottom.



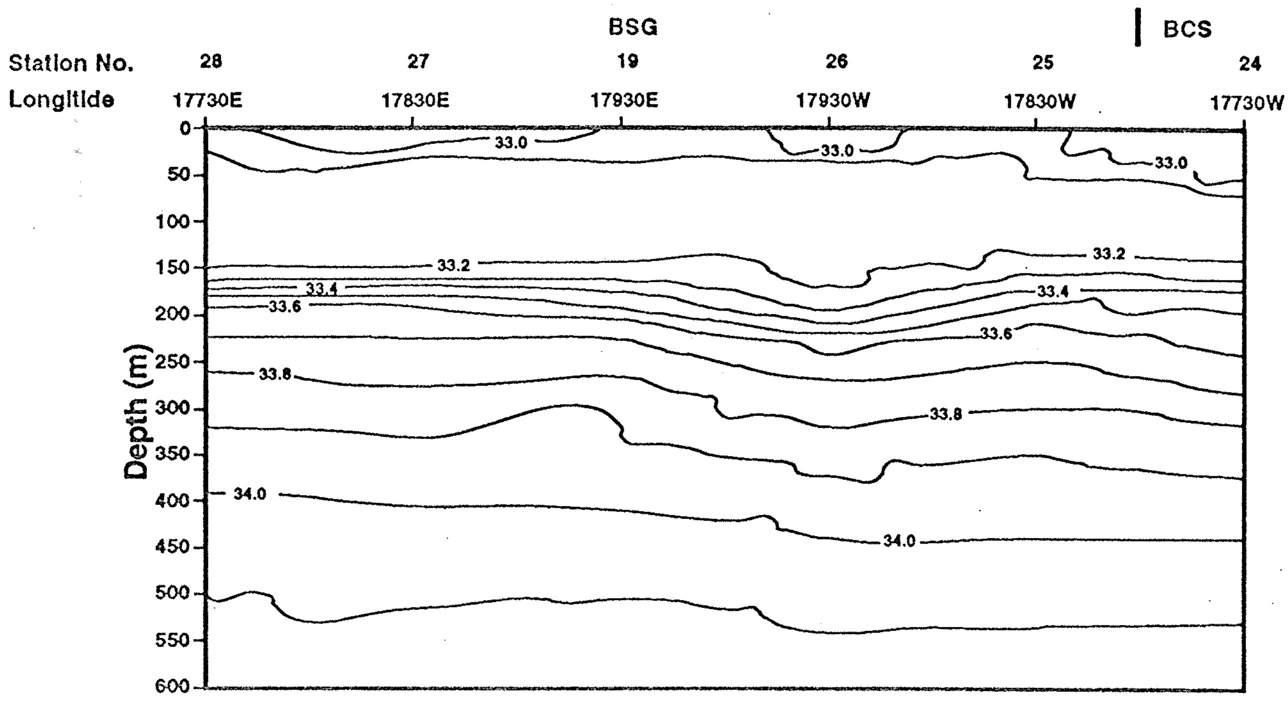


Figure 3. Vertical profile of water temperature (top, °C) and salinity (bottom, psu, practical salinity units) found in surface waters along an east-west transect at 56°30'N latitude. BSG=Bering Sea Gyre, BCS=Bering Current System.

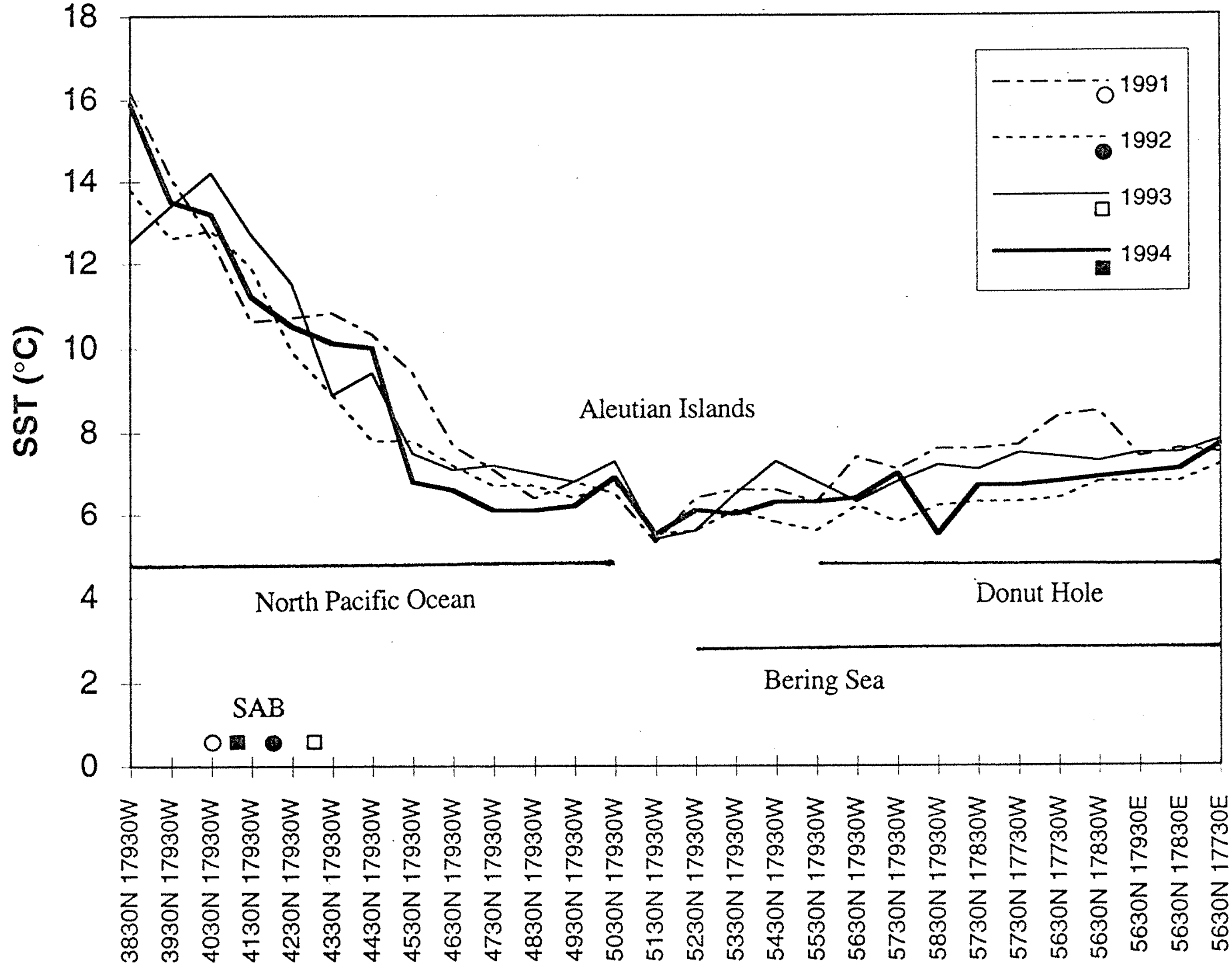


Figure 4. Approximate location of the subarctic boundary (SAB) where it intersects the cruise track and sea surface temperature in the North Pacific Ocean and Bering Sea during the salmon research cruises of the *Wakatake maru* in June and July, 1991-1994.

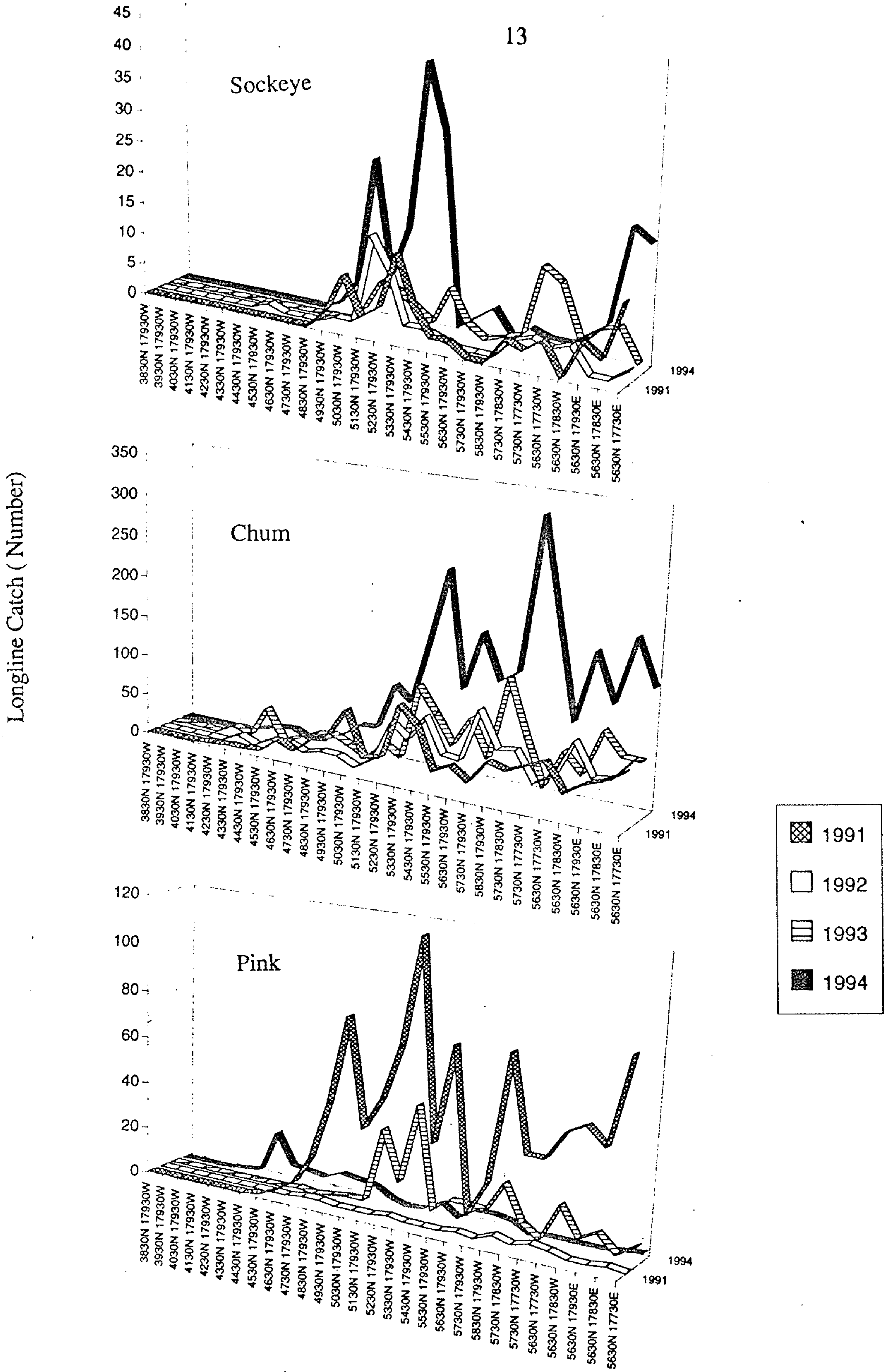


Figure 5. Number of salmonids caught by longline along the transect at 179°30'N (stations 1-21) and in the central Bering Sea (stations 22-28) in June and July 1991-1994. Longline fishing effort was the same 1991-1994.

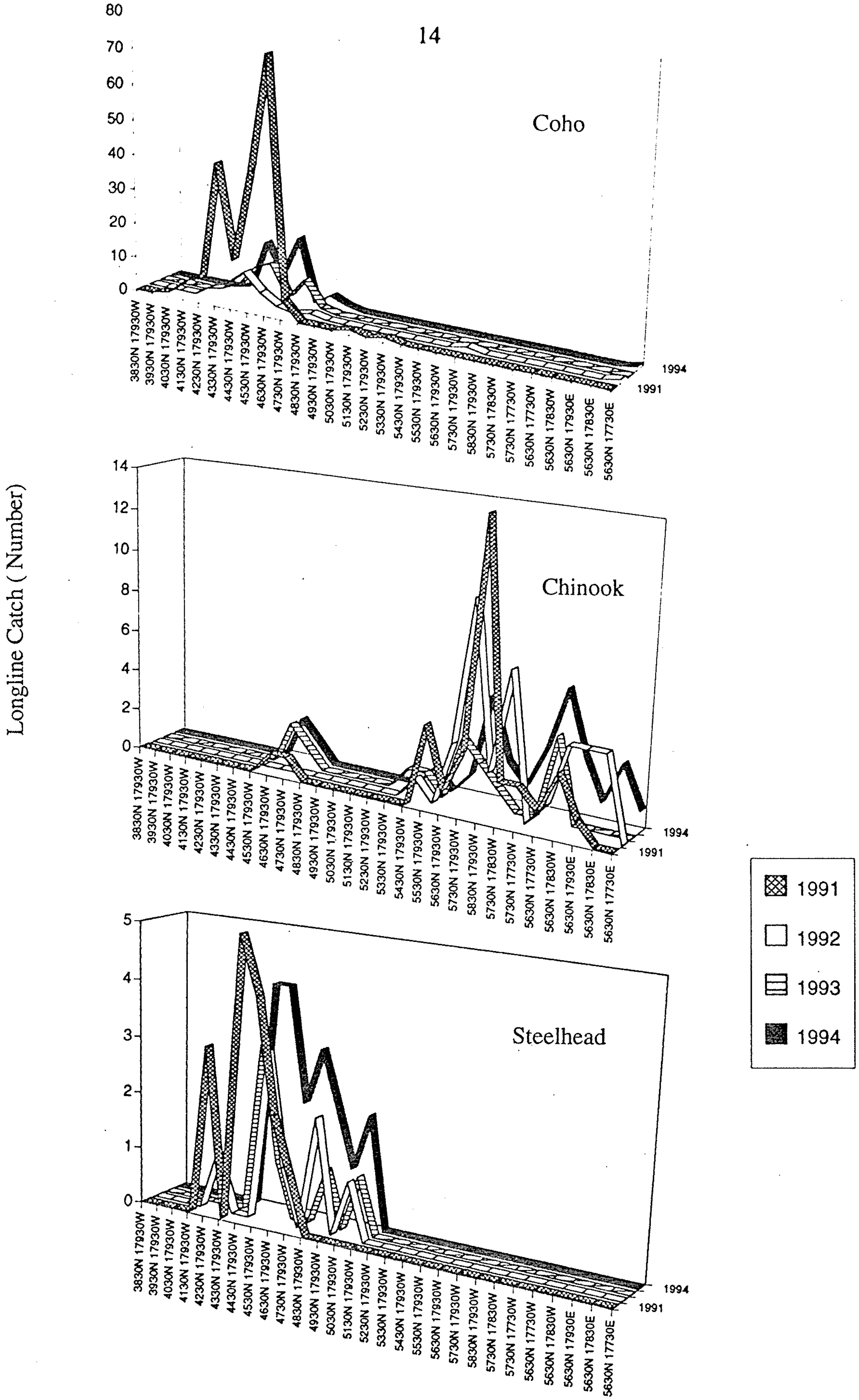


Figure 5. Continued.

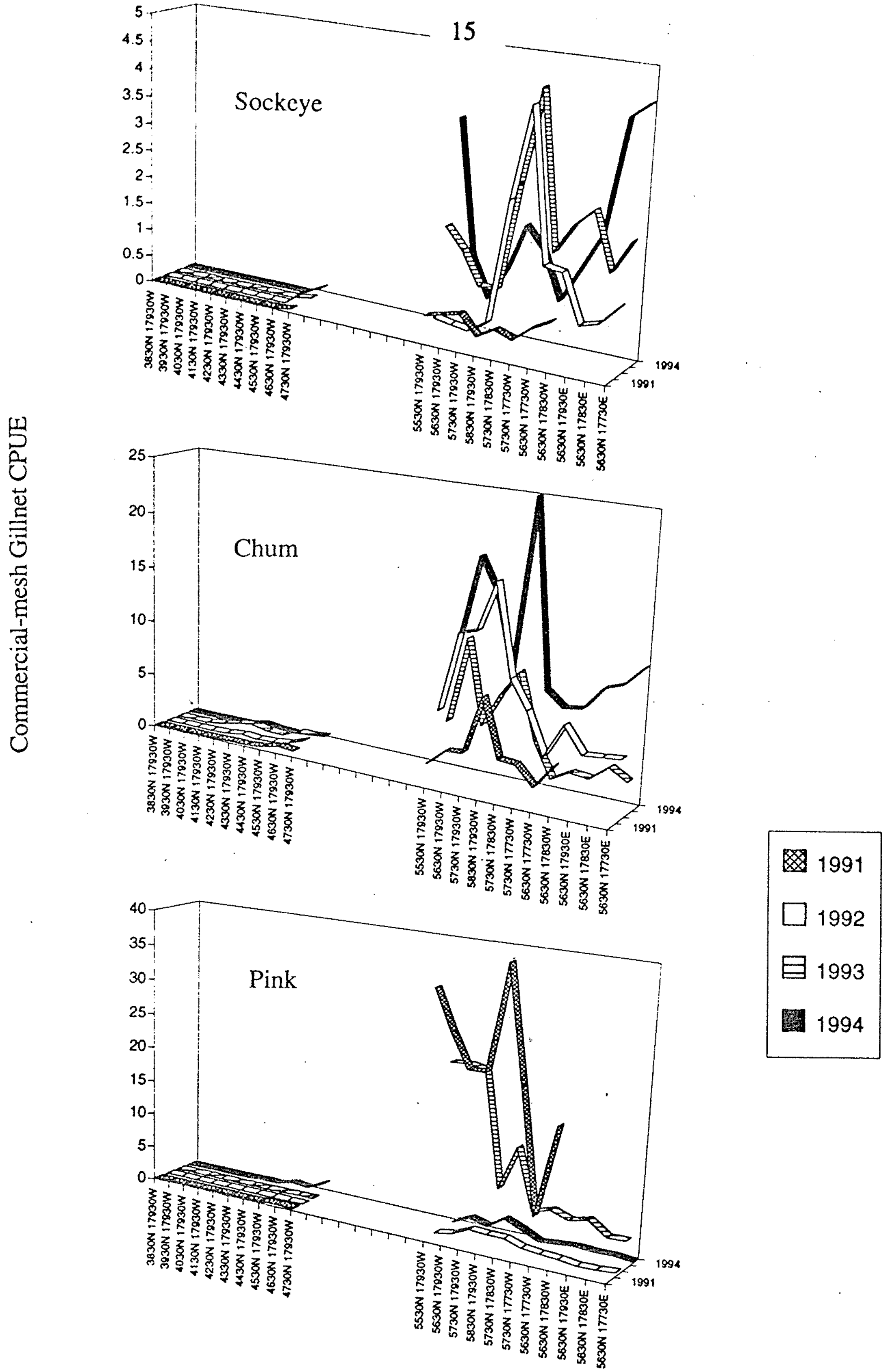


Figure 6. Catch per unit of effort (CPUE, number of fish caught per tan) for salmonids and neon flying squid caught at stations along a transect at 179°30'W longitude (stations 1-21) and in the central Bering Sea (stations 22-28) in June and July 1991-1994. Gillnets were not fished between 48°30'N and 54°30'N because these stations were within the U. S. 200-mile EEZ. Commercial-mesh size is 115 mm.

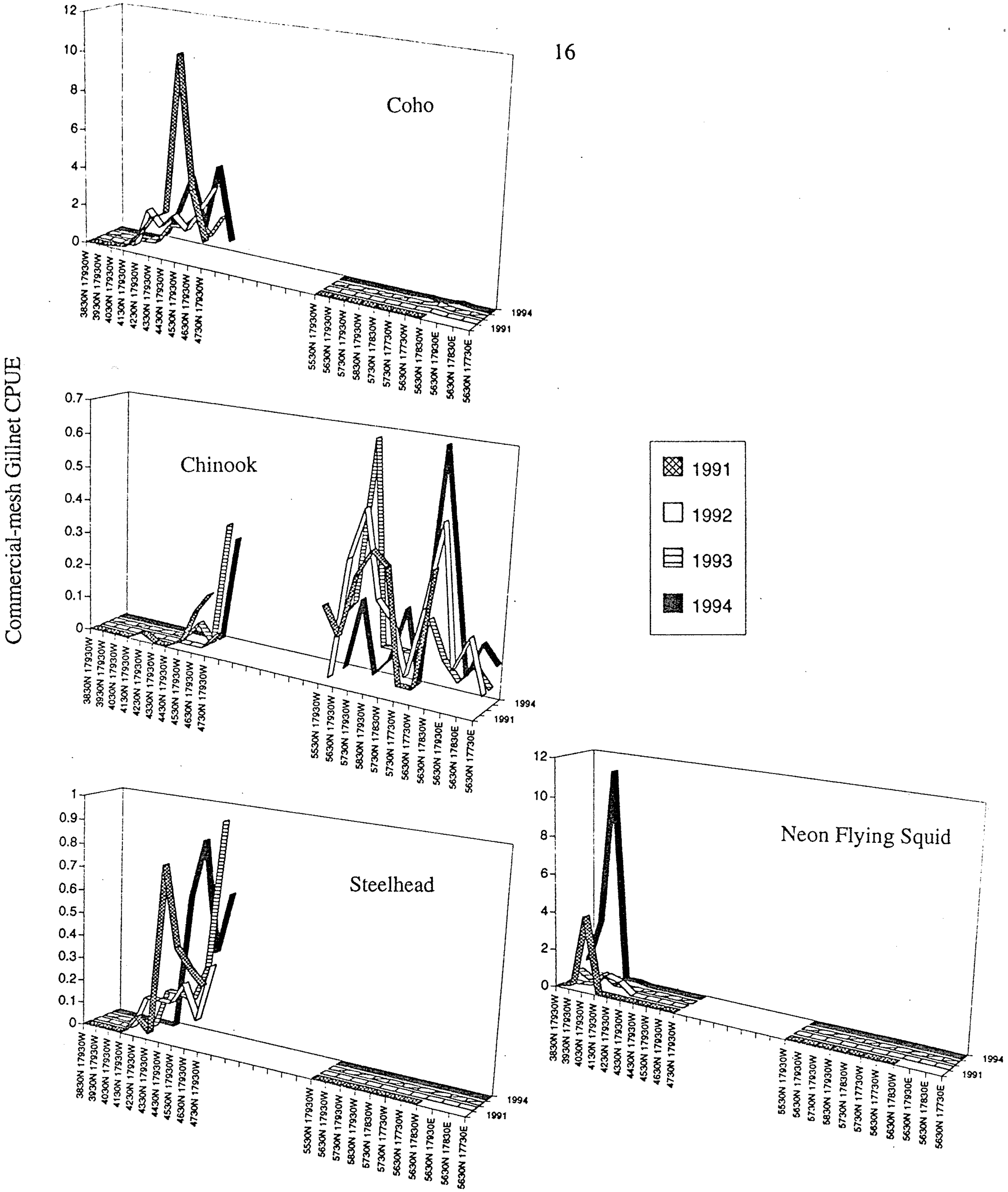


Figure 6. Continued.

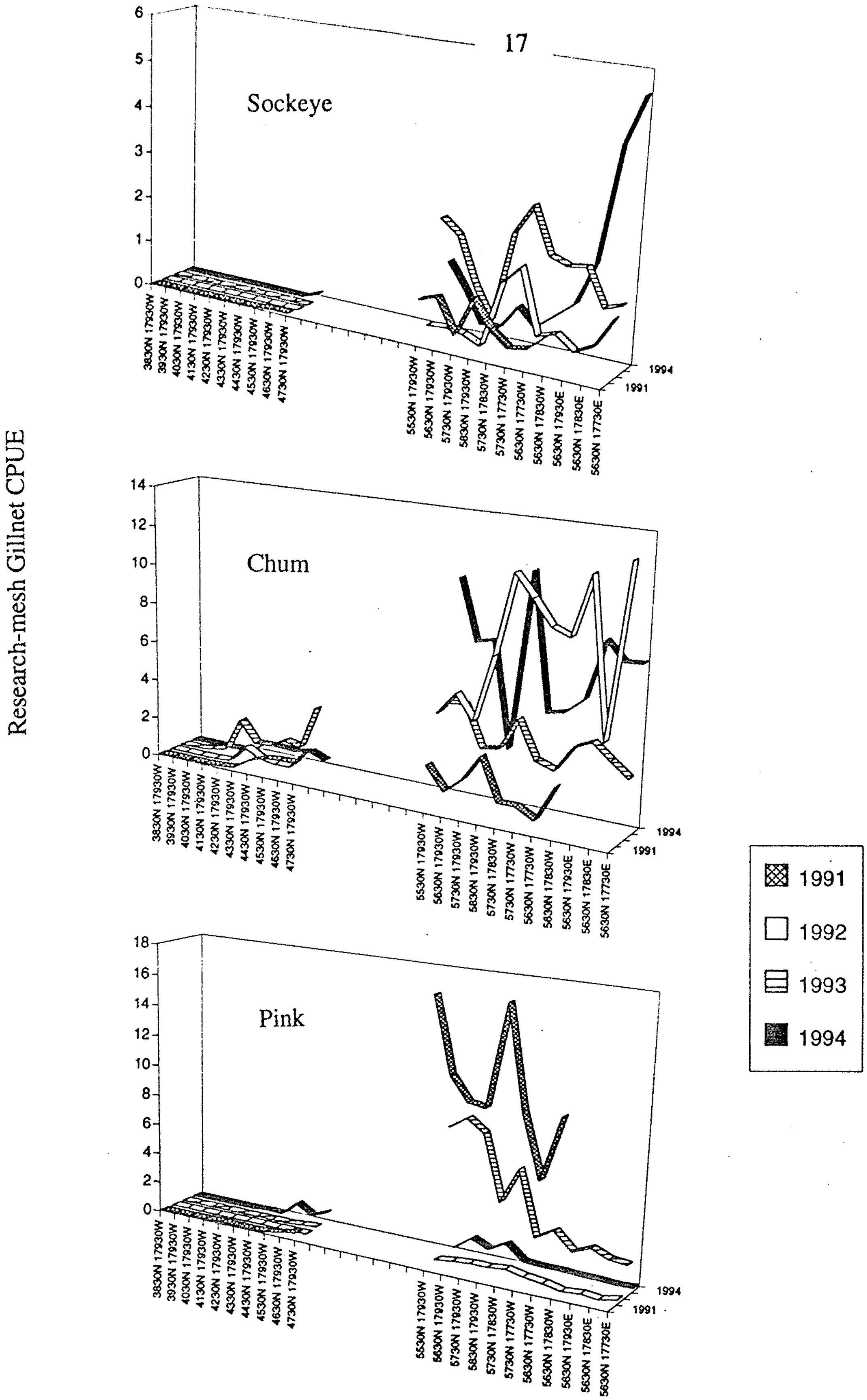


Figure 7. Catch per unit of effort (CPUE, number of fish caught per tan) for salmonids and neon flying squid caught at stations along a transect at 179°30'W longitude (stations 1-21) and in the central Bering Sea (stations 22-28) in June and July 1991-1994. Gillnets were not fished between 48°30'N and 54°30'N because these stations were within the U. S. 200-mile EEZ. Research-mesh sizes include the following: 48 mm, 55 mm, 63 mm, 72 mm, 82 mm, 93 mm, 106 mm, 121 mm, 138 m, and 157 mm.

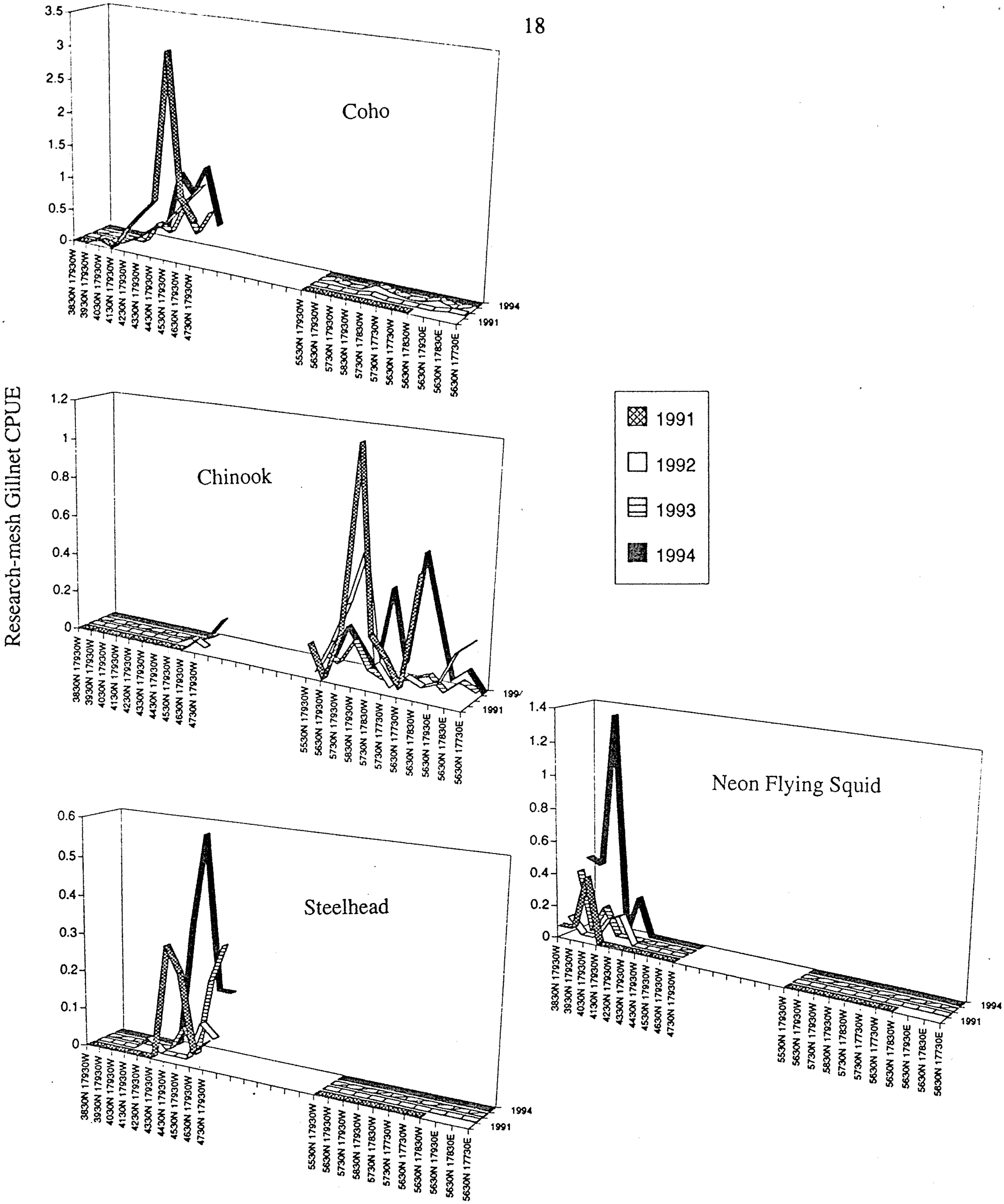


Figure 7. Continued.

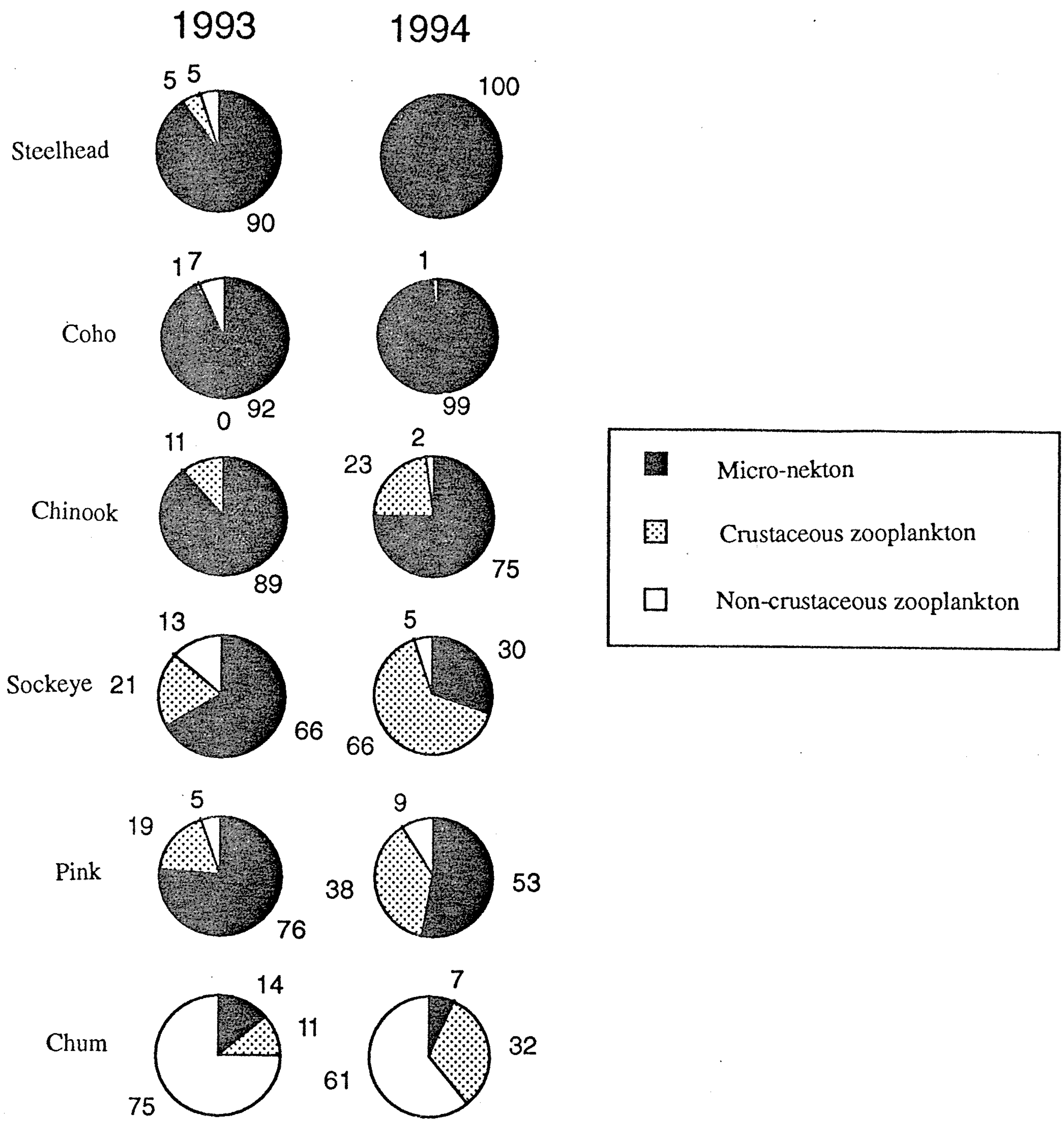


Figure 8. Percentage of prey types found in the stomachs of salmonids caught along the transect at 179°30'W longitude and in the central Bering Sea in 1993 and 1994. Micro-nekton includes fish and squid. Crustaceous zooplankton includes euphausiids, copepods, amphipods, ostracods, and decapods. Non-crustaceous zooplankton includes pteropods, gelatinous zooplankton, appendicularians, polychaetes, chaetognaths, and salps.

Table 1. Location, sea surface temperature (SST, °C), surface salinity (psu), catch of salmonids, other fishes, squids, and birds caught by longline (B), salmon research-mesh gillnet (C), and commercial-mesh gillnet (A) are listed for each fishing station. At stations 1 through 7, 30 tans (1 tan=50 m) of research-mesh gillnet (3 tans per 48 mm, 55 mm, 63 mm, 72 mm, 82 mm, 93 mm, 106 mm, 121 mm, 138 mm, and 157 mm mesh sizes), two tans of saury gillnet (1 tan per 29 mm and 37 mm mesh size), and 17 tans of commercial-mesh gillnet (115 mm) were fished. At stations 8 through 28, the saury gillnet was replaced with an additional 2 tans of commercial-mesh gillnet. The overall length of the gillnet was maintained at 49 tans (2450 m) throughout the cruise.

Sta	Date	Location	SST Salinity	Gear	Sockeye	Chum	Pink	Coho	Chinook	Steelhead	Dolly Varden	Neon Flying Squid	Other Squids	Pacific Pomfret	Atka Mackerel	Lancet Fish	Walleye Pollock	Sharks	Pacific Saury	Dagger Tooth	Other Fishes	Sea Birds	Marine Mammals
1	6-18	38°30 N 179°30 W	15.9	B	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
			34.35	C	0	0	0	0	0	0	0	13	5	1	0	0	0	2	0	0	0	0	0
				A	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0
				Total	0	0	0	0	0	0	0	26	5	1	0	0	0	3	0	0	0	0	0
2	6-19	39°30 N 179°30 W	13.5	B	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0
			34.53	C	0	0	0	0	0	0	0	12	1	10	0	0	0	3	0	0	0	0	0
				A	0	0	0	0	0	0	0	51	0	6	0	0	0	1	0	0	0	0	0
				Total	0	0	0	0	0	0	0	63	1	29	0	0	0	4	0	0	0	0	0
3	6-20	40°30 N 179°30 W	13.2	B	0	0	0	0	0	0	0	0	0	32	0	0	0	0	0	0	0	0	0
			34.11	C	0	0	0	0	0	0	0	40	1	22	0	0	0	0	0	0	1	0	0
				A	0	0	0	0	0	0	0	189	0	15	0	0	0	0	0	0	0	0	0
				Total	0	0	0	0	0	0	0	229	1	69	0	0	0	0	0	0	1	0	0
4	6-21	41°30 N 179°39 W	11.2	B	0	0	0	0	0	0	0	0	0	18	0	0	0	0	0	0	0	0	0
			34.04	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				A	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0
				Total	0	0	0	0	0	0	0	2	0	18	0	0	0	1	0	0	0	0	0
5	6-22	42°30 N 179°30 W	10.5	B	0	1	1	0	0	0	0	0	0	29	0	0	0	0	0	0	0	0	0
			33.83	C	0	2	0	5	0	0	0	7	6	16	0	0	0	0	521	0	0	0	0
				A	0	1	0	4	0	0	0	4	0	2	0	0	0	1	0	0	0	0	0
				Total	0	4	1	9	0	0	0	11	6	47	0	0	0	1	521	0	0	0	0
6	6-22	43°30 N 179°30 W	10.1	B	0	6	2	1	0	0	0	0	1	20	0	0	0	0	0	0	0	0	0
			33.79	C	0	17	3	6	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0
				A	0	6	3	28	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0
				Total	0	29	8	35	0	0	0	0	7	26	0	0	0	1	0	0	0	0	0
7*	6-24	44°30 N 179°30 W	10.0	B	0	44	39	36	0	20	0	0	1	47	0	0	0	1	0	0	0	0	0
			33.88	C	0	17	2	33	0	10	0	0	7	0	0	0	0	0	0	0	0	0	0
				A	0	3	2	61	0	10	0	0	0	0	0	0	0	2	0	0	0	0	0
				Total	0	64	43	130	0	40	0	0	8	47	0	0	0	3	0	0	0	0	0

Table 1. Continued.

Sta	Date	Location	SST Salinity	Gear	Sockeye	Chum	Pink	Coho	Chinook	Steelhead	Dolly Varden	Neon Flying Squid	Other Squids	Pacific Pomfret	Atka Mackerel	Lancet Fish	Walleye Pollock	Sharks	Pacific Saury	Dagger Tooth	Other Fishes	Sea Birds	Marine Mammals
8	6-25	45°30 N 179°30 W	6.8	B	0	14	7	7	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
			32.92	C	0	15	30	25	0	17	0	0	25	0	0	0	0	5	0	0	0	3	0
				A	0	2	14	20	0	16	0	0	1	0	0	0	0	2	0	0	0	1	0
				Total	0	31	51	52	0	37	0	0	26	0	0	0	0	7	0	0	0	4	0
9	6-26	46°30 N 179°30 W	6.6	B	0	5	6	18	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
			32.95	C	0	20	12	38	0	5	0	0	6	0	0	0	0	0	0	0	0	2	0
				A	0	5	9	85	0	7	0	0	0	0	0	0	0	2	0	0	0	1	0
				Total	0	30	27	141	2	14	0	0	6	0	0	0	0	2	0	0	0	3	0
10	6-27	47°30 N 179°30 W	6.1	B	0	8	5	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0
			32.94	C	4	11	24	12	3	5	0	0	1	0	0	0	0	0	0	0	0	0	0
				A	3	8	32	13	6	12	0	0	0	0	0	0	0	0	0	0	0	1	0
				Total	7	27	61	25	10	20	0	0	1	0	0	0	0	0	0	0	0	1	0
11	6-28	48°30 N 179°30 W	6.1	B	1	19	8	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
			32.96																				
12*	6-29	49°30 N 179°30 W	6.2	B	20	179	41	2	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0
			32.79																				
13	6-30	50°30 N 179°30 W	6.9	B	25	38	6	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0
			32.46																				
14	7-1	51°30 N 179°30 W	5.5	B	7	95	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			33.07																				
15	7-2	52°30 N 179°30 W	6.1	B	15	78	0	0	0	0	0	0	0	0	0	0	11	0	0	0	0	0	0
			33.02																				
16	7-3	53°30 N 179°30 W	6.0	B	41	159	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			33.10																				
17*	7-4	54°30 N 179°30 W	6.3	B	60	435	7	0	2	0	0	0	0	0	0	0	2	0	0	0	0	4	0
			33.13																				

Table 1. Continued.

Sta	Date	Location	SST Salinity	Gear	Sockeye	Chum	Pink	Coho	Chinook	Steelhead	Dolly Varden	Neon Flying Squid	Other Squids	Pacific Pomfret	Atka Mackerel	Lancet Fish	Walleye Pollock	Sharks	Pacific Saury	Dagger Tooth	Other Fishes	Sea Birds	Marine Mammals
18	7-5	55°30 N 179°30 W	6.3	B	1	107	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			33.00	C	45	324	10	0	0	0	0	0	1	0	7	0	0	0	0	0	0	16	0
				A	71	237	7	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	0
				Total	117	668	17	0	0	0	0	0	1	0	7	0	0	1	0	0	0	19	0
19	7-6	56°30 N 179°30 W	6.4	B	3	178	5	0	1	0	0	0	0	0	0	0	3	0	0	0	0	0	0
			32.96	C	29	235	25	0	6	0	0	0	6	0	1	0	0	0	0	0	0	6	0
				A	25	368	28	0	4	0	0	0	0	0	0	0	9	0	0	0	0	3	0
				Total	57	781	58	0	11	0	0	0	6	0	1	0	12	0	0	0	0	9	0
20	7-7	57°30 N 179°30 W	7.0	B	5	124	5	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			33.07	C	9	241	21	0	3	0	0	0	0	0	0	0	6	0	0	0	0	36	0
				A	12	313	15	0	0	0	0	0	0	0	0	0	8	0	0	0	0	147	0
				Total	26	678	41	0	8	0	0	0	0	0	0	0	14	0	0	0	0	183	0
21	7-8	58°30 N 179°30 W	5.5	B	1	138	4	0	2	0	0	0	0	0	0	0	98	0	0	0	0	0	0
			32.21	C	9	86	39	0	0	0	2	0	1	0	2	0	70	0	0	0	0	1	0
				A	23	189	46	0	1	0	0	0	0	0	0	0	4	0	0	0	0	1	0
				Total	33	413	89	0	3	0	2	0	1	0	2	0	172	0	0	0	0	2	0
22	7-9	57°30 N 178°30 W	6.7	B	3	324	0	0	1	0	0	0	0	0	0	0	8	0	0	0	0	1	0
			32.47	C	25	348	11	0	13	0	0	0	1	0	12	0	7	0	0	0	0	5	0
				A	39	475	26	0	4	0	0	0	0	0	0	0	10	0	0	0	0	3	0
				Total	67	1147	37	0	18	0	0	0	1	0	12	0	25	0	0	0	0	9	0
23	7-10	57°30 N 177°30 W	6.7	B	2	205	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0
			32.90	C	14	149	8	0	2	0	0	0	0	0	4	0	1	0	0	0	0	8	0
				A	32	168	3	0	0	0	0	0	0	0	0	0	6	0	0	0	1	8	0
				Total	48	522	12	0	5	0	0	0	0	0	4	0	7	0	0	0	1	17	0
24	7-11	56°30 N 177°30 W	6.8	B	2	92	1	0	6	0	0	0	1	0	0	0	1	0	0	0	0	0	0
			32.71	C	24	155	8	0	19	0	0	0	1	0	0	0	1	0	0	0	0	9	0
				A	16	143	8	1	13	0	0	0	0	0	0	0	2	0	0	0	0	1	0
				Total	42	390	17	1	38	0	0	0	2	0	0	0	4	0	0	0	0	10	0
25	7-12	56°30 N 178°30 W	6.9	B	3	179	1	0	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0
			33.06	C	34	178	6	0	10	0	0	0	4	0	1	0	2	0	0	0	0	0	0
				A	28	149	12	0	7	0	0	0	1	0	0	0	5	1	0	0	0	4	0
				Total	65	506	19	0	20	0	0	0	5	0	1	0	8	1	0	0	0	4	0

Table 1. Continued.

Sta	Date	Location	SST Salinity	Gear	Sockeye	Chum	Pink	Coho	Chinook	Steelhead	Dolly Varden	Neon Flying Squid	Other Squids	Pacific Pomfret	Atka Mackerel	Lancet Fish	Walleye Pollock	Sharks	Pacific Saury	Dagger Tooth	Other Fishes	Sea Birds	Marine Mammals
26	7-13	56°30 N 179°30 E	7.0	B	6	122	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			33.09	C	62	266	6	0	1	0	0	0	5	0	3	0	0	0	0	0	0	1	0
				A	40	188	9	2	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0
				Total	108	576	16	2	3	0	0	0	5	0	3	0	0	0	0	0	0	4	0
27	7-14	56°30 N 178°30 E	7.1	B	21	203	2	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			33.20	C	136	240	4	0	3	0	0	0	7	0	81	0	0	0	0	0	0	0	0
				A	79	199	10	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3	0
				Total	236	642	16	0	9	0	0	0	7	0	81	0	0	0	0	0	0	3	0
28	7-15	56°30 N 177°30 E	7.7	B	19	149	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			33.10	C	166	242	6	0	0	0	0	0	5	0	5	0	0	0	0	0	0	5	0
				A	84	231	6	0	2	0	0	0	0	0	0	0	0	0	0	0	3	19	0
				Total	269	622	15	1	3	0	0	0	5	0	5	0	0	0	0	0	3	24	0
		Subtotal		B	235	2902	148	68	32	38	0	0	3	159	1	0	124	2	0	0	0	6	0
				C	557	2546	215	119	60	37	2	72	88	54	116	0	87	10	521	0	1	92	0
				A	452	2685	230	214	41	45	0	259	3	24	0	0	44	12	0	0	4	198	0
		Total			1244	8133	593	401	133	120	2	331	94	237	117	0	255	24	521	0	5	296	0

*B is a total of five longline operations: four 20-hachi operations and one 30-hachi operation.

Table 2. Research activities conducted on the *Wakatake maru* in 1994.

A. Activities conducted at T (transit) stations:

Subject	Location	Sampling Device	Sampling Depth	Data or Samples Collected
Oceanography	5° longitude intervals	CTD	0-600 m	depth, temperature, and salinity
	1° longitude intervals	XBT	0-460 m	depth, temperature
Primary Production	5° longitude intervals	bucket	0 m	amount of chl-a/1 liter of seawater, identification of phytoplankton
Secondary Production	5° longitude intervals	Norpac	0-150 m	biomass and identification of macro-zooplankton

B. Activities conducted at F (fishing) stations:

Subject	Location	Sampling Device	Sampling Depth	Data or Samples Collected
Oceanography	1° latitude intervals	CTD	0-600 m	depth, temperature, and salinity
Primary Production	1° latitude intervals	Go-Flow water sampler	0, 10, 20, 30, 50, 75, 100 m	amount of chl-a/1 liter of seawater, nutrient analysis, identification of phytoplankton
Secondary Production	1° latitude intervals	Norpac	0-150 m	biomass and identification of macro-zooplankton,
		Bongo	0-150 m	fish larvae, and
		ORI	0-250 m	micro-nekton
		fish larval net	0 m	

Table 2. Continued.

C. Activities conducted at F (fishing) stations:

Subject	Location	Fishing Gear	Method	Data or Samples Collected
Salmonid Studies	1° latitude intervals	longline is 3330 m and 1470 hooks in overall length (30-hatchi)	set at the surface for 30 minutes at dusk in the evening*	distribution and abundance, stomach contents, diurnal feeding activity, scales and otoliths, chum salmon isozyme, fat, protein, and RNA/DNA contents, examination of fish for salmon lice, fin-clips and slash marks
	1° latitude intervals (38°N-44°N) (38°N-44°N) (44°N-58°N) (44°N-58°N)	gillnet is 2450 m in overall length; 32-tans research 17-tans commercial, 30-tans research 19-tans commercial	12-hour soak 4 pm to 4 am	distribution and abundance, scales and otoliths, chum salmon isozyme, fat, protein, and RNA-DNA contents, examination of fish for salmon lice, fin-clips, and slash marks
Non-salmonid Studies	1° latitude intervals	longline gillnet	same as above	saury and pomfret length frequencies, and round samples

* except stations 7, 12, and 17 where four additional 20-hachi longline operations were conducted over a 24-hour period.

Table 3. Description of the sampling equipment and methodology used to collect macro-zooplankton and micro-nekton by the *Wakatake maru* in 1994.

Net	Purpose	Ring Diameter	Overall Length	Mesh Size	Depression Weight	Towing Method	Wire Angle	Ship Speed	Wire Speed	Sample Preservation	Comments
Norpac	catches macro-zooplankton; long time series in the North Pacific	0.45 m	1.95 m	0.335 mm	10 kg	0-150 m vertical	measured and added wire length recorded	0 knots; drifting	1.0m/sec	bottled with formalin	flow meter used and calibrated 3X at first and last T-station
Bongo	catches macro-zooplankton; does not use a bridal maybe less net avoidance by zooplankton	0.70 m (2 rings: 1 designated red, 1 designated blue)	3.5 m	red=0.330 mm blue=0.600 mm	20 kg	0-150 m oblique	45°; wire length is 210 m	setting and retrieval is 1.5 knots	setting is 0.6m/sec retreival is 0.3m/sec	bottled with formalin	flowmeter used and calibrated 3X at first and last F-station
ORI	catches mega-zooplankton and micro-nekton	2.0 m	8.66 m	2.0 mm	50 kg	0-250 m oblique	60°; wire length is 500 m	setting is 2.0 knots retreival is 1.5 knots	1.0 m/sec	bottled with formalin	flowmeter used and calibrated 3X at first and last F-station
Fish larval net	catches fish larvae, micro-nekton, and small squid	1.3 m	4.5 m	2.0 mm (frontal portion), 0.335 mm (codend)	N/A	surface horizontal	N/A	2.0 knots	stationary	cotton bag put in a bucket of formalin	towed for 10 minutes; flowmeter broken

Table 4. Catch location and biological data for fin-clipped salmonids caught by the *Wakatake maru* in 1994 (N=67).

Date	Location	Species	Length (mm)	Weight (gms)	Sex	Gonad Weight	Gear	Sample Number
6-24	44°30N179°30W	Sthd	525	1610	M	1	B	15-02
6-24	44°30N179°30W	Sthd	541	1580	F	4	B	15-07
6-24	44°30N179°30W	Sthd	590	2000	M	1	B	15-08
6-24	44°30N179°30W	Sthd	564	1920	M	2	B	15-11
6-24	44°30N179°30W	Sthd	561	1850	M	10	B	15-12
6-24	44°30N179°30W	Coho	600	2450	M	17	B	15-17
6-24	44°30N179°30W	Sthd	530	1520	M	10	B	15-19
6-24	44°30N179°30W	Sthd	534	1540	M	6	B	16-06
6-24	44°30N179°30W	Sthd	546	1750	F	6	B	16-07
6-24	44°30N179°30W	Sthd	558	1800	F	5	B	16-08
6-24	44°30N179°30W	Sthd	598	1960	M	2	B	16-09
6-24	44°30N179°30W	Sthd	598	2150	M	10	B	16-10
6-24	44°30N179°30W	Sthd	570	1940	F	13	B	16-11
6-24	44°30N179°30W	Sthd	572	1820	M	8	B	17-26
6-24	44°30N179°30W	Sthd	574	2100	F	13	B	18-12
6-24	44°30N179°30W	Sthd	558	1880	F	15	B	18-13
6-24	44°30N179°30W	Sthd	590	1980	M	5	B	18-14
6-25	44°30N179°30W	Sthd	540	1540	M	2	A115	22-02
6-25	44°30N179°30W	Sthd	600	1740	M	3	A115	22-03
6-25	44°30N179°30W	Sthd	560	1640	M	2	A115	22-04
6-25	44°30N179°30W	Sthd	581	2200	M	2	C121	23-01
6-25	44°30N179°30W	Sthd	580	1900	F	5	C121	23-02
6-25	44°30N179°30W	Sthd	576	1850	F	5	C121	23-04
6-25	44°30N179°30W	Sthd	561	1850	F	16	C121	23-05
6-25	44°30N179°30W	Sthd	570	1880	M	2	C106	25-02
6-25	44°30N179°30W	Sthd	530	1560	F	3	C093	27-01

Table 4. Continued.

Date	Location	Species	Length (mm)	Weight (gms)	Sex	Gonad Weight	Gear	Sample Number
6-25	44°30N179°30W	Sthd	560	1600	F	15	C093	27-02
6-25	44°30N179°30W	Sthd	566	1720	M	5	C093	27-03
6-25	45°30N179°30W	Sthd	548	1700	M	5	B	33-13
6-25	45°30N179°30W	Sthd	682	3250	F	43	B	33-22
6-26	45°30N179°30W	Sthd	570	1720	M	62	A115	36-01
6-26	45°30N179°30W	Sthd	644	2550	F	22	A115	36-02
6-26	45°30N179°30W	Sthd	536	1600	F	4	A115	36-03
6-26	45°30N179°30W	Sthd	540	1620	M	1	A115	36-04
6-26	45°30N179°30W	Sthd	540	1540	M	2	A115	36-05
6-26	45°30N179°30W	Sthd	594	1920	F	3	A115	36-06
6-26	45°30N179°30W	Sthd	638	2330	M	5	A115	36-07
6-26	45°30N179°30W	Sthd	678	1680	M	4	A115	36-15
6-26	45°30N179°30W	Sthd	544	1600	F	13	A115	36-16
6-26	45°30N179°30W	Sthd	590	2010	F	5	C121	39-09
6-26	45°30N179°30W	Sthd	586	1930	F	13	C121	39-10
6-26	45°30N179°30W	Sthd	550	1750	M	7	C121	39-11
6-26	45°30N179°30W	Sthd	460	1650	M	3	C106	40-04
6-26	45°30N179°30W	Sthd	600	2200	M	13	C106	40-05
6-26	45°30N179°30W	Sthd	552	1750	M	18	C093	41-01
6-26	45°30N179°30W	Sthd	580	2100	F	18	C093	41-02
6-26	45°30N179°30W	Sthd	554	1720	F	14	C138	42-05
6-26	45°30N179°30W	Sthd	666	1980	F	12	C082	44-12
6-27	46°30N179°30W	Sthd	554	1900	M	2	C093	52-20
6-27	46°30N179°30W	Sthd	558	1640	M	2	A115	53-11
6-27	46°30N179°30W	Sthd	568	1840	F	7	A115	53-12
6-27	47°30N179°30W	Sthd	592	2100	F	15	B	58-07
6-28	47°30N179°30W	Sthd	781	5150	M	10	C121	60-05
6-28	47°30N179°30W	Sthd	781	4800	M	10	C138	61-06
6-28	47°30N179°30W	Sthd	604	2150	M	2	A115	64-01

Table 4. Continued.

Date	Location	Species	Length (mm)	Weight (gms)	Sex	Gonad Weight	Gear	Sample Number
6-28	47°30N179°30W	Sthd	776	4950	M	7	A115	64-02
6-28	47°30N179°30W	Sthd	688	3300	F	10	A115	64-03
6-28	47°30N179°30W	Sthd	582	2050	M	2	A115	64-04
6-28	47°30N179°30W	Sthd	618	2200	M	2	A115	64-05
6-28	47°30N179°30W	Sthd	508	1860	F	12	A115	64-06
6-28	47°30N179°30W	Sthd	672	3150	M	5	A115	64-07
6-28*	47°30N179°30W	Sthd	672	3000	F	23	A115	VClip
6-28	48°30N179°30W	Sthd	796	5750	F	21	B	70-26
6-29	49°30N179°30W	Sthd	724	3950	F	41	B	72-30
6-29	49°30N179°30W	Sthd	712	3600	F	45	B	81-13
6-30	50°30N179°30W	Sthd	712	3800	F	42	B	83-10
6-30	50°30N179°30W	Sthd	737	3650	M	7	B	84-15

*This fish was lacking a ventral fin, but it had an adipose fin. The absence of a ventral fin may indicate the fish originated from the Columbia River. A snout was not collected from this steelhead trout. The Columbia Basin steelhead policy states that a left ventral clip (single or in combination) is reserved for coded-wire tags placed in Columbia River Basin steelhead and may not be used without a coded-wire tag (Johnson and Longwill 1993). An adipose clip may be used in conjunction with the left-ventral clip and coded-wire tag to indicate a harvestable coded-wire tagged steelhead. The adipose clip (single or in combination) on steelhead in the Columbia Basin is reserved (effective 9/83) to identify harvestable fish and is no longer a flag indicating a coded-wire tag.

Table 5. Catch location and biological data for Dolly Varden (*Salvelinus malma*) caught by the *Wakatake maru* in 1994.

Date	Location	Length (mm)	Weight (gms)	Mesh Size	Sample Number
7-9	58°30N179°30W	450	780	C072	189-01
7-9	58°30N179°30W	484	920	C082	190-13

Table 6. Mean percent volume of prey found in salmonid stomach contents summarized by oceanographic region and prey category. The mean percent volume was visually estimated for each prey category. Index of stomach content weight (SCI=prey weight X 100/body weight) includes empty stomachs. TZ=Transition Zone, TD=Transition Domain, SCS=Subarctic Current System, ACS=Alaska Current System, BCS=Bering Current System, BSG=Bering Sea Gyre, SQ=squid, FI=fish, EU=euphausiids, CO=copepods, AM=amphipods, MY=mysids, OS=ostracods, DE=decapods, PT=pteropods, Coel=coelenterates, Cten=ctenophores, AP=appendicularia, PO=polychaetes, CH=chaetognaths, SA=salps, CL=*Clione*, HE=heteropods, OC=octopus, UN=unidentified material.

Sockeye

Region	N	SCI	SQ	FI	EU	CO	AM	MY	OS	DE	PT	Coel	Cten	AP	PO	CH	SA	CL	HE	OC	UN
SCS	26	0.87	65	0	19	6	7	0	0	0	3	0	0	0	0	0	0	0	0	0	0
ACS	7	0.83	2	0	0	0	61	24	0	3	10	0	0	0	0	0	0	0	0	0	0
BCS	34	0.45	0	1	38	3	51	3	0	1	1	0	0	0	0	2	0	0	0	0	0
BSG	74	0.99	20	6	14	40	14	0	0	0	4	1	0	0	0	0	0	0	0	0	0
Total	141																				
Mean		0.83	25	4	17	27	20	2	0	0	4	1	0	0	0	0	0	0	0	0	0

Chum

Region	N	SCI	SQ	FI	EU	CO	AM	MY	OS	DE	PT	Coel	Cten	AP	PO	CH	SA	CL	HE	OC	UN
TD	32	1.05	4	1	1	1	2	0	4	0	2	5	33	0	0	35	0	0	2	0	10
SCS	72	0.85	2	1	9	1	4	0	0	0	21	13	2	0	0	3	0	2	0	0	42
ACS	20	1.23	22	13	22	4	19	6	0	0	1	9	4	0	0	0	0	0	0	0	1
BCS	60	0.83	4	3	6	5	21	6	0	0	6	22	2	0	1	4	0	0	0	0	21
BSG	218	1.01	4	2	18	7	12	0	0	0	7	40	1	0	0	3	0	0	0	0	6
Total	402																				
Mean		0.97	5	2	14	5	12	1	0	0	8	28	4	0	0	6	0	0	0	0	14

Pink

Region	N	SCI	SQ	FI	EU	CO	AM	MY	OS	DE	PT	Coel	Cten	AP	PO	CH	SA	CL	HE	OC	UN
TD	29	0.66	0	6	1	44	11	0	5	0	7	0	0	0	0	25	0	0	0	0	0
SCS	32	2.34	69	1	11	9	4	0	0	0	6	0	0	0	0	1	0	0	0	0	0
ACS	2	0.96	0	17	0	0	27	37	0	0	20	0	0	0	0	0	0	0	0	0	0
BCS	2	0.52	48	14	3	3	25	0	0	0	3	0	0	0	0	3	0	0	0	0	0
BSG	24	1.50	30	16	39	11	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Total	89																				
Mean		1.49	47	6	17	14	5	1	1	0	5	0	0	0	0	4	0	0	0	0	0

Table 6. Continued.

Coho

Region	N	SCI	SQ	FI	EU	CO	AM	MY	OS	DE	PT	Coel	Cten	AP	PO	CH	SA	CL	HE	OC	UN
TD	23	1.22	74	23	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0
SCS	22	2.91	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	45																				
Mean		2.05	92	7	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0

Chinook

Region	N	SCI	SQ	FI	EU	CO	AM	MY	OS	DE	PT	Coel	Cten	AP	PO	CH	SA	CL	HE	OC	UN
SCS	3	0.28	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BCS	6	0.50	53	24	0	0	20	0	0	0	2	0	0	0	0	2	0	0	0	0	0
BSG	20	1.13	45	7	10	8	9	2	0	0	4	5	2	0	0	4	0	0	0	0	4
Total	29																				
Mean		0.35	66	8	17	0	6	0	0	0	1	1	0	0	0	1	0	0	0	0	0

Steelhead

Region	N	SCI	SQ	FI	EU	CO	AM	MY	OS	DE	PT	Coel	Cten	AP	PO	CH	SA	CL	HE	OC	UN
TD	8	0.78	55	43	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
SCS	10	1.28	92	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	18																				
Mean		1.05	80	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0