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Migrations, Abundance, and Origins of Salmonids in Offshore Waters of the North Pacific - 1995

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Abstract

This report summarizes research on high seas salmonids conducted in 1995 by the Fisheries Research Institute (FRI), University of Washington, under contract to the U.S. National Marine Fisheries Service. The work is largely in response to U.S. research and enforcement commitments to the North Pacific Anadromous Fish Commission (NPAFC). The research was in three major areas: (1) international cooperative high seas sampling and tagging, (2) ocean ecology, stock assessment, and carrying capacity research, and (3) scale pattern analyses to determine age, growth, and stock origins of salmon. Sampling and tagging were carried out aboard two Japanese research vessels in June and July in the central North Pacific Ocean, Bering Sea, and Gulf of Alaska. Salmonids were tagged, marked with oxytetracycline for experimental age and growth validation research, and released. Ten U.S. high seas salmon tags were returned between 1 September 1994 and 31 August 1995. The results from pink salmon tagging in the central Gulf of Alaska (10% tag recovery rate) indicate extensive mixing of South Peninsula, Kodiak, Prince William Sound, and Southeast Alaska pink salmon during their last month at sea. Salmonids were examined for missing fins, and coded-wire tags were recovered from three fish (all Washington origin steelhead). Research gillnet catch, age, weight, and length data, and stomach contents data from cooperative Japan-U.S. cruises were summarized by oceanographic region. Cooperative Japan-U.S. research on salmonid food habits in the North Pacific indicates that there is a limitation in the capacity of crustaceous zooplankton to provide energy for salmon production. Bioenergetic modeling of pink salmon using high seas field data showed that at a constant ration salmonids have much better growth in the cooler water temperatures of the Bering Sea than in the warmer waters of the Transition Domain of the central North Pacific. Prey energy density is being measured from new field collections of salmonid prey organisms. Graduate student research begun in 1995 involves the development of a generalized model of system organization and carrying capacity. Scales, otoliths, and biological data from the chum salmon bycatch in the 1994 B-season pollock fishery in the Bering Sea were analyzed. A scale pattern study of the stocks of chum salmon in the B-season bycatch, initiated in fall of 1994, was continued. The results will be used in a Master's thesis to estimate fleet-wide bycatch of chum salmon by region-of-origin. Chum scale measurement techniques were standardized with Fisheries Agency of Japan (FAJ) researchers, who are collecting the Asian chum scale data for this analysis and cooperative studies of chum salmon growth. The utility of the historical FAJ chum baseline in stock identification was investigated. Measurement of scales for the 1994 North American chum salmon baseline was completed, and preliminary analysis indicates three major clusters of North American stocks. A time series of scale measurement data from salmonids caught on the high seas is being collected to investigate trends in salmonid abundance and growth by major ocean production region. FRI is cooperating with Japanese researchers in a study of the relationships between fish size, scale growth, and rates of protein synthesis (determined by RNA-DNA analysis) in chum, pink, and sockeye salmon caught on the high seas. The long-term (1907-1991) Bristol Bay (Nushagak commercial fishery) sockeye salmon scale growth time series was updated with 1992-1994 data. Paired otolith and scale samples are being collected from salmonids during international cooperative high seas research cruises for the development of indices of ocean growth. FRI personnel participated in the 1994-95 U.S. section, annual, and research planning meetings of NPAFC, and evaluated the preliminary NPAFC science plan.

International Cooperative High Seas Sampling and Tagging

1995 High Seas Field Work

Hydrographic, plankton, and salmonid sampling was carried out aboard two Japanese research vessels, the *Wakatake maru* and the *Oshoro maru*, in June and July in the central North Pacific Ocean, Bering Sea, and Gulf of Alaska (Fig. 1, Tables 1 and 2). Additional sampling was conducted for salmonid feeding ecology, growth, stock identification, and condition studies (Tables 3 and 4). In international waters, surface longlines (B-gear) and gillnets (C-gear is non-selective varied research mesh and A-gear is commercial mesh) were used to catch salmonids. Inside the U.S. EEZ, only the surface longline was used to catch fish. The total *Wakatake maru* salmonid catch in the central North Pacific and Bering Sea was 7,894 fish by gillnet and 1,651 fish by longline (Table 5). The total *Oshoro maru* salmonid catch in the central North Pacific and Gulf of Alaska was 2,254 fish by gillnet and 244 fish by longline (Table 6). Tagging operations were conducted aboard both vessels, and 405 salmonids were double-tagged (FRI and Japan tags; 58 in 1994), marked with oxytetracycline (for age and growth validation), and released (Tables 5 and 6).

1995 High Seas Tag Recoveries

In 1995 FRI advertised for the return of high seas salmon and steelhead tags and whole fish samples. The advertising effort had two components: a public service radio announcement and a mailing. The radio announcements were sent to public radio stations throughout Alaska (n=12) with the request that the announcements be read on the air before or after the local fishing report. The mailing consisted of a cover letter, poster, and business reply envelope that were sent to addresses in Alaska, Yukon Territories, British Columbia, Washington, Oregon, Idaho, and California (n=1362). The mailing was sent to public and tribal agencies, and commissions (n=351), commercial and sport fishermen's associations (n=107), fishing guides, lodges, and suppliers (n=73), periodicals (n=16), places frequented by fishermen including airports, city offices, post offices, grocery and liquor stores (n=95), seafood buyers (n=206), and salmon processors registered with the Alaska Department of Fish and Game (ADF&G) as intending to operate in Alaskan fisheries (n=514). This year, FRI improved the efficiency of sorting, updating, and printing labels by converting the permanent mailing list into an electronic form. A short article on FRI's tag recovery effort appeared in the August 1995 issue (Vol. 20, No. 8) of *Fisheries*. Embroidered patches for recovery rewards and information on the high seas tagging program were provided to fisheries management and enforcement personnel in Kamchatka, Russia. Hokkaido salmon hatchery personnel are cooperating in efforts to recover whole fish samples of tagged chum salmon for age and growth validation studies.

Ten U.S. high seas salmon tags were returned between 1 September 1994 and 31 August 1995 (Table 7). There were no returns of whole fish samples from these recoveries. One tag was a late return from a sockeye salmon that was released in 1977 in the area south of Adak Island in the central Aleutians, and recovered in 1979 in the Naknek-Kvichak District of Bristol Bay, Alaska (Table 7, Tag No. B 977).

Double-tagging experiments were initiated by FRI in 1993, in response to information that recoveries of Japanese and Canadian high-seas tags were not being reported by Alaskan fishermen. Two disk tags, one U.S. tag with FRI's address and one Japanese tag, were attached to the fish with a single plastic cinch strap. There were nine recoveries of U.S./Japan tags from double-tagging experiments conducted aboard the Japanese research vessels *Oshoro maru* in 1994 and 1995 and the *Wakatake maru* in 1995. One of these was a high-seas recovery from a pink salmon that was tagged and released during an evening longline operation aboard the *Wakatake maru* in the central Bering Sea, and caught the following morning at the same location during a research gillnet operation (Table 7, Tag No. Japan JJ6190/US KK155).

A sockeye salmon, released in the western Gulf of Alaska in June 1994, was recovered in the Russian River, Alaska (Cook Inlet area) in June 1995 (Table 7, Tag No. Japan CC2016/US EE0059). From a total of 71 pink salmon tagged and released in the central Gulf of Alaska from July 7 to July 11, 1995, there were seven recoveries in Alaska reported through August 31, 1995 (10% recovery rate; Table 7). Because some of the fish were caught in mixed stock fisheries, the recovery location does not necessarily indicate the stock of origin of the fish, but the results indicate extensive mixing in the central Gulf of Alaska of South Peninsula, Kodiak, Prince William Sound, and Southeast Alaska pink salmon during their last month at sea (Fig. 2).

In 1995, we explored the potential use of the Internet and World Wide Web as a tool for making the high seas tag release/recovery database, which is maintained and updated by FRI, more accessible to users. We hope to construct a public access utility that will create graphic maps of salmon distribution. This would give remote users the ability to create their own maps of the historical distribution of individual salmon stocks, which is information for which we receive many requests each year.

Coded-Wire Tag Recoveries

During 1995 gillnet and longline operations aboard the *Wakatake maru* and *Oshoro maru*, 12,043 salmonids were examined for missing fins. Snouts, collected from 51 steelhead lacking the adipose or left pelvic fin or both fins, were sent to NMFS, Auke Bay Laboratory, for examination for coded-wire tags. Of these, three steelhead contained a coded-wire tag: (1) a Lyons Ferry Hatchery summer-run steelhead released in April 1994 into the Walla Walla River, Washington, and recovered at 45°30'N, 179°30'W, (2) a Lake Quinault Hatchery winter steelhead released in April 1994 into Lake Quinault, Washington, and recovered at 47°30'N, 179°30'W, and (3) a Quinault National Fish Hatchery winter-run steelhead released in May 1994 into the Hoh River, Washington, and recovered at 51°30'N, 145°00'W. One steelhead lacking an adipose fin was tagged and released aboard the *Oshoro maru.*

Ocean Ecology, Stock Assessment, and Carrying Capacity Research

Summary of Japanese Research Vessel Data by Oceanographic Region

The *Wakatake maru* (1991-1995) and *Oshoro maru* (1994 and 1995) research gillnet (C gear) catch, age, weight, and length data, and salmonid stomach contents data were summarized by oceanographic region (Table 8). The identification of oceanographic regions was based on observed temperature and salinity profiles. Relative abundance of salmonids was estimated by calculating catch per unit effort, where one unit of effort was equal to one operation of the non-selective research-mesh gillnet (30 tans of C-gear). For the *Wakatake maru*, size at age data were available only from 1991 to 1994. For the *Oshoro maru*, 1995 age determinations were made by FRI biologists from acetate impressions of scale samples. All other age determinations were made by personnel at the National Research Institute of Far Seas Fisheries (NRIFSF), Fisheries Agency of Japan (FAJ). In the stomach contents analysis, the percent composition of each prey species by volume, which was visually estimated from the stomach contents, was multiplied by the total prey weight for each fish to estimate weight for each prey category. The composition by weight for each prey category was summed for all the individual fish in the oceanographic region, and divided by the total prey weight of all fish in the region to estimate mean percent composition by weight.

Oceanographic conditions and salmon distribution

In the central North Pacific in June 1995, the Subarctic Boundary was located between 41°30'N and 42°30'N, which was approximately 1° farther north than in June 1994 (40°30'N and 41°30'N in 1994). In June 1995, average sea temperatures were cooler in the Transition Zone (south of the Subarctic Boundary), similar in the Transition Domain (north of the Subarctic Boundary), and warmer in the Subarctic Current than in 1994 (Tables 9 and 10). In

July 1995, average sea temperatures were warmer in the Bering Sea Current System and cooler in the Gulf of Alaska than in 1994. The approximate southern limit of salmon distribution in the central North Pacific in June was 41°30'N (SST 12.4° C), where one chum salmon was caught by the *Wakatake maru* (Table 5). This was a 1° southward shift in the southern limit of distribution from 1994 (42°30'N, SST 10.5°C).

Salmonid species composition and stock abundance of salmon

From 1991 through 1995, the relative abundance of salmonids in research gillnet catches has been highest in the Bering Sea in July (Tables 9 and 10). In 1995, pink salmon were the most abundant species in the Bering Sea, chum and coho salmon predominated in the central North Pacific Ocean, sockeye salmon were the most abundant species in the western Gulf of Alaska, and chum salmon predominated in the central Gulf of Alaska. In the Bering Sea, pink salmon predominate in odd-year cycles and chum salmon are more abundant in even years (Table 9). Total salmonid abundance decreased from that in 1994 in the central North Pacific, Transition Domain, in 1995. In the central North Pacific, Subarctic Current, CPUE data from the *Oshoro maru* in mid June and the *Wakatake maru* in late June do not show a consistent pattern. In the Gulf of Alaska, total salmonid abundance was lower than 1994 in the Western Gulf of Alaska, Subarctic Current, and higher in both regions of the central Gulf of Alaska (Table 10).

Age composition and average body size of salmon

The mean body size of all species in research gillnet catches in the central North Pacific in late June and in the Bering Sea in July was larger in 1995 than in 1994 (Table 11). In the Bering Sea, the majority of sockeye salmon in July were immature fish, and ocean age .1 fish were more abundant in odd years and ocean age .2 fish were more abundant in even years (Table 12). In 1995, the percentage of immature sockeye in the western Gulf of Alaska catches was much higher (65%) than in 1994 (4%), whereas in the central Gulf of Alaska maturing sockeye predominated in both years (88% of the catch in 1995 and 77% of the catch in 1994). Ocean age .2 sockeye were the predominant age group in the Gulf of Alaska in both 1994 and 1995, and the average body size of age .2 sockeye was smaller in 1995 than in 1994 (Table 13).

In June and July, ocean age .2 was usually the most abundant age group of chum salmon in research gillnet catches in the offshore waters of the central North Pacific Ocean and Gulf of Alaska, whereas percentages of age .3 chum salmon were higher than age .2 fish in two of four years in the Bering Sea (Tables 14 and 15). In the central Gulf of Alaska, age .1 chum predominated in 1994 and age .2 chum predominated in 1995, which may indicate good survival of the 1992 brood year. Mean body size of age .2 chum salmon was smaller in the western Gulf of Alaska and larger in the central Gulf of Alaska in 1995 than in 1994 (Table 15).

All pink salmon in research gillnet catches in June and July were maturing ocean age .1 fish (Tables 16 and 17). The average body size of pink salmon in the Bering Sea in July 1995 was the largest in recent odd years (Table 11). In the central North Pacific Subarctic Current region in late June, mean body size of pink salmon has been larger in even years than in odd years (Table 16). Average body weight of pink salmon in the central North Pacific in mid-June, the western Gulf of Alaska in late June, and the Gulf of Alaska in early July was smaller in 1995 than in 1994 (Table 17).

All coho salmon in June and July gillnet catches in offshore waters were maturing ocean age .1 fish (Tables 18 and 19). The *Wakatake maru* data from the central North Pacific, Subarctic Current, show an increasing trend in the mean body size of coho salmon in this region in late June since 1992 (Table 18). However, the mean body size of coho salmon in

Subarctic Current area of the central North Pacific in mid-June, western Gulf of Alaska in late June, and central Gulf of Alaska in early July was smaller in 1995 than in 1994 (Table 19).

The number of chinook and steelhead caught in the North Pacific Ocean were not sufficient to discern trends in ocean age composition or body size (Tables 20-23). The few chinook salmon caught in research-mesh gillnet in the offshore waters of the central North Pacific and Gulf of Alaska in June and July were immature age .2 fish (Tables 20-21). Ocean ages .1 and .2 fish predominated in chinook catches in the central Bering Sea in July, although older fish (ages .3 and .4) were also present (Table 20). Ocean age .1 and .2 steelhead were the predominant age groups in the offshore waters of the central North Pacific and Gulf of Alaska (Tables 22 and 23). In early July, juvenile (ocean age .0) steelhead were distributed in the central Gulf of Alaska (Table 23).

Food habits

The results of the stomach content analyses from samples collected aboard the *Oshoro maru* and *Wakatake maru* are not directly comparable because all of the *Wakatake maru* samples were collected from fish caught during evening longline sets, and the *Oshoro maru* data were from fish caught in gillnets retrieved at sunrise. In 1995, the percentage of empty stomachs was generally low in the *Wakatake maru* samples, and was usually much higher for all species in the *Oshoro maru* samples (Tables 24-35).

A general comparison of major prey groups found in the stomachs of salmon during the *Wakatake maru* cruises in 1994 and 1995 was made (Tables 24-29). A more specific comparison over the years 1991-1995 is forthcoming after the data are reanalyzed using the same criteria for separating oceanographic regions and the handling of empty stomachs in the data. Chum salmon stomach samples collected in the central North Pacific in late June 1994 and 1995 contained gelatinous zooplankton (coelenterates, ctenophores, and salps), amphipods, and euphausiids. Squid were also eaten in 1994 but not in 1995. Results for both years indicate that in the Bering Sea in July, gelatinous zooplankton and euphausiids were important prey of chum salmon. Amphipods were also common prey of chum salmon in 1994, whereas fish were common prey in 1995. Pink salmon fed on diverse prey groups including squid, amphipods, copepods, pteropods, and fish in the central North Pacific in late June. Euphausiids were more common in samples from 1995, than in those from 1994. In the Bering Sea in July, pink salmon stomach contents contained many of the same groups, including squid, fish, euphausiids, and amphipods. Copepods were abundant in 1994 pink salmon samples, but not in 1995 samples. Squid and fish were the common prey groups consistently found in both year's samples from coho, chinook, and steelhead.

Sampling for stomach contents during the *Oshoro maru* cruise was done primarily in the Gulf of Alaska. *Oshoro maru* personnel collected stomachs from coho salmon along the 180° transect, but these data are not available. In the western Gulf of Alaska, Subarctic Current, the percentage of empty stomachs in sockeye, pink, and chum salmon was lower in 1995 than in 1994 (Tables 30-32). A high percentage of the stomach contents of chum salmon were too well digested to identify, but the predominant prey in sockeye and pink salmon stomachs changed from squid in 1994 to euphausiids, copepods, and amphipods in 1995. The mean stomach content index (SCI) was substantially lower in sockeye and pink salmon and higher in chum salmon in 1995 than in 1994. The SCI of coho salmon, which fed on squid in both years, was substantially lower in 1995, than in 1994 (Table 33). Few chinook and steelhead were sampled, but the mean percent composition of squid was lower and of fish was higher in these species in 1995 than in 1994 (Tables 34 and 35).

In the central Gulf of Alaska, Subarctic Current, the percentage of empty stomachs in 1995 was higher than in 1994 in all species except chum (Tables 30-35). The stomach contents of chum were largely unidentifiable, and squid was the predominant prey in the diets of all other species in both years.

In the central Gulf of Alaska, Dilute Domain, the percentage of empty stomachs in sockeye, chum, and pink salmon samples was substantially higher in 1995 than in 1994 (Tables 30-35). In 1995, sockeye salmon fed primarily on squid; chum salmon with identifiable stomach contents fed primarily on euphausiids and polychaetes; pink salmon fed primarily on euphausiids, squid, and pteropods; coho fed on squid; and steelhead fed on squid and fish. Percentages of amphipods and copepods in pink and sockeye stomachs were lower in 1995 than in 1994. For stomachs that contained prey, the SCI was higher for all species in 1995 than in 1994.

Cooperative Japan-U.S. Research on Food Habits and Abundance

In a related cooperative study with Japanese researchers, which was reported at the annual meeting of the North Pacific Marine Science Organization (PICES) in October 1994, the food habits and abundance of six species of Pacific salmon and the biomass of prey organisms in the central North Pacific Ocean and the Bering Sea in the summer of 1991 and 1992 were examined. Salmon were caught by surface longline using the same level of fishing effort for both years. Chum and pink salmon were the predominant species in the study area and represented 44% and 41% of the total catch (n=1215) in 1991, and the distribution of these species approximately overlapped. In 1992, chum salmon were 87% of the total catch (n=603), but the catch of pink salmon decreased to 1% of total catch due to the odd/even year fluctuations in abundance of Asian pink salmon that are distributed in the study area. When pink salmon were not abundant, the diet of chum salmon shifted from non-crustaceous zooplankton (appendicularians, jelly fish, pteropods, chaetognaths, and polychaetes) to a diet similar to pink salmon, namely crustaceous zooplankton (euphausiids, amphipods, and copepods). Annual biomass (wet weight: mg/m^3) of crustaceous zooplankton was negatively correlated with the number of pink salmon caught in 1991 ($r=0.586$; $p<=0.05$) and number of chum salmon caught in 1992 ($r=0.616$; $p<=0.05$). Due to the shift in chum food habits when there is a high abundance of pink salmon and to the negative correlation between crustaceous zooplankton biomass and abundance of crustaceous zooplankton consumers (pink and chum salmon), we hypothesize that there is a limitation in the capacity of crustaceous zooplankton to provide energy for salmon production.

Bioenergetics Modeling

The relationships between sea-surface temperature and pink salmon food habits were examined using estimates of consumption and growth obtained from a published bioenergetics model (Fish Bioenergetics Model 2 by Wisconsin Sea Grant). Simulations were used to estimate the amount of prey consumed for a specified growth increment (g) and to estimate growth for a specified daily ration of prey (% body weight). Model input variables such as sea-surface temperature and prey composition were from data collected on the salmon research cruises of the *Wakatake maru*. The influence of temperature on consumption was simulated for a pink salmon with a constant growth increment (150 g), diet composition, and temperature for a 30-day simulation, and the simulation was repeated for 11 different temperatures. Results showed that as temperature increased from 2° to 12°C, the amount of prey consumed must be increased by 38% in order for the fish to add 150 g in weight in one month (Fig. 3). Simulations also showed that prey composition and prey energy density influenced daily ration and conversion efficiency of pink salmon. Published energy densities indicate that fish and euphausiids are diet components with the highest energy density. A diet containing a high proportion of fish (49%) required a small daily ration (1.79% body weight) to maintain a growth increment of 150 g at 6.5 °C. However, a diet containing a large proportion of squid (50%) required a ration of 2.24% body weight per day in order to grow 150 g in the same time period (Fig. 4). When a constant daily ration of 1.5% body weight was used to simulate growth at several temperatures, the range in the amount of prey consumed was small (14.7 to 15.4 g per day), but the response in growth increment was large (23 to 114 g; Fig. 5). With this constant ration, a pink salmon living at a water temperature of 6.0°C, a temperature condition common in the central Bering Sea in summer, might grow approximately 94 g in 30 days, while a fish living at 12°C, a temperature condition common in the Transition Domain of the central North Pacific, might grow 23 g in the same period. This is a decrease in growth of 76% from the lower to higher water temperature (Fig. 5). Simulations demonstrated that small changes in ration size, prey energy density, and temperature can have a large influence on growth and that the model is a useful tool for fine-tuning data collection and for interpreting relationships between environmental variables, salmon feeding habits, and growth.

Prey Caloric Density and Type Specimens

Estimates of ocean salmon growth and consumption based on the bioenergetics model indicated that the model is sensitive to prey energy density. The prey energy density values were from published values of related prey organisms or prey from other regions. In order to improve the energy density estimates, we will measure prey energy densities using bomb calorimetry. The procedure for bomb calorimetry incinerates about 1 g of dried material, thus, a fairly large homogeneous sample (approximately 10 g) of prey organisms is required for the calorimetry. During the summer 1995 salmon research cruises of the *Oshoro maru* and *Wakatake maru,* fresh prey organisms including samples of fish, fish larvae, pteropods, squid, amphipods, copepods, euphausiids, and gelatinous zooplankton were collected for identification and bomb calorimetry. Specimens for bomb calorimetry were frozen, and type specimens for identification were preserved in buffered formalin.

Carrying Capacity Modeling

Graduate student research begun in 1995 involves the development of a generalized model of system organization and carrying capacity (Appendix A).

Scale Pattern Analyses of Age, Growth, and Stock Origins

Analyses of 1994 B-Season Chum Scales, Otoliths, and Biological Data

Chum salmon scales collected by NMFS observers during the 1994 B-season pollock fishery were analyzed to determine if the samples were adequate for use in stock origin studies. The total number of fish in the 1994 scale samples was more that two times larger (n=2,039; Table 36) than in 1993 (n=882). Age 0.3 fish predominated in both years (65% of total), but the percentage of age 0.4 fish was higher (25% of total) in 1994 than in 1993 (12%), and the percentage of age 0.2 fish was lower (9% in 1994, 22% in 1993). As in 1993, the majority of the 1994 samples were from fish caught in area 517 (64% in 1994, 70% in 1993), and the samples from statistical areas west of 170°W (areas 521 and 541) had a higher proportion of the younger age groups than samples from areas east of 170°W. Because of the lack of age .0 and .1 chum salmon in the 1993 observer samples, we speculated in last year's report that these smaller salmon may not be retained by the gear used in the B-season fishery. In 1994, the observers collected scales from four age .1 chum salmon.

To determine the approximate number of scales that could be used for a stock identification study, the samples were stratified by area, month, age group, and body area of scale collection (Table 37). In general, scales collected from body areas "A" or "B" are usable in scale pattern analyses, although in some cases the body area of scale collection was not correctly identified by observers. In addition, the observers sometimes failed to note the body area of scale collection (coded "U" in Table 37). For age 0.3 fish, these unidentified body-area scales were evaluated with a standard set of criteria to decide whether or not they are usable for scale pattern analysis. This preliminary analysis indicates that a high percentage of the age 0.3 scales (91%) are usable for scale pattern analyses.

Biological data collected by NMFS observers were also examined to determine if there were changes in size or condition of the fish between 1993 and 1994. Mean lengths, weights, and condition factors of chum salmon in the 1994 samples are shown in Table 38. In statistical area 517, where the majority of the samples were collected, ages 0.2 and 0.3 fish of both sexes were significantly larger in 1994 than in 1993 (Table 39). A similar relationship was found for chum salmon caught by research gillnet sampling in the offshore waters of the Gulf of Alaska in July 1993 and 1994 (Table 40).

The age composition of chum salmon in the 1994 B-season bycatch that were sampled for use in protein electrophoresis stock identification analyses was determined by examination of otoliths (Table 41). Age 0.3 fish were also the predominant age group in the otolith (68%) samples, but the percentage of younger (age 0.2) fish was higher and the percentage of older (age 0.4) fish was lower in the otolith samples than in the scale samples (Tables 36 and 41). A subset of the scale and otolith data from fish that were caught in the same hauls shows a similar disparity in age composition estimates (scales: 9% 0.2, 70% 0.3, 21% 0.4, and <1% 0.6, n=155 fish; otoliths: 23% 0.2, 70% 0.3, 6% 0.4, and 1% 0.5, n=160 fish). Although the scales and otoliths in these hauls were not necessarily sampled from the same fish, the differences in age composition between the two samples are probably due to differences in techniques used to age scales and otoliths. FRI is using the FAJ method of ageing chum salmon scales, where two apparent annular marks in close proximity to one another are interpreted as two separate annuli. FAJ has validated this interpretation for Japanese hatchery salmon with marking studies. It is possible that two closely spaced annuli were interpreted as one annulus on the chum salmon otoliths. If sampling for genetic stock identification studies is continued, both scales and otoliths should be collected from the same fish so that inconsistencies in ageing techniques can be resolved.

<u>Stock Origins of Chum Salmon in the Incidental Catch of the 1994 Pollock B-Season Fishery</u>

A scale pattern study of the stocks of chum salmon incidentally caught by the southeast Bering Sea trawl fishery was initiated in fall of 1994. Because FAJ has an archive of several years of chum salmon scale data, and is also conducting two scale pattern studies for stock identification of chum salmon, FRI is working collaboratively with them on the collection of data from 1994 runs of chum salmon. The two main components of the collaboration have been (1) obtaining the baseline data from FAJ and (2) measuring North American chum scales, in exchange for FAJ measurements of Asian chum scales.

In order to use the baseline effectively and exchange data on 1994 scales, it was necessary to standardize measurement techniques with FAJ scientists. This was accomplished by a visit to the NRIFSF in Shimizu in January 1995, and by measuring a sample of scales that were included in the 1986 FAJ baseline data. The 1986 test sample consisted of 50 scales from Nyyskiy Bay, Sakhalin, Russia. Measurements were made by two FRI scientists, and the measurements were tested against each other and against the FAJ baseline using paired sample t-tests. Sources of any differences were investigated, and scales were remeasured until differences were not statistically significant. Single-factor three-group ANOVAs for each variable were not significant.

The FAJ chum salmon scale baseline data comprise six years (1972, 1973, 1981, 1982, 1986, and 1987) with between 16 and 38 stocks for each year (Table 42). The 1972 baseline lacks representative samples from southeastern Alaska, 1973 lacks northwestern and southeastern Alaska, 1986 and 1987 lack British Columbia samples, and 1972, 1973, 1981, and 1982 all lack samples from Washington. Scale variables and data formats differ between years, but all years have at least a set of five variables commonly used by FAJ. These five variables include only three (number of circuli in the first and second halves of the first ocean zone, and width of the first ocean zone) from the first ocean year, which we believe is the area of the scale most likely to contain information useful in separating regional stocks. The data from 1972, 1973, 1981, and 1982 also include distances between groups of 5 circuli in the first ocean zone ("quintuplets"). Because these additional variables in the first ocean zone were available, our investigation of the utility of the FAJ historical baseline for classification of 1994 chum has focused on these four years.

The 1972 and 1973 baselines are from a period before a postulated oceanographic "regime shift" in 1976, while the 1981, 1982, 1986, and 1987 data are from the current regime which seems to favor Alaskan salmon stocks. When used in \ maximum likelihood stock allocation method, the 1981 and 1982 baselines from the current regime performed better in classifying the 1994 North American stocks than did the 1972 and 1973 baselines (Table 43). The 1981 baseline performed slightly better in allocating stocks from Norton Sound (average correct 70%), the Alaska Peninsula (94%), Cook Inlet (100%), and Prince William Sound/northern southeastern Alaska stocks (63%), while the 1982 baseline performed slightly better with Yukon/Kuskokwim (64%), Bristol Bay (97%), and southern southeastern Alaska/B.C. (95%) stocks.

We have measured 2,282 scales from a representative sampling of 56 stocks across the main range of chum salmon in North America, from Kotzebuc Sound in Alaska to Willapa Bay in Washington (Table 43). FAJ scientists are completing their measurements of 1994 chum scales from Japan and Russia, and will soon provide both their measurements and the scale samples to FRI. Test samples will be re-measured by both FRI scientists and tested to ensure that techniques are the same. If significant differences are discovered between FRI and FAJ measurements, FRI scientists will re-measure the entire 1994 Asian sample to ensure consistency with the North American samples already measured. In addition to measurements of the first ocean zone for the bycatch study, our measurements also extended to the edge of the scale in order to provide circulus count and zone size information for proposed cooperative growth studies.

Preliminary examination of scale characters indicate three major clusters of North American stocks: western Alaska and western south central Alaska (from Kotzebue to Cook Inlet); eastern south central and northern southeastern Alaska (from Prince William Sound to Baranof Island), and from southern southeastern Alaska to Washington, including British Columbia. Further analysis of regional stock groupings will be conducted when 1994 Asian scale data are received.

We have measured 1,011 scales from age 0.3 chum salmon sampled by U.S. observers from the 1994 trawl bycatch (Table 44). The scales are predominantly (59%) from statistical areas 517 in August and September. Areas 513, 519, and 521 yield samples near or greater than 100 when all months are combined. When the 1994 Asian baseline data is received, we will estimate the stock proportions in these samples. The results will be used in a Master's thesis to estimate fleet-wide bycatch of chum salmon by region-of-origin (Appendix B).

Ocean Growth of Salmonids in Key Rearing Areas

FRI is collecting a time series of scale measurement data from salmonids caught on the high seas to investigate trends in salmonid abundance and growth by major ocean production region. At present, scale measurement data are being collected from salmonids caught during June-July *Wakatake maru* (1991-1995) and *Oshoro maru* (1980-1995) research cruises in the Bering Sea, central North Pacific, and Gulf of Alaska. The last ocean zone on the scale is being measured for samples of up to 30 fish per species per major ocean age/maturity group (sockeye: .1, .2, .3; pink: .1; chum: .1, .2, .3; coho: .1) and oceanographic region (Table 8). Relationships between scale growth, relative abundance, length, weight, sex, gonad weight, maturity, food habits, and oceanographic conditions will be examined.

In related studies, FRI is cooperating with Japanese researchers in a study of the relationships between fish size, scale growth, and rates of protein synthesis (determined by RNA-DNA analysis) in chum, pink, and sockeye salmon caught on the high seas. The long-term (1907-1991) Bristol Bay (Nushagak commercial fishery) sockeye salmon scale growth time series was updated with 1992-1994 data. Paired otolith and scale samples are being collected from salmonids during international cooperative high seas research cruises for the development of indices of ocean growth. Salmon and steelhead were experimentally marked with oxytetracycline for age and growth validation, during tagging operations aboard Japanese research vessels in the Bering Sea and Gulf of Alaska in 1995. The results of these studies will be reported in 1996.

NPAFC Activities

Three project members attended the U.S. Section meeting (October 1, 1994) in Sea-Tac. K. Myers served as rapporteur for the 1994 Committee on Scientific Research and Statistics (CSRS); attended the Second Annual meeting of the NPAFC in Vladivostok, Russia (October 9-15, 1994); and served as chair of the CSRS editorial committee. Four project members attended the NPAFC Research Planning and Coordinating Meeting in Seattle (March 6-10, 1995); K. Myers served as rapporteur and chair of the editorial committee.

FRI evaluated the preliminary NPAFC science plan that was developed at the March 1995 planning meeting. We suggested that the NPAFC plan should have its own salmon-related focus, and should be more that just a restatement of the two PICES-related topics identified by the CSRS at its first annual meeting. The introduction should identify a few specific issues or concerns critical to salmon management and conservation (e.g., carrying capacity, hatchery vs. wild production, stock interactions, and climate change). The components of the "Master Plan" should focus on these specific concerns by identifying priority research objectives, for example:

Evaluate intraspecific and interspecific stock interactions of salmonids through study of stock identification, seasonal oceanic distributions and migrations, feeding, growth, population fluctuations, etc.

Evaluate interactions among natural and artificially produced stocks in the ocean to provide guidelines for stocking.

Evaluate effects of short- and long-term climate changes on oceanographic conditions and marine productivity of salmonids.

Expand research to cover total ocean life history, including juvenile and wintering stages.

Establish an international program for long-term monitoring of changes in salmon productivity by selecting sites (hatchery and natural production) for standardized recording of such features as age, size, growth rate, survival, etc.

Expand and coordinate international research on factors affecting early marine growth and survival of salmonids in coastal waters.

Focus research to determine specific causes of marine natural mortality of salmonids.

Develop improved methods for forecasting abundance of salmon runs.

Continue to assess bycatch of salmonids in non-salmon fisheries and catch in illegal directed fisheries.

Once a few specific salmon-related issues and priority research objectives have been identified, it will be much easier to develop a realistic time schedule, outline methods, and coordinate research programs.

Acknowledgments

Dr. Y. Ishida (Fisheries Agency of Japan, National Research Institute of Far Seas Fisheries, Shimizu) is specially acknowledged for his long-term support, cooperation, and participation in international high seas salmonid research. Capt. Y. Hayasaka and the officers, crew, teachers, students aboard the R/V *Wakatake maru*, and M. Takahashi, Tokyo University of Fisheries, are thanked for their careful collection of data and samples. The staff of the Hokkaido Management Bureau of Training Ships provided logistical support in Hakodate. Dean K. Yamauchi, Faculty of Fisheries, Hokkaido University, and Capt. G. Anma, Chief Officer H. Yamaguchi, H. Onishi, and the other officers, research staff, crew, and cadets of the *Oshoro maru* cooperated in all aspects of 1995 high seas sampling and tagging in the Gulf of Alaska, and provided the *Oshoro maru* catch, biological, and oceanographic data. We could not have undertaken our chum salmon stock identification study without the great help and cooperation of many scientists who provided chum salmon scale samples and data: Karen Teig at the domestic observer program of the Alaska Fisheries Science Center (NMFS); Hal Geiger, Tracy Lingnau, Jim Menard, Dan Schneiderhan, Doug Molyneaux, Bev Cross, Wes Ghormley, Patricia Nelson, Bob Murphy, David Waltemyer, Steve Moffitt, Ben Van Alen, and Craig Farrington at the Alaska Department of Fish and Game; Jeff Till at the Department of Fisheries and Oceans Canada; John Sneva at the Washington Department of Fish and Game; and Yukimasa Ishida and Sotoo Ito of the Fisheries Agency of Japan. The Auke Bay Laboratory, NMFS, provided chum otolith samples and information on coded-wire tags. Funding for the U.S. portion of this research was provided by the Auke Bay Laboratory, Alaska Fisheries Science Center, U.S. National Marine Fisheries Service (NOAA Cont. No. 50ABNF400001).

Appendix A

Carrying Capacity and Internal Organization
Changing the System While Keeping the 'K'

(Abstract accepted by PICES for the 1995 Annual Meeting)

Kerim Y. Aydin

Carrying capacity is a macroscopic property of biological systems that implies nothing about the underlying mechanisms of growth limitation. Carrying capacity can be described in terms of individuals, biomass, or in terms of energy input and output as a function of system size. If energy requirements are used, the internal organization of the system becomes critical. Cells growing within an organism show a degree of "self-organization" or facilitation, whereas individuals in a population may either cooperate or compete for resources. Internal organization of a system may be defined by interactions affecting energy flow between various components of the system, whether between cells in an individual, individuals in a population, or populations within an ecosystem. Total metabolism and growth potential change not only with changing energy input, but also with changes in the internal organization of the system. Internal reorganization may affect system efficiency, thus changing the system biomass without a corresponding change in energy input.

A generalized model of system organization and carrying capacity, beginning with the growth of cells in an individual, is being developed. The model shows that the changes in size and numbers of Pacific salmonids may result from a reorganization of the system and not from a fundamental limit of carrying capacity. Endrocrine systems may represent an evolutionary control of internal organization, using growth and temperature during critical periods as signals to control final overall individual size independent of total prey biomass or growth potential.

Appendix B - Master's Thesis Outline

Estimates of Origin of Chum Salmon (*Oncorhynchus keta*) in the Incidental Catch of the 1994 Pollock B-Season Fishery in the Bering Sea using Scale Pattern Analysis

William S. Patton

I. Introduction

A. Statement of the Problem

1. Describe the incidental catches of chum salmon in the BS/AI groundfish fisheries, particularly in the pollock B-season fishery;
2. Describe the status of western Alaskan chum stocks;
3. Review NPFMC's 1995 modification of the BS/AI groundfish FMP to include specific time/area closures during the pollock B-season;

B. Background

1. Describe current knowledge of chum salmon life history, oceanic distribution and migration in the Bering Sea; discuss validity of distribution knowledge based on tagging data;

II. Methods

A. Scale Pattern Analysis

1. Describe the theory and precedence of how scale pattern characters are used to discriminate stocks from a stock mixture using a standard baseline of known stocks, with particular reference to genetic and environmental variability (among and within stocks), inter-annual variability, brood-year specificity, and chum salmon life history;
2. Describe the sources of scale samples, collection methods, sample selection methods, scale measurement technique, the choice of scale pattern variables measured, and measurement validation techniques;
3. Describe the organization of the stock composition analyses with respect to the specific scale pattern baselines used and the stratification of the bycatch stock mixture by time and area;

B. Statistical Discrimination

1. Describe the statistical theory and procedure of Russell Millar's maximum-likelihood method of discriminating individuals from within a mixture;
2. Explain how classification groupings were determined from the clustering of canonical variables;
3. Describe how classification accuracy and confidence intervals were established using simulation tests and 'jack-knifing';

C. Estimation of Total Fleet-wide Chum Bycatch

1. Describe the method by which the stock proportion estimates were extrapolated to the total 1994 B-season pollock fishery incidental catch of chum salmon;

III. Results

A. Compatibility of Scale Measurement Techniques

1. Describe the results of scale measurement compatibility tests;

B. Stock Proportion Estimates

1. Calculate the proportion estimates-of-origin and confidence intervals resulting from the maximum-likelihood analyses;
2. Describe the accuracy of each classification model as determined from the simulation tests;

C. Fleet-wide Bycatch Estimates

1. Describe the total 1994 B-season chum bycatch distribution by statistical area, time and region-of-origin as estimated by the stock composition analyses;

IV. Discussion

A. Evaluation of the Methods

1. compare the results of the analyses with respect to the different standard baselines used; comment on the usefulness of historical (prior brood-year) scale baselines for stock identification;
2. Evaluate the quality of U.S. observer scale samples; discuss the importance of standardizing scale collection and measurement techniques;

B. Stock Proportion Estimates
1. Discuss the accuracy of the results, potential biases, strengths and weaknesses;
2. Briefly compare the results of this scale pattern-based stock composition analysis with the results of the concurrent genetics-based analysis;

C. Estimates and Distribution of Total Chum Bycatch
1. Discuss the significance of the estimated total 1994 B-season chum bycatch by region-of-origin with respect to the potential impact on salmon runs, especially in western Alaska;
2. Compare the estimated 1994 B-season chum bycatch distribution with what is currently understood about chum salmon oceanic distribution;
3. Evaluate the effectiveness of the NPFMC's regulatory amendment at reducing the incidental catch of western Alaskan chum salmon by examining the origin of chum caught within the area of closure in 1994.

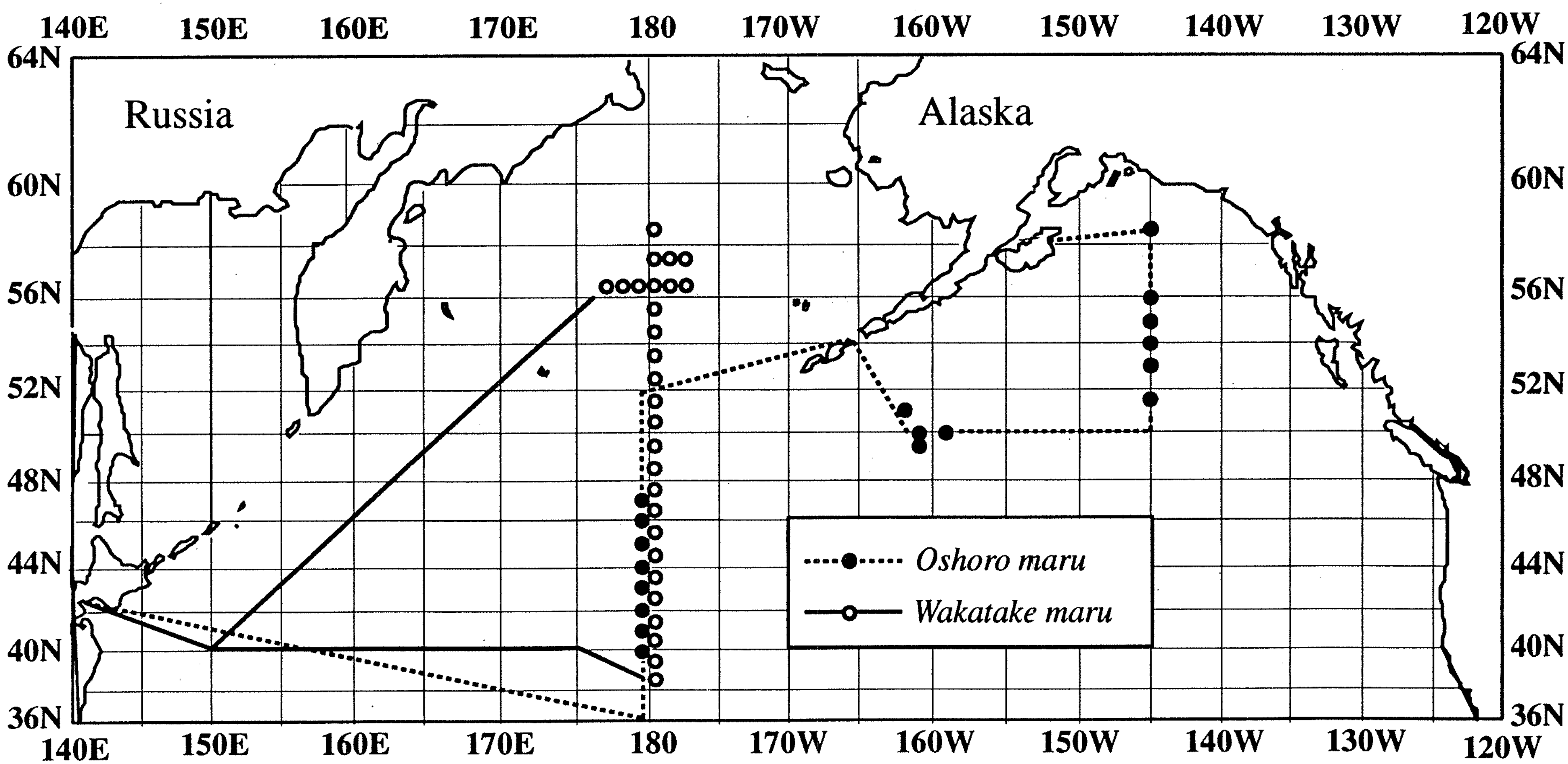

Figure 1. Cruise tracks of vessels on which FRI personnel participated in cooperative salmon research, 1995.

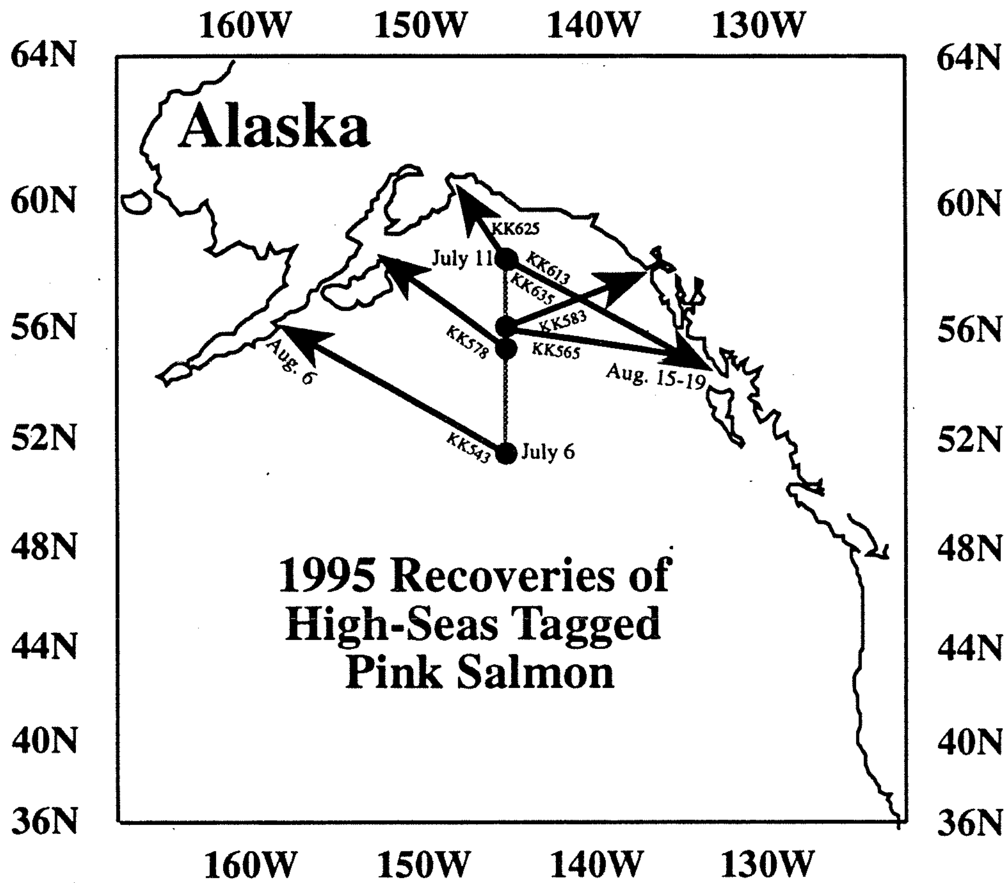

Figure 2. Map showing release (filled circles) and recovery (arrows) locations of pink salmon tagged during longline operations aboard the *Oshoro maru* along the 145°W transect, July 6-11, 1995. All recoveries were reported in August, 1995. Exact recovery dates are shown, if known.

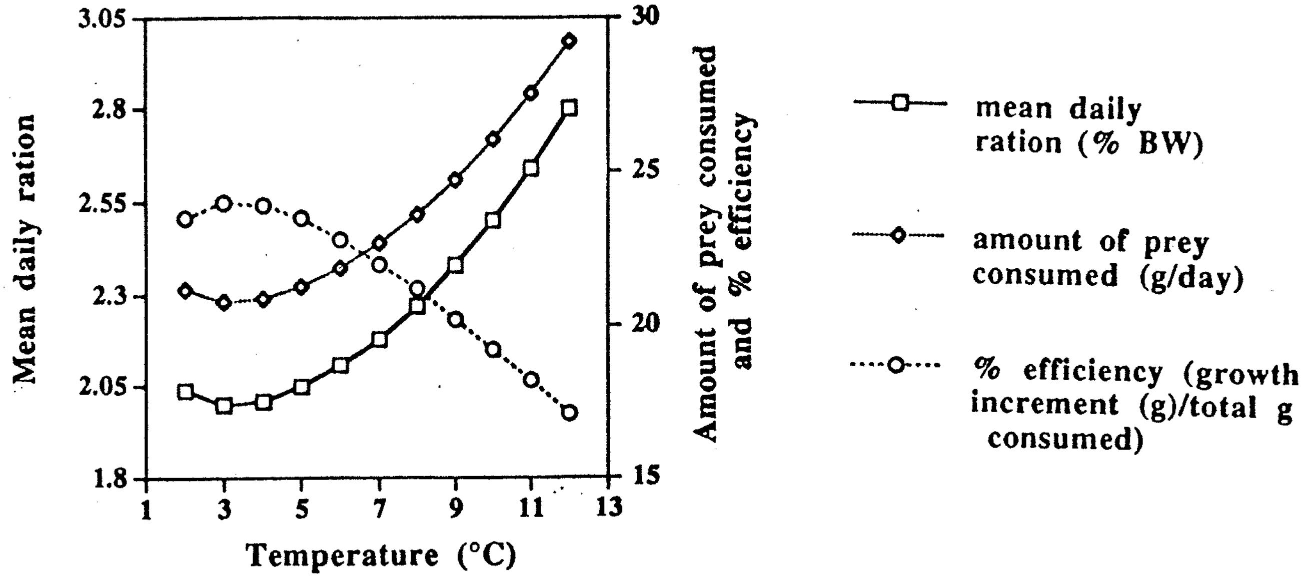

Figure 3. Relationship between mean daily ration (percent body weight), amount of prey consumed (g/day), and percent efficiency (growth increment/total g consumed) when temperature (°C) was constant for one 30-day simulation but varied between simulations. Prey composition and growth increment (150 g) were constant for all simulations. The amount of prey consumed and percent efficiency were both plotted on the yy-axis.

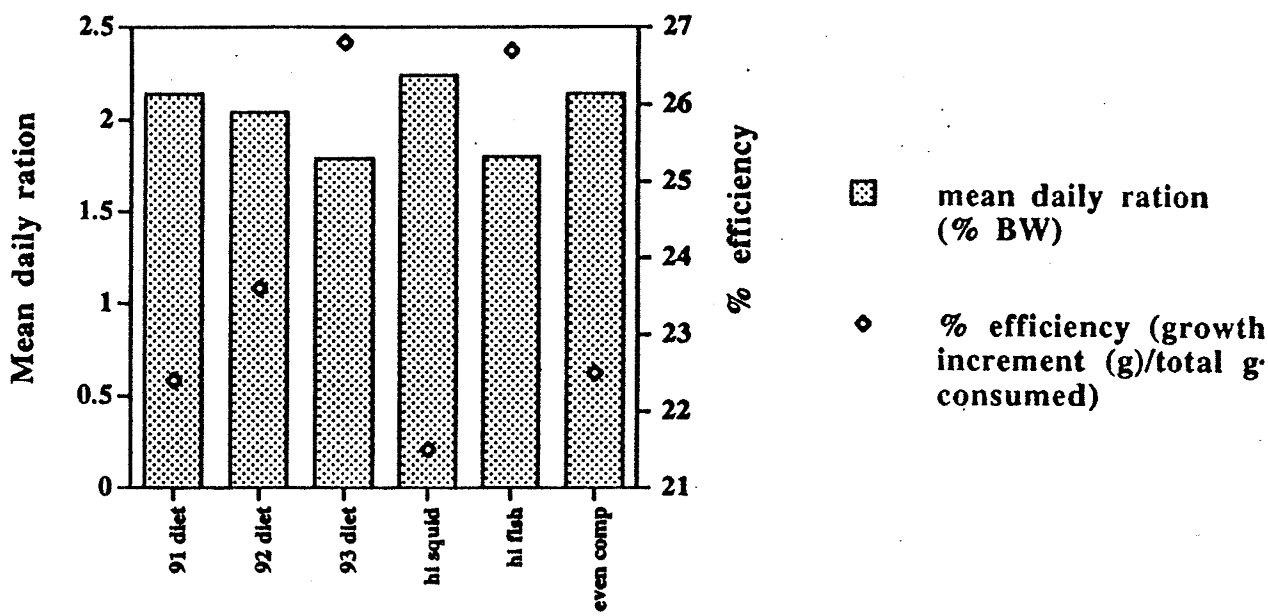

Figure 4. Relationship between daily ration (percent body weight) and percent efficiency (growth increment/total g consumed) over a 30 day time period for three average diets observed in the Bering Sea in 1991-1993 and three specified diets, one high in squid composition (hisquid), one high in fish composition (hifish) and one with an evenly apportioned composition.

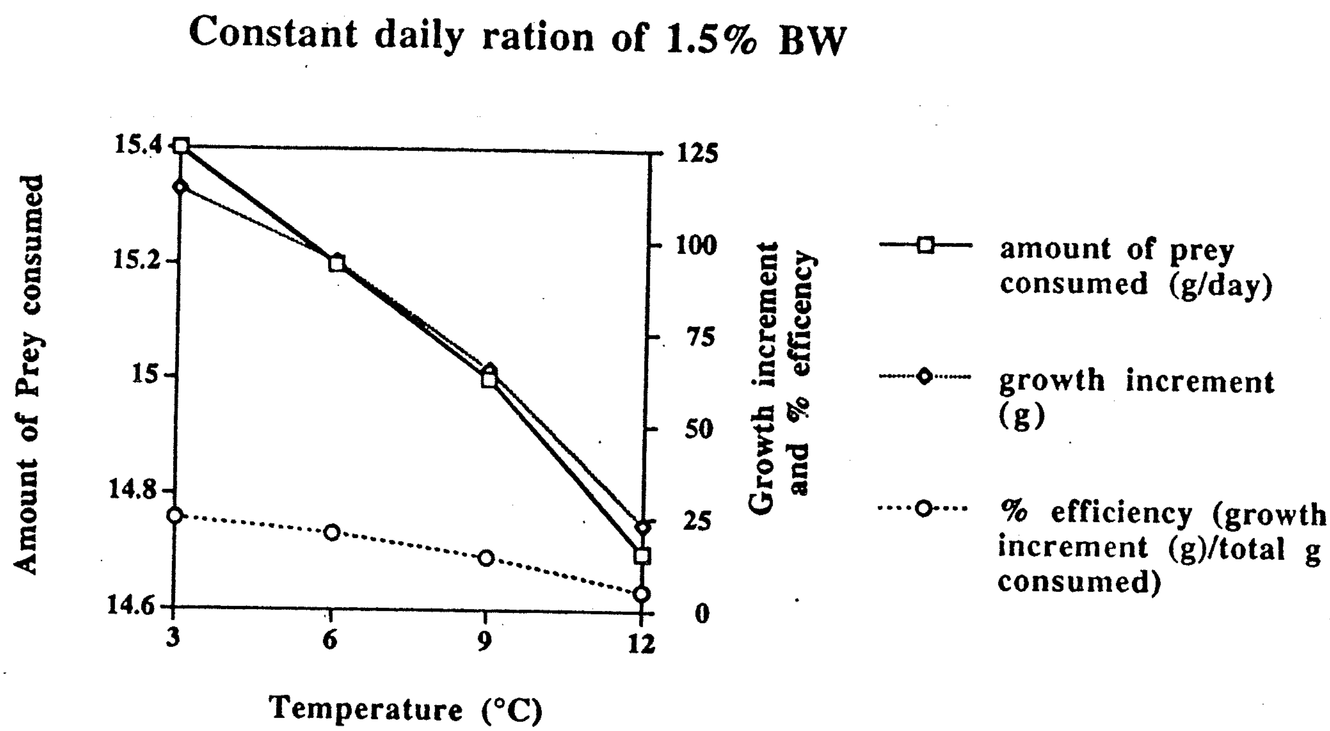

Figure 5. Relationship between amount of prey consumed (g/day), growth increment (g) for 30 days, and percent efficiency (growth increment/total g consumed) when daily ration was constant at 1.5% of body weight. Simulations were performed at four different temperatures and prey composition was constant. The growth increment and percent efficiency were both plotted on the yy-axis.

Table 1. Description of research gear and fishing operations conducted aboard the *Wakatake maru* in 1995. Sampling stations included 28 fishing stations (F-stations) and 56 transit stations (T-stations) that were located along a direct route going to and returning from the fishing area.

Research Item/Gear	Purpose	Specifications	Deployment	Sample/Data	Comments
A. Hydrographic					
Conductivity, Temperature, and Depth Sensor (CTD)	Collect temperature and salinity data by depth	Alec Memory CTD sensor, made by the Alec Electronics Co. Ltd., Japan	Vertical, surface to 600 m or to the bottom; work on deck and data processing done by officers and crew	Temperature and salinity recorded at 5 m intervals and outputted to paper	Collected at all F-stations; T-stations at 5° longitude intervals
Expendable Bathy-Thermograph (XBT)	Collect temperature data by depth		Vertical, surface to 460 m; work on deck and data processing done by officers and crew	Temperature and depth recorded at 1 m intervals and outputted to paper and floppy disk	Collected at all T-stations
Salinity Reference Sample	Collect water samples for laboratory determination of salinity and to standardize CTD and XBT data	Bucket water sampler	Surface collection; work done by crew	Water sample stored in brown bottles sealed with a cork	Collected at all F-stations; T-stations at 5° longitude intervals
Secchi Disk Depth	Estimate water transparency	White disk tied to a rope measured at 1 m intervals; disk diameter=??	Daylight; disk lowered over the ship's side by the crew	Disk is lowered into the water and the depth is recorded when the disk disappears from view	Collected at all F-stations; T-stations at 5° longitude intervals

Table 1. Continued.

Research Item/Gear	Purpose	Specifications	Deployment	Sample/Data	Comments
B. Phytoplankton					
Chlorophyl-a, Nutrients, and Phytoplankton Species Identification	Estimate phyto-plankton biomass, measure dissolved nutrient levels (phosphate, nitrate) and identify phytoplankton species	Bucket water sampler	Surface collection; Work done by crew and research staff	Chlorophyl-a: 1 l seawater is filtered and the filter is stored frozen at -20°C; Nutrients: 50-60 ml seawater is frozen at -20°C; Phyto-plankton: 500 ml seawater preserved in 5% formalin	Collected at all F-stations; Chloro-phyl-a samples also collected at T-stations at 5° longitude intervals; Samples later analyzed in the laboratory
C. Zooplankton					
Norpac Net (design improved in 1995)	Estimate biomass and identification of macro-zooplankton	Ring diameter: 0.45 m; Mesh size: 0.335 mm; Filtering cloth: GG54; Length of cylindrical portion of net: 0.650 m; Length of conical portion of net: 1.3 m; The design of the Norpac was improved by inser-tion of a cylindrical section of cloth between the net opening and the conical-shaped tail section; The remodelled design has improved filtration efficiencies over the older Norpac design	Vertical tow; 0-150 m; Depression weight: 15 kg; Ship speed: 0 kts, drifting; Wire speed: 1 m/sec; Work done by crew and research staff	Bottled with 7% formalin; sample bottles color-coded with yellow tape	Collected at all F-stations and T-stations at 5° longitude intervals; Flow meter used and calibrated 5X and first and last T-stations; Wire angle measured and added wire length recorded; Samples later analyzed in the laboratory

Table 1. Continued.

Research Item/Gear	Purpose	Specifications	Deployment	Sample/Data	Comments
C. Zooplankton (cont'd)					
Bongo Net	Estimate biomass and identification of macro-zooplankton; Intercalibration with Norpac net	Ring diameter: 0.70 m; Overall length: 3.5 m; 2 rings: 1 designated red, mesh size=0.600 mm, 1 designated blue, mesh size=0.335 mm	Vertical tow; 0-150 m; Depression weight: 50 kg; Ship speed: 0 kts, drifting Wire speed: 1 m/sec; Work done by crew and research staff	Bottled with 7% formalin; sample bottles color-coded with red and blue tape	Collected at all F-stations; Flow meter used and calibrated 5X at first and last F-stations; Wire angle measured and added wire length recorded
Fish Larval Net	Collect fish larvae and micro-nekton	Ring diameter: 1.3 m Overall length: 4.5 m Mesh size: 2.0 mm (frontal portion), 0.335 mm (codend)	Horizontal tow at the surface; Ship speed: 2 kts; Wire speed: stationary; net towed for 10 minutes; Work done by crew and research staff	Sample placed in a cotton bag and stored in a bucket with 10% formalin	Collected at all F-stations; No flow meter used
D. Salmonids					
Gillnet	Salmon abundance and biological data for ocean ecology and stock assessment	Overall length: 2.45 km (49 tans; 50m/tan); Depth approx. 7.5 m; Net configured with non-selective research-mesh (C-gear) and commer-cial-mesh (A-gear); North of 44°30N: 30-tans C-gear and 19 tans A-gear; C-gear: 3 tans each of 48 mm, 93 mm, 157 mm, 106 mm, 63 mm, 121 mm, 72 mm, 138 mm, 82 mm, and 55 mm mesh sizes;	Set 1600 (local time) and hauled 0400 the next morning; Work done by crew and research staff	Routine biological data: count all fish by species and mesh size and measure a maximum of 60 fish per species per mesh size for fork length, body weight, sex, gonad weight, and scale samples	Collected at all F-stations outside the U.S. 200-mile zone (outside EEZ; St. 1-10, 18-28); Routine scale collection: 1 scale per fish from sockeye, chum, and pink; 2 scales per fish from coho, chinook, and steelhead

Table 1. Continued.

Research Item/Gear	Purpose	Specifications	Deployment	Sample/Data	Comments
D. Salmonids					
Gillnet (con'd)		A-gear: 115 mm, 4 tans on one end of the gillnet and 15 tans on the other end; 38°30N-44°30N: 32-tans C-gear and 17-tans A-gear, 1 tan 29 mm and 37 mm added to C-gear and 2 tans removed from A-gear			
Surface Longline	Capture of live fish; Fish that have recently fed	Overall length: approx. 3.36 km (30 hachi [baskets]); Hachi mainline length: approximately 112 m; Number of branch lines per hachi: 47; Interval between branch lines: approx. 2.1 m; Fishing depth of hooks: 1.3 m; Bait: salted Japanese anchovy	Set 30 minutes before sunset (local) time, and hauled 30 minutes after sunset; Work done by crew and research staff	Routine biological data: count all fish by species and measure a maximum of 60 fish per species for fork length, body weight, sex, gonad weight, and a scale sample; When conducting tagging operations, viable fish were measured for fork length, a scale removed, and fish were double-tagged with FAJ and FRI tags	Collected at all F-stations; in the Bering Sea (Stations 18-28) fish were tagged with red 1.6 cm Petersen disk tags attached to the fish in front of the dorsal fin with a plastic cinch

Table 2. Description of research gear and fishing operations conducted aboard the *Oshoro maru* in 1995.

Research Item/Gear	Purpose	Specifications	Deployment	Sample/Data	Comments
A. Hydrographic					
Neil Brown Mark III B CTD	Collect temperature and salinity data; sampling along 180° in the North Pacific began in 1978, 145°W transect in 1980-81, 1994-95	CTD winch: Hydraulic 1t x 72 m/min., 6.4 ø x 4,000 m	Vertical, to 1500 m or 3,000 m depth, or to the bottom; Work on deck and data processing done by deck officers, crew, and cadets	Sal., temp., dynamic depth anomaly at 0, 10, 20, 30, 40, 50, 75, 100, 125, 150, 200, 250, 300, 400, 500, 600, 700, 800, 900, 1000, 1200, 1500, 2000, 2500, and 3000 m	Sigma-t, thermo-steric anomaly, specific volume anomaly, geo-potential anomaly calculated by ship-shipboard computer
B. Plankton					
Norpac Net	Estimate biomass and identify macro-zooplankton; time series in the Gulf of Alaska with the same net and similar methods 1956-62, 1980-85, 1987-present	Ring diameter: 0.45 m; Mesh Size: 0.35 mm; Filtering Cloth: #200; Length: 1.8 m	Vertical tow: 0-150 m or bottom; Ship speed: 0 knots, drifting; Work on deck done by deck officers, crew, and cadets	Bottled with formalin	copepods are the predominant taxa collected by this gear
C. Salmonids					
Research Gillnet	Salmon abundance and biological data for ocean ecology and stock assess-ment; non-selective research (C) net introduced in 1971; systematic surveys with gillnet for abundance estimation commenced in 1972, 145°W transect in 1980-81,1994-95	Overall length: 2.45 km (49 tans;50 m/tan); Depth: approx. 6 m; Net configuration [research (C) or commercial (A) mesh size (mm)/amount (tans)]: A115/10, C48/3, C93/3, C157/3, C106/3, C63/3, C121/3, C72/3, C138/3, C82/3, C55/3, A121/9; Hydraulic net hauler: 0.3 t x 177 m/min.	Set (local) time: sunset, approximately 1800; Haul (ship) time: sunrise, approximately 0500; Operation supervised by captain and officers; work done by all crew, cadets, and research staff	No. of fish by mesh and species; For each mesh size in C-net: fork length, sex, gonad weight, scale(s) for up to 100 fish of each species (body weight for up to 60 fish); A-net: same data as C-net except up to 60 fish of each species sampled per mesh.	1 scale per fish from sockeye, chum, and pink; 2 scales per fish from coho, chinook, and steelhead (1 scale from each side of body)

Table 2. continued.

Research Item/Gear	Purpose	Specifications	Deployment	Sample/Data	Comments
C. Salmonids (cont'd)					
Surface Longline	Live capture of fish for high seas tagging research; long time series of data 1955-present in North Pacific	No. hachi (baskets) per operation: 10-13; Hachi mainline length: 127 m; No. branch lines/hachi: 34; Interval between branch lines: 3 m; Fishing depth of hooks: approximately 2 m; Bait: small salted anchovy	Set (local) time: before sunrise, approx. 0430; Haul (local) time: after sunrise and completion of gillnet operation, approx. 0630; Operation supervised by captain and deck officers; work done by all crew, cadets, and research staff	No. of fish by species; Mortalities: fork length, body weight, scale(s); Viable fish: fork length, scale(s), tag nos.	Fish are tagged with red and white 1.6 cm Petersen disk tags attached to the fish in front of the dorsal fin with a plastic cinch

Table 3. Description of research activities conducted aboard the *Wakatake maru* in 1995.

Subject	Species	Sample	Fishing Gear	Method	Data or Samples Collected
A. Salmonid Feeding Ecology					
Food Habits	All salmon	Stomach contents	Longline	Stomachs from esophagus to pyloric valve collected from up to 20 fish of each species	Prey weight, % compostion by prey type, % empty stomachs, collected on board ship; Occasionally, specimens of prey organisms were preserved in formalin for later species identification
Bioenergetics	Salmonid prey	Fresh, whole specimens	Fish larval net, gillnet, and longline	Extra tows of the fish larval net or fresh salmon stomach contents	Fresh specimens in good condition frozen for caloric content analysis
Trophodymanics	Sockeye, chum, and pink	Muscle, liver, and stomach contents	Longline	Muscle: removed from area immediately anterior to anal fin, whole liver, and stomach contents removed from 10 fish per species per longline operation, F-stations 1-21	Samples frozen for heavy isotope analysis of carbon and nitrogen; Accompanying biological and food habits data
B. Salmonid Ocean Growth					
Growth Indices	All salmon	Paired otolith and scale samples	Gillnet and Longline	Otoliths collected from heads sampled for food habits studies; Supplemented from additional samples	Paired otoliths and scale samples; Accompanying biological and food habits data

Table 3. Continued.

Subject	Species	Sample	Fishing Gear	Method	Data or Samples Collected
Growth Indices (cont'd)	Chum and pink	Marked otoliths	Longline	To experimentally mark their otoliths, tagged live fish were injected with either OTC, (25 mg OTC/kg fish dissolved in 1% saline solution), a 1% saline solution, or not injected, and put into a tank supplied with fresh seawater	Scales collected when the fish were tagged; Scales and otoliths collected when the fish died; Accompanying biological data
Growth Rates	Sockeye, chum, and pink	Muscle	Gillnet and Longline	Muscle sample (half a fillet) approximately 2.5 cm wide was removed from area immediatiely behind the pectoral fin	Muscle sample (frozen) for RNA-DNA analysis to determine rate of protein synthesis; Accompanying biological data, scale, and otolith samples
Age and Growth Validation	Chum and and pink	Marked fish	Longline	During tagging operations in the Bering Sea, fish were injected with OTC and released for recovery in inshore fisheries	Tag numbers (FAJ and FRI), scale samples, and accompanying biological data

Table 3. Continued.

Subject	Species	Sample	Fishing Gear	Method	Data or Samples Collected
C. Stock Identification					
Gel Electrophoresis	Chum	Muscle, heart, liver, and eye	Gillnet and longline	Tissue samples removed from fish during collection of routine biological data	Tissue samples frozen from a maximum of 100 chum from each of 2 stations in the North Pacific (9 &10) and Bering Sea (19&20); Accompanying biological data and scale samples
	Chinook	Muscle, heart, liver, and eye	Gillnet and longline	Tissue samples removed from fish during collection of routine biological data	Tissue samples frozen from a maximum 100 chinook salmon; Accompanying biological, scale and otolith samples
Parasites	Chinook	Brain tissue	Gillnet and longline	Tissue samples removed from fish during collection of routine biological data	Tissue samples frozen from a maximum 100 chinook salmon; Accompanying biological, scale and otolith samples; Incidence of *Myxobolus arcticus* and *M. neurobius* determined later in the laboratory
	Sockeye	Visceral adhesion	Gillnet and longline	Observation during routine biological data collection	Incidence of visceral adhesion (indicator of the presence of *Philonema onchorhynchii)* recorded on biological data sheets

Table 3. Continued.

Subject	Species	Sample	Fishing Gear	Method	Data or Samples Collected
Scale Patterns (Hatchery vs. Wild Stocks)	Steelhead	Increased scale sampling; Paired otolith and scale samples	Gillnet and longline	Up to 10 extra scales from adult fish	Scales, otoliths, and routine biological data
Morphometry and Gel Electrophoresis (Species Verification/ Stock Identification)	Dolly Varden	Round sample	Gillnet and longline	Collected a round sample when Dolly Varden were caught	Round sample frozen in block; Accompanying length and weight data
D. Tagging					
High Seas Coded-Wire Tag Recovery	All salmon	Snouts	Gillnet and longline	Snouts were removed from fish lacking the adipose fin or left ventral fin or both	Snouts were salted and frozen; Accompanying biological data, scales, and otolith samples
High Seas Tagging	Chum and pink	Live fish	Longline	Fish were tagged with FAJ and FRI disk tags placed in front of the dorsal fin on the same cinch; caught and released in the Bering Sea St. 18-28	Scales and fork length collected when fish tagged
E. Salmonid Body Condition	All salmon	Incidence of salmon lice	Gillnet and longline	Salmon were observed for the incidence of parasites during routine biological data collection	Number and position of salmon lice (*Lepeophtheirus salmonis*) on the salmon; Accompanying biological data

Table 3. Continued.

Subject	Species	Sample	Fishing Gear	Method	Data or Samples Collected
E. Salmonid Body Condition (cont'd)	All salmon	Examination of slash marks	Gillnet and longline	Salmon were observed for the presence of injuries during the course of collecting routine biological data	Photographs taken of injured fish; Accompanying biological data
F. Non-salmonid Catches	Salmon sharks	Stomachs	Gillnet and longline	Collected a sample when shark was caught	Length, sex, and stomach sample collected; Stomach sample frozen
	Pacific Saury	Round sample	Gillnet (research-mesh 29 and 37 mm)	Small mesh size was used from 38°30N to 44°30N	Length measured; Maximum 100 fish per mesh size; Round sample frozen
	Walleye Pollock	Round sample	Gillnet and longline	Collected a sample when pollock was caught	Fork length and body weight measured; Round sample frozen
	Neon Flying Squid	Round sample	Gillnet	Collected a sample when squid was caught	Mantle length recorded; Round sample frozen; Maximum 10 individuals per station
	Pacific Pomfret	Round sample	Gillnet and longline	Collected a sample when pomfret was caught	Fork length measured; Round sample frozen
	Sea Birds	Round sample	Gillnet	Collected a sample when birds were caught	Enumerated by species and mesh size; Round sample frozen

Table 4. Additional salmonid research activities conducted aboard the *Oshoro maru* in 1995.

Subject	Sample (no. collected)	Fishing Gear	Method	Data or Samples Collected
A. Salmonid Feeding Ecology				
Food habits	Stomachs (593 salmonids) All species	Gillnet and longline	Stomachs from esophagus to pyloric valve collected from up to 20 fish of each species in each gillnet or longline operation (mortalities only)	Prey weight, % composition by prey type, % empty stomachs, digestion index collected in shipboard laboratory; type specimens of prey for identification to genus and species (preserved in formalin); specimens of prey for caloric content analysis (frozen)
Trophodynamic studies	Muscle samples (220 fish); All Species	Gillnet and longline	Thumb-sized wedge of muscle from nape of first five fish of each species sampled at each gillnet station (some longline morts)	Muscle sample (frozen) for heavy isotope analysis; accompanying biological and food habits data; samples provided to Canada (PBS) for analysis
B. Salmonid Ocean Growth				
Growth Indices	Paired otolith and scale samples (93 salmon); All species	Gillnet and longline	Otoliths collected from heads sampled for trophodynamic studies, cleaned, dried and stored in scintillation vials	Otoliths; accompanying scale samples, biological and food habits data

Table 4. continued.

Subject	Sample (no. collected)	Fishing Gear	Method	Data or Samples Collected
B. Salmonid Ocean Growth (cont'd)				
Age and Growth Validation	Marked fish (135 live fish); All species	Longline	During tagging operations in Gulf of Alaska, viable fish injected with 25 mg oxytetracycline hydrochloride/kg fish dissolved in 1% saline solution	Tag nos., scale samples, and accompanying biological data
C. Stock Identification				
Genetic stock identification	Tissue samples (118 pink salmon)	Gillnet and longline	Samples for iso-zyme analysis from up to 16 pink salmon in each gillnet (A-net) operation (some long-longline morts)	Heart, liver, eye, and muscle tissue (frozen); fork length, body weight, sex, gonad weight, scale sample
Steelhead ocean life history and hatchery/wild stock identification	Scale samples (all steelhead in catch); Paired otolith and scale samples (37 steelhead); whole juvenile fish (9 fish)	Gillnet and longline	Up to ten extra scales from all adult fish and whole fish samples of all juvenile steelhead were collected on deck	Scales, otoliths fork length, body weight, sex, gonad weight, volumetric measurements on some juvenile fish
D. Tagging				
High seas coded-wire tag recovery	Snouts from fish lacking the adipose or left ventral fin or both (20 fish); All species	Gillnet and longline (mortalities)	All fish in the catch were examined, and snouts were collected from fish with missing fins	Snouts (frozen) and accompanying catch, data, biological data, and scale samples; snouts shipped to NMFS/AFSC/ABL for analysis

Table 4. continued.

Subject	Sample (no. collected)	Fishing Gear	Method	Data or Samples Collected
D. Tagging (cont'd)				
Double-tagging experiments	Tagged fish (136 live fish); All species	Longline	All viable salmonids in longline catch at Gulf of Alaska stations were double-tagged with Japan and FRI tags	Tag nos.: Japan DD9024-9159/FRI KK500-635; accompanying catch, data, biological data, and scale samples
E. Salmonid Body Condition				
Fish condition/ moisture analysis	Muscle tissue (104 fish); All species	Gillnet and longline	Muscle samples (8-30 g) from behind head collected from up to 20 fish of each species in the catch	Weight (g) of muscle sample; muscle sample (frozen); accompanying biological and food habits data
Fish condition/ lipid analysis	Livers (220 fish); All species	Gillnet and longline	Samples for lipid analysis were collected from the first five fish of each species sampled at each gillnet station (some longline morts.)	Whole livers from all species except pink salmon (frozen); pink salmon samples were from same fish sampled for genetic analysis; weight (g) of whole liver from pink salmon; accompanying biological and food habits data; samples and data provided to Canada (PBS) for analysis

Table 5. Salmonids, other fishes, squids, and birds caught during the summer salmon research cruise of the *Wakatake maru*, 1995. Location, sea surface temperature (SST, °C) surface salinity (psu, practical salinity units), and catch by longline (B), salmon research-mesh gillnet (C), and commercial-mesh gillnet (A) are listed for each fishing station.

Sta	Date	Location	SST Salinity	Gear	Sockeye	Chum	Pink	Coho	Chinook	Steelhead	Dolly Varden	Total Salmonids	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	18-Jun-95	38°30 N	13.8	B	0	0	0	0	0	0	0	0	0	0	1	0	0	0	6	0	0	0	0	0
		179°30 W	34.0	C	0	0	0	0	0	0	0	0	28	0	6	0	0	0	2	0	0	1	0	0
				A	0	0	0	0	0	0	0	0	10	0	2	0	0	0	4	0	0	0	0	0
				Total	0	0	0	0	0	0	0	0	38	0	9	0	0	0	12	0	0	1	0	0
2	19-Jun-95	39°30 N	13.3	B	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0
		179°30 W	34.1	C	0	0	0	0	0	0	0	0	18	4	4	0	0	0	3	132	0	7	0	0
				A	0	0	0	0	0	0	0	0	10	0	1	0	0	0	1	0	0	0	0	0
				Total	0	0	0	0	0	0	0	0	28	4	12	0	0	0	4	132	0	7	0	0
3	20-Jun-95	40°30 N	12.6	B	0	0	0	0	0	0	0	0	0	0	22	0	0	0	0	0	0	0	0	0
		179°30 W	34.1	C	0	0	0	0	0	0	0	0	4	4	18	0	0	0	3	0	0	1	0	0
				A	0	0	0	0	0	0	0	0	2	0	4	0	0	0	2	0	0	0	0	0
				Total	0	0	0	0	0	0	0	0	6	4	44	0	0	0	5	0	0	1	0	0
4	21-Jun-95	41°30 N	12.4	B	0	0	0	0	0	0	0	0	0	0	77	0	0	0	0	0	0	0	0	0
		179°39 W	34.1	C	0	1	0	0	0	0	0	1	15	5	37	0	0	0	2	75	0	1	0	0
				A	0	0	0	0	0	0	0	0	46	0	21	0	0	0	0	0	0	0	0	0
				Total	0	1	0	0	0	0	0	1	61	5	135	0	0	0	2	75	0	1	0	0
5	22-Jun-95	42°30 N	10.8	B	0	1	0	6	0	0	0	7	0	0	4	0	0	0	0	0	0	1	0	0
		179°30 W	33.8	C	0	1	0	0	0	0	0	1	0	7	5	0	0	0	0	0	0	8	0	0
				A	0	2	0	2	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
				Total	0	4	0	8	0	0	0	12	0	7	9	0	0	0	0	0	0	9	0	0
6	23-Jun-95	43°30 N	11.1	B	0	4	2	7	0	1	0	14	0	0	13	0	0	0	0	0	0	0	0	0
		179°30 W	33.5	C	0	3	1	15	0	0	0	19	0	2	49	0	0	0	1	0	0	1	0	0
				A	0	11	0	15	0	0	0	26	0	0	19	0	0	0	0	0	0	0	1	0
				Total	0	18	3	37	0	1	0	59	0	2	81	0	0	0	1	0	0	1	1	0
7	24-Jun-95	44°30 N	9.8	B	0	2	1	2	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0
		179°30 W	33.8	C	0	7	5	12	0	1	0	25	0	8	0	0	0	0	1	0	0	0	3	0
				A	0	6	1	17	0	2	0	26	0	0	0	0	0	0	0	0	0	0	0	0
				Total	0	15	7	31	0	3	0	56	0	8	0	0	0	0	1	0	0	0	3	0

Table 5. Continued.

Sta	Date	Location	SST Salinity	Gear	Sockeye	Chum	Pink	Coho	Chinook	Steelhead	Dolly Varden	Total Salmonids	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	25-Jun-95	45°30 N	8.3	B	0	20	0	27	0	2	0	49	0	0	0	0	0	0	0	0	0	0	0	0
		179°30 W	33.1	C	0	6	3	51	0	12	0	72	0	22	0	0	0	0	0	0	0	14	1	0
				A	0	8	2	57	0	7	0	74	0	0	0	0	0	0	4	0	0	0	0	0
				Total	0	34	5	135	0	21	0	195	0	22	0	0	0	0	4	0	0	14	1	0
9	26-Jun-95	46°30 N	7.9	B	0	3	2	23	0	3	0	31	0	0	0	0	0	0	0	0	0	0	0	0
		179°30 W	32.9	C	0	4	4	21	0	2	0	31	0	22	0	0	0	0	0	0	0	0	0	0
				A	2	5	4	32	0	6	0	49	0	2	0	0	0	0	0	0	0	0	0	0
				Total	2	12	10	76	0	11	0	111	0	24	0	0	0	0	0	0	0	0	0	0
10	27-Jun-95	47°30 N	7.1	B	0	150	3	1	1	3	0	158	0	0	0	0	0	0	0	0	0	0	0	0
		179°30 W	33.0	C	2	89	13	5	2	9	0	120	0	1	0	0	0	0	1	0	0	0	0	0
				A	1	136	4	9	9	7	0	166	0	1	0	0	0	0	0	0	0	0	0	0
				Total	3	375	20	15	12	19	0	444	0	2	0	0	0	0	1	0	0	0	0	0
11	28-Jun-95	48°30 N	7.2	B	3	22	5	3	2	1	0	36	0	1	0	0	0	0	0	0	0	0	0	0
		179°30 W	32.9																					
12	29-Jun-95	49°30 N	6.4	B	5	40	17	1	0	0	0	63	0	0	0	0	0	0	0	0	0	0	0	0
		179°30 W	33.0																					
13	30-Jun-95	50°30 N	6.4	B	7	35	4	1	1	0	0	48	0	0	0	0	0	0	0	0	0	0	0	0
		179°30 W	32.8																					
14	1-Jul-95	51°30 N	6.4	B	14	8	11	0	0	0	0	33	0	0	0	0	0	0	0	0	0	2	0	0
		179°30 W	32.7																					
15	2-Jul-95	52°30 N	5.9	B	32	24	26	0	0	0	0	82	0	0	0	9	0	0	0	0	0	0	0	0
		179°30 W	33.2																					
16	3-Jul-95	53°30 N	6.7	B	8	56	15	0	0	0	0	79	0	0	0	1	0	0	0	0	0	0	0	0
		179°30 W	33.1																					
17	4-Jul-95	54°30 N	6.5	B	14	90	51	0	0	0	0	155	0	0	0	0	0	0	0	0	0	0	0	0
		179°30 W	33.0																					

Table 5. Continued.

Sta	Date	Location	SST Salinity	Gear	Sockeye	Chum	Pink	Coho	Chinook	Steelhead	Dolly Varden	Total Salmonids	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	5-Jul-95	55°30 N	6.5	B	2	26	10	0	0	0	0	38	0	0	0	0	0	0	0	0	0	0	0	0
		179°30 W	32.9	Tagged	0	8	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0
				C	27	100	305	0	0	0	0	432	0	0	0	0	0	0	0	0	0	0	3	0
				A	28	74	524	0	0	0	0	626	0	0	0	0	0	0	0	0	0	0	0	0
				Total	57	200	839	0	0	0	0	1096	0	0	0	0	0	0	0	0	0	0	3	0
19	6-Jul-95	56°30 N	6.6	B	6	19	15	0	1	0	0	41	0	0	0	0	0	0	0	0	0	0	0	0
		179°30 W	33.0	C	20	33	233	2	2	0	0	290	0	0	0	0	0	0	0	0	0	0	2	0
				A	26	51	366	1	3	0	0	447	0	0	0	0	0	0	1	0	0	0	2	0
				Total	52	103	614	3	6	0	0	778	0	0	0	0	0	0	1	0	0	0	4	0
20	7-Jul-95	57°30 N	6.4	B	7	2	99	0	1	0	0	109	0	0	0	0	0	0	0	0	0	0	0	0
		179°30 W	33.0	Tagged	0	0	18	0	0	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0
				C	13	18	281	0	0	0	0	312	0	1	0	1	0	1	0	0	0	0	3	0
				A	17	28	367	0	1	0	1	414	0	0	0	0	0	0	0	0	0	0	1	0
				Total	37	48	747	0	2	0	0	834	0	1	0	1	0	1	0	0	0	0	4	0
21	8-Jul-95	58°30 N	7.9	B	8	34	75	0	5	0	1	123	0	0	0	0	0	0	0	0	0	0	0	0
		179°30 W	32.8	Tagged	0	11	17	0	0	0	0	28	0	0	0	0	0	0	0	0	0	0	0	0
				C	30	24	197	0	18	0	2	271	0	0	0	0	0	0	0	0	0	0	1	0
				A	33	35	414	0	4	0	0	486	0	0	0	0	0	0	0	0	0	0	2	0
				Total	71	93	686	0	27	0	3	880	0	0	0	0	0	0	0	0	0	0	3	0
22	9-Jul-95	57°30 N	7.5	B	34	64	84	0	4	0	0	186	0	0	0	0	0	0	0	0	0	0	0	0
		178°30 W	32.9	Tagged	0	20	24	0	0	0	0	44	0	0	0	0	0	0	0	0	0	0	0	0
				C	46	75	120	0	11	0	0	252	0	6	0	0	0	0	0	0	0	0	3	0
				A	52	98	141	0	5	0	0	296	0	0	0	0	0	2	0	0	0	0	5	0
				Total	132	237	345	0	20	0	0	734	0	6	0	0	0	2	0	0	0	0	8	0
23	10-Jul-95	57°30 N	7.6	B	14	40	14	0	1	0	0	69	0	0	0	0	0	0	0	0	0	0	0	0
		177°30 W	32.9	Tagged	0	23	6	0	0	0	0	29	0	0	0	0	0	0	0	0	0	0	0	0
				C	59	23	217	1	2	0	0	302	0	0	0	0	0	0	0	0	0	1	17	0
				A	78	38	291	1	0	0	0	408	0	0	0	0	0	0	0	0	0	0	2	0
				Total	151	101	522	2	3	0	0	779	0	0	0	0	0	0	0	0	0	1	19	0

Table 5. Continued.

Sta	Date	Location	SST Salinity	Gear	Sockeye	Chum	Pink	Coho	Chinook	Steelhead	Dolly Varden	Total Salmonids	Neon Flying Squid	Other Squids	Pacific Pomfret	Atka Mackerel	Lancet Fish	Walleye Pollock	Sharks	Pacific Saury	Dagger Tooth	Other Fishes	Sea Birds	Marine Mammals
24	11-Jul-95	56°30 N	8.0	B	11	31	29	0	6	0	0	77	0	0	0	0	0	1	0	0	0	0	0	0
		177°30 W	33.0	Tagged	0	17	16	0	0	0	0	33	0	0	0	0	0	0	0	0	0	0	0	0
				C	38	103	132	0	10	0	0	283	0	1	0	0	0	0	0	0	0	0	1	0
				A	35	86	147	1	18	0	0	287	0	0	0	0	0	0	0	0	0	0	1	0
				Total	84	220	308	1	34	0	0	647	0	1	0	0	0	1	0	0	0	0	2	0
25	12-Jul-95	56°30 N	8.3	B	14	39	22	0	1	0	0	76	0	0	0	0	0	0	0	0	0	0	0	0
		178°30 W	33.0	Tagged	1	15	7	0	0	0	0	23	0	0	0	0	0	0	0	0	0	0	0	0
				C	53	86	59	1	3	0	0	202	0	1	0	0	0	0	0	0	0	0	12	0
				A	57	77	108	1	6	0	0	249	0	0	0	0	0	0	0	0	0	0	13	0
				Total	124	202	189	2	10	0	0	527	0	1	0	0	0	0	0	0	0	0	25	0
26	13-Jul-95	56°30 N	7.9	B	8	12	16	0	19	0	0	55	0	0	0	0	0	0	0	0	0	0	0	0
		179°30 E	33.0	Tagged	0	7	11	0	0	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0
				C	64	84	141	0	12	0	0	301	0	9	0	0	0	7	0	0	0	0	3	0
				A	60	80	219	1	12	0	0	372	0	0	0	0	0	0	0	0	0	0	0	0
				Total	132	176	376	1	43	0	0	728	0	9	0	0	0	7	0	0	0	0	3	0
27	14-Jul-95	56°30 N	8.2	B	9	34	27	0	8	0	0	78	0	0	0	0	0	0	0	0	0	0	0	0
		178°30 E	32.9	Tagged	1	14	10	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0
				C	27	80	139	0	5	0	0	251	0	14	0	0	0	0	0	0	0	0	1	0
				A	44	97	144	1	10	0	0	296	0	0	0	0	0	0	0	0	0	0	0	0
				Total	80	211	310	1	23	0	0	625	0	14	0	0	0	0	0	0	0	0	1	0
28	15-Jul-95	56°30 N	8.1	B	6	20	11	0	2	0	0	39	0	0	0	0	0	0	0	0	0	0	0	0
		177°30 E	32.9	Tagged	0	12	8	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0
				C	39	76	95	2	8	0	0	220	0	11	0	0	0	2	0	0	0	0	0	0
				A	53	52	168	1	9	0	0	283	0	0	0	0	0	0	0	0	0	0	0	0
				Total	98	148	274	3	19	0	0	542	0	11	0	0	0	2	0	0	0	0	0	0
		Subtotal		B	202	776	539	71	52	10	1	1651	0	1	124	10	0	1	6	0	0	3	0	0
				Tagged	2	127	117	0	0	0	0	246	0	0	0	0	0	0	0	0	0	0	0	0
				C	418	813	1945	110	73	24	2	3385	65	118	119	1	0	10	13	207	0	34	50	0
				A	486	884	2900	139	77	22	1	4509	68	3	47	0	0	2	12	0	0	0	27	0
		Total			1106	2473	5384	320	202	56	4	9545	133	122	290	11	0	13	31	207	0	37	77	0

Table 6. Salmonids, other fishes, squids, and birds caught during the summer salmon research cruise of the *Oshoro maru*, 1995. Location, sea surface temperature (SST, °C), surface salinity (psu, practical salinity units), and catch by longline (B), salmon research-mesh gillnet (C), and commercial-mesh gillnet (A) are listed for each fishing station.

Sta	Date	Location	SST Salin.	Gear	Sock-eye	Chum	Pink	Coho	Chi-nook	Steel-head	Dolly Varden	Total Salmon	Neon Flying Squid	Other Squid	Pacific Pomfret	Sharks	Other Fishes	Sea Birds	Marine Mammals
G01	12-Jun-95	40°00 N	12.1	C	0	0	0	0	0	0	0	0	1	1	9	0	0	0	0
		179°59 E	34.1	A	0	0	0	0	0	0	0	0	13	0	3	0	0	0	0
				Total	0	0	0	0	0	0	0	0	14	1	12	0	0	0	0
G02	13-Jun-95	41°00 N	11.6	C	0	0	0	0	0	0	0	0	10	0	3	1	0	0	0
		179°59 E	34.2	A	0	0	0	0	0	0	0	0	116	0	20	0	0	0	0
				Total	0	0	0	0	0	0	0	0	126	0	23	1	0	0	0
G03	14-Jun-95	42°00 N	10.5	C	0	0	0	1	0	0	0	1	7	14	6	0	0	0	0
		179°59W	33.9	A	0	0	0	2	0	1	0	3	8	0	4	0	0	0	0
				Total	0	0	0	3	0	1	0	4	15	14	10	0	0	0	0
G04	15-Jun-95	42°59 N	9.5	C	0	1	0	2	0	0	0	3	1	11	0	1	0	0	0
		179°59W	33.9	A	0	6	0	13	0	0	0	19	0	0	0	2	0	0	0
				Total	0	7	0	15	0	0	0	22	1	11	0	3	0	0	0
L01	16-Jun-95	44°00 N	9.6	B	0	0	0	3	0	0	0	3	0	0	0	0	0	0	0
		179°59W	33.5	Tagged	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0
G05		43°59 N		C	0	0	0	4	0	1	0	5	0	24	0	0	0	0	0
		179°59W		A	0	2	0	4	1	3	0	10	0	0	0	2	0	0	0
				Total	0	2	0	11	1	4	0	18	0	24	0	2	0	0	0
L02	17-Jun-95	44°59 N	8.3	B	0	0	0	12	0	0	0	12	0	0	0	0	0	0	0
		179°59W	33.2	Tagged	0	0	0	12	0	0	0	12	0	0	0	0	0	0	0
G06				C	0	21	5	66	0	3	0	95	0	6	0	1	0	0	0
				A	0	1	1	87	2	3	0	94	0	0	0	0	0	0	0
				Total	0	22	6	165	2	6	0	201	0	6	0	1	0	0	0

Table 6. continued.

Sta	Date	Location	SST Salin.	Gear	Sock-eye	Chum	Pink	Coho	Chi-nook	Steel-head	Dolly Varden	Total Salmon	Neon Flying Squid	Other Squid	Pacific Pomfret	Sharks	Other Fishes	Sea Birds	Marine Mammals
L03	18-Jun-95	46°00 N	7.4	B	0	2	1	4	0	0	0	7	0	0	0	0	0	0	0
		179°59 E	33.0	Tagged	0	2	1	4	0	0	0	7	0	0	0	0	0	0	0
G07				C	2	10	1	6	0	1	0	20	0	0	0	1	0	0	0
				A	0	0	0	1	0	2	0	3	0	0	0	0	0	0	0
				Total	2	12	2	11	0	3	0	30	0	0	0	1	0	0	0
L04	19-Jun-95	47°02 N	7.4	B	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0
		179°57 W	32.9	Tagged	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0
G08		47°00 N		C	3	5	37	0	0	0	0	45	0	3	0	0	0	0	0
		179°59 W		A	1	2	1	1	2	2	0	9	0	0	0	0	0	0	0
				Total	4	7	40	1	2	2	0	56	0	3	0	0	0	0	0
L05	26-Jun-95	49°58 N	CTD	B	0	9	1	0	0	0	0	10	0	0	0	0	0	0	0
		161°04 W	Broken	Tagged	0	9	1	0	0	0	0	10	0	0	0	0	0	0	0
G09		50°00 N		C	29	8	4	0	0	6	0	47	0	0	0	0	0	0	0
		160°59 W		A	4	1	0	1	2	0	0	8	0	0	0	0	0	0	0
				Total	33	18	5	1	2	6	0	65	0	0	0	0	0	0	0
L06	27-Jun-95	49°35N	CTD	B	1	7	4	1	0	0	0	13	0	0	0	0	0	0	0
		161°12 W	Broken	Tagged	1	5	3	1	0	0	0	10	0	0	0	0	0	0	0
G10	28-Jun-95	50°00 N	CTD	C	39	42	28	5	0	2	0	116	0	3	0	0	0	1	0
		159°00 W	Broken	A	29	4	49	4	3	2	0	91	0	0	0	0	0	0	0
				Total	68	46	77	9	3	4	0	207	0	3	0	0	0	1	0
L07	2-Jul-95	51°00 N	CTD	B	0	22	4	0	1	0	0	27	0	0	0	0	0	0	0
		161°50 W	Broken	Tagged	0	13	4	0	0	0	0	17	0	0	0	0	0	0	0

Table 6. continued.

Sta	Date	Location	SST Salin.	Gear	Sock-eye	Chum	Pink	Coho	Chi-nook	Steel-head	Dolly Varden	Total Salmon	Neon Flying Squid	Other Squid	Pacific Pomfret	Sharks	Other Fishes	Sea Birds	Marine Mammals
L08	6-Jul-95	51°30 N	9.9	B	1	0	13	4	0	5	0	23	0	0	0	0	0	0	0
		145°00 W	32.5	Tagged	0	0	6	1	0	2	0	9	0	0	0	0	0	0	0
G11		51°29 N		C	29	68	18	16	1	8	0	140	0	7	0	0	1	0	0
		144°59 W		A	43	41	17	28	1	13	0	143	0	0	0	0	0	2	0
				Total	73	109	48	48	2	26	0	306	0	7	0	0	1	2	0
L09	7-Jul-95	53°01 N	10.8	B	1	5	5	1	0	0	0	12	0	0	0	0	0	0	0
		144°56 W	32.5	Tagged	0	3	2	0	0	0	0	5	0	0	0	0	0	0	0
G12		53°00 N		C	20	89	36	8	1	7	0	161	0	4	0	0	0	0	0
		145°00 W		A	34	52	19	16	3	9	0	133	0	0	0	0	0	1	0
				Total	55	146	60	25	4	16	0	306	0	4	0	0	0	1	0
L10	8-Jul-95	54°01 N	10.4	B	1	2	3	9	0	1	0	16	0	0	0	0	0	0	0
		144°58 W	32.3	Tagged	1	1	2	3	0	1	0	8	0	0	0	0	0	0	0
G13		53°59 N		C	44	90	44	19	1	6	0	204	0	11	0	0	0	0	0
		145°00 W		A	47	124	40	14	0	6	0	231	0	0	0	0	0	2	0
				Total	92	216	87	42	1	13	0	451	0	11	0	0	0	2	0
L11	9-Jul-95	54°59 N	11.1	B	0	12	12	3	0	0	0	27	0	0	0	0	0	0	0
		145°03 W	32.5	Tagged	0	8	11	3	0	0	0	22	0	0	0	0	0	0	0
G14		55°00 N		C	32	93	41	12	0	2	0	180	0	12	0	0	0	1	0
		144°59 W		A	38	21	42	20	0	7	0	128	0	0	0	0	0	0	0
				Total	70	126	95	35	0	9	0	335	0	12	0	0	0	1	0

Table 6. continued.

Sta	Date	Location	SST Salin.	Gear	Sock-eye	Chum	Pink	Coho	Chi-nook	Steel-head	Dolly Varden	Total Salmon	Neon Flying Squid	Other Squid	Pacific Pomfret	Sharks	Other Fishes	Sea Birds	Marine Mammals
L12	10-Jul-95	55°55 N	11.5	B	0	4	32	0	0	0	0	36	0	0	0	0	0	0	0
		145°11 W	32.3	Tagged	0	1	21	0	0	0	0	22	0	0	0	0	0	0	0
G15		56°00 N		C	49	83	49	15	0	1	0	197	0	4	0	1	0	0	0
		145°00 W		A	57	47	43	20	0	1	0	168	0	0	0	0	0	0	0
				Total	106	134	124	35	0	2	0	401	0	4	0	1	0	0	0
L13	11-Jul-95	58°19 N	12.3	B	1	7	47	1	0	0	0	56	0	0	0	0	0	0	0
		144°59 W	32.2	Tagged	1	2	29	1	0	0	0	33	0	0	0	0	0	0	0
	TOTAL			B	5	70	124	38	1	6	0	244	0	0	0	0	0	0	0
				Tagged	3	44	82	27	0	3	0	159	0	0	0	0	0	0	0
				C	247	510	263	154	3	37	0	1214	19	100	18	5	1	2	0
				A	253	301	212	211	14	49	0	1040	137	0	27	4	0	5	0
				Total	505	881	599	403	18	92	0	2498	156	100	45	9	1	7	0

Table 7. Release and recovery information for US and US-Japan tags returned from Sept. 1, 1994 to August 31, 1995.

Release								Recovery								Rel/Rec		
Species	Agency	Tag No.(s)	Date	Location	Vessel, Set No.,gear	Rel. Age	Length (mm)	Date	Location	Code	Gear	Length (mm)	Weight (kg)	Sex	Gonad Wt. (gm)	Distance (km)	Notes	Tag Return by:
Sockeye	FRI	B 977	July 31, 1977	176°25W 51°28N, W8050, Adak Index Area, south of Adak I., central Aleutians	Commander, C026, purse seine	2.1	330	July 12, 1979	157°10W 58°45N, Naknek-Kvichak, Ships Channel, Bristol Bay, Alaska	47-0	Gillnet	560-660 (est.)	2.3-2.5 (est.)	Male		1,459	Prev. recs. from same operation: 2 Bristol Bay sockeye in 1978 &1979; 1 Bristol Bay chum in 1979	John W. Johnson, fisherman, Iliamna, Alaska
Sockeye	JAPAN US/FRI	CC2016 EE0059	June 28, 1994	156°56W 50°03N, W6050, Western Gulf of Alaska	Oshoro maru, floating longline	1.2	454	June 23, 1995	150°00W 60°29N, Russian R., Cook Inlet, Alaska; 2.4 km above Russian R.-Kenai R. Confluence	57-3	Sport, Coho fly, fly rod	560-660 (est.)	2.7 (est.)	Male		1,238	Prev. recs. from same station: 1 Hoh R., Washington, hatchery steelhead (CWT)	Steve Rinker, fisherman Anchorage, Alaska
Pink	JAPAN US/FRI	JJ6190 KK155	July 11, 1995	177°30W 56°30N, W8056, central Bering Sea	Wakatake maru, floating longline	0.1	469	July 12, 1995	177°30W 56°30N, W8056, central Bering Sea	25	Wakatake maru, research gillnet C-138	468	1.26	Male	70	0	OTC marked, otolith collected	Nancy Davis, FRI
Pink	JAPAN US/FRI	DD9149 KK625	July 11, 1995	144°59W 58°19N, W4558, north-central Gulf of Alaska	Oshoro maru, L13, floating longline	0.1	482	Before Aug. 9, 1995	147°55W 59°49N, Prince William Sound, Alaska, San Juan District	59-6						236	Addit. recs. from same operation: 2 pink salmon Dall Island, Southeast Alaska in 1995	Ryan Deming, fisherman, Blaine, Washington

Table 7. Continued.

Release								Recovery								Rel/Rec		
Species	Agency	Tag No.(s)	Date	Location	Vessel, Set No.,gear	Rel. Age	Length (mm)	Date	Location	Code	Gear	Length (mm)	Weight (kg)	Sex	Gonad Wt. (gm)	Distance (km)	Notes	Tag Return by:
Pink	JAPAN US/FRI	DD9102 KK578	July 9, 1995	145°03W 54°59N, W5054, central Gulf of Alaska	Oshoro maru, L11, floating longline	0.1	506	Before Aug. 8, 1995	153°37W 57°53N, Broken Point, Uganik Bay, Kodiak, Alaska	55-1	Gillnet					617	Addit. recs. from same operation: 1 pink salmon Dall Island, Southeast Alaska, 1995	Travis Harrington, fisherman, Kodiak, Alaska; JAPAN tag not returned
Pink	JAPAN US/FRI	DD9067 KK543	July 6, 1995	145°00W 51°30N, W4550, south central Gulf of Alaska	Oshoro maru, L08, floating longline	0.1	480	Aug. 6, 1995	157°45W 56°35N, Stat. Area 272-50, Chignik Management area, Chignik Alaska	54-2			1.5			1,003	Addit. recs. from same station: 1 Hoh R., Washington, hatchery steelhead (winter run) (CWT)	Kevin Murphy, Manager, Aleutian Dragon Fisheries, Chignik, Alaska
Pink	JAPAN US/FRI	DD9107 KK583	July 10, 1995	145°11W 55°55N W5054, central Gulf of Alaska	Oshoro maru, L12, floating longline	0.1	468	On or before Aug. 22, 1995	136°00W 57°33'N, Ford Arm Weir, Southeast Alaska	62-0	Weir					588		Reported by Bill Heard, NMFS, ABL, Juneau, from Karl Hofmeister, ADF&G; no tags returned
Pink	JAPAN US/FRI	DD9159 KK635	July 11, 1995	144°59W 58°19N W4558, north central Gulf of Alaska	Oshoro maru, L13, floating longline	0.1	524	Aug. 18 or 19, 1995	133°00W 54°57N, Dist. 104-20, Dall Island, Southeast Alaska	65-2	Seine					821	Addit. recs. from same operation: 2 pink salmon Dall Island & Prince William Snd., Alaska, 1995	Cathy Robinson, ADF&G, Petersburg, Alaska

Table 7. Continued.

Release								Recovery								Rel/Rec		
Species	Agency	Tag No.(s)	Date	Location	Vessel, Set No.,gear	Rel. Age	Length (mm)	Date	Location	Code	Gear	Length (mm)	Weight (kg)	Sex	Gonad Wt. (gm)	Distance (km)	Notes	Tag Return by:
Pink	JAPAN US/FRI	DD9137 KK613	July 11, 1995	144°59W 58°19N W4558, north central Gulf of Alaska	Oshoro maru, L13, floating longline	0.1	497	Aug. 19, 1995	133°00W 54°57N, Dist. 104-20, Dall Island Southeast Alaska	65-2	Seine	549	1.4	Male		821	Addit. recs. from same operation: 2 pink salmon Dall Island & Prince William Snd., Alaska, 1995	Walt Dauderis, fisherman, Sultan, Washington, and Cathy Robinson, ADF&G, Petersburg, Alaska
Pink	JAPAN US/FRI	DD9089 KK565	July 9, 1995	145°03W 54°59N, W5054, central Gulf of Alaska	Oshoro maru, L11, floating longline	0.1	Length not meas-ured	Aug. 15, 1995	133°00W 54°57N, Dist. 104-20, Dall Island Southeast Alaska	65-2						768	Addit. recs. from same operation: 1 pink salmon Uganik Bay, Kodiak, Alaska	James Olson, F/V Renaissance, fisherman, Dufur, Oregon

Table 8. Criteria used to determine the oceanographic domain where salmon and steelhead were caught during the research cruises of the *Oshoro maru* and *Wakatake maru*, in summer, 1995. The upper layer is the limit of winter turnover, approximately 0-200 m. References are Dodimead et al. 1963 INPFC Bull. 13 and Favorite et al. 1976 INPFC Bull. 33.

Oceanographic Domain	Criteria	References
Transition Zone	Thermocline persits all year; No temperature inversions; Salinity is maximum at the surface and decreases to a minimum at >500 m; Salinity is >34.0 ‰ at the suface	Dodimead et al. 1963
Subarctic Boundary	34.0 ‰ vertical isohaline from the surface to approximately 200-400 m	Dodimead et al. 1963 and Favorite et al. 1976
Transition Domain	Salinity is >33.2 ‰ at the surface and >33.4 ‰ at the bottom of the upper layer; Northern boundary is where the 4° C isotherm descends below 100 m	Dodimead et al. 1963 and Favorite et al. 1976
Subarctic Current	Characterized by relatively cool, dilute surface waters and homogeneous environmental conditions; At 125 m, temperature and salinity approximately 3.5°C and 33.4 ‰ at 180°; approximately 4.4°C and 33.4 ‰ at 150°W in July	Favorite et al. 1976
Ridge Domain	Found below the surface layer; Cold, saline, nutrient-rich, O_2-poor water flows upwards indicated by upward bending isotherms and isohalines; 4°C isotherm is located at < 100 m	Favorite et al. 1976
Dilute Domain	Cannot identify below 300 m; Summertime temperatures are 4°-6°C at 125-300 m and dilute water less than or equal to 33.0 ‰ at 0-125 m	Favorite et al. 1976
Alaska Stream	4°C isotherm descends below 100 m and dilute water, < 32.6 ‰ at the surface; Alaska Stream and Dilute Domain can penetrate across the top of Ridge Domain	Favorite et al. 1976
Bering Sea	Geographical area characterized by cold, saline surface waters, of approximately 33.0 ‰; Waters more saline than the Alaska Stream	Favorite et al. 1976

Table 9. Catch (number of salmonids) per unit (30-tans, 1500 m) of effort by C-gear (research-mesh gillnet) calculated by oceanographic region and year for the Japanese research vessel, *Wakatake maru*. Research-mesh gillnet is composed of 3 tans each for the following mesh sizes: 55 mm, 63 mm, 72 mm, 82 mm, 93 mm, 106 mm, 121 mm, 138 mm, and 157 mm.

Year	Sampling Dates	No. of Sta.	Locations	Mean Temperature 0 m	Mean Temperature 100 m	Mean Salinity 0 m	Mean Salinity 100 m	Mean Catch per 30 tans C-gear: Sockeye	Chum	Pink	Coho	Chinook	Steelhead	Dolly Varden	Total Salmonids
			Central North Pacific - Transition Zone												
1995	18-21 Jun	4	38°N-41°N, 180°	13.0	10.8	34.1	34.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	18-20 Jun	3	38°N-40°N, 180°	14.2	11.6	34.3	34.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	17-22 Jun	5	38°N-42°N, 180°	12.9	10.6	34.2	34.2	0.0	13.4	0.0	0.0	0.0	0.0	0.0	13.4
1992	17-20 Jun	4	38°N-41°N, 180°	12.8	10.2	34.2	34.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	12-14 Jun	3	38°N-40°N, 180°	14.3	11.2	34.2	34.3	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.7
			Central North Pacific - Transition Domain												
1995	22-24 Jun	3	42°N-44°N, 180°	10.6	8.4	33.7	33.9	0.0	3.7	2.0	9.0	0.0	0.3	0.0	15.0
1994	21-24 Jun	4	41°N-44°N, 180°	10.5	8.6	33.9	33.9	0.0	9.0	1.3	11.0	0.0	2.5	0.0	23.8
1993	23-25 Jun	2	43°N-44°N, 180°	9.2	7.7	33.7	33.9	0.0	27.5	0.0	8.5	0.0	1.0	0.0	37.0
1992	21-22 Jun	2	42°N-43°N, 180°	9.4	9.1	33.7	34.0	0.0	15.0	0.0	5.5	0.0	0.5	0.0	21.0
1991	15-19 Jun	5	41°N-45°N, 180°	10.4	8.3	33.5	33.8	0.0	10.6	0.4	29.2	0.0	3.2	0.0	43.4
			Central North Pacific - Subarctic Current												
1995	25-27 Jun	3	45°N-47°N, 180	7.8	4.7	33.0	33.2	0.7	33.0	6.7	25.7	0.7	7.7	0.0	74.3
1994	25-27 Jun	3	45°N-47°N, 180°	6.5	3.9	32.9	33.0	1.3	15.3	22.0	25.0	1.0	9.0	0.0	73.7
1993	26-28 Jun	3	45°N-47°N, 180°	7.3	3.6	33.0	33.2	0.0	58.3	2.7	16.3	0.3	5.0	0.0	82.7
1992	23-25 Jun	3	44°N-46°N, 180°	7.6	4.8	33.2	33.3	0.0	12.7	0.3	19.3	0.3	1.0	0.0	33.7
1991	20-21 Jun	3	46°N-47°N, 180°	7.4	4.5	33.0	33.1	1.0	30.5	10.5	24.0	1.0	1.5	0.0	68.5
			North Pacific - Ridge Domain												
1992	26-Jun	1	47°N, 180°	6.7	3.1	33.0	33.1	0.0	40.0	1.0	34.0	0.0	2.0	0.0	77.0
			Bering Sea												
1995	5-15 Jul	11	55°N-58°N, 177°W-177°E	7.5	2.0	32.9	33.1	37.8	63.8	174.5	0.5	6.5	0.0	0.2	283.3
1994	5-15 Jul	11	55°N-58°N, 177°W-177°E	6.7	1.8	32.9	33.2	50.3	224.0	13.1	0.0	5.2	0.0	0.2	292.7
1993	6-16 Jul	11	55°N-58°N, 177°W-177°E	7.2	2.1	33.1	33.2	58.2	111.6	141.2	0.8	1.4	0.0	0.0	313.2
1992	4-14 Jul	11	55°N-58°N, 177°W-177°E	6.4	2.5	33.0	33.3	22.8	257.5	9.0	0.3	5.4	0.0	0.5	295.5
1991	1-8 Jul	8	55°N-58°N, 180°-177°W	7.6	2.2	33.0	33.2	22.9	53.9	365.5	0.0	9.9	0.0	0.0	452.1

Table 10. Catch (number of salmonids) per unit (30-tans, 1500 m) of effort by C-gear (research-mesh gillnet) calculated by oceanographic region and year for the Japanese research vessel, *Oshoro maru.* Research-mesh gillnet is composed of 3 tans each for the following mesh sizes: 55 mm, 63 mm, 72 mm, 82 mm, 93 mm, 106 mm, 121 mm, 138 mm, 157 mm.

Year	Sampling Dates	Number of Stations	Locations	Mean Temperature 0 m	Mean Temperature 100 m	Mean Salinity 0 m	Mean Salinity 100 m	Catch per 30 tans C-gear: Sockeye	Chum	Pink	Coho	Chinook	Steelhead	Total Salmon
			Central North Pacific - Transition Zone											
1995	12-13 June	2	40°N-41°N, 180°	11.9	10.4	34.2	34.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	11-13 June	3	39°N-41°N, 180°	13.0	11.1	34.1	34.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			Central North Pacific - Transition Domain											
1995	14-16 June	3	42°N-44°N, 180°	9.9	8.8	33.8	34.0	0.0	0.3	0.0	2.3	0.0	0.3	3.0
1994	14-15 June	2	42°N-43°N, 180°	9.9	8.4	33.9	33.9	0.0	24.0	1.5	38.0	0.0	0.5	64.0
			Central North Pacific - Subarctic Current											
1995	17-19 June	3	45°N-47°N, 180°	7.7	5.6	33.0	33.3	1.7	12.0	14.3	24.0	0.0	1.3	53.3
1994	17-18 June	2	45°N-46°N, 180°	7.0	5.7	33.2	33.3	0.0	27.5	18.0	16.5	0.5	5.0	67.5
			Western Gulf of Alaska - Subarctic Current											
1995	26-28 June	2	50°N, 161°-159°W	No CTD	No CTD	No CTD	No CTD	34.0	25.0	16.0	2.5	0.0	4.0	81.5
1994	28-Jun	1	50°N, 157°W	8.3	4.6	32.6	33.4	88.0	54.0	20.0	17.0	1.0	4.0	184.0
			Central Gulf of Alaska - Subarctic Current											
1995	6-7 July	2	51°-53°N, 145°W	10.4	4.8	32.5	33.1	24.5	78.5	27.0	12.0	1.0	7.5	150.5
1994	2-5 July	4	50°N-53°N, 145°W	10.7	5.9	32.5	32.9	15.3	30.0	24.5	10.8	0.3	3.3	84.0
			Central Gulf of Alaska - Ridge/Dilute Domains											
1995	8-10 July	3	54°N-56°N, 145°W	11.0	5.2	32.4	32.8	41.7	88.7	44.7	15.3	0.3	3.0	193.7
1994	6-8 July	3	54°N-56°N, 145°W	11.5	5.5	32.3	33.1	67.3	15.7	38.0	13.7	0.0	1.3	136.0

Table 11. Mean fork length (mm) and body weight (g) of salmonids caught in the research-mesh gillnet (C-gear) during fishing operations of the *Wakatake maru*, 1991-1995.

		Sockeye			Chum			Pink			Coho			Chinook			Steelhead		
Year	Sampling Dates	N	Fork Length (mm)	Body Weight (g)	N	Fork Length (mm)	Body Weight (g)	N	Fork Length (mm)	Body Weight (g)	N	Fork Length (mm)	Body Weight (g)	N	Fork Length (mm)	Body Weight (g)	N	Fork Length (mm)	Body Weight (g)
Central North Pacific																			
1995	18-27 Jun	2	606	2950	111	478	1376	26	461	1095	104	529	1806	2	697	5000	24	603	2144
1994	18-27 Jun	4	449	1277	81	418	826	73	456	1027	121	523	1735	3	616	3150	37	578	2112
1993	17-28 Jun	0			296	410	779	8	429	738	67	517	1703	1	624	3700	17	635	2382
1992	17-25 Jun	0			107	403	784	3	455	917	103	505	1563	1	575	2300	6	652	2746
1991	12-21 Jun	2	315	295	113	417	819	23	423	793	197	521	1678	2	572	2625	19	584	2214
Bering Sea																			
1995	5-15 Jul	416	495	1564	702	491	1489	1919	469	1291	6	601	2875	71	486	1598	0		
1994	5-15 Jul	554	423	919	2281	461	1138	143	444	1055	0			56	523	2322	0		
1993	6-16 Jul	637	419	907	1223	481	1343	1434	449	1106	9	556	2166	15	592	3015	0		
1992	4-14 Jul	247	435	1125	2821	432	777	100	451	1153	3	568	2450	59	503	1916	0		
1991	1-8 Jul	183	401	1033	423	537	1973	1315	447	1108	0			78	419	1083	0		

Table 12. Ocean age composition (%) and mean fork length (mm), body weight (g), and standard deviation (sd) of sockeye salmon caught in the research-mesh gillnet (C-gear) during fishing operations of the *Wakatake maru*, 1991-1994.

Sampling		Ocean Age .1						Ocean Age .2						Ocean Age .3						Ocean Age .4					
Year	Dates	N	% Age	Fork length (mm) mean	Fork length (mm) sd	Body weight (g) mean	Body weight (g) sd	N	% Age	Fork length (mm) mean	Fork length (mm) sd	Body weight (g) mean	Body weight (g) sd	N	% Age	Fork length (mm) mean	Fork length (mm) sd	Body weight (g) mean	Body weight (g) sd	N	% Age	Fork length (mm) mean	Fork length (mm) sd	Body weight (g) mean	Body weight (g) sd
Central North Pacific - Subarctic Current (44°N-46°N, 180°)																									
1994	25-27 Jun	2	50	365	49	464	91	1	25	452		980		1	25	615		3200							
1993	26-28 Jun	0						0						0											
1992	23-25 Jun	0						0						0											
1991	20-21 Jun	2	100	315	5	295	7	0						0											
Bering Sea (55°N-58°N, 177°W-177°E)																									
1994	5-15 Jul	133	37	430	26	404	97	209	57	474	30	1189	255	23	6	583	38	2643	651	0					
1993	6-16 Jul	297	52	351	25	430	101	246	43	483	36	1301	329	31	5	571	44	2423	773	2	0	628	20	3275	601
1992	4-14 Jul	92	39	337	31	392	105	126	54	483	31	1364	324	16	7	584	46	2929	803	1	0	650		4500	
1991	1-8 Jul	101	59	313	21	332	70	38	22	480	39	1335	477	30	18	595	44	2851	781	2	1	653	33	4225	460

Table 13. Ocean age composition (%) and mean fork length (mm), body weight (g), and standard deviation (sd) of sockeye salmon caught in the research-mesh gillnet (C-gear) during fishing operations of the *Oshoro maru*, 1994-1995.

		Ocean Age .1						Ocean Age .2						Ocean Age .3						Ocean Age .4					
	Sampling	No.	%	Fork length		Body Weight		No.	%	Fork length		Body Weight		No.	%	Fork length		Body Weight		No.	%	Fork length		Body Weight	
Year	Dates	Fish	Age	Mean	sd	Mean	sd	Fish	Age	Mean	sd	Mean	sd	Fish	Age	Mean	sd	Mean	sd	Fish	Age	Mean	sd	Mean	sd
Western Gulf of Alaska - Subarctic Current (50°N, 157°-161°W)																									
1995	26-28 June	22	33	365	41	557	183	41	62	460	26	1146	246	3	5	565	44	2103	645	0					
1994	28-Jun	71	86	341	23	449	97	11	13	467	40	1248	439	1	1	630		3500		0					
Central Gulf of Alaska - Subarctic Current (50°N-53°N, 145°W)																									
1995	6-7 July	11	26	375	31	658	178	24	57	541	47	2175	575	7	17	607	67	3121	524	0					
1994	2-5 July	5	10	358	14	556	46	44	85	551	38	2414	463	3	5	563	55	2413	890	0					
Central Gulf of Alaska - Ridge/Dilute Domains (54°N-56°N, 145°W)																									
1995	8-10 July	21	17	345	22	486	101	53	43	544	47	2038	566	43	40	606	34	2863	541	0					
1994	6-8 July	12	7	344	27	486	106	124	72	555	39	2204	443	34	20	607	32	2807	493	1	1	650		2750	

Table 14. Ocean age composition (%) and mean fork length (mm), body weight (g), and standard deviation (sd) of chum salmon caught in the research-mesh gillnet (C-gear) during fishing operations of the *Wakatake maru*, 1991-1994.

Sampling		Ocean Age .1						Ocean Age .2						Ocean Age .3						Ocean Age .4						Ocean Age .5					
			%	Fork length (mm)		Body weight (g)			%	Fork length (mm)		Body weight (g)			%	Fork length (mm)		Body weight (g)			%	Fork length (mm)		Body weight (g)			%	Fork length (mm)		Body weight (g)	
Year	Dates	N	Age	mean	sd	mean	sd	N	Age	mean	sd	mean	sd	N	Age	mean	sd	mean	sd	N	Age	mean	sd	mean	sd	N	Age	mean	sd	mean	sd
Central North Pacific - Transition Domain (41°N-45°N, 180°)																															
1994	21-24 Jun	5	15	334	9	408	23	22	67	422	29	831	192	6	18	480	32	1202	207	0	0										
1993	23-25 Jun	4	8	326	9	355	13	37	79	425	16	841	126	6	13	479	26	1255	252	0	0										
1992	21-22 Jun	1	3	362		520		24	83	418	12	846	143	3	10	470	21	1207	172	1	4	542		1800							
1991	15-19 Jun	9	19	309	13	271	41	34	71	413	25	757	166	5	10	525	65	1804	803	0	0										
Central North Pacific - Subarctic Current (44°N-47°N, 180°)																															
1994	43	10	23	341	21	419	72	22	51	414	27	780	209	10	23	482	26	1221	281	1	3	488		1220							
1993	151	56	37	338	19	385	98	83	55	419	24	784	140	11	7	501	31	1577	554	1	1	494		1570							
1992	35	11	31	309	6	291	30	21	60	422	21	797	163	3	9	488	4	1340	260	0											
1991	57	2	3	344	25	430	85	47	83	421	25	804	164	8	14	491	40	1343	304	0											
Central North Pacific - Ridge Domain (47°N, 180)																															
1992	38	18	47	316	8	289	24	12	32	436	24	931	195	6	16	491	19	1338	195	2	5	594	54	2600	424						
Bering Sea (55°N-58°N, 177°E-177°W)																															
1994	1871	328	18	356	22	438	102	582	31	437	32	887	226	824	44	510	35	1484	342	133	7	562	47	2126	654	4	0	573	61	2330	605
1993	1064	78	7	368	20	488	90	544	51	442	29	942	223	352	33	535	42	1835	518	83	8	588	56	2564	885	7	1	594	40	2617	647
1992	2571	928	36	350	22	204	220	857	33	429	32	583	472	629	25	514	40	1409	743	154	6	586	46	2528	767	3	0	600	72	3017	1158
1991	380	2	1	363	11	450	14	112	29	449	34	995	272	167	44	556	39	2071	504	82	22	604	45	2844	703	17	4	613	27	3119	466

Table 15. Ocean age composition (%) and mean fork length (mm), body weight (g), and standard deviation (sd) of chum salmon caught in the research-mesh gillnet (C-gear) during fishing operations of the *Oshoro maru*, 1994-1995.

		Ocean Age .1						Ocean Age .2						Ocean Age .3						Ocean Age .4					
	Sampling	No.	%	Fork length		Body weight		No.	%	Fork length		Body weight		No.	%	Fork length		Body weight		No.	%	Fork length		Body weight	
Year	Dates	Fish	Age	Mean	sd	Mean	sd	Fish	Age	Mean	sd	Mean	sd	Fish	Age	Mean	sd	Mean	sd	Fish	Age	Mean	sd	Mean	sd
Central North Pacific - Transition Domain (42°-44°N, 180°)																									
1995	14-16 June	0						0						0						0					
1994	14-15 June	6	14	334	16	472	89	28	67	412	27	809	172	8	19	454	22	1045	209	0					
Central North Pacific - Subarctic Current (45°-47°N, 180°)																									
1995	17-19 June	20	65	316	10	320	37	3	10	428	7	873	136	7	23	492	56	1166	350	0					
1994	17-18 June	24	56	316	23	362	90	18	42	406	24	733	132	1	2	472		1100		0					
Western Gulf of Alaska - Subarctic Current (50°N, 157°-161°W)																									
1995	26-28 June	1	2	334		380		35	71	439	30	910	211	13	27	470	44	1177	251	0					
1994	29-Jun	2	4	360	14	530	14	34	68	440	26	959	206	13	27	483	24	1245	252	1	2	562		1900	
Central Gulf of Alaska - Subarctic Current (50°-53°N, 145°W)																									
1995	6-7 July	1	1	402		640		126	91	475	30	1314	266	11	8	518	24	1688	365	0					
1994	2-5 July	50	50	386	14	657	96	43	42	459	30	1138	257	8	8	484	37	1356	310	0					
Central Gulf of Alaska - Ridge/Dilute Domains (54°-56°N, 145°W)																									
1995	8-10 July	35	14	437	111	799	232	180	74	493	31	1386	254	28	11	531	27	1759	333	1	1	528		1540	
1994	6-8 July	22	55	399	17	782	159	17	43	477	31	1376	361	1	2	520		2320		0					

Table 16. Ocean age composition (%) and mean fork length (mm), body weight (g), and standard deviation (sd) of pink salmon caught in the research-mesh gillnet (C-gear) during fishing operations of the *Wakatake maru*, 1991-1994.

		Ocean Age .1					
	Sampling		% at	Fork length (mm)		Body weight (g)	
Year	Dates	N	Age	mean	sd	mean	sd
Central North Pacific - Transition Domain (41°N-45°N, 180°)							
1994	21-24 Jun	7	100	469	38	1063	265
1993	23-25 Jun	0					
1992	21-22 Jun	0					
1991	15-19 Jun	2	100	431	21	860	198
Central North Pacific - Subarctic Current (44°N-47°N, 180°)							
1994	25-27 Jun	66	100	455	28	1023	210
1993	26-28 Jun	8	100	429	21	738	134
1992	23-25 Jun	2	100	458	0	920	57
1991	20-21 Jun	21	100	423	35	787	252
Central North Pacific - Ridge Domain (47°N, 180°)							
1992	26-Jun	1	100	450		910	
Bering Sea (55°N-58°N, 177°E-177°W)							
1994	5-15 Jul	143	100	444	30	1055	262
1993	6-16 Jul	1434	100	449	27	1106	240
1992	4-14 Jul	100	100	451	27	1153	255
1991	1-8 Jul	1315	100	447	41	1108	362

Table 17. Ocean age composition (%) and mean fork length (mm), body weight (g), and standard deviation (sd) of pink salmon caught in the research-mesh gillnet (C-gear) during fishing operations of the *Oshoro maru*, 1994-1995.

		Ocean Age .1					
	Sampling	No.	%	Fork length		Body weight	
Year	Dates	Fish	Age	Mean	sd	Mean	sd
Central North Pacific - Subarctic Current (45°-47°N, 180°)							
1995	17-19 June	44	100	410	28	732	141
1994	17-18 June	38	100	427	23	839	144
Western Gulf of Alaska - Subarctic Current (50°N, 157°-161°W)							
1995	26-28 June	32	100	471	31	1174	231
1994	29-June	20	100	463	34	1256	347
Central Gulf of Alaska - Subarctic Current (50°-53°N, 145°W)							
1995	6-7 July	55	100	489	27	1483	379
1994	2-5 July	99	100	492	24	1699	388
Central Gulf of Alaska - Ridge/Dilute Domains (54°-56°N, 145°W)							
1995	8-10 July	134	100	479	32	1276	349
1994	6-8 July	115	100	477	28	1332	375

Table 18. Ocean age composition (%) and mean fork length (mm), body weight (g), and standard deviation (sd) of coho salmon caught in the research-mesh gillnet (C-gear) during fishing operations of the *Wakatake maru*, 1991-1994.

Sampling			Ocean Age .1				
			%	Fork length (mm)		Body Weight (g)	
Year	Dates	N	Age	mean	sd	mean	sd
Central North Pacific - Transition Domain (41°N-44°N, 180°)							
1994	21-24 Jun	43	100	516	39	1563	414
1993	23-25 Jun	18	100	506	58	1562	472
1992	21-22 Jun	11	100	512	55	1678	486
1991	15-19 Jun	146	100	519	38	1611	343
Central North Pacific — Subarctic Current (44°N-47°N, 180°)							
1994	25-27 Jun	78	100	527	39	1829	415
1993	26-28 Jun	49	100	521	48	1755	512
1992	23-25 Jun	58	100	503	31	1514	340
1991	20-21 Jun	49	100	526	39	1821	419
Central North Pacific - Ridge Domain (47°N, 180°)							
1992	26-Jun	34	100	507	39	1611	367
Bering Sea (55°N-58°N, 177°E-177°W)							
1994	5-15 Jul	0					
1993	6-16 Jul	9	100	556	33	2166	581
1992	4-14 Jul	3	100	568	37	2450	492
1991	1-8 Jul	0					

Table 19. Ocean age composition (%) and mean fork length (mm), body weight (g), and standard deviation (sd) of coho salmon caught in the research-mesh gillnet (C-gear) during fishing operations of the *Oshoro maru*, 1994-1995.

		Ocean Age .1					
	Sampling	No.	%	Fork length		Body weight	
Year	Dates	Fish	Age	Mean	sd	Mean	sd
Central North Pacific - Transition Domain (42°-44°N, 180°)							
1995	14-16 June	0					
1994	14-15 June	76	100	522	40	1759	420
Central North Pacific - Subarctic Current (45°-47°N, 180°)							
1995	17-19 June	77	100	520	41	1780	417
1994	17-18 June	33	100	529	4	1880	465
Western Gulf of Alaska - Subarctic Current (50°N, 157°-161°W)							
1995	26-28 June	5	100	561	45	2354	679
1994	29-June	17	100	610	48	3324	539
Central Gulf of Alaska - Subarctic Current (50°-53°N, 145°W)							
1995	6-7 July	22	100	571	51	2668	755
1994	2-5 July	45	100	593	54	2998	928
Central Gulf of Alaska - Ridge/Dilute Domains (54°-56°N, 145°W)							
1995	8-10 July	43	100	581	39	2626	552
1994	6-8 July	42	100	611	45	3045	683

Table 20. Ocean age composition (%) and mean fork length (mm), body weight (g), and standard deviation (sd) of chinook salmon caught in the research-mesh gillnet (C-gear) during fishing operations of the *Wakatake maru*, 1991-1994.

	Sampling	Ocean Age .1						Ocean Age .2						Ocean Age .3						Ocean Age .4					
			%	Fork length (mm)		Body weight (g)			%	Fork length (mm)		Body weight (g)			%	Fork length (mm)		Body weight (g)			%	Fork length (mm)		Body weight (g)	
Year	Dates	N	Age	mean	sd	mean	sd	N	Age	mean	sd	mean	sd	N	Age	mean	sd	mean	sd	N	Age	mean	sd	mean	sd
Central North Pacific - Subarctic Current																									
(44°N-47°N, 180°)																									
1994	25-27 Jun	0						3	100	616	33	3150	477	0						0					
1993	26-28 Jun	0						1	100	624		3700		0						0					
1992	23-26 Jun	0						1	100	575		2300		0						0					
1991	20-21 Jun	0						2	100	572	82	2625	926	0						0					
Central North Pacific - Ridge Domain																									
(47°N, 180°)																									
1992	26-Jun	0						0						0						0					
Bering Sea																									
1994	5-15 Jul	25	47	374	31	595	210	11	21	543	57	2179	740	17	32	720	41	4855	1129	0					
1993	6-16 Jul	1	8	352		480		7	59	573	25	2340	314	3	25	716	95	4710	2175	1	8	862		8600	
1992	4-14 Jul	17	36	356	27	525	116	23	49	567	47	2333	709	6	13	654	27	3822	648	1	2	850		7650	
1991	1-8 Jul	45	66	345	26	497	120	21	31	530	57	1816	634	2	3	715	18	4050	71	0					

Table 21. Ocean age composition (%) and mean fork length (mm), body weight (g), and standard deviation (sd) of chinook salmon caught in the research-mesh gillnet (C-gear) during fishing operations of the *Oshoro maru*, 1994-1995.

		Ocean Age .2					
	Sampling	No.	%	Fork length		Body weight	
Year	Dates	Fish	Age	Mean	sd	Mean	sd
Central North Pacific - Subarctic Current (45°-47°N, 180°)							
1995	17-19 June	0					
1994	17-18 June	1	100	680		4150	
Central Gulf of Alaska - All Areas (50°-56°N, 145°W)							
1995	6-10 July	3	100	635	23	3667	513
1994	2-8 July	0					

Table 22. Ocean age composition (%) and mean fork length (mm), body weight (g), and standard deviation (sd) of steelhead trout caught in the research-mesh gillnet (C-gear) during fishing operations of the *Wakatake maru*, 1991-1994.

Sample		Ocean Age .1						Ocean Age .2					
			%	Fork length (mm)		Body weight (g)			%	Fork length (mm)		Body weight (g)	
Year	Dates	N	Age	mean	sd	mean	sd	N	Age	mean	sd	mean	sd
Central North Pacific - Transition Domain (41°N-45°N, 180°)													
1994	21-24 Jun	9	100	564	16	1812	189	0					
1993	23-25 Jun	1	50	540		1520		1	50	656		2650	
1992	21-22 Jun	0						1	100	718		4000	
1991	15-19 Jun	8	73	542	49	1608	434	3	27	741	24	4533	797
Central North Pacific - Subarctic Current (44°N-47°N, 180°)													
1994	25-27 Jun	21	84	551	44	1850	231	4	16	692	61	3538	1090
1993	26-28 Jun	4	40	563	24	1695	93	6	60	688	70	2975	424
1992	23-25 Jun	0						3	100	663	49	2867	568
1991	20-21 Jun	2	75	522	60	1315	403	1	25	710		3800	
Central North Pacific - Ridge Domain (47°N, 180°)													
1992	26-Jun	1	50	548		1530		1	50	658		2350	

Table 23. Ocean age composition (%) and mean fork length (mm), body weight (g), and standard deviation (sd) of steelhead trout caught in the research-mesh gillnet (C-gear) during fishing operations of the *Oshoro maru*, 1994-1995.

		Ocean Age .0						Ocean Age .1						Ocean Age .2						Ocean Age .3					
	Sampling	No.	%	Fork length		Body weight		No.	%	Fork length		Body weight		No.	%	Fork length		Body weight		No.	% at	Fork length		Body weight	
Year	Dates	Fish	Age	Mean	sd	Mean	sd	Fish	Age	Mean	sd	Mean	sd	Fish	Age	Mean	sd	Mean	sd	Fish	Age	Mean	sd	Mean	sd
Central North Pacific - Subarctic Current (45°-47°N, 180°)																									
1995	17-19 June	0						3	60	566	26	1733	321	2	40	676	25	3150	3040	0					
1994	17-18 June	0						6	86	524	22	1547	232	1	14	664		3200		0					
Western Gulf of Alaska - Subarctic Current (50°N, 157°-161°W)																									
1995	26-28 June	0						4	50	558	18	1680	123	4	50	712	60	3112	435	0					
1994	29-Jun	0						0						4	100	639	72	2860	662	0					
Central Gulf of Alaska - Subarctic Current (50°-53°N, 145°W)																									
1995	6-7 July	4	27	338	55	418	200	9	60	541	35	1596	307	2	13	698	40	3500	212	0					
1994	2-5 July	11	100	329	28	391	116	0						0						0					
Central Gulf of Alaska - Ridge/Dilute Domains (54°-56°N, 145°W)																									
1995	8-10 July	3	33	303	10	327	31	4	45	557	20	2125	402	0						2	22	722	67	4625	2934
1994	6-8 July	2	100	348	74	430	184	0						0						0					

Table 24. Mean percent composition of stomach contents of sockeye salmon caught during fishing operations of the *Wakatake maru* in 1995 and summarized by oceanographic regions. % empty= percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI = prey weight X 100/body weight. EU=euphausiids, CO=copepods, AM=amphipods, DE=decapods, SQ=squids, PT=pteropods (shelled and naked), FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton, including coelenterates, ctenophores, and salps, Other= rare groups that may include mysids, heteropods, and cladocera, Unid=unidentified material.

Year	N	% Empty	Mean Prey Weight (g)	Mean SCI	Mean % composition by weight											
					EU	CO	AM	DE	SQ	PT	FI	PO	CH	GE	Other	Unid
Central North Pacific - Ridge Domain (48°N-49°N, 180°)																
1995	8	0	25	1.09	0	29	22	0	46	0	2	0	1	0	0	0
Central North Pacific - Alaska Stream (50°N-51°N, 180°)																
1995	21	0	25	0.99	68	5	5	0	4	8	2	1	2	6	0	0
Bering Sea (52°N-58°N, 180° & 177°E-177°W)																
1995	144	1	10	0.67	14	4	42	3	18	9	9	0	0	1	0	0

Table 25. Mean percent composition of stomach contents of chum salmon caught during fishing operations of the *Wakatake maru* in 1995 and summarized by oceanographic regions. % empty= percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI = prey weight X 100/body weight. EU=euphausiids, CO=copepods, AM=amphipods, DE=decapods, SQ=squids, PT=pteropods (shelled and naked), FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton, including coelenterates, ctenophores, and salps, Other= rare groups that may include mysids, heteropods, and cladocera, Unid=unidentified material.

			Mean Prey	Mean	Mean % composition by weight											
Year	N	% Empty	Weight (g)	SCI	EU	CO	AM	DE	SQ	PT	FI	PO	CH	GE	Oth	Unid
Central North Pacific - Transition Domain (42°N-44°N, 180°)																
1995	7	0	9	0.85	0	3	0	0	0	0	24	0	7	63	3	0
Central North Pacific - Subarctic Current (45°N-47°N, 180°)																
1995	41	0	8	0.70	32	2	4	0	4	4	0	1	2	49	1	2
Central North Pacific - Ridge Domain (48°N-49°N, 180°)																
1995	29	0	11	0.95	46	3	14	0	2	2	2	0	10	18	0	3
Central North Pacific - Alaska Stream (50°N-51°N, 180°)																
1995	28	4	12	0.91	41	0	1	0	3	13	1	15	0	27	0	0
Bering Sea (52°N-58°N, 180°, 177°E-177°W)																
1995	216	2	14	1.01	29	1	9	1	6	8	20	0	0	23	0	3

Table 26. Mean percent composition of stomach contents of pink salmon caught during fishing operations of the *Wakatake maru* in 1995 and summarized by oceanographic regions. % empty= percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI = prey weight X 100/body weight. EU=euphausiids, CO=copepods, AM=amphipods, DE=decapods, SQ=squids, PT=pteropods (shelled and naked), FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton, including coelenterates, ctenophores, and salps, Other= rare groups that may include mysids, heteropods, and cladocera, Unid=unidentified material.

			Mean Prey	Mean	Mean % composition by weight											
Year	N	% Empty	Weight (g)	SCI	EU	CO	AM	DE	SQ	PT	FI	PO	CH	GE	Other	Unid
Central North Pacific - Transition Domain (42°N-44°N, 180°)																
1995	3	0	17	1.83	0	3	5	0	2	0	20	0	43	0	27	0
Central North Pacific - Subarctic Current (45°N-47°N, 180°)																
1995	5	40	5	0.50	0	18	11	0	60	1	7	3	0	0	0	0
Central North Pacific - Ridge Domain (48°N-49°N, 180°)																
1995	22	5	17	1.71	1	34	23	0	26	4	7	0	5	0	0	0
Central North Pacific - Alaska Stream (50°N-51°N, 180°)																
1995	14	0	17	1.44	52	0	7	0	8	17	15	1	0	0	0	0
Bering Sea (52°N-58°N, 180° & 177°E-177°W)																
1995	186	0	15	1.19	16	8	15	3	24	11	24	0	0	0	0	0

Table 27. Mean percent composition of stomach contents of coho salmon caught during fishing operations of the *Wakatake maru* in 1995 and summarized by oceanographic regions. % empty= percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI = prey weight X 100/body weight. EU=euphausiids, CO=copepods, AM=amphipods, DE=decapods, SQ=squids, PT=pteropods (shelled and naked), FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton, including coelenterates, ctenophores, and salps, Other= rare groups that may include mysids, heteropods, and cladocera, Unid=unidentified material.

			Mean Prey	Mean	Mean % composition by weight											
Year	N	% Empty	Weight (g)	SCI	EU	CO	AM	DE	SQ	PT	FI	PO	CH	GE	Other	Unid
Central North Pacific- Transition Domain (42°N-44°N, 180°)																
1995	15	7	25	1.38	0	0	3	0	65	2	31	0	0	0	0	0
Central North Pacific- Subarctic Current (45°N-47°N, 180°)																
1995	41	2	51	3.00	0	0	0	0	99	0	1	0	0	0	0	0
Central North Pacific- Ridge Domain (48°N-49°N, 180°)																
1995	4	0	68	3.71	0	0	0	0	100	0	0	0	0	0	0	0
Central North Pacific- Alaska Current (50°N-51°N, 180°)																
1995	1	0	47	2.47	85	0	0	0	10	0	5	0	0	0	0	0

Table 28. Mean percent composition of stomach contents of chinook salmon caught during fishing operations of the *Wakatake maru* in 1995 and summarized by oceanographic regions. % empty= percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI = prey weight X 100/body weight. EU=euphausiids, CO=copepods, AM=amphipods, DE=decapods, SQ=squids, PT=pteropods (shelled and naked), FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton, including coelenterates, ctenophores, and salps, Other= rare groups that may include mysids, heteropods, and cladocera, Unid=unidentified material.

			Mean Prey	Mean	Mean % composition by weight											
Year	N	% Empty	Weight (g)	SCI	EU	CO	AM	DE	SQ	PT	FI	PO	CH	GE	Other	Unid
Central North Pacific - Ridge Domain (48°N-49°N, 180°)																
1995	2	0	39	1.21	0	0	0	0	100	0	0	0	0	0	0	0
Central North Pacific -Alaska Stream (50°N-51°N, 180°)																
1995	1	0	43	0.95	0	0	0	0	100	0	0	0	0	0	0	0
Bering Sea (52°N-58°N, 180° & 177°E-177°W)																
1995	44	16	10	0.63	16	0	0	0	55	0	29	0	0	0	0	0

Table 29. Mean percent composition of stomach contents of steelhead trout caught during fishing operations of the *Wakatake maru* in 1995 and summarized by oceanographic regions. % empty= percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI = prey weight X 100/body weight. EU=euphausiids, CO=copepods, AM=amphipods, DE=decapods, SQ=squids, PT=pteropods (shelled and naked), FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton, including coelenterates, ctenophores, and salps, Other= rare groups that may include mysids, heteropods, and cladocera, Unid=unidentified material.

			Mean Prey	Mean	Mean % composition by weight											
Year	N	% Empty	Weight (g)	SCI	EU	CO	AM	DE	SQ	PT	FI	PO	CH	GE	Other	Unid
Central North Pacific - Transition Domain (42°N-44°N, 180°)																
1995	1	0	5	0.27	0	0	0	0	0	5	95	0	0	0	0	0
Central North Pacific - Subarctic Current (45°N-47°N, 180°)																
1995	8	38	10	0.49	1	0	2	12	20	0	65	0	0	0	0	0
Central North Pacific - Ridge Domain (48°N-49°N, 180°)																
1995	1	0	194	3.88	0	0	0	0	90	0	10	0	0	0	0	0

Table 30. Mean percent composition of stomach contents of sockeye salmon caught during fishing operations of the *Oshoro maru* in 1994 and 1995 and summarized by oceanographic regions. % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=prey weight X 100/body weight. EU=euphausiids, CO=copepods, AM=amphipods, DE=decapods, SQ=squids, PT=pteropods (shelled and naked), FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton, including coelenterates, ctenophores, and salps, Other=rare groups that may include mysids, heterpods, and cladocera, Unid=Unidentified material.

			Mean Prey	Mean	Mean % composition by weight											
Year	N	% Empty	Weight	SCI	EU	CO	AM	DE	SQ	PT	FI	PO	CH	GE	Other	Unid
Western Gulf of Alaska - Subarctic Current (50°N, 157°-161°W)																
1995	32	28	3	0.24	19	32	16	0	20	5	0	0	0	0	0	9
1994	11	36	72	4.33	0	0	0	0	99	0	1	0	0	0	0	0
Central Gulf of Alaska - Subarctic Current (50°-53°N, 145°W)																
1995	28	29	40	1.68	0	0	1	0	99	0	1	0	0	0	0	0
1994	47	9	35	1.54	0	0	1	0	99	0	0	0	0	0	0	0
Central Gulf of Alaska - Ridge/Dilute Domains (54°-56°N, 145°W)																
1995	48	65	11	0.52	4	2	0	0	86	5	2	0	0	0	0	2
1994	58	31	7	0.44	20	8	24	0	31	11	3	0	0	0	1	3

Table 31. Mean percent composition of stomach contents of chum salmon caught during fishing operations of the *Oshoro maru* in 1994 and 1995 and summarized by oceanographic regions. % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=prey weight X 100/body weight. EU=euphausiids, CO=copepods, AM=amphipods, DE=decapods, SQ=squids, PT=pteropods (shelled and naked), FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton, including coelenterates, ctenophores, and salps, Other=rare groups that may include mysids, heterpods, and cladocera, Unid=Unidentified material.

			Mean Prey	Mean	Mean % composition by weight											
Year	N	% Empty	Weight	SCI	EU	CO	AM	DE	SQ	PT	FI	PO	CH	GE	Other	Unid
Western Gulf of Alaska - Subarctic Current (50°N, 157°-161°W)																
1995	29	31	4	0.42	0	5	13	0	3	0	0	1	0	1	2	74
1994	16	44	1	0.13	0	0	0	0	0	70	22	0	0	0	0	9
Central Gulf of Alaska - Subarctic Current (50°-53°N, 145°W)																
1995	23	13	12	0.73	0	0	1	0	0	0	0	0	0	9	0	90
1994	57	35	3	0.30	0	0	7	0	1	42	0	2	0	0	2	48
Central Gulf of Alaska - Ridge/Dilute Domains (54°-56°N, 145°W)																
1995	57	58	6	0.48	21	0	2	0	0	8	4	14	0	0	0	50
1994	58	14	5	0.36	5	0	32	0	0	18	0	1	0	2	2	40

Table 32. Mean percent composition of stomach contents of pink salmon caught during fishing operations of the *Oshoro maru* in 1994 and 1995 and summarized by oceanographic regions. % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=prey weight X 100/body weight. EU=euphausiids, CO=copepods, AM=amphipods, DE=decapods, SQ=squids, PT=pteropods (shelled and naked), FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton, including coelenterates, ctenophores, and salps, Other=rare groups that may include mysids, heterpods, and cladocera, Unid=Unidentified material.

			Mean Prey	Mean	Mean % composition by weight											
Year	N	% Empty	Weight	SCI	EU	CO	AM	DE	SQ	PT	FI	PO	CH	GE	Other	Unid
Western Gulf of Alaska - Subarctic Current (50°N, 157°-161°W)																
1995	30	7	11	0.89	0	79	6	0	2	0	0	0	0	0	0	13
1994	15	20	44	2.83	0	0	0	0	98	0	1	0	0	0	0	0
Central Gulf of Alaska - Subarctic Current (50°-53°N, 145°W)																
1995	26	46	5	0.36	1	0	6	0	67	13	0	0	0	0	9	4
1994	37	30	18	1.05	0	0	2	0	89	7	0	0	0	0	0	2
Central Gulf of Alaska - Ridge/Dilute Domains (54°-56°N, 145°W)																
1995	52	52	9	0.68	37	8	3	0	25	19	1	0	0	0	0	6
1994	65	29	4	0.30	1	29	23	0	16	18	7	0	0	0	0	4

Table 33. Mean percent composition of stomach contents of coho salmon caught during fishing operations of the *Oshoro maru* in 1994 and 1995 and summarized by oceanographic regions. % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=prey weight X 100/body weight. EU=euphausiids, CO=copepods, AM=amphipods, DE=decapods, SQ=squids, PT=pteropods (shelled and naked), FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton, including coelenterates, ctenophores, and salps, Other=rare groups that may include mysids, heterpods, and cladocera, Unid=Unidentified material.

			Mean Prey	Mean	Mean % composition by weight											
Year	N	% Empty	Weight	SCI	EU	CO	AM	DE	SQ	PT	FI	PO	CH	GE	Other	Unid
Western Gulf of Alaska - Subarctic Current (50°N, 157°-161°W)																
1995	10	50	12	0.52	0	0	0	0	96	0	0	0	0	0	0	4
1994	12	8	48	2.29	0	0	0	0	99	0	0	0	0	0	0	1
Central Gulf of Alaska - Subarctic Current (50°-53°N, 145°W)																
1995	33	48	34	1.53	0	0	0	0	99	0	1	0	0	0	0	0
1994	34	9	71	2.57	0	0	0	0	100	0	0	0	0	0	0	0
Central Gulf of Alaska - Ridge/Dilute Domains (54°-56°N, 145°W)																
1995	51	53	16	0.62	10	0	0	0	87	0	3	0	0	0	0	0
1994	57	51	7	0.23	2	0	5	0	78	8	6	0	0	0	0	0

Table 34. Mean percent composition of stomach contents of chinook salmon caught during fishing operations of the *Oshoro maru* in 1994 and 1995 and summarized by oceanographic regions. % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=prey weight X 100/body weight. EU=euphausiids, CO=copepods, AM=amphipods, DE=decapods, SQ=squids, PT=pteropods (shelled and naked), FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton, including coelenterates, ctenophores, and salps, Other=rare groups that may include mysids, heterpods, and cladocera, Unid=Unidentified material.

			Mean Prey	Mean	Mean % composition by weight											
Year	N	% Empty	Weight	SCI	EU	CO	AM	DE	SQ	PT	FI	PO	CH	GE	Other	Unid
Western Gulf of Alaska - Subarctic Current (50°N, 157°-161°W)																
1995	5	60	3	0.11	0	0	0	0	33	0	67	0	0	0	0	0
1994	2	50	52	1.74	0	0	0	0	100	0	0	0	0	0	0	0
Central Gulf of Alaska - Subarctic Current (50°-53°N, 145°W)																
1995	6	50	32	0.76	0	0	0	0	100	0	0	0	0	0	0	0
1994	9	11	48	1.18	0	0	0	0	95	0	0	0	0	0	0	5
Central Gulf of Alaska - Ridge/Dilute Domains (54°-56°N, 145°W)																
1995	1	100														
1994	0															

Table 35. Mean percent composition of stomach contents of steelhead trout caught during fishing operations of the *Oshoro maru* in 1994 and 1995 and summarized by oceanographic regions. % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=prey weight X 100/body weight. EU=euphausiids, CO=copepods, AM=amphipods, DE=decapods, SQ=squids, PT=pteropods (shelled and naked), FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton, including coelenterates, ctenophores, and salps, Other=rare groups that may include mysids, heterpods, and cladocera, Unid=Unidentified material.

			Mean Prey	Mean	Mean % composition by weight											
Year	N	% Empty	Weight	SCI	EU	CO	AM	DE	SQ	PT	FI	PO	CH	GE	Other	Unid
Western Gulf of Alaska - Subarctic Current (50°N, 157°-161°W)																
1995	10	30	11	0.50	0	1	1	0	29	0	61	0	0	0	5	3
1994	9	44	27	1.14	0	0	0	0	94	0	6	0	0	0	0	0
Central Gulf of Alaska - Subarctic Current (50°-53°N, 145°W)																
1995	37	27	18	1.15	0	0	1	0	93	0	4	1	0	0	1	0
1994	13	8	3	0.62	0	0	0	0	72	8	17	0	0	0	0	3
Central Gulf of Alaska - Ridge/Dilute Domains (54°-56°N, 145°W)																
1995	22	27	6	0.25	0	0	0	0	61	2	24	13	0	0	1	0
1994	6	50	3	0.13	0	0	49	0	0	0	51	0	0	0	0	0

Table 36. Age composition of chum salmon in NMFS observer scale samples collected during the 1994 Bering Sea pollock B-season fishery (August 15 through October 8). n = sample size.

NMFS Stat. Area		Ocean Age Group 0.1	0.2	0.3	0.4	0.5	0.6	0.7	Total
509	n	0	4	52	25	3	0	0	84
			4.76%	61.90%	29.76%	3.57%			
513	n	0	18	116	59	2	0	0	195
			9.23%	59.49%	30.26%	1.03%			
517	n	1	89	863	327	18	4	1	1303
		0.08%	6.83%	66.23%	25.10%	1.38%	0.31%	0.08%	
518	n	0	0	1	1	0	0	0	2
				50.00%	50.00%				
519	n	0	12	107	40	5	0	0	164
			7.32%	65.24%	24.39%	3.05%			
521	n	0	39	178	46	4	0	0	267
			14.61%	66.67%	17.23%	1.50%			
541	n	3	12	6	3	0	0	0	24
		12.50%	50.00%	25.00%	12.50%				
Total	n	4	174	1323	501	32	4	1	2039
		0.20%	8.53%	64.88%	24.57%	1.57%	0.20%	0.05%	

Table 37. The number of chum salmon by age group, body area of scale collection (A=preferred area, B=adjacent to preferred area, C=other, and U=unidentified) NMFS statistical area, and month for NMFS observer samples from the 1994 B-season pollock fishery in the Bering Sea.

		Age 0.1					Age 0.2					Age 0.3						Age 0.4					Age 0.5					Age 0.6					Age 0.7					
Area	Month	A	B	C	U	*Total*	A	B	C	U	*Total*	A	B	C	U	*Total*	Useable	A	B	C	U	*Total*	A	B	C	U	*Total*	A	B	C	U	*Total*	A	B	C	U	*Total*	Grand Total
509	8					0	1				1	17		3		20	17	7	2	3		12	3				3					0					0	36
	9					0	2	1			3	30	2			32	32	10	3			13					0					0					0	48
	sum	0	0	0	0	0	3	1	0	0	4	47	2	3	0	52	49	17	5	3	0	25	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	84
513	8					0	7	1			8	37	10		1	48	47	20	4			24	1				1					0					0	81
	9					0	3	6			9	19	33		14	66	65	13	13	1	7	34					0					0					0	109
	10					0	1				1	1		1		2	1			1		1	1				1					0					0	5
	sum	0	0	0	0	0	11	7	0	0	18	57	43	1	15	116	113	33	17	2	7	59	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	195
517	8	1				1	18	5	2		25	168	51	2	4	225	207	60	31	5	5	101	5	3		1	9	1	1			2	1				1	364
	9					0	40	14	1	7	62	424	146	15	40	625	583	154	49	2	16	221	4	4		1	9	1			1	2					0	919
	10					0		1	1		2	7	1	3	1	12	9	3	1	1	1	6					0					0					0	20
	sum	1	0	0	0	1	58	20	4	7	89	599	198	20	45	862	799	217	81	8	22	328	9	7	0	2	18	2	1	0	1	4	1	0	0	0	1	1303
518	9					0					0	1				1	1	1				1					0					0					0	2
	sum	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
519	8					0	5				5	41	10		2	53	49	13	5		1	19	1				1					0					0	78
	9					0	4	2			6	32	2	7	2	43	35	14		2	1	17	1		1	1	3					0					0	69
	10					0	1				1	8	3			11	10	4				4	1				1					0					0	17
	sum	0	0	0	0	0	10	2	0	0	12	81	15	7	4	107	94	31	5	2	2	40	3	0	1	1	5	0	0	0	0	0	0	0	0	0	0	164
521	8					0	19	6	1	1	27	71	12	4	14	101	78	18	5	2	1	26	1	1			2					0					0	156
	9					0	4			8	12	33	24		20	77	71	7	6		7	20	1			1	2					0					0	111
	sum	0	0	0	0	0	23	6	1	9	39	104	36	4	34	178	149	25	11	2	8	46	2	1	0	1	4	0	0	0	0	0	0	0	0	0	0	267
541	9					0				3	3				1	1	1				1	1					0					0					0	5
	10	3				3	6	3			9	3	2			5	2	2				2					0					0					0	19
	sum	3	0	0	0	3	6	3	0	3	12	3	2	0	1	6	3	2	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24
Sum						4					174					1322	1208					502					32					4					1	2039

Table 38. Mean length, weight, and condition factor by NMFS statistical area, month, and age group for combined sexes of chum salmon in the NMFS observer scale samples collected during the 1994 B-season pollock fishery.

Stat. Area	Month	Age	N	Mean/SD	Length (cm)	Weight (kg)	Cond. Factor (g/cm3)
509	8	0.2	1		63.0	3.1	0.0124
509	8	0.3	20	Mean	58.3	2.7	0.0131
				Std. Dev.	5.5	0.8	0.0010
509	8	0.4	12	Mean	57.5	2.6	0.0129
				Std. Dev.	6.6	1.1	0.0013
509	8	0.5	3	Mean	64.7	3.3	0.0116
				Std. Dev.	10.3	1.7	0.0006
509	9	0.2	3	Mean	59.3	2.6	0.0126
				Std. Dev.	5.9	0.6	0.0009
509	9	0.3	32	Mean	64.1	3.6	0.0134
				Std. Dev.	6.5	1.1	0.0016
509	9	0.4	13	Mean	65.9	4.1	0.0139
				Std. Dev.	6.0	1.3	0.0022
513	8	0.2	8	Mean	54.6	2.3	0.0117
				Std. Dev.	3.6	0.3	0.0048
513	8	0.3	48	Mean	58.1	2.5	0.0127
				Std. Dev.	6.0	0.9	0.0019
513	8	0.4	24	Mean	61.3	3.3	0.0139
				Std. Dev.	6.6	1.3	0.0021
513	8	0.5	1		64.0	3.3	0.0126
513	9	0.2	9	Mean	57.6	2.5	0.0128
				Std. Dev.	5.8	0.6	0.0018
513	9	0.3	66	Mean	60.5	3.2	0.0141
				Std. Dev.	5.5	1.0	0.0026
513	9	0.4	34	Mean	62.3	3.5	0.0140
				Std. Dev.	6.3	1.2	0.0014
513	10	0.2	1		59.0	3.3	0.0161
513	10	0.3	2	Mean	60.0	3.1	0.0144
				Std. Dev.	1.4	0.1	0.0004
513	10	0.4	1		63.0	3.0	0.0120
513	10	0.5	1		51.0	1.4	0.0107
517	8	0.1	1		43.0	0.8	0.0101
517	8	0.2	25	Mean	52.2	1.9	0.0129
				Std. Dev.	4.8	0.7	0.0024
517	8	0.3	225	Mean	59.7	3.0	0.0136
				Std. Dev.	6.9	1.3	0.0024
517	8	0.4	101	Mean	62.7	3.5	0.0137
				Std. Dev.	8.7	1.7	0.0028
517	8	0.5	9	Mean	69.7	4.7	0.0141
				Std. Dev.	9.1	1.2	0.0034

Table 38. continued.

Stat. Area	Month	Age	N	Mean/SD	Length (cm)	Weight (kg)	Cond. Factor (g/cm3)
517	8	0.6	2	Mean	77.5	6.0	0.0129
				Std. Dev.	3.5	0.4	0.0009
517	8	0.7	1		70.0	6.3	0.0184
517	9	0.2	62	Mean	55.1	2.2	0.0126
				Std. Dev.	5.3	0.7	0.0021
517	9	0.3	625	Mean	60.5	3.0	0.0132
				Std. Dev.	6.8	1.2	0.0024
517	9	0.4	221	Mean	62.1	3.3	0.0133
				Std. Dev.	5.9	1.2	0.0021
517	9	0.5	9	Mean	68.6	4.7	0.0139
				Std. Dev.	7.5	1.7	0.0015
517	9	0.6	2	Mean	67.0	3.9	0.0131
				Std. Dev.	7.1	0.8	0.0016
517	10	0.2	2	Mean	59.5	3.0	0.0142
				Std. Dev.	9.2	1.0	0.0017
517	10	0.3	12	Mean	56.3	2.4	0.0133
				Std. Dev.	3.5	0.7	0.0016
517	10	0.4	6	Mean	60.8	3.0	0.0130
				Std. Dev.	5.5	1.1	0.0020
518	9	0.3	1		60.0	2.5	0.0116
518	9	0.4	1		71.0	5.4	0.0151
519	8	0.2	5	Mean	55.8	2.2	0.0125
				Std. Dev.	5.9	0.8	0.0020
519	8	0.3	53	Mean	58.3	2.6	0.0128
				Std. Dev.	5.0	0.9	0.0016
519	8	0.4	19	Mean	59.6	2.8	0.0128
				Std. Dev.	6.1	1.0	0.0016
519	8	0.5	1		61.0	3.2	0.0141
519	9	0.2	6	Mean	54.3	2.1	0.0127
				Std. Dev.	3.4	0.4	0.0014
519	9	0.3	43	Mean	59.8	3.0	0.0137
				Std. Dev.	5.7	1.0	0.0016
519	9	0.4	17	Mean	63.4	3.5	0.0136
				Std. Dev.	5.5	1.0	0.0010
519	9	0.5	3	Mean	61.3	3.3	0.0140
				Std. Dev.	5.7	0.8	0.0008
519	10	0.2	1		51.0	1.6	0.0121
519	10	0.3	11	Mean	55.6	2.2	0.0122
				Std. Dev.	4.5	0.7	0.0020
519	10	0.4	4	Mean	64.5	4.1	0.0152
				Std. Dev.	3.3	0.8	0.0008
519	10	0.5	1		57.0	2.5	0.0135

Table 38. continued.

Stat. Area	Month	Age	N	Mean/SD	Length (cm)	Weight (kg)	Cond. Factor (g/cm3)
521	8	0.2	27	Mean	50.3	1.6	0.0123
				Std. Dev.	4.5	0.5	0.0022
521	8	0.3	101	Mean	55.7	2.2	0.0125
				Std. Dev.	5.4	0.8	0.0020
521	8	0.4	26	Mean	60.7	2.9	0.0126
				Std. Dev.	6.7	1.0	0.0018
521	8	0.5	2	Mean	62.0	3.5	0.0141
				Std. Dev.	4.2	1.3	0.0027
521	9	0.2	12	Mean	51.3	2.3	0.0277
				Std. Dev.	11.5	1.6	0.0491
521	9	0.3	77	Mean	56.4	2.4	0.0128
				Std. Dev.	5.5	0.9	0.0021
521	9	0.4	20	Mean	59.1	2.6	0.0124
				Std. Dev.	5.9	0.9	0.0017
521	9	0.5	2	Mean	65.5	3.6	0.0124
				Std. Dev.	17.7	2.1	0.0024
541	9	0.3	3	Mean	45.0	1.2	0.0131
				Std. Dev.	2.6	0.3	0.0029
541	9	0.4	1		60.0	3.1	0.0139
541	9	0.5	1		63.0	3.1	0.0184
541	10	0.1	3	Mean	37.7	0.9	0.0168
				Std. Dev.	1.5	0.1	0.0168
541	10	0.2	9	Mean	46.9	1.3	0.0122
				Std. Dev.	4.0	0.3	0.0022
541	10	0.3	5	Mean	52.4	1.9	0.0129
				Std. Dev.	4.9	0.5	0.0026
541	10	0.4	2	Mean	55.5	2.35	0.0137
				Std. Dev.	2.1	0.4	0.0005

Table 39. Comparison of mean sizes of chum salmon caught in the 1993 and 1994 B-season pollock fishery in Bering Sea Area 517.

Date	Sex	Age	N	Length (cm)	Std. Dev.	P-value	Weight (kg)	Std. Dev.	P-value
Aug-94	Female	0.2	13	51.9	6.1	0.701	1.8	0.8	0.112
Aug-93			16	51.2	3.6		1.5	0.4	
Aug-94	Male	0.2	12	52.4 *	2.9	0.016	1.9 *	0.5	0.002
Aug-93			34	50.0	4.5		1.5	0.5	
Aug-94	Female	0.3	96	58.8 *	6.7	0.000	2.8 *	1.0	0.000
Aug-93			96	54.4	6.0		2.1	1.2	
Aug-94	Male	0.3	120	60.6 *	7.0	0.000	3.2 *	1.5	0.000
Aug-93			118	54.3	5.9		2.1	0.9	
Aug-94	Female	0.4	48	61.7 *	8.1	0.015	3.3 *	1.3	0.001
Aug-93			12	58.4	5.1		2.6	0.7	
Aug-94	Male	0.4	52	63.3	9.1	0.288	3.7	1.9	0.178
Aug-93			15	61.7	6.8		3.2	1.3	
Aug-94	Male	0.5	4	68.8	12.9	0.644	4.6	1.6	0.403
Aug-93			2	65.5	2.1		4.0	0.4	
Sep-94	Female	0.2	30	55.2 *	6.2	0.000	2.2 *	0.8	0.001
Sep-93			37	50.1	5.0		1.6	0.6	
Sep-94	Male	0.2	32	55.0 *	4.5	0.010	2.1 *	0.6	0.027
Sep-93			27	52.1	5.0		1.8	0.6	
Sep-94	Female	0.3	259	60.2 *	7.0	0.000	3.0 *	1.2	0.000
Sep-93			96	55.8	7.0		2.2	1.0	
Sep-94	Male	0.3	361	60.7 *	6.7	0.000	3.1 *	1.2	0.000
Sep-93			120	57.3	7.6		2.5	1.1	
Sep-94	Female	0.4	92	62.0	6.4	0.326	3.2	1.2	0.132
Sep-93			11	63.1	8.1		3.6	1.7	
Sep-94	Male	0.4	127	62.1	5.6	0.077	3.4	1.1	0.106
Sep-93			25	63.9	9.0		3.7	1.7	

* = statistically significant difference
(T-Test, a = .05).

Table 40. Comparison of mean sizes of chum salmon caught during research gillnet sampling aboard the *Oshoro maru* in the offshore waters of the Gulf of Alaska in July 1993 and 1994.

Date	Age	N	Length (cm)	Std. Dev.	P-value	Weight (kg)	Std. Dev.	P-Value
Jul-94	0.1	79	38.7 *	1.9		0.7 *	0.1	0.000
Jul-93		135	37.0	1.9	0.000	0.5	0.1	
Jul-94	0.2	156	45.6 *	3.2	0.000	1.1 *	0.3	0.000
Jul-93		237	43.2	3.1		0.9	0.2	
Jul-94	0.3	62	50.4 *	3.8	0.010	1.5 *	0.5	0.004
Jul-93		71	48.7	4.7		1.3	0.5	
Jul-94	0.4	3	58.3	8.9	0.741	2.6	1.2	0.946
Jul-93		5	59.9	6.1		2.6	0.8	

* = statistically significant difference
(T-Test, a=.05).

Table 41. Age composition of chum salmon determined from otoliths collected during the 1994 Bering Seas pollock B-season fishery (August 29 through October 8).

NMFS Stat. Area		Ocean Age Group 0.1	0.2	0.3	0.4	0.5	0.6	0.7	Total
509	n	0	1	7	0	0	0	0	8
			12.50%	87.50%					
513	n	0	2	22	2	0	0	0	26
			7.69%	84.62%	7.69%	0.00%			
517	n	4	62	201	19	3	0	0	289
		1.38%	21.45%	69.55%	6.57%	1.04%			
518	n	0	0	0	0	0	0	0	0
519	n	0	0	0	0	0	0	0	0
521	n	0	24	51	10	0	1	0	86
			27.91%	59.30%	11.63%		1.16%		
541	n	3	6	4	0	0	0	0	13
		23.08%	46.15%	30.77%					
Total	n	7	95	285	31	3	1	0	422
		1.66%	22.51%	67.54%	7.35%	0.71%	0.24%	0.00%	

Table 42. Stock composition of Fisheries Agency of Japan age 0.3 chum salmon scale baseline data.

Area	Stock	1972	1973	1981	1982	1986	1987
Japan							
	Gakko River	103	66	56	35	40	
	Tsugaruishi River	96		60	26	70	38
	Yubetsu River	65	148	59	23	58	21
	Nishibetsu River	81	99	108	29	78	47
	Tokachi River	172		63	47	55	69
	Yurappu River			89	28	44	63
	Ishikari River	304	99	80	55	40	72
Russia							
	Amur River (summer run)			75	64	75	20
	Amur River (fall run)					63	70
	Amur Liman	255	275	103	56		
	Nyyskiy Bay				16	38	42
	Kukhtui River	23	83	48	48	43	63
	Taui River				32	72	91
	North Okhotsk Sea	49	67				
	Bolshaya Germander River			51			
	Bolshaya River	109	73	73	22	38	75
	Kamchatka River		141	60	21	77	41
	Khaylyulya River			74	26	71	42
	Anadyr River			34	23	62	96
Alaska							
	Kotzebue Sound	80		56	37	11	13
	Norton Sound			49	60		
	Unalakleet			51	79	45	34
	Yukon River (summer run)	63		28	69	28	
	Yukon River (fall run)	40		65		75	81
	Kuskokwim	57		51	39	85	46
	Togiak River	205	103		52		
	Nushagak River	230	76		43		
	Herendeen Bay (N. Pen.)		94				
	Bristol Bay			62		71	30
	Shumagin Islands			68	44	87	
	Kukak Bay (S. Pen.)		119		61	76	23
	Kiliuda Bay (Kodiak)	85		113		83	44
	Afognak Island			31			
	Sturgeon River (Kodiak)			63			
	Olga Bay (Kodiak)		7				
	Uyak Bay (Kodiak)		8				
	Cook Inlet	217	214	86	78	87	37
	Prince William Sound			127	68	65	65
	Taku Inlet			30	36	50	
	Lynn Canal			44	62	55	
	Excursion Inlet			8		51	71
	Point Sophia			9			
	Tenekee Inlet				75		
	Petersburg						75
	Ketchikan					68	65

Table 42. continued

Area Stock	1972	1973	1981	1982	1986	1987
British Columbia						
Area 3			15			
Skeena River			23	43		
Area 4			23			
Dean Channel	106					
Bella Coola River			68	41		
Rivers Inlet			18			
Area 12	158					
Fraser River	182		72	43	91	
Area 23	100					
Washington						
Puget Sound					65	70
Washington Coast						23
Total	**2,780**	**1,672**	**2,193**	**1,481**	**2,017**	**1,527**

Table 43. Allocation of 1994 North American chum baseline samples by previous year baseline samples using Millar's maximum-likelihood method.

Region	Area	Stock or sample	N	Correct allocation 1972	1973	1981	1982
AYK	Kotzebue	Kotzebue commercial	50	0.50**	*	0.60	0.98**
	Norton Sound	Nome	48	0.08	0.00	0.51	0.51
		Snake	38	0.12	0.00	0.42	0.42
		Kwiniuk	51	0.00	0.09	0.91	0.76
		Unalakleet	53	0.09	0.09	0.94	0.73
		avg		*0.07*	*0.04*	*0.70*	*0.60*
	Yukon	Middlemouth test summer	53	0.07	0.33	0.83	0.72
		Middlemouth test fall	52	0.03	0.22	0.62	0.34
	Kuskokwim	early	49	0.06	0.56	0.52	0.76
		middle	50	0.10	0.54	0.43	0.73
		late	63	0.00	0.49	0.39	0.67
		avg		*0.05*	*0.43*	*0.56*	*0.64*
Bristol Bay	Bristol Bay	Togiak	54	0.35	0.47	0.97	0.97
		Nushagak	55	0.20	0.78	0.82	0.97
		avg		*0.28*	*0.62*	*0.90*	*0.97*
AK Peninsula	N. Peninsula	Harbor-Strogonof Pt.	51	0.10	0.26	0.92	0.63
	S. Peninsula	C. Lutke (Unimak)	50	0.14	0.48	0.85	0.82
		Volcano Bay	48	0.09	0.00	1.00	0.19
		Pavlof Bay	50	0.28	0.17	1.00	0.88
		avg		*0.15*	*0.23*	*0.94*	*0.63*
S. Central AK	Cook Inlet	Upper Cook Inlet drift	50	0.60	0.86	1.00	0.94
	Pr.Wm. Sound	WHN hatchery	41	*	*	0.29	0.19
		SG hatchery	36	*	*	0.91	0.51
		Coghill commercial	48	*	*	0.76	0.49
		N. commercial	6	*	*	0.60	0.79
		E. commercial	11	*	*	0.67	0.16
SE Alaska	N. SE	Excursion Inlet commercial	50	*	*	0.65	0.88
		Herman Cr. escapement	50	*	*	0.54	0.56
		Amalga Hbr. hatch.	49	*	*	0.90	0.89
		Taku Inlet (Juneau)	50	*	*	0.64	0.81
		Canyon Is. esc. (Taku)	54	*	*	0.29	0.37
		Hidden Falls hatchery	50	*	*	0.94	0.96
		Medvejie hatchery	49	*	*	0.35	0.41
		avg.				*0.63*	*0.58*

(continued)

Table 43. continued

Region	Area	Stock or sample	N	Correct allocation 1972	1973	1981	1982
SE Alaska	S. SE	Hugh Smith escapement	35	0.73***	*	0.87***	0.97***
		Marx Cr. escapement	50	0.90***	*	0.98***	0.98***
		Fish Cr. escapement	48	0.95***	*	0.98***	0.98***
B.C.	N. B.C.	Q. Charlottes - Mather	30	0.88	*	0.91	1.00
		Q. Charlottes - Pallant	30	0.66	*	0.94	1.00
		Skeena	15	0.46	*	1.00	1.00
		Kitimat	33	0.62	*	0.85	0.96
		Kitimat - Hirsch Cr.	30	1.00	*	0.90	0.92
		Bella Coola- Snootli	28	0.83	*	0.82	0.94
		Bella Coola - N. Bentinck	30	0.75	*	0.80	0.99
		Nimpkish	5	1.00	*	0.76	0.80
		Nimpkish - Alert Bay	40	0.95	*	0.64	0.78
		Little Qualicum	27	0.75	*	0.90	1.00
		Big Qualicum	30	0.83	*	0.90	0.96
	Fraser	Chehalis	18	0.39	*	0.99	1.00
		Harrison	51	0.55	*	0.75	0.87
		Chilliwack	49	1.00	*	0.91	1.00
	Vanc. Is.	Nitinat	50	1.00	*	0.93	0.94
		Conuma	19	1.00	*	0.70	0.88
		Nootka	30	1.00	*	0.86	0.97
		avg.		*0.81*		*0.87*	*0.95*
Washington	Coast	Nooksack/Samish	30	*	*	*	*
		Skagit	30	*	*	*	*
		Stilliguamish/Snohomish	31	*	*	*	*
		S. Puget Sound	48	*	*	*	*
		Hood Canal	50	*	*	*	*
		Grays Harbor	36	*	*	*	*
		Willapa Bay	50	*	*	*	*
Total 1994 scales:			2,282				

* representative stocks were not in baseline
** correct classification to Russian group, where Kotzebue sample had clustered in that year.
*** correct classification to B.C. group, where 1994 southern southeastern Alaska samples cluster

Table 44. Age 0.3 chum scale samples measured from observer samples of chum bycatch.

NMFS Area	Month: August	September	October	All Months
509	17	33		50
513	46	63	1	110
517	206	390	9	605
518		1		1
519	47	34	10	91
521	78	71		149
541		1	4	5
TOTAL	**394**	**593**	**24**	**1,011**