NORTH PACIFIC ANADROMOUS FISH COMMISSION NEWSLETTER

COOPERATIVE ENFORCEMENT EFFORTS ON THE HIGH SEAS

The North Pacific Anadromous Fish Commission (NPAFC) Convention prohibits all salmon fishing in the North Pacific Ocean and its adjacent seas, north of 33° North latitude, beyond the 200-mile exclusive economic zones. Cooperative enforcement efforts have resulted in the detection of several high seas driftnet vessels in 1997. Of the sightings, one resulted in seizure and prosecution. Two 1997 sightings are described below.

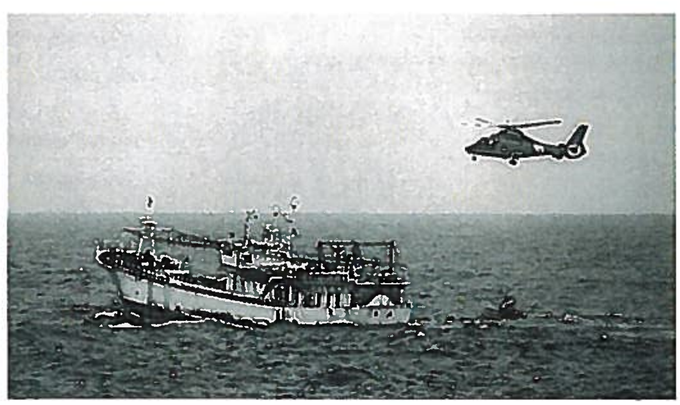
In early June, U.S. fishermen reported a suspected driftnet vessel fishing approximately 750 nautical miles northwest of Midway Island. A U.S. Coast Guard aircraft, acting on this information, located the vessel and confirmed its illegal activity. The Japanese government dispatched a fisheries patrol ship to intercept and identify the vessel. The patrol craft tracked the driftnet vessel until the Japanese ship ran low on fuel and water and was forced to return to port. Governments of countries in the estimated path of the fishing vessel were notified so appropriate enforcement action could be taken if the vessel entered their areas of jurisdiction. However, no further sightings of this vessel occurred.

In late June, a Canadian patrol aircraft detected another driftnet vessel, the *Cao Yu 6025*, approximately 1100 nautical miles northwest of Midway Island. The Canadian aircraft continued to track the vessel until two U.S. Coast Guard patrol vessels intercepted and boarded it south of Japan. The boarding teams found approximately twelve miles of gillnet aboard the vessel. The *Cao Yu's* claim of nationality was refuted, and the U.S. government assimilated the vessel as stateless and issued orders to seize the vessel and its catch. The Coast Guard towed the vessel to Guam to face prosecution under U.S. law.

Cooperative efforts will continue to identify those vessels that defy the terms of the Convention.

—*Greg Hitchen*
U.S. National Marine Fisheries Service Enforcement

An H-65 helicopter and two boarding teams from *CGC Basswood* and *CGC Chase* were used to intercept and seize high seas driftnet vessel *Cao Yu 6025* on July 10, 1997.
U.S. Coast Guard photo by HS1 Orlando May, CGC Basswood



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PUBLISHED BY

NPAFC Secretariat
6640 Northwest Marine Drive
Vancouver, BC, V6T 1X2 CANADA
Tel: (604) 228-1128
Fax: (604) 228-1135
E-mail: irina@unixg.ubc.ca

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The Commission invites you to submit articles on NPAFC-related activities for publication in the newsletter.

BRISTOL BAY SOCKEYE SALMON

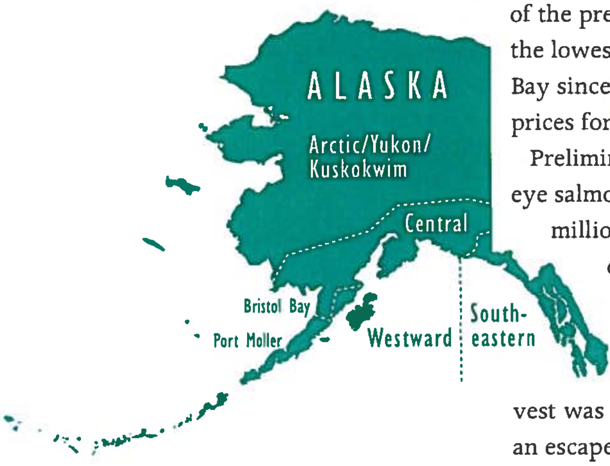
The Bristol Bay sockeye salmon industry, including thousands of independent fishing captains, crew members, and processing workers, suffered a blow this year from the combined effects of the failure of the pre- and in-season run forecasts, the lowest catch of sockeye salmon in the Bay since 1978, and low early-season prices for fish.

Preliminary estimates for the total sockeye salmon run to Bristol Bay are 18.9 million fish (catch: 12.3 million fish; escapement: 6.6 million fish). The preseason forecast by the Alaska Department of Fish and Game for inshore harvest was 24.8 million sockeye salmon and an escapement goal of 8.8 million fish. At the traditional July 4 peak, returns to all rivers were low, but the in-season Port Moller test-fishing results indicated that the sockeye salmon were just behind schedule. By mid July, however, it was clear that the fish were not just late, they were missing.

The failure of all the preseason and in-season run forecasts to predict low returns to the Bay has fishery managers and biologists scratching their heads and scrambling for any available scientific data. All indications point to something that happened in the ocean. Theories run the gamut from illegal fishery interceptions to poor survival caused by adverse changes in ocean conditions.

What happened to the "missing" fish? At an October meeting at the University of Washington School of Fisheries in Seattle, scientists, processors, and fishermen—focusing on Bristol Bay and Port Moller test-fishery events—discussed possible interceptions by other fisheries, the nature of the 1997 El Niño, and the environmental changes that have occurred in the northeastern Pacific Ocean in the last few years with regard to interdecadal oscillation of climate and fish production. In summarizing the results of the discussion, Professor Ray Hilborn, Director of the Fisheries Research Institute at the School of Fisheries, said that "clearly the answer could be a combination of events." Because of the lack of scientific research on Bristol Bay salmon in the ocean, we may never know what happened to this year's run.

—Kate Myers
Fisheries Research Institute
University of Washington



NPAFC REPRESENTATIVES

CANADA
David Bevan
Department of Fisheries and Oceans
Garnet Jones, B.C. Packers
Gerry Kristianson, Sport Fishing Institute

JAPAN
Koji Imamura
Japan Sea Farming Association
Nabuaki Tanaka, Ministry of Foreign Affairs, Economic Affairs Division
Satoshi Watanabe
Fisheries Agency

RUSSIA
Vladimir Fedorenko
Fisheries Representative in the U.S.A.
Vladimir Izmailov
Department of Fisheries
Vladimir Pautov
Dalryba

UNITED STATES
Guy McMinds, Quinault Indian Nation
Steven Pennoyer, NOAA/NMFS
Fran Ulmer, Lieutenant Governor
State of Alaska

PRELIMINARY 1997 ALASKA COMMERCIAL SALMON HARVESTS
Updated September 22, 1997
In Thousands of Fish

Region	Sockeye	Chum	Pink	Coho	Chinook	Total
Southeast	2,429	10,633	28,037	1,480	281	42,860
Central	20,797	2,573	28,451	254	143	52,218
Arctic/Yukon/ Kuskokwim	123	339	<1	198	173	833
Westward	7,581	1,345	14,170	641	39	23,776
Total	**30,930**	**14,890**	**70,658**	**2,573**	**636**	**119,687**

Source: Alaska Department of Fish and Game

http://www.state.ak.us/adfg/cfmd/geninfo/finfish/salmon/catchval/blusheet/bluef97/htm

SARDINES & MACKEREL IN CANADIAN WATERS

During the Pacific Biological Station's cruise, June 16–July 13, 1997, we conducted survey work in the Strait of Georgia, Puget Sound, and coastal waters from northern Oregon to the northern tip of Vancouver Island.

The coastal survey completed 59 sets from northern Oregon to northern Vancouver Island. The most abundant species caught were Pacific sardines (*Sardinops sagax*): 227,898 fish, and chub mackerel (*Scomber japonicus*): 12,926 fish. The total area fished (swept by the net) at depths of 0-30 m was 11.2 km^2, giving us catch rates of 20,348 sardines/km^2 and 1,154 chub mackerel/km^2.

Sardines were common throughout our study area, but were most abundant off the southwest coast of Vancouver Island. Sardine catches were many times higher than those in 1992–93 and appeared to be fishable concentrations.

Chub mackerel were most abundant off the Washington coast, yet we still had good catches off Vancouver Island. We examined approximately 525 mackerel stomachs and found no salmon remains, but we did find remains of sardines. These are the largest mackerel catches we have seen since 1992 when they first entered the Canadian 200-mile zone in any quantity, and they appear to be widely dispersed all along the Canadian southern coast. If we convert the catch/km^2 into numbers and weights in the survey area out to 45 km offshore, the sardine population could be 133,000 t or 730 million fish and the chub mackerel 20,000 t or 42 million fish. These estimates are only gross approximations, but they do indicate that the abundances were large.

It is apparent there was a major shift in mackerel and sardine distribution that occurred prior to the predicted El Niño.

—Dick Beamish and Sandy McFarlane
Pacific Biological Station

PACIFIC SALMON IN THE STRAIT OF GEORGIA

The results of the Pacific Biological Station's rope-trawl fishing activities in 1996 and 1997 indicated that juvenile pink, chum, and sockeye salmon remained in the Strait of Georgia until late in 1996 and a portion of these fish overwintered in the Strait of Juan de Fuca. In September 1996, the catch per hour of ocean age 0 (first year in the ocean) salmon in the Strait of Georgia was 42 chum, 44 coho, 36 chinook, 16 sockeye, and 24 pink salmon. In November, the catch rate per hour declined, but all five species were still found—16 chum, 10 coho, 7 chinook, 1 sockeye, 8 pink. In February, only chinook salmon (1 fish/hr) remained, but in the Strait of Juan de Fuca and off southwest Vancouver Island, all five species (ocean age 1) were found with the following catch rates: 24 chum, 57 coho, 64 chinook, 5 sockeye, and 7 pink. By April-May, virtually all pink and sockeye salmon were absent from the catches in all areas but a small number of chum remained. Coho and chinook salmon were present off the west coast of Vancouver Island, but no coho salmon were found in the Strait of Georgia. Some ocean age 1 coho salmon were caught in Puget Sound, but catch rates in 21 sets were only 1 coho/hr indicating a very low abundance. It is clear that most coho salmon left the Strait of Georgia and Puget Sound in late fall and early winter and had not returned by mid-July 1997 when we finished our summer cruise. This behavior is associated with a change of climate in the 1990s.

—Dick Beamish and Sandy McFarlane
Pacific Biological Station

"HOT" RUN OF CANADIAN EARLY STUART SOCKEYE SALMON

This year's early Stuart component of the Fraser River, B.C., sockeye salmon run was 1.5 million, making it the largest run on record for this stock and greatly exceeding the forecasted 1.0 million fish. Gross spawning escapement through the lower river and in-river catch were estimated at 1.1 million fish.

The early Stuart run was six days later than normal, and a significant portion of the run approached the mouth of the Fraser River through Canadian waters via Johnstone Strait, instead of making their usual approach through the southern Strait of Juan de Fuca. The latter route brings the fish through U.S. waters, where they could be caught by U.S. fishers. Preliminary commercial catches were 206,000 fish for Canada and 115,000 fish for the United States. Preliminary non-commercial catches totaled 393,000 fish, mainly by in-river aboriginal fishers.

—Irina Shestakova
North Pacific Anadromous Fish Commission

PRELIMINARY 1997 FRASER RIVER HARVEST & ESCAPEMENT

Updated September 19, 1997
In Thousands of Fish

	Sockeye	Pink
COMMERCIAL CATCH		
Canada	8,638	3,629
United States	1,558	1,522
NON-COMMERCIAL CATCH		
	1,356	60
CATCH & ESCAPEMENT		
Catch	11,552	5,211
Escapement	5,060	4,265
Total	**16,612**	**9,476**

Source: Pacific Salmon Commission
Internet address: www.psc.org

The Excitement OF HIGH SEAS SALMON RESEARCH

Imagine the thrill of 40-meter seas and 75-knot winds pounding against the shivering hull of a research vessel, 2,700 km offshore, on a cold December night; or an encounter with the business (tooth) end of a thrashing, 300-kg salmon shark who does not want to have his stomach contents examined; or, the terrifying sight of a graduate student falling overboard without a life jacket! Granted, the weeks, and sometimes months spent at sea each year doing dangerous, endless, and exhausting work can be mind-numbing. Those who cannot overcome their boredom or the agony of seasickness, quickly discover that life at sea is not for them. But others return year after year, as salmon migrate to the sea. Why? Perhaps, it's the universal lure and mystery of travel and adventure on the high seas, the potential for scientific discovery, or the chance to advance scientific knowledge of salmon in the North Pacific Ocean. For those of you who have never had the opportunity, and wonder what salmon research on the high seas is like, this article, the first in a series of reports on NPAFC-related research, features a brief glimpse at one day of activities aboard a U.S. vessel.

0800 hours: 7 August 1997. Daybreak. It's a cold day in August in the central Aleutian Islands. Three biologists sit at a table in the galley aboard the *Great Pacific*, gulping down black coffee, getting ready for their 16-hour work day. The four-man crew dons raingear, boots, and hard-hats, and heads out onto deck. The vessel, a commercial pollock trawler during the fishing season, has been chartered by the U.S. National Marine Fisheries Service, Alaska Fisheries Science Center, Auke Bay Laboratory, for broad-scale surveys of distribution, growth, bioenergetics, and identification of salmon stocks in the Gulf of Alaska and Aleutian Islands, as part of the U.S. commitment to international cooperative high-seas salmon research under NPAFC.

In the wheelhouse, the dark outline of Adak Island barely shows beneath the swirling fog. The captain runs the vessel in as close as possible to shore. A biologist assists the crew in raising and lowering the small, portable CTD, which measures water temperature and salinity at 1-meter increments from the surface to the bottom. The skipper makes a quick 180° turn, heading the vessel out to sea on a line perpendicular to shore, as the

FRI High-Seas Archives, UW

net is spooled off the stern reel. The crew hooks wire cables to the two big trawl doors, which spread the mouth of the net open. The net, a rope trawl, is specially designed for catching salmon. Long rope leads attached to the net guide fish into the 44-meter horizontal by 13-meter vertical opening, without producing too much drag in the water. The vessel has the horsepower and fuel capacity needed to tow the big net through the water at 5 knots, a speed necessary to catch salmon.

The survey design calls for fishing along linear transects, perpendicular to shore over nearshore, slope (200-m bottom contour), and oceanic depths. Adak, one of 19 locations sampled during the survey, is an area of mixing of Asian and N. American salmon, and has been the site of much historical (1955-1978) salmon research. In August, catches are likely to include immature salmon from two of the largest stocks in the North Pacific Ocean: wild sockeye salmon from Bristol Bay, Alaska, and hatchery chum salmon from Hokkaido, Japan.

Cruising along the South Alaska Peninsula aboard the *Great Pacific.*

FRI High-Seas Archives, University of Washington

0857: 4.2 nm offshore. Nearshore habitat. All tows on this survey line are 1/2-hour long. The droning sound of winches alerts everyone that the net is coming in. Biologists stand clear until the trawl doors are up, keeping out of the crew's way and well away from the wire cables, which could easily cut off your head if they snapped. The crew wrestles the big, banging trawl doors back into place. A biologist quickly drops a small plastic bucket overboard, pulls it back in, and measures the sea-surface temperature with a small electronic probe. The cool, 6.4°C temperature indicates upwelling, nutrient rich water, which should be good sockeye salmon habitat.

As the net is rewound onto the reel, the captain adeptly shakes down fish caught in the top of the net by unwinding and abruptly stopping the reel. Gulls cut the air over the trailing end of the net, shrieking for something to eat. A crane lifts the cod end of the net onto a large sorting table, which can hold up to a ton of fish. A crewman unlaces the inner bag, and a small catch, mostly jellyfish, a few Atka mackerel (*Pleurogrammus monopterygius*), a rockfish (*Sebastes*), and a spiny lumpsucker (*Eumicrotremus orbis*) spills out onto the table. No salmon! The disappointing catch is quickly counted and returned to the sea.

1020: 7.9 nm offshore. Slope habitat. 6.5°C. The net comes up with five chum salmon, two adult pink salmon—probably from local Aleutian Island stocks, and one juvenile Atka mackerel. A biologist quickly collects blood samples from the chum salmon for growth hormone studies. The samples will be shared with Japanese scientists at Hokkaido University, who are studying the role of sex hormones in salmon maturation and migration. The fish are weighed and measured, and scale, otolith (ear stone), and tissue samples are collected. Later, experts at the Alaska Department of Fish and Game Lab in Juneau will examine the otolith samples for thermal marks, artificially induced in hatchery fish to identify individual stocks. Auke Bay Lab experts will use the tissue samples to identify stocks. One biologist spends the time between tows working in a makeshift laboratory on deck, examining salmon stomachs, which are mostly empty. No feeding going on here, and where are the sockeye?

For lunch, the biologists make sandwiches in the galley, as the hungry crew devours a huge meal of sausage, eggs, and fried potatoes.

1253: 17.2 nm. Oceanic habitat. 7.2°C. The catch is two immature chum and, finally, two sockeye. A daggertooth (*Anotopterus pharao*), has a stomach full of juvenile greenling (Hexagrammidae), sandlance (*Ammodytes hexapterus*), and rockfish. An immature sockeye is full of small, gray hyperiid amphipods (*Parathemisto*), which sometimes form huge congregations, but the other salmon stomachs are almost empty.

1542: 27.5 nm. 9.6°C. The dramatic warming in water temperature, indicates the influence of the westward flowing Alaska Coastal Current. The catch remains small, five sockeye with mostly empty stomachs. Three days earlier, catches 384 nm to the east at Cape Prominance on the south side of Unalaska Island were huge—almost 500 salmon in a one hour tow at a surface water temperature of 12.8°C! What else is different?

1817: 37.6 nm. 9.4°C. Another small catch, 9 salmon, but now the sockeye stomachs are full of large, bright orange copepods (*Calanus cristatus*) and chum contain clear, marble-sized gelatinous zooplankton (*Salpa*). The difference between species could indicate feeding competition. If so, the sockeye may be the winners, because salps have low caloric value compared to copepods.

Biological sampling on board the *Great Pacific*
FRI High-Seas Archives, University of Washington

For dinner, the biologists and crew sit down to a pasta and Caesar salad dinner, prepared by one of the crew, who does double-duty as cook. Everyone pitches in to wash dishes.

2115: 50.2 nm. 9.3°C. Sunset. Our largest salmon catch on this transect (72 sockeye, 3 chum). The net also comes up with hundreds of small, gonatid squid. The sockeye salmon stomachs are nearly full of a mix of euphausiids, copepods, pteropods (small snail-like mollusks; *Limacina*), and amphipods. Good feeding, but lots of variation in prey composition between individual salmon indicates patchy prey distribution.

2355: 57.4 nm. 9.7°C. It's night, and the strong tidal current has altered the tow path. The net brings in four flying squid (*Ommastrepes bartramii*) and a small, mixed-species catch of salmon. Everyone is tired. The biologists silently finish their work, and quickly turn in for a restless night of sleep, accompanied by the sounds of the roaring engine as the vessel pitches through dark swells. The crew takes turns at night watch, running the vessel on toward tomorrow's survey line, 146 nm to the northwest at Amchitka Pass, just beyond the international dateline.

—Kate Myers
Fisheries Research Institute
University of Washington

GLOBAL CLIMATE INDICES

In 1996, the Aleutian Low Pressure Index declined, indicating a continued weakening of the winter low pressure in the subarctic Pacific. The Southern Oscillation Index was positive, indicating a La Niña state and a continued weakening of El Niño conditions. Northern Hemisphere surface temperatures remained warm and were the tenth highest on record. The North Atlantic Oscillation Index was negative for the first time since the late 1980s, reversing a trend of strong positive indices. The length of day changed from a trend of slowing down that started in the mid-1980s to a speeding up. In general, 1996 was a year of change in trends; however, it was not known if a new trend had started. In the first six months of 1997, the dominant direction of the westerly winds was typical of the period prior to 1977 and quite different than the pattern from 1977 to 1996. Despite the changes in pressure and wind patterns, there was little change in the general warming trend of the Northern Hemisphere.

—Dick Beamish and Sandy McFarlane
Pacific Biological Station

In 1997, a very strong El Niño-Southern Oscillation (ENSO) event began. The Multivariate ENSO Index value is already higher than that of any recorded ENSO event at a similar date, and this El Niño is expected to be the strongest this century. Recent El Niños have peaked in the next spring and returned to non-ENSO conditions by the following autumn. General forecasts from past ENSO behavior are that winter temperatures will be warmer than usual in Japan, the Japan Sea, the Gulf of Alaska, and from southern Alaska through British Columbia to Washington and Oregon. Warmer temperatures may mean reduced snowpacks and runoff the following summer.

Sea-surface temperature anomalies in early October 1997 show warmer (about +2°C) than normal water in the southern Kuril Islands, Shelekova Bay, the western Bering Sea, the northern Gulf of Alaska, and in a narrow band along the western North American coast. Temperatures are cooler (-2°C) than normal in the central Sea of Okhotsk and in a band between 35°–45°N across the entire North Pacific. Temperatures are also slightly cooler than normal in the eastern Bering Sea.

A number of biological anomalies possibly associated with the developing El Niño have been reported in the eastern North Pacific and Bering Sea this summer and fall. Large numbers of some species of seabirds have died in the eastern Bering Sea, southern Alaska, and the Pacific Northwest. Warm-climate birds and fish have been sighted from California to Alaska. Yellowfin tuna (*Thunnus albacares*), albacore (*T. alalunga*), and ocean sunfish (*Mola mola*) have been caught off southern Alaska, sunfish and large numbers of mackerel (*Scomber japonicus*) off British Columbia, and marlin (*Tetrapturus audax*), yellowfin tuna, and barracuda (*Sphyraena argentea*) off Washington. Fall chinook returned to the Sacramento River about seven weeks early, and sockeye salmon were found in rivers in southern Oregon and northern California, far south of their southernmost spawning river.

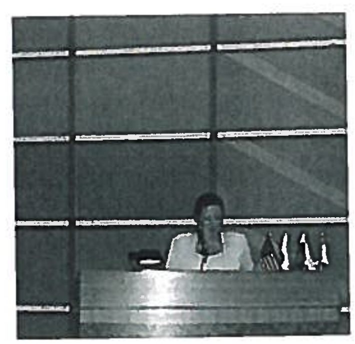
—Robert Walker
Fisheries Research Institute
University of Washington

COOPERATION KEY TO VIABILITY OF NORTH PACIFIC RESOURCES

The fourth North Pacific Rim Fisheries Conference was held April 22-24, 1997 in Tokyo, Japan. The purpose of the conference was to discuss the common problems and goals or joint international efforts to achieve sustainable fisheries in the North Pacific Ocean. International fishery organizations, including NPAFC, INFOFISH (Malaysia), and the Pacific Salmon Commission (Vancouver, B.C.) presented information on their roles in promoting sustainable fisheries and activities that contribute to the fishing interests of Pacific Rim nations.

Several discussions dealt with management and conservation issues facing North Pacific salmon stocks and Alaskan pollock stocks in the Bering Sea. Many honest disagreements were presented: the U.S. and Canada over salmon interception; Russia and Japan on the carrying capacity of chum salmon; China, Japan, and Korea on ongoing bilateral fisheries issues in their respective economic zones; and the issues related to pollock in the Bering Sea. The conference provided a neutral forum for discussion and establishment of relationships, which will serve as the foundation for resolving differences—the key to ensuring the long-term viability of the resource for the mutual benefit of all Pacific Rim nations.

—Adapted from text by Shawneen Conover
U.S. Conference Coordinator



Dr. Irina Shestakova, Executive Director, NPAFC, presents "The Role of the North Pacific Anadromous Fish Commission in Development of International Regime of Conservation of Marine Living Resources."

Shawneen Conover

(adapted from a translation by A.A. Shurigina, KamchatNIRO)

Avacha Bay, Petropavlovsk-Kamchatskii

FRI, High-Seas Archives, University of Washington

KAMCHATSKI LOSOS

Research fishing (103 operations) was conducted aboard the *SRTM Kamchatski Losos* from May 2 to October 2, 1996. Scientists collected information on catch composition; biological data from all salmon species: 932 sockeye, 1028 chum, 306 coho, and 100 chinook salmon (2580 samples in total); salmon scales (2580 samples) and otoliths (140 samples); morphometric measurements on 40 chum and 20 coho; hydrobiological data (10 sets); and hydrological data in Avacha Bay (5 observations), eastern Sea of Okhotsk (12), Petropavlovsk-Commander subzone (13), and in the western Bering Sea (4). Preliminary morphometric analysis of chum and coho salmon did not indicate significant variability between externally differing individuals, excluding large fishes with small body weight. In all salmon species, the predominant prey were young squid and juvenile codfish. In July, stomach fullness was decreasing. In the Bering Sea in August, intense feeding was noted only in coho , which were feeding on young squid and Pacific sandfish. Among the sockeye salmon sampled, 18% had empty stomachs. In August in the Bering Sea, 100% of the sockeye salmon were immature, and in September in the western part of the Petropavlovsk-Commander subzone 100% of the sockeye and chinook salmon were immature. Sockeye were the predominant species in the catches—67.7%. Many fish had injuries caused by marine mammals and seabirds.

—*T.I. Ukolova, KamchatNIRO*

F/V YUPITER

Investigations aboard the *F/V Yupiter* (May 30–July 23, 1996) were in a large area bounded by the 50°50′N-latitude line on the south and the 60°N-latitude line on the north (37 operations in the northwestern Pacific Ocean and 6 in the southwestern Bering Sea). The purposes were to develop purse-seine fishing techniques for tagging salmon aboard RMS-type vessels and to collect data for salmon stock differentiation, biostatistics, and oceanographic conditions during salmon migrations. At the onset of the expedition, it was clear that the vessel was not adequately equipped for purse seining, and the purse seine was not used. Viable individuals from gillnet catches were used for tagging. The fish were tagged with Denison anchor tags on the left side of the body below the dorsal fin. In total, 87 individuals were tagged. Tag-release data were provided to the Fisheries Research Institute, University of Washington. Biological data were collected from 3726 salmon: 1335 sockeye, 1234 chum, 1111 pink, 22 coho, and 24 chinook salmon; and 246 stomachs, 222 otoliths, and 3500 scale samples were collected from salmon. Oceanographic observations were made near the Kuril Islands (15 stations) and in the western Bering Sea (46 stations). Sockeye, chum, and pink salmon fed primarily on anchovy, euphausiids, and juvenile squid; coho salmon fed on squid, juvenile greenlings, euphausiids, and anchovy; chinook salmon fed on juvenile squid.

—*A.B. Dekshtein, KamchatNIRO*

STR DEZNEVO

From May 25 to June 15, 1996, salmon were sampled in the northwestern Pacific Ocean (between 52°-55°N latitude, 160°-164°E longitude) and the Bering Sea (56°-60°N latitude, 164°-173°E longitude) aboard the *STR Deznevo* to determine migration directions and timing of the most important salmon stocks within the Russian 200-mile zone and abundance of adult salmon in the offshore fishery zone. Samples and data were collected to characterize abundance, species composition, age structure, feeding and biological conditions during salmon feeding and prespawning migrations; to differentiate individuals in mixed-stock catches (scales, otoliths, parasites); and to determine concomitant environmental conditions. Percentage composition of the catches was: 50.2% sockeye, 42.6% chum, 5.4% pink, 1.8% chinook, and 0.1% coho salmon. Predominant prey (in decreasing order of importance) for all species was juvenile squid, juvenile fish, euphausiid spawners (20-25 mm long), hyperiid amphipods (adults 10-12 mm long and juveniles 1.5-2.0 mm long), and copepods. For the period of observation, from 60-94% of sockeye, 92-100% of chum, 59-88% of pink, and 50-86% of chinook salmon were not feeding.

—*V.I. Shershneva, KamchatNIRO*

INTERNATIONAL HIGH SEAS SALMON TAGGING

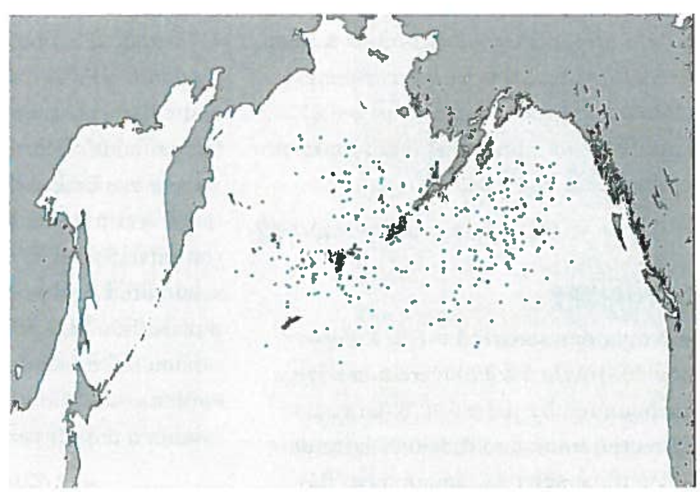
How do NPAFC scientists know where the salmon stocks of their different nations travel on the waters of the North Pacific? There are a number of methods used—scale pattern analysis, genetic stock identification, and occurrence of natural parasite tags among them—but tagging is the technique which has been used the longest and provides the most accurate stock-specific information. Tagging of salmon on the high seas of the North Pacific Ocean began with the International North Pacific Fisheries Commission. In 1954, Japanese scientists caught and released 991 salmon to which they had attached small numbered plastic disks. In the years that have followed, Canadian, Russian, and U.S. scientists have joined them in releasing over 465,000 externally-tagged salmon on the high seas for recovery in fisheries near their spawning streams. In June and July of 1997, 818 fish (90 sockeye, 420 chum, 270 pink, 19 coho, 5 chinook salmon, and 14 steelhead trout) were tagged aboard Japanese research vessels in the central North Pacific, Bering Sea, and Gulf of Alaska. Fourteen tags were recovered in Hokkaido (12 chum), Kamchatka (1 chum), and the Pacific Northwest (1 sockeye) from 1995-1997 high-seas releases.

Red-and-white 15-18 mm diameter plastic Petersen disks have been the tags most commonly applied on the high seas, but a variety of tubes, darts, and flags were also tried. In recent years other tagging methods have been used. Since 1981, scientists aboard salmon research vessels have looked for salmon and steelhead with missing adipose fins, an indication that they may contain internal coded-wire tags inserted into young fish of some stocks leaving freshwater (primarily hatchery releases) by North American management agencies. Different types of tags have been employed to study migratory behavior of salmon. A Japanese scientist tracked individuals of six species with small radio transmitter tags in the late 1980s and early 1990s and learned much about the depth and speed at which individual fish travel. Currently salmon biologists are testing archival tags, tags with microcircuits which can record temperature, pressure (underwater depth), and light levels. While expensive, the information gathered by these tags should greatly increase our understanding of the oceanic behavior and migration of salmon. To study growth of individual salmon, many tagged fish in recent years have been injected with oxytetracycline. This antibiotic leaves a mark on ototliths (ear stones) and other calcified parts which is visible under ultraviolet light. By examining the amount of growth after the mark, scientists can get a more precise estimate of the growth that occurred during the days between release and recovery.

The success of the tagging program depends on the cooperation of people in the fishing industry around the Pacific Rim. Tag-return centers are maintained in Sapporo (for Japanese recoveries), Petropavlovsk-Kamchatskii (for Russian recoveries) and Seattle (for North American recoveries). Efforts to encourage return of tags include wide distribution of posters and newspaper articles; radio announcements; and rewards for those who return tags. Tags are returned by commercial fishermen, cannery workers, recreational fishers, and agency biologists. Tags have been found attached to nets with the fish missing, and recovered from gravel along spawning rivers years after the fish returned. One tag was even found under a skunk cabbage!

To date, almost 18,000 of the external tags released on the high seas have been recovered. The data collected from tag recoveries have sketched out the oceanic ranges of stocks from the major salmon-producing regions around the Pacific Rim ,as can be seen in this map of tagging locations of Bristol Bay sockeye. Further tagging efforts will fill in gaps in our knowledge of oceanic distribution and provide information on changes in the historic ranges. The tagging program is one of the most important scientific efforts of NPAFC and demonstrates the truly international character of the organization. Tags are released by all national sections, and recovered in all countries.

Robert Walker, Fisheries Research Institute
University of Washington



High Seas Tagging Locations of Bristol Bay Sockeye