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Migrations, Abundance, and Origins of Salmonids in Offshore Waters of the North Pacific, 1999

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1. Executive Summary

This report summarizes research on high seas salmonids conducted in FY99 (1 October 1998-30 September 1999) by the Fisheries Research Institute (FRI), School of Fisheries, University of Washington, under contract to the U.S. National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA). The contract work is a continuation of research required to meet United States' commitments to the North Pacific Anadromous Fish Commission (NPAFC), which operates under the NOAA Authorization Act of 1992 (PL 102-567, Title VIII: North Pacific Anadromous Stocks Convention). The principal goal of this work is to address scientific research issues raised by the NPAFC. New lines of research may be developed in response to the changing situation of salmonids and fisheries in the North Pacific.

The four member nations of NPAFC (Canada, Japan, Russia, and the United States) share a common concern about "the impact of change in the productivity of the North Pacific Ocean on Pacific salmon." Since 1993, NPAFC's scientific research has focused on two critical issues: "(1) the factors affecting current trends in the productivity of the North Pacific Ocean and their impacts on salmonid carrying capacity, and (2) the factors affecting changes in biological characteristics of Pacific salmon. " To address these issues, our international cooperative high seas salmon research in FY99 was conducted in two major areas: (1) salmon stock origin studies for research, management, and enforcement, including high seas tagging (data storage tags, high seas disk tags, coded-wire tags), scale pattern analysis, and other methods (genetic stock identification and thermal otolith marks), and (2) ocean ecology, carrying capacity, and climate change studies, including salmon research vessel cruises, food habits research, growth studies, and carrying capacity and bioenergetics research. This report also summarizes research coordination with the Auke Bay Laboratory (ABL, Alaska Fisheries Science Center, NMFS), participation in NPAFC meetings, and 1998-99 reports, documents, and publications.

Information on stock-specific ocean distribution, migration, and behavior patterns of salmon is needed to understand the mechanisms underlying changes in the ocean production of salmon. High seas salmon tagging provides direct information on stock origins of salmon migrating in the Bering Sea and North Pacific Ocean. FRI's high seas tagging work includes release of disk-tagged salmon at sea, activities for recovery of high seas tags from inshore areas, recovery of coded-wire tags (CWTs) from fish caught during high seas fishing operations, and maintenance, updating, and analyses of high seas tag release and recovery databases. The most significant new information in FY99 pertaining to ocean distribution and migration patterns of salmon was the recovery of two CWT California (Sacramento River Basin) chinook salmon in the Bering Sea (north side of Unimak Pass) in May 1998. There is no prior information from tagging or other stock identification studies to indicate that California chinook salmon migrate to the Bering

Sea. A disk-tagged chinook salmon recovered in the Yentna River (tributary to the Susitna River, upper Cook Inlet) is the first reported recovery of a central Alaskan chinook salmon tagged in offshore waters of the Gulf of Alaska (GOA). A log-linear model analysis of historical CWT recoveries of Columbia River upriver bright fall chinook salmon stock showed that their ocean distributions were fairly consistent from year to year, indicating little impact from the 1982-83 El Niño event.

In 1998, FRI initiated cooperative programs with ABL and the Fisheries Agency of Japan (FAJ) to place data storage tags (DSTs), which measure water temperature and swimming depth, on salmonids at sea. Data from 1998 recoveries of temperature-recording DSTs showed a clear diel pattern of higher, relatively constant average temperatures at night, with narrower temperature ranges and fewer descents than during the day. Alaskan pink and coho salmon and steelhead tagged in the GOA were at higher temperatures on average (10°-12°C) than Japanese chum salmon tagged in the Bering Sea (8°-10°C). Japanese chum salmon were also found at a wider range of temperatures (-1°-22°C vs. 5°-15°C). This is probably related both to the different oceanographic regions through which the fish migrated, as well as species differences in thermal ranges and vertical movements. Proportions of time that individual fish spent at different temperatures seemed to vary among oceanographic regions. Data from temperature-depth tags recovered in 1999 (one sockeye, two pink, and four coho salmon tagged in the GOA in July) show that salmon spent most of the time in the top 40 meters, with infrequent excursions to 60-100 m. All species show considerable diurnal and shorter-term variation in ambient temperatures, which suggests that ocean distribution of salmon may be linked more to prey distribution, foraging, and migration than to sea surface temperatures.

Twenty-one years (1978-1998) of high seas salmon scale pattern analyses, which provided estimates of the proportions of Asian and North American salmon in various fisheries in the North Pacific Ocean and Bering Sea, were reviewed. The results suggest that the area of intermingling of Asian and North American salmon in the Bering Sea and North Pacific Ocean is wider than that shown by direct evidence from tag experiments. Validation of the results of scale pattern analysis and other indirect methods of stock identification of salmon on the high seas is needed. The results of a sockeye salmon scale-aging test involving salmon scientists from Russia, Japan, Canada, and the U.S. indicated the need for international review and standardization of methods and criteria used to interpret freshwater age and growth patterns on salmon scales.

Cooperative studies to identify geographical origins of pink and chum salmon in the GOA in spring and summer were conducted with FAJ, ABL, and Alaska Department of Fish and Game scientists. In general, the results of genetic stock identification analyses and recoveries of thermal otolith marks showed a broad pattern of mixing of Asian and North American salmon, with Asian stocks predominating in the western GOA and North American stocks predominating in the central GOA. Recoveries of otolith-marked hatchery salmon in May 1999 extended the known southwestern range of maturing Prince William Sound pink salmon to 42°N, 165°W in spring and to 47°N, 165°W in summer. Some maturing, otolith-marked chum salmon caught in the waters off Prince William

Sound in May were from an early southeastern Alaska hatchery run (peak harvest in mid-July). The studies showed that sufficient numbers of thermally marked hatchery salmon could be recovered during high seas surveys to provide significant new stock-specific information on ocean distribution and migration patterns of salmon.

Summaries are presented of salmon research cruise data and salmonid food habits. Survey coverage of the same oceanographic regions in different seasons was increased, particularly by adding spring and summer surveys along the 165°W and 145°W transects by researchers aboard the *Great Pacific* and *Oshoro maru*. The overlap in survey areas enabled a comparison of catch, age, weight and length data, and stomach contents data from spring and summer research cruises in these areas. At 165°W, sockeye salmon were more abundant in May, although more than two-thirds of the fish were immature, suggesting that Bristol Bay fish may have already left this area in early May. Chum salmon, predominantly immature, and pink salmon were more abundant in July than in May. At 145°W, the more northerly stations in May had catches with more mature sockeye salmon than in July. Chum salmon age and maturity completely changed from older, mature fish in May to younger, immature fish in July. In southerly waters at 145°W, a higher proportion of the sockeye salmon caught in July was mature and older than in May. Comparison of salmonid food habits data indicated that gelatinous zooplankton (appendicularians) was more abundant in sockeye, chum, and pink salmon stomachs in May, while crustaceous zooplankton and squid make up more of their diets in July. Eight years of salmonid food habits data collected from the central North Pacific and Bering Sea are summarized, and trends indicated some broad changes in prey composition with respect to oceanographic areas and salmon predator size for some prey groups, but not all. An experiment on diel changes of salmon prey composition and stomach content weight indicated that salmon shift dominant prey groups between daytime and nighttime periods, suggesting that sampling fish throughout the diel cycle is required to provide an accurate assessment of salmon feeding ecology. Digestion rates estimated from weight of stomach contents from diel sampling did not improve on estimates previously obtained by shipboard experiments.

Growth studies indicated that inter- and intra-specific differences in time of ocean annulus formation on salmon scales reflect differences in growth rates, regulated by feeding conditions. Measurements were made of scales of chum and sockeye salmon caught by Japanese research vessels in the GOA from 1982 to 1997. Early growth (first and second ocean years) on sockeye salmon scales shows no trend with time, but edge growth (third ocean year and edge growth variables) was less in the 1990s samples than in 1980s samples. Chum salmon scale edge growth was also slightly lower in the 1990s. Blood plasma levels of insulin-like growth factor-I (IGF-I) may be a new index for ocean growth of Pacific salmon in offshore waters. Levels of IGF-I correlated significantly with body and liver weight in all species except pink salmon.

Other information summarized in this report includes the results of carrying capacity and bioenergetics research. New bioenergetic models using DST temperature data indicated that high-seas salmon growth is more sensitive to food consumption than to temperature. Food habits data from the 1950s, 1960s, 1980s, and 1990s and oceanographic and zooplankton data from the *Oshoro maru* GOA cruises in the 1990s were used to develop a conceptual model for density-dependent growth of maturing pink and sockeye salmon. This model differs from previous models of salmon carrying capacity in that the critical period of density-dependent growth occurs in winter for pink salmon and ocean age-.2 sockeye salmon, rather than in the final weeks of their summer homeward migration. An important component of this model was the quantification of the ontogenetic shift of pink and sockeye salmon diets from zooplankton to micronektonic squid. This switch occurs as a function of salmon body weight. Most pink salmon in the GOA achieve the body weight to make this dietary transition during the spring of their maturation year (ocean age-.1), while most sockeye make the transition during the spring of their third ocean year (ocean age-.2). A 10% difference in an individual salmon's body weight at the end of winter may translate into a 50% difference in its body weight at the end of summer, as the initial difference in body weights will determine when the salmon reach a large enough size to catch squid.

A sensitivity analysis of bioenergetics models using correlations between prey weight and prey type indicated that the presence of squid in the stomachs of salmon is an important predictor of salmon growth potential for pink, sockeye, and coho salmon. The changing size of the area of overlap between squid and salmon distribution in the 1980s and 1990s (decreasing trend between the early 1980s and 1998, followed by an increase in 1999) was highly correlated with the body weight of sockeye salmon caught near the Fraser River and less significantly with Bristol Bay and some central Alaskan sockeye salmon body weights.

We reviewed the results of U.S. research in the 1990s on the physical and biological factors affecting ocean production of Pacific salmon, and provided preliminary recommendations for revisions to the NPAFC Science Plan. We suggest a stronger emphasis on (1) the development of new technologies and international baselines for salmon stock identification, (2) coordinated field research and monitoring programs to provide a platform for process studies, as well as data on interannual variation in ocean growth, distribution, and run timing of key stocks, and (3) the development and dissemination of international databases needed to advance scientific knowledge of salmon in international waters.

2. Introduction

Since 1955, the U.S. Government has contracted the Fisheries Research Institute (FRI), School of Fisheries, University of Washington, to conduct research on issues related to Pacific salmon and steelhead trout (*Oncorhynchus* spp.) in the North Pacific Ocean. This work has included participation of FRI scientists in the deliberations of the International North Pacific Fisheries Commission (INPFC, 1955-1992) and the North Pacific Anadromous Fish Commission (NPAFC, 1993-present). The results of FRI's long-term High Seas Salmon Research Program have established a strong scientific basis for conservation and management of U.S. salmon stocks in international waters of the North Pacific Ocean and Bering Sea. The work presented herein by FRI is a continuation of research required to meet United States' commitments to the NPAFC, which operates under the NOAA Authorization Act of 1992 (PL 102-567, Title VIII: North Pacific Anadromous Stocks Convention).

The NPAFC Convention (Convention for the Conservation of Anadromous Stocks in the North Pacific Ocean) entered into force on 16 February 1993. The Convention prohibits directed fishing for anadromous stocks in international waters of the North Pacific Ocean and its adjacent seas (north of 33°N latitude, beyond 200-mile zones). Incidental taking of anadromous stocks in fisheries directed at other species is strictly limited, and retention of incidental take is prohibited. The NPAFC member nations (Canada, Japan, Russia, and the United States) can act individually or collectively to prevent unauthorized fishing activities and trafficking in illegally harvested fish; and they have the authority to board, inspect, and seize fishing vessels of other member-nations operating in violation of the Convention. The NPAFC, established under the Convention, serves as a forum for international coordination of scientific research and enforcement activities and promotion of conservation of Pacific salmon and ecologically related species in the Convention area and adjacent waters.

Article VII of the NPAFC Convention calls for extensive cooperation among member-nations in conducting scientific research for the purpose of conservation of anadromous stocks. With respect to the Convention area, cooperation includes "collecting, reporting and exchanging biostatistical information, fisheries data, including catch and fishing effort statistics, biological samples and other relevant data." Pertaining to areas adjacent to the Convention area, the member-nations can be requested by the NPAFC to provide "catch information, enhancement information, materials such as biological samples and other technical data or information related to anadromous stocks and ecologically related species." The Convention calls for the development of "appropriate cooperation programs, including scientific observer programs, to collect fishing information in the Convention Area for the purpose of scientific research on anadromous stocks." Member-nations are also to cooperate in scientific exchanges such as seminars, workshops, and exchanges of scientific personnel for high seas research cruises.

At the 1993 annual meeting of NPAFC, the Committee on Scientific Research and Statistics (CSRS) identified "the impact of change in the productivity of the North Pacific Ocean on Pacific salmon" as a critical research issue. CSRS scientists agreed that research on this issue should focus on: " (1) the factors affecting current trends in the productivity of the North Pacific Ocean and their impacts on salmonid carrying capacity, and (2) the factors affecting changes in biological characteristics of Pacific salmon. These characteristics include growth, size at maturity, age at maturity, oceanic distribution, survival, and abundance." Since 1995, the CSRS has developed annual Science Plans to address this research. A new and substantially revised NPAFC Science Plan will be developed in FY00.

In 1995, the U.S. National Marine Fisheries Service (NMFS), Alaska Fisheries Science Center, Auke Bay Laboratory (ABL), developed an Ocean Carrying Capacity (OCC) research plan to address the research issues identified by NPAFC. The two principal goals of the plan are "to describe the role and spatial distribution of salmonids in the marine ecosystem, and to test for density dependence in the growth rate of salmonids during various periods of ocean residency." As part of the NPAFC Science Plan, the 1999-2000 U.S. plan incorporates OCC research on (1) coastal juvenile salmon studies, (2) Gulf of Alaska (GOA) ocean ecology, (3) retrospective analyses, (4) stock identification, and (5) high seas salmon studies. High seas salmon research at FRI is fully integrated with the OCC Program at ABL, the research, management, and enforcement activities of NPAFC, and, as needed, other relevant international organizations and bilateral agreements.

FRI has a long-term commitment to conservation and management of Pacific salmon and steelhead trout, and is continuing a program of research on migrations, abundance, and origins of salmonids in the North Pacific Ocean and adjacent seas. Our principal research goal is to address research issues and associated questions raised in the NPAFC Science Plan through an integrated program of field, laboratory, and computer modeling research. New lines of research may be developed in response to the changing situation of salmonids and fisheries in the North Pacific. The work involves use of FRI's large archive of historical high seas salmon research samples and data (1954-present), as well as new samples and data acquired through our well-established cooperative high seas salmon research programs with Canada, Japan, and Russia (1983-present).

This annual report summarizes our international cooperative high seas salmon research results in FY99 (1 October 1998-30 September 1999) under NOAA Contract No. 50ABNF700003, as well as some pertinent results from previous years. The research was conducted in two major areas: (1) salmon stock origin studies for research, management, and enforcement, including high seas tagging (data storage tags, high seas disk tags, coded-wire tags), scale pattern analysis, and other methods (genetic stock identification and thermal otolith marks), and (2) ocean ecology, carrying capacity, and climate change studies, including salmon research vessel cruises, food habits research, growth studies, and carrying capacity and bioenergetics research. This report also summarizes research coordination with the Auke Bay Laboratory (ABL, Alaska Fisheries Science Center, NMFS), participation in NPAFC meetings, and 1998-99 reports, documents, and publications.

3. International Cooperative High Seas Salmon Research

3.1 Stock Origin Studies for Research, Management, and Enforcement

3.1.1 High seas tagging program

Since 1955, FRI has conducted a high seas tagging program consisting of release of disk-tagged salmon at sea, recovery activities for high seas tags from inshore areas, and recovery of coded-wire tags from fish caught during high seas fishing operations. In 1998, FRI added additional activities including cooperative programs with ABL and Fisheries Agency of Japan (FAJ) for placing data storage tags (DSTs) on salmonids at sea, and the responsibility for managing the high seas salmonid coded-wire tag (CWT) database (1981-present) and reporting CWT recoveries to NPAFC.

3.1.1.1 Data storage tags

3.1.1.1.1 1998 Tagging

A total of eight temperature-only data storage tags were recovered from fifty-five tags placed on salmonids in the North Pacific Ocean and Bering Sea during three research cruises in 1998 (Walker et al. 1998c). The data from four tags (a pink (*O. gorbuscha*) and a coho salmon (*O. kisutch*) and a steelhead trout (*O. mykiss*) recovered in Alaska; a chum salmon (*O. keta*) recovered in Japan) were discussed in the 1998 Annual Report (Myers et al. 1998d). The remaining four tags were all maturing chum salmon recovered in Japan from September through November (Walker et al. 1999a). The general pattern of the temperature data is similar for all five Japanese chum salmon (Fig. 1). After an initial period of relatively constant temperatures, the fish enter a phase of gradually increasing maximum temperatures and daily temperature ranges. Temperatures then sharply decline for a brief period 1-2 months following tagging, then increase again. The final phase varies between fish, reflecting different capture locations and dates. The data from one fish (Tag 271) showed a remarkable four-week period of daily excursions between relatively constant warm temperatures at night and constant very cold (1°C) temperatures during the day.

The data from the 1998 tag recoveries were analyzed and summarized in a manuscript accepted for publication in *Fisheries Oceanography* (Walker et al. in press). These tags contained the first long-term records of ambient temperature data recorded from Pacific salmonids migrating at sea. The major findings were:

- A clear diel pattern of higher, relatively constant average temperatures at night, with narrower temperature ranges and fewer descents than during the day. Fish tagged in the GOA were at higher temperatures on average (10°-12°C) than chum salmon tagged in the Bering Sea (8°-10°C). Chum salmon were also found at a wider range of temperatures (-1°-22°C vs. 5°-15°C). This is probably related both to the different oceanographic regions through which the fish migrated, as well as species differences in thermal ranges and vertical movements. Proportions of time that individual fish spent at different temperatures seemed to vary among oceanographic regions.

- The considerable diurnal and shorter-term variation in ambient temperatures suggests that offshore ocean distribution may be linked more to prey distribution, foraging, and migration than to sea surface temperatures.

- An initial period (4-21 days) of day and night temperatures near those of sea surface temperatures may have been a period of recuperation from tagging trauma; subsequent data revealed diel patterns of dives to deeper, cooler water and ascents to the surface. If true, near-surface orientation immediately following tagging and vertical movement data from short-term ultrasonic telemetry studies may not represent normal behavior of fish.

- Steelhead trout may descend to moderate depths (50 m) and not be limited to the top few meters, as had been believed.

- Japanese chum salmon may seek deep, cold waters as they encounter warm surface temperatures on their homeward migrations.

3.1.1.1.2 1999 Tagging

Eighty-nine data storage tags, which record temperature only (n=44) or temperature and depth data (n=45), were placed on Pacific salmonids in the North Pacific Ocean and Bering Sea during three research cruises (Table 1; Walker et al. 1999a). In May aboard the F/V *Great Pacific* 24 sockeye (*O. nerka*), 8 chum, 1 coho, and 1 chinook salmon (*O. tshawytscha*) were tagged with DSTs in the GOA. Three sockeye salmon were tagged in June in the central North Pacific, and seven chum salmon were tagged in July in the Bering Sea aboard the R/V *Wakatake maru*. Forty-five salmonids were tagged aboard the T/S *Oshoro maru* on transects along 165°W (1 steelhead) and 145°W (6 sockeye, 17 pink, and 21 coho) in late June and early July. As of September 30, 1999, thirteen DSTs have been returned from fish tagged in the GOA. Five sockeye salmon were recovered in Alaska (Chignik Lagoon, Copper River, Port Moller, and two in Taku Inlet). A chum salmon was recovered at Unimak Pass. Two pink salmon were recovered: one at Kodiak Island and one in southeast Alaska off Gravina Island. Four coho salmon were recovered in south central Alaska (Stepovak Bay, Kodiak Island, Cook Inlet, and Tsiu River). One chinook salmon was recovered in the Yentna River. Graphs of ambient temperature data and pressure data from these tags are presented in Figs. 2 to 11. The data from the 1999 recoveries have not been analyzed yet, but there are some obvious features. Data from seven temperature-depth tags (a sockeye, two pink, and four coho salmon tagged in the

GOA in July) show fish spent most of the time in the top 40 meters, with infrequent excursions to 60-100 m. Although estimated times of sunrise and sunset have not been calculated and fitted to the data, temperature and depth data seem to indicate a diurnal behavior cycle similar to that seen in 1998.

3.1.1.2 High seas disk tags

3.1.1.2.1 Releases

With the goal to maximize return of disk tags from coastal areas in North America and Asia, FRI developed a new high seas disk tag in 1997. These tags display in English, Japanese, and Russian the addresses of high seas salmon tag collection centers in Hokkaido, Japan (National Salmon Resources Center), Petropavlovsk, Russia (KamchatNIRO) and the United States (FRI). Salmonids released during cooperative Japanese cruises have been double-tagged with these new tags and FAJ disk tags.

Scientists aboard the *Great Pacific* in the GOA and eastern North Pacific conducted tagging operations on viable salmonids caught by trawl in 1998 and 1999 (Fig. 12; Carlson et al. 1998, 1999b). In 1998, seven salmonids were released with disk tags and DSTs. In 1999, tagging experiments were expanded resulting in 62 salmon releases, including 41 sockeye, 18 chum, 1 coho and 2 chinook salmon. Among these tagged fish, 34 also carried DSTs (Table 1, Carlson et al. 1999b). Recoveries of six salmon prove the feasibility of tagging trawl-caught salmon in good condition.

Tagging operations on viable salmonids caught by longline were conducted by scientists aboard the *Wakatake maru* in the central North Pacific and Bering Sea in summer 1998-1999 (Fig. 12; Ueno et al. 1998, Fukuwaka et al. 1999). In 1998, 884 salmonids were disk tagged and released, including 35 salmonids tagged with DSTs. In 1999, tagging experiments resulted in the release of a total of 398 salmonids, including 16 sockeye, 241 chum, 134 pink, 5 coho, and 2 chinook salmon. Among these releases, 36 fish were tagged with DSTs (Fig. 12, Table 1).

In 1999 aboard the *Oshoro maru*, 26 salmonids (41 in 1998) in the central North Pacific Ocean along the 165°W transect, and 63 salmon (28 salmonids in 1998) in the GOA along the 145°W transect were double disk-tagged and released including 45 salmon also tagged with DSTs (Fig. 12; Table 1; Yamaguchi et al. 1999). Along 180°, 10 fish were disk-tagged in 1998.

3.1.1.2.2 Recoveries

From 1 September 1997 to 15 September 1998, seventeen Japan-U.S. disk tags were recovered, including five fish that also carried DSTs. Data storage tags were recovered from one each of steelhead, pink and coho salmon that returned to Alaska and from two chum salmon that returned to Hokkaido, Japan. The remaining disk tag recoveries included 12 chum salmon that were recovered in Japan (Myers et al. 1998b).

High seas tag recoveries have increased dramatically to a total of 75 Japan-U.S. tags and 6 U.S. tags in the period from 15 September 1998 through 30 September 1999, (68 chum, 5 sockeye, 3 pink, 4 coho, and 1 chinook salmon; Table 2; Walker et al. 1999a, Fukuwaka et al. 1999). These tagged salmon were released in 1998 and 1999 during US tagging operations aboard the F/V *Great Pacific* in the GOA in May and during cooperative Japan-U.S. tagging operations aboard the *Wakatake maru* and *Oshoro maru* in the central Aleutian Islands, Bering Sea, and GOA in June and July. The sockeye, pink, coho, and chinook salmon and one chum salmon were released in the central GOA in May and July 1999 and recovered in Alaska; all but one carried data storage tags. The sockeye were recovered in Chignik Lagoon, in the Copper River, in Taku Inlet, and off Port Moller. One chum salmon was recovered at Unimak Pass. The pink salmon were recovered at Kodiak Island and in southeast Alaska off Gravina and Dall Islands. The coho salmon were recovered in south central Alaska (Stepovak Bay, Kodiak Island, Cook Inlet, and Tsiu River). The chinook salmon was recovered in the Yentna River. This recovery is the first recovery of a central Alaska chinook salmon tagged in offshore waters. Sixty-seven maturing chum salmon released in July 1998 in the central Aleutian Islands and Bering Sea were recovered in Hokkaido and Honshu from September to December 1998. Four maturing chum salmon, recovered in Hokkaido and Honshu, carried U.S. data storage tags. Two maturing chum salmon, recovered in Hokkaido, carried a different type of data storage tag implanted by Japanese scientists.

3.1.1.2.3 Processing center for tag recoveries

Since 1956, FRI has served as the North American processing center for recovery of high seas salmonid tags. This activity requires advertising for tag returns, returning tags and recovery information to appropriate agencies, returning information on tag recoveries and a reward to fishermen and processors who return high seas tags, and reporting new tag recoveries in documents for NPAFC (Myers et al. 1998b, Walker et al. 1999a).

Each year in the spring, we advertise for return of high seas salmon tags by mailing approximately 1400 informational packets to addresses in Alaska, British Columbia, Washington, Oregon, and California. These packets are sent to federal, state, and tribal fisheries research and management agencies, fishermen's organizations, salmon buyers and processors, and post offices. The informational packet includes a letter explaining the tagging program and the importance of returning tags, a poster advertising for tag returns (Fig. 13), and a business-reply envelope that includes a form for recording recovery information (tag number, date, location, fishing gear) and salmon biological data (species, sex, body weight, and how to collect scales).

Since 1991, we have offered a custom-embroidered cap as a reward for people who return high seas tags. The reward caps are embroidered with colorful, stylized salmon and lettering emphasizing the cooperative aspects of the high seas salmon tagging program. These caps are available in several colors, so the person receiving the reward can select a cap color of their own choosing.

3.1.1.2.4 Maintenance and updating of databases.

The high seas salmon tag release and recovery databases were updated with data provided at the 1998 NPAFC annual meeting. Japan reported double-tagging operations conducted with the United States. The release database was updated with 44 operations in which 962 fish were tagged and released. Seventeen fish were added to the tag recovery database (14 recoveries from Japan, 3 recoveries from Alaska). The updated databases are available to all national sections. Preliminary information from cruise data in preparation for the 1999 NPAFC annual meeting indicates 566 fish were tagged during operations on three research cruises, and 81 recoveries were reported. New tag release and recovery information was added to the databases.

3.1.1.3 Coded-wire tags

3.1.1.3.1 Snout collection for potential recovery of coded-wire tags

Snouts were collected from fin-clipped salmonids because these fish may contain a coded-wire tag. During high seas salmon research operations, 69 snouts were recovered from fin-clipped salmonids in 1997 and 70 were recovered in 1998, primarily from steelhead (total n=126), although snouts were also collected from sockeye (n=4), coho (n=6), chum (n=2), and chinook salmon (n=1; Myers et al. 1998d).

In 1999, aboard the *Oshoro maru*, 58 snouts were collected from salmonids lacking the adipose fin including 42 steelhead and 12 coho, 2 sockeye, 1 pink, and 1 chinook salmon (Table 3). Snouts were frozen and delivered to ABL for recovery of coded-wire tags. Aboard the *Wakatake maru*, snouts were recovered from eight steelhead lacking the adipose fin. These snouts have not yet been examined to determine if they contain coded-wire tags.

3.1.1.3.2 High seas recoveries of coded-wire tagged salmonids

Information on high seas recoveries of coded-wire tagged (CWT) salmonids has been reported annually to the INPFC (1981-1992) and to the NPAFC (1993-present). The Regional Mark Processing Center, Pacific States Marine Fisheries Commission, incorporates the high seas CWT recovery data into their coastwide, on-line CWT recovery data set (Regional Mark Information System (RMIS), http://www.psmfc.org/rmpc/cwt_reports.html).

In 1999, we reported new data for 339 CWT salmon recovered from incidental catches by the U.S. commercial groundfish (trawl) fishery in the U.S. Exclusive Economic Zone in 1995 (1 coho and 17 chinook), 1997 (28 chinook), 1998 (174 chinook), and 1999 (119 chinook) (Table 4a; Myers et al. 1999a). Some CWT chinook salmon were recovered in processing plants from combined catches of several vessels; therefore, in those cases the recovery locations appear as NMFS statistical areas (Appendix Figs. 1 and 2). New data for 51 CWT salmonids recovered during U.S. and Japanese salmon research vessel operations in the North Pacific Ocean in 1997 (1 steelhead), 1998 (1 sockeye, 22 coho, 15 chinook, and 10 steelhead), and 1999 (2 chinook) are listed in Table 4b.

The most significant new information from these recoveries pertaining to ocean distribution and migration patterns of salmon is the recovery of two California (Sacramento River Basin) chinook salmon in the Bering Sea (north side of Unimak Pass) in May 1998 (Tag codes 0501020201 and 0601140510, Table 4a). There is no prior information from tagging or other stock identification studies to indicate that California chinook salmon migrate to the Bering Sea. The northwestern limit of the known ocean range of California chinook salmon (Sacramento R.) was established by a CWT salmon recovery in the GOA near Kodiak Island (152°17'W, 56°53'N) in November 1984. The new recoveries are a westward range extension of 790 km (great circle distance) from this previous recovery.

3.1.1.3.3 Ocean distribution of CWT Columbia R. chinook

A log-linear model analysis of brood year 1978-1990 CWT data that incorporates fishing effort was used to investigate the summer ocean distribution of three components of the Columbia River upriver bright (URB) fall chinook salmon stock--Priest Rapids hatchery (PRH), Lyon's Ferry hatchery (LYF), and Hanford Reach wild (HAN) (Norris and Hyun 1999). The hatchery (PRH) and wild (HAN) components from the Hanford Reach region have the same ocean distribution, but have significantly different maturation rates and/or catchability coefficients. The LYF component did not migrate as far north as the other two components. Cohorts from all components move farther north with age. For the PRH and HAN releases, the percentages of the age 3-, 4-, and 5-year old cohorts residing in Alaska were 11%, 46%, and 55%, respectively. For the LYF releases, the percentages of the age 3-, 4-, and 5-year old cohorts residing in Alaska were 2%, 24%, and 41%, respectively. Lack of recoveries in the nearshore coastal waters of central B.C. suggests that most of the URB stock migrates west of Vancouver Island and the Queen Charlotte Islands. Ocean distributions were fairly consistent from year to year, especially for the age 4- and 5-year old cohorts, indicating little impact from the 1982-83 El Niño event.

3.1.2 Scale pattern analyses

3.1.2.1 Review of historical high seas scale pattern analyses

Twenty-one years (1978-1998) of high seas salmon scale pattern analyses, which provided estimates of the proportions of Asian and North American salmon in various fisheries in the North Pacific Ocean and Bering Sea, were reviewed (Myers 1998b).

These fisheries include the former Japanese mothership and landbased driftnet salmon fisheries, the former Asian high seas squid driftnet fisheries, unauthorized high seas salmon driftnet fisheries, and foreign, joint-venture, and domestic trawl fisheries in the U.S. Exclusive Economic Zone (EEZ). Much of the research was part of a cooperative effort by the scientists of Canada, Japan, and the United States under the auspices of the INPFC.

The major contribution of the high seas salmon scale pattern research (1978-1992) was to provide the first quantitative estimates of the relative proportions of Asian and North American sockeye, chum, coho, and chinook salmon in the region of the North Pacific Ocean southwest of 46°N, 175°W (former landbased driftnet fishery area). The final results of these studies indicated that the majority of immature and maturing sockeye salmon and immature chinook salmon migrating in the southwest of 46°N, 175°W in May-July are of Russian (Kamchatka Peninsula) origin. Bias was suspected in the results of chum and coho salmon scale pattern analyses that were not corroborated by direct information from tag recoveries. Information from tag experiments indicates that the majority of chum salmon in this area are Asian (Russian and Japanese origin). Intermingling of Asian and North American coho salmon occurs in the area between 170°E and 175°W, and the proportion of North American stocks in this region may be higher than is indicated by tag experiments.

U.S. scale pattern analyses to estimate regional composition of salmon in the area of the former Japanese mothership fishery involved two species, sockeye salmon and chinook salmon. Scale pattern estimates for mixing proportions of sockeye salmon pertained only to the area of mothership fishery south of 50°N. Estimated proportions of western Alaska (Bristol Bay) sockeye salmon were higher in the mothership fishery area than in the landbased fishery area, and were highest in the eastern portions of the area and declined to the west. Estimated proportions of Asian fish in eastern subareas were higher in both May and June than was indicated by tagging studies. A technique based on age determinations from scale samples may have underestimated interceptions of Alaskan sockeye salmon by the Japanese mothership fishery.

The results of all scale pattern analyses have consistently indicated that western Alaska is the predominant regional stock of chinook salmon in the Bering Sea portion of the former mothership fishery area, and these results are substantiated by parasite and tagging studies. The results for the North Pacific portion of the mothership fishery area are less conclusive, but indicate a broader mixture of stocks from both Kamchatka and Alaska.

Chinook and chum salmon are the major salmonid species in the bycatch of walleye pollock (*Theragra chalcogramma*) trawl fisheries operating in the U.S. EEZ in the eastern Bering Sea and Aleutian Islands. In fisheries conducted in the late 1970s and early 1980s (September through April), estimated regional stock composition of the chinook salmon bycatch averaged 60% western Alaska, 17% central Alaska, 14% Kamchatka, and 9% southeast Alaska and British Columbia. Estimated interceptions of chum salmon in the 1994 trawl fishery (weighted by time, August-October) included a broad mixture of stocks from Asia (Russia and Japan, 50%), western and central Alaska (18%), and southeast Alaska, British Columbia, and Washington (32%). The estimated bycatch of western Alaska chinook and chum salmon by these fisheries was negligible compared to the size of inshore runs of these species in western Alaska.

Chum and coho salmon were the major salmonid species in the bycatch of the former Asian high seas squid driftnet fisheries, which operated in the area south of 46°N, between 170°E and 145°W. Tag data indicate that in the eastern region (east of 170°W), where most of the salmon bycatch was taken, there is a mixture of Asian (Russia and Japan) and western Alaska stocks. Scale pattern analyses indicated that western Alaska was the predominant regional stock of coho salmon in the bycatch of the 1990 Japanese squid driftnet fishery, the 1991 Asian squid driftnet fisheries, and an unauthorized Taiwanese salmon catch in 1989. The scale pattern estimates may have been biased because the baselines did not include data for all major coho salmon stocks. Scale pattern analyses indicated that chum salmon caught by the 1990 Japanese squid driftnet fishery were of Russian and western Alaskan origin, and chum salmon caught in an unauthorized Taiwanese salmon fishery in 1989 were of Asian (Russia and Japan) origin.

The results of historical scale pattern analyses suggest that the area of intermingling of Asian and North American salmon in the Bering Sea and North Pacific Ocean is wider than that shown by direct evidence from tag experiments. Our present understanding of stock-specific distribution, migration patterns, and relative of abundance of salmon in offshore waters is limited. Much work remains to validate the results of scale pattern analysis and other indirect methods of stock identification of salmon on the high seas.

3.1.2.2 NPAFC sockeye salmon scale aging test

The most accurate results from stock identification of salmon using scale pattern analysis are obtained when both baseline and mixture samples are composed of fish of the same age class and brood year. In most cases, however, the true ages of salmon in scale samples are not known. Therefore, consistency in scale age determinations in both the baseline and mixture samples is critical for accurate stock identification results. Problems can arise when resource agency scale experts use additional knowledge of stock-specific life history traits to assist in determining age from scales for the baseline samples that cannot be applied to the mixture samples. At the March 1997 NPAFC research planning meeting in Vancouver, B.C., the Working Group on Stock Identification and Growth discussed the need to test inter-laboratory variation in scale age and growth data. We conducted an experiment where experts at nine laboratories in Canada, Japan, Russia and the U.S. determined sockeye salmon scale ages. Results indicated a high degree of consistency in ocean ages and substantial variation in freshwater ages and suggested the need for international review and standardization of methods and criteria used to interpret freshwater age and growth patterns on salmon scales (Myers 1998a).

3.1.2.3 Cooperative exchanges of scale samples with KamchatNIRO

In recent years, the Kamchatka Research Institute of Fisheries and Oceanography (KamchatNIRO), Petropavlovsk, Kamchatka, and FRI have made annual exchanges of acetate impressions of scales and biological data from adult sockeye salmon returning to the Kamchatka Peninsula and Bristol Bay (Port Moller Test Fishery). In FY99, KamchatNIRO provided samples and data collected in 1999 from eight rivers (Khailyulya, Kikhchik, Bolshaya, Kamchatka, Vorovskaya, Palana, Ozernaya, and Avacha rivers in Kamchatka, Russia). We plan to use these samples in cooperative U.S.-Russia studies to estimate mixing proportions of regional stocks of Asian and North American sockeye salmon in the Bering Sea and North Pacific Ocean and for comparative studies of ocean growth.

3.1.3 Other studies of stock origins

3.1.3.1 Identification of scales from illegal driftnet fishing

FRI evaluated and confirmed species identification and age determinations of salmon scales taken from two vessels illegally fishing driftnets for salmon south of the western Aleutian Islands in 1998 (Myers et al. 1998d). All scales were of chum and sockeye salmon, mostly ocean age-.3, and the species composition was consistent with the area where the vessels were intercepted. Lack of growth at the edge of the scale indicated the fish were caught in spring, and the age composition was typical of larger, maturing fish. In 1999, FRI supplied information to the U.S. Coast Guard on field identification of salmon species for fish sampled onboard vessels conducting illegal fishing of high seas driftnets.

3.1.3.2 Geographical origin of chum and pink salmon in the GOA

FRI participated in cooperative studies with FAJ, ABL, and Alaska Department of Fish and Game scientists to identify geographical origins of chum salmon in the GOA in summer 1998 (Kawana et al. 1999, Urawa et al. 1999b,c). Genetic stock identification (GSI) and thermal otolith marking techniques were used to analyze samples collected aboard the *Oshoro maru* from catches along 165°W and 145°W (40-56°N) in June and July 1998. The GSI results indicated mixing of Asian and North American chum salmon along both transects, with Asian stocks predominating in the western GOA and North American stocks predominating in the central GOA. Immature, thermally-marked chum salmon, released from hatcheries in southeast Alaska and Prince William Sound (PWS), were caught primarily along the 145°W transect, and were most abundant in catches south of 52°N. Maturing, thermally-marked pink salmon released from PWS hatcheries were most abundant in northern waters (55-56°N) along the 145°W transect. The recovery of a thermally-marked PWS hatchery pink salmon at 47°N, 165°W is a southwestward extension of the known ocean range of maturing central Alaskan pink salmon in summer.

In coordinated research with ABL, the results of broad-scale surveys of juvenile and immature salmon in near-surface waters in coastal and offshore areas of the GOA, in spring and summer, 1996-1999, were reported (Carlson et al. 1999a). Recoveries of otolith-marked hatchery salmon in May 1999 extended the known southwestern range of maturing, central Alaska (PWS) pink salmon to 42°N, 165°W. Some maturing, otolith-marked chum salmon caught in the coastal waters off Prince William Sound in May were from an early southeastern Alaska hatchery run (peak harvest in mid-July). We concluded that sufficient numbers of thermally marked hatchery salmon could be recovered during coastal and offshore salmon surveys to provide significant new stock-specific information on ocean distribution and migration patterns of salmon.

3.2 Ocean Ecology, Carrying Capacity, and Climate Change

3.2.1 Salmon research vessel cruises

In 1997-1999, FRI scientists participated in cooperative salmon research cruises with Hokkaido National Fisheries Research Institute (HNFRI; *Wakatake maru*, *Kaiyo maru*), Hokkaido University (HU; *Oshoro maru*), and ABL (*Great Pacific*). In 1997, there was little overlap in the cruise tracks of these research vessels (Fig. 12). The *Oshoro maru* operated in the GOA in June and July, the *Wakatake maru* sampled the central North Pacific in June and Bering Sea in July, and the *Great Pacific* conducted sampling operations in the Aleutian Islands in August. With relatively few opportunities to sample ocean salmon aboard research vessels, a need for more efficient use of ship time to resample the same geographic or oceanographic areas in different seasons was recognized. Therefore, in 1998 when the *Kaiyo maru* was available for ocean salmon research in February, the vessel returned to the same areas visited in the summer by the *Wakatake maru* along the 180° transect, as well as 165°E, which is sampled by the *Hokko maru* in an annual HNFRI summer survey. In addition, the *Oshoro maru* added a transect at 165°W in the eastern North Pacific, and the *Great Pacific* added an offshore transect at 145°W in May, which overlapped the same area sampled by the *Oshoro maru* in July (Fig. 12). In 1999, addition of a transect at 165°W to the cruise track of the *Great Pacific* in May brought further changes and increased coverage of the same geographic regions in different seasons. These changes resulted in spring and summer sampling along 165°W and 145°W by researchers aboard the *Great Pacific* and *Oshoro maru* and contributed significantly towards achieving a sampling scheme accounting for seasonal variability in the survey areas.

3.2.1.1 *Oshoro maru*

Two FRI scientists (R. Walker and S. Hyun) participated in the cooperative Japan-U.S. salmon research cruise on board the T/S *Oshoro maru* from 21 June to 16 July 1999 (Fig. 12, Table 5; Yamaguchi et al. 1999). Salmon surveys conducted aboard the *Oshoro maru* in the central North Pacific Ocean and GOA have provided valuable time series of fisheries and oceanographic data. This was the sixth consecutive year of cooperative Japan-U.S. sampling for salmon along a 145°W-longitude transect in the central GOA in early July, and the second year of a new transect along 165°W in late June. (Salmon fishing along 180° longitude was not conducted in 1999, due to time and budget constraints and because of duplication of sampling one week later by the *Wakatake maru*.) The primary objective of the 1999 cooperative research was to continue the collection of oceanographic and biological data along the 165°W and 145°W transects. In 1999, late-June mean SSTs were about 1°C cooler than in 1998 (8.5°C) at comparable gillnet stations on the 165°W transect, and early July mean SSTs (9.0°C) were 1.2°C cooler than in 1998 along the 145°W transect and 1.4°C cooler than the 1994-98 average along 145°W (mean 10.4°C). The northern edge of the Subarctic Current was at an average position (51°N), further south than in 1998 (53°N). Catches by gillnet totaled 2,919 salmonids, including 529 salmonids (645 in 1998) along the 165°W transect and 2,390 salmonids (2,264 in 1998) in the GOA.

3.2.1.2 *Wakatake maru*

One FRI scientist (N. Davis) participated in the cooperative Japan-U.S. salmon research cruise on board the *Wakatake maru* in June and July 1997 and 1998, and this vessel conducted cooperative tagging and collection of samples for FRI in 1999 (Fig. 12; Ueno et al. 1998). Research cruise activities included collection of data on oceanography, primary production, zooplankton, salmonids, and other fishes. Catches in 1997 totaled 15,914 salmonids, and pink salmon were the most abundant species (68%), followed by chum (19%), sockeye (9%), coho (3%), chinook salmon and steelhead (1%), and one Dolly Varden. Odd year catches are dominated by the high abundance of pink salmon in the Bering Sea. In contrast, the total catch in 1998 was approximately half of the total in 1997, amounting to 8,635 salmonids. This catch was dominated by chum (76%), followed by sockeye (8%), coho (7%), chinook (5%), pink (2%), steelhead and Dolly Varden (1%), and one masu salmon (Ohkuma et al. 1999). In 1999, an abundant year for pink salmon in the Bering Sea was characterized by lower than expected total catches, particularly for sockeye, coho, and chum salmon. A total of 12,568 salmonids was caught, including primarily pink salmon (76%) followed by chum (17%), sockeye (5%), coho and chinook salmon (1% each), and steelhead (<1%).

3.2.1.3 *Kaiyo maru*

One FRI scientist (N. Davis) participated in the cooperative Japan-Russia-U.S. salmon research cruise on board the *Kaiyo maru* from 3 February to 2 March 1998 in the western (165°E) and central (180°) North Pacific Ocean and Bering Sea (180°) (Fig. 12; Davis 1998a, Ishida et al. 1998b). This was the third overwintering salmonid survey (December 1992, January 1996, and February 1998) conducted by researchers on the *Kaiyo maru,* and this cruise was the first wintertime salmon research cruise in the central Bering Sea since 1964. The combined results of the three *Kaiyo maru* surveys indicate that salmon in their first ocean winter are distributed well offshore, and that in the western North Pacific Ocean, chum and pink salmon are more abundant in offshore waters in February than in December or January (Davis 1999). Most of the salmon catch (2,381 salmonids) in February 1998 was distributed in a narrow band from 42°-45°N in the western North Pacific Ocean (at 165°E). Chinook salmon was the only species caught in the Bering Sea. Most of the new information collected during this cruise pertained to wintertime salmon distribution in the Bering Sea. There was no catch of sockeye salmon in the central Bering Sea in 1998, unlike the results of earlier studies in the 1960s. Sockeye salmon may have changed their winter distribution, or the sampling effort by the *Kaiyo maru* may have been insufficient to catch sockeye salmon. Chum salmon were not caught in the Bering Sea during the 1998 cruise, but in other studies incidental catches of chum and chinook salmon near the 200-m depth contour suggest that these salmon may reside on or near the bottom at this depth in the Bering Sea. These results suggest that a detailed wintertime trawl survey in the Bering Sea would be helpful in updating our models of salmon distribution and seasonal movement.

3.2.1.4 Trends in salmonid abundance, maturity, age, and size

On the *Oshoro maru* salmon research cruise along the 165°W transect in late June, salmonids were caught by research gillnet in the Ridge Domain (47°-50°N) and the Subarctic Current (44°-45°30'N; Table 6; Yamaguchi et al. 1999). Sockeye salmon were less abundant in both areas, while chum salmon were at levels similar to those of 1998. Pink salmon were four times as abundant as in 1998 in the Ridge Domain. Coho salmon were again almost absent in the Ridge Domain; abundance in the Subarctic Current was half that of 1998.

Along the 145°W transect in early July, salmonids were caught by research gillnet in the Subarctic Current (50°-51°N) and the Ridge/Dilute Domains (52°N-56°N). The relative abundance of sockeye and chum salmon in catches in both regions of the 145°W transect was generally near 1994-98 average values (Table 6). In the Subarctic Current. sockeye salmon were predominantly maturing, ocean age-.2 fish. In the Ridge/Dilute Domains, where in previous years sockeye salmon were predominantly maturing ages-.2 and .3 fish, catches were evenly distributed among immature age-.1, immature age-.2, and maturing age-.2 sockeye salmon (Table 7). Chum salmon in both areas were almost all (88%-90%) immature, ocean age-.2 (Table 8). The abundances of both pink and coho salmon in both oceanographic areas in 1999 were the highest observed in all six years of sampling. The few chinook salmon caught along 145°W were all immature ocean age-.2. Steelhead are usually predominantly juvenile, ocean age-.0 fish, but in 1999 half of the fish were maturing (Table 9). Fork lengths, body weights, and condition factors of salmonids in the 1994-99 *Oshoro maru* research gillnet (C-gear) catches are summarized by species, age group and oceanic area (Tables 10-13). Preliminary statistical analyses of these biological data indicate that variation between stations within one year is as high as variation between years or between oceanic areas.

There is a correspondence between catches of pink salmon in the Ridge/Dilute Domain (northern end of 145°W transect) and catches in south central Alaska (Fig. 14). The previous highest average CPUE (57 pink salmon in research mesh) was in 1998, but in 1999 the average CPUE jumped to 95 fish (Table 6). Catches were also high in the Subarctic Current, where the CPUE was 58. This leads to expectations of a very large run of pink salmon in central Alaska. In line with the large numbers of pink salmon and theories of density dependence, pink salmon body size was extremely small (mean weight 1098 g vs. 1994-98 average of 1311; mean length of 453 mm vs. 1994-98 average of 475), although condition factor was close to average (Table 12).

In 1999, the ABL-chartered vessel *Great Pacific* conducted a similar research track to that of the *Oshoro maru* approximately seven weeks earlier (May 3-24, Fig. 12). A full report of the cruise was made by ABL (Carlson et al. 1999b), but a preliminary comparison of abundance, age, maturity, and size data is presented here. Several cautions are in order:

- some sample sizes from both cruises are low, so the accuracy of average sizes and age composition may be low.

- the gear used were different; the *Great Pacific* can catch smaller fish with its trawl. (It is significant that although the trawl can catch juveniles, none were caught in offshore areas.)

- to expand sample sizes, comparisons are made using *Great Pacific* haul stations split at latitudes corresponding to those of oceanographic boundaries determined on the *Oshoro* maru cruise. These may have less meaning for the earlier cruise, when the mixed layer was much deeper and when it is harder to determine oceanographic regions. In addition, *Great Pacific* stations were included to the north and south of *Oshoro maru* sampling.

Relative CPUE indices from the two vessels indicate sockeye salmon were more abundant in May and chum and pink salmon were more abundant in July in the Ridge Domain (47°N-51°N *GP*, 47°N-50°N *Oshoro*) along the 165°W transect (Fig. 15, Tables 6 and 14). Although higher sockeye abundance in May would seem likely, due to the presence of Bristol Bay sockeye stocks on their homeward migration, in fact both cruises had similar age and maturity profiles, with two-thirds or more of the fish immature (Fig. 16, Table 15). This suggests that many Bristol Bay fish may not be in this area in early May. Chum salmon were bigger, older, and all mature in May. These are perhaps maturing western Alaskan summer-run fish on homeward migrations. Nearly all fish were immature in June. CPUE indices of all species were similar in the Subarctic Current (41°N-46°20'N *GP*, 44°N-45°30'N *Oshoro*) along the 165°W transect. Here chum salmon were predominantly immature age 0.2 fish on both cruises. Pink and coho salmon were smaller in May, as would be expected from sampling earlier in the season.

Along the 145°W transect in the Ridge/Dilute Domains (52°N-57°30'N *GP*, 52°N-57°30'N *Oshoro*), relative CPUE indices showed that pink salmon were much more abundant in July, and coho were somewhat so (Fig. 15, Tables 6 and 14). At these stations, north of the Subarctic Current, the *Great Pacific* caught no pink salmon (or coho, chinook, or steelhead) and no immature fish. Sockeye in May were all mature and predominantly ocean age-.2, but in July only 41% were mature and fish were evenly distributed among immature ocean age.1, immature age-.2, and mature age-.2 fish (Fig.

17, Table 15). Chum salmon age and maturity completely changed, from older (96% age 0.3 and 0.4) mature (100%) fish in May to younger (89% age 0.2) immature (97%) fish in July.

In the Subarctic Current (42°30'N-51°N *GP*, 50°N-51°N *Oshoro*), relative CPUE indices of all species were similar; sockeye and chum salmon were somewhat more abundant in May (Fig. 15). Ocean age-.2 was the dominant sockeye age class in both months, but a higher proportion of July fish were mature (94% vs. 28%) and older (29% age-.3 vs. 0%, Fig. 17, Table 15). May fish were also smaller. To a lesser degree than on the northern part of the transect, there were more old, maturing chum salmon in May than in July (23% age 0.3 and 0.4 vs. 10%; 20 % mature vs. 0%). Pink and coho salmon were smaller on the May cruise.

3.2.2 Food habits research

3.2.2.1 Summary of salmon food habits, *Great Pacific*

Shipboard analyses were conducted on stomach contents of salmon caught during the 3 May to 24 May 1999 cruise of the F/V *Great Pacific*. Stomach contents data were summarized by salmon species, region, and major prey category (Table 16). The major prey of sockeye salmon was euphausiids in the Ridge/Dilute Domains along 145°W (central GOA) and gelatinous zooplankton (primarily appendicularia) in the Subarctic Current. In the Ridge Domain along 165°W sockeye were eating mainly amphipods. In stomach contents of chum salmon, gelatinous zooplankton predominated in most areas. Along 165°W, chum salmon contents were often too well digested to identify to major prey categories. In the Ridge/Dilute Domains in the central GOA chum prey were roughly evenly divided between euphausiids, pteropods, gelatinous zooplankton, polychaetes, and copepods. Copepods and amphipods were the major prey of pink salmon along 165°W and together with gelatinous zooplankton (primarily appendicularia) and pteropods composed most of the diet in the Subarctic Current along 145°W.

3.2.2.2 Summary of salmon food habits, *Oshoro maru*

Six years of sampling along a 145°W transect by the *Oshoro maru* in the central GOA have shown some striking differences in the food habits of salmonids in Ridge/Dilute Domain versus Subarctic Current areas (Tables 17-18). In the Subarctic Current, squid, primarily *Berryteuthis anonychus*, has been the dominant prey of all species except chum salmon, which had a much more diverse diet (primarily euphausiids, amphipods, pteropods, and gelatinous zooplankton). This corroborates the results of earlier studies, and highlights the importance of *B. anonychus* in the diets of salmon in the Subarctic Current area of the GOA. In 1999 there was a major reduction in the percentage of squid in the diets of sockeye and pink salmon and steelhead trout in this area, and stomach content indices (SCI; prey weight*100/body weight) were lower than five-year means for all species. Pink salmon in particular showed a very large decline in proportion of squid in its diet, from an average of 65% to 2%. This was probably due to both a decrease in availability of squid and the small size of pink salmon (as discussed above), substantiating a hypothesis that below a certain size pink salmon are unable to feed on squid.

In the Dilute Domain (Table 17), prey composition of stomach contents of sockeye, chum, and pink salmon is more diverse and the mean SCI is often lower than in the Subarctic Current. Coho, chinook, and steelhead tend to specialize in feeding on squid and fish, regardless of oceanic area, but in 1999 coho diet was more diverse, with high proportions of euphausiids and amphipods as well as squid.

The first two years of sampling along a 165°W transect showed some differences in salmonid food habits in the Subarctic Current compared with feeding in that same oceanographic region along 145°W (Table 19). Squid were still an important food item for all species except chum salmon, but not always the dominant prey. Food habits of sockeye, pink, and chum salmon in the Ridge Domain were similar to those found in that domain and the Dilute Domain along 145°W.

3.2.2.3 Comparison of GOA salmon food habits in spring and summer

A comparison of food habits in May from the *Great Pacific* and in June-July from the *Oshoro maru* shows that the SCI was higher in May along 145°W especially in the Ridge/Dilute domain (2-4 times higher than in July for sockeye and chum; Tables 16-18). In general, gelatinous zooplankton (appendicularia, ctenophores) were much more abundant in sockeye, chum, and pink salmon stomachs in May (14-71% of diet). Crustaceous zooplankton, especially amphipods, and squid made up higher percentages of diets in the Ridge/Dilute Domains in July. Differences between the two cruises were less pronounced along 165°W (Tables 16 and 19). In May SCI was higher for chum salmon and much higher for pink salmon in the Subarctic Current. There were no outstanding differences in prey categories.

3.2.2.4 Trends in salmonid food habits, *Wakatake maru*, 1991-1998

Researchers on board the *Wakatake maru* have examined salmon stomach contents at sea along 180° longitude in the central North Pacific Ocean and the central Bering Sea for eight years. These data were summarized by year, species, oceanographic domain, size, and maturity.

3.2.2.4.1 Central North Pacific Ocean

In the central North Pacific, few salmon were caught in the area south of the Subarctic Boundary in the Transition Zone. Most were chum salmon, which fed on myctophids, salps, and heteropods, a transparent mollusc (Table 20). In the Transition Domain, more salmon species were sampled. The chum salmon in the Transition

Domain fed on chaetognaths, gelatinous forms, e.g., salps, coelenterates, and ctenophores, heteropods, and crustaceans (euphausiids, amphipods, and ostracods; Table 21). The pink salmon caught in the Transition Domain fed on ostracods, chaetognaths, and crustaceans. Ostracods and heteropods are characteristic of salmon stomach contents in catches in these southern waters. Coho salmon fed on squid (*B. anonychus*) and fish, identified in 1997 as Japanese anchovy (Nagasawa and Davis 1998). Steelhead caught in the Transition Domain fed on squid (henceforth *B. anonychus*, unless otherwise noted), myctophids (often *Tarletonbeania crenularis*), and floating debris including wood, and plastic sheet and foam material often encrusted with gooseneck barnacles (Table 21). Chum salmon in the area of the Subarctic Current fed heavily on gelatinous forms (coelenterates, ctenophores, and salps), chaetognaths, and unidentified material, which could be digested gelatinous prey (Table 22). In 1993, chum fed heavily on appendicularia ("other" category), suggesting that appendicularia may have a patchy distribution and when abundant can be important prey for chum salmon. In the Subarctic Current, sockeye and pink salmon fed on squid, amphipods, copepods and pteropods, while chinook and coho salmon fed predominately on squid, and steelhead fed on squid, fish (Atka mackerel (*Pleurogrammus monopterygius)*, three-spine sticklebacks (*Gasterosteus aculeatus*)) and floating debris (Table 22). There is not much difference in salmon prey composition between the Subarctic Current and the Ridge Domain further to the north, except that in the Ridge Domain coho salmon fed on small larval squids rather than feeding exclusively on adult *B. anonychus* (Table 23). In the Alaska Stream, sockeye salmon fed predominately on crustaceans and squid, but in 1995 and 1997, also fed rather uncharacteristically upon gelatinous forms, indicating that feeding on gelatinous prey is not exclusively the specialty of chum salmon. In 1997, chum, pink, and sockeye salmon stomachs contained a large proportion of appendicularia, suggesting that several species of salmon feed on appendicularia when this prey is available (Table 24).

The salmon stomach contents data were grouped by body weight and maturity group for fish collected in the central North Pacific Ocean from 1991 to 1998. Morishita's diversity index was calculated, whereby the index equals one when there is one prey category and equals 13 if there were equal proportions in each of 12 categories. In the central North Pacific Ocean, the most diverse diet is shown by chum (8.1) followed by pink (6.4), sockeye (6.0), and steelhead (3.6; Table 25). Coho (1.8) and chinook salmon (1.3) had the lowest diversity of prey composition. Copepods and amphipods are a higher component of the diet of sockeye smaller than 2500 g. Although squid are eaten by sockeye of all sizes, there is a trend towards more squid and euphausiids in the diet with increasing fish size, particularly for sockeye salmon larger than 2500 g (Table 25). Gelatinous zooplankton is a major component of chum salmon diets in all size groups of fish, suggesting that prey composition may not to be related to fish size or maturity for the size groups included in this study. All the pink and coho salmon were maturing ocean age-.1 fish; therefore there is a narrow range of size groups in the sample. However, there is a trend indicating that copepods and amphipods are more important in the diets of smaller pink salmon (<1000 g), and there is an increasing proportion of squid in the diets of pink salmon larger than 1000 g (Table 25). Squid are important prey of coho salmon of all size groups sampled, if the single fish in the largest size class is discounted from consideration. With increasing coho salmon body size, amphipods decrease and fish increase in the diet (particularly for coho larger than 2500 g, Table 25). There are no data for small chinook (less than 1500 g), but squid is the primary prey of chinook salmon for all sizes for which there are data. Squid and fish are important prey for steelhead at all sizes, but steelhead greater than 2000 g tend to eat more squid and less floating debris.

3.2.2.4.2 Bering Sea

Stomach contents data collected from fish caught in the Bering Sea indicate that sockeye, pink, chum, and chinook salmon contain a higher proportion of squid, fish, and euphausiids than salmon caught in the central North Pacific (Table 26). In the Bering Sea samples, there is a greater variety of squid than in the waters to the south. The squids observed in these stomachs include adult *B. anonychus*, small larval squids that could be young *B. anonychus*, and other unidentified gonatid squids. There is also a greater variety of fish, including larval flatfish and other fishes, juvenile pollock, *Hemilepidotus* sp., Atka mackerel, and myctophids (likely *Stenobrachius leucopsarus*; Table 26). The rich variety of prey found in salmon stomachs in the Bering Sea during summer suggests favorable summertime feeding. Correspondingly, summer CPUEs (catch per 30 tans of research mesh gillnet) of salmon in the Bering Sea are approximately five times higher than CPUEs in the central North Pacific (Myers et al. 1998d).

Sockeye, chum, pink, and chinook salmon prey compositions were stratified into odd and even year-of-catch because there is a strong pulse of abundant odd-year pink salmon in the Bering Sea, amounting to an approximate thirty-fold fluctuation in pink salmon abundance (Myers et al. 1998d). For sockeye salmon the average SCI (prey weight as a proportion of body weight) for all fish was lower (0.61) in odd years than in even years (0.90), suggesting that ration may be lower for sockeye salmon during periods of high pink salmon abundance (Table 27). Euphausiids and copepods are fed upon by sockeye salmon of all sizes, but were more common in the stomach contents collected in even than odd years. Crab larvae appeared more commonly in sockeye salmon sampled during odd years. Sockeye salmon fed heavily on squid and fish regardless of body weight. Amphipods were more abundant in the stomach contents of sockeye salmon smaller than 2000 g. The SCI of chum salmon is higher for odd years (1.30) than for even years (1.07, Table 28). In even years, euphausiids and copepods are more common in the diets of chum salmon. In contrast, fish, appendicularia, and unidentified material that may be digested gelatinous zooplankton are more common in stomach contents sampled from chum salmon caught in odd years. This suggests that although the volume of prey in the chum stomachs may not change greatly during periods of high pink salmon abundance, the spectrum of prey types may change. Chum salmon in the Bering Sea, like those caught in the central North Pacific, do not appear to change their diet in relation to size and maturity within the size ranges considered in this study (Table 28). Pink salmon ate much more fish and squid in the Bering Sea than in the central North Pacific. The SCI for pink salmon is higher in even (1.48) than odd years (1.28), which suggests decreased feeding during periods of high pink salmon abundance (Table 29). When pink salmon are abundant in the Bering Sea, their diet includes more amphipods and squid and less fish than in even years. Conversely, in even years the stomachs of pink salmon contain more euphausiids. There is a trend for increasing proportion of euphausiids in the diets of pink salmon larger than 1500 g. There is more diversity in the prey composition of chinook salmon in the Bering Sea than in the central North Pacific because chinook salmon of all sizes eat more fish and euphausiids in the Bering Sea than in the central North Pacific (Table 30). During odd years, small chinook salmon, less than 1000 g, may not eat as many euphausiids as chinook salmon sampled during even years.

Catches of Dolly Varden char (*Salvelinus malma*) during research operations of the *Wakatake maru* in the Bering Sea were five times more abundant in July 1998 than at any time since sampling began in 1991, which provided a rare opportunity to examine the stomach contents from a large number of fish (Ueno et al. 1998). Results of stomach content analysis indicated the proportion of empty stomachs increased with body size, and thus ration (SCI) decreased from 2.2 to 0.4 with increasing char body weight (Table 31). Fish, primarily myctophids, were an important prey of all sizes of char, and were the predominant prey of char larger than 2000 g. Euphausiids were also more common in larger fish. Amphipods were an important prey of char, particularly of char smaller than 1500 g. Stomachs of small char, less than 500 g body weight, did not contain squid, but char larger than 1500 g contained 10-15% squid (small larval squid) by volume. Because the char diet consisted of fish, amphipods, euphausiids, and squid, their diet was similar to that of pink salmon caught in the same vicinity in the Bering Sea.

3.2.2.5 Diel variation in feeding habits and estimates of digestion rate

Salmon caught by surface gillnet in the central Bering Sea were sampled for diel changes in prey composition and stomach content weight (Davis et al. 1998a, 1999). Salmon fed throughout the day, but peak catches and feeding activity varied among species. Pink salmon catches peaked between midnight and shortly after sunrise, and their feeding activity showed two peaks, after sunset and at noon. Sockeye salmon feeding activity increased just after sunset, and catches peaked in the early morning hours after sunrise. Chum salmon catches showed two peaks (sunrise and mid-day), and feeding activity peaked in mid to late afternoon.

Dominant prey species shifted between daytime and nighttime feeding periods; At night, sockeye and pink salmon fed primarily on euphausiids and copepods, while chum salmon diets were more diverse (gelatinous zooplankton, euphausiids, pteropods, fish, and appendicularia). During the day, sockeye salmon fed on crab larvae and fish; pink salmon fed on fish, squid, and crab larvae; and chum salmon fed on fish. Our results suggest that sampling fish throughout the diel cycle is required to provide an accurate assessment of salmon feeding ecology.

Digestion rates were estimated based on changes in stomach content weight from fish sampled over the diel period. However, the digestion estimates yielded no improvement to those already provided by more direct observation during shipboard experiments. There was a lack of a clearly defined peak followed by a trough in the stomach contents data, and sensitivity analyses indicated that digestion rates are sensitive to estimated start and end times of feeding. This may be due to dissimilar diel feeding periods for different prey in the salmon diet.

3.2.3 Growth studies

3.2.3.1 Time of scale annulus formation in chinook salmon

A large database (5,066 fish) of information on time of formation of the last ocean annulus on scales collected from coded-wire tagged chinook salmon recovered in Washington State coastal waters from 1988 to 1993 was analyzed and reported in 1998 (Hyun et al. 1998). The most important finding was that time of ocean annulus formation varied by freshwater age or behavioral type. Chinook salmon that migrated to the ocean in their first year (freshwater age 0.) completed formation of the last ocean annulus in March, and chinook salmon that migrated to the ocean in their second year (freshwater age 1.) completed annulus formation in April. Inter- and intra-specific differences in time of ocean annulus formation on salmon scales likely reflect differences in growth rates, regulated by feeding conditions.

3.2.3.2 Chum and sockeye salmon growth in the GOA

Studies were conducted of growth on scales collected from salmon caught during high seas research cruises in the GOA. This is an extension of an earlier study of scale growth of pink and chum salmon south of the central Aleutian Islands (Walker et al. 1998d). Measurements were made of scales of chum and sockeye salmon caught by Japanese research vessels from 1982 to 1997 and examined for stomach contents. Measurements were taken to the end of each annular mark and at the edge of the scale, and to every circulus on the scale. Scale measurements (particularly growth at the edge of the scale) were then compared to indices of stomach fullness and other measures of condition and growth. Edge growth of scales from 1993-97 for ocean age-.2 chum and sockeye shows no correlation with prey weight or SCI. Edge growth of scales from 1983-85/1993-95/1997 shows no correlation with stomach fullness indices. Early growth (first and second ocean years) on sockeye salmon scales shows no trend with time, but edge growth (third ocean year and edge growth variables) was less in the 1990s samples than in 1980s samples. Chum salmon scale edge growth was also slightly lower in the 1990s.

3.2.3.3 Growth hormone studies

Blood plasma levels of insulin-like growth factor-I (IGF-I) may be a new index for ocean growth of Pacific salmon in offshore waters as levels of IGF-I have been shown to correlate significantly with body and liver weight in all species except pink salmon (Myers et al. 1998a). This work has continued since 1997 by collection of blood plasma from representative size and age groups of salmonids during different seasons, years, and oceanographic areas. These samples were collected in June, July, August 1997, and May 1998 from the GOA and Aleutians Islands area (*Oshorò maru* and *Great Pacific*) and from February 1998 surveys the western and central North Pacific Ocean and Bering Sea (*Kaiyo maru*). NMFS scientists have postponed analyses of these samples until completion of new studies of IGF-I binding proteins. Results will be reported when these analyses are completed.

3.2.4 Carrying Capacity and Bioenergetics Research

3.2.4.1 Bioenergetic models of salmon growth using DST temperature data

Data storage tags provide a new technology for acquiring environmental data from salmon migrating at sea. In 1998 and 1999, temperature-recording data tags were recovered in Alaska and Japan from salmonids tagged in the GOA and Bering Sea (see section 3.1.1.1). One use of temperature data records is to improve bioenergetic models of salmon growth in the ocean. Recent bioenergetic models of salmon growth have often used constant, fixed temperatures, as information on actual daily temperature regimes for salmon was lacking. We used actual frequencies of time spent at different temperatures and overall average temperatures in a bioenergetic model, and compared the results to simulated salmon marine growth under constant temperatures (Walker et al. 1999b). Over a 30-day simulation, final weights of fish at actual temperatures differed from weights of fish at a constant temperature by 0.4%-2.3%. Differences were usually negative, because fish migrated from cooler waters where the constant temperatures used in our analyses were chosen, to warmer coastal waters. The level of resolution of the actual temperature data (overall average, proportion of time at different temperatures, daily averages, daily day/night averages) made little difference (0.2%) in final weight estimates. We conclude that high-seas salmon growth is more sensitive to food consumption than to temperature.

3.2.4.2 Salmon carrying capacity in the GOA

Food habits data from the 1950s, 1960s, 1980s, and 1990s and oceanographic and zooplankton data from the *Oshoro maru* GOA cruises in the 1990s were used to develop a conceptual model for density-dependent growth of maturing pink and sockeye salmon (Fig. 18; Aydin unpublished). This model differs from previous models of salmon carrying capacity in that it places a critical period of density-dependent growth in the winter for pink and ocean age-.2 sockeye salmon, rather than in the final weeks of their summer homeward migration. An important component of this model was the quantification of the ontogenetic shift of pink and sockeye salmon diets from zooplankton to micronektonic squid. This switch occurs as a function of salmon body weight (Fig. 19). Most pink salmon in the GOA achieve the body weight to make this dietary transition during the spring of their maturation year (ocean age-.1), while most sockeye make the transition during the spring of their third ocean year (ocean age-.2).

Making this transition greatly increases a salmon's potential for growth when micronektonic squid are present in the ocean environment. Therefore, the period immediately prior to this feeding transition, winter and early spring, is especially critical to growth. A 10% difference in an individual salmon's body weight at the end of winter may translate into a 50% difference in its body weight at the end of summer, as the initial difference in body weights will determine when the salmon reach a large enough size to catch squid.

Winter is a period of time when (1) salmon ocean ranges may be most limited, (2) mesozooplankton production is low, (3) both fish and micronekton are eating zooplankton and (4) the ocean ranges of pink and sockeye salmon stocks from Russia, Bristol Bay, central Alaska, southeast Alaska, British Columbia and Washington State show the most overlap in the GOA. Hence, it is probably during this time that between-stock density-dependent prey limitation takes place.

Pink salmon will be most strongly affected by this density dependence, due both to their high numbers and their need to obtain their final size during a single year at sea. Maturing ocean age-.2 sockeye would be affected as well, yet the timing of their maturation decision, if occurring in the winter, may mitigate density dependence. Coho salmon and older sockeye salmon, which feed at a higher trophic level, may be limited by the abundance of squid as described below, but not as influenced by winter density dependence. Chum salmon density dependence has not been quantified, due to their high digestion rates, distinct feeding mode, and unidentifiable nature of some of their prey in samples.

During the summer on the open ocean, environmental variation in prey distribution is probably more important than density dependence. Oceanographic conditions in the summer affect salmon growth both directly and indirectly. Directly, water temperature is an important physiological factor in determining salmon growth. Indirectly, temperature and circulation patterns may affect the abundance and distribution of prey.

A sensitivity analysis of bioenergetics models, using the *Oshoro maru* data, showed that within the range of sampled variation, prey weight was the most significant factor influencing growth overall of salmon sampled, while water temperature was the second. The water temperatures used in the bioenergetics model reflected the full range of temperatures in the upper 40 m of the water column. Body weight of salmon and prey type did not have as large an effect on the bioenergetics predictions (Fig. 20). However, this sensitivity analysis only models the "direct" physiological effects of the input variables on growth rate, and does not any include correlations which may exist between the input variables of water temperature, prey type, prey quantity, or salmon body weight. The importance of salmon body weight is mentioned above. When the analysis is repeated using the actual correlations between prey weight and prey type, the presence of squid becomes an important predictor of salmon growth potential for pink, sockeye and coho salmon in the GOA.

Squid presence is correlated with a composite of oceanographic conditions, including lower sea surface temperatures and weaker seasonal thermoclines. However, this correlation may result from a prey distribution mechanism involving ocean circulation patterns rather than water temperature. An examination of squid densities measured from salmon stomach contents reveals a precipitous decline in squid density from south to north along 145° W. Interannual variation in the latitude at which this decline occurs is correlated with the latitudinal July sea surface temperature minimum, which may be associated with the edge of the Alaskan Gyre (Fig. 21).

South of the July sea surface temperature minimum, surface waters are influenced by the West Wind Drift, and are generally cooler, less stratified, and contain a high abundance of squid in the diets of all salmon except chum. North of the minimum, surface waters are warmer and more stratified, and squid is replaced in salmon diets by less energy-dense zooplankton. NORPAC-net sampling indicates that summer zooplankton densities are higher in the north and lower in the south. The latitude of the temperature minimum varies from year to year, from a low of 49.5°N in 1983 to a high of 54°N in 1982, 1985 and 1986.

Previous studies of salmon growth found negative correlations between sea surface temperatures in the center of the GOA and the adult body size of some salmon stocks, such as Fraser River sockeye. Furthermore, researchers have projected a substantial decrease in viable salmon habitat in some scenarios of future global warming. The direct, physiological effect of warming sea surface temperatures on salmon growth may be mitigated by the ability of salmon to migrate vertically to cooler temperatures (Walker et al. 1998c). It is possible that sea surface temperatures measured at a single geographical location are, in current and past oceanic regimes, partially correlated with changes in ocean circulation, and thus with changes in prey abundance.

As evidenced by the diets of other fish species, micronektonic squid distribution in the summer extends farther south in the ocean than salmon distribution. Thus, there is a range of overlap between salmon and squid. Within the region of overlap, squid densities do not vary significantly from year to year. However, the total area of the overlap varies significantly.

The area of squid-salmon overlap can be computed as the area between the 13° isotherm in the south, which has been hypothesized as the southern limit to the distribution of sockeye salmon in the GOA, and the temperature minimum in the north (Fig. 16). In this study, the total ocean area is computed for the years 1982-99 between these two boundaries and 150°W and 160°W longitude, a major center of distribution for Fraser River sockeye.

The total area of proposed dietary overlap varies between a low of 1.0 million square kilometers in 1997 and a high 1.8 million square kilometers in 1987. It shows a strong negative correlation (r=0.9) with sea surface temperatures used in previous analyses of Fraser River sockeye body weights (Fig. 22). There is a decreasing trend in the size of the area between the early 1980s and 1998, followed by an increase in 1999. This change is highly correlated with the body weights of seine-caught sockeye salmon in fishing areas near the Fraser River. The correlation explains approximately 95% of the previously described relationship between ocean sea surface temperature and Fraser River sockeye body weight variation.

It is possible that sea surface temperature is the driving variable affecting salmon growth and squid abundance independently, although the sensitivity model suggests that prey distribution is more important as a direct control of growth (Fig. 20). The relationship between squid distribution and the Gyre temperature minima has only been examined in detail along 145°W longitude in July, although similar patterns have been noted previously further to the west. Bristol Bay and some central Alaskan sockeye salmon body weights also show a correlation with the area of overlap, but the correlation is less significant and may be muted by feeding in the Alaska Current during the final weeks of migration.

It is not known if this squid distribution relationship holds prior to the "regime shift" of 1976. Indeed, the conceptual model of density-dependence still requires the presence of zooplankton in early months to enable salmon to consume squid in later months. It is possible that in regimes with low abundance of zooplankton, the significance of squid as a prey item decreases and its importance as a salmon competitor increases.

Further work should extend this model of squid and salmon overlap to examine its importance further to the west, especially as more data becomes available along the 165°W and 180° transects. Moreover, to confirm these results, it is important to begin a sampling program for micronektonic squid in parallel with salmon food habits studies.

3.2.4.3 Physical and biological factors affecting ocean production of salmon

We reviewed the results of U.S. research in the 1990s on the physical and biological factors affecting ocean production of Pacific salmon and provided preliminary recommendation for revisions to the NPAFC Science Plan (Myers et al. 1999b). The current U.S. research plan includes studies on juvenile salmon in coastal waters, ecology of salmon in the GOA, retrospective analyses of long-term data series, development and application of stock identification techniques, and international cooperative high seas salmon research. Our review indicates that climate-induced variation in productivity and fishing are the two major factors affecting ocean production of salmon, but the underlying mechanisms are not well known.

The high seas distribution of salmon appears to be closely associated with distribution of their prey. Most growth occurs in summer months. High seas food-habit and bioenergetic studies provide evidence of feeding competition and density-dependent growth in summer. Density-dependent prey limitation probably takes place in winter, when lipid stores are critical to salmon survival. Sea temperature is the most important physical factor affecting growth, but bioenergetic models indicate that prey consumption is more important to growth in offshore waters than temperature. New salmon behavior studies using data storage tags show considerable diurnal and shorter-term variation in ambient temperatures and swimming depth in summer, indicating that non-lethal sea surface temperatures do not regulate the behavior of salmon on the high seas. These results do not minimize the potential problems associated with global warming, but warmer ocean temperatures in winter are associated with increased production of Alaska salmon. In the absence of large-scale high seas salmon fisheries, climate-induced changes in ocean productivity, acting through the food chain, may be the major factor affecting high seas production of salmon.

The revised NPAFC Science Plan will probably continue to address issues related to ocean productivity, carrying capacity, and changes in biological characteristics of salmon. Because funding for salmon research in international waters is limited, NPAFC needs a science plan that is both practical and relevant. Our preliminary recommendations are to replace the three components of the current science plan, (1) salmonid life history, (2) salmonid population dynamics, and (3) salmonid habitat and ecosystem, with methodological components that will focus and direct cooperative research efforts within the NPAFC forum. We suggest a stronger emphasis on (1) the development of new technologies and international baselines for salmon stock identification, (2) coordinated field research and monitoring programs to provide a platform for process studies, as well as data on interannual variation in ocean growth, distribution, and run timing of key stocks, and (3) the development and dissemination of international databases needed to advance scientific knowledge of salmon in international waters.

4. Research Coordination with ABL

During 1998-1999, all research by FRI was fully coordinated with ABL. This coordination included assistance in the writing and review of research plans and results, and participation of FRI scientists (K. Myers or S. Hyun) on board three cruises of the ABL-chartered research vessel *Great Pacific* (Fig. 12; Carlson et al. 1998, 1999b). In addition, FRI has provided samples, databases, and other ocean salmon research information to ABL, and coordinated transfer of information regarding high-seas CWT recovery records from ABL.

5. NPAFC Participation

5.1 Meetings

FRI scientists have regularly participated as U.S. salmon experts at NPAFC meetings, 1993-present. K. Myers has served as the U.S. member of the Science Sub-Committee since her appointment in October 1997. N. Davis served as the U.S. member of the Methodology Standardization Working Group, 1996-1999. K. Myers and R. Walker participated in the Committee on Scientific Research and Statistics (CSRS) at the 6th Annual Meeting in Moscow, Russia, Nov. 1-6, 1998, and K. Myers was the designated Rapporteur for this meeting. K. Myers participated in the CSRS at the 7th Annual Meeting in Juneau, Alaska, October 24-29, 1999, and was appointed Rapporteur for the 8th annual meeting in Tokyo. FRI researchers also participated in the NPAFC Research Planning and Coordinating Meeting held in March in Vancouver, B.C., Canada, 1998-1999 (K. Myers, R. Walker, and N. Davis). The NPAFC workshop "Climate Change and Salmon Production" was held in Vancouver, B.C., Canada, Mar 26-27, 1998, and FRI researchers presented or co-authored two research papers for that meeting (Aydin 1998, Kaeriyama et al. 1998). K. Myers, R. Walker, N. Davis, K. Aydin, and S. Hyun presented or co-authored ten papers at the NPAFC symposium entitled "Recent Changes in Ocean Production of Pacific Salmon" in Juneau, Alaska, November 1-2, 1999 (Aydin et al. 1999a,b, Carlson et al. 1999a, Davis et al. 1999, Kaeriyama et al. 1999, Myers and Carlson 1999, Myers et al. 1999b, Norris and Hyun 1999, Urawa et al. 1999c, Walker et al. 1999b), and submitted four abstracts to PICES for a joint conference on "Beyond El Niño", in La Jolla, California in March 2000. K. Myers is on the organizing committee for an NPAFC workshop, "Factors Affecting Production of Juvenile Salmon," to be held together with PICES in October 2000 in Tokyo, Japan.

5.2 NPAFC Documents and Reports

In 1998 and 1999, 23 documents were submitted or co-authored by FRI researchers for the CSRS at the NPAFC 6th and 7th Annual Meetings including Carlson et al. 1998; Davis 1998b; Davis et al. 1998a; Hyun et al. 1998; Ishida and Davis 1998; Ishida et al. 1998a,b; Myers 1998a, Myers and Hyun 1998; Myers et al. 1998b,c; Ueno et al. 1998; Urawa et al. 1998; Walker 1998; Walker et al. 1998 a,c; Carlson et al. 1999b; Kawana et al. 1999; Myers et al. 1999a; Ohkuma et al. 1999; Urawa et al. 1999b; Walker et al. 1999a; and Yamaguchi et al. 1999.

K. Myers served as the technical editor of the NPAFC Technical Report that was the Proceedings of the Workshop on Climate Change and Salmon Production held in Vancouver in March, 1998 (Myers, 1998c). Annually since 1997, K. Myers and C. Schwartz have edited and produced two issues of the NPAFC Newsletter (Spring 1997 Vol. 1(1), Autumn 1997 Vol. 1(2), Winter 1998 Vol. 2(1), Summer 1998 Vol. 2(2), Winter 1999 Vol. 3(1), and Summer 1999 Vol. 3(2)).

6. 1998-1999 Reports, Documents, and Publications

The authors supported by NOAA Contract No. 50ABNF700003 are indicated in bold characters.

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Aydin, K.Y., K.W. Myers, and R.V. Walker. 1999b. Multiple-scale variation in oceanographic and biological processes in the Alaskan Gyre—consequences for maturing salmon growth and carrying capacity. P. 6 *in* Abstracts of papers presented at the NPAFC International Symposium, Recent Changes in Ocean Production of Pacific Salmon, November 1-2, 1999, Juneau, Alaska. NPAFC, Vancouver, B.C.

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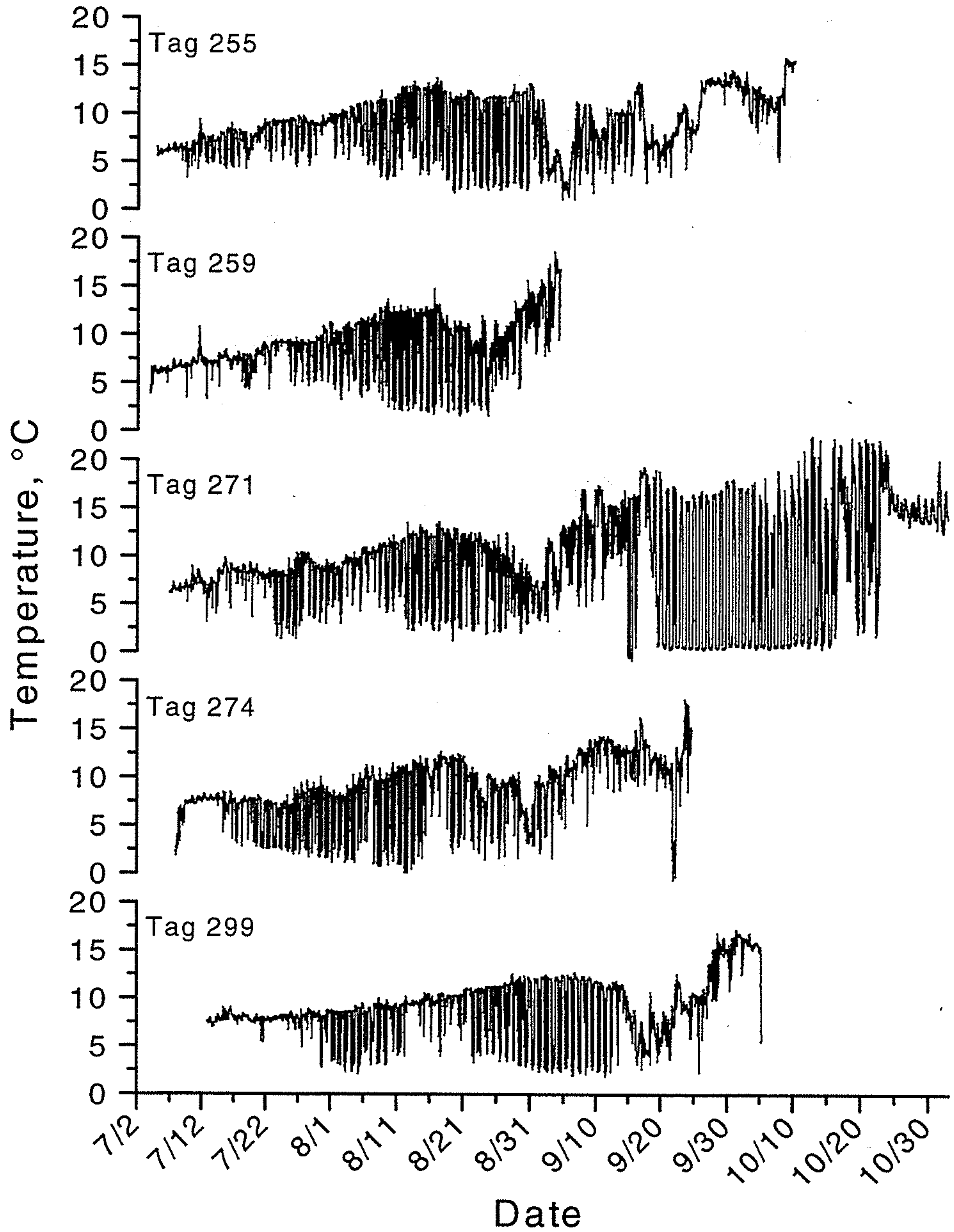


Figure 1. Ambient temperature data encountered by five chum salmon tagged in July 1998 in the Bering Sea and recovered in Hokkaido and Honshu, Japan. Tag 259 was previously reported and is included for comparison (Myers et al. 1998).

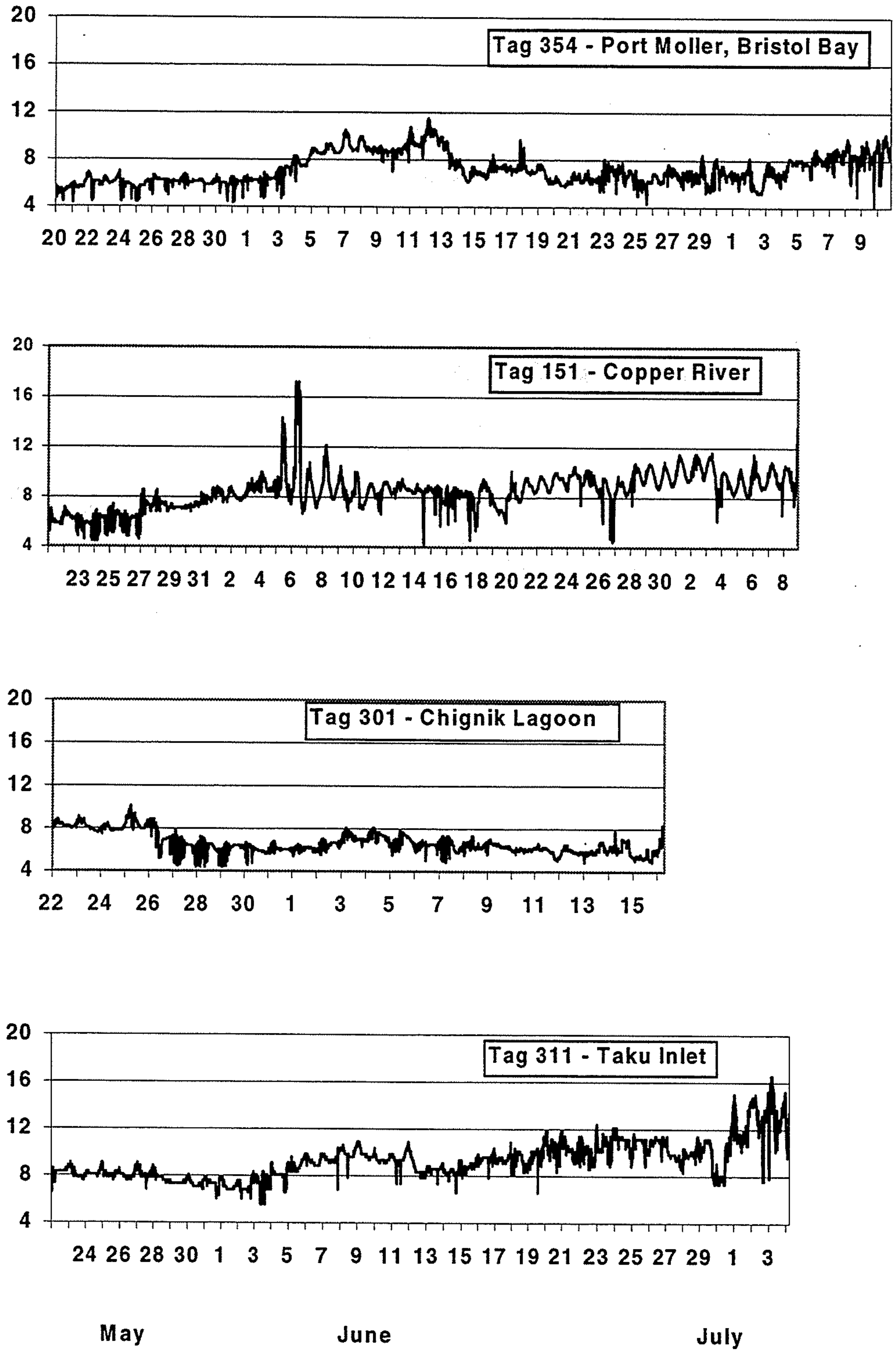


Figure 2. Ambient temperature data from data storage tags placed on four sockeye salmon in the Gulf of Alaska in May 1999 and recovered in Alaska.

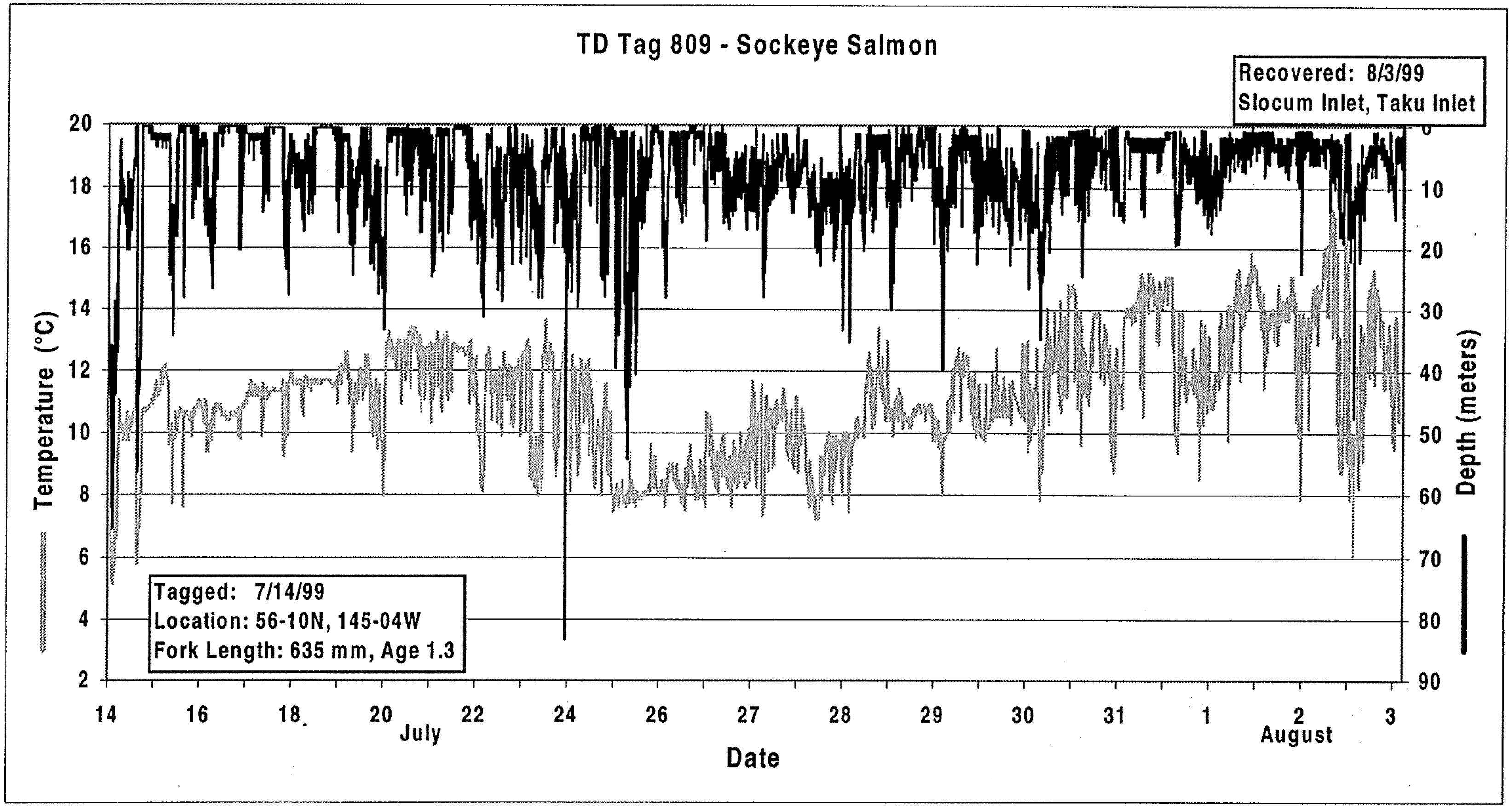


Figure 3. Temperature and depth data recorded on a data storage tag placed on a 635 mm sockeye salmon in the Gulf of Alaska on 14 July 1999 and recovered in Slocum Inlet,Taku Inlet, Alaska on 3 August 1999.

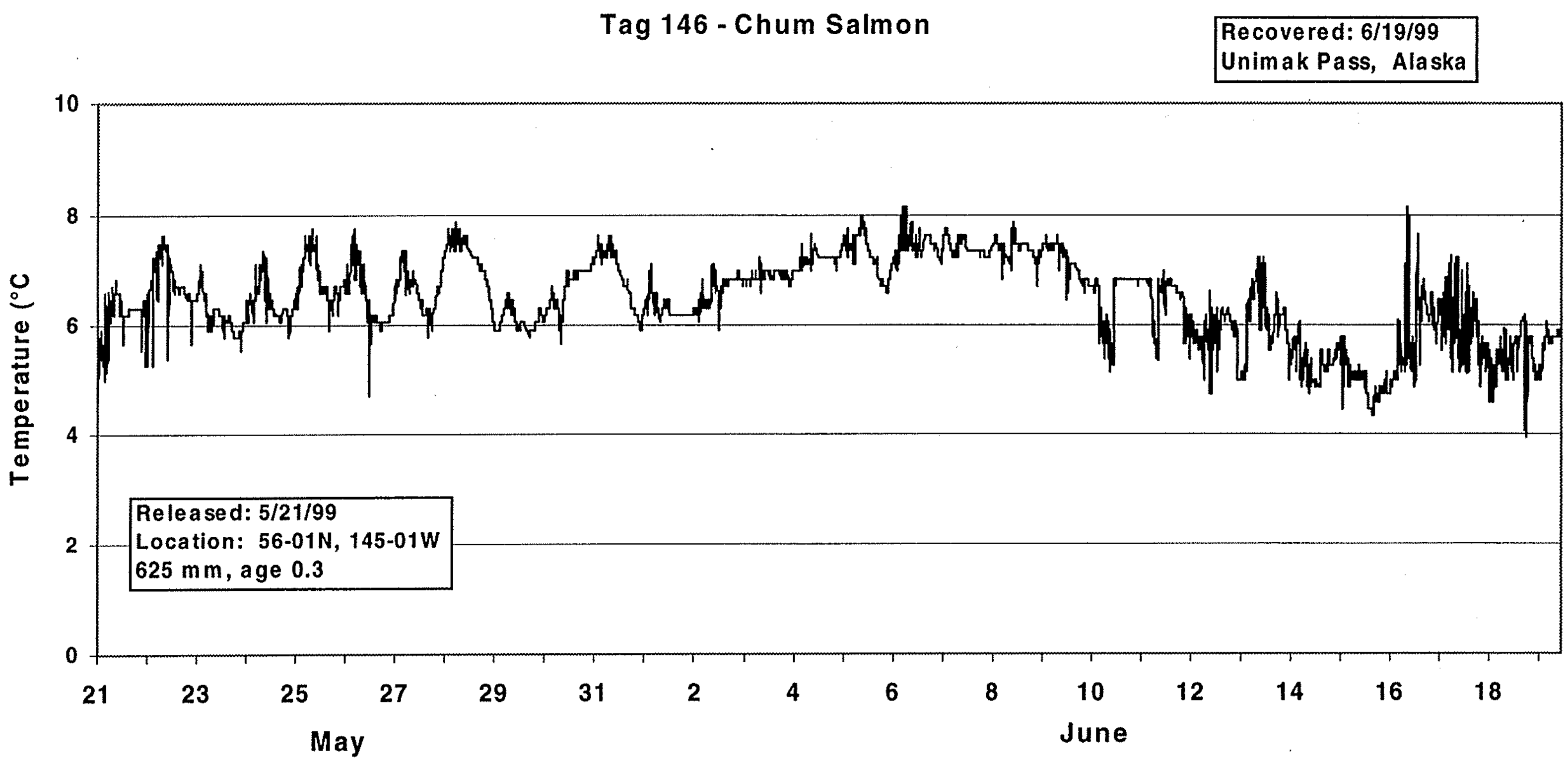


Figure 4. Temperature data recorded on a data storage tag placed on a 625 mm chum salmon in the Gulf of Alaska on 21 May 1999 and recovered in Unimak Pass, Alaska on 19 June 1999.

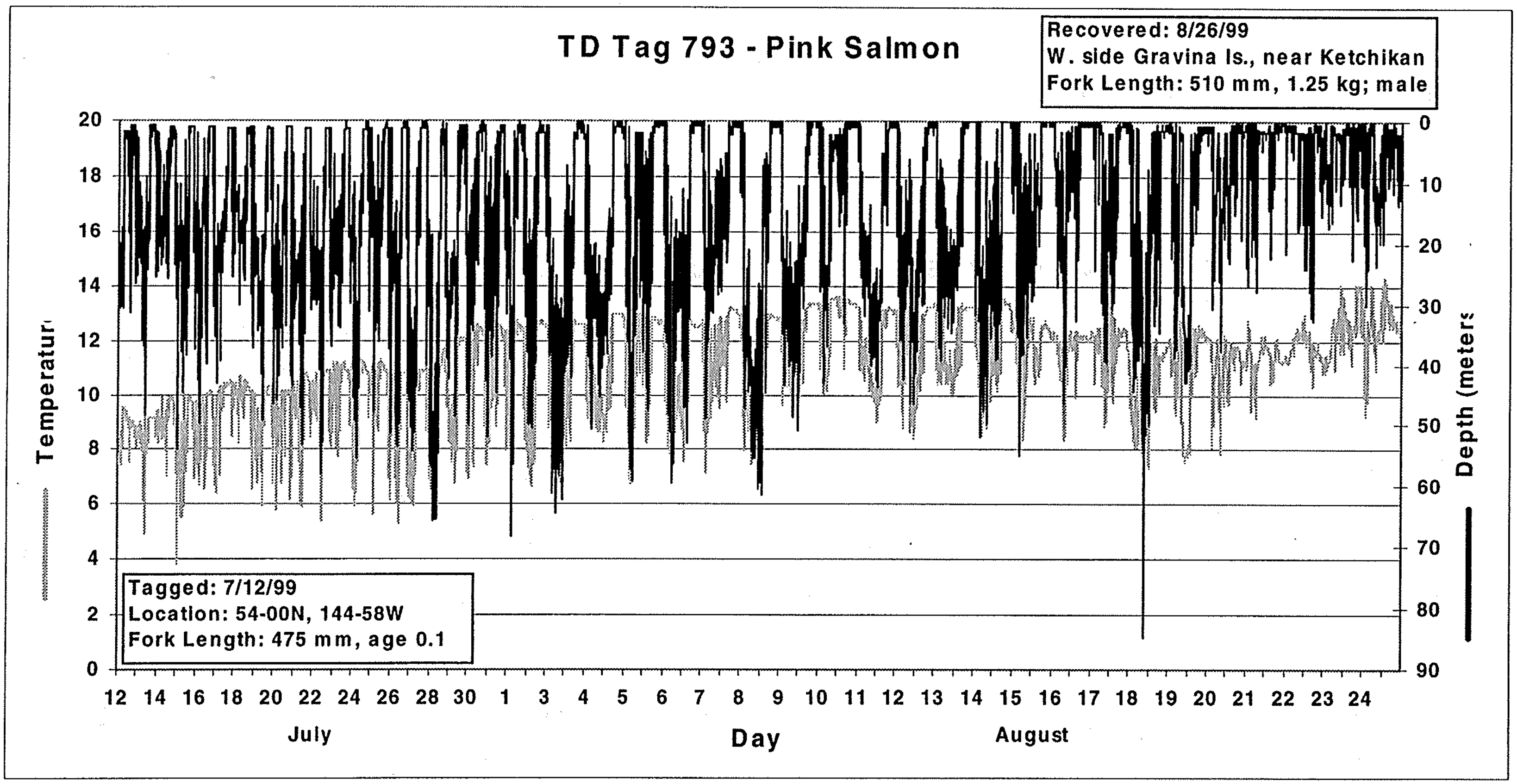


Figure 5. Temperature and depth data recorded on a data storage tag placed on a 475 mm pink salmon in the Gulf of Alaska on 12 July 1999 and recovered off the west coast of Gravina Island, southeast Alaska on 26 August 1999.

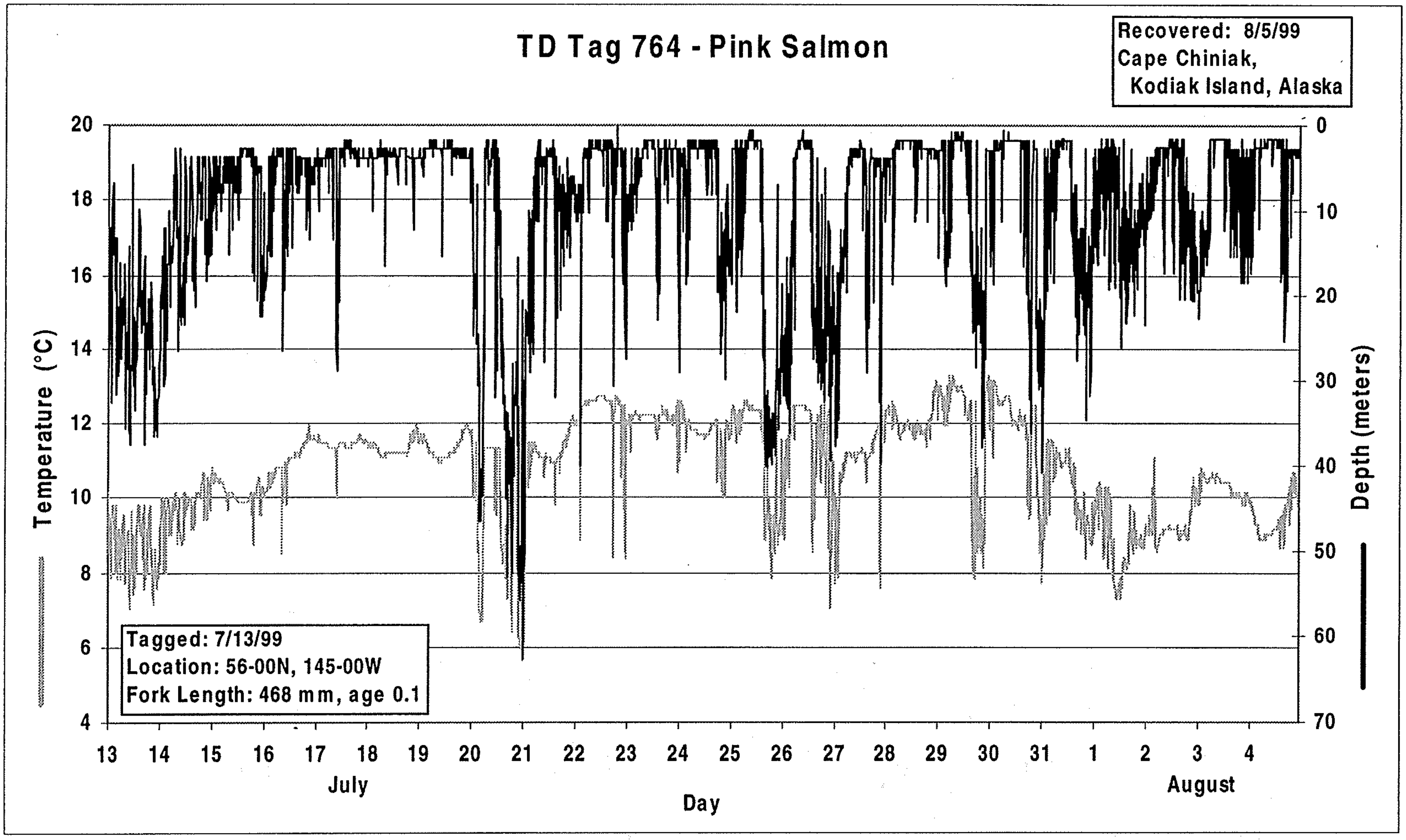


Figure 6. Temperature and depth data recorded on a data storage tag placed on a 468 mm pink salmon in the Gulf of Alaska on 13 July 1999 and recovered off Cape Chiniak, Kodiak Island, Alaska on 5 August 1999.

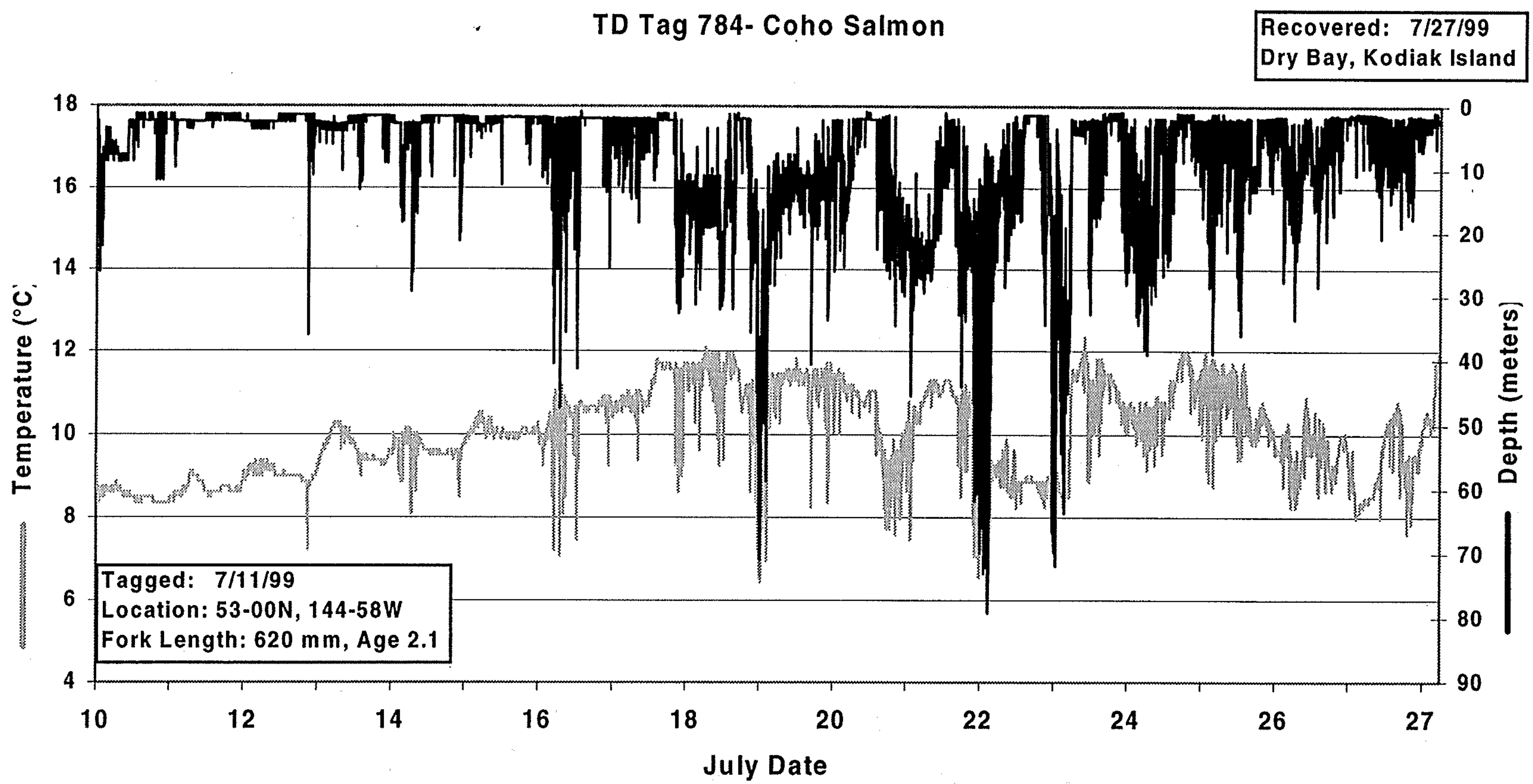


Figure 7. Temperature and depth data recorded on a data storage tag placed on a 620 mm coho salmon in the Gulf of Alaska on 11 July 1999 and recovered in Dry Bay (Sukhoi Bay), Kodiak Island, Alaska on 27 July 1999.

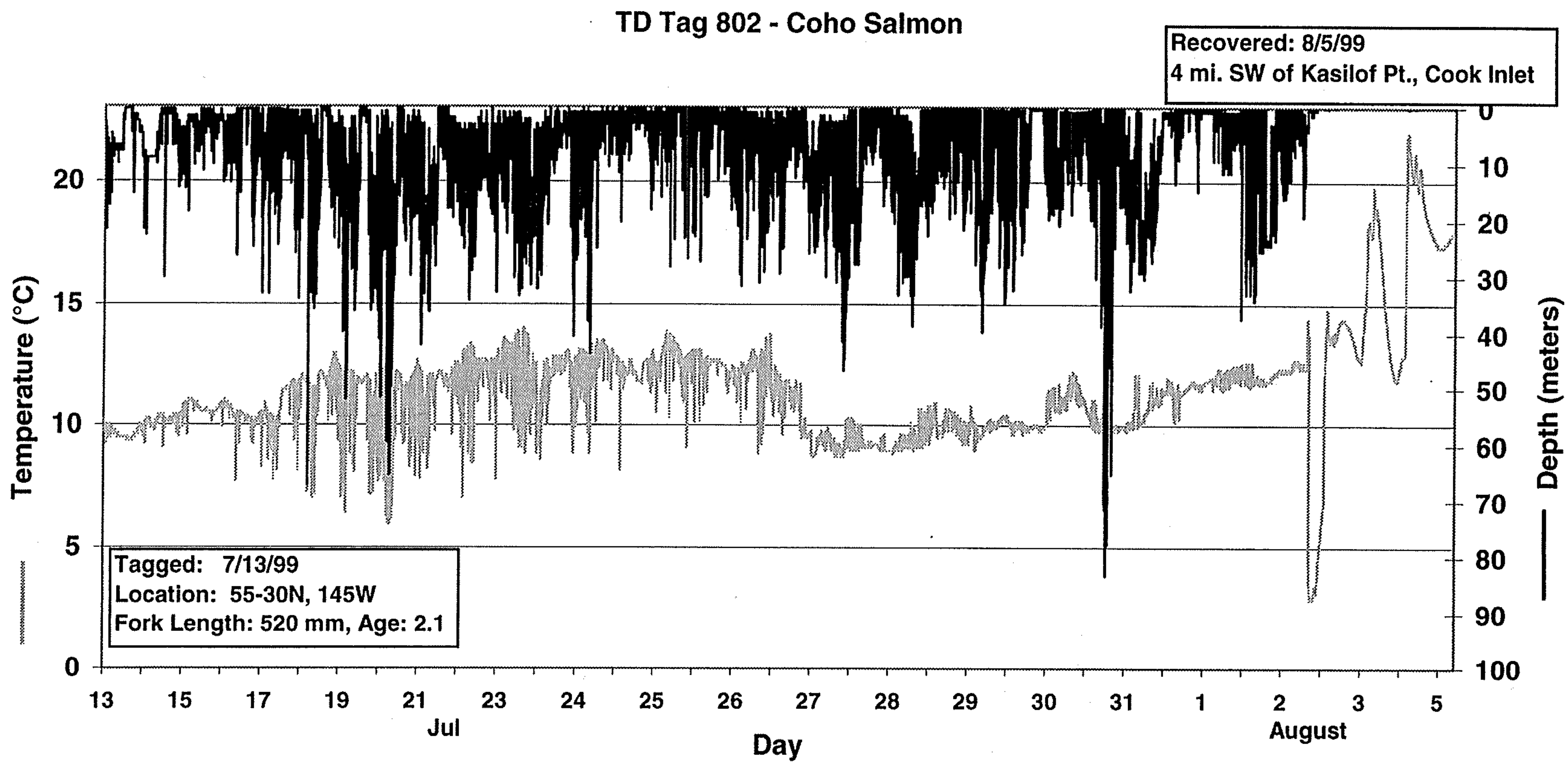


Figure 8. Temperature and depth data recorded on a data storage tag placed on a 520 mm coho salmon in the Gulf of Alaska on 13 July 1999 and recovered at Kasilof Point, Cook Inlet, Alaska on 5 August 1999.

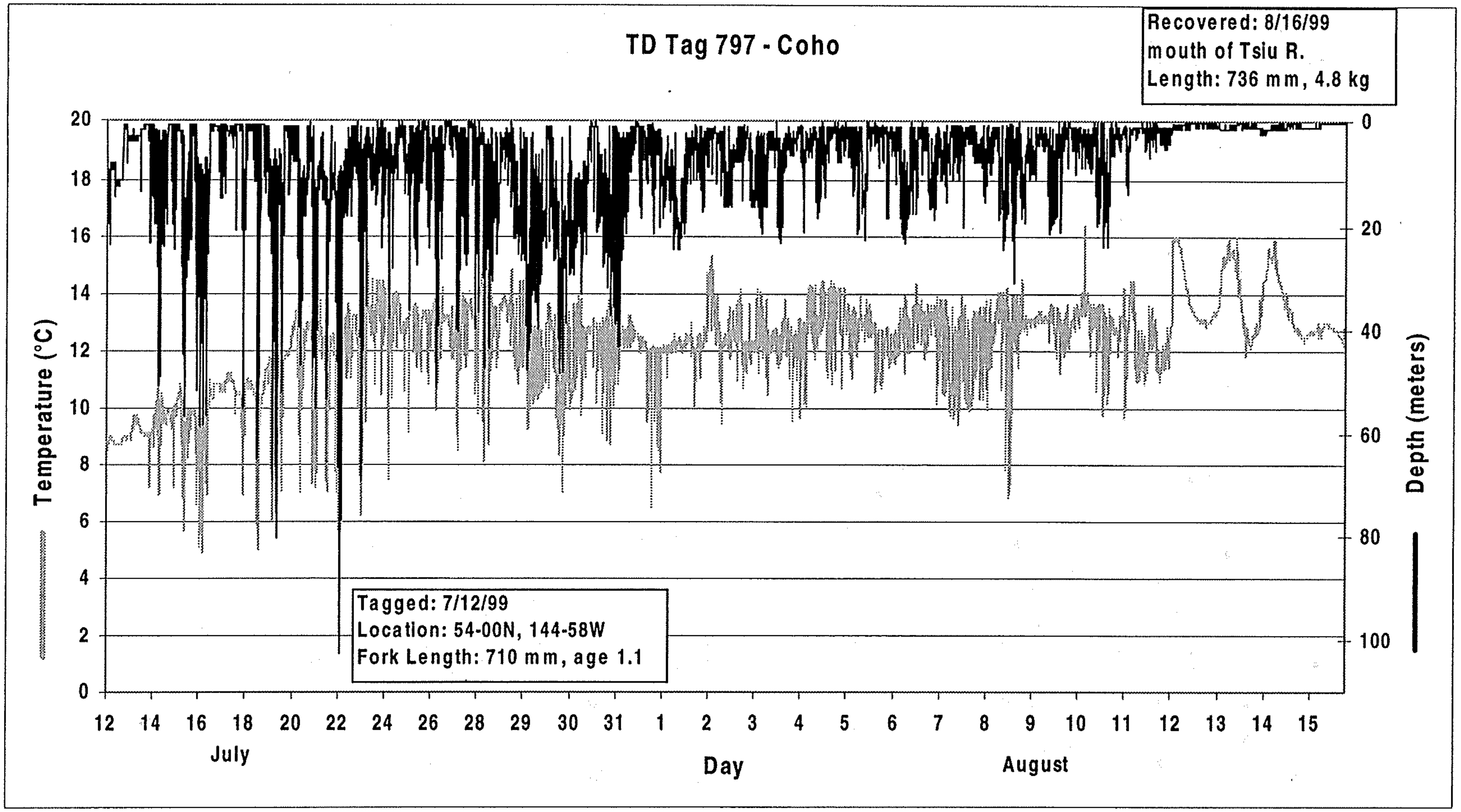


Figure 9. Temperature and depth data recorded on a data storage tag placed on a 710 mm coho salmon in the Gulf of Alaska on 12 July 1999 and recovered in the Tsiu River, Alaska on 16 August 1999.

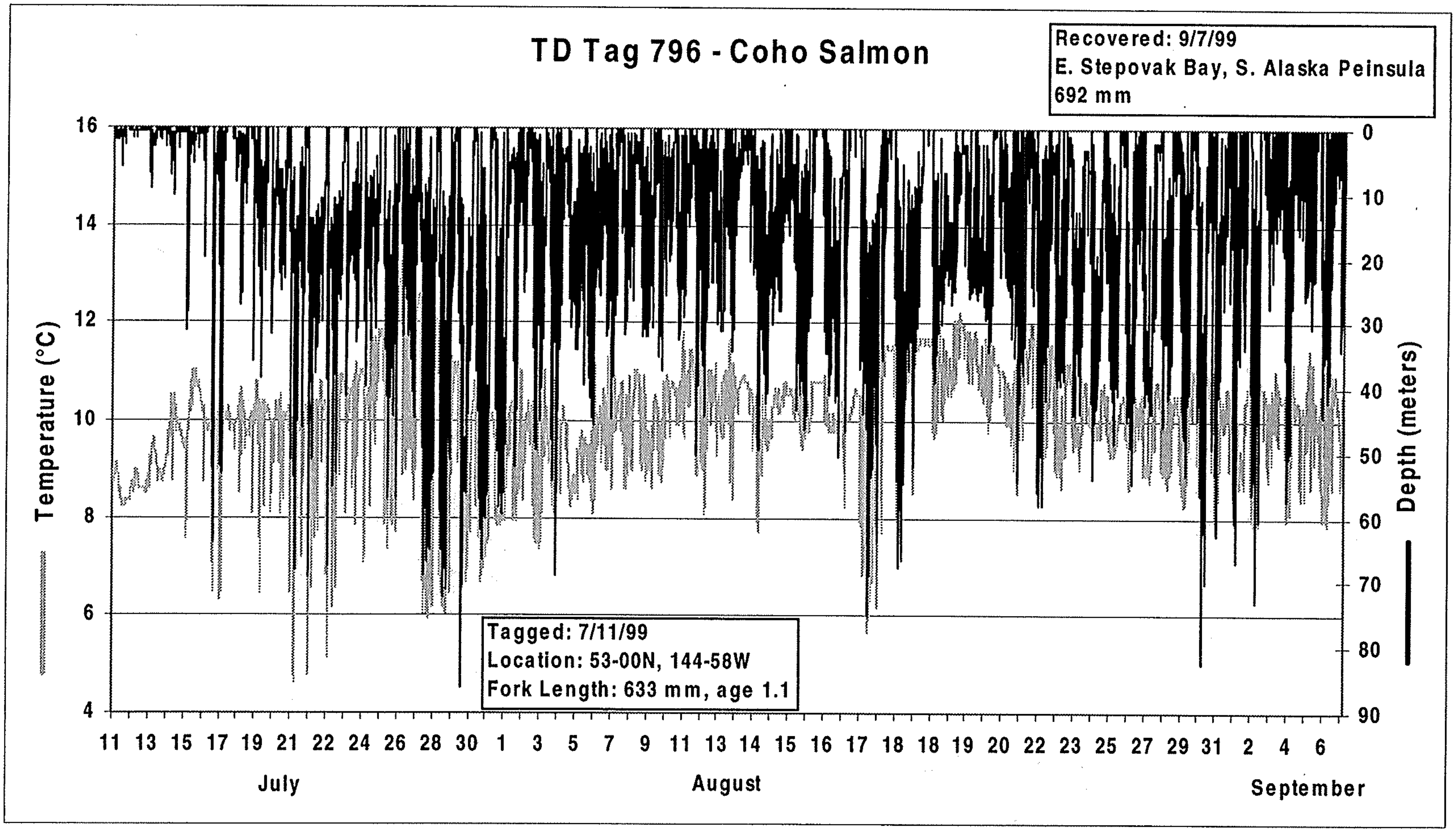


Figure 10. Temperature and depth data recorded on a data storage tag placed on a 633 mm coho salmon in the Gulf of Alaska on 11 July 1999 and recovered in Stepovak Bay, south side of Alaska Peninsula, Alaska on 7 September 1999.

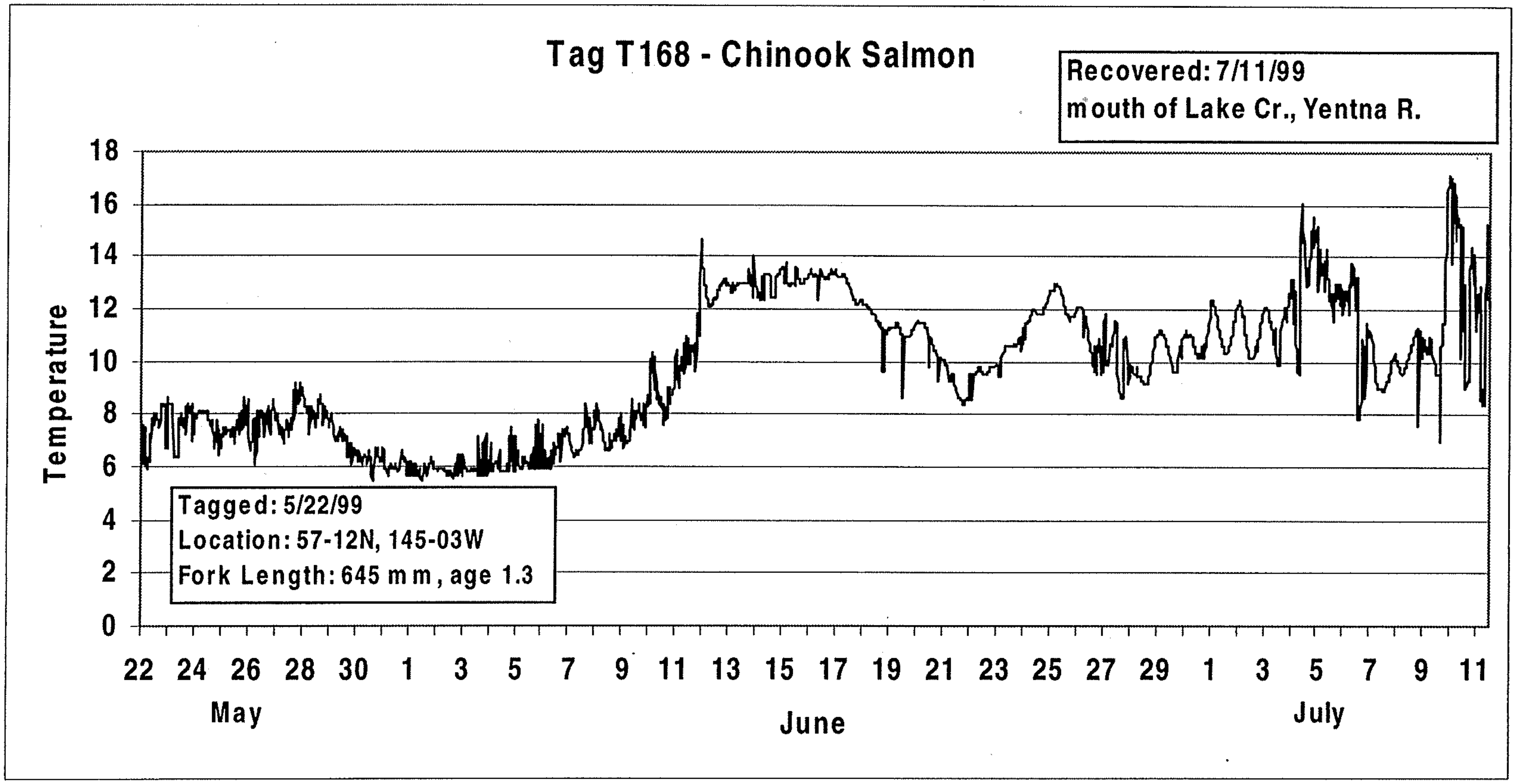


Figure 11. Temperature data recorded on a data storage tag placed on a 645 mm chinook salmon in the Gulf of Alaska on 22 May 1999 and recovered in Lake Creek, Yentna River, Alaska on 11 July 1999.

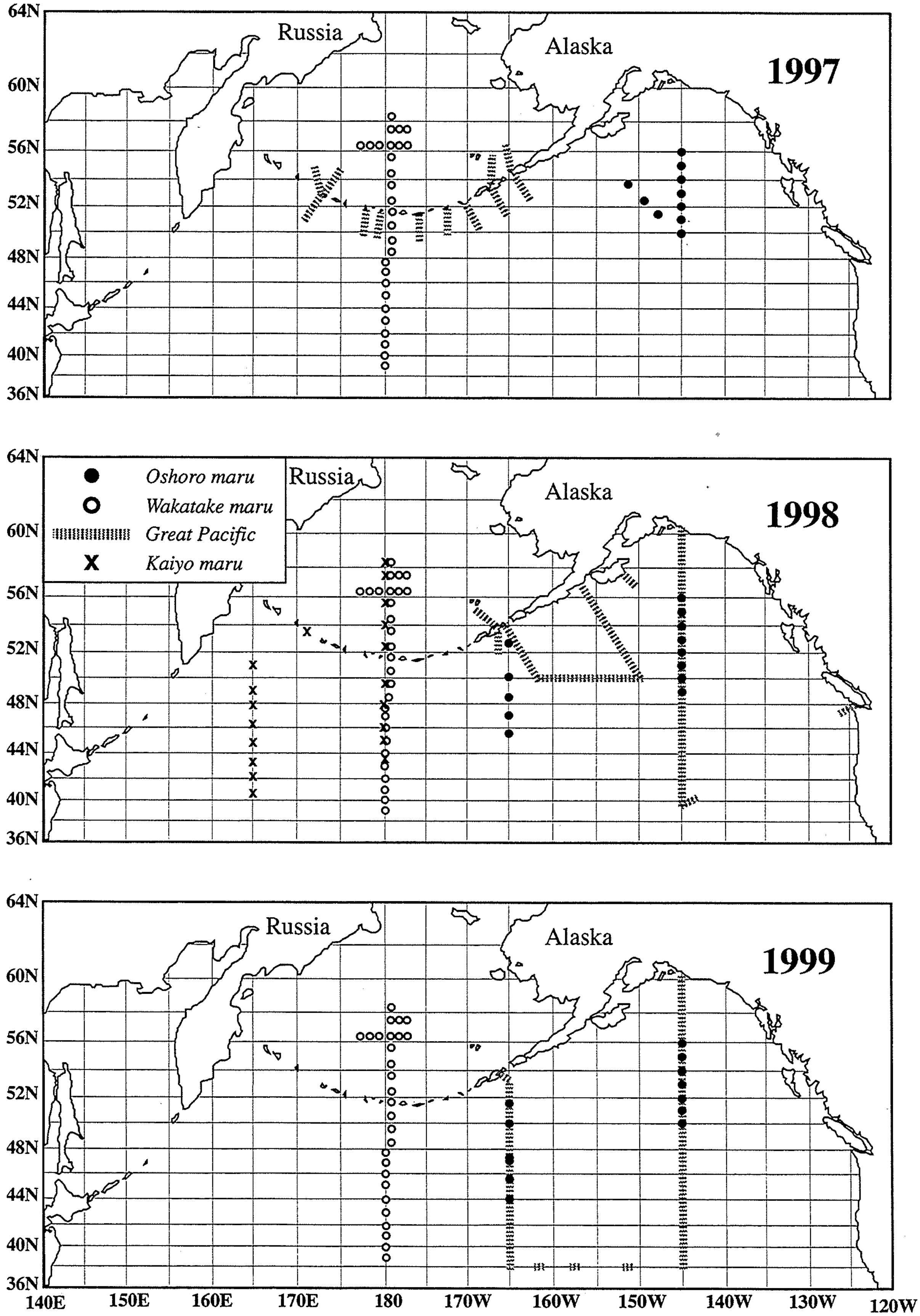


Figure 12. Survey areas sampled during cooperative FRI high seas salmon research cruises, 1997-99.

Figure 13. Poster advertising for return of high seas salmon and steelhead tags.

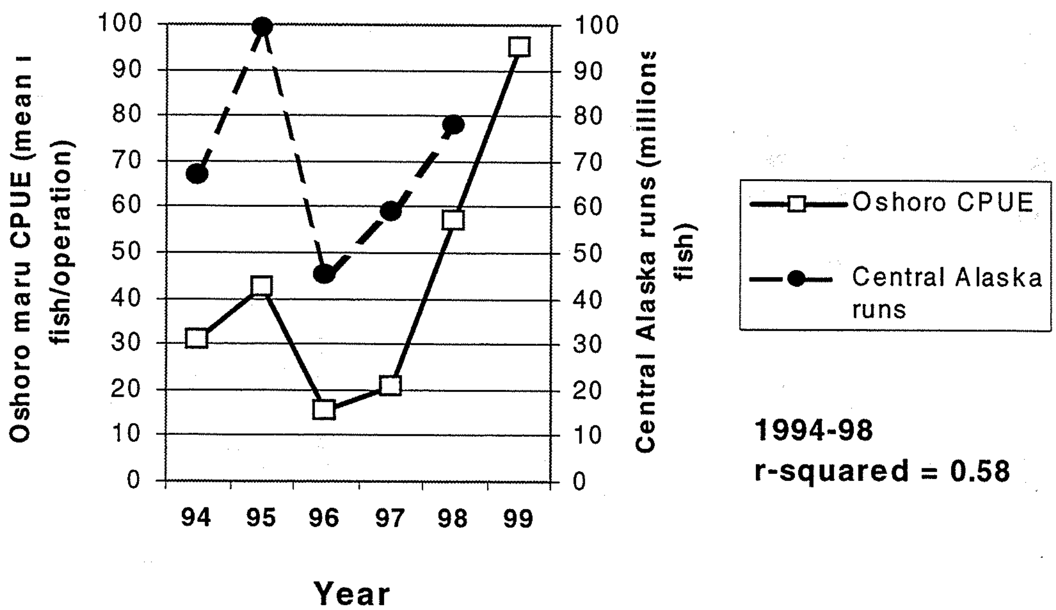
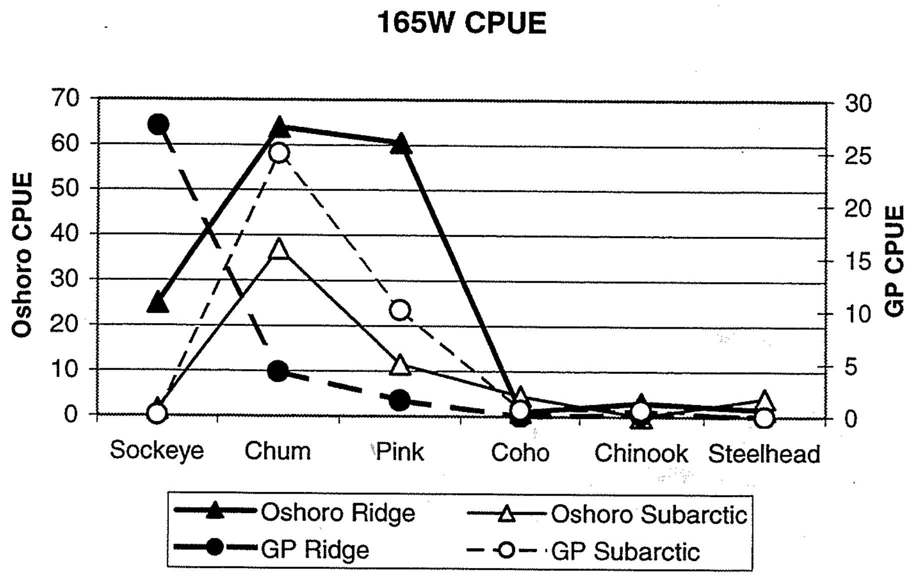


Figure 14. Relationship between varied-mesh research gillnet catch of pink salmon in the Ridge/Dilute Domains of the central Gulf of Alaska by the *Oshoro maru* and runs of pink salmon to central Alaska, 1994-98.



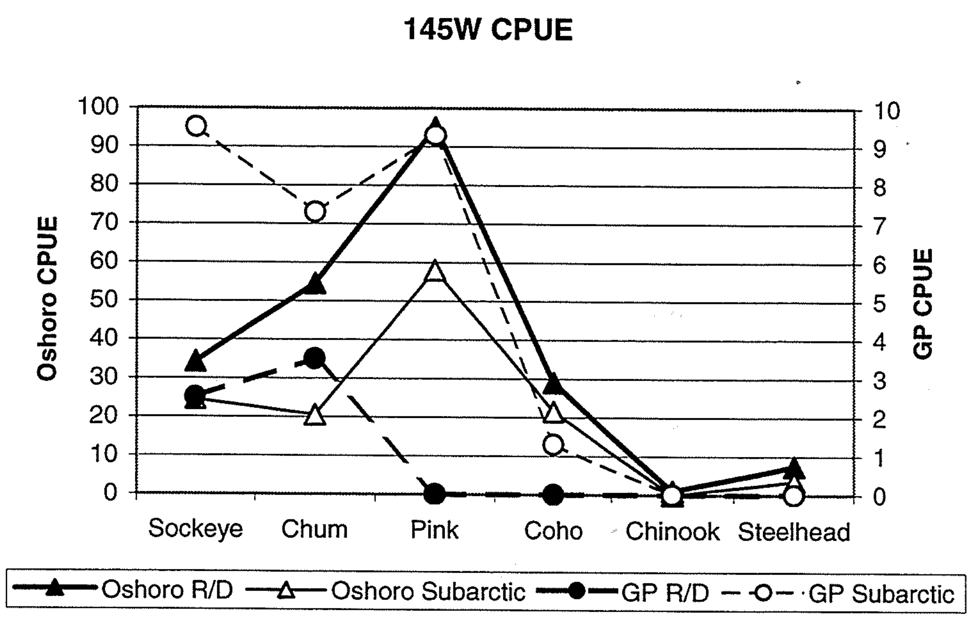
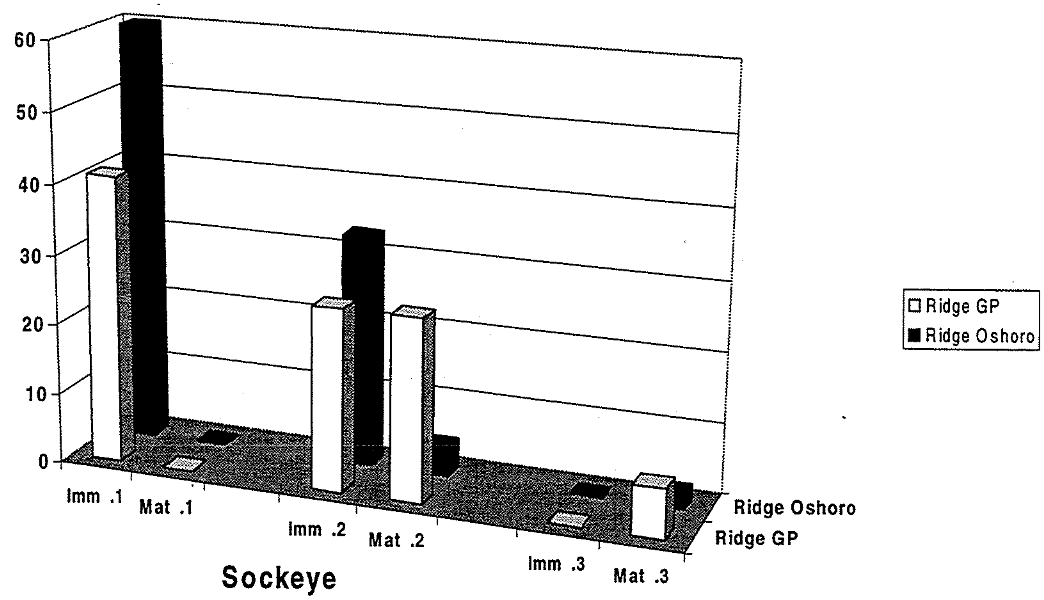


Figure 15. Comparison of 1999 *Great Pacific* (GP) and *Oshoro maru* CPUE along two transects and in two oceanographic regions in each transect. *Great Pacific* CPUE is catch per 1-hour tow. *Oshoro maru* CPUE is research gillnet catch per set.

165°W Transect



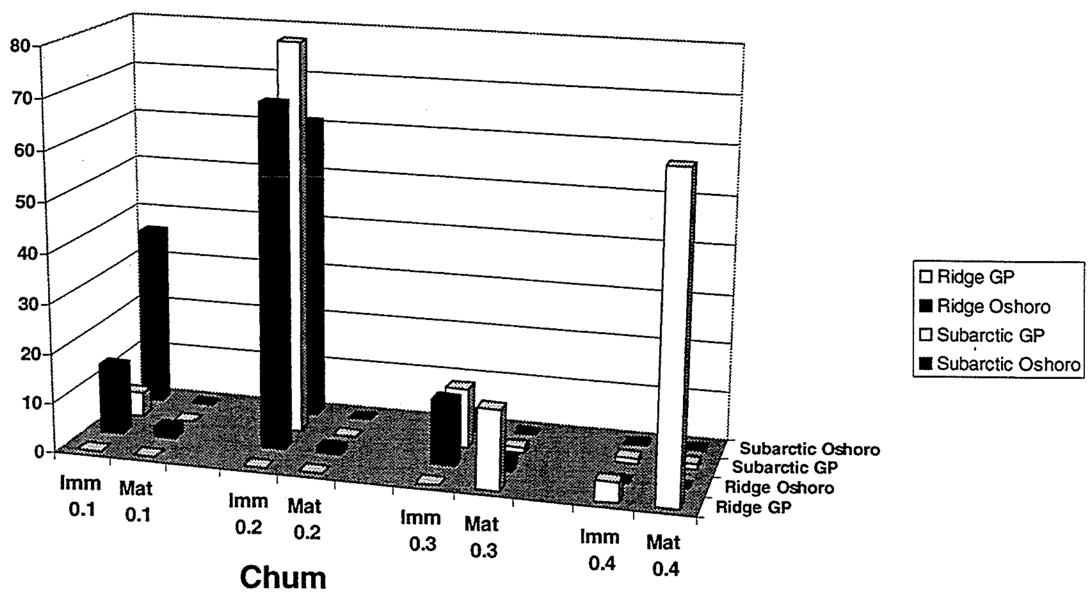
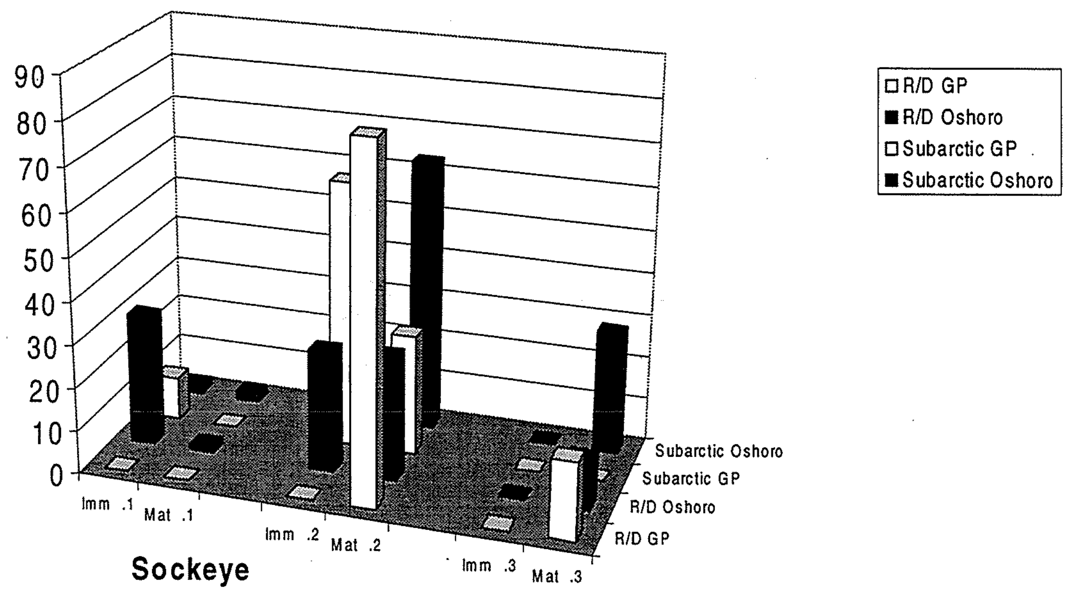


Figure 16. Comparison of sockeye and chum salmon age and maturity composition in catches of the *Great Pacific* and *Oshoro maru* along 165°W in May and June 1999. Catches are divided into Ridge Domain (north of 46°30'N) and Subarctic Current (south of 46°30'N). Catches of sockeye salmon in the Subarctic Current were very low for both vessels and are not plotted.

145°W Transect



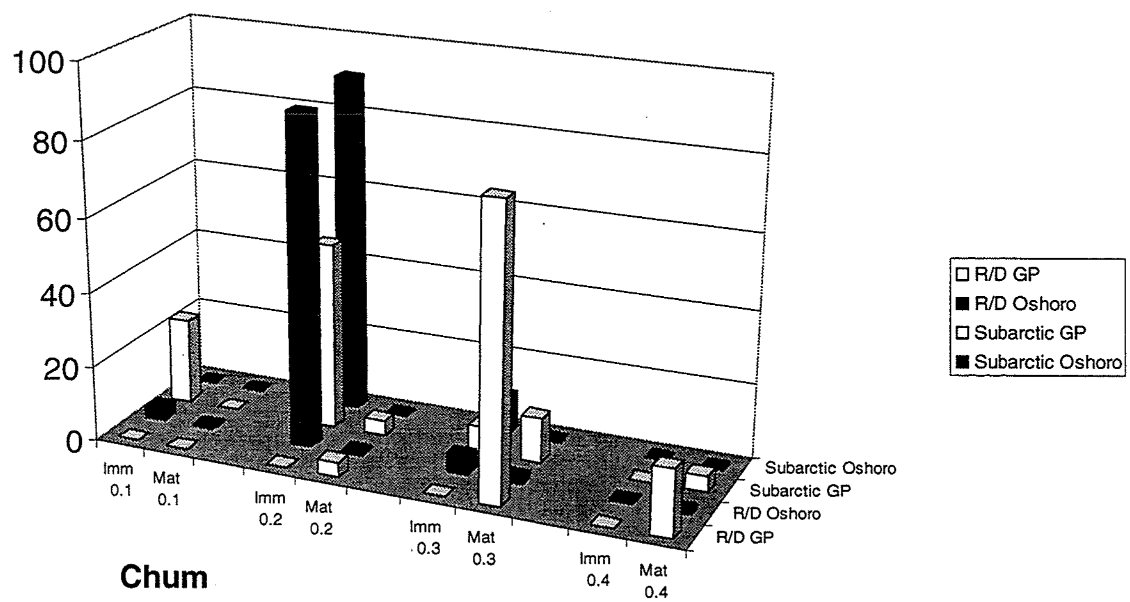


Figure 17. Comparison of sockeye and chum salmon age and maturity composition in catches of the *Great Pacific* and *Oshoro maru* along 145°W in May and July 1999. Catches are divided into Ridge/Dilute Domain (north of 51°30'N) and Subarctic Current (south of 51°30'N).

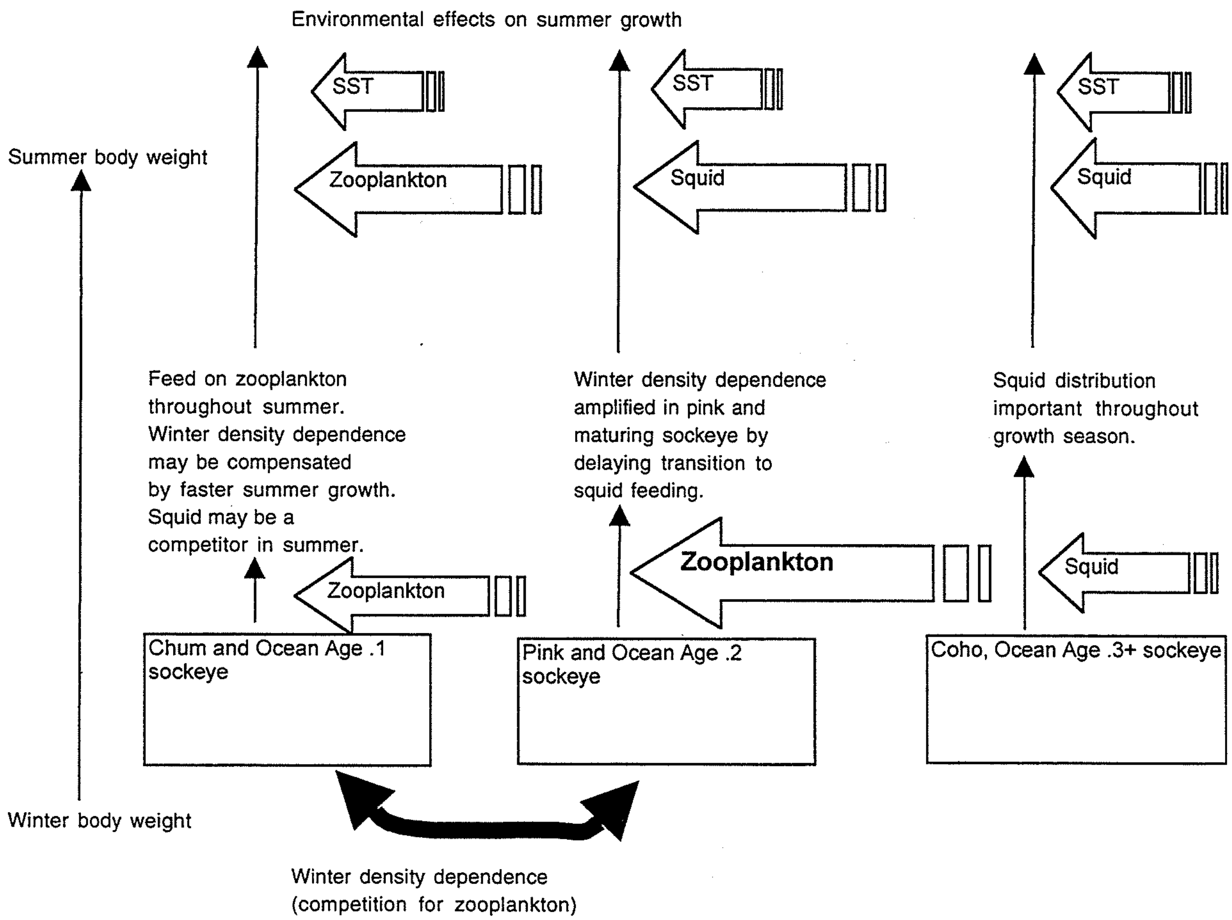


Figure 18. A conceptual model of density dependence vs. environmental control of growth for salmon from winter to summer. For pink and some sockeye salmon, density dependence (food competition) may be strongest in the winter, although sockeye salmon may respond to density dependence by delaying maturation. Black arrows indicate influences on salmon growth, with size of arrows proportional to the importance of each influence in determining final body weight.

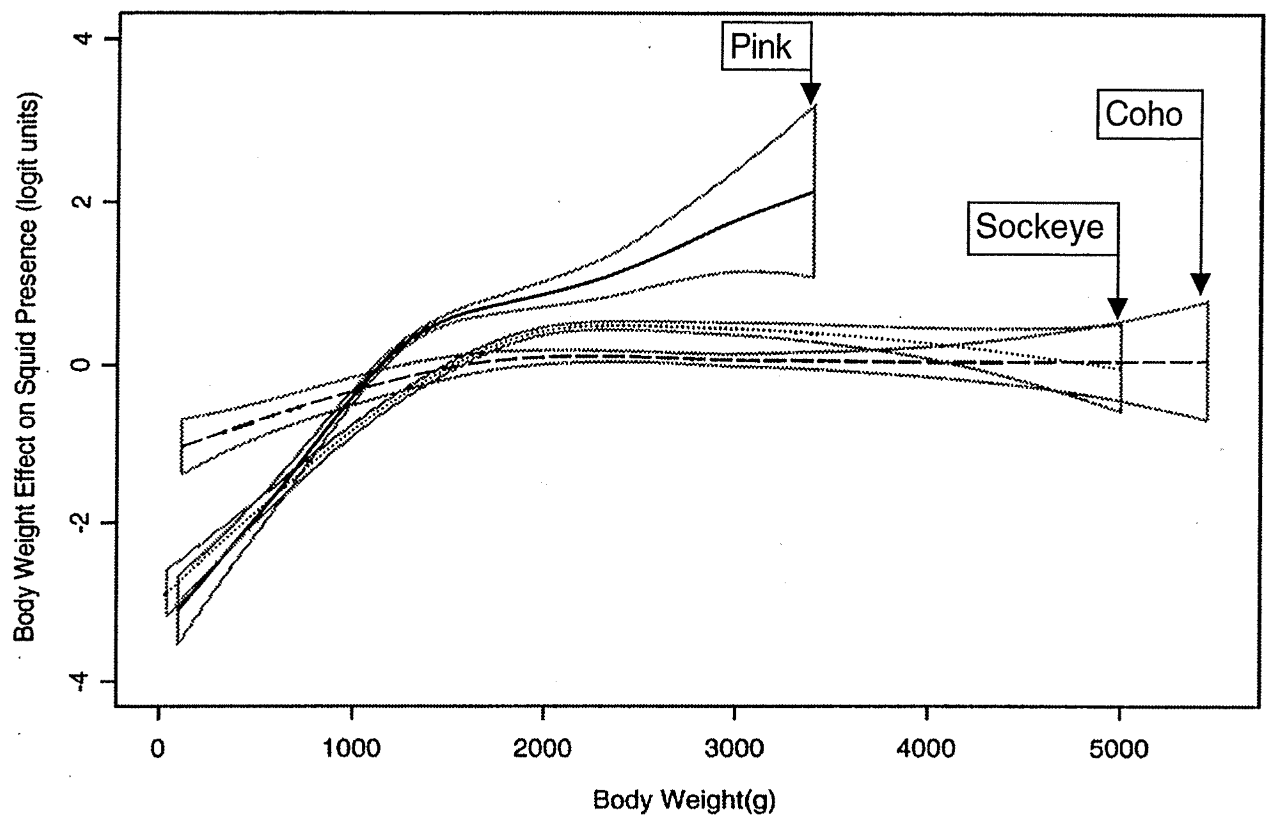


Figure 19. Adjusted logistic response of the presence or absence of micronektonic squid as a function of the body weight of pink salmon (solid line), sockeye salmon (dotted line) and coho salmon (dashed line). Gray boxed areas show pointwise standard errors. Results are from a general additive model and compensate for environmental and seasonal factors. While the body weight dependence is similar for all available months of data, most pink salmon make the transition to squid feeding in the spring of their maturing year (ocean age-.1), while most sockeye salmon make the transition in the spring of their ocean age-.2 year.

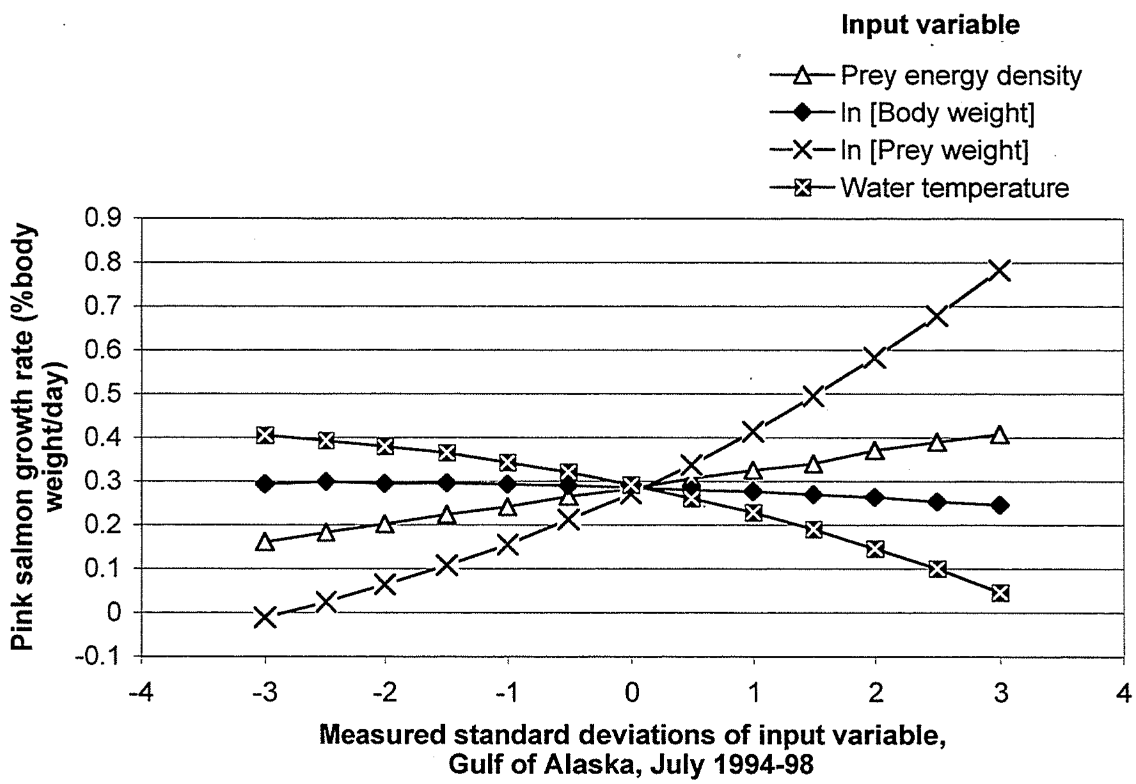


Figure 20. Sensitivity analysis of four input variables to a bioenergetics model of pink salmon growth. Variables used are body weight, water temperature (0-40 m depth), prey weight as a percentage of salmon body weight, and prey caloric density (cal/g wet weight). The range shown on the x-axis is the number of standard deviations from the mean value for each variable, while the growth is shown as a percentage of salmon body weight. The standard deviations are computed from data measured on the R.V. *Oshoro maru* 1994-98, and represent the natural range of variation for each parameter.

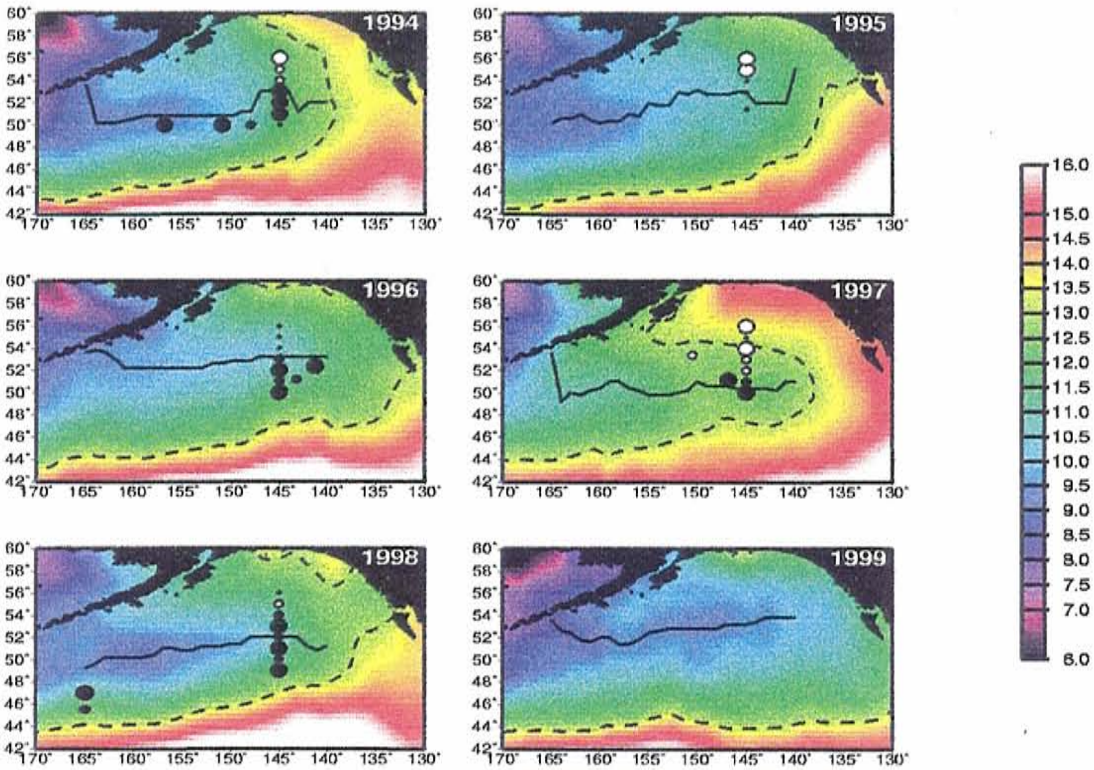


Figure 21. Sea surface temperatures for July are shown with squid densities as measured from salmon stomachs, 1994-1998. Sea surface temperatures are colors, while squid densities are circles. Large black circles indicate squid densities significantly lower than averge. The solid line shows the July latitudinal temperture minimum in the Alaskan Gyre, which has a high correlation with the latitude at which squid densities switch from above average to below average. The dotted line shows the 13°C isotherm which has been proposed as the southern temperature maximum for sockeye salmon during July.

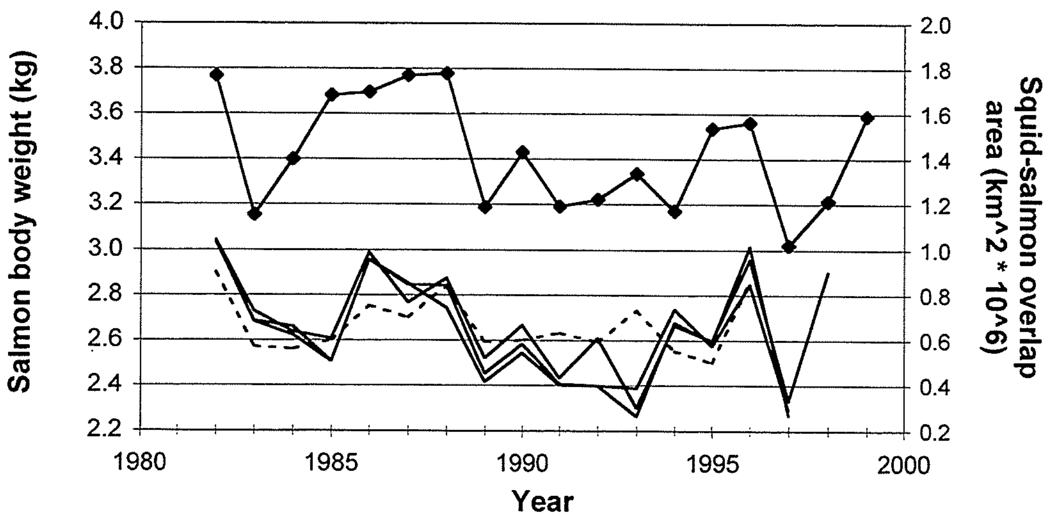


Figure 22. Area of overlapping distribution of squid and salmon (upper line), as calculated by the distance enclosed each year by 150°W-160°W on the east and west, the Alaska Gyre sea surface temperature minimum on the north, and the 13°C sea surface temperature isotherm on the south. Lower data series are body weights for seine-caught sockeye salmon in three British Columbia statistical areas that predominantly catch Fraser River fish (solid lines), and the Bristol Bay fishery sockeye salmon body weights (dashed line). Correlations between the area of overlap and body weights are between R=0.63 and 0.65 for all body weights shown.

Table 1. Disk tags released from U.S. vessels and all U.S. data storage tags placed on salmonids in the North Pacific Ocean and Bering Sea in 1999. T = temperature only; TD = temperature and depth. SST = sea surface temperature in °C (*Wakatake maru* and *Oshoro maru);* HT = headrope temperature approx. 1 m below surface (*Great Pacific).* LL = longline; H&L = hook and line. FRI = Fisheries Research Institute; FAJ = Fisheries Agency of Japan.

Vessel and Data Tag #	Tag Type	Species	Release Date	Location Latitude	Location Longitude	SST or HT	Gear	Fork Length	Age	Other tags FRI	Other tags FAJ
F/V *Great Pacific*											
320	T	Coho	5/17/99	47°07'N	144°59'W	6.6	Trawl	525	2.1	LL1200	
324	T	Chum	5/18/99	48°27'N	145°01'W	6.5	Trawl	532	X.3	LL1201	
325	T	Chum	5/18/99	48°27'N	145°01'W	6.5	Trawl	505	0.1	LL1202	
330	T	Sockeye	5/18/99	49°06'N	144°58'W	5.4	Trawl	535	1.2	LL1203	
327	T	Chum	5/19/99	52°06'N	144°59'W	4.8	Trawl	550	0.1	LL1204	
331	T	Sockeye	5/19/99	52°06'N	144°59'W	4.8	Trawl	485	2.2	LL1205	
333	T	Chum	5/20/99	54°45'N	145°00'W	4.9	Trawl	580	0.1	LL1206	
336	T	Sockeye	5/20/99	54°45'N	145°00'W	4.9	Trawl	625	1.3	LL1207	
338	T	Sockeye	5/20/99	54°45'N	145°00'W	4.9	Trawl	590	1.2	LL1208	
339	T	Sockeye	5/20/99	54°45'N	145°00'W	4.9	Trawl	535	1.2	LL1209	
344	T	Sockeye	5/20/99	54°45'N	145°00'W	4.9	Trawl	615	2.2	LL1210	
351	T	Sockeye	5/20/99	54°45'N	145°00'W	4.9	Trawl	520	2.2	LL1211	
353	T	Sockeye	5/20/99	54°45'N	145°00'W	4.9	Trawl	490	X.2	LL1212	
354	T	Sockeye	5/20/99	54°45'N	145°00'W	4.9	Trawl	490	2.2	LL1213	
359	T	Chum	5/20/99	54°45'N	145°00'W	4.9	Trawl	590	X.X	LL1214	
362	T	Sockeye	5/20/99	54°45'N	145°00'W	4.9	Trawl	555	3.3	LL1215	
369	T	Chum	5/20/99	55°17'N	145°00'W	4.7	Trawl	560	0.3	LL1216	
379	T	Sockeye	5/20/99	55°37'N	145°00'W	5.0	Trawl	585	2.3	LL1217	
380	T	Sockeye	5/21/99	56°15'N	145°01'W	5.7	Trawl	600	1.3	LL1220	
410	T	Chum	5/21/99	56°15'N	145°01'W	5.7	Trawl	530	0.3	LL1221	
411	T	Sockeye	5/21/99	56°15'N	145°01'W	5.7	Trawl	580	1.3	LL1222	
439	T	Sockeye	5/21/99	56°15'N	145°01'W	5.7	Trawl	625	0.3	LL1224	
146	T	Chum	5/21/99	56°15'N	145°01'W	5.7	Trawl	625	0.3	LL1225	
147	T	Sockeye	5/21/99	56°15'N	145°01'W	5.7	Trawl	500	3.2	LL1226	
151	T	Sockeye	5/21/99	56°40'N	145°01'W	5.1	Trawl	555	2.3	LL1229	
168	T	Chinook	5/21/99	57°12'N	145°04'W	5.8	Trawl	645	0.3	LL1230	
144	T	Sockeye	5/21/99	57°12'N	145°04'W	5.8	Trawl	595	1.3	LL1231	
153	T	Sockeye	5/21/99	57°12'N	145°04'W	5.8	Trawl	500	2.2	LL1232	
148	T	Sockeye	5/21/99	57°37'N	145°00'W	6.9	Trawl	535	1.2	LL1233	
149	T	Sockeye	5/21/99	57°37'N	145°00'W	6.9	Trawl	575	2.2	LL1234	
155	T	Sockeye	5/21/99	57°37'N	145°00'W	6.9	Trawl	525	1.2	LL1235	
301	T	Sockeye	5/22/99	58°26'N	145°00'W	7.2	Trawl	640	1.3	LL1236	
310	T	Sockeye	5/22/99	58°26'N	145°00'W	7.2	Trawl	630	1.3	LL1237	
	Disk	Sockeye	5/22/99	58°26'N	145°00'W	7.2	Trawl	600	1.3	LL1239	
	Disk	Sockeye	5/22/99	58°26'N	145°00'W	7.2	Trawl	610	1.3	LL1238	
	Disk	Sockeye	5/22/99	58°26'N	145°00'W	7.2	Trawl	590	1.3	LL1240	
	Disk	Chum	5/22/99	58°26'N	145°00'W	7.2	Trawl	640	0.5	LL1249	
	Disk	Sockeye	5/22/99	58°26'N	145°00'W	7.2	Trawl	555	1.2	LL1272	
311	T	Sockeye	5/22/99	58°58'N	145°00'W	7.3	Trawl	635	1.3	LL1248	
	Disk	Sockeye	5/22/99	58°58'N	145°00'W	7.3	Trawl	635	2.3	LL1246	
	Disk	Sockeye	5/22/99	58°58'N	145°00'W	7.3	Trawl	500	2.2	LL1247	
	Disk	Sockeye	5/22/99	58°58'N	145°00'W	7.3	Trawl	630	0.3	LL1245	

continued

Table 1. Continued.

Vessel and Data Tag #	Tag Type	Species	Release Date	Location Latitude	Location Longitude	SST or HT	Gear	Fork Length	Age	Other tags FRI	Other tags FAJ
	Disk	Sockeye	5/22/99	58°58'N	145°00'W	7.3	Trawl	620	X.3	LL1244	
	Disk	Sockeye	5/22/99	58°58'N	145°00'W	7.3	Trawl	620	2.3	LL1243	
	Disk	Sockeye	5/22/99	58°58'N	145°00'W	7.3	Trawl	605	1.3	LL1242	
	Disk	Sockeye	5/22/99	58°58'N	145°00'W	7.3	Trawl	555	1.2	LL1241	
	Disk	Sockeye	5/22/99	58°58'N	145°00'W	7.3	Trawl	585	1.3	LL1250	
	Disk	Chum	5/22/99	58°58'N	145°00'W	7.3	Trawl	630	0.3	LL1251	
	Disk	Chum	5/22/99	58°58'N	145°00'W	7.3	Trawl	595	0.3	LL1252	
	Disk	Sockeye	5/22/99	59°05'N	144°59'W	7.0	Trawl	550	3.2	LL1253	
	Disk	Sockeye	5/22/99	59°05'N	144°59'W	7.0	Trawl	545	1.3	LL1254	
	Disk	Sockeye	5/22/99	59°05'N	144°59'W	7.0	Trawl	610	2.2	LL1255	
	Disk	Sockeye	5/22/99	59°05'N	144°59'W	7.0	Trawl	650	1.3	LL1256	
	Disk	Chum	5/22/99	59°05'N	144°59'W	7.0	Trawl	660	X.3	LL1257	
	Disk	Chum	5/22/99	59°05'N	144°59'W	7.0	Trawl	600	0.3	LL1258	
	Disk	Chum	5/22/99	59°05'N	144°59'W	7.0	Trawl	570	0.2	LL1259	
	Disk	Chum	5/22/99	59°05'N	144°59'W	7.0	Trawl	650	0.4	LL1260	
	Disk	Chinook	5/22/99	59°30'N	145°08'W	7.2	Trawl	1000	0.4	LL1261	
	Disk	Chum	5/22/99	59°30'N	145°08'W	7.2	Trawl	655	0.4	LL1273	
	Disk	Chum	5/22/99	59°30'N	145°08'W	7.2	Trawl	660	0.3	LL1274	
	Disk	Sockeye	5/22/99	59°30'N	145°08'W	7.2	Trawl	565	2.2	LL1275	
	Disk	Chum	5/22/99	59°30'N	145°08'W	7.2	Trawl	680	0.5	LL1276	
R/V *Wakatake maru*											
225	T	Sockeye	6/25/99	47°00'N	180°00'	6.1	LL	583		LL2909	HH2138
231	T	Sockeye	6/28/99	49°30'N	180°00'	5.9	LL	550		LL2927	HH2156
239	T	Sockeye	6/28/99	50°30'N	180°00'	6.4	LL	543		LL2936	HH2165
236	T	Chum	7/2/99	53°30'N	180°00'	7.3	LL	614		LL2971	HH2200
247	T	Chum	7/2/99	53°30'N	180°00'	7.3	LL	601		LL2983	HH2212
253	T	Chum	7/4/99	55°30'N	180°00'	6.5	LL	572		LL2997	HH2226
256	T	Chum	7/4/99	55°30'N	180°00'	6.5	LL	608		LL2998	HH2227
263	T	Chum	7/6/99	57°30'N	180°00'	6.0	LL	590		LL3052	HH2281
270	T	Chum	7/10/99	56°30'N	178°00'W	6.8	LL	569		LL3117	HH2346
284	T	Chum	7/10/99	56°30'N	178°00'W	6.8	LL	499		LL3127	HH2356
T/S *Oshoro maru*											
752	TD	Steelhead	6/25/99	50°00'N	164° 56'W	6.4	LL	555	X.1	LL1320	BB2520
754	TD	Sockeye	7/8/99	49° 59'N	145° 00'W	8.6	LL	591	1.3	LL1329	BB2529
755	TD	Coho	7/8/99	49° 59'N	145° 00'W	8.6	LL	520	X.1	LL1330	BB2530
756	TD	Coho	7/8/99	50°30'N	145° 00'W	8.7	H&L	591	X.1	LL1331	BB2531
758	TD	Coho	7/8/99	50°30'N	145° 00'W	8.7	H&L	600	1.1	LL1332	BB2532
759	TD	Sockeye	7/8/99	51°00'N	145° 00'W	8.3	H&L	575	1.2	LL1333	BB2533
760	TD	Coho	7/8/99	51°00'N	145° 00'W	8.3	H&L	481	1.1	LL1334	BB2534
779	TD	Coho	7/9/99	51°02'N	144° 57'W	8.3	LL	635	2.1	LL1335	BB2535
781	TD	Pink	7/9/99	51°02'N	144° 57'W	8.3	LL	472		LL1336	BB2536
782	TD	Sockeye	7/9/99	51°02'N	144° 57'W	8.3	LL	551	1.2	LL1337	BB2537
783	TD	Coho	7/9/99	51°02'N	144° 57'W	8.3	LL	585	1.1	LL1339	BB2539
786	TD	Pink	7/9/99	51°02'N	144° 57'W	8.3	LL	455	0.1	LL1340	BB2540

continued

Table 1. Continued.

Vessel and Data Tag #	Tag Type	Species	Release Date	Location Latitude	Location Longitude	SST or HT	Gear	Fork Length	Age	Other tags FRI	Other tags FAJ
785	TD	Pink	7/9/99	52°00'N	145° 00'W	8.49	H&L	448	0.1	LL1341	BB2541
787	TD	Pink	7/9/99	52°00'N	145° 00'W	8.49	H&L	434	0.1	LL1342	BB2542
788	TD	Pink	7/10/99	52°02'N	144° 58'W	8.5	LL	468	0.1	LL1345	BB2545
789	TD	Coho	7/10/99	52°02'N	144° 58'W	8.5	LL	551	X.1	LL1347	BB2547
790	TD	Sockeye	7/10/99	52°02'N	144° 58'W	8.5	LL	585	1.2	LL1350	BB2550
792	TD	Coho	7/10/99	52°02'N	144° 58'W	8.5	LL	585	2.1	LL1353	BB2553
757	TD	Coho	7/10/99	52°30'N	145° 00'W	8.35	H&L	620	1.1	LL1354	BB2554
795	TD	Coho	7/11/99	53°00'N	144° 58'W	8.8	LL	620	1.1	LL1357	BB2557
796	TD	Coho	7/11/99	53°00'N	144° 58'W	8.8	LL	633	1.1	LL1361	BB2561
775	TD	Coho	7/11/99	53°00'N	144° 58'W	8.8	LL	476	1.1	LL1359	BB2559
784	TD	Coho	7/11/99	53°00'N	144° 58'W	8.8	LL	620	2.1	LL1362	BB2562
794	TD	Coho	7/11/99	53°00'N	144° 58'W	8.8	LL	652	1.1	LL1367	BB2567
797	TD	Coho	7/12/99	54°00'N	144° 58'W	9.1	LL	710	1.1	LL1372	BB2572
791	TD	Pink	7/12/99	54°00'N	144° 58'W	9.1	LL	470	0.1	LL1368	BB2568
793	TD	Pink	7/12/99	54°00'N	144° 58'W	9.1	LL	475	0.1	LL1376	BB2576
773	TD	Coho	7/12/99	54°00'N	144° 58'W	9.1	LL	555	1.1	LL1378	BB2578
803	TD	Coho	7/12/99	54°30'N	145° 00'W	9.2	H&L	556	1.1	LL1379	BB2579
804	TD	Sockeye	7/12/99	55°00'N	145° 00'W	9.3	H&L	660	X.2	LL1380	BB2580
799	TD	Coho	7/13/99	55°04'N	144° 57'W	9.2	LL	600	1.1	LL1382	BB2582
802	TD	Coho	7/13/99	55°30'N	145° 00'W	9.6	H&L	520	2.1	LL1386	BB2586
806	TD	Pink	7/13/99	55°30'N	145° 00'W	9.6	H&L	485	0.1	LL1387	BB2587
764	TD	Pink	7/13/99	56°00'N	145° 00'W	10.2	H&L	468	0.1	LL1388	BB2588
768	TD	Coho	7/13/99	56°00'N	145° 00'W	10.2	H&L	576	X.1	LL1389	BB2589
704	TD	Pink	7/13/99	56°00'N	145° 00'W	10.2	H&L	492	0.1	LL1390	BB2590
771	TD	Pink	7/14/99	56°10'N	145° 04'W	10.2	LL	480	0.1	LL1394	BB2594
711	TD	Pink	7/14/99	56°10'N	145° 04'W	10.2	LL	474	0.1	LL1395	BB2595
714	TD	Pink	7/14/99	56°10'N	145° 04'W	10.2	LL	550	0.1	LL1400	BB2600
808	TD	Coho	7/14/99	56°10'N	145° 04'W	10.2	LL	591	X.1	LL1402	BB2602
809	TD	Sockeye	7/14/99	56°10'N	145° 04'W	10.2	LL	635	1.3	LL1403	BB2603
715	TD	Pink	7/14/99	56°10'N	145° 04'W	10.2	LL	434	0.1	LL1404	BB2604
720	TD	Pink	7/14/99	56°10'N	145° 04'W	10.2	LL	450	0.1	LL1406	BB2606
722	TD	Pink	7/14/99	56°10'N	145° 04'W	10.2	LL	518	0.1	LL1407	BB2607
723	TD	Pink	7/14/99	56°10'N	145° 04'W	10.2	LL	404	0.1	LL1410	BB2610

Table 2. Release and recovery information for U.S. tags and cooperative Japan-U.S. tags returned from 16 September 1998 to 30 September 1999. A blank indicates the information is not available. LL=longline, GN= gillnet, PS=purse seine, HL=hook and line. Age designation is the European method, first number is the number of freshwater annuli, second number is thenumber of ocean annuli. FL=fork length, TL=total length, BW=body weight, NMT= Northwest Marine Technology, and CDI=Conservation Devices, Inc.

U.S. Tag. No.	Japan Tag No.	Release							Recovery										
		Date	Lat (°N)	Long	2°X5° Area	Gear	FL (mm)	Age	Date	Lat (°N)	Long	Area Code	Gear	Sex	FL (mm)	BW (g)	Gonad (g)	Age	Location
A. Sockeye Salmon																			
LL1229, data tag (Kiwi) no. 151		21-May-99	56°40	145°01W	W5056	trawl	555	2.3	9-Jul-99	61°29	144°27W	60-0	dipnet	male	-	-	-	-	Copper R. (near O'Brian Ck), central Alaska, USA
LL1236, data tag (Kiwi) no. 301		22-May-99	58°26	145°00W	W4558	trawl	640	1.3	16-Jun-99	56°20	158°29W	54-1	PS	-	-	-	-	1.3	Chignik Lagoon, Pacific coast of Alaska Peninsula, central Alaska, USA
LL1248, data tag (Kiwi) no. 311		22-May-99	58°58	145°00W	W4558	trawl	635	1.3	4-Jul-99	58°12	134°06W	63-2	GN	male	652	-	-	-	Taku Inlet, 10 mi south of Juneau, southeast Alaska, USA
LL1213, data tag (Kiwi) no. 354		20-May-99	54°46	145°00W	W4554	trawl	490	2.2	11-Jul-99	56°31	159°53W	50-2	-	-	-	-	-	-	Three Hills, approx. 30 mi north of Port Moller, Bering Sea, western Alaska, USA
LL1403, data tag (CDI) no. 809	BB2603	14-Jul-99	56°10	145°04W	W5056	LL	635	1.3	3-Aug-99	58°07	134°04W	63-2	GN	-	-	-	-	-	Slocum Inlet, Taku Inlet, 15 miles southeast of Juneau, southeast Alaska, USA
B. Chum Salmon																			
LL1225, data tag (Kiwi) no. 146		21-May-99	56°15	145°01W	W5056	trawl	625	0.3	21-Jun-99	54°20	164°50W	53-0	PS	-	-	-	-	0.3	South Unimak Is., Pacific coast of the Aleutian Islands, Alaska, USA

Table 2. continued.

U.S. Tag No.	Japan Tag No.	Release Date	Release Lat (°N)	Release Long	Release 2°X5° Area	Release Gear	Release FL (mm)	Release Age	Recovery Date	Recovery Lat (°N)	Recovery Long	Recovery Area Code	Recovery Gear	Recovery Sex	Recovery FL (mm)	Recovery BW (g)	Recovery Gonad (g)	Recovery Age	Recovery Location
B. Chum salmon, continued.																			
LL2403, data tag (Kiwi) no. 274	MM1455	07-Jul-98	56°30	179°30W	W8056	LL	680	0.4	24-Sep-98	44°19	145°21E	02-0	GN	male	716	-	-	-	2 miles off Akaiwa, Shiretoko Peninsula, Nokke St., Hokkaido, Japan
LL2772, data tag (Kiwi) no. 299	MM1824	12-Jul-98	56°30	177°30W	W8056	LL	577	0.3	05-Oct-98	43°41	145°09E	02-0	setnet	female	590	2400	-	0.3	Shibetsu, Nemuro Strait coast, Hokkaido, Japan
LL2222, data tag (Kiwi) no. 255	MM1274	04-Jul-98	53°30	179°30W	W8052	LL	560	0.3	10-Oct-98	44°13	143°40E	02-2	setnet	male	610	2110	-	0.3	Yubetsu, Okhotsk Sea coast Hokkaido, Japan
LL2348, data tag (Kiwi) no. 271	MM1400	06-Jul-98	55°30	179°30W	W8054	LL	592	0.3	31-Oct-98	36°47	137°05E	01-1	fish trap	male	610	1800	-	-	Sho R., Japan Sea coast, Toyama Prefecture, Japan
LL2774, data tag (NMT) no. 894	MM1826	12-Jul-98	56°30	177°30W	W8056	LL	570	0.3	10-Oct-98	43°51	145°06E	02-0	setnet	female	590	2200	-	0.3	Shibetsu, Nemuro St. coast, Hokkaido, Japan
LL2773, data tag (NMT) no. 895	MM1825	12-Jul-98	56°30	177°30W	W8056	LL	590	0.3	03-Oct-98	43°20	145°22E	02-0	setnet	female	598	2000	-	0.3	Bekkai, Nemuro St. coast, Hokkaido, Japan
LL2292	MM1344	06-Jul-98	55°30	179°30W	W8054	LL	582	0.3	12-Sep-98	44°02	144°48E	02-2	setnet	female	610	2200	-	0.3	Utoro, Okhotsk Sea coast, Hokkaido, Japan

Table 2. continued.

U.S. Tag. No.	Japan Tag No.	Release Date	Release Lat (°N)	Release Long	Release 2°X5° Area	Release Gear	Release FL (mm)	Release Age	Recovery Date	Recovery Lat (°N)	Recovery Long	Recovery Area Code	Recovery Gear	Recovery Sex	Recovery FL (mm)	Recovery BW (g)	Recovery Gonad (g)	Recovery Age	Recovery Location
B. Chum salmon, continued.																			
LL2253	MM1305	05-Jul-98	54°30	179°30W	W8054	LL	610	0.3	21-Sep-98	-	-	02-0	setnet	male	635	2500	-	0.3	Shibetsu, Nemuro St. coast, Hokkaido, Japan
LL2505	MM1557	08-Jul-98	57°30	179°30W	W8056	LL	564	X.X	22-Sep-98	44°22	145°22E	02-0	setnet	female	-	3000	-	-	Rausu, Nemuro St. coast, Hokkaido, Japan
LL2421	MM1473	08-Jul-98	57°30	179°30W	W8056	LL	530	0.3	26-Sep-98	44°07	145°16E	02-0	setnet	-	-	-	-	-	Rausu, Nemuro St. coast, Hokkaido, Japan
LL2649	MM1701	10-Jul-98	57°30	178°24W	W8056	LL	600	0.4	01-Oct-98	44°10	145°19E	02-0	setnet	male	-	2700	-	-	Rausu, Nemuro St. coast, Hokkaido, Japan
LL2848	MM1900	15-Jul-98	56°30	178°30E	E7556	LL	645	0.4	18-Sep-98	43°55	144°42E	02-2	setnet	-	-	-	-	-	Shari, Okhotsk Sea coast, Hokkaido, Japan
LL2510	MM1562	09-Jul-98	58°30	179°30W	W8058	LL	567	0.3	08-Oct-98	44°30	142°39E	02-2	setnet	male	610	2400	-	0.3	Ohmu, Okhotsk Sea coast, Hokkaido, Japan
LL2541	MM1593	09-Jul-98	58°30	179°30W	W8058	LL	569	0.3	08-Oct-98	44°01	144°15E	02-2	setnet	-	-	-	-	-	Abashiri, Okhotsk Sea coast, Hokkaido, Japan

Table 2. continued.

U.S. Tag. No.	Japan Tag No.	Release Date	Release Lat (°N)	Release Long	Release 2°X5° Area	Release Gear	Release FL (mm)	Release Age	Recovery Date	Recovery Lat (°N)	Recovery Long	Recovery Area Code	Recovery Gear	Recovery Sex	Recovery FL (mm)	Recovery BW (g)	Recovery Gonad (g)	Recovery Age	Recovery Location
B. Chum salmon, continued.																			
LL2346	MM1398	06-Jul-98	55°30	179°30W	W8054	LL	619	0.4	01-Oct-98	-	-	02-2	setnet	-	-	-	-	-	Rausu, Nemuro St. coast, Hokkaido, Japan
LL2439	MM1491	08-Jul-98	57°30	179°30W	W8056	LL	556	0.3	07-Oct-98	43°38	145°12E	02-0	setnet	female	580	2300	-	0.3	Shibetsu, Nemuro St. coast, Hokkaido, Japan
LL2367	MM1419	07-Jul-98	56°30	179°30W	W8056	LL	580	0.3	08-Oct-98	43°11	145°37E	02-1	setnet	male	630	2200	-	0.3	Ochiishi, Pacific coast, Hokkaido, Japan
LL2396	MM1448	07-Jul-98	56°30	179°30W	W8056	LL	556	0.3	01-Oct-98	44°03	144°16E	02-2	setnet	-	-	-	-	-	Abashiri, Okhotsk Sea coast, Hokkaido, Japan
LL2651	MM1703	10-Jul-98	57°30	178°24W	W8056	LL	608	0.3	05-Oct-98	42°35	143°34E	02-1	setnet	-	-	-	-	-	Toyokoro, Pacific coast, Hokkaido, Japan
LL2606	MM1658	10-Jul-98	57°30	178°24W	W8056	LL	544	0.3	14-Oct-98	43°37	145°15E	02-0	setnet	male	-	-	-	-	Betsukai, Nemuro St. coast, Hokkaido, Japan
LL2487	MM1539	08-Jul-98	57°30	179°30W	W8056	LL	666	0.4	20-Oct-98	43°43	145°07E	02-0	setnet	male	670	2400	-	0.4	Shibetsu, Nemuro St. coast, Hokkaido, Japan

Table 2. continued.

U.S. Tag. No.	Japan Tag No.	Release Date	Release Lat (°N)	Release Long	Release 2°X5° Area	Release Gear	Release FL (mm)	Release Age	Recovery Date	Recovery Lat (°N)	Recovery Long	Recovery Area Code	Recovery Gear	Recovery Sex	Recovery FL (mm)	Recovery BW (g)	Recovery Gonad (g)	Recovery Age	Recovery Location
B. Chum salmon, continued.																			
LL2727	MM1779	12-Jul-98	56°30	177°30W	W8056	LL	559	0.3	22-Oct-98	43°38	145°12E	02-0	setnet	female	580	1400	-	0.3	Shibetsu, Nemuro St. coast, Hokkaido, Japan
LL2805	MM1857	14-Jul-98	56°30	179°30E	E7556	LL	600	0.3	24-Sep-98	44°57	142°36E	02-2	-	female	635	2600	-	0.3	Esashi, Okhotsk Sea coast, Hokkaido, Japan
LL2540	MM1592	09-Jul-98	58°30	179°30W	W8058	LL	533	0.3	7-Oct-98	45°30	142°30E	02-2	setnet	male	590	2100	-	0.3	Esashi, Okhotsk Sea coast, Hokkaido, Japan
LL2696	MM1748	11-Jul-98	57°30	177°30W	W8056	LL	563	0.3	24-Oct-98	42°11	143°19E	02-1	setnet	male	580	1900	-	0.3	Hiroo, Pacific coast, Hokkaido, Japan
LL2858	MM1910	15-Jul-98	56°30	178°30E	E7556	LL	630	0.3	18-Sep-98	44°18	145°17E	02-2	setnet	male	670	3100	-	0.3	Shari, Okhotsk Sea coast, Hokkaido, Japan
LL2827	MM1879	15-Jul-98	56°30	178°30E	E7556	LL	523	0.2	21-Oct-98	-	-	02-2	setnet	female	530	2900	-	0.2	Koshimizu, Okhotsk Sea coast, Hokkaido, Japan
LL2400	MM1452	07-Jul-98	56°30	179°30W	W8056	LL	572	0.3	21-Oct-98	44°40	142°52E	02-2	setnet	-	-	-	-	-	Omu, Okhotsk Sea coast, Hokkaido, Japan

Table 2. continued.

U.S. Tag. No.	Japan Tag No.	Release Date	Release Lat (°N)	Release Long	Release 2°X5° Area	Release Gear	Release FL (mm)	Release Age	Recovery Date	Recovery Lat (°N)	Recovery Long	Recovery Area Code	Recovery Gear	Recovery Sex	Recovery FL (mm)	Recovery BW (g)	Recovery Gonad (g)	Recovery Age	Location
B. Chum salmon, continued.																			
LL2429	MM1481	08-Jul-98	57°30	179°30W	W8056	LL	594	0.3	26-Oct-98	43°48	145°06E	02-0	setnet	female	620	2000	-	0.3	Shibetsu, Nemuro St. coast, Hokkaido, Japan
LL2739	MM1791	12-Jul-98	56°30	177°30W	W8056	LL	544	0.3	26-Oct-98	43°39	145°10E	02-0	setnet	female	560	1800	-	-	Shibetsu, Nemuro St. coast, Hokkaido, Japan
LL2376	MM1428	07-Jul-98	56°30	179°30W	W8056	LL	534	0.3	05-Oct-98	43°17	145°41E	02-0	setnet	male	520	1550	-	0.3	Nemuro, Nemuro St. coast, Hokkaido, Japan
LL2547	MM1599	09-Jul-98	58°30	179°30W	W8058	LL	570	0.3	13-Oct-98	43°21	145°48E	02-0	setnet	female	570	1900	-	0.3	Shibetsu, Nemuro St. coast, Hokkaido, Japan
LL2698	MM1750	11-Jul-98	57°30	177°30W	W8056	LL	556	0.3	26-Oct-98	43°42	145°07E	02-0	setnet	male	550	2200	-	-	Shibetsu, Nemuro St. coast, Hokkaido, Japan
LL2730	MM1782	12-Jul-98	56°30	177°30W	W8056	LL	524	0.2	27-Oct-98	43°39	145°10E	02-0	setnet	-	-	1800	-	-	Shibetsu, Nemuro St. coast, Hokkaido, Japan
LL2884	MM1934	16-Jul-98	56°30	177°36E	E7556	LL	492	0.2	28-Oct-98	-	-	02-0	-	male	515	1800	-	0.2	Shibetsu, Nemuro St. coast, Hokkaido, Japan

Table 2. continued.

U.S. Tag. No.	Japan Tag No.	Release							Recovery											
		Date	Lat (°N)	Long	2°X5° Area	Gear	FL (mm)	Age	Date	Lat (°N)	Long	Area Code	Gear	Sex	FL (mm)	BW (g)	Gonad (g)	Age	Location
B. Chum salmon, continued.																			
LL2340	MM1392	06-Jun-98	55°30	179°30W	W8054	LL	589	0.3	31-Oct-98	43°24	145°13E	02-0	fish trap	female	605	2000	-	0.3	Nishibetsu R., Nemuro St. coast, Hokkaido, Japan
LL2811	MM1863	14-Jul-98	56°30	179°30E	E7556	LL	443	0.4	04-Nov-98	43°41	145°08E	02-0	setnet	male	510	2000	-	-	Shibetsu, Nemuro St. coast, Hokkaido, Japan
LL2642	MM1694	10-Jul-98	57°30	178°24W	W8056	LL	574	0.3	04-Nov-98	40°57	141°23E	01-0	setnet	-	-	-	-	-	Tomari, Pacific coast, Aomori Prefecture, Japan
LL2554	MM1606	09-Jul-98	58°30	179°30W	W8058	LL	598	0.3	26-Oct-98	42°08	141°02E	02-1	setnet	male	620	1800	-	0.3	Osatsube, Pacific coast, Hokkaido, Japan
LL2829	MM1881	15-Jul-98	56°30	178°30E	E7556	LL	552	0.3	27-Oct-98	44°12	145°21E	02-0	setnet	male	-	-	-	-	Rausu, Nemuro St. coast, Hokkaido, Japan
LL2550	MM1602	09-Jul-98	58°30	179°30W	W8058	LL	545	0.3	20-Oct-98	44°02	145°14E	02-0	setnet	male	570	1780	-	-	Rausu, Nemuro St. coast, Hokkaido, Japan
LL2709	MM1761	11-Jul-98	57°30	177°30W	W8056	LL	524	0.3	27-Oct-98	44°22	145°22E	02-0	setnet	-	-	-	-	-	Rausu, Nemuro St. coast, Hokkaido, Japan

Table 2. continued.

U.S. Tag. No.	Japan Tag No.	Release Date	Release Lat (°N)	Release Long	Release 2°X5° Area	Release Gear	Release FL (mm)	Release Age	Recovery Date	Recovery Lat (°N)	Recovery Long	Recovery Area Code	Recovery Gear	Recovery Sex	Recovery FL (mm)	Recovery BW (g)	Recovery Gonad (g)	Recovery Age	Recovery Location
B. Chum salmon, continued.																			
LL2486	MM1538	08-Jul-98	57°30	179°30W	W8056	LL	543	0.3	13-Oct-98	44°12	145°21E	02-2	setnet	male	-	2000	-	-	Rausu, Nemuro St. coast, Hokkaido, Japan
LL2478	MM1530	08-Jul-98	57°30	179°30W	W8056	LL	554	0.3	2-Oct-98	44°09	145°07E	02-2	setnet	-	-	-	-	-	Utoro, Okhotsk Sea coast, Hokkaido, Japan
LL2479	MM1531	08/Jul/98	57°30	179°30W	W8056	LL	590	0.3	2-Oct-98	44°18	145°18E	02-2	setnet	-	-	-	-	-	Utoro, Okhotsk Sea coast, Hokkaido, Japan
LL2393	MM1445	07-Jul-98	56°30	179°30W	W8056	LL	576	0.3	10-Oct-98	44°05	145°01E	02-2	setnet	female	-	-	-	-	Utoro, Okhotsk Sea coast, Hokkaido, Japan
LL2371	MM1423	07-Jul-98	56°30	179°30W	W8056	LL	578	0.3	10-Oct-98	44°09	145°07E	02-2	setnet	-	-	-	-	-	Utoro, Okhotsk Sea coast, Hokkaido, Japan
LL2653	MM1705	10-Jul-98	57°30	178°24W	W8056	LL	590	0.3	16-Oct-98	44°09	145°07E	02-2	setnet	-	-	-	-	-	Utoro, Okhotsk Sea coast, Hokkaido, Japan
LL2514	MM1566	09-Jul-98	58°30	179°30W	W8058	LL	571	0.3	4-Dec-98	42°18	140°17E	02-1	setnet	male	600	1850	-	0.3	Yakumo, Pacific coast, Hokkaido, Japan

Table 2. continued.

U.S. Tag. No.	Japan Tag No.	Release Date	Release Lat (°N)	Release Long	Release 2°X5° Area	Release Gear	Release FL (mm)	Release Age	Recovery Date	Recovery Lat (°N)	Recovery Long	Recovery Area Code	Recovery Gear	Recovery Sex	Recovery FL (mm)	Recovery BW (g)	Recovery Gonad (g)	Recovery Age	Recovery Location
B. Chum salmon, continued.																			
LL2391	MM1443	07-Jul-98	56°30	179°30W	W8056	LL	582	0.3	14-Sep-98	44°38	142°54E	02-2	setnet	female	590	2400	-	-	Horonai, Okhotsk Sea coast, Hokkaido, Japan
LL2570	MM1622	09-Jul-98	58°30	179°30W	W8058	LL	580	0.3	18-Nov-98	44°38	142°54E	02-2	fish trap	-	-	-	-	-	Shari River, Okhotsk Sea coast, Hokkaido, Japan
LL2465	MM1517	08-Jul-98	57°30	179°30W	W8056	LL	575	0.3	26-Oct-98	43°36	145°21E	02-0	setnet	-	-	-	-	-	Bekkai, Nemuro St. coast, Hokkaido, Japan
LL2446	MM1498	08-Jul-98	57°30	179°30W	W8056	LL	508	0.2	26-Oct-98	43°34	145°22E	02-0	setnet	-	-	-	-	-	Bekkai, Nemuro St. coast, Hokkaido, Japan
LL2491	MM1543	08-Jul-98	57°30	179°30W	W8056	LL	583	0.4	25-Sep-98	43°56	144°28E	02-2	setnet	male	620	2700	-	-	Koshimizu, Okhotsk Sea coast, Hokkaido, Japan
LL2562	MM1614	09-Jul-98	58°30	179°30W	W8058	LL	589	0.3	01-Oct-98	43°57	144°22E	02-2	setnet	male	640	2700	-	-	Koshimizu, Okhotsk Sea coast, Hokkaido, Japan
LL2496	MM1548	08-Jul-98	57°30	179°30W	W8056	LL	604	0.3	07-Oct-98	44°06	144°16E	02-2	setnet	-	-	-	-	-	Abashiri, Okhotsk Sea coast, Hokkaido, Japan

Table 2. continued.

U.S. Tag. No.	Japan Tag No.	Release Date	Release Lat (°N)	Release Long	Release 2°X5° Area	Release Gear	Release FL (mm)	Release Age	Recovery Date	Recovery Lat (°N)	Recovery Long	Recovery Area Code	Recovery Gear	Recovery Sex	Recovery FL (mm)	Recovery BW (g)	Recovery Gonad (g)	Recovery Age	Recovery Location
B. Chum salmon, continued.																			
LL2368	MM1420	07-Jul-98	56°30	179°30W	W8056	LL	610	0.4	10-Oct-98	43°57	144°25E	02-2	setnet	-	-	-	-	-	Koshimizu, Okhotsk Sea coast, Hokkaido, Japan
LL2412	MM1464	08-Jul-98	57°30	179°30W	W8056	LL	539	0.3	16-Oct-98	44°03	144°16E	02-2	setnet	-	620	2300	-	-	Abashiri, Okhotsk Sea coast, Hokkaido, Japan
LL2707	MM1759	11-Jul-98	57°30	177°30W	W8056	LL	564	0.3	16-Oct-98	43°59	144°19E	02-2	setnet	-	640	2400	-	-	Abashiri, Okhotsk Sea coast, Hokkaido, Japan
LL2186	MM1238	04-Jul-98	53°30	179°30W	W8052	LL	526	0.2	02-Nov-98	44°03	144°16E	02-2	setnet	-	-	-	-	-	Abashiri, Okhotsk Sea coast, Hokkaido, Japan
LL2489	MM1541	08-Jul-98	57°30	179°30W	W8056	LL	634	0.4	05-Oct-98	43°25	145°21E	02-0	setnet	female	672	2900	-	0.4	Bekkai, Nemuro St. coast, Hokkaido, Japan
LL2259	MM1311	05-Jul-98	54°30	179°30W	W8054	LL	530	0.3	27-Oct-98	44°02	144°48E	02-2	setnet	-	-	-	-	-	Shari, Okhotsk Sea coast, Hokkaido, Japan
LL2586	MM1638	10-Jul-98	57°30	178°24W	W8056	LL	594	0.3	26-Nov-98	39°59	139°42E	01-1	setnet	female	640	2000	-	-	Oga Peninsula, Japan Sea coast, Akita Prefecuture, Japan

Table 2. continued.

U.S. Tag No.	Japan Tag No.	Release Date	Release Lat (°N)	Release Long	Release 2°X5° Area	Release Gear	Release FL (mm)	Release Age	Recovery Date	Recovery Lat (°N)	Recovery Long	Recovery Area Code	Recovery Gear	Recovery Sex	Recovery FL (mm)	Recovery BW (g)	Recovery Gonad (g)	Recovery Age	Recovery Location
B. Chum salmon, continued.																			
LL2677	MM1729	11-Jul-98	57°30	177°30W	W8056	LL	585	0.3	5-Oct-98	40°10	141°53E	01-0	setnet	female	590	2100	-	0.3	Kuji, Pacific coast, Iwate Prefecutre, Japan
LL2423	MM1475	08-Jul-98	57°30	179°30W	W8056	LL	510	0.3	16-Nov-98	40°10	141°53E	01-0	setnet	male	530	1100	-	0.3	Kuji, Pacific coast, Iwate Prefecutre, Japan
LL2572	MM1624	09-Jul-98	58°30	179°30W	W8058	LL	587	0.3	7-Oct-98	41°57	143°12E	02-1	setnet	female	620	2480	-	0.3	Erimo, Pacific coast, Hokkaido, Japan
LL2214	MM1266	04-Jul-98	53°30	179°30W	W8052	LL	530	0.3	14-Oct-98	41°56	143°16E	02-1	setnet	male	570	1760	-	0.3	Erimo Peninsula, Pacific coast, Hokkaido, Japan
C. Pink salmon																			
LL1376, data tag (CDI) no. 793	BB2576	12-Jul-99	54°00	144°58W	W4554	HL	475	0.1	26-Aug-99	55°15	131°55W	66	PS	male	510	1250	-	-	west side of Gravina Is., near Ketchikan, southeast Alaska, USA
LL1388, data tag (CDI) no. 764	BB2588	13-Jul-99	56°00	145°00W	W4556	HL	468	0.1	5-Aug-99	57°38	152°09W	56-2	PS	-	-	-	-	-	off Cape Chiniak, north Kodiak Is., central Alaska, USA
LL1396, disk tag	BB2596	14-Jul-99	56°10	145°04W	W5056	LL	444	0.1	17-Aug-99	54°49	132°59W	65-2	PS	male	-	-	-	-	Port Bazan, west side of Dall Is., southeast Alaska, USA

Table 2. continued.

U.S. Tag. No.	Japan Tag No.	Release							Recovery										
		Date	Lat (°N)	Long	2°X5° Area	Gear	FL (mm)	Age	Date	Lat (°N)	Long	Area Code	Gear	Sex	FL (mm)	BW (g)	Gonad (g)	Age	Location
D. Coho salmon																			
LL1361, data tag (CDI) no. 796	BB2561	11-Jul-99	53°00	144°58W	W4552	LL	633	1.1	7-Sep-99	55°45	159°40W	53-4	-	-	692	-	-	-	north of Pad Island, Stepovak Bay, south side of Alaska Peninsula, USA
LL1362, data tag (CDI) no. 784	BB2562	11-Jul-99	53°00	144°58W	W4552	LL	620	2.1	27-Jul-99	56°57	154°21W	56-0	-	-	-	-	-	-	Dry Bay, (Sukhoi Bay, near Alitak Bay) south coast of Kodiak Is., central Alaska, USA
LL1372, data tag (CDI) no.797	BB2572	12-Jul-99	54°00	144°58W	W4554	HL	710	1.1	16-Aug-99	60°04	143°08W	61-6	HL	-	736	4770	-	-	0.25 miles upstream from mouth of Tsiu R., central Alaska, USA
LL1386, data tag (CDI) no. 802	BB2586	13-Jul-99	55°30	145°00W	W4554	HL	520	2.1	05-Aug-99	60°20	151°25W	57-3	GN	-	-	1550	-	-	4 miles southwest of Kasilof Pt., Cook Inlet, central Alaska, USA
E. Chinook salmon																			
LL1230, data tag (Kiwi) no. 168		21-May-99	57°12	145°03W	W5056	trawl	645	1.3	11-Jul-99	61°54	150°54W	57-6	HL	-	-	-	-	-	mouth of Lake Creek, Yentna R., central Alaska, USA

Table 3. Snouts collected from salmonids without adipose fins caught by T/S *Oshoro maru,* 1999. Gear: A=commercial mesh gillnet; C=varied mesh gillnet; followed by mesh size (mm). N=58 (42 steelhead and 12 coho, 2 sockeye, 1 pink, and 1 chinook salmon).

Species	Gillnet station	Date	Latitude	Longitude	Gear	Fork Length (mm)	Weight (g)	Sex	Gonad weight (g)	Age
Steelhead	9901	6/25/99	50°00'N	165°00'W	A115	600	1960	M	1	R.1
Steelhead	9901	6/25/99	50°00'N	165°00'W	A115	558	1680	M	1	R.1
Steelhead	9901	6/25/99	50°00'N	165°00'W	A121	494	2100	M	2	R.1
Steelhead*	9901	6/25/99	50°00'N	165°00'W	A121	486	2040	M	5	1.1
Steelhead	9901	6/25/99	50°00'N	165°00'W	A121	580	1860	F	48	1.1
Steelhead	9901	6/25/99	50°00'N	165°00'W	C093	606	1920	M	3	R.1
Steelhead	9903	6/28/99	45°30'N	165°00'W	A115	540	1470	F	6	1.1
Steelhead	9903	6/28/99	45°30'N	165°00'W	A115	572	1900	F	7	1.1
Steelhead	9903	6/28/99	45°30'N	165°00'W	A115	550	1790	F	2	R.1
Steelhead	9903	6/28/99	45°30'N	165°00'W	A121	600	2100	M	17	1.1
Steelhead	9903	6/28/99	45°30'N	165°00'W	A121	620	2270	M	15	R.1
Steelhead	9903	6/28/99	45°30'N	165°00'W	C72	568	1720	M	2	R.1
Steelhead	9903	6/28/99	45°30'N	165°00'W	C82	452	1610	F	15	R.1
Steelhead	9903	6/28/99	45°30'N	165°00'W	C93	592	2050	M	1	R.1
Steelhead	9903	6/28/99	45°30'N	165°00'W	C106	538	1600	F	2	R.1
Steelhead	9903	6/28/99	45°30'N	165°00'W	C106	596	2150	M	1	R.1
Steelhead	9904	6/29/99	44°01'N	165°01'W	A115	602	2300	M	1	R.1
Steelhead	9904	6/29/99	44°01'N	165°01'W	A115	544	1560	F	3	1.1
Steelhead	9904	6/29/99	44°01'N	165°01'W	A121	558	1990	F	8	R.1
Steelhead	9904	6/29/99	44°01'N	165°01'W	A121	594	2050	F	1	R.1
Steelhead	9904	6/29/99	44°01'N	165°01'W	A121	542	1000	F	2	1.1
Coho	9907	7/8/99	49°58'N	144°58'W	A115	590	2860	M	100	1.1
Coho	9907	7/8/99	49°58'N	144°58'W	A115	620	3250	F	50	2.1
Steelhead	9907	7/8/99	49°58'N	144°58'W	A121	590	1980	M	2	1.1
Coho	9907	7/8/99	49°58'N	144°58'W	C093	610	2900	M	14	2.1
Coho	9907	7/8/99	49°58'N	144°58'W	C106	470	1330	F	23	1.1
Coho	9908	7/9/99	51°00'N	144°59'W	A115	582	2700	F	40	1.1
Coho	9908	7/9/99	51°00'N	144°59'W	A115	606	2780	F	34	1.1
Steelhead	9908	7/9/99	51°00'N	144°59'W	A121	560	1960	M	5	R.1
Steelhead	9908	7/9/99	51°00'N	144°59'W	C093	562	1760	F	8	R.1
Coho	9909	7/10/99	52°00'N	145°00'W	A115	590	2370	M	16	2.1
Steelhead	9909	7/10/99	52°00'N	145°00'W	C55	305	255	M	1	1.0
Steelhead	9909	7/10/99	52°00'N	145°00'W	C72	310	285	F	2	1.0
Steelhead	9909	7/10/99	52°00'N	145°00'W	C106	548	1580	F	12	R.1
Sockeye	9910	7/11/99	53°01'N	145°00'W	A115	594	2300	F	130	1.3
Steelhead	9910	7/11/99	53°01'N	145°00'W	A115	540	1780	F	10	1.1
Steelhead	9910	7/11/99	53°01'N	145°00'W	A121	590	1860	M	1	2.2
Steelhead	9910	7/11/99	53°01'N	145°00'W	A121	586	1860	F	4	1.1
Steelhead	9910	7/11/99	53°01'N	145°00'W	A121	610	2320	F	14	X.2
Steelhead	9910	7/11/99	53°01'N	145°00'W	A121	534	1750	F	3	R.1
Steelhead	9910	7/11/99	53°01'N	145°00'W	C72	312	320	M	1	1.0
Steelhead	9910	7/11/99	53°01'N	145°00'W	C72	318	355	M	1	X.0
Steelhead	9910	7/11/99	53°01'N	145°00'W	C82	318	355	M	1	1.0
Sockeye	9910	7/11/99	53°01'N	145°00'W	C93	454	1080	M	1	1.2
Steelhead	9910	7/11/99	53°01'N	145°00'W	C93	578	1880	M	10	1.1
Steelhead	9910	7/11/99	53°01'N	145°00'W	C93	562	1720	F	9	X.1
Pink	9911	7/12/99	54°00'N	145°00'W	C48	468	1340	M	9	0.1
Chinook	9911	7/12/99	54°00'N	145°00'W	C93	642	3480	M	2	1.2
Coho	9911	7/12/99	54°00'N	145°00'W	C106	614	2620	F	42	X.1
Steelhead	9911	7/12/99	54°00'N	145°00'W	C138	564	1600	M	10	1.1
Coho	9912	7/13/99	55°00'N	145°00'W	A115	644	2970	F	49	1.1
Coho	9912	7/13/99	55°00'N	145°00'W	C63	638	3100	F	58	1.1
Steelhead	9912	7/13/99	55°00'N	145°00'W	C82	592	1860	M	4	1.1
Coho	9912	7/13/99	55°00'N	145°00'W	C106	560	2240	F	58	1.1
Coho	9913	7/14/99	56°00'N	145°00'W	A115	606	2720	F	60	1.1
Steelhead	9913	7/14/99	56°00'N	145°00'W	A115	592	2180	M	1	X.1
Steelhead	9913	7/14/99	56°00'N	145°00'W	C63	300	260	F	3	X.0
Steelhead	9913	7/14/99	56°00'N	145°00'W	C63	298	247	M	2	1.0

* also right pelvic fin clipped

Table 4a. Release and recovery information for coded-wire tagged salmon caught in commercial trawls in the U.S. 200-mile zone. All recoveries in the table are reported for the first time (1 September 1998 - 31 August 1999 reporting period). ADFG=Alaska Department of Fish and Game, CDFG=California Dept. Fish and Game, CDFO = Canada Dept. of Fisheries and Oceans, COOP=Cooperative - agency releases, EBMD=East Bay Municipal Utilities District, FWS=US Fish and Wildlife Service, KTHC=Ketchikan Tribal Hatchery Corporation, HVT=Hoopa Valley Tribe, MAKA=Makah Tribe, MUCK=Muckleshoot Tribe, NEZP=Nez Perce Tribe, NISQ= Nisqually Tribe, NMFS=National Marine Fisheries Service, NSRA=Northern Southeast Regional Aquaculture Assoc., ODFW=Oregon Dept. Fish and Wildlife, PGAM=Port Gamble S'Klallam Tribe, QDNR=Quinault Dept. of Natural Resources, SSRA=Southern Southeast Regional Aquaculture Assn., SUQ=Suquamish Indian Tribe, WDFW=Washington Dept. Fish and Wildlife. TSFT= body length measurement from the tip of the snout to the fork of the tail, WT=whole body weight, D=degree, M=minute. Statistical recovery areas are shown in Figs. 1 and 2.

RELEASE INFORMATION								RECOVERY INFORMATION										
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT		LONG			TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION
									D	M	D	M	DIR					
213049	COHO	95	AGATE PASS SEA PENS	WA	SUQ	46057	970511	980625	48	24	124	51	W	430	900	M	TRAWL	NE NORTH PACIFIC
020314	CHINOOK	91	R-ADAMS RIVER UPPER	BC	CDFO	75839	920519	950602	56	45	154	22	W	750	5900	F	TRAWL	GULF OF ALASKA
020521	CHINOOK	91	R-CEDAR RIVER/ SKEENA	BC	CDFO	25775	930415	950605	57	10	152	28	W	590	2600	F	TRAWL	GULF OF ALASKA
026343	CHINOOK	91	R-BABINE R, UPPER	BC	CDFO	20870	930505	950605	57	10	152	28	W	660	3800	F	TRAWL	GULF OF ALASKA
026343	CHINOOK	91	R-BABINE R, UPPER	BC	CDFO	20870	930505	980000					W				TRAWL	NE NORTH PACIFIC
032245	CHINOOK	95	L PORT WALTER 109-10	AK	NMFS	15499	970515	990214	57	40	154	22	W	630	3500	F	TRAWL	GULF OF ALASKA
032246	CHINOOK	95	L PORT WALTER 109-10	AK	NMFS	11748	970515	990212	57	29	154	39	W	620	2980	M	TRAWL	GULF OF ALASKA
032306	CHINOOK	95	L PORT WALTER 109-10	AK	NMFS	7747	970516	980926	56	24	158	4	W	550	2200	M	TRAWL	GULF OF ALASKA

Table 4a. Continued.

RELEASE INFORMATION								RECOVERY INFORMATION										
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION
036220	CHINOOK	94	L PORT WALTER 109-10	AK	NMFS	14248	960517	980606	58	41	153	19	W	550	1700	M	TRAWL	GULF OF ALASKA
043829	CHINOOK	95	UNUK R 101-75	AK	ADFG	12517	970401	990214	57	32	154	39	W	620	3300	F	TRAWL	GULF OF ALASKA
044213	CHINOOK	93	UNUK R 101-75	AK	ADFG	3227	950410	980918	56	25	158	12	W	850	9000	F	TRAWL	GULF OF ALASKA
044234	CHINOOK	94	TAKU R 111-32	AK	ADFG	10224	960501	981001	56	56	155	3	W	660	4400	F	TRAWL	GULF OF ALASKA
044325	CHINOOK	93	KASNYKU BAY 112-11	AK	NSRA	27876	950606	980125	60	13	147	0	W	660	3800	F	TRAWL	GULF OF ALASKA
044329	CHINOOK	93	BEAR COVE 113-41	AK	NSRA	9666	950519	980204	AREA 620				W	770	6050	F	TRAWL	GULF OF ALASKA
044432	CHINOOK	93	EARL WEST COV 107-40	AK	ADFG	28681	950521	980124	59	59	148	22	W	800	7300	F	TRAWL	GULF OF ALASKA
044504	CHINOOK	94	KETCHIKAN CR 101-47	AK	KTHC	10310	960515	981005	56	29	165	50	W	700	4800	F	TRAWL	BERING SEA
044532	CHINOOK	95	EARL WEST COV 107-40	AK	ADFG	18555	970528	990213	57	32	154	38	W	570	2200	M	TRAWL	GULF OF ALASKA
044533	CHINOOK	94	BEAR COVE 113-41	AK	NSRA	21119	960516	980628	55	48	158	55	W	640	3350	F	TRAWL	GULF OF ALASKA
044544	CHINOOK	94	NEETS BAY 101-90	AK	SSRA	6842	960603	990213	AREA 620				W	810	7700	M	TRAWL	GULF OF ALASKA
044610	CHINOOK	94	CRYSTAL CR 106-44	AK	ADFG	24117	960516	980123	60	0	148	21	W	500	1600	F	TRAWL	GULF OF ALASKA
044611	CHINOOK	94	CRYSTAL CR 106-44	AK	ADFG	26311	960516	980125	60	13	147	41	W	510	2000	F	TRAWL	GULF OF ALASKA
044633	CHINOOK	95	TAKU R 111-32	AK	ADFG	10064	970508	980915	55	2	160	23	W	470	1100	F	TRAWL	GULF OF ALASKA
044701	CHINOOK	95	BEAR COVE 113-41	AK	NSRA	53689	970520	981012	57	36	154	40	W	570	2000	F	TRAWL	GULF OF ALASKA
044701	CHINOOK	95	BEAR COVE 113-41	AK	NSRA	53689	970520	981026	55	19	165	8	W	750			TRAWL	BERING SEA
044701	CHINOOK	95	BEAR COVE 113-41	AK	NSRA	53689	970520	990124	57	05	152	26	W	562	2900	M	TRAWL	GULF OF ALASKA
044701	CHINOOK	95	BEAR COVE 113-41	AK	NSRA	53689	970520	990212	57	34	154	38	W	630	3500		TRAWL	GULF OF ALASKA

Table 4a. Continued.

RELEASE INFORMATION								RECOVERY INFORMATION											
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION
044711	CHINOOK	95	KASNYKU BAY 112-11	AK	NSRA	89430	970527	980927	57	7	152	28	W	530	2000		TRAWL	GULF OF ALASKA
044711	CHINOOK	95	KASNYKU BAY 112-11	AK	NSRA	89430	970527	990201	57	14	154	54	W	680	3800	F	TRAWL	GULF OF ALASKA
044711	CHINOOK	95	KASNYKU BAY 112-11	AK	NSRA	89430	970527	990202	56	31	155	38	W	750	4800	M	TRAWL	GULF OF ALASKA
044711	CHINOOK	95	KASNYKU BAY 112-11	AK	NSRA	89430	970527	990204	57	45	154	10	W	640	3450	M	TRAWL	GULF OF ALASKA
044718	CHINOOK	95	CRYSTAL CR 106-44	AK	ADFG	9821	970529	980914	57	18	152	28	W	520	1900		TRAWL	GULF OF ALASKA
044738	CHINOOK	95	KETCHIKAN CR 101-47	AK	KTHC	9024	970515	980921	56	46	155	10	W	520	2800	M	TRAWL	GULF OF ALASKA
044757	CHINOOK	95	HERRING COVE 101-45	AK	SSRA	10868	970516	990212	57	29	154	39	W	570	2340	F	TRAWL	GULF OF ALASKA
0501011207	CHINOOK	94	COLEMAN NFH	CA	FWS	50036	950424	980517	43	16	124	44	W	720	6200	F	TRAWL	NE NORTH PACIFIC
0501011211	CHINOOK	95	LTL WHITE SALMON@NFH	WA	FWS	196920	960627	980923	56	45	155	12	W	600	2800	F	TRAWL	GULF OF ALASKA
0501011211	CHINOOK	95	LTL WHITE SALMON@NFH	WA	FWS	196920	960627	990216	57	41	154	21	W	610	3000	F	TRAWL	GULF OF ALASKA
0501020201	CHINOOK	95	COLEMAN NFH	CA	FWS	268960	960423	980518	54	54	165	19	W	630	3200	M	TRAWL	BERING SEA
0501020201	CHINOOK	95	COLEMAN NFH	CA	FWS	268960	960423	980616	48	3	125	22	W	600	2500	F	TRAWL	NE NORTH PACIFIC
0501020202	CHINOOK	95	RINGOLD POND (TROUT)	WA	WDFW	187818	960627	990216	57	45	154	11	W	574	2100	M	TRAWL	GULF OF ALASKA
0501020205	CHINOOK	95	NOT REPORTED	WA	FWS		960523	980919	56	24	158	7	W	570	3250	F	TRAWL	GULF OF ALASKA
0501020406	CHINOOK	96	RINGOLD POND (TROUT)	WA	WDFW	196887	970615	980619	48	24	124	54	W	402	750	M	TRAWL	NE NORTH PACIFIC
0501020406	CHINOOK	96	RINGOLD POND (TROUT)	WA	WDFW	196887	970615	980624	48	27	124	47	W	380	700	M	TRAWL	NE NORTH PACIFIC
0501020406	CHINOOK	96	RINGOLD POND (TROUT)	WA	WDFW	196887	970615	990210	57	27	154	46	W	530	1600	M	TRAWL	GULF OF ALASKA
0501020406	CHINOOK	96	RINGOLD POND (TROUT)	WA	WDFW	196887	970615	990215	57	34	154	38	W	510	2000		TRAWL	GULF OF ALASKA
053861	CHINOOK	95	COOK CR 21.0429	WA	FWS	46811	960722	980120	54	45	165	40	W	500	1650	M	TRAWL	BERING SEA

Table 4a. Continued.

RELEASE INFORMATION								RECOVERY INFORMATION											
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION
053953	CHINOOK	95	COOK CR 21.0429	WA	FWS	49274	960722	990204	57	38	154	24	W	650	6500	F	TRAWL	GULF OF ALASKA
054125	CHINOOK	96	COLEMAN NFH	CA	FWS	57739	970116	980706	48	20	125	15	W	440	1000	F	TRAWL	NE NORTH PACIFIC
054345	CHINOOK	96	SPRING CR 29.0159	WA	FWS	70566	970515	990628	48	11	124	57	W	570	2400	M	TRAWL	NE NORTH PACIFIC
054346	CHINOOK	96	SPRING CR 29.0159	WA	FWS	71227	970515	980625	48	24	124	51	W	400	700	F	TRAWL	NE NORTH PACIFIC
054453	CHINOOK	96	METHOW R 48.0002	WA	FWS	106197	980414	981001	56	56	155	3	W	330	600	M	TRAWL	GULF OF ALASKA
0601020206	CHINOOK	95	IRON GATE HATCHERY	CA	CDFG	53477	961112	990604	48	21	125	2	W	460	1200		TRAWL	NE NORTH PACIFIC
0601080314	CHINOOK	92	HORSE LINTO CREEK	CA	CDFG	33931	930620	950427	43	54	124	36	W	540	2100	M	TRAWL	NE NORTH PACIFIC
0601080406	CHINOOK	92	JUNCTION CITY	CA	CDFG	4914	930518	950427	43	53	124	45	W	510	1500	F	TRAWL	NE NORTH PACIFIC
0601140508	CHINOOK	95	RODEO MINOR PORT	CA	CDFG	47188	960709	980611	44	47	124	39	W	680	4300	M	TRAWL	NE NORTH PACIFIC
0601140510	CHINOOK	95	RODEO MINOR PORT	CA	CDFG	49410	960709	980517	54	44	165	13	W	590	2200	M	TRAWL	BERING SEA
0601140604	CHINOOK	95	YUBA CITY	CA	CDFG	50371	960515	980609	43	55	124	58	W	541	1750	F	TRAWL	NE NORTH PACIFIC
0601140605	CHINOOK	95	FEATHER RIVER	CA	CDFG	53526	960405	990000	48	16	124	57	W	680		F	TRAWL	NE NORTH PACIFIC
060217	CHINOOK	95	THORNTON	CA	EBMD	52123	960515	990516	47	46	125	7	W	900	10300		TRAWL	NE NORTH PACIFIC
060218	CHINOOK	95	JERSEY PT,SAN JOAQ.R	CA	EBMD	50832	960520	980623	48	20	124	51	W	535	1600	M	TRAWL	NE NORTH PACIFIC
060219	CHINOOK	95	JERSEY PT,SAN JOAQ.R	CA	EBMD	52389	960520	980000	AREA	670			W				TRAWL	NE NORTH PACIFIC
060228	CHINOOK	95	RODEO MINOR PORT	CA	EBMD	52608	960606	990605	48	19	124	57	W	910		F	TRAWL	NE NORTH PACIFIC
060230	CHINOOK	96	RODEO MINOR PORT	CA	EBMD	50235	970602	990606	48	17	124	55	W	610	2800	M	TRAWL	NE NORTH PACIFIC
060230	CHINOOK	96	RODEO MINOR PORT	CA	EBMD	50235	970602	990610	47	38	124	57	W	600	2500	F	TRAWL	NE NORTH PACIFIC
062936	CHINOOK	95	MOSS LANDING MIN. PT	CA	CDFG	58815	960703	980602	44	11	124	59	W	680	4600	M	TRAWL	NE NORTH PACIFIC

Table 4a. Continued.

RELEASE INFORMATION								RECOVERY INFORMATION										
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	LONG DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION
062937	CHINOOK	95	RODEO MINOR PORT	CA	CDFG	150089	960626	980616	48	4	125	18	W	590	2600	F	TRAWL	NE NORTH PACIFIC
062937	CHINOOK	95	RODEO MINOR PORT	CA	CDFG	150089	960626	990526	45	59	124	43	W	690	3820		TRAWL	NE NORTH PACIFIC
062938	CHINOOK	95	RODEO MINOR PORT	CA	CDFG	149440	960626	990522	46	39	124	43	W	950	6940		TRAWL	NE NORTH PACIFIC
063136	CHINOOK	92	GEORGIANNA SLOUGH	CA	CDFG	51560	930510	950430	46	17	124	41	W	530	1800	M	TRAWL	NE NORTH PACIFIC
063151	CHINOOK	94	STEWART ROAD	CA	CDFG	50265	950505	980527	47	50	125	16	W	895	11050	M	TRAWL	NE NORTH PACIFIC
065226	CHINOOK	95	TRINITY R HATCHERY	CA	HVT	110327	961001	980521	44	8	124	57	W	520	1400	F	TRAWL	NE NORTH PACIFIC
065734	CHINOOK	92	TRINITY R HATCHERY	CA	CDFG	53675	931001	950426	43	9	124	48	W	550	1900	M	TRAWL	NE NORTH PACIFIC
065735	CHINOOK	92	TRINITY R HATCHERY	CA	CDFG	56281	931001	950427	43	53	124	45	W	560	2000	F	TRAWL	NE NORTH PACIFIC
065735	CHINOOK	92	TRINITY R HATCHERY	CA	CDFG	56281	931001	950427	43	53	124	45	W	470	1100	F	TRAWL	NE NORTH PACIFIC
065735	CHINOOK	92	TRINITY R HATCHERY	CA	CDFG	56281	931001	950427	43	53	124	45	W	490	1400	F	TRAWL	NE NORTH PACIFIC
070423	CHINOOK	92	ELK RIVER	OR	ODFW	36278	931129	950420	43	53	124	44	W	590	2000	F	TRAWL	NE NORTH PACIFIC
070423	CHINOOK	92	ELK RIVER	OR	ODFW	36278	931129	950427	43	50	124	33	W	480	1300	M	TRAWL	NE NORTH PACIFIC
070425	CHINOOK	92	ELK RIVER	OR	ODFW	32475	931116	950415	45	19	124	23	W	588	3400	M	TRAWL	NE NORTH PACIFIC
070450	CHINOOK	94	MCKENZIE R-1	OR	ODFW	30170	960208	980123	57	4	152	23	W	660	3300	F	TRAWL	GULF OF ALASKA
070542	CHINOOK	94	BIG CR - L COL. R	OR	ODFW	26881	950829	980617	43	16	124	42	W	640	3100	F	TRAWL	NE NORTH PACIFIC
070752	CHINOOK	95	UMPQUA R	OR	ODFW	80680	961001	981012	57	36	154	40	W	520	2600	M	TRAWL	GULF OF ALASKA
070752	CHINOOK	95	UMPQUA R	OR	ODFW	80680	961001	990217	57	18	154	53	W	620	3250	F	TRAWL	GULF OF ALASKA
070854	CHINOOK	94	ELK R	OR	ODFW	194243	950928	990525	47	29	124	50	W	720	5500	F	TRAWL	NE NORTH PACIFIC
070857	CHINOOK	94	SANTIAM R, S FK	OR	ODFW	30113	960311	980914	55	8	160	15	W	620	3100	M	TRAWL	GULF OF ALASKA

Table 4a. Continued.

RELEASE INFORMATION								RECOVERY INFORMATION											
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION
070858	CHINOOK	94	SANTIAM R, S FK	OR	ODFW	30533	960205	980926	AREA 610				W		7000	M	TRAWL	GULF OF ALASKA
070932	CHINOOK	94	HUNTER CR - S. COAST	OR	ODFW	23918	951017	980610	44	45	124	37	W	580	2610	F	TRAWL	NE NORTH PACIFIC
070957	CHINOOK	94	TRASK R	OR	ODFW	25438	950817	990530	46	49	124	54	W	870		F	TRAWL	NE NORTH PACIFIC
070962	CHINOOK	94	SALMON R/OR - COAST	OR	ODFW	172256	950814	981012	57	38	154	34	W	770	7400	F	TRAWL	GULF OF ALASKA
071151	CHINOOK	94	SANDY R	OR	ODFW	23634	960311	981010	56	24	157	54	W	470	1710	M	TRAWL	GULF OF ALASKA
071251	CHINOOK	96	BIG CR - L COL. R	OR	ODFW	217574	970505	980625	48	21	124	52	W	395	700	M	TRAWL	NE NORTH PACIFIC
071252	CHINOOK	95	SALMON R/OR - COAST	OR	ODFW	171301	960815	971007	55	17	164	21	W	460	1300	M	TRAWL	BERING SEA
071252	CHINOOK	95	SALMON R/OR - COAST	OR	ODFW	171301	960815	980923	56	45	155	12	W	680	4400	F	TRAWL	GULF OF ALASKA
071334	CHINOOK	95	MORGAN CR (COOS R)	OR	ODFW	23556	960915	971004	54	58	165	3	W	480	1640	F	TRAWL	BERING SEA
071357	CHINOOK	95	CLACKAMAS R	OR	ODFW	29211	970320	990607	47	46	125	2	W	700	3690	M	TRAWL	NE NORTH PACIFIC
075737	CHINOOK	92	BIG CR - L COL. R	OR	ODFW	51797	930825	950421	46	41	124	47	W	496	1300	F	TRAWL	NE NORTH PACIFIC
091748	CHINOOK	95	UMATILLA R	OR	ODFW	25260	970325	990213	57	32	154	38	W	520	2300	F	TRAWL	GULF OF ALASKA
091850	CHINOOK	96	TRASK R	OR	ODFW	25695	970819	980210	57	27	154	46	W	500	1260	M	TRAWL	GULF OF ALASKA
091851	CHINOOK	96	TRASK R	OR	ODFW	25801	970819	990214	57	40	154	22	W	460	1500	M	TRAWL	GULF OF ALASKA
092120	CHINOOK	96	SANTIAM R, S FK	OR	ODFW	52336	971028	990215	57	39	154	21	W	540	1900	M	TRAWL	GULF OF ALASKA
092148	CHINOOK	96	ELK RIVER	OR	ODFW	175967	970826	990216	57	41	154	21	W	410	900	M	TRAWL	GULF OF ALASKA
092148	CHINOOK	96	ELK RIVER	OR	ODFW	175967	970826	990216	57	49	154	11	W	480	1700	F	TRAWL	GULF OF ALASKA
092149	CHINOOK	96	SALMON R/OR - COAST	OR	ODFW	194096	970814	980925	55	17	164	51	W	420	1200	F	TRAWL	BERING SEA
092149	CHINOOK	96	SALMON R/OR - COAST	OR	ODFW	194096	970814	990214	57	40	154	22	W	480	2000	F	TRAWL	GULF OF ALASKA

Table 4a. Continued.

RELEASE INFORMATION								RECOVERY INFORMATION										
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION
092215	CHINOOK	96	YOUNGS R & BAY	OR	ODFW	49392	980401	990201	57	40	154	20	W	490	1500	M	TRAWL	GULF OF ALASKA
092215	CHINOOK	96	YOUNGS R & BAY	OR	ODFW	49392	980401	990216	57	49	154	11	W	460	1100	F	TRAWL	GULF OF ALASKA
092241	CHINOOK	96	MCKENZIE R-1	OR	ODFW	35705	971111	990216	57	49	154	11	W	440	1400	F	TRAWL	GULF OF ALASKA
092242	CHINOOK	96	MCKENZIE R-1	OR	ODFW	28685	980305	990215	57	39	154	21	W	470	1300	M	TRAWL	GULF OF ALASKA
092247	CHINOOK	96	MCKENZIE R-1	OR	ODFW	46287	980205	990213	57	29	154	44	W	450	1200	F	TRAWL	GULF OF ALASKA
092250	CHINOOK	96	MCKENZIE R-1	OR	ODFW	149671	971111	980212	57	34	154	38	W	440	1500		TRAWL	GULF OF ALASKA
092250	CHINOOK	96	MCKENZIE R-1	OR	ODFW	149671	971111	990214	57	40	154	22	W	480	1600	F	TRAWL	GULF OF ALASKA
092250	CHINOOK	96	MCKENZIE R-1	OR	ODFW	149671	971111	990216	57	47	154	9	W	500	1300	F	TRAWL	GULF OF ALASKA
092319	CHINOOK	96	SANTIAM R & N FK-1	OR	ODFW	244804	980302	990216	57	49	154	11	W	450	1400	M	TRAWL	GULF OF ALASKA
092320	CHINOOK	96	SANTIAM R & N FK-1	OR	ODFW	407781	980302	990213	AREA 620				W	450	1000	F	TRAWL	GULF OF ALASKA
092320	CHINOOK	96	SANTIAM R & N FK-1	OR	ODFW	407781	980302	990214	57	40	154	22	W	450	1300	M	TRAWL	GULF OF ALASKA
092320	CHINOOK	96	SANTIAM R & N FK-1	OR	ODFW	407781	980302	990217	57	29	154	43	W	440	1100	F	TRAWL	GULF OF ALASKA
1301040102	CHINOOK	95	WILLOW CR 247-41	AK	ADFG	13474	960928	980910	55	02	160	24	W	420	1000	F	TRAWL	GULF OF ALASKA
180431	CHINOOK	91	R-HIRSCH CREEK	BC	CDFO	28463	920501	950126	55	20	164	58	W	680	3800	F	TRAWL	BERING SEA
180611	CHINOOK	92	R-BABINE R, UPPER	BC	CDFO	10235	940429	980602	54	55	160	19	W	830	7600	F	TRAWL	GULF OF ALASKA
180634	CHINOOK	94	R-NAHMINT RIVER	BC	CDFO	29280	950515	980919	56	25	158	0	W	780	6700	F	TRAWL	GULF OF ALASKA
180640	CHINOOK	94	R-KITSUMKALUM R	BC	CDFO	30010	950613	980917	55	5	165	25	W	830	6990	M	TRAWL	BERING SEA
180642	CHINOOK	94	R-KITSUMKALUM R	BC	CDFO	30867	950613	980622	AREA 620				W	700	4700	M	TRAWL	GULF OF ALASKA

Table 4a. Continued.

RELEASE INFORMATION								RECOVERY INFORMATION										
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION
181229	CHINOOK	94	R-ATNARKO SPAWN CHAN	BC	CDFO	58670	950606	970918	AREA 620				W	657	4600	M	TRAWL	GULF OF ALASKA
181229	CHINOOK	94	R-ATNARKO SPAWN CHAN	BC	CDFO	58670	950606	980917	54	26	158	7	W	750	5500	F	TRAWL	GULF OF ALASKA
181237	CHINOOK	93	R-ATNARKO R LOWER	BC	CDFO	58496	940612	980203	56	29	155	36	W	840	7500	F	TRAWL	GULF OF ALASKA
181238	CHINOOK	93	R-ATNARKO SPAWN CHAN	BC	CDFO	56041	950511	980129	55	06	165	16	W	840	7800	F	TRAWL	BERING SEA
181238	CHINOOK	93	R-ATNARKO SPAWN CHAN	BC	CDFO	56041	950511	981006	55	47	158	57	W	800	9100	F	TRAWL	GULF OF ALASKA
181240	CHINOOK	94	R-BULKLEY R UPPER	BC	CDFO	88058	960430	980124	57	3	152	22	W	490	1700	F	TRAWL	GULF OF ALASKA
181318	CHINOOK	94	R-KILBELLA BAY	BC	CDFO	41217	950616	980918	56	25	158	12	W	810	8300	F	TRAWL	GULF OF ALASKA
181346	CHINOOK	95	R-NITINAT LAKE	BC	CDFO	27741	960504	980915	55	2	160	25	W	630	3500	F	TRAWL	GULF OF ALASKA
181348	CHINOOK	95	R-NITINAT LAKE	BC	CDFO	27723	960606	980130	55	08	166	30	W	471	1225	F	TRAWL	BERING SEA
181348	CHINOOK	95	R-NITINAT LAKE	BC	CDFO	27723	960606	980615	54	53	160	17	W	520	1900	F	TRAWL	GULF OF ALASKA
181349	CHINOOK	95	R-NITINAT RIVER	BC	CDFO	26435	960608	981001	56	56	155	3	W	670	5000	F	TRAWL	GULF OF ALASKA
181424	CHINOOK	93	R-KITSUMKALUM R	BC	CDFO	50119	940602	970904	AREA 610				W	830	7800	F	TRAWL	GULF OF ALASKA
181428	CHINOOK	93	R-MITCHIE CREEK	BC	CDFO	50210	940601	980310	59	26	178	5	W	760	5400	F	TRAWL	BERING SEA
181445	CHINOOK	93	R-QUESNEL RIVER	BC	CDFO	73231	950403	980601	54	54	160	17	W	710	4500	F	TRAWL	GULF OF ALASKA
181457	CHINOOK	94	R-ROBERTSON CREEK	BC	CDFO	28246	950606	980911	56	23	157	50	W	730	7110	F	TRAWL	GULF OF ALASKA
181459	CHINOOK	94	R-ROBERTSON CREEK	BC	CDFO	27769	950611	971004	55	10	165	3	W	570	2600	F	TRAWL	BERING SEA
181504	CHINOOK	94	R-DOME CREEK	BC	CDFO	25115	960410	971008	54	42	165	40	W	520	2200	M	TRAWL	BERING SEA
181514	CHINOOK	95	R-BIRKENHEAD RIVER	BC	CDFO	40392	970300	980903	AREA 620				W		2300	M	TRAWL	GULF OF ALASKA

Table 4a. Continued.

RELEASE INFORMATION								RECOVERY INFORMATION										
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION
181514	CHINOOK	95	R-BIRKENHEAD RIVER	BC	CDFO	40392	970300	980913	55	0	160	29	W	540	2100	M	TRAWL	GULF OF ALASKA
181514	CHINOOK	95	R-BIRKENHEAD RIVER	BC	CDFO	40392	970300	981002	56	24	158	7	W	620	4300	F	TRAWL	GULF OF ALASKA
181514	CHINOOK	95	R-BIRKENHEAD RIVER	BC	CDFO	40392	970300	990101	AREA 620				W	620	3500		TRAWL	GULF OF ALASKA
181514	CHINOOK	95	R-BIRKENHEAD RIVER	BC	CDFO	40392	970300	990201	57	14	154	54	W	600	2700	M	TRAWL	GULF OF ALASKA
181514	CHINOOK	95	R-BIRKENHEAD RIVER	BC	CDFO	40392	970300	990214	57	40	154	22	W	580	3100	F	TRAWL	GULF OF ALASKA
181514	CHINOOK	95	R-BIRKENHEAD RIVER	BC	CDFO	40392	970300	990214	57	33	154	39	W	580	2400	M	TRAWL	GULF OF ALASKA
181654	CHINOOK	95	R-BULKLEY R UPPER	BC	CDFO	25028	970422	990126	57	4	152	24	W	570	2200	F	TRAWL	GULF OF ALASKA
181655	CHINOOK	95	R-BULKLEY R UPPER	BC	CDFO	25055	970422	990204	56	25	155	44	W	570	3100		TRAWL	GULF OF ALASKA
181814	CHINOOK	94	R-CONUMA ESTUARY	BC	CDFO	27587	950421	980911	55	2	160	25	W	750	8150	F	TRAWL	GULF OF ALASKA
181816	CHINOOK	94	R-CONUMA ESTUARY	BC	CDFO	25921	950513	980606	58	41	153	19	W	630	2800	F	TRAWL	GULF OF ALASKA
181823	CHINOOK	94	R-TAHSIS RIVER	BC	CDFO	25235	950627	971005	54	55	166	00	W	650	3700	F	TRAWL	BERING SEA
181823	CHINOOK	94	R-TAHSIS RIVER	BC	CDFO	25235	950627	971014	55	18	160	38	W	570	2600	M	TRAWL	GULF OF ALASKA
181841	CHINOOK	94	R-NITINAT RIVER	BC	CDFO	32642	950606	980917	56	24	158	7	W	770	6400	M	TRAWL	GULF OF ALASKA
181841	CHINOOK	94	R-NITINAT RIVER	BC	CDFO	32642	950606	980918	56	12	158	25	W	720	5600	M	TRAWL	GULF OF ALASKA
181841	CHINOOK	94	R-NITINAT RIVER	BC	CDFO	32642	950606	981009	55	24	157	56	W	640	5200	F	TRAWL	GULF OF ALASKA
181860	CHINOOK	94	R-NITINAT LAKE	BC	CDFO	22479	950524	971007	55	17	164	21	W	610	3180	F	TRAWL	BERING SEA
181860	CHINOOK	94	R-NITINAT LAKE	BC	CDFO	22479	950524	980917	56	23	157	49	W	680	5180		TRAWL	GULF OF ALASKA
181861	CHINOOK	94	R-SARITA R	BC	CDFO	22441	950529	980210	55	16	164	39	W	650	3400	F	TRAWL	BERING SEA
181862	CHINOOK	94	R-NITINAT LAKE	BC	CDFO	21778	950512	971007	55	17	164	21	W	720	5600	M	TRAWL	BERING SEA

Table 4a. Continued.

RELEASE INFORMATION								RECOVERY INFORMATION											
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION
181863	CHINOOK	96	R-NITINAT LAKE	BC	CDFO	22116	970611	990125	55	32	160	17	W	510	2000	M	TRAWL	GULF OF ALASKA
181863	CHINOOK	96	R-NITINAT LAKE	BC	CDFO	22116	970611	990214	57	40	154	22	W	490	1800	F	TRAWL	GULF OF ALASKA
181904	CHINOOK	96	R-NITINAT LAKE	BC	CDFO	21315	970605	990212	57	34	154	38	W	500	1900		TRAWL	GULF OF ALASKA
181952	CHINOOK	94	R-NICOLA RIVER	BC	CDFO	48208	960506	980131	54	58	164	54	W	570	1900	F	TRAWL	BERING SEA
181952	CHINOOK	94	R-NICOLA RIVER	BC	CDFO	48208	960506	990523	47	50	125	23	W	740	5450		TRAWL	NE NORTH PACIFIC
181953	CHINOOK	94	R-NICOLA RIVER	BC	CDFO	49541	960506	971008	55	15	164	45	W	540	2400	M	TRAWL	BERING SEA
181953	CHINOOK	94	R-NICOLA RIVER	BC	CDFO	49541	960506	980124	56	32	159	34	W	600	2800	M	TRAWL	GULF OF ALASKA
182151	CHINOOK	95	R-CONUMA RIVER	BC	CDFO	38412	960605	980921	56	25	157	40	W	580	3100	M	TRAWL	GULF OF ALASKA
182152	CHINOOK	95	R-SALLOOMT RIVER	BC	CDFO	37888	960604	980921	56	25	157	40	W	660	4100	M	TRAWL	GULF OF ALASKA
182156	CHINOOK	94	R-KITSUMKALUM R	BC	CDFO	30171	950613	970918	AREA 620				W	699	5100	M	TRAWL	GULF OF ALASKA
182156	CHINOOK	94	R-KITSUMKALUM R	BC	CDFO	30171	950613	981023	54	42	165	52	W	780	7300	F	TRAWL	BERING SEA
182220	CHINOOK	94	R-ROBERTSON CREEK	BC	CDFO	27514	950605	970926	54	41	165	26	W	540	1990	F	TRAWL	BERING SEA
182221	CHINOOK	94	R-ROBERTSON CREEK	BC	CDFO	26885	950605	971008	54	51	164	59	W	590	3000		TRAWL	BERING SEA
182227	CHINOOK	95	R-ROBERTSON CREEK	BC	CDFO	25675	960603	980919	56	25	158	0	W	680	4200	M	TRAWL	GULF OF ALASKA
182231	CHINOOK	95	R-ROBERTSON CREEK	BC	CDFO	25368	960531	981009	56	23	157	41	W	750	7820	M	TRAWL	GULF OF ALASKA
182239	CHINOOK	96	R-CAPILANO RIVER	BC	CDFO	25119	970520	980625	48	21	124	52	W	440	900	M	TRAWL	NE NORTH PACIFIC
182240	CHINOOK	96	R-CAPILANO RIVER	BC	CDFO	24919	970520	990529	48	12	124	58	W	570	2100	F	TRAWL	NE NORTH PACIFIC
182250	CHINOOK	95	R-KILBELLA BAY	BC	CDFO	51822	960623	980124	56	32	155	34	W	550	2300	M	TRAWL	GULF OF ALASKA

Table 4a. Continued.

RELEASE INFORMATION								RECOVERY INFORMATION										
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION
182251	CHINOOK	95	R-TRANQUILLE EST	BC	CDFO	50229	960619	980915	55	2	160	23	W	620	3500	F	TRAWL	GULF OF ALASKA
182251	CHINOOK	95	R-TRANQUILLE EST	BC	CDFO	50229	960619	980918	56	25	158	12	W	850	9000	M	TRAWL	GULF OF ALASKA
182251	CHINOOK	95	R-TRANQUILLE EST	BC	CDFO	50229	960619	981006	56	24	158	4	W	500	1980	F	TRAWL	GULF OF ALASKA
182251	CHINOOK	95	R-TRANQUILLE EST	BC	CDFO	50229	960619	990201	57	40	154	21	W	570	2200	F	TRAWL	GULF OF ALASKA
182251	CHINOOK	95	R-TRANQUILLE EST	BC	CDFO	50229	960619	990217	57	18	154	53	W	610	3250	F	TRAWL	GULF OF ALASKA
182261	CHINOOK	95	R-CHILLIWACK RIVER	BC	CDFO	49252	960529	980607	48	16	125	3	W	560	2200	F	TRAWL	NE NORTH PACIFIC
182316	CHINOOK	95	R-BABINE RIVER	BC	CDFO	11080	970430	981008	57	33	154	40	W	560	2680	F	TRAWL	GULF OF ALASKA
182317	CHINOOK	95	R-BABINE RIVER	BC	CDFO	11086	970430	981002	56	24	158	4	W	550	3250	F	TRAWL	GULF OF ALASKA
182318	CHINOOK	95	R-BABINE RIVER	BC	CDFO	10855	970430	981016	54	45	165	40	W	590	2600	M	TRAWL	BERING SEA
182342	CHINOOK	95	R-KITSUMKALUM R	BC	CDFO	28450	960610	990202	54	58	164	58	W	650	3000	M	TRAWL	GULF OF ALASKA
182344	CHINOOK	95	R-KITSUMKALUM R	BC	CDFO	28241	960610	980920	57	2	154	57	W	540	2400	F	TRAWL	GULF OF ALASKA
182347	CHINOOK	95	R-BIG QUALICUM RIVER	BC	CDFO	27253	960529	980124	59	59	148	22	W	530	1800	M	TRAWL	GULF OF ALASKA
182461	CHINOOK	95	R-SHUSWAP R. MIDDLE	BC	CDFO	75329	960528	980911	AREA 610				W	660	3400	F	TRAWL	GULF OF ALASKA
182501	CHINOOK	96	R-SHUSWAP R. MIDDLE	BC	CDFO	74457	970528	980911	55	2	160	25	W	510	2150	F	TRAWL	GULF OF ALASKA
182501	CHINOOK	96	R-SHUSWAP R. MIDDLE	BC	CDFO	74457	970528	990124	55	33	160	2	W	540	2500	F	TRAWL	GULF OF ALASKA
182501	CHINOOK	96	R-SHUSWAP R. MIDDLE	BC	CDFO	74457	970528	990125	AREA 610				W	570	2200		TRAWL	GULF OF ALASKA
182501	CHINOOK	96	R-SHUSWAP R. MIDDLE	BC	CDFO	74457	970528	990216	57	39	154	21	W	530	1900	F	TRAWL	GULF OF ALASKA

Table 4a. Continued.

RELEASE INFORMATION								RECOVERY INFORMATION										
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION
182529	CHINOOK	96	R-ATNARKO R UPPER	BC	CDFO	25022	970609	990124	57	40	154	21	W	600	3500	M	TRAWL	GULF OF ALASKA
182531	CHINOOK	96	R-ATNARKO SPAWN CHAN	BC	CDFO	24773	970609	980922	56	23	157	46	W	460	1300	M	TRAWL	GULF OF ALASKA
182531	CHINOOK	96	R-ATNARKO SPAWN CHAN	BC	CDFO	24773	970609	990214	57	33	154	39	W	540	2200	F	TRAWL	GULF OF ALASKA
182533	CHINOOK	96	R-ATNARKO SPAWN CHAN	BC	CDFO	22897	970609	981007	55	22	166	8	W	500	1900	M	TRAWL	BERING SEA
182533	CHINOOK	96	R-ATNARKO SPAWN CHAN	BC	CDFO	22897	970609	990201	57	42	154	15	W	530	1750		TRAWL	GULF OF ALASKA
182533	CHINOOK	96	R-ATNARKO SPAWN CHAN	BC	CDFO	22897	970609	990213	57	32	154	38	W	520	1700	M	TRAWL	GULF OF ALASKA
182731	CHINOOK	95	R-NICOLA RIVER	BC	CDFO	49898	970501	980917	56	24	158	7	W	590	2500	M	TRAWL	GULF OF ALASKA
182731	CHINOOK	95	R-NICOLA RIVER	BC	CDFO	49898	970501	981023	54	8	166	25	W	560	2400	F	TRAWL	BERING SEA
182731	CHINOOK	95	R-NICOLA RIVER	BC	CDFO	49898	970501	981024	54	39	165	34	W	520	2100	F	TRAWL	BERING SEA
182731	CHINOOK	95	R-NICOLA RIVER	BC	CDFO	49898	970501	981112	55	41	165	27	W	600	3200	F	TRAWL	BERING SEA
182732	CHINOOK	95	R-NICOLA RIVER	BC	CDFO	50275	970501	980911	55	2	160	25	W	680	6100	M	TRAWL	GULF OF ALASKA
182732	CHINOOK	95	R-NICOLA RIVER	BC	CDFO	50275	970501	980914	AREA 610				W	570	2400	M	TRAWL	GULF OF ALASKA
182732	CHINOOK	95	R-NICOLA RIVER	BC	CDFO	50275	970501	990217	57	29	154	43	W	610	3700	F	TRAWL	GULF OF ALASKA
182733	CHINOOK	95	R-SALMON R/THOMPSON	BC	CDFO	50668	970430	980915	55	2	160	23	W	520	1900	M	TRAWL	GULF OF ALASKA
182733	CHINOOK	95	R-SALMON R/THOMPSON	BC	CDFO	50668	970430	981011	56	27	157	45	W	560	2700	F	TRAWL	GULF OF ALASKA
182733	CHINOOK	95	R-SALMON R/THOMPSON	BC	CDFO	50668	970430	990201	57	40	154	20	W	560	2550	M	TRAWL	GULF OF ALASKA
182733	CHINOOK	95	R-SALMON R/THOMPSON	BC	CDFO	50668	970430	990417	55	33	155	58	W	620	3200	M	TRAWL	GULF OF ALASKA
182734	CHINOOK	95	R-SPIUS CREEK	BC	CDFO	47160	970429	981001	54	32	165	39	W	590	3350	F	TRAWL	BERING SEA
182734	CHINOOK	95	R-SPIUS CREEK	BC	CDFO	47160	970429	981020	54	26	165	47	W	680	3900	F	TRAWL	BERING SEA

Table 4a. Continued.

RELEASE INFORMATION								RECOVERY INFORMATION											
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION
182754	CHINOOK	96	R-KITSUMKALUM R	BC	CDFO	29002	970618	990120	57	7	152	23	W	540	1800		TRAWL	GULF OF ALASKA
182833	CHINOOK	96	R-YAKOUN RIVER	BC	CDFO	26037	970707	990216	57	49	154	11	W	570	2600	F	TRAWL	GULF OF ALASKA
182834	CHINOOK	96	R-CHUCKWALLA RIVER	BC	CDFO	31052	970613	990216	57	49	154	11	W	510	2000	M	TRAWL	GULF OF ALASKA
182847	CHINOOK	96	R-CHEHALIS RIVER/BC	BC	CDFO	50954	970520	990527	47	58	125	20	W	630	2900	M	TRAWL	NE NORTH PACIFIC
182847	CHINOOK	96	R-CHEHALIS RIVER/BC	BC	CDFO	50954	970520	990628	48	8	124	59	W	550	1900	M	TRAWL	NE NORTH PACIFIC
182848	CHINOOK	96	R-CHEHALIS RIVER/BC	BC	CDFO	43221	970606	980715	48	23	124	50	W	460	1050	M	TRAWL	NE NORTH PACIFIC
182848	CHINOOK	96	R-CHEHALIS RIVER/BC	BC	CDFO	43221	970606	990614	48	15	125	12	W	610	2700	M	TRAWL	NE NORTH PACIFIC
182848	CHINOOK	96	R-CHEHALIS RIVER/BC	BC	CDFO	43221	970606	990627	48	12	124	57	W	560	2200	M	TRAWL	NE NORTH PACIFIC
182849	CHINOOK	96	R-KILDALA RIVER	BC	CDFO	53773	970506	990211	AREA 620				W	550	2200	F	TRAWL	GULF OF ALASKA
182850	CHINOOK	96	R-KITIMAT LOWER	BC	CDFO	54819	970512	980905	55	49	158	59	W	540	2300	F	TRAWL	GULF OF ALASKA
182850	CHINOOK	96	R-KITIMAT LOWER	BC	CDFO	54819	970512	990211	AREA 620				W	540	2000	M	TRAWL	GULF OF ALASKA
182850	CHINOOK	96	R-KITIMAT LOWER	BC	CDFO	54819	970512	990214	57	40	154	22	W	560	2400	F	TRAWL	GULF OF ALASKA
182855	CHINOOK	96	R-KILBELLA BAY	BC	CDFO	48714	970725	990126	57	59	152	29	W	483	1400	F	TRAWL	GULF OF ALASKA
182855	CHINOOK	96	R-KILBELLA BAY	BC	CDFO	48714	970725	990201	57	40	154	20	W		1300	M	TRAWL	GULF OF ALASKA
182857	CHINOOK	96	R-CHILLIWACK RIVER	BC	CDFO	41252	970526	980620	48	23	124	51	W	410	800	M	TRAWL	NE NORTH PACIFIC
182857	CHINOOK	96	R-CHILLIWACK RIVER	BC	CDFO	41252	970526	980814	48	25	124	56	W	480	2500	M	TRAWL	NE NORTH PACIFIC
182857	CHINOOK	96	R-CHILLIWACK RIVER	BC	CDFO	41252	970526	980815	48	14	125	11	W	440	950	M	TRAWL	NE NORTH PACIFIC
182857	CHINOOK	96	R-CHILLIWACK RIVER	BC	CDFO	41252	970526	981018	54	32	165	39	W	560	2350	F	TRAWL	BERING SEA

Table 4a. Continued.

RELEASE INFORMATION								RECOVERY INFORMATION										
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION
182857	CHINOOK	96	R-CHILLIWACK RIVER	BC	CDFO	41252	970526	990617	48	13	124	56	W	560	2100	F	TRAWL	NE NORTH PACIFIC
182858	CHINOOK	96	R-STAVE RIVER	BC	CDFO	46690	970508	990531	48	17	124	55	W	490	1300	F	TRAWL	NE NORTH PACIFIC
182858	CHINOOK	96	R-STAVE RIVER	BC	CDFO	46690	970508	990625	48	11	125	12	W	590	2600	F	TRAWL	NE NORTH PACIFIC
183147	CHINOOK	95	R-ATNARKO R UPPER	BC	CDFO	88051	960607	980615	54	50	160	17	W	570	2500	F	TRAWL	GULF OF ALASKA
183147	CHINOOK	95	R-ATNARKO R UPPER	BC	CDFO	88051	960607	980922	56	24	158	0	W	760	6200	M	TRAWL	GULF OF ALASKA
183147	CHINOOK	95	R-ATNARKO R UPPER	BC	CDFO	88051	960607	990212	55	45	164	47	W	750	4800		TRAWL	BERING SEA
183147	CHINOOK	95	R-ATNARKO R UPPER	BC	CDFO	88051	960607	990214	57	37	154	30	W	630	3300	F	TRAWL	GULF OF ALASKA
183147	CHINOOK	95	R-ATNARKO R UPPER	BC	CDFO	88051	960607	990216	57	47	154	08	W	680	4600	M	TRAWL	GULF OF ALASKA
183148	CHINOOK	95	R-ATNARKO SPAWN CHAN	BC	CDFO	87497	960606	980605	54	57	160	16	W	530	2000	F	TRAWL	GULF OF ALASKA
183148	CHINOOK	95	R-ATNARKO SPAWN CHAN	BC	CDFO	87497	960606	981012	57	38	154	34	W	660	4400	F	TRAWL	GULF OF ALASKA
183148	CHINOOK	95	R-ATNARKO SPAWN CHAN	BC	CDFO	87497	960606	990320	54	50	165	27	W	680	3900	F	TRAWL	BERING SEA
183149	CHINOOK	96	R-SHUSWAP R LOWER	BC	CDFO	75714	970516	990216	57	47	154	08	W	500	1800	M	TRAWL	GULF OF ALASKA
183348	CHINOOK	95	R-JUDAS CR	BC	CDFO	50814	960604	990330	57	43	173	34	W	660	3320	M	TRAWL	BERING SEA
183355	CHINOOK	96	R-TRANQUILLE EST	BC	CDFO	50106	970630	981001	AREAS 513/517				W	440	1400	M	TRAWL	BERING SEA
183355	CHINOOK	96	R-TRANQUILLE EST	BC	CDFO	50106	970630	981010	56	24	157	54	W	770	7150	M	TRAWL	GULF OF ALASKA
183355	CHINOOK	96	R-TRANQUILLE EST	BC	CDFO	50106	970630	990126	55	32	160	16	W	550	2500	M	TRAWL	GULF OF ALASKA
212606	CHINOOK	94	KALAMA CR 11.0017	WA	NISQ	203635	950530	981107	48	17	125	1	W	700	4000	F	TRAWL	NE NORTH PACIFIC
212920	CHINOOK	94	QUINAULT LAKE (21)	WA	QDNR	73642	950626	970929	54	37	165	35	W	610	3000	M	TRAWL	BERING SEA
212940	CHINOOK	95	WHITE R 10.0031	WA	MUCK	252670	960530	980807	48	22	125	1	W	460	1000	F	TRAWL	NE NORTH PACIFIC

Table 4a. Continued.

RELEASE INFORMATION								RECOVERY INFORMATION											
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION
212941	CHINOOK	95	WHITE R 10.0031	WA	MUCK	75403	970415	980814	48	25	124	54	W	480	2500	M	TRAWL	NE NORTH PACIFIC
212941	CHINOOK	95	WHITE R 10.0031	WA	MUCK	75403	970415	980815	48	14	125	11	W	410	800	M	TRAWL	NE NORTH PACIFIC
212946	CHINOOK	95	CLEAR CR 11.0013	WA	NISQ	215503	960506	990624	48	19	124	56	W	650	3900	F	TRAWL	NE NORTH PACIFIC
212948	CHINOOK	95	SALMON R 21.0139	WA	QDNR	209929	960731	980929	56	24	158	6	W	600	4500	M	TRAWL	GULF OF ALASKA
212953	CHINOOK	96	HOKO R 19.0148	WA	MAKA	81578	970617	990201	57	42	154	15	W	480	1020		TRAWL	GULF OF ALASKA
212957	CHINOOK	96	CLEAR CR 11.0013C	WA	NISQ	226046	970506	980615	48	6	125	17	W	400	800	F	TRAWL	NE NORTH PACIFIC
212957	CHINOOK	96	CLEAR CR 11.0013C	WA	NISQ	226046	970506	980625	48	24	124	51	W	410	800	F	TRAWL	NE NORTH PACIFIC
212961	CHINOOK	96	SALMON R 21.0139	WA	QDNR	206522	970729	980915	AREA 610				W	420	1000	F	TRAWL	GULF OF ALASKA
212963	CHINOOK	96	GROVERS CR 15.0299	WA	SUQ	201607	970430	980623	48	22	124	51	W	380	500	M	TRAWL	NE NORTH PACIFIC
212963	CHINOOK	96	GROVERS CR 15.0299	WA	SUQ	201607	970430	980807	48	21	125	2	W	420	800	M	TRAWL	NE NORTH PACIFIC
213037	CHINOOK	96	LTL BOSTON C 15.0350	WA	PGAM	71870	970523	990621	48	18	124	55	W	530	1750	M	TRAWL	NE NORTH PACIFIC
215512	CHINOOK	96	QUINAULT LAKE (21)	WA	QDNR	70061	970831	980921	56	50	155	6	W	460	1600	M	TRAWL	GULF OF ALASKA
312315	CHINOOK	93	HALIBUT CV LAG241-15	AK	ADFG	21035	940610	970817	54	49	165	34	W	730	4800	F	TRAWL	BERING SEA
312427	CHINOOK	94	CROOKED CR 244-30	AK	ADFG	38408	950605	970921	54	48	165	47	W	610	3400	F	TRAWL	BERING SEA
312428	CHINOOK	94	SHIP CR 247-50	AK	ADFG	38604	950524	970909	AREA 517				W				TRAWL	BERING SEA
312430	CHINOOK	94	HALIBUT CV LAG241-15	AK	ADFG	36685	950613	970930	54	43	165	37	W	620	2900	F	TRAWL	BERING SEA
312435	CHINOOK	94	NINILCHIK R 244-20	AK	ADFG	54353	950530	970921	54	45	165	50	W	680	4400	M	TRAWL	BERING SEA
312507	CHINOOK	95	HOMER SPIT 241-13	AK	ADFG	39070	960531	970926	54	39	165	27	W	490	2050	M	TRAWL	BERING SEA
312507	CHINOOK	95	HOMER SPIT 241-13	AK	ADFG	39070	960531	971012	54	43	165	35	W	510	2750	F	TRAWL	BERING SEA

Table 4a. Continued.

RELEASE INFORMATION								RECOVERY INFORMATION											
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION
312508	CHINOOK	95	SHIP CR 247-50	AK	ADFG	40108	960529	981023	54	8	166	25	W	660	4000	M	TRAWL	BERING SEA
312509	CHINOOK	95	BUSKIN R 259-21	AK	ADFG	40681	960523	971004	55	10	165	3	W	460	1300	M	TRAWL	BERING SEA
312510	CHINOOK	95	SELDOVIA HBR 241-11	AK	ADFG	39610	960612	980907	54	49	165	35	W	700	4900	F	TRAWL	BERING SEA
312510	CHINOOK	95	SELDOVIA HBR 241-11	AK	ADFG	39610	960612	980921	59	39	178	14	W	670	4080	M	TRAWL	BERING SEA
312511	CHINOOK	95	HALIBUT CV LAG 241-15	AK	ADFG	39345	960604	970908	54	10	166	25	W	490	1600	M	TRAWL	BERING SEA
312511	CHINOOK	95	HALIBUT CV LAG241-15	AK	ADFG	39345	960604	971010	55	35	165	16	W			M	TRAWL	BERING SEA
312511	CHINOOK	95	HALIBUT CV LAG 241-15	AK	ADFG	39345	960604	981016	54	50	165	42	W	710	5000	F	TRAWL	BERING SEA
312512	CHINOOK	95	CROOKED CR 244-30	AK	ADFG	40215	960606	971008	55	35	165	16	W	450	1000	M	TRAWL	BERING SEA
312512	CHINOOK	95	CROOKED CR 244-30	AK	ADFG	40215	960606	971016	AREAS 517/519				W	590	1900	M	TRAWL	BERING SEA
312512	CHINOOK	95	CROOKED CR 244-30	AK	ADFG	40215	960606	981031	54	40	165	59	W	630	3000	F	TRAWL	BERING SEA
312514	CHINOOK	95	DECEPTION CR 247-41	AK	ADFG	42595	960614	981007	54	45	165	30	W	700	8400	F	TRAWL	BERING SEA
312514	CHINOOK	95	DECEPTION CR 247-41	AK	ADFG	42595	960614	981021	54	36	165	36	W	620	3600	M	TRAWL	BERING SEA
312515	CHINOOK	95	NINILCHIK R 244-20	AK	ADFG	50962	960613	971008	54	57	164	59	W	460	1400	M	TRAWL	BERING SEA
312515	CHINOOK	95	NINILCHIK R 244-20	AK	ADFG	50962	960613	980906	54	45	165	24	W	680	3900	F	TRAWL	BERING SEA
312550	CHINOOK	95	KENAI R 244-30	AK	ADFG	5629	970629	981001	56	56	155	3	W	420	1100	M	TRAWL	GULF OF ALASKA
312554	CHINOOK	95	KILLEY R 244-30	AK	ADFG	6255	970608	981015	54	58	164	59	W	490	1800	M	TRAWL	BERING SEA
312555	CHINOOK	96	CROOKED CR 244-30	AK	ADFG	39038	970529	980923	54	17	165	59	W	480		M	TRAWL	BERING SEA
312556	CHINOOK	96	SHIP CR 247-50	AK	ADFG	40319	970528	980605	54	59	160	17	W	370	700	M	TRAWL	GULF OF ALASKA
312556	CHINOOK	96	SHIP CR 247-50	AK	ADFG	40319	970528	980911	55	4	160	18	W	480	1400	M	TRAWL	GULF OF ALASKA

Table 4a. Continued.

RELEASE INFORMATION								RECOVERY INFORMATION											
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION
312556	CHINOOK	96	SHIP CR 247-50	AK	ADFG	40319	970528	980911	55	2	160	25	W	440	1280	F	TRAWL	GULF OF ALASKA
312556	CHINOOK	96	SHIP CR 247-50	AK	ADFG	40319	970528	980927	54	7	166	26	W	490	1800	M	TRAWL	BERING SEA
312557	CHINOOK	96	SELDOVIA HBR 241-11	AK	ADFG	39834	970606	980928	57	0	154	59	W	420	1200	F	TRAWL	GULF OF ALASKA
312557	CHINOOK	96	SELDOVIA HBR 241-11	AK	ADFG	39834	970606	990211	AREA 620				W	480	1200	F	TRAWL	GULF OF ALASKA
312560	CHINOOK	96	HOMER SPIT 241-13	AK	ADFG	38810	970602	981029	57	29	154	33	W	470	1300	F	TRAWL	GULF OF ALASKA
312603	CHINOOK	96	DECEPTION CR 247-41	AK	ADFG	47078	970611	980909	55	1	160	26	W	480	1710	F	TRAWL	GULF OF ALASKA
312603	CHINOOK	96	DECEPTION CR 247-41	AK	ADFG	47078	970611	981011	56	22	157	45	W	490	1400	M	TRAWL	GULF OF ALASKA
312604	CHINOOK	96	DECEPTION CR 247-41	AK	ADFG	47051	970611	980910	AREA 610				W	630	1700	M	TRAWL	GULF OF ALASKA
312604	CHINOOK	96	DECEPTION CR 247-41	AK	ADFG	47051	970611	981011	55	16	165	23	W	500	1800	M	TRAWL	BERING SEA
312605	CHINOOK	96	DECEPTION CR 247-41	AK	ADFG	46072	970611	980913	55	0	160	29	W	460	1000	F	TRAWL	GULF OF ALASKA
312605	CHINOOK	96	DECEPTION CR 247-41	AK	ADFG	46072	970611	980920	56	24	158	9	W	490	1300	F	TRAWL	GULF OF ALASKA
312605	CHINOOK	96	DECEPTION CR 247-41	AK	ADFG	46072	970611	980923	56	45	155	12	W	470	1800	F	TRAWL	GULF OF ALASKA
312605	CHINOOK	96	DECEPTION CR 247-41	AK	ADFG	46072	970611	981007	54	29	165	39	W	500	1600	M	TRAWL	BERING SEA
312605	CHINOOK	96	DECEPTION CR 247-41	AK	ADFG	46072	970611	981011	55	23	165	3	W	450	1200	M	TRAWL	BERING SEA
312605	CHINOOK	96	DECEPTION CR 247-41	AK	ADFG	46072	970611	981011	54	41	165	44	W	460	1300	M	TRAWL	BERING SEA
312605	CHINOOK	96	DECEPTION CR 247-41	AK	ADFG	46072	970611	981018	AREA 517				W	510	1500	M	TRAWL	BERING SEA
312605	CHINOOK	96	DECEPTION CR 247-41	AK	ADFG	46072	970611	990204	57	42	154	12	W	530	1450		TRAWL	GULF OF ALASKA
312608	CHINOOK	96	NINILCHIK R 244-20	AK	ADFG	50292	970617	981001	56	56	155	3	W	490	1600	M	TRAWL	GULF OF ALASKA
312608	CHINOOK	96	NINILCHIK R 244-20	AK	ADFG	50292	970617	981013	54	45	165	20	W	460	1200	F	TRAWL	BERING SEA

Table 4a. Continued.

RELEASE INFORMATION								RECOVERY INFORMATION											
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION
312608	CHINOOK	96	NINILCHIK R 244-20	AK	ADFG	50292	970617	981016	54	45	165	40	W	460	1200	F	TRAWL	BERING SEA
312608	CHINOOK	96	NINILCHIK R 244-20	AK	ADFG	50292	970617	990214	57	40	154	22	W	560	2700	M	TRAWL	GULF OF ALASKA
312635	CHINOOK	97	NINILCHIK R 244-20	AK	ADFG	47480	980615	990216	57	47	154	08	W	290	400	F	TRAWL	GULF OF ALASKA
630120	CHINOOK	96	COL.R. @ TURTLE ROCK	WA	WDFW	192588	970630	980920	57	46	153	3	W	450	1200	F	TRAWL	GULF OF ALASKA
630127	CHINOOK	96	BIG SOOS CR 09.0072	WA	WDFW	198332	970509	990606	48	17	124	55	W	460	1200	M	TRAWL	NE NORTH PACIFIC
630134	CHINOOK	96	COLUMBIA NEAR WELLS	WA	WDFW	197143	980415	990528	45	49	124	40	W	490	1340		TRAWL	NE NORTH PACIFIC
630148	CHINOOK	96	PURDY CR 16.0005	WA	WDFW	217308	970512	980625	48	24	124	51	W	390	600	F	TRAWL	NE NORTH PACIFIC
630148	CHINOOK	96	PURDY CR 16.0005	WA	WDFW	217308	970512	990604	48	21	125	2	W	530	1700		TRAWL	NE NORTH PACIFIC
630148	CHINOOK	96	PURDY CR 16.0005	WA	WDFW	217308	970512	990605	48	19	124	57	W	450	1100	F	TRAWL	NE NORTH PACIFIC
630160	CHINOOK	96	WALLACE R 07.0940	WA	WDFW	206262	980317	990606	47	14	124	55	W	590	1650	M	TRAWL	NE NORTH PACIFIC
634559	CHINOOK	91	COWLITZ R 26.0002	WA	WDFW	31792	930405	950421	46	41	124	47	W	630	2400	F	TRAWL	NE NORTH PACIFIC
634912	CHINOOK	92	SNAKE R-LOWR 33.0002	WA	WDFW	51168	940418	950421	46	41	124	47	W	430		M	TRAWL	NE NORTH PACIFIC
635209	CHINOOK	96	FALLERT CR 27.0017	WA	WDFW	105515	980202	990215	57	39	154	21	W	480	1400	F	TRAWL	GULF OF ALASKA
635529	CHINOOK	96	GREEN R 09.0001	WA	WDFW	147949	980424	990606	48	16	124	55	W	380	700	M	TRAWL	NE NORTH PACIFIC
635534	CHINOOK	95	SIMILKAMEEN R 490325	WA	WDFW	180826	970401	980915	55	2	160	23	W	550	2300	F	TRAWL	GULF OF ALASKA
635624	CHINOOK	94	WHATCOM CR 01.0566	WA	COOP	96211	950523	980521	54	47	165	34	W	740	4800	M	TRAWL	BERING SEA
635848	CHINOOK	94	FRIDAY CR 03.0017	WA	WDFW	92848	960301	990628	48	8	124	59	W	700	4600	F	TRAWL	NE NORTH PACIFIC
635958	CHINOOK	95	SNAKE R ABV CLARKSTN	WA	NEZP	72137	970417	980625	48	6	125	17	W	440	700	F	TRAWL	NE NORTH PACIFIC
635958	CHINOOK	95	SNAKE R ABV CLARKSTN	WA	NEZP	72137	970417	990617	48	15	124	57	W	580	2600	F	TRAWL	NE NORTH PACIFIC

Table 4a. Continued.

RELEASE INFORMATION								RECOVERY INFORMATION											
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION
635959	CHINOOK	95	CLWTR R, MAINSTEM	ID	NEZP	72556	970414	990617	48	13	124	56	W	600	3100	F	TRAWL	NE NORTH PACIFIC
636002	CHINOOK	94	WILLAPA R 24.0251	WA	COOP	18885	960528	990201	57	40	154	21	W	600	2100	F	TRAWL	GULF OF ALASKA
636006	CHINOOK	95	KLICKITAT R 30.0002	WA	WDFW	101123	960529	990125	AREA 610				W	610	2900		TRAWL	GULF OF ALASKA
636019	CHINOOK	95	COWLITZ R 26.0002	WA	WDFW	19676	970401	990530	48	11	124	57	W	520	1900	F	TRAWL	NE NORTH PACIFIC
636054	CHINOOK	96	COL.R ROCKY R-WELLS	WA	WDFW	228703	970618	990214	57	37	154	27	W	590	2300	F	TRAWL	GULF OF ALASKA
636063	CHINOOK	95	KALAMA R 27.0002	WA	WDFW	82467	970401	980917	56	24	158	7	W	610	3000	F	TRAWL	GULF OF ALASKA
636063	CHINOOK	95	KALAMA R 27.0002	WA	WDFW	82467	970401	990216	57	47	154	8	W	580	2500	M	TRAWL	GULF OF ALASKA
636320	CHINOOK	95	SNAKE R.	ID	WDFW	217795	970404	980615	48	6	125	17	W	430	900	F	TRAWL	NE NORTH PACIFIC
636320	CHINOOK	95	SNAKE R.	ID	WDFW	217795	970404	990519	46	29	124	30	W	620	2540		TRAWL	NE NORTH PACIFIC
636320	CHINOOK	95	SNAKE R.	ID	WDFW	217795	970404	990531	48	17	124	55	W	550	1900	F	TRAWL	NE NORTH PACIFIC
636320	CHINOOK	95	SNAKE R.	ID	WDFW	217795	970404	990617	48	14	124	53	W	680	4600	F	TRAWL	NE NORTH PACIFIC
636320	CHINOOK	95	SNAKE R.	ID	WDFW	217795	970404	990622	48	11	124	59	W	610	2800	F	TRAWL	NE NORTH PACIFIC
636321	CHINOOK	95	SNAKE R.	ID	WDFW	217810	970404	980618	48	24	125	13	W	440	1000	M	TRAWL	NE NORTH PACIFIC
636321	CHINOOK	95	SNAKE R.	ID	WDFW	217810	970404	980806	48	13	125	13	W	440	950	M	TRAWL	NE NORTH PACIFIC
636328	CHINOOK	96	COL.R PRIEST-WANAPUM	WA	WDFW	192726	970618	990201	57	40	154	20	W	480	1200		TRAWL	GULF OF ALASKA

Table 4b. Release and recovery information for coded-wire tagged salmon caught in Japanese and U.S. research trawls (RESTRAWL), gillnets (RESGILL), and longlines (RESLL) in the North Pacific Ocean and Bering Sea. All recoveries in the table are reported for the first time (1 September 1998 - 31 August 1999 reporting period). ADFG=Alaska Department of Fish and Game, CDFO = Canada Dept. of Fisheries and Oceans, DIPC=Douglas Island Pink and Chum, Inc., FWS=US Fish and Wildlife Service, IDFG=Idaho Department of Fish and Game, MIC=Metlakatla Indian Community, NSRA=Northern Southeast Regional Aquaculture Assoc., ODFW=Oregon Dept. Fish and Wildlife, QDNR=Quinault Dept. of Natural Resources, SSRA=Southern Southeast Regional Aquaculture Assn., WDFW=Washington Dept. Fish and Wildlife, UW=College of Fisheries, University of Washington. TSFT= body length measurement from the tip of the snout to the fork of the tail, WT=whole body weight, D=degree, M=minute.

RELEASE INFORMATION								RECOVERY INFORMATION												
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	LONG DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION	RESEARCH VESSEL
044354	SOCKEYE	92	HUGH SMITH LK 101-30	AK	ADFG	17503	950507	980705	54	0	145	0	W	575	2600	M	RESGILL	GULF OF ALASKA	OSHORO MARU
044708	COHO	96	SHAMROCK BAY 113-32	AK	NSRA	40069	980522	980730	59	32	144	45	W	263	320		RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
044950	COHO	96	EARL WEST COV 107-40	AK	SSRA	10311	980519	980725	56	9	134	49	W	235	190		RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
044954	COHO	96	NEETS BAY 101-90	AK	SSRA	10085	980528	980725	56	9	134	49	W	248	190		RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
080161	COHO	96	R-SNOOTLI CREEK	BC	CDFO	11707	980521	980725	56	1	135	13	W	240	146		RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
092306	COHO	96	TONGUE PT. LOWER COL	OR	ODFW	18355	980501	980803	58	50	152	20	W	296	310	M	RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
181657	COHO	96	R-KITIMAT LOWER	BC	CDFO	28973	980427	980801	59	7	148	25	W	272	270	F	RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
312503	COHO	94	MOOSE R 244-30	AK	ADFG	11248	970530	980704	55	0	145	0	W	634	3550	F	RESGILL	GULF OF ALASKA	OSHORO MARU
312563	COHO	95	SHIP CR 247-50	AK	ADFG	45741	970528	980705	54	0	145	0	W	608	3400	F	RESGILL	GULF OF ALASKA	OSHORO MARU
312602	COHO	95	BIRD CR 247-60	AK	ADFG	45469	970520	980703	56	0	145	0	W	614	3150	F	RESGILL	GULF OF ALASKA	OSHORO MARU
312625	COHO	96	BIRD CR 247-60	AK	ADFG	46094	980518	980803	58	50	153	11	W	177	50	F	RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
312627	COHO	96	EKLUTNA TAILRACE 247	AK	ADFG	45512	980519	980803	58	50	153	11	W	198	80	M	RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
312627	COHO	96	EKLUTNA TAILRACE 247	AK	ADFG	45512	980519	980803	58	50	153	11	W	165	50	F	RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
312627	COHO	96	EKLUTNA TAILRACE 247	AK	ADFG	45512	980519	980803	58	50	153	11	W	184	60	F	RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
312652	COHO	96	CAMPBELL CR 247-60	AK	ADFG	22296	980518	980803	58	50	153	11	W	155	40	M	RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
312654	COHO	96	EKLUTNA TAILRACE 247	AK	ADFG	20590	980519	980803	58	50	153	11	W	169	50	F	RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
312655	COHO	96	EKLUTNA TAILRACE 247	AK	ADFG	22998	980519	980803	58	50	153	11	W	176	60	M	RESTRAWL	GULF OF ALASKA	GREAT PACIFIC

Table 4b. Continued.

RELEASE INFORMATION								RECOVERY INFORMATION											
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	LONG DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION	RESEARCH VESSEL
312656	COHO	96	EKLUTNA TAILRACE 247	AK	ADFG	22782	980519	980803	58	50	153	11	W	182	70	M	RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
471733	COHO	96	TAMGAS CR	AK	MIC	17320	980518	980725	56	9	134	49	W	259	200		RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
471734	COHO	96	TAMGAS CR	AK	MIC	12604	980518	980725	56	9	134	49	W	240	150		RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
630340	COHO	96	SATSOP R -EF 22.0360	WA	WDFW	63981	980401	980801	59	7	148	25	W	285	280	F	RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
636156	COHO	96	LEWIS R 27.0168	WA	WDFW	73472	980420	980801	59	7	148	25	W	279	270	F	RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
636213	COHO	96	SATSOP R –EF 22.0360	WA	WDFW	59914	980401	980727	58	3	137	15	W	301			RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
053706	CHINOOK	96	ENTIAT R		FWS	17793	980401	980525	48	12	125	13	W	180	61		RESTRAWL	NE NORTH PACIFIC	GREAT PACIFIC
053716	CHINOOK	96	DWORSHAK NAT. HATCH	ID	FWS	71202	980325	980728	59	30	139	56	W	248	198		RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
053855	CHINOOK	96	WIND R 29.0023	WA	FWS	94938	980420	980803	58	50	153	11	W	269	250	M	RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
053855	CHINOOK	96	WIND R 29.0023	WA	FWS	94938	980420	980525	48	12	125	13	W	158	45		RESTRAWL	NE NORTH PACIFIC	GREAT PACIFIC
054955	CHINOOK	96	WARM SPRINGS R	OR	FWS	27363	980415	980525	48	12	125	13	W	218	129		RESTRAWL	NE NORTH PACIFIC	GREAT PACIFIC
054958	CHINOOK	96	WARM SPRINGS R	OR	FWS	27106	980415	980525	48	12	125	13	W	153	34		RESTRAWL	NE NORTH PACIFIC	GREAT PACIFIC
092225	CHINOOK	96	DESCHUTES R-2/OR	OR	ODFW	89579	980415	980525	48	12	125	13	W	171	60		RESTRAWL	NE NORTH PACIFIC	GREAT PACIFIC
092227	CHINOOK	96	HOOD R W FK (HOOD R)	OR	ODFW	62886	980422	980525	48	12	125	13	W	174	62		RESTRAWL	NE NORTH PACIFIC	GREAT PACIFIC
092319	CHINOOK	96	SANTIAM R & N FK-1	OR	ODFW	244804	980302	980730	59	47	144	39	W	283	300		RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
092320	CHINOOK	96	SANTIAM R & N FK-1	OR	ODFW	407781	980302	980730	59	47	144	39	W	282	300		RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
105126	CHINOOK	96	SALMON R @ HAMMER CK	ID	IDFG	51931	980329	980730	59	32	144	45	W	240	187	M	RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
180211	CHINOOK	94	R-CHILLIWACK RIVER	BC	CDFO	23969	950515	980525	47	58	125	25	W	662	3700	F	RESTRAWL	NE NORTH PACIFIC	GREAT PACIFIC
312603	CHINOOK	96	DECEPTION CR 247-41	AK	ADFG	47078	970611	980509	56	30	156	30	W	328	380	M	RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
312608	CHINOOK	96	NINILCHIK R 244-20	AK	ADFG	50292	970617	980509	56	30	156	30	W	315	400		RESTRAWL	GULF OF ALASKA	GREAT PACIFIC

Table 4b. Continued.

RELEASE INFORMATION								RECOVERY INFORMATION											
TAG CODE	SPECIES	BROOD YEAR	RELEASE SITE	STATE/ PROV	AGENCY	NUMBER TAGGED	DATE	DATE	LAT D	LAT M	LONG D	LONG M	DIR	TSFT (mm)	WT (g)	SEX	GEAR	OCEANIC REGION	RESEARCH VESSEL
500438	CHINOOK	96	AUKE BAY 111-50	AK	DIPC	9527	980528	990522	59	30	145	4	W	393	840	M	RESTRAWL	GULF OF ALASKA	GREAT PACIFIC
630118	CHINOOK	96	PORTAGE BAY/SHIP CNL	WA	UW	165011	970513	980525	48	23	125	10	W	360	500		RESTRAWL	NE NORTH PACIFIC	GREAT PACIFIC
636063	CHINOOK	95	KALAMA R 27.0002	WA	WDFW	82467	970401	990527	57	52	151	55	W	650	4100	F	RESTRAWL	GULF OF ALASKA	HICKORY WIND
054148	STEELHEAD	96	MAIN STEM CLEARWATER	ID	FWS	21758	970430	980623	43	0	180	0	W	462	1600	M	RESGILL	CENTRAL NORTH PACIFIC	WAKATAKE MARU
054150	STEELHEAD	96	S.FK. CLEARWATER R.	ID	FWS	20481	970424	980711	45	0	165	0	E	564	1800	M	RESGILL	WESTERN NORTH PACIFIC	HOKKO MARU
071163	STEELHEAD	95	SPRING CR	OR	ODFW	27311	960409	970802	48	30	171	22	E	571	1920	M	RESGILL	WESTERN NORTH PACIFIC	HOKUSEI MARU
105145	STEELHEAD	96	CLEAR CR.	ID	IDFG	31672	970428	980613	43	0	180	0	W	570	1660	M	RESGILL	CENTRAL NORTH PACIFIC	OSHORO MARU
212938	STEELHEAD	95	QUINAULT L, NET PENS	WA	QDNR	46168	960501	980627	46	0	180	0	W	640	2520	F	RESGILL	CENTRAL NORTH PACIFIC	WAKATAKE MARU
213030	STEELHEAD	96	COOK CR 21.0429	WA	FWS	14789	970513	980627	48	30	165	0	W	521	1300	F	RESGILL	GULF OF ALASKA	OSHORO MARU
215509	STEELHEAD	96	QUINAULT LAKE (21)	WA	QDNR	31130	970414	980626	45	0	180	0	W	582	1680	M	RESGILL	CENTRAL NORTH PACIFIC	WAKATAKE MARU
215509	STEELHEAD	96	QUINAULT LAKE (21)	WA	QDNR	31130	970414	980627	47	0	180	0	W	592	2000	F	RESLL	CENTRAL NORTH PACIFIC	WAKATAKE MARU
635204*2	STEELHEAD	97	COWLITZ R	WA	WDFW		980418	980709	50	0	145	0	W				RESGILL	GULF OF ALASKA	OSHORO MARU
635318*2	STEELHEAD	95	COWLITZ R	WA	WDFW		960415	980704	51	0	165	0	E	720	3950	M	RESGILL	WESTERN NORTH PACIFIC	HOKKO MARU
635919*2	STEELHEAD	97	COWLITZ R	WA	WDFW		980418	980707	52	0	145	0	W	321	330	M	RESGILL	GULF OF ALASKA	OSHORO MARU

*2 indicates that the tag code was reused (release data provided by the Washington Department of Fish and Wildlife).

Table 5. Gillnet stations, mean water temperature, and salinities by oceanic region along transect lines of the *Oshoro maru*, summer 1994-99.

Transect	Ocean		Number of	Latitude, °N		Sampling Dates		Water temperature, °C				Water salinity, psu			
								at 0m		at 100m		at 0m		at 100m	
line	domain	Year	stations	start	end	start	end	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
145° W	R/D	1999	5	52	56	July 11	July 15	9.2	0.7	4.4	1.1	32.76	0.09	33.46	0.35
	Domains	1998	3	54	56	July 4	July 6	10.4	0.5	4.7	0.5	32.36	0.21	33.29	0.10
		1997	5	52	56	July 9	July 13	12.5	0.2	4.6	0.6	32.58	0.04	33.20	0.30
		1996	5	52	56	July 4	July 8	9.8	0.5	4.7	0.3	32.58	0.03	32.92	0.13
		1995	4	53	56	July 8	July 11	10.8	0.5	5.0	0.5	31.24	1.79	32.94	0.31
		1994	6	51	56	July 4	July 9	11.1	0.5	5.6	0.5	32.37	0.14	32.95	0.22
	Subarctic	1999	2	50	51	July 9	July 10	8.5	0.2	5.1	0.2	32.71	0.00	32.87	0.01
	Current	1998	5	49	53	July 7	July 11	10.2	0.4	5.4	0.3	32.45	0.12	33.16	0.22
		1997	2	50	51	July 7	July 8	12.0	0.3	5.1	0.2	32.54	0.03	33.13	0.13
		1996	2	50	51	July 9	July 10	9.8	0.1	5.6	0.1	32.61	0.04	32.93	0.02
		1995	1	51.5	51.5	July 7	July 7	9.8	-	5.1	-	28.70	-	33.02	-
		1994	1	50	50	July 3	July 3	10.5	-	6.5	-	32.60	-	33.30	-
165° W	Ridge	1999	2	47	50	June 25	June 27	6.8	0.8	3.9	0.9	32.70	0.04	32.81	0.02
		1998	1	50	50	June 27	June 27	7.3	-	4.1	-	32.18	-	32.97	-
	Subarctic	1999	2	44	45.5	June 28	June 30	9.1	0.9	32.8	0.1	3.92	0.87	33.01	0.11
		1998	3	45.5	48.5	June 28	June 29	8.7	0.8	5.4	0.2	32.40	0.11	32.98	0.09
180°	Subarctic	1998	1	47	47	June 16	June 16	5.9	-	3.9	-	31.89	-	33.02	-
	Current	1997	2	46	47	June 19	June 20	7.4	0.6	5.6	1.4	33.09	0.23	33.17	0.25
		1996	3	45	47	June 18	June 20	9.3	0.5	5.1	0.9	32.90	0.19	33.24	0.23
		1995	3	45	47	June 18	June 20	7.7	0.5	5.6	0.9	33.03	0.15	33.30	0.26
		1994	2	45	46	June 18	June 19	7.0	1.4	5.7	2.1	33.15	0.21	33.30	0.42
	Transition	1998	2	43	45	June 14	June 15	8.3	0.7	6.2	0.3	32.94	0.31	33.35	0.02
	Domain	1997	3	40	44	June 13	June 16	9.6	1.5	8.3	1.7	33.62	0.26	33.76	0.41
		1996	4	41	44	June 14	June 17	11.0	0.3	8.1	0.9	33.53	0.19	33.80	0.12
		1995	3	42	44	June 15	June 17	9.9	0.6	8.8	0.3	33.77	0.23	34.00	0.00
		1994	2	42	43	June 15	June 16	9.9	0.4	8.4	0.5	33.85	0.07	33.85	0.07
	Transition	1998	1	39	39	June 12	June 12	14.5	-	11.0	-	34.12	-	34.23	-
	Zone	1997	1	39	39	June 12	June 12	13.6	-	11.8	-	34.43	-	34.39	-
		1996	2	39	40	June 12	June 13	14.2	0.2	11.7	0.7	34.24	0.13	34.33	0.10
		1995	2	40	41	June 13	June 14	11.9	0.4	10.4	0.1	34.15	0.07	34.20	0.00
		1994	3	39	41	June 12	June 14	13.0	0.9	11.1	0.4	34.10	0.00	34.20	0.00

Table 6. Catch (number of salmonids) per unit effort by C-gear summarized by oceanic region and transect line for the research vessel *Oshoro maru*, 1994-1999. One unit of effort is equal to one operation of the 30-tan (1500 m) non-selective research meshgillnet, except as indicated below.

					C.P.U.E.											
Transect	Ocean		Total	Tans per	Sockeye		Chum		Pink		Coho		Chinook		Steelhead	
line	domain	Year	sets	unit effort	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
145° W	R/D Domains	1999	5	30	34.2	11.4	54.6	30.3	95.0	84.4	29.0	7.9	1.0	1.7	7.4	3.0
		1998	3	30	41.0	24.9	34.3	10.6	57.3	12.3	18.3	10.1	1.7	2.9	4.3	2.1
		1997	5	30	59.6	22.9	48.0	39.5	21.0	15.4	10.2	5.7	0.0	0.0	3.4	2.5
		1996	5	27	33.8	16.6	65.2	40.1	15.4	14.8	20.4	10.6	0.4	0.9	6.2	6.6
		1995	4	30	36.3	13.0	88.8	4.2	42.5	5.4	13.5	4.7	0.5	0.6	4.0	2.9
		1994	6	30	42.5	32.6	26.2	24.7	30.8	14.7	14.0	6.8	0.2	0.4	2.3	2.7
	Subarctic Current	1999	2	28.5	24.5	17.7	20.5	6.4	58.0	7.1	21.5	9.2	0.0	0.0	3.5	4.9
		1998	5	30	32.0	22.8	31.4	19.0	21.0	14.5	5.6	6.5	0.4	0.9	7.4	3.4
		1997	2	30	14.5	6.4	14.5	0.7	0.0	0.0	2.0	1.4	0.0	0.0	0.0	0.0
		1996	2	26	7.5	6.4	10.5	3.5	16.0	1.4	6.0	7.1	0.0	0.0	2.0	0.0
		1995	1	30	29.0	-	68.0	-	18.0	-	15.0	-	1.0	-	8.0	-
		1994	1	30	9.0	-	10.0	-	27.0	-	0.0	-	0.0	-	2.0	-
165° W	Ridge	1999	2	30	25.0	35.4	64.0	38.2	60.5	68.6	1.0	0.0	3.0	4.2	1.5	2.1
		1998	1	30	78.0	-	82.0	-	14.0	-	0.0	-	0.0	-	0.0	-
	Subarctic	1999	2	30	1.5	2.1	37.0	38.2	11.5	12.0	4.5	0.7	0.0	0.0	4.0	5.7
		1998	3	30	20.0	11.0	42.0	22.7	13.7	9.0	10.3	13.8	0.3	0.6	1.7	1.5
180°	Subarctic Current	1998	1	30	72.0	-	43.0	-	5.0	-	2.0	-	0.0	-	1.0	-
		1997	2	30	8.0	1.4	22.5	14.8	29.5	3.5	2.0	1.4	0.5	0.7	1.0	0.0
		1996	3	28	0.0	-	33.7	24.2	3.3	2.1	24.3	11.0	0.7	0.6	2.0	1.7
		1995	3	30	1.7	1.5	12.0	8.2	14.3	19.7	24.0	36.5	0.0	-	1.3	1.5
		1994	2	30	0.0	0.0	27.5	9.2	18.0	5.7	16.5	3.5	0.5	0.7	5.0	2.8
	Transition Domain	1998	2	30	2.0	2.8	18.5	0.7	0.5	0.7	12.0	11.3	0.0	0.0	5.0	1.4
		1997	4	30	0.3	0.5	8.0	5.4	5.8	7.3	3.0	3.4	0.0	0.0	1.3	1.5
		1996	4	30	0.0	0.0	5.8	6.9	0.5	1.0	7.0	8.2	0.0	0.0	1.0	0.8
		1995	3	30	0.0	0.0	0.7	0.6	0.0	-	2.3	1.5	0.0	0.0	0.3	0.6
		1994	2	30	0.0	0.0	24.0	25.5	4.5	3.5	38.0	28.3	0.0	0.0	0.5	0.7
	Transition Zone	1998	1	30	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-
		1997	1	30	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-
		1996	2	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1995	2	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		1994	3	30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 7. Ocean age composition and maturity at age of sockeye salmon caught by the *Oshoro maru* research gillnet, 1994-99. Percent values indicate average percentage of fish in specific age class and maturity in each catch, grouped by oceanic region and year.

Sockeye salmon

Transect Line	Ocean Domain	Year	N	Ocean Age 1 Immature	Ocean Age 1 Mature	Ocean Age 1 Total	Ocean Age 2 Immature	Ocean Age 2 Mature	Ocean Age 2 Total	Ocean Age 3 Immature	Ocean Age 3 Mature	Ocean Age 3 Total	Ocean Age 4 Immature	Ocean Age 4 Mature	Ocean Age 4 Total	% Mature Overall
				Percent of (year x domain) catch in each category												
145° W	R/D Domains	1999	167	31	1	32	28	29	57		11	11				41
		1998	119	14	3	17	3	34	37	2	42	44		3	3	82
		*1997	294	2	2	4	6	65	70	0.34	25	25				92
		1996	154	10	3	13	5	54	58		28	28		1	1	85
		1995	132	10	11	20	2	45	47		33	33				89
		1994	214	4	3	7	18	57	75		17	17		0.47	0.47	78
	Subarctic Current	1999	49	2	2	4	4	63	67	0	29	29				94
		1998	148	1		1	3	68	72		27	27				95
		1997	28	7	7	14	18	61	79		7	7				75
		1996	13	15		15		77	77		8	8				85
		1995	22	5	9	14	9	59	68		14	14		5	5	86
		1994	9	11		11	33	56	89							56
165° W	Ridge Domain	1999	48	60		60	33	4	38		2	2				6
		1998	74	59	7	66	11	7	18	3	14	16				27
	Subarctic Current	1999	3					67	67		33	33				100
		1998	59	27	8	36	8	31	39	2	24	25				63
180	Subarctic Current	1998	69	88	3	91	7	1	9							4
		1997	16	25		25	69	6	75							6
		1995	2	50		50	50		50							0
		1994	1	100		100										0
	Transition Domain	1998	1				100		100							0
		1997	1	100		100										0

*Catch included 1 immature ocean-age 5 fish.

Table 8. Ocean age composition and maturity at age of chum salmon caught by the *Oshoro maru* research gillnet, 1994-99. Percent values indicate average percentage of fish in specific age class and maturity in each catch, grouped by oceanic region and year.

Chum salmon

Transect Line	Ocean Domain	Year	N	Ocean Age 1 Immature	Ocean Age 1 Mature	Ocean Age 1 Total	Ocean Age 2 Immature	Ocean Age 2 Mature	Ocean Age 2 Total	Ocean Age 3 Immature	Ocean Age 3 Mature	Ocean Age 3 Total	Ocean Age 4 Immature	Ocean Age 4 Mature	Ocean Age 4 Total	% Mature Overall
				Percent of (year x domain) catch in each category												
145° W	R/D Domains	1999	274	3	0	4	88	1	89	5	1	6	0	1	1	3
		1998	97	13		13	55	6	61	15	9	25		1	1	16
		*1997	232	39	3	43	53	2	54	2	0.43	3				6
		1996	276	17	1	18	74	3	77	1	3	4				7
		1995	315	8	3	11	59	19	77	6	5	11		0.32	0.32	27
		1994	133	47	7	53	31	10	41	2	4	6				20
	Subarctic Current	1999	41				90	0	90	10	0	10				0
		1998	153	51		51	45		45	3	1	4				1
		1997	29	41		41	59		59							0
		1996	18				100		100							0
		1995	62	2		2	81	11	92	5	2	6				13
		1994	8	13		13	50	25	75		13	13				38
165° W	Ridge Domain	1999	128	14	2	16	69	1	70	13	2	15				5
		1998	75	1	1	3	9	21	31	17	47	64		3	3	72
	Subarctic Current	1999	72	36		36	61		61	3		3				0
		1998	120	19		19	48	14	63	11	8	18				22
180	Subarctic Current	1998	42	19		19	71		71	5	5	10				5
		1997	41	76		76	15		15	2	2	5	2	2	5	5
		1996	58	48		48	34	9	43	2	7	9				16
		1995	23	39	9	48	13	9	22	17	9	26		4	4	30
		1994	43	56		56	40	2	42		2	2				5
	Transition Domain	1998	37	49	3	51	46		46	3		3				3
		1997	30	47		47	43	7	50	3		3				7
		1996	15	47		47	47	7	53							7
		1995	1										100		100	0
		1994	42	5	10	14	50	17	67	14	5	19				31

*Catch included 1 immature ocean-age 0 fish.

Table 9. Ocean age composition and maturity at age of chinook salmon and steelhead caught by the *Oshoro maru* research gillnet, 1994-99. Percent values indicate average percentage of fish in specific age class and maturity in each catch, grouped by oceanic region and year.

Chinook salmon

Transect	Ocean			Percent of (year x domain) catch in each category									% Mature
				Ocean Age 1			Ocean Age 2			Ocean Age 3			
Line	Domain	Year	N	Immature	Mature	Total	Immature	Mature	Total	Immature	Mature	Total	Overall
145° W	R/D Domains	1999	5				100	0	100				0
		1998	5	40		40	60		60				0
		1996	3	33		33	67		67				0
	Subarctic Current	1998	2				100		100				0
165° W	Ridge Domain	1999	6				83		83	17		17	0
	Subarctic Current	1998	1				100		100				0
180	Subarctic Current	1997	1					100	100				100
		1996	1				100		100				0
		1994	1				100		100				0

Steelhead

Transect	Ocean			Percent of (year x domain) catch in each category													% Mature
				Ocean Age 0			Ocean Age 1			Ocean Age 2			Ocean Age 3			
Line	Domain	Year	N	Immature	Mature	Total	Immature	Mature	Total	Immature	Mature	Total	Immature	Mature	Total	Overall
145° W	R/D Domains	**1999	37	22	3	24	35	22	57	0	11	11	0	5	5	43
		1998	13	54		54		15	15		8	8		23	23	46
		1997	16	44	31	75		13	13		13	13				56
		*1996	32	59		59	16	9	25		6	6		3	3	25
		1995	1										100		100	0
		1994	14	79	7	86								14	14	21
	Subarctic Current	***1999	7				14	14	29	0	43	43	0	14	14	86
		1998	37	51	3	54	14	22	35		11	11				35
		1996	4	50		50	25		25		25	25				25
		1994	2	50		50								50	50	50
165° W	Ridge Domain	1999	3				0	100	100							100
	Subarctic Current	1999	8				50	50	100							50
		1998	5				20	60	80		20	20				80
180	Subarctic Current	1998	1					100	100							100
		1997	2					50	50					50	50	100
		1996	6					50	50	17		17	17	17	33	67
		1994	10				60		60		10	10	10	20	30	30
	Transition Domain	1998	10					20	20		60	60		20	20	100
		1997	5					60	60		40	40				100
		1996	4				50	50	100							50
		1994	1				100		100							0

*Catch included one mature ocean-age 4 fish; **Catch included one mature ocean-age 4 fish; ***Catch included one mature ocean-age 4 fish.

Table 10. Number sampled, mean and standard deviation of fork length (F.L., mm), body weight (B.W., g), and condition factor (C.F.=106*B.W./F.L.3) of sockeye salmon caught by the *Oshoro maru* research gillnet, 1994-99, grouped by ocean age.

Sockeye salmon

Transect	Ocean		Ocean Age 1							Ocean Age 2							Ocean Age 3							Ocean Age 4						
				F.L.		B.W.		C.F.			F.L.		B.W.		C.F.			F.L.		B.W.		C.F.			F.L.		B.W.		C.F.	
Line	Domain	Year	N	mean	s.d.	mean	s.d.	mean	s.d.	N	mean	s.d.	mean	s.d.	mean	s.d.	N	mean	s.d.	mean	s.d.	mean	s.d.	N	mean	s.d.	mean	s.d.	mean	s.d.
145 W	R/D Domains	1999	53	342	33	452	156	10.9	0.9	98	519	61	1815	737	12.3	1.1	19	620	47	3059	727	12.6	1.0							
		1998	20	348	24	518	137	12.1	1.8	44	554	48	2260	619	12.9	1.0	52	610	31	2910	517	12.7	1.0	3	556	41	2287	658	13.0	1.5
		*1997	12	413	80	1005	657	13.0	1.4	209	552	36	2225	471	12.9	2.3	74	610	39	2978	641	12.7	1.8							
		1996	20	359	52	589	458	11.6	1.2	90	563	46	2475	647	13.5	1.3	43	626	40	3360	669	13.5	1.3	1	610	-	3400	-	15.0	-
		1995	27	349	23	527	133	12.2	1.6	62	546	47	2083	565	12.5	1.1	43	607	41	2878	561	12.9	2.0							
		1994	16	347	25	503	99	11.9	1.6	160	555	39	2255	463	13.1	1.7	37	603	35	2775	528	12.5	1.2	1	650	-	2750	-	10.0	-
	Subarctic Current	1999	2	470	150	1570	1428	12.6	1.3	33	561	33	2299	480	12.8	1.0	14	613	34	3072	630	13.1	1.0							
		1998	2	371	15	570	71	11.2	0.0	106	572	37	2641	584	13.9	1.1	40	613	31	3039	501	13.1	1.1							
		1997	4	457	82	1295	714	12.4	1.7	22	539	27	2031	398	12.8	1.2	2	617	59	2970	891	12.4	0.2							
		1996	2	369	4	550	14	11.0	0.7	10	578	29	2638	410	13.6	0.8	1	650	-	4050	-	14.7	-							
		1995	3	386	48	680	314	11.3	1.2	15	537	50	2157	577	13.8	3.2	3	593	105	3167	679	16.2	6.2	1	640	-	3000	-	11.4	-
		1994	1	360	-	560	-	12.0	-	8	547	28	2341	292	14.3	1.0														
165 W	Ridge Domain	1999	28	342	18	458	79	11.4	1.6	18	468	42	1186	351	11.3	0.9	1	592	-	2340	-	11.3	-							
		1998	49	332	22	426	118	10.7	3.2	13	483	76	1454	738	11.7	2.2	12	603	44	3010	1060	13.2	2.2							
	Subarctic Current	1999								2	547	30	1680	14	10.4	1.8	1	622	-	3100	-	12.9	-							
		1998	21	353	65	545	319	11.6	1.3	23	515	53	1723	588	12.1	0.8	15	589	26	2656	365	12.9	0.8							
180	Subarctic Current	1998	65	324	21	392	84	11.5	1.9	6	419	17	844	135	9.6	5.0														
		1997	4	329	38	436	116	12.2	1.5	12	442	27	896	166	10.3	0.8														
		1995	1	288	-	250	-	10.5	-	2	437	10	1230	42	14.8	1.5														
		1994	1	312	-	350	-	11.5	-																					
	Transition Domain	1998								1	480	-	1240	-	11.2	-														
		1997	1	308	-	312	-	10.7	-																					

*includes one ocean age 5 fish, FL 924, BW 7300, CF 9.25.

Table 11. Number sampled, mean and standard deviation of fork length (F.L., mm), body weight (B.W., g), and condition factor (C.F.=106*B.W./F.L.3) of chum salmon caught by the *Oshoro maru* research gillnet, 1994-999, grouped by ocean age.

Chum salmon

Transect	Ocean		Ocean Age 1							Ocean Age 2							Ocean Age 3							Ocean Age 4						
				F.L.		B.W.		C.F.			F.L.		B.W.		C.F.			F.L.		B.W.		C.F.			F.L.		B.W.		C.F.	
Line	Domain	Year	N	mean	s.d.	mean	s.d.	mean	s.d.	N	mean	s.d.	mean	s.d.	mean	s.d.	N	mean	s.d.	mean	s.d.	mean	s.d.	N	mean	s.d.	mean	s.d.	mean	s.d.
145 W	R/D Domains	1999	10	394	44	695	258	10.9	1.1	242	470	34	1153	307	10.9	0.8	17	545	85	2058	1209	11.4	1.3	3	629	48	2883	1107	11.3	1.8
		1998	15	398	45	736	367	11.1	1.1	60	516	51	1631	561	11.6	1.3	24	579	72	2423	936	11.9	2.0	1	529	-	1820	-	12.3	-
		1997	99	390	29	742	189	12.3	1.4	126	459	29	1134	219	11.7	1.0	6	511	61	1583	531	11.6	1.9							
		1996	51	405	32	771	185	11.5	1.6	214	471	27	1216	209	11.5	0.9	12	586	97	2698	1428	12.3	1.2							
		1995	34	421	75	803	212	11.3	2.6	244	490	30	1387	245	11.8	1.7	36	527	28	1721	307	11.6	1.1	1	528	-	1540	-	10.5	-
		1994	71	390	16	696	132	11.7	1.6	54	464	31	1205	313	11.9	1.5	8	492	37	1494	452	12.3	1.8							
	Subarctic Current	1999								37	448	25	986	176	10.8	0.6	4	534	85	1865	1013	11.5	0.5							
		1998	78	387	24	656	138	11.2	0.7	69	471	45	1264	335	11.8	0.7	6	554	65	2162	957	12.0	1.5							
		1997	12	370	24	640	138	12.5	1.1	17	444	27	1145	190	13.0	0.9														
		1996								18	476	49	1237	268	11.6	2.0														
		1995	1	402	-	640	-	9.9	-	57	470	33	1219	271	11.5	0.7	4	510	23	1550	283	11.6	1.1							
		1994	1	380	-	650	-	11.8	-	6	463	35	1213	263	12.1	0.6	1	460	-	1220	-	12.5	-							
165 W	Ridge Domain	1999	20	357	48	477	183	10.3	1.6	88	422	24	814	151	10.8	1.2	18	483	42	1234	334	10.8	0.9							
		1998	2	386	73	670	325	11.3	0.7	23	469	58	1100	363	10.6	2.2	48	518	29	1605	277	11.5	1.3	2	522	8	1575	35	11.1	0.2
	Subarctic Current	1999	23	331	15	399	56	11.0	0.8	44	420	19	859	136	11.5	0.8	2	438	42	1030	354	12.0	0.7							
		1998	25	322	27	378	117	11.0	1.3	75	445	41	1099	313	12.1	0.9	22	507	35	1551	291	11.9	1.3							
180	Subarctic Current	1998	8	343	32	474	134	11.5	1.4	30	387	22	661	94	11.5	2.2	4	433	54	940	334	11.3	0.3							
		1997	32	312	10	337	30	11.0	1.0	7	398	33	673	175	9.2	4.1	2	478	11	1210	184	11.0	0.9	2	466	118	1410	1174	12.0	2.2
		1996	28	321	26	322	49	9.8	1.2	27	436	21	917	140	11.0	0.8	5	472	17	1196	118	11.3	0.2							
		1995	21	315	10	320	36	10.2	0.7	5	431	8	902	109	11.2	1.0	6	500	57	1195	374	9.6	2.3	1	575	-	2200	-	11.6	-
		1994	24	316	23	362	90	11.4	1.3	18	406	24	733	132	10.8	0.8	1	472	-	1100	-	10.5	-							
	Transition Domain	1998	19	334	29	376	97	10.0	1.4	18	385	24	667	138	10.0	3.7	1	480	-	1180	-	10.7	-							
		1997	15	305	12	294	36	9.7	2.9	15	416	32	814	82	8.1	5.1	1	450	-	820	-	9.0	-							
		1996	7	329	16	354	57	9.9	1.3	8	426	16	863	102	11.2	0.5														
		1995																						1	516	-	1620	-	11.8	-
		1994	6	334	16	472	89	12.8	2.7	28	412	27	809	172	11.4	1.1	8	454	22	1045	209	11.1	1.1							

*includes 1 ocean age 0 fish: FL 402, BW 760, CF 11.7

Table 12. Number sampled, mean and standard deviation of fork length (F.L., mm), body weight (B.W., g), and condition factor (C.F.= 106*B.W./F.L.3) of pink and coho salmon caught by the *Oshoro maru* research gillnet, 1994-99, grouped by ocean age.

Pink salmon

				Ocean Age 1					
Transect Line	Ocean Domain	Year	N	F.L. mean	s.d.	B.W. mean	s.d.	C.F. mean	s.d.
145 W	R/D Domains	1999	429	453	29	1098	254	11.6	0.9
		1998	170	469	31	1228	325	11.7	1.2
		1997	102	475	27	1300	217	11.7	2.2
		1996	73	466	32	1217	339	11.5	2.9
		1995	170	483	31	1337	370	11.7	1.6
		1994	186	483	28	1472	424	12.8	2.3
	Subarctic Current	1999	116	440	20	954	148	11.1	0.8
		1998	104	480	30	1435	368	12.7	1.5
		1996	30	493	32	1582	358	13.0	1.6
		1995	18	475	25	1326	383	12.1	1.7
		1994	28	491	22	1699	357	14.2	1.7
165 W	Ridge Domain	1999	109	415	21	878	119	12.2	0.9
		1998	14	437	23	1050	191	12.5	0.7
	Subarctic Current	1999	20	441	11	959	73	11.1	0.6
		1998	40	452	33	1106	270	11.7	0.9
180	Subarctic Current	1998	5	418	38	832	223	11.2	0.6
		1997	58	418	24	841	136	11.0	2.3
		1996	10	427	25	843	189	10.7	0.9
		1995	44	410	28	733	141	10.7	1.8
		1994	38	427	23	839	144	10.7	0.9
	Transition Domain	1998	1	440	-	900	-	10.6	-
		1997	22	426	26	884	243	10.1	3.4
		1996	2	418	6	760	28	10.4	0.0
		1994	11	430	15	894	95	11.2	0.8

Coho salmon

				Ocean Age 1					
Transect Line	Ocean Domain	Year	N	F.L. mean	s.d.	B.W. mean	s.d.	C.F. mean	s.d.
145 W	R/D Domains	1999	141	583	46	2423	553	12.0	0.9
		1998	54	615	34	3102	612	13.2	1.4
		1997	50	580	47	2670	711	13.3	1.4
		1996	111	587	44	2817	659	13.8	1.7
		1995	51	579	40	2607	565	13.3	1.7
		1994	87	602	50	3021	815	13.6	1.9
	Subarctic Current	1999	42	570	44	2373	517	12.6	0.9
		1998	28	616	48	3239	1011	13.5	1.6
		1997	4	544	89	2390	1062	14.1	0.4
		1996	12	602	40	3237	468	14.8	1.8
		1995	15	566	57	2671	856	14.3	1.1
165 W	Ridge Domain	1999	2	535	83	1950	1061	12.0	1.2
	Subarctic Current	1999	9	536	26	1893	297	12.3	1.3
		1998	31	567	45	2534	577	13.8	2.3
180	Subarctic Current	1998	2	510	28	1890	495	14.1	1.4
		1997	4	465	83	1195	698	11.0	0.9
		1996	69	505	42	1592	465	11.7	2.5
		1995	72	519	38	1783	402	12.6	1.2
		1994	33	529	41	1880	465	12.4	0.9
	Transition Domain	1998	24	503	43	1537	403	11.2	2.6
		1997	12	488	60	1474	741	11.0	3.7
		1996	30	510	37	1547	341	11.7	2.1
		1995	7	545	57	1940	469	11.9	1.3
		1994	76	522	40	1759	420	12.2	1.5

Table 13. Number sampled, mean and standard deviation of fork length (F.L., mm), body weight (B.W., g), and condition factor (C.F.= 106* B.W./F.L.3) of chinook salmon and steelhead caught by the *Oshoro maru* research gillnet, 1994-99, grouped by ocean age.

Chinook salmon

Transect	Ocean		Ocean Age 1							Ocean Age 2							Ocean Age 3						
				F.L.		B.W.		C.F.			F.L.		B.W.		C.F.			F.L.		B.W.		C.F.	
Line	Domain	Year	N	mean	s.d.	mean	s.d.	mean	s.d.	N	mean	s.d.	mean	s.d.	mean	s.d.	N	mean	s.d.	mean	s.d.	mean	s.d.
145 W	R/D Domains	1999								5	642	26	3512	435	13	0							
		1998	2	572	30	2390	325	13	0	3	662	78	4300	1704	14	1							
		1996	1	374	-	550	-	11	-	2	563	10	2480	28	14	1							
		1995								1	652	-	4100	-	15	-							
	Subarctic Current	1998								2	656	84	4350	1697	15	0							
		1995								1	644	-	3800	-	14	-							
165 W	Ridge Domain	1999								5	576	20	2586	428	13	1	1	722	-	5100	-	14	-
	Subarctic Current	1998								1	676	-	4700	-	15	-							
180	Subarctic Current	1997								1	642	-	3400	-	13	-							
		1996								1	654	-	3360	-	12	-							
		1994								1	680	-	4150	-	13	-							

Steelhead

Transect	Ocean		Ocean Age 0							Ocean Age 1							Ocean Age 2							Ocean Age 3						
				F.L.		B.W.		C.F.			F.L.		B.W.		C.F.			F.L.		B.W.		C.F.			F.L.		B.W.		C.F.	
Line	Domain	Year	N	mean	s.d.	mean	s.d.	mean	s.d.	N	mean	s.d.	mean	s.d.	mean	s.d.	N	mean	s.d.	mean	s.d.	mean	s.d.	N	mean	s.d.	mean	s.d.	mean	s.d.
145 W	R/D Domains	**1999	9	329	39	369	142	10.0	1.1	21	567	28	1753	286	9.6	0.8	4	695	28	2820	381	8.4	1.1	2	745	52	3775	389	9.2	1.0
		1998	7	331	25	396	81	10.8	0.4	2	556	5	1800	226	10.5	1.6	1	581	-	2240	-	11.4	-	3	747	46	4100	1015	9.7	1.0
		1997	12	314	36	345	149	10.6	1.6	2	587	11	2070	184	10.2	0.4	2	746	35	4000	707	9.8	3.1							
		*1996	19	323	22	342	88	10.0	1.3	8	525	45	1461	233	10.2	1.7	2	721	7	2910	14	7.8	0.3	1	700	-	3250	-	9.5	-
		1995	6	311	33	332	94	10.9	1.2	6	548	34	1897	546	11.5	3.3	1	609	-	3100	-	13.7	-	1	675	-	2550	-	8.3	-
		1994	12	327	28	372	80	10.6	1.2																					
	Subarctic Current	***1999								2	558	6	1695	92	9.8	0.2	3	727	38	3073	166	8.1	1.1	1	710	-	3050	-	8.5	-
		1998	20	356	55	527	320	10.5	1.2	13	570	39	2145	492	11.4	1.3	4	695	72	4038	1006	11.9	0.9							
		1997	2	337	55	520	99	14.1	4.2	1	518	-	1580	-	11.4	-	1	732	-	4930	-	12.6	-							
		1996								7	557	56	1901	672	10.7	0.8														
		1995	1	400	-	700	-	10.9	-																					
165 W	Ridge Domain	1999								3	576	42	1760	349	9.1	0.5														
	Subarctic Current	1999								8	552	46	1786	248	10.9	2.7														
		1998								4	561	28	1820	385	10.2	0.7	1	584	-	2060	-	10.3	-							
180	Subarctic Current	1998								1	585	-	1600	-	8.0	-														
		1997								1	575	-	1800	-	9.5	-								1	662	-	2700	-	9.3	-
		1996								3	560	39	1703	278	9.7	0.8	1	604	-	1880	-	8.5	-							
		1995								2	578	22	1900	198	9.8	0.1	2	676	25	3150	3041	10.8	11.0							
		1994								6	524	22	1547	232	10.7	1.0	1	664	-	3200	-	10.9	-							
	Transition Domain	1998								2	563	4	1760	28	9.9	0.0	6	677	45	2760	570	8.9	1.1	2	710	85	3225	884	9.0	0.7
		1997								3	554	12	1380	170	5.5	4.9	2	713	18	3650	212	10.1	0.2							
		1996								4	558	15	1850	319	10.6	1.0														
		1995								1	542	-	1400	-	8.8	-														
		1994								1	582	-	2000	-	10.1	-														

*includes 1 ocean age 4 fish: FL 800, BW 3950, CF 7.7; **includes 1 ocean age 4 fish: FL 830, BW 9720, CF 17.0; ***includes 1 ocean age 4 fish: FL 754, BW 4050, CF 9.4.

Table 14. Average catch (number) per one hour trawl tow summarized by ocean region and transect line for the *Great Pacific,* 1999. Along the 145°W transect: R/D = Ridge/Dilute Domain = 52°N-57°30'N; Subarctic = 42°30'N-51°N. Along the 165°W transect: Ridge Domain = 47°N-51°N; Subarctic = 41°N-46°20'N.

Transect line	Domain	Total tows	Mean tow duration (hr)	Mean tow distance	Standardized catch per 1 hr tow											
					Sockeye		Chum		Pink		Coho		Chinook		Steelhead	
					mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
145°W	R/D	10	1.5	6.20	2.5	2.7	3.5	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Subarctic	11	1	2.51	9.5	15.3	7.3	8.8	9.3	10.6	1.3	2.1	0.0	0.0	0.0	0.0
165°W	Ridge	6	1	4.22	27.5	40.5	4.2	2.2	1.5	2.0	0.0	0.0	0.2	0.4	0.0	0.0
	Subarctic	7	1	5.26	0.1	0.4	24.9	24.8	10.1	16.2	0.6	1.0	0.6	0.8	0.0	0.0

Table 15. Comparison of age composition, maturity, mean fork length (F.L. mm), body weight (B.W., g), and condition factor (C.F. = 106*B.W./F.L.3) of salmon caught by the *Great Pacific (GP)* trawl and *Oshoro maru* research gillnet in 1999. Along the 145°W transect: R/D = Ridge/Dilute Domain = 52°N-57°30'N *GP*, 52°N-57°30'N *Oshoro;* Subarctic = 42°30'N-51°N GP, 50°N-51°N *Oshoro.* Along the 165°W transect: Ridge Domain = 47°N-51°N *GP*, 47°N-50°N *Oshoro;* Subarctic = 41°N-46°20'N *GP*, 44°N-45°30'N *Oshoro.*

				Ocean age 1							Ocean age 2							Ocean age 3							Ocean age 4						
Transect line	Species	Ocean domain	Ship	N	%	% Imm	% Mat	F.L. mean	B.W. mean	C.F. mean	N	%	% Imm	% Mat	F.L. mean	B.W. mean	C.F. mean	N	%	% Imm	% Mat	F.L. mean	B.W. mean	C.F. mean	N	%	% Imm	% Mat	F.L. mean	B.W. mean	C.F. mean
145° W	Sockeye	R/D	*GP*	0							28	82	0	82	513	1802	13.0	6	18	0	18	561	2435	13.5	0						
			Oshoro	53	32	31	1	342	452	10.9	95	57	28	29	519	1815	12.3	19	11	0	11	620	3059	12.6	0						
		Subarctic	*GP*	3	10	10	0	279	300	13.8	26	90	62	28	422	850	11.2	0							0						
			Oshoro	2	4	2	2	470	1570	12.6	33	67	4	63	561	2299	12.8	14	29	0	29	613	3072	13.1	0						
	Chum	R/D	*GP*	0							2	4	0	4	558	2200	12.7	35	78	0	78	586	2459	12.2	8	18	0	18	619	2876	12.0
			Oshoro	10	4	3	0	394	695	10.9	244	89	88	1	468	1153	11.7	17	6	5	1	545	2058	11.4	3	1	0	1	629	2883	11.3
		Subarctic	*GP*	17	23	23	0	312	337	11.3	40	54	50	4	418	794	10.6	14	19	7	12	507	1451	10.9	3	4	0	4	557	1803	10.4
			Oshoro	0							37	90	90	0	448	986	10.8	4	10	10	0	534	1865	11.5	0						
	Pink	Subarctic	*GP*	101			100	371	530	10.2	0							0							0						
			Oshoro	116			100	440	954	11.1	0							0							0						
	Coho	Subarctic	*GP*	13			100	485	1322	11.3	0							0							0						
			Oshoro	42			100	570	2373	12.6	0							0							0						
165° W	Sockeye	Ridge	*GP*	11	41	41	0	265	247	13.1	14	52	26	26	465	1291	12.4	2	7	0	7	550	2040	12.0	0						
			Oshoro	29	60	60	0	342	458	11.4	18	38	33	4	468	1186	11.3	1	2	0	2	592	2340	11.3	0						
		Subarctic	*GP*	0							1	100	100	0	391	620	10.4	0							0						
			Oshoro	0							2	67	0	67	547	1680	10.4	1	33	0	33	622	3100	12.9	0						
	*Chum	Ridge	*GP*	0							0							4	16	0	16	571	2285	12.2	17	68	4	64	577	2244	11.7
			Oshoro	20	16	14	2	357	477	10.3	89	70	69	1	422	814	10.8	19	15	13	2	483	1234	10.8	0						
		Subarctic	*GP*	7	5	5	0	301	347	11.8	116	79	79	0	398	696	11.0	20	14	12	1	460	1087	10.8	3	2	1	1	566	2020	11.1
			Oshoro	26	36	36	0	331	399	11.0	44	61	61	0	420	859	11.5	2	3	3	0	438	1030	12.0	0						
	Pink	Ridge	*GP*	8			100	365	509	10.2	0							0							0						
			Oshoro	109			100	415	878	12.2	0							0							0						
		Subarctic	*GP*	65			100	359	482	10.4	0							0							0						
			Oshoro	20			100	441	959	11.1	0							0							0						
	Coho	Subarctic	*GP*	4			100	440	1098	11.8	0							0							0						
			Oshoro	9			100	536	1893	12.3	0							0							0						

* Five age 5 chum salmon were caught by the *Great Pacific* (four mature fish from the Ridge Domain and one immature fish from the Subarctic Domain).

Table 16. Mean % composition of stomach contents of salmonids caught along the 145°W and 165°W transect lines by the *Great Pacific* in 1999. PW=prey weight; % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=PW*100/body weight. Prey composition is based on visual estimates. Along the 145°W transect: R/D = Ridge/Dilute Domain = 52°N-57°30'N; Subarctic = 42°30'N-51°N. Along the 165°W transect: Ridge Domain = 47°N-51°N; Subarctic = 41°N-46°20'N.

Transect line	Domain	Species	N	% empty	mean pw	mean SCI	Mean % composition by volume											
							EU	CO	AM	CR	SQ	PT	FI	PO	CH	GE	OTH	UNID
145°W	R/D	Sockeye	26	0	20	1.23	56	11	1	0	0	11	1	0	5	14	0	0
		Chum	39	5	37	1.46	20	13	0	0	1	19	1	14	0	16	0	16
	Subarctic	Sockeye	44	18	8	0.96	1	2	19	0	1	4	0	0	1	71	0	0
		Chum	60	7	8	0.81	2	2	8	0	0	4	0	0	0	61	0	22
		Pink	61	28	5	0.80	2	15	34	0	0	12	2	0	0	32	4	0
		Coho	13	8	28	1.71	10	8	28	0	34	18	0	3	0	0	0	0
165°W	Ridge	Sockeye	46	11	6	0.56	7	12	65	0	5	7	2	1	2	0	0	0
		Chum	25	0	25	1.10	8	1	3	0	0	8	6	1	2	20	0	49
		Pink	9	0	6	1.19	0	85	15	0	0	0	0	0	0	0	0	0
		Chinook	1	0	1	0.26	0	60	40	0	0	0	0	0	0	0	0	0
	Subarctic	Sockeye	1	0	1	0.16	0	0	0	0	0	0	0	100	0	0	0	0
		Chum	64	3	6	0.88	0	0	7	0	1	14	0	0	6	8	0	63
		Pink	36	25	6	1.39	13	37	45	0	0	2	0	0	0	0	3	0
		Coho	4	0	16	1.45	40	5	30	0	25	0	0	0	0	0	0	0
		Chinook	4	0	17	0.74	0	0	0	0	50	0	50	0	0	0	0	0

Prey categories are: EU=euphausiids, CO=copepods, AM=amphipods, CR=crab larvae, SQ=squids, PT=pteropods (shelled and naked), FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton, including appendicularia, coelenterates, ctenophores, and salps. OTH=other groups, UNID=unidentified material.

Table 17. Mean % composition of stomach contents of salmonids caught in the Ridge/Dilute Domains along the 145° W transect line by the *Oshoro maru,* 1994-99. PW=prey weight; % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=PW*100/body weight. Prey composition is based on visual estimates.

			%	mean	mean	Mean % composition by volume											
Species	Year	N	empty	pw	SCI	EU	CO	AM	CR	SQ	PT	FI	PO	CH	GE	OTH	UNID
Sockeye	1999	146	14	4	0.30	18	23	19	0	10	13	4	4	0	1	3	6
	1998	64	25	20	0.74	7	6	11	0	32	27	3	2	0	2	5	5
	1997	145	14	12	0.55	25	49	5	0	9	2	5	2	0	0	2	0
	1996	96	25	26	0.96	6	14	9	0	62	2	5	0	0	0	0	2
	1995	67	52	25	0.97	6	3	3	0	48	17	7	0	0	0	2	16
	1994	90	18	21	0.97	9	5	21	0	49	6	4	2	0	0	0	5
Chum	1999	138	6	4	0.32	13	4	24	0	0	4	1	1	0	12	2	38
	1998	60	38	6	0.36	4	4	18	1	0	33	0	0	0	10	0	29
	1997	122	27	6	0.58	22	5	3	0	0	14	1	7	0	26	0	22
	1996	105	42	5	0.30	25	3	9	0	1	4	2	2	0	27	0	27
	1995	70	51	8	0.55	9	0	3	0	0	5	3	8	0	2	0	69
	1994	97	19	4	0.35	3	0	32	0	1	21	0	1	0	3	0	39
Pink	1999	144	6	7	0.66	24	47	17	0	2	3	1	0	0	0	0	6
	1998	61	13	10	0.71	1	15	17	0	22	38	2	0	0	0	0	3
	1997	118	13	11	0.83	27	53	6	0	2	9	1	0	0	0	0	1
	1996	76	29	14	1.04	7	13	13	2	45	5	4	0	0	0	11	1
	1995	68	54	9	0.63	12	10	11	0	20	28	6	1	0	0	0	13
	1994	94	27	11	0.69	1	10	18	2	36	20	3	0	0	0	0	10
Coho	1999	138	37	5	0.22	23	5	24	0	33	5	0	0	0	0	1	8
	1998	70	37	37	1.16	8	0	7	0	77	8	0	0	0	0	0	0
	1997	88	56	17	0.63	13	4	2	0	59	7	14	0	0	0	0	0
	1996	92	27	43	1.50	0	0	0	0	99	0	1	0	0	0	0	0
	1995	65	54	17	0.68	15	0	2	0	65	0	18	0	0	0	0	0
	1994	89	34	41	1.47	3	0	7	0	73	9	7	0	0	0	0	1
Chinook	1999	10	60	37	0.68	23	0	0	0	25	0	0	0	0	0	0	53
	1998	17	47	15	0.47	0	0	6	0	94	0	0	0	0	0	0	0
	1997	0															
	1996	7	29	42	1.57	0	0	0	0	80	0	0	0	0	0	0	20
	1995	5	40	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	81	0	0	0	0	0	0	19
Steelhead	1999	57	14	8	0.73	3	2	2	0	31	3	34	6	0	1	11	6
	1998	17	6	47	2.24	0	0	1	0	46	5	46	0	0	0	1	0
	1997	26	8	29	1.60	0	0	3	0	10	8	58	0	0	0	21	0
	1996	42	38	19	1.30	0	0	1	0	44	0	29	4	0	0	18	4
	1995	40	35	13	0.68	0	0	0	0	47	8	32	12	0	0	0	0
	1994	17	18	3	0.55	0	0	9	0	43	9	33	0	0	0	0	6

Prey categories are: EU=euphausiids, CO=copepods, AM=amphipods, CR=crab larvae, SQ=squids, PT=pteropods (shelled and naked), FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton, including coelenterates, ctenophores, and salps. OTH=other groups, UNID=unidentified material.

Table 18. Mean % composition of stomach contents of salmonids caught in the Subarctic Current along the 145° W transect line by the *Oshoro maru,* 1994-99. PW=prey weight; % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=PW*100/body weight. Prey composition is based on visual estimates.

			%	mean	mean	Mean % composition by volume											
Species	Year	N	empty	pw	SCI	EU	CO	AM	CR	SQ	PT	FI	PO	CH	GE	OTH	UNID
Sockeye	1999	59	19	19	0.77	2	23	13	0	53	1	0	2	0	3	0	3
	1998	127	13	37	1.45	1	0	0	0	92	5	0	0	0	0	1	0
	1997	51	14	38	1.83	0	0	0	0	93	3	4	0	0	0	0	0
	1996	39	18	30	1.20	0	0	0	0	100	0	0	0	0	0	0	0
	1995	11	27	30	1.35	0	0	0	0	88	0	0	0	0	0	0	13
	1994	12	25	20	1.19	0	0	0	0	100	0	0	0	0	0	0	0
Chum	1999	43	7	3	0.36	1	5	48	0	0	9	0	0	0	4	1	32
	1998	105	31	4	0.30	2	1	11	0	1	27	1	4	0	6	0	47
	1997	37	16	7	0.73	6	0	1	0	0	1	0	7	0	28	0	56
	1996	25	44	6	0.43	2	0	2	0	7	2	0	0	0	37	1	49
	1995	10	0	12	0.74	0	0	0	0	0	0	0	0	0	29	0	72
	1994	16	50	2	0.17	0	0	0	0	0	13	0	1	0	1	0	84
Pink	1999	60	17	4	0.36	0	31	39	0	2	10	0	0	0	0	2	15
	1998	116	16	23	1.52	0	0	1	0	80	16	2	0	0	0	0	0
	1997	1	0	11	0.71	0	0	0	0	60	20	20	0	0	0	0	0
	1996	51	6	18	1.09	0	0	0	0	71	23	6	0	0	0	0	0
	1995	10	20	5	0.30	1	0	18	0	49	3	0	0	0	0	21	9
	1994	14	21	8	0.45	0	0	0	0	66	25	0	0	0	0	0	9
Coho	1999	60	15	36	1.51	1	1	2	0	93	0	0	0	0	0	0	4
	1998	57	12	41	1.28	0	0	0	0	93	2	3	0	0	0	2	0
	1997	11	27	59	2.10	0	0	0	0	100	0	0	0	0	0	0	0
	1996	22	45	36	1.18	0	0	0	0	100	0	0	0	0	0	0	0
	1995	19	42	43	1.87	0	0	0	0	100	0	0	0	0	0	0	0
	1994	1	100														
Chinook	1999	0															
	1998	8	25	65	1.45	0	0	0	0	99	0	0	0	0	0	0	1
	1997	0															
	1996	1	100														
	1995	2	100														
	1994	0															
Steelhead	1999	21	24	7	0.31	0	0	13	0	24	0	32	6	0	0	25	0
	1998	48	4	22	1.23	2	0	2	0	61	14	17	3	0	0	0	2
	1997	8	25	24	0.92	0	0	0	0	83	0	0	17	0	0	0	0
	1996	5	0	13	0.50	0	0	1	0	51	26	22	0	0	0	0	0
	1995	19	11	15	1.02	0	0	18	0	61	0	9	9	0	0	3	0
	1994	1	0	1	0.07	0	0	0	0	100	0	0	0	0	0	0	0

Prey categories are: EU=euphausiids, CO=copepods, AM=amphipods, CR=crab larvae, SQ=squids, PT=pteropods (shelled and naked), FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton, including coelenterates, ctenophores, and salps. OTH=other groups, UNID=unidentified material.

Table 19. Mean % composition of stomach contents of salmonids caught along the 165° W transect line by the *Oshoro maru,* 1998 and 1999. PW=prey weight; % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=PW*100/body weight. Prey composition is based on visual estimates.

				%	mean	mean	Mean % composition by volume											
Domain	Species	Year	N	empty	pw	SCI	EU	CO	AM	CR	SQ	PT	FI	PO	CH	GE	OTH	UNID
Ridge Domain	Sockeye	1999	29	7	7	0.60	0	19	63	0	10	5	1	0	0	0	0	2
		1998	26	31	4	0.38	2	7	36	0	10	24	5	0	0	0	0	17
	Chum	1999	55	2	5	0.67	0	4	16	0	2	4	0	0	2	23	0	49
		1998	18	22	6	0.35	0	3	14	0	13	40	0	0	0	6	0	23
	Pink	1999	38	5	14	1.62	20	54	9	0	4	6	0	0	4	0	0	4
		1998	11	0	17	1.42	0	39	18	0	1	19	4	0	0	0	0	20
	Coho	1999	4	0	13	0.54	0	0	1	0	96	0	0	0	0	0	3	0
	Chinook	1999	15	0	92	2.92	0	0	0	0	99	0	0	0	0	0	0	0
	Steelhead	1999	14	0	11	0.59	0	0	3	0	11	0	81	4	0	0	0	0
Subarctic Current	Sockeye	1999	3	0	52	2.20	0	0	0	0	99	0	0	0	0	1	0	0
		1998	45	16	8	0.56	3	5	54	0	29	2	0	1	0	1	0	5
	Chum	1999	40	23	3	0.36	0	6	8	0	0	8	0	0	1	2	0	74
		1998	58	10	5	0.48	3	3	7	0	2	2	0	0	0	0	0	83
	Pink	1999	20	35	3	0.19	0	12	43	0	10	1	15	0	4	0	10	5
		1998	47	15	7	0.58	0	3	44	0	33	17	4	0	0	0	0	0
	Coho	1999	24	29	11	0.58	0	0	0	0	80	0	18	0	0	0	0	2
		1998	28	25	44	1.69	0	0	0	0	94	6	0	0	0	0	0	0
	Chinook	1998	6	17	37	1.12	0	0	0	0	100	0	0	0	0	0	0	0
	Steelhead	1999	22	0	15	0.82	0	0	0	0	39	1	32	22	0	0	2	4
		1998	9	33	16	0.83	0	0	1	0	33	0	50	17	0	0	0	0

Prey categories are: EU=euphausiids, CO=copepods, AM=amphipods, CR=crab larvae, SQ=squids, PT=pteropods (shelled and naked), FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton, including coelenterates, ctenophores, and salps. OTH=other groups, UNID=unidentified material.

Table 20. Mean percent composition of stomach contents of salmonids caught in the Transition Zone along the 180° longitude transect line by the *Wakatake maru,* 1991-1998. PW=prey weight, % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=PW*100/body weight. Prey composition is based on visual estimates.

Transition Zone

			%	Mean	Mean	Mean % composition by volume											
Species	Year	N	empty	PW	SCI	EU	CO	AM	CR	SQ	PT	FI	PO	CH	GE	OTH	UNID
Sockeye	1998	0															
	1997	0															
	1996	0															
	1995	0															
	1994	0															
	1993	0															
	1992	0															
	1991	0															
Chum	1998	0															
	1997	3	0	4.3	0.37	0	0	0	0	0	0	20	0	0	2	78	0
	1996	0															
	1995	1	0	8	0.45	0	5	0	0	0	0	0	0	0	95	0	0
	1994	0															
	1993	14	14	5	0.62	0	4	0	0	1	0	11	0	2	65	0	17
	1992	0															
	1991	0															
Pink	1998	0															
	1997	1	0	1	0.12	0	0	0	0	30	40	0	0	0	0	30	0
	1996	0															
	1995	0															
	1994	0															
	1993	0															
	1992	0															
	1991	0															
Coho	1998	0															
	1997	4	25	71	2.03	0	0	0	0	0	0	100	0	0	0	0	0
	1996	0															
	1995	0															
	1994	0															
	1993	1	100														
	1992	0															
	1991	1	100														
Chinook	1998	0															
	1997	0															
	1996	0															
	1995	0															
	1994	0															
	1993	0															
	1992	0															
	1991	0															
Steelhead	1998	0															
	1997	0															
	1996	0															
	1995	0															
	1994	0															
	1993	0															
	1992	0															
	1991	0															

Prey categories are EU=euphausiids, CO=copepods, AM=amphipods, CR=crab larvae, SQ=squids, PT=pteropods, FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton (coelenterates, ctenophores, and salps), OTH=other groups, and UNID=unidentified material.

Table 21. Mean percent composition of stomach contents of salmonids caught in the Transition Domain along the 180° longitude transect line by the *Wakatake maru,* 1991-1998. PW=prey weight, % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=PW*100/body weight. Prey composition is based on visual estimates.

Transition Domain

			%	Mean	Mean	Mean % composition by volume											
Species	Year	N	empty	PW	SCI	EU	CO	AM	CR	SQ	PT	FI	PO	CH	GE	OTH	UNID
Sockeye	1998	0															
	1997	0															
	1996	0															
	1995	0															
	1994	0															
	1993	0															
	1992	0															
	1991	0															
Chum	1998	24	8	3	0.56	1	5	2	0	0	9	5	1	13	44	13	7
	1997	32	6	5	0.56	10	8	5	0	1	1	5	2	35	25	7	1
	1996	10	0	14	1.22	4	4	2	0	0	0	4	4	21	17	34	10
	1995	7	0	9	0.85	0	3	1	0	0	0	32	0	9	51	4	0
	1994	18	0	9	1.05	1	1	2	0	1	2	1	0	38	39	11	4
	1993	23	4	10	1.13	0	5	6	0	0	8	7	1	30	25	11	7
	1992	10	0	9	1.04	39	5	10	0	0	0	3	2	0	3	0	38
	1991	14	0	16	1.92	5	0	18	0	0	0	0	0	0	2	0	75
Pink	1998	4	0	8	0.87	0	1	25	0	14	2	11	0	0	0	47	0
	1997	6	17	11	1.19	6	9	3	0	4	10	7	0	57	0	4	0
	1996	0															
	1995	3	0	17	1.83	0	3	6	0	2	0	17	0	43	0	29	0
	1994	23	4	6	0.63	1	50	11	0	4	15	2	0	10	0	6	1
	1993	0															
	1992	0															
	1991	1	0	7	0.96	10	0	90	0	0	0	0	0	0	0	0	0
Coho	1998	39	41	21	1.17	0	0	3	0	91	5	1	0	0	0	0	0
	1997	78	35	20	1.08	6	2	7	0	48	9	28	0	0	0	0	0
	1996	13	15	41	2.04	18	0	1	0	74	3	4	0	0	0	0	0
	1995	15	7	25	1.38	0	0	11	0	54	9	26	0	0	0	0	0
	1994	16	19	13	0.84	0	0	17	0	34	27	22	0	0	0	0	0
	1993	13	15	7	0.44	1	0	3	0	15	79	0	0	0	2	0	0
	1992	8	0	25	1.44	12	1	4	0	76	1	1	0	0	5	0	0
	1991	57	9	26	1.37	4	0	23	0	59	11	2	0	0	1	0	0
Chinook	1998	0															
	1997	0															
	1996	0															
	1995	0															
	1994	0															
	1993	0															
	1992	0															
	1991	0															
Steelhead	1998	6	50	5	0.30	0	0	3	0	16	5	46	0	0	0	30	0
	1997	26	27	7	0.35	3	1	16	0	9	3	9	31	0	0	28	0
	1996	2	0	64	3.49	0	0	0	0	70	0	30	0	0	0	0	0
	1995	1	0	5	0.27	0	0	0	0	0	5	95	0	0	0	0	0
	1994	4	0	3	0.16	0	0	20	0	25	20	35	0	0	0	0	0
	1993	1	0	16	0.88	5	0	5	0	85	5	0	0	0	0	0	0
	1992	1	0	20	0.91	5	0	0	0	90	5	0	0	0	0	0	0
	1991	11	0	22	1.38	1	0	18	1	68	2	10	0	0	0	0	0

Prey categories are EU=euphausiids, CO=copepods, AM=amphipods, CR=crab larvae, SQ=squids, PT=pteropods, FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton (coelenterates, ctenophores, and salps), OTH=other groups, and UNID=unidentified material.

Table 22. Mean percent composition of stomach contents of salmonids caught in the Subarctic Current along the 180° longitude transect line by the *Wakatake maru,* 1991-1998. PW=prey weight, % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=PW*100/body weight. Prey composition is based on visual estimates.

Subarctic Current

			%	Mean	Mean	Mean % composition by volume											
Species	Year	N	empty	PW	SCI	EU	CO	AM	CR	SQ	PT	FI	PO	CH	GE	OTH	UNID
Sockeye	1998	10	50	9	0.96	0	6	0	0	94	0	0	0	0	0	0	0
	1997	17	0	17	0.94	11	24	9	0	38	0	0	5	10	0	3	0
	1996	1	100														
	1995	0															
	1994	0															
	1993	0															
	1992	1	0	2	0.15	0	0	50	0	0	50	0	0	0	0	0	0
	1991	0															
Chum	1998	44	27	4	0.60	0	4	4	0	1	25	1	2	6	11	1	45
	1997	32	3	8	0.75	6	5	10	0	0	2	1	3	45	24	0	4
	1996	67	0	8	0.72	1	1	5	0	6	8	1	5	10	43	8	12
	1995	41	0	8	0.70	28	3	5	0	3	6	0	1	1	50	0	3
	1994	27	1	11	1.16	0	0	0	0	0	3	0	0	17	32	0	48
	1993	39	0	12	1.61	0	3	5	0	1	17	0	7	4	2	45	16
	1992	18	11	5	0.62	6	1	26	0	8	9	0	2	12	11	0	25
	1991	34	9	13	1.32	0	0	4	0	2	0	0	0	0	2	0	92
Pink	1998	2	0	32	2.52	0	1	4	0	70	0	0	0	0	0	25	0
	1997	38	3	11	1.07	5	78	8	0	1	2	0	0	6	0	0	0
	1996	7	14	6	0.36	0	10	28	0	21	19	1	0	0	8	11	2
	1995	5	40	5	0.50	0	21	12	0	30	1	33	0	3	0	0	0
	1994	18	0	16	1.41	0	11	15	0	26	17	4	0	15	0	2	10
	1993	1	0	1	0.09	0	0	30	0	0	70	0	0	0	0	0	0
	1992	0															
	1991	13	0	10	1.29	7	4	24	0	10	49	0	0	0	0	0	6
Coho	1998	47	0	57	2.61	0	0	0	0	95	0	5	0	0	0	0	0
	1997	47	15	33	2.33	1	1	4	0	86	0	8	0	0	0	0	0
	1996	69	26	20	1.12	0	0	14	0	75	6	0	0	0	4	1	0
	1995	41	2	51	3.00	0	0	0	0	99	0	1	0	0	0	0	0
	1994	25	8	53	2.87	0	0	4	0	95	0	1	0	0	0	0	0
	1993	21	0	32	1.74	0	0	5	0	90	0	5	0	0	0	0	0
	1992	11	0	7	0.50	0	1	74	0	17	2	4	0	1	1	0	0
	1991	25	0	53	2.69	0	0	0	0	100	0	0	0	0	0	0	0
Chinook	1998	5	0	41	1.54	0	0	0	0	100	0	0	0	0	0	0	0
	1997	24	29	28	1.12	12	0	0	0	83	0	5	0	0	0	0	0
	1996	2	0	19	0.26	0	0	0	0	100	0	0	0	0	0	0	0
	1995	1	100														
	1994	3	0	13	0.28	0	0	0	0	100	0	0	0	0	0	0	0
	1993	3	33	74	1.94	0	0	0	0	100	0	0	0	0	0	0	0
	1992	0															
	1991	2	0	23	0.49	0	0	2	0	63	0	0	0	0	0	0	35
Steelhead	1998	15	0	37	1.72	0	0	0	0	79	0	15	0	0	0	6	0
	1997	26	12	13	0.67	1	1	3	0	22	0	41	9	0	0	23	0
	1996	13	15	5	0.34	0	0	8	0	36	0	39	1	0	0	16	0
	1995	8	38	10	0.49	0	0	11	10	28	0	51	0	0	0	0	0
	1994	9	0	33	1.39	0	0	0	0	74	0	26	0	0	0	0	0
	1993	1	0	2	0.06	0	0	100	0	0	0	0	0	0	0	0	0
	1992	4	0	7	0.37	26	0	26	0	23	0	25	0	0	0	0	0
	1991	3	0	70	2.22	0	0	3	7	77	0	13	0	0	0	0	0

Prey categories are EU=euphausiids, CO=copepods, AM=amphipods, CR=crab larvae, SQ=squids, PT=pteropods, FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton (coelenterates, ctenophores, and salps), OTH=other groups, and UNID=unidentified material.

Table 23. Mean percent composition of stomach contents of salmonids caught in the Ridge Domain along the 180° longitude transect line by the *Wakatake maru,* 1991-1998. PW=prey weight, % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=PW*100/body weight. Prey composition is based on visual estimates.

Ridge Domain

			%	Mean	Mean	Mean % composition by volume											
Species	Year	N	empty	PW	SCI	EU	CO	AM	CR	SQ	PT	FI	PO	CH	GE	OTH	UNID
Sockeye	1998	7	14	5	0.25	0	15	25	0	45	0	0	3	0	0	12	0
	1997	10	0	20	1.04	47	29	10	0	10	3	0	0	1	0	0	0
	1996	9	0	20	0.82	30	7	24	0	21	9	6	0	1	0	2	0
	1995	8	0	25	1.09	0	22	20	0	51	2	1	0	4	0	0	0
	1994	6	17	11	0.43	0	37	6	0	40	17	0	0	0	0	0	0
	1993	0															
	1992	0															
	1991	4	25	17	0.96	27	18	7	0	0	8	0	0	3	0	0	37
Chum	1998	13	15	2	0.42	1	3	35	0	1	21	0	0	26	8	2	3
	1997	30	3	11	1.16	36	1	5	0	1	22	1	10	17	7	0	0
	1996	27	15	13	1.01	15	7	23	0	4	41	0	0	5	5	0	0
	1995	29	0	11	0.95	48	3	11	0	5	2	1	0	11	16	0	3
	1994	41	0	7	0.78	7	2	4	0	2	20	1	0	3	28	0	33
	1993	38	3	11	1.19	2	0	2	0	3	28	0	1	2	0	61	1
	1992	9	11	5	0.66	0	4	47	0	0	0	5	0	23	0	0	21
	1991	39	3	8	1.33	9	8	3	0	1	5	0	0	9	1	0	64
Pink	1998	6	0	20	1.71	10	43	23	0	19	1	2	0	0	0	2	0
	1997	16	0	27	2.68	37	34	5	0	6	10	8	0	0	0	0	0
	1996	1	0	13	1.21	20	35	35	0	5	5	0	0	0	0	0	0
	1995	22	5	17	1.71	1	32	19	0	27	8	8	0	5	0	0	0
	1994	15	0	35	2.72	20	10	5	0	52	12	0	0	0	0	1	0
	1993	3	0	17	1.92	22	2	13	0	21	40	0	0	0	0	2	0
	1992	2	0	4	0.39	3	5	67	0	0	0	25	0	0	0	0	0
	1991	40	0	17	2.19	43	30	2	0	8	14	1	0	2	0	0	0
Coho	1998	2	100														
	1997	5	0	36	2.48	47	0	1	0	49	0	1	0	0	0	2	0
	1996	0															
	1995	4	0	68	3.71	0	0	1	0	98	0	1	0	0	0	0	0
	1994	4	0	97	3.75	25	0	0	0	75	0	0	0	0	0	0	0
	1993	1	0	29	1.47	0	0	0	0	95	5	0	0	0	0	0	0
	1992	1	0	83	4.15	0	0	0	0	100	0	0	0	0	0	0	0
	1991	0															
Chinook	1998	3	67	29	0.85	0	0	0	0	100	0	0	0	0	0	0	0
	1997	2	50	1	0.02	100	0	0	0	0	0	0	0	0	0	0	0
	1996	0															
	1995	2	0	39	1.21	0	0	0	0	100	0	0	0	0	0	0	0
	1994	0															
	1993	0															
	1992	0															
	1991	0															
Steelhead	1998	0															
	1997	3	0	7	0.24	12	0	0	0	12	0	55	0	0	0	21	0
	1996	6	0	30	0.75	0	0	3	0	38	0	59	0	0	0	0	0
	1995	1	0	194	3.88	0	0	0	0	90	0	10	0	0	0	0	0
	1994	3	0	76	1.47	0	0	0	0	83	0	17	0	0	0	0	0
	1993	1	0	41	1.78	0	0	0	0	95	5	0	0	0	0	0	0
	1992	2	0	99	2.79	0	0	0	0	80	0	20	0	0	0	0	0
	1991	0															

Prey categories are EU=euphausiids, CO=copepods, AM=amphipods, CR=crab larvae, SQ=squids, PT=pteropods, FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton (coelenterates, ctenophores, and salps), OTH=other groups, and UNID=unidentified material.

Table 24. Mean percent composition of stomach contents of salmonids caught in the Alaska Stream along the 180° longitude transect line by the *Wakatake maru,* 1991-1998. PW=prey weight, % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=PW*100/body weight. Prey composition is based on visual estimates.

Alaska Stream

			%	Mean	Mean	Mean % composition by volume											
Species	Year	N	empty	PW	SCI	EU	CO	AM	CR	SQ	PT	FI	PO	CH	GE	OTH	UNID
Sockeye	1998	1	0	64	3.05	0	0	2	0	0	1	95	2	0	0	0	0
	1997	3	0	8	0.50	26	0	2	0	0	4	3	20	0	15	30	0
	1996	4	25	14	0.56	12	0	35	0	40	12	1	0	0	0	0	0
	1995	21	0	25	0.99	26	6	14	1	8	21	4	4	2	13	1	0
	1994	27	4	25	1.01	14	2	26	0	45	7	1	0	0	1	4	0
	1993	2	0	11	0.39	0	0	65	0	0	0	0	35	0	0	0	0
	1992	2	0	13	0.90	10	0	25	0	65	0	0	0	0	0	0	0
	1991	18	33	5	0.34	17	2	28	0	6	42	0	0	0	0	1	4
Chum	1998	16	0	24	1.24	0	1	6	0	1	21	1	41	0	20	0	9
	1997	2	0	16	2.29	0	0	1	0	0	3	0	0	48	0	48	0
	1996	10	20	19	0.56	9	0	25	0	8	4	16	1	1	23	13	0
	1995	28	4	12	0.91	34	0	1	0	10	19	0	10	1	25	0	0
	1994	40	5	10	1.02	19	3	15	0	14	30	5	0	0	10	3	1
	1993	6	17	14	1.22	0	0	4	6	0	1	2	82	1	4	0	0
	1992	5	0	5	0.47	0	4	32	0	0	6	0	0	15	29	0	14
	1991	47	4	10	1.27	2	1	5	0	2	17	3	0	1	0	0	69
Pink	1998	0															
	1997	10	0	4	0.44	5	0	10	1	5	2	7	0	0	4	66	0
	1996	0															
	1995	14	0	17	1.44	27	1	14	1	10	20	24	3	0	0	0	0
	1994	8	0	25	2.15	17	25	11	0	24	7	6	0	0	0	10	0
	1993	2	0	10	0.95	0	3	15	0	0	15	60	2	0	5	0	0
	1992	0															
	1991	47	9	10	1.07	13	2	18	0	8	51	6	0	0	0	2	0
Coho	1998	0															
	1997	1	0	68	3.80	0	0	0	0	0	0	100	0	0	0	0	0
	1996	0															
	1995	1	0	47	2.47	85	0	0	0	10	0	5	0	0	0	0	0
	1994	0															
	1993	0															
	1992	0															
	1991	1	0	7	0.28	20	0	0	0	40	0	40	0	0	0	0	0
Chinook	1998	1	0	115	1.60	0	0	0	0	100	0	0	0	0	0	0	0
	1997	0															
	1996	0															
	1995	1	0	43	0.95	0	0	0	0	100	0	0	0	0	0	0	0
	1994	0															
	1993	0															
	1992	0															
	1991	0															
Steelhead	1998	0															
	1997	0															
	1996	0															
	1995	0															
	1994	2	0	28	0.72	0	0	0	0	50	0	50	0	0	0	0	0
	1993	1	100														
	1992	1	0	40	0.85	0	0	0	0	60	0	40	0	0	0	0	0
	1991	0															

Prey categories are EU=euphausiids, CO=copepods, AM=amphipods, CR=crab larvae, SQ=squids, PT=pteropods, FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton (coelenterates, ctenophores, and salps), OTH=other groups, and UNID=unidentified material.

Table 25. Mean percent composition of stomach contents of salmonids caught in the central North Pacific Ocean by the *Wakatake maru,* 1991-1998, stratified by body weight and maturity group. PW=prey weight, % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=PW*100/body weight. Prey composition is based on visual estimates. MDI=Morishita's diversity index.

Central North Pacific Ocean 1991-1998

Species	Weight (g) or maturity	N	% empty	Mean PW	Mean SCI	Mean % composition by volume EU	CO	AM	CR	SQ	PT	FI	PO	CH	GE	Oth	UNID	MDI
Sockeye	<500	2	100															
	500-999	18	11	7	0.81	12	3	25	0	27	13	0	0	9	0	6	5	5.76
	1000-1499	35	11	7	0.60	9	16	27	0	17	17	2	3	2	1	5	1	6.23
	1500-1999	18	17	18	1.00	19	15	22	1	26	4	2	1	0	1	6	3	5.78
	2000-2499	20	5	20	0.87	14	20	19	0	27	6	5	5	0	3	1	0	5.89
	2500-2999	36	8	27	0.99	23	8	9	0	37	12	1	2	1	7	0	0	4.62
	3000-3999	20	10	30	0.92	23	6	12	0	42	7	1	3	1	2	3	0	4.05
	≥4000	2	0	33	0.82	32	1	6	0	48	0	13	0	0	0	0	0	2.88
	immatures	58	17	10	0.75	12	11	26	0	21	16	1	2	3	1	5	2	6.26
	maturing	93	8	23	0.91	20	11	14	0	34	8	3	3	1	4	1	1	5.28
	all fish	151	11	18	0.85	17	11	19	0	29	11	2	2	2	3	3	1	5.95
Chum	<500	118	12	4	1.05	5	4	11	0	2	17	0	1	18	14	7	21	7.25
	500-999	388	6	8	1.01	6	3	7	0	2	10	3	2	10	13	13	31	6.56
	1000-1499	233	3	11	0.91	17	2	7	0	3	10	2	5	9	27	6	12	7.23
	1500-1999	64	0	15	0.90	12	2	6	0	7	25	1	6	5	23	4	9	6.85
	2000-2499	24	4	23	1.06	10	1	6	0	4	15	1	13	11	27	3	9	7.13
	2500-2999	3	33	11	0.42	1	0	2	0	0	0	0	2	0	15	40	40	2.97
	3000-3999	7	0	21	0.64	4	0	12	0	8	8	17	23	1	18	3	6	7.19
	≥4000	1	0	100	2.30	0	0	0	0	2	0	0	0	0	98	0	0	1.04
	immatures	673	6	8	0.98	9	3	7	0	3	12	2	3	10	18	10	23	7.87
	maturing	165	5	14	0.96	12	3	8	0	3	14	3	6	10	21	6	14	8.68
	all fish	838	6	9	0.98	10	3	7	0	3	12	2	4	10	18	9	22	8.11
Pink	<500	2	0	10	3.16	20	25	45	0	10	0	0	0	0	0	0	0	3.25
	500-999	162	3	12	1.39	16	23	13	0	9	22	6	0	5	0	5	1	6.57
	1000-1499	138	4	18	1.57	11	29	12	0	18	14	5	0	4	0	6	1	6.17
	1500-1999	6	0	11	0.66	37	8	14	0	22	12	3	2	0	0	0	2	4.55
	all fish	308	4	15	1.47	14	26	13	0	13	19	5	0	4	0	5	1	6.44
Coho	500-999	16	25	8	0.95	0	0	17	0	51	19	9	0	0	4	0	0	3.05
	1000-1499	143	16	21	1.64	1	1	12	0	76	5	4	0	0	0	1	0	1.69
	1500-1999	228	19	31	1.80	3	1	9	0	75	5	6	0	0	1	0	0	1.74
	2000-2499	129	12	45	2.06	5	0	5	0	72	9	9	0	0	0	0	0	1.87
	2500-2999	25	8	61	2.28	3	0	2	0	75	0	20	0	0	0	0	0	1.67
	3000-3999	9	11	99	2.97	0	0	1	0	56	13	30	0	0	0	0	0	2.41
	≥4000	1	0	1	0.02	0	0	100	0	0	0	0	0	0	0	0	0	1.00
	all fish	551	16	34	1.84	3	0	9	0	74	6	7	0	0	1	0	0	1.78
Chinook	1500-1999	4	25	15	0.86	0	0	0	0	100	0	0	0	0	0	0	0	1.00
	2000-2499	12	50	24	1.11	17	0	0	0	83	0	0	0	0	0	0	0	1.40
	2500-2999	16	13	30	1.12	7	0	0	0	81	0	7	0	0	0	0	5	1.50
	3000-3999	9	33	52	1.45	0	0	0	0	100	0	0	0	0	0	0	0	1.00
	4000-4999	5	0	25	0.55	20	0	0	0	80	0	0	0	0	0	0	0	1.48
	≥5000	3	0	57	0.77	0	0	0	0	100	0	0	0	0	0	0	0	1.00
	immatures	47	26	31	0.95	8	0	0	0	87	0	3	0	0	0	0	2	1.31
	maturing	2	0	65	2.71	0	0	0	0	100	0	0	0	0	0	0	0	1.00
	all fish	49	24	33	1.05	8	0	0	0	87	0	3	0	0	0	0	2	1.31
Steelhead	1000-1499	22	14	8	0.55	0	1	10	0	37	1	25	11	0	0	15	0	4.23
	1500-1999	64	19	18	1.04	1	0	8	0	33	1	35	7	0	0	15	0	3.88
	2000-2499	21	5	18	0.84	3	0	9	0	53	6	16	0	0	0	13	0	3.04
	2500-2999	11	27	35	1.29	0	0	2	0	69	0	16	10	0	0	3	0	1.97
	3000-3999	20	0	31	0.90	0	0	7	0	41	0	36	5	0	0	11	0	3.22
	≥4000	13	0	53	1.11	8	0	10	0	58	0	22	1	0	0	1	0	2.53
	immatures	37	14	26	1.29	1	0	14	0	64	3	17	0	0	0	1	0	2.20
	maturing	114	12	22	0.82	2	0	6	0	36	1	32	8	0	0	15	0	3.88
	all fish	151	13	23	0.94	2	0	8	0	43	1	28	6	0	0	12	0	3.56

Prey categories are EU=euphausiids, CO=copepods, AM=amphipods, CR=crab larvae, SQ=squids, PT=pteropods, FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton (coelenterates, ctenophores, and salps), OTH=other groups, and UNID=unidentified material.

Table 26. Mean percent composition of stomach contents of salmonids caught in the central Bering Sea by the *Wakatake maru,* 1991-1998. PW=prey weight, % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=PW*100/body weight. Prey composition is based on visual estimates.

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			%	Mean	Mean	Mean % composition by volume											
Species	Year	N	empty	PW	SCI	EU	CO	AM	CR	SQ	PT	FI	PO	CH	GE	OTH	UNID
Sockeye	1998	113	19	12	1.21	28	18	18	2	14	8	10	0	0	1	1	0
	1997	114	11	7	0.51	9	21	25	9	10	11	11	0	0	0	4	0
	1996	134	16	12	0.70	24	13	16	1	15	11	19	0	0	1	0	0
	1995	144	1	10	0.67	9	6	36	5	22	12	9	0	0	1	0	0
	1994	115	10	11	0.90	15	20	30	0	22	5	7	0	0	0	1	0
	1993	79	15	9	0.65	3	10	19	1	31	3	28	0	0	0	2	3
	1992	36	14	13	0.68	11	30	22	0	18	0	14	0	2	3	0	0
	1991	69	14	9	0.55	13	5	7	0	32	13	14	0	0	5	3	8
Chum	1998	316	5	13	1.02	19	9	14	1	4	19	7	10	0	11	1	5
	1997	174	3	14	1.05	20	2	6	1	5	28	5	5	2	8	16	2
	1996	238	6	15	1.00	39	3	9	0	2	20	10	0	0	13	4	0
	1995	216	2	14	1.01	23	1	12	1	7	9	22	0	0	23	0	2
	1994	279	1	11	0.99	13	6	13	0	5	7	2	0	3	39	1	11
	1993	291	4	16	1.42	6	2	4	0	10	5	14	1	0	27	29	2
	1992	235	1	19	1.33	26	17	13	0	13	0	5	0	1	6	0	19
	1991	311	1	23	1.53	8	2	4	0	3	4	1	0	0	11	22	45
Pink	1998	31	13	12	1.46	12	16	11	4	15	6	36	0	0	0	0	0
	1997	181	16	10	0.88	9	14	16	6	15	10	27	0	0	0	3	0
	1996	52	8	19	1.43	21	5	5	3	14	2	50	0	0	0	0	0
	1995	186	0	15	1.19	9	8	14	5	26	12	26	0	0	0	0	0
	1994	28	0	17	1.37	23	12	8	4	28	2	23	0	0	0	0	0
	1993	159	3	16	1.36	2	6	10	0	28	2	50	0	0	0	2	0
	1992	14	0	27	1.95	14	12	6	0	40	0	21	0	0	0	4	3
	1991	312	7	17	1.42	14	7	11	0	33	6	21	0	0	1	0	7
Coho	1998	1	100														
	1997	8	50	16	0.94	15	0	0	0	36	0	49	0	0	0	0	0
	1996	2	0	76	2.07	0	0	0	0	0	0	100	0	0	0	0	0
	1995	0															
	1994	0															
	1993	0															
	1992	2	0	9	0.63	87	0	5	0	5	0	3	0	0	0	0	0
	1991	2	0	11	0.30	50	0	0	0	50	0	0	0	0	0	0	0
Chinook	1998	96	34	15	0.82	12	3	2	0	66	0	16	0	0	0	0	1
	1997	54	35	13	0.54	29	0	0	0	52	0	19	0	0	0	0	0
	1996	72	19	25	1.03	18	0	2	0	47	1	32	0	0	0	0	0
	1995	44	16	10	0.63	16	0	0	0	52	0	29	0	0	0	0	3
	1994	26	31	12	0.54	20	0	10	0	58	1	8	0	0	3	0	0
	1993	12	17	12	0.54	27	0	0	0	39	0	34	0	0	0	0	0
	1992	37	19	18	0.78	43	4	0	0	44	0	9	0	0	0	0	0
	1991	30	17	19	0.86	33	1	0	0	43	0	23	0	0	0	0	0
Steelhead	1998	0															
	1997	0															
	1996	0															
	1995	0															
	1994	0															
	1993	0															
	1992	0															
	1991	0															

Prey categories are EU=euphausiids, CO=copepods, AM=amphipods, CR=crab larvae, SQ=squids, PT=pteropods, FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton (coelenterates, ctenophores, and salps), OTH=other groups, and UNID=unidentified material.

Table 27. Mean percent composition of stomach contents of sockeye salmon caught in the central Bering Sea by the *Wakatake maru,* 1991-1998, stratified by year, body weight, and maturity group. PW=prey weight, % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=PW*100/body weight. Prey composition is based on visual estimates. MDI=Morishita's diversity index.

Sockeye, Central Bering Sea 1991-1998

Years	Weight (g) or maturity	N	% empty	Mean PW	Mean SCI	Mean % composition by volume: EU	CO	AM	CR	SQ	PT	FI	PO	CH	GE	OTH	UNID	MDI
Odd	<500	2	50	1	0.25	20	0	0	0	0	0	70	0	0	0	10	0	1.87
	500-999	22	0	4	0.48	6	6	19	7	34	9	14	0	0	0	1	4	5.40
	1000-1499	237	8	8	0.66	7	12	29	4	20	12	12	0	0	0	3	1	6.01
	1500-1999	81	11	11	0.68	11	12	25	2	25	5	17	0	0	0	1	2	5.70
	2000-2499	29	14	8	0.36	5	13	12	11	21	11	13	0	0	8	2	4	8.43
	2500-2999	17	12	8	0.31	10	2	20	7	21	22	15	0	0	1	0	2	6.16
	3000-3999	17	12	12	0.35	25	6	6	10	19	15	8	0	0	7	3	1	7.04
	≥4000	1	0	15	0.36	100	0	0	0	0	0	0	0	0	0	0	0	1.00
	immatures	282	8	8	0.63	7	9	27	4	23	10	16	0	0	0	3	1	5.93
	maturing	124	11	10	0.56	13	14	21	6	19	11	9	0	0	3	1	3	7.48
	all fish	406	9	9	0.61	9	11	25	5	22	10	13	0	0	1	2	2	6.54
Even	<500	47	19	4	1.25	24	12	28	0	11	14	8	0	0	3	0	0	5.52
	500-999	44	9	7	0.95	20	13	38	1	7	6	12	0	1	0	2	0	4.61
	1000-1499	183	17	12	0.92	17	21	24	1	21	5	10	0	1	0	0	0	5.58
	1500-1999	48	19	13	0.83	26	12	15	0	21	12	14	0	0	0	0	0	5.74
	2000-2499	23	9	14	0.64	23	14	13	0	17	5	25	0	0	0	3	0	5.68
	2500-2999	14	7	21	0.81	18	17	5	2	22	5	31	0	0	0	0	0	4.92
	3000-3999	32	6	20	0.62	30	26	4	3	10	11	12	0	0	3	1	0	5.28
	≥4000	7	29	20	0.48	36	25	0	0	37	0	2	0	0	0	0	0	3.10
	immatures	306	16	10	0.92	19	17	26	1	16	8	12	0	0	1	0	0	5.85
	maturing	92	12	19	0.81	29	21	7	2	19	5	15	0	0	1	1	0	5.36
	all fish	398	15	12	0.90	21	18	21	1	17	7	13	0	0	1	1	0	6.13
All	<500	49	20	4	1.23	24	12	27	0	10	14	10	0	0	3	0	0	5.64
	500-999	66	6	6	0.78	15	11	31	3	17	7	13	0	1	0	1	1	5.74
	1000-1499	420	12	10	0.77	11	15	27	3	21	9	12	0	0	0	2	0	5.99
	1500-1999	129	14	12	0.73	17	12	21	2	23	7	16	0	0	0	1	1	6.13
	2000-2499	52	12	11	0.49	13	13	13	6	19	8	18	0	0	5	3	2	8.05
	2500-2999	31	10	14	0.54	14	9	13	5	22	14	22	0	0	0	0	1	6.45
	3000-3999	49	8	17	0.53	28	20	5	6	13	12	10	0	0	4	1	1	6.28
	≥4000	8	25	19	0.46	46	21	0	0	31	0	2	0	0	0	0	0	2.89
	immatures	588	12	9	0.77	13	13	26	2	20	9	14	0	0	1	1	1	6.20
	maturing	216	12	14	0.66	20	17	15	4	19	9	11	0	0	2	1	2	7.06
	all fish	804	12	10	0.74	15	14	23	3	20	9	13	0	0	1	1	1	6.55

Prey categories are EU=euphausiids, CO=copepods, AM=amphipods, CR=crab larvae, SQ=squids, PT=pteropods, FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton (coelenterates, ctenophores, and salps), OTH=other groups, and UNID=unidentified material.

Table 28. Mean percent composition of stomach contents of chum salmon caught in the central Bering Sea by the *Wakatake maru,* 1991-1998, stratified by year, body weight, and maturity group. PW=prey weight, % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=PW*100/body weight. Prey composition is based on visual estimates. MDI=Morishita's diversity index.

Chum, Central Bering Sea 1991-1998

Years	Weight (g)		%	Mean	Mean	Mean % composition by volume												MDI
	or maturity	N	empty	PW	SCI	EU	CO	AM	CR	SQ	PT	FI	PO	CH	GE	OTH	UNID	
Odd	<500	30	0	5	1.35	2	1	18	1	5	14	12	0	5	6	5	31	6.03
	500-999	332	2	12	1.49	6	2	8	1	7	6	12	1	0	13	25	19	7.12
	1000-1499	258	3	15	1.27	17	2	6	0	7	9	13	2	0	17	15	12	8.32
	1500-1999	161	1	21	1.23	18	2	4	0	4	13	10	1	0	21	16	11	7.34
	2000-2499	99	4	26	1.20	20	1	2	0	5	15	5	2	1	24	13	12	6.72
	2500-2999	65	6	28	1.05	12	1	3	0	4	13	3	1	0	27	19	17	6.08
	3000-3999	35	3	28	0.85	10	1	2	0	6	13	7	0	0	21	18	22	6.56
	≥4000	12	0	33	0.74	1	1	5	0	6	3	14	2	1	33	10	24	5.11
	immatures	600	2	13	1.37	12	2	7	0	7	8	12	1	0	15	20	16	8.01
	maturing	392	3	24	1.18	14	2	3	0	5	13	8	1	0	22	17	15	7.25
	all fish	992	2	17	1.30	13	2	6	0	6	10	10	1	0	18	18	16	7.92
Even	<500	81	1	6	1.43	11	8	27	2	5	12	2	5	6	13	1	8	7.71
	500-999	250	3	10	1.27	14	12	21	0	7	10	4	2	2	17	2	9	8.06
	1000-1499	226	2	15	1.20	24	7	11	0	6	12	5	3	0	20	1	11	7.16
	1500-1999	252	4	16	0.93	27	9	8	0	7	13	7	3	0	18	1	7	6.95
	2000-2499	152	6	18	0.83	30	8	4	0	6	15	6	3	0	17	1	10	6.28
	2500-2999	53	8	22	0.79	35	4	4	0	4	12	12	4	1	15	0	9	5.55
	3000-3999	48	4	22	0.66	35	4	6	0	6	12	5	3	0	20	2	7	5.37
	≥4000	6	17	16	0.37	20	0	1	0	0	1	4	4	1	57	0	12	2.66
	immatures	663	3	12	1.20	19	10	16	0	6	11	6	3	1	17	2	9	8.29
	maturing	405	5	18	0.87	31	6	6	0	6	13	6	3	0	19	1	9	6.09
	all fish	1068	4	14	1.07	23	9	12	0	6	12	6	3	1	18	1	9	7.70
All	<500	111	1	6	1.41	8	6	25	2	5	13	5	3	6	11	2	14	8.15
	500-999	582	2	11	1.40	9	7	13	1	7	8	8	2	1	15	15	14	9.63
	1000-1499	484	2	15	1.24	21	4	8	0	6	10	9	2	0	19	9	12	8.06
	1500-1999	413	3	18	1.05	24	6	7	0	6	13	8	2	0	19	7	8	7.57
	2000-2499	251	5	21	0.98	26	5	3	0	5	15	6	3	0	20	6	11	6.77
	2500-2999	118	7	25	0.94	22	2	4	0	4	13	7	2	0	21	11	14	7.07
	3000-3999	83	4	25	0.74	24	2	5	0	6	13	6	2	0	21	8	13	6.95
	≥4000	18	6	28	0.63	6	1	4	0	4	3	11	3	1	40	7	20	4.59
	immatures	1263	2	13	1.28	16	6	12	0	6	10	9	2	1	16	10	12	9.36
	maturing	797	4	21	1.02	22	4	5	0	5	13	7	2	0	21	9	12	7.40
	all fish	2060	3	16	1.18	18	5	9	0	6	11	8	2	1	18	10	12	8.81

Prey categories are EU=euphausiids, CO=copepods, AM=amphipods, CR=crab larvae, SQ=squids, PT=pteropods, FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton (coelenterates, ctenophores, and salps), OTH=other groups, and UNID=unidentified material.

Table 29. Mean percent composition of stomach contents of maturing pink salmon caught in the central Bering Sea by the *Wakatake maru,* 1991-1998, stratified by year and body weight. PW=prey weight, % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=PW*100/body weight. Prey composition is based on visual estimates. MDI=Morishita's diversity index.

Pink, Central Bering Sea 1991-1998

Years	Body Weight (g)	N	% empty	Mean PW	Mean SCI	Mean % composition by volume												MDI
						EU	CO	AM	CR	SQ	PT	FI	PO	CH	GE	OTH	UNID	
Odd	<500	3	0	14	9.61	3	0	3	0	14	0	80	0	0	0	0	0	1.52
	500-999	191	9	10	1.18	7	9	16	2	26	8	24	0	0	0	3	5	6.04
	1000-1499	558	7	15	1.26	9	8	12	3	27	7	31	0	0	0	1	2	5.10
	1500-1999	78	3	21	1.29	15	7	7	5	28	8	25	0	0	2	1	2	5.72
	2000-2499	8	0	35	1.56	17	4	16	0	18	8	27	0	1	7	0	2	6.07
	all fish	838	7	15	1.28	9	8	12	3	27	7	29	0	0	1	1	3	5.42
Even	<500	3	33	11	2.61	0	18	7	7	8	40	20	0	0	0	0	0	4.15
	500-999	30	10	11	1.36	14	11	15	4	18	2	36	0	0	0	0	0	4.76
	1000-1499	74	5	18	1.44	19	10	5	4	19	2	39	0	0	0	1	1	4.32
	1500-1999	18	0	29	1.71	26	6	3	1	31	1	32	0	0	0	0	0	3.80
	2000-2499	0																
	all fish	125	6	18	1.48	19	10	7	3	21	3	37	0	0	0	0	0	4.42
All	<500	6	17	13	6.81	2	7	5	3	11	16	56	0	0	0	0	0	2.83
	500-999	221	9	10	1.20	8	10	15	2	25	7	26	0	0	0	3	4	5.94
	1000-1499	632	6	16	1.28	10	8	11	3	26	7	32	0	0	0	1	2	5.08
	1500-1999	96	2	23	1.37	17	7	6	4	28	7	27	0	0	2	1	1	5.33
	2000-2499	8	0	35	1.56	17	4	16	0	18	8	27	0	1	7	0	2	6.07
	all fish	963	7	15	1.31	10	8	12	3	26	7	30	0	0	1	1	2	5.36

Prey categories are EU=euphausiids, CO=copepods, AM=amphipods, CR=crab larvae, SQ=squids, PT=pteropods, FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton (coelenterates, ctenophores, and salps), OTH=other groups, and UNID=unidentified material.

Table 30. Mean percent composition of stomach contents of chinook salmon caught in the central Bering Sea by the *Wakatake maru,* 1991-1998, stratified by year, body weight, and maturity group. PW=prey weight, % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=PW*100/body weight. Prey composition is based on visual estimates. MDI=Morishita's diversity index.

Chinook, Central Bering Sea 1991-1998

Years	Weight (g) or maturity	N	% empty	Mean PW	Mean SCI	Mean % composition by volume EU	CO	AM	CR	SQ	PT	FI	PO	CH	GE	OTH	UNID	MDI
Odd	<500	3	0	3	0.70	0	0	0	0	50	0	17	0	0	0	0	33	2.62
	500-999	11	9	7	0.87	6	0	0	0	59	0	35	0	0	0	0	0	2.13
	1000-1499	15	27	11	0.84	21	0	1	0	45	0	33	0	0	0	0	0	2.86
	1500-1999	42	26	9	0.51	26	1	0	0	43	0	29	0	0	0	0	1	3.03
	2000-2499	43	23	11	0.51	31	0	0	0	50	0	19	0	0	0	0	0	2.66
	2500-2999	13	23	18	0.70	23	1	0	0	55	0	21	0	0	0	0	0	2.54
	3000-3999	8	38	35	0.96	16	0	0	0	54	0	30	0	0	0	0	0	2.49
	4000-4999	3	0	10	0.24	60	0	0	0	23	0	17	0	0	0	0	0	2.29
	≥5000	2	0	107	2.05	47	0	3	0	50	0	0	0	0	0	0	0	2.14
	immatures	140	23	13	0.64	25	1	0	0	48	0	25	0	0	0	0	1	2.86
	maturing	0																
	all fish	140	23	13	0.64	25	1	0	0	48	0	25	0	0	0	0	1	2.86
Even	<500	18	22	3	0.73	16	14	0	0	42	2	26	0	0	0	0	0	3.54
	500-999	35	26	5	0.76	10	1	8	0	50	0	31	0	0	0	0	0	2.81
	1000-1499	18	39	12	1.00	37	0	0	0	56	0	7	0	0	0	0	0	2.22
	1500-1999	33	24	18	1.02	20	0	0	0	59	0	19	0	0	2	0	0	2.39
	2000-2499	42	24	16	0.74	26	0	0	0	54	0	19	0	0	0	0	1	2.57
	2500-2999	29	24	17	0.67	15	0	6	0	64	1	14	0	0	0	0	0	2.22
	3000-3999	26	35	33	0.94	14	0	3	0	60	0	21	0	0	0	0	2	2.39
	4000-4999	15	20	36	0.85	20	8	5	0	53	0	14	0	0	0	0	0	2.92
	≥5000	15	33	48	0.95	46	0	0	0	47	0	7	0	0	0	0	0	2.32
	immatures	228	27	18	0.83	21	2	3	0	54	0	20	0	0	0	0	0	2.70
	maturing	3	0	70	2.15	2	0	0	0	65	0	33	0	0	0	0	0	1.90
	all fish	231	27	19	0.85	20	2	3	0	55	0	20	0	0	0	0	0	2.65
All	<500	21	19	3	0.92	12	11	0	0	41	2	28	0	0	0	0	6	3.71
	500-999	46	22	6	0.79	9	1	6	0	52	0	32	0	0	0	0	0	2.64
	1000-1499	33	33	12	0.92	29	0	0	0	51	0	20	0	0	0	0	0	2.65
	1500-1999	75	25	13	0.74	23	0	0	0	50	0	25	0	0	1	0	1	2.78
	2000-2499	85	24	14	0.62	29	0	0	0	52	0	19	0	0	0	0	0	2.60
	2500-2999	42	24	18	0.67	17	0	4	0	62	1	16	0	0	0	0	0	2.30
	3000-3999	34	35	33	0.94	14	0	2	0	59	0	23	0	0	0	0	2	2.41
	4000-4999	18	17	31	0.73	28	6	4	0	47	0	15	0	0	0	0	0	3.12
	≥5000	17	29	58	1.14	46	0	1	0	47	0	6	0	0	0	0	0	2.32
	immatures	368	26	16	0.75	22	1	2	0	52	0	22	0	0	0	0	1	2.77
	maturing	3	0	70	2.15	2	0	0	0	65	0	33	0	0	0	0	0	1.90
	all fish	371	25	17	0.77	22	1	1	0	52	1	22	0	0	0	0	1	2.77

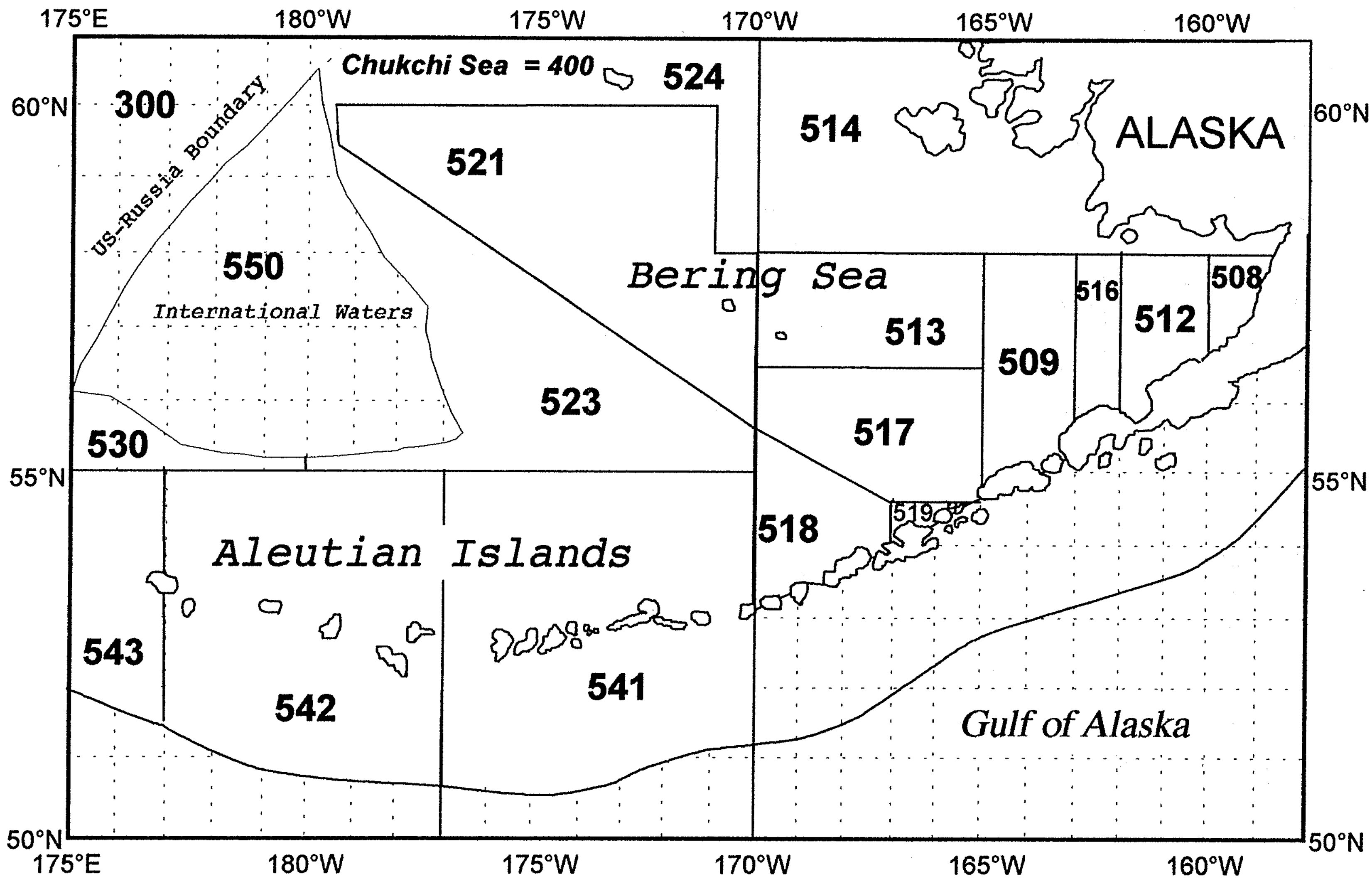
Prey categories are EU=euphausiids, CO=copepods, AM=amphipods, CR=crab larvae, SQ=squids, PT=pteropods, FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton (coelenterates, ctenophores, and salps), OTH=other groups, and UNID=unidentified material.

Table 31. Mean percent composition of stomach contents of Dolly Varden caught in the central Bering Sea by the *Wakatake maru,* July 1998, stratified by body weight. PW=prey weight, % empty=percent of stomachs that did not contain stomach contents. Empty stomachs were not included in other table entries. SCI=PW*100/body weight. Prey composition is based on visual estimates. MDI= Morishita's diversity index.

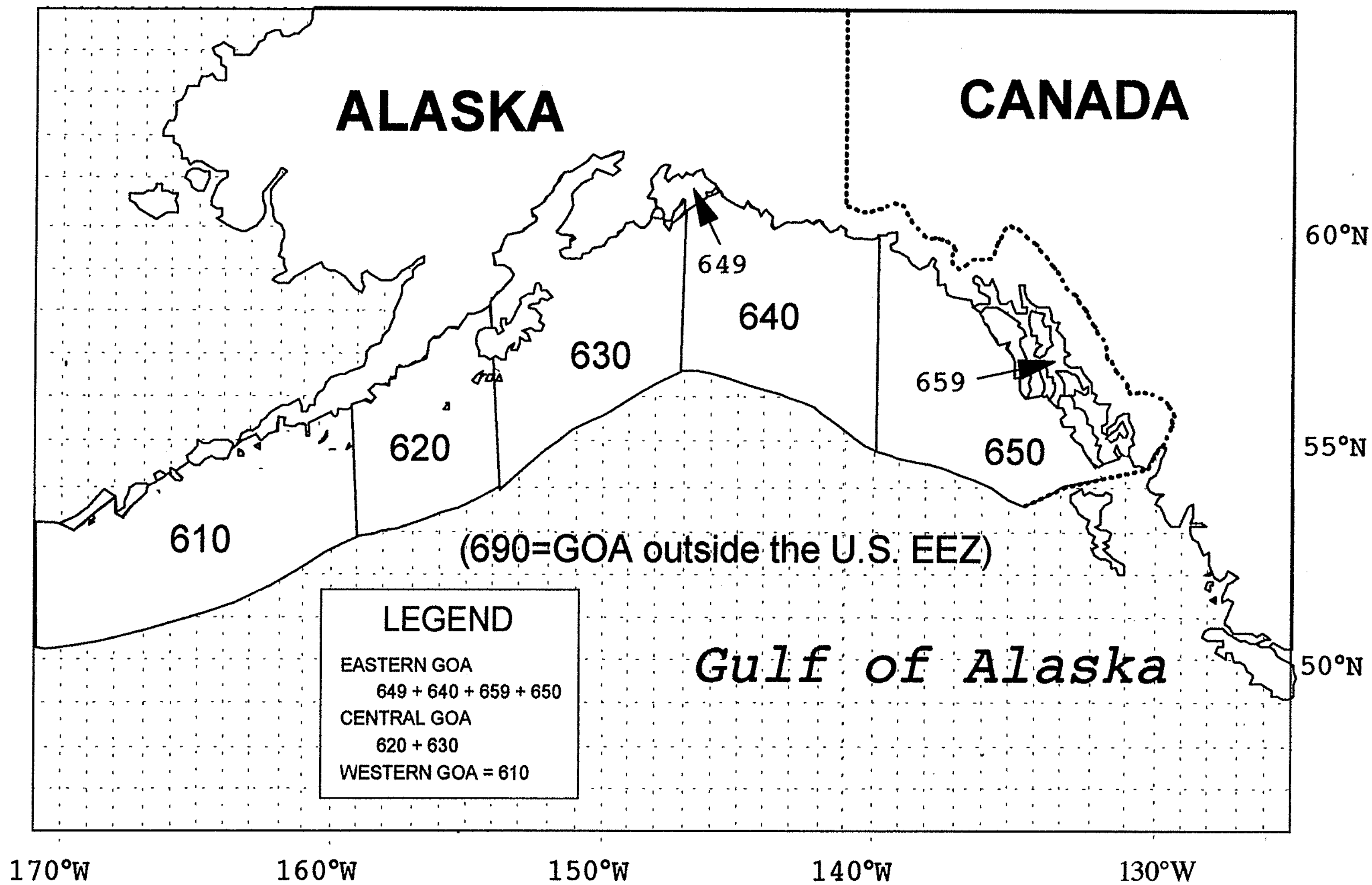
Dolly Varden, Bering Sea, 1998

Body weight (g)	N	% empty	Mean PW	Mean SCI	Mean % composition by volume												MDI
					EU	CO	AM	DE	SQ	PT	FI	PO	CH	GE	Oth	UNID	
<500	9	0	9	2.16	2	1	49	0	0	0	48	0	0	0	0	0	2.15
500-999	27	4	7	1.05	6	14	41	0	3	0	35	0	0	0	1	0	3.25
1000-1499	22	5	12	1.03	22	1	37	0	8	0	29	0	0	0	3	0	3.71
1500-1999	19	11	9	0.51	28	1	20	0	15	1	29	0	0	0	6	0	4.52
≥2000	8	38	9	0.40	13	1	7	0	10	0	69	0	0	0	0	0	1.99
all fish	85	8	9	1.01	15	6	34	0	7	0	36	0	0	0	2	0	3.71

Prey categories are EU=euphausiids, Co=copepods, AM=amphipods, CR=crab larvae, SQ=squids, PT=pteropods, FI=fish, PO=polychaetes, CH=chaetognaths, GE=gelatinous zooplankton (coelenterates, ctenophores, and salps), OTH=other groups, and UNID=unidentified material.



Appendix Figure 1. Locations of US National Marine Fisheries Service (NMFS) statistical areas in the eastern Bering Sea and Aleutians Islands portion of the US Exclusive Economic Zone (EEZ).



Appendix Figure 2. Locations of US National Marine Fisheries Service (NMFS) statistical areas in the Gulf of Alaska portion of the US Exclusive Economic Zone (EEZ).