HJR
27

DATE: 3/23/90 FURTHER:

DATE TURNED INTO OFFICE: 4-10-90

Resources Committee considered CSHJR 27 (Resources)

Relating to compensation for lost revenue and income caused by high seas interceptions of Alaskan salmon.

and recommended:

[✓] replace with SCS CS HJR 27 (Res) [✓] same title
[ ] or adopt CS [ ] new title
[ ] technical title change (HB only)

[ ] attached amendment(s)
[ ] letter of intent adopted

[✓] do pass

[ ] do not pass

[ ] no recommendation

[ ] individual recommendations

[ ] further referral to

ATTACHES NEW FISCAL NOTE(S): Dept/Date:

[ ] fiscal note(s)

[✓] zero fiscal note(s) Rev

[ ] appropriation-no fiscal note

APPROVES PREVIOUS: Dept/Date:

[ ] fiscal note(s)

[ ] zero fiscal note(s)

[ ] Governor's bill w/fiscal note

SIGNING DO PASS:

[signatures]

"good luck"

OTHER RECOMMENDATIONS:

[signature]

Chair: Signature and Recommendation

Representative Jim Zawacki
Alaska State Legislature

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PUBLIC SAFETY
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M E M O R A N D U M

TO: SENATOR BETTYE FAHRENKAMP, CHAIR
SENATE RESOURCES COMMITTEE

FROM: Jim Zawacki
Representative

DATE: March 26, 1990

RE: HJR 27

I would like to respectfully request that HJR 27, Relating to Compensation for Lost Revenue and Income Caused by High Seas Interceptions of Alaska Salmon, be scheduled for a hearing at the earliest convenience of the Chair.

Thank you for your time and consideration.

Representative Jim Zawacki
Alaska State Legislature

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M E M O R A N D U M

TO: ALL REPRESENTATIVES
ALASKA STATE LEGISLATURE

FROM: Representative Jim Zawacki

DATE: March 22, 1990

SUBJ: HJR 27

OBJECTIVE: To assist and protect Alaska's fisherman and to assure that the anadromous fish of Alaska origin are protected on the high seas.

SUMMARY: HJR27, requests the President of the United States to bring action before the appropriate international tribunal for recovery of damages on behalf of the State of Alaska and the fisherman of Alaska for revenue and income lost as a consequence of the illegal high seas interception of Alaska salmon.

It also requests the President of the United States to renegotiate existing fisheries treaties and agreements with Japan, South Korea, and Taiwan to provide procedures whereby individual fisherman, fisherman's associations and the states may recover damages from foreign fishing companies for income and revenue lost due to high seas interceptions in violation of the treaty or agreements.

HRJ27 further requests the Congress of the United States to establish a fund to reimburse Alaska fisherman and the State of Alaska for the income and revenue lost by the high seas interception of Alaska salmon and that this fund be financed by a tariff on the fishery products originating in those nations whose fisherman are intercepting Alaska salmon on the high seas.

CONCERNS: Throughout the committee process questions were raised regarding "Federal constitutional concerns with the language or the intent of HJR27." Alaska's delegation to to the United States Congress could find no such constitutional problems.

The constitution of the United States specifically allows citizens to petition the Congress; presumably, any citizen also has the right to contact the President, who is elected by the citizenry. Thus the resolution itself seems to pose no problems.

Your support of Alaska's fisherman, the protection of Alaska's fishing industry and Alaska's future would be greatly appreciated.

I encourage a YES vote on HJR27. Thank you.

ENDORSEMENTS OF HJR27

March 22, 1990

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1. SEACOPS
2. Bristol Bay Native Corporation
3. Alaska Independent Fishermans' Marketing Association
4. Western Alaska Cooperative Marketing Association
5. Bristol Bay Herring Marketing Co-op
6. Kotzebue Fishermans' Association
7. Bristol Bay Driftnetters' Association
8. City of Manokotak
9. Bristol Bay Borough
10. City Council of Mountain Village
11. North Slope Borough
12. City and Borough of Sitka
13. Ketchikan Gateway Borough
14. United Fisherman of Alaska

UNITED FISHERMEN OF ALASKA

211 4th Street, Suite 106
Juneau, AK 99801
907-586-2820

March 21, 1990

Representative Jim Zawacki
Room 609 Court Building
PO Box V
Juneau, AK 99811

Dear Representative Zawacki:

At the annual board of directors meeting, of the United Fishermen of Alaska, HJR27 was reviewed.

The board unanimously endorsed the concept set forth in the resolution.

If you have any questions concerning this matter, please feel free to contact our office.

Sincerely,

Ken Castner
Executive Director

FILE COPY

An Estimate of Lost Revenue to Fishermen,
Processor Employees and Processors
Due to the High Seas Interception
of Southeast Alaska's Pink Salmon

Economic Development Center
UAS - Ketchikan

January 5, 1989

S.E.A.C.O.P.S.
700 WATER STREET-UPPER
KETCHIKAN, ALASKA 99901
(907) 225-8004

Summary

At the request of SEACOPS the following estimates of lost revenue due to high seas salmon interception were developed at the Economic Development Center, UAS-Ketchikan.

It is difficult to find a single measure of income from the Southeast Alaska salmon fishery (ex-vessel price for fish, wages to fishermen and processor employees, wholesale price for the processed fish, the processor's net income after production costs) with which to estimate the losses due to high seas salmon interception. Each one only tells part of the story and to add them together results in either mixing apples and oranges or counting the same dollar twice. For this report I have tried to estimate only two kinds of lost income: 1. The personal income to fishermen (crew shares) and to processor employees (wages) and 2. The net operating income (income after production costs have been subtracted) to boat owner/operators and processors.

To estimate the lost revenue, a hypothetical 1988 salmon season was constructed based on the salmon returns that had been predicted for Southeast Alaska by the Alaska Department of Fish & Game. This hypothetical season was then compared to the actual 1988 salmon season in Southeast Alaska. Estimates for the number and weight of salmon caught in Southeast Alaska in 1988 are from Alaska Department of Fish & Game (ADF&G) harvest estimates (as of 9/30/88). Ex-vessel

and wholesale prices for Southeast Alaska salmon are from the National Marine Fisheries Service's "Fishery Market News" with some adjustments based on interviews with Southeast Alaska fishermen and processors. Estimates of production and labor costs are from Southeast Alaska cannery and cold storage operators.

Apart from the difference between the number of salmon that actually returned and the number that were predicted there are three other variables that have been factored into the hypothetical season:

1. An increase in the amount of fishing time for seiners, drift gillnetters and trollers as a result of there being more pinks and cohos

2. An adjustment in the ex-vessel price (the price of the fish paid by the processor to the fisherman) of almost all salmon species due to the greater volume of fish harvested

3. An adjustment in the per unit wholesale value of the catch due to a greater volume of fish on the market.

With all of the above taken into account the revenue lost in the Southeast Alaska salmon fishery due to high seas salmon interception is estimated to be:

$ 25.8 million to fishermen

$ 7.7 million to processor employees

$ 54.7 million to processors

In the process of preparing this report two significant future losses due to high seas interception surfaced: 1. Diminished future runs of chum and coho due to over fishing on the high seas and 2. Lost customers for canned and fresh salmon due to increases in price and a scarcity of product. Estimating these losses was beyond the scope of this report even though in time they will probably dwarf the losses that are estimated here.

THE SENATE
FIFTEENTH LEGISLATURE, 1990
STATE OF HAWAII

S.C.R. NO. 46
S.D. 1

SENATE CONCURRENT RESOLUTION

URGING THE PRESIDENT OF THE UNITED STATES AND THE UNITED STATES CONGRESS TO SUSPEND TRADE RELATIONS WITH ANY NATION SUPPORTING OR SANCTIONING THE PRACTICE OF DRIFTNET FISHING.

WHEREAS, driftnet fishing fleets, which are capable of spinning out approximately 30,000 miles of net every day, are decimating the Pacific fisheries resource and illegally trapping and killing endangered or threatened marine life and seabirds having little or no commercial value; and

WHEREAS, these fine, monofilament nets stretch as much as thirty miles in length and forty feet down, indiscriminately trapping whales, dolphins, sharks, fur seals, billfish, salmon, tuna, and albatross, brutalizing and killing them; and

WHEREAS, these dead or dying creatures are then discarded, left to rot or die slow, agonizing deaths; and

WHEREAS, the devastation caused by lost or abandoned driftnets is perhaps worse, as these highly durable nets continue to "ghost fish" indefinitely, continuing to trap and ensnare fish and other marine life for no beneficial purpose whatsoever; and

WHEREAS, these nets sink with the weight of their helpless victims, only to rise up again as the corpses rot and decompose to renew the devastating cycle; and

WHEREAS, at the South Pacific Fisheries Forum held in June 1989, twenty nations called for the Asian driftnet fishing fleets to end their plunder of the Pacific; and

WHEREAS, a "Proclamation on High Seas Driftnet Fisheries in the North Pacific Ocean," dated October 1989, was signed by the Premier of British Columbia and the Governors of Alaska, Washington, Oregon, Idaho, California, and Hawaii to urge Canada and the United States to initiate diplomatic efforts through the United Nations and other appropriate forums to secure a international ban on driftnet fishing on the high seas and

WHEREAS, only Japan and Taiwan, which maintain large driftnet fleets, refused to join in this effort, and South Korea, although it pulled its driftnet fishing vessels out of the south

Pacific, continues to maintain driftnet fishing operations in the north Pacific; and

WHEREAS, despite Japan's contention that there is insufficient scientific data to prove driftnet fishing is harmful to the environment, Japan has banned driftnets closer than 700 miles to its shores for the last ten years to protect its own fisheries; and

WHEREAS, existing evidence tends to refute Japan's position, for example:

(1) In 1988-1989, driftnetters caught between 40,000 and 50,000 tons of albacore tuna, which is four to five times greater than the sustainable yield of the Pacific, and such exploitation could cause a collapse of the fishery within two years;

(2) Research by Canadian fisheries biologists has revealed unacceptable numbers of mortalities for various species of whales, dolphins, porpoise, seals, seabirds, and other marine life as a result of driftnet fishing;

(3) Biologists believe that hundreds of thousands, perhaps millions, of seabirds perish each year in driftnets of the more than 1,000 fishing vessels in the Pacific ocean; and

(4) Scientists studying whale populations fear that driftnetting may pose an even greater threat to the existence of whales than commercial whaling;

and

WHEREAS, newly outfitted fishing vessels can carry twice the amount of driftnet as older vessels; and

WHEREAS, the Hawaii State Legislature has previously acted to prohibit the deplorable practice of driftnet fishing in Hawaiian waters by enacting Act 345 during the Regular Session of 1989; and

WHEREAS, stronger measures must be taken to send a message to driftnet fishing nations that the brutal and indiscriminate killing of marine life through the use of driftnets will no longer be tolerated; now, therefore,

BE IT RESOLVED by the Senate of the Fifteenth Legislature of the State of Hawaii, Regular Session of 1990, the House of Representatives concurring, that the Legislature hereby publicly condemns the practice of driftnet fishing and expresses its deep concern over the continuation of the practice; and

BE IT FURTHER RESOLVED that the President of the United States and the United States Congress are urged to suspend trade relations with any nation supporting or sanctioning the practice of driftnet fishing; and

BE IT FURTHER RESOLVED that certified copies of this Concurrent Resolution be transmitted to the President of the United States, the President of the United States Senate, the Speaker of the United States House of Representatives, and Hawaii's congressional delegation.

Salmon smuggler enters guilty plea

The Associated Press

SEATTLE — A Taiwanese fish broker arrested in an undercover sting operation last summer has pleaded guilty to conspiracy, smuggling and money-laundering charges related to pirated salmon. He faces up to 30 years in prison and $1 million in fines, officials said.

Patrick Lee, 41, entered the plea Monday and will be sentenced March 23.

Assistant U.S. Attorney Robert Chadwell said charges involving trade in smaller amounts of salmon were dropped as part of a plea agreement.

Lee was arrested last summer with five others following a six-month sting operation in which federal agents agreed to pay $1.3 million for salmon caught illegally by two Taiwanese fishing boats.

Such harvests have outraged Alaska fishermen, who charge the Taiwanese and other high-seas fishermen are taking salmon that otherwise would return to state waters to spawn. Scientist sampling of the high-seas salmon have found that some return to Asian spawning grounds, and some to North America.

The six men caught in the Seattle sting were charged with violating the Lacey Act, which prohibits commerce in illegally caught fish or wildlife. Taiwan has a law expressly forbidding its fishing boats from catching salmon since no salmon breed in its rivers.

Lee's name was noticed last spring when he placed ads in an international seafood journal for headed and gutted salmon.

Undercover investigators arranged to buy 500 tons of salmon for $1.3 million.

Lee and John Chin-Hong Wang, a naturalized American citizen who had just graduated from the Massachusetts Institute of Technology and whose father was a vessel owner, flew together from Taiwan to Seattle, investigators said.

According to a court filing, an undercover agent, code-named "Frambes," showed Lee $1.5 million in cash in a safe deposit box at Seafirst Bank, supposedly to cover the purchase.

Please see Page D-3, FISH

FISH: Taiwanese broker pleads guilty to salmon scam

Continued from Page D-1

Frambes contacted undercover agents on Redfin, a leased freighter, and confirmed they had rendezvoused with two Taiwanese squid boats on the high seas and had seen the salmon in their holds.

Lee and Wesley Meng Hsu, identified as Lee's Los Angeles agent, then went into a private room at Seafirst Bank where Frambes handed over an initial payment of $330,000.

Hsu and Lee were arrested outside the bank with the money in Hsu's briefcase.

Meanwhile, at sea, the captains of the two squid boats, Meng Gin Hsu and Chan Lon Lin, were invited on board the Redfin. Once aboard the U.S.-flagged vessel, they were arrested, with interpreter Jen Chu.

As a Coast Guard cutter arrived on the scene, the two Taiwanese vessels fled. In an ensuing chase, one boat escaped while the other was boarded by the Coast Guard and Taiwanese authorities.

The arrests, combined with the conviction of two major fish brokers earlier this year, has dried up the sale of pirated salmon in the United States, said Wayne Lewis, the special agent in charge of law enforcement at the National Marine Fisheries Service.

But he said Taiwanese driftnet boats continue to pirate U.S. salmon.

Anchorage Times
Nov. 3, 1989

U.S. seeks ban on drift netting

Sen. Ted Stevens
. . . initiated idea

By DANIEL R. SADDLER
Times Writer

The United States has introduced a resolution in the United Nations General Assembly seeking a global moratorium on the use of drift nets to harvest fish on the high seas.

The resolution asks all nations to voluntarily end use of the nets by June 30, 1992, and to cooperate in collection of scientific data on the impact of the fishing practice on marine life.

It also seeks an immediate ban on high-seas drift netting in the South Pacific to prevent irreversable damage to fish resources and to give time for development of fish management plans.

In recent years, fishing vessels from Japan, Tai-

See Ban, page A-6

Ban: High-seas drift netting

Continued from page A-1

wan, South Korea and China have increased their use of the nets. Stretched up to 40 miles through the international waters, the monofilament nets efficiently harvest many species of fish and squid, but also indiscriminately snare marine mammals, seabirds and other species.

The resolution echoes the concerns of fishermen and environmentalists in Alaska and elsewhere that improper use of driftnets represents a "strip mining" of the oceans.

"Large-scale pelagic drift-net fishing is an indisc... nate fishing method which threatens the ef... .ve conservation of living marine resources ...h as highly migratory and anadromous species ... fish, birds and marine mammals," the resolution said.

In recent months the United States signed driftnet treaties with Japan, Taiwan and South Korea, requiring observers to gather data on catches and watch for fishing abuses, and in some cases, granting enforcement powers to the U.S. Coast Guard.

Alaska Sen. Ted Stevens proposed the idea for a U.N. resolution to Secretary of State James Baker several months ago, Jane Robbins, a Stevens aide, said Thursday.

"United Nations approval of this resolution would place tremendous worldwide pressure on the governments of Japan, Taiwan and South Korea to put an end to their high seas drift-net fleets," Stevens said in announcing the resolution.

Stevens hopes to build global pressure to bear against those Asian nations to end the practice and to make sure that any driftnets banned in one ocean don't end up in the North Pacific to compete with Alaska fishermen.

"There's been a move in the South Pacific to start a moratorium on drift nets down there, and Sen. Stevens is worried that the fleets that operate in the South Pacific were kicked out they might move to the North Pacific," said Robbins.

U.N. delegations from New Zealand and Australia co-sponsored the resolution, introduced in the General Assembly Thursday afternoon by Thomas Pickering, the U.S. ambassador to the United Nations.

The non-binding resolution will be referred to the U.N. Committee on Environment for consideration, and a vote could come by early December, Robbins said.

DON YOUNG
CONGRESSMAN FOR ALL ALASKA

WASHINGTON OFFICE
2331 RAYBURN BUILDING
TELEPHONE 202/225-5765

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INTERIOR AND INSULAR AFFAIRS
MERCHANT MARINE AND FISHERIES
POST OFFICE AND CIVIL SERVICE

Congress of the United States
House of Representatives

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Washington, D.C. 20515
January 10, 1990

Honorable Jim Zawacki
Alaska House of Representatives
Pouch V
Juneau, AK 99811

Dear Jim:

Thank you for your letter regarding House Joint Resolution #27. I appreciated hearing from you.

I have asked my staff on the Subcommittee on Fisheries and Wildlife Conservation and the Environment to review the resolution as you requested. A copy of the memo that was prepared is enclosed. I hope that this will be of help in deciding whether to move forward with your resolution.

If I can provide any additional information or assistance, please let me know.

Sincerely,

DON YOUNG
Congressman for All Alaska

Enclosure

DY:rhm

U.S. House of Representatives
Committee on
Merchant Marine and Fisheries
Room 1334, Longworth House Office Building
Washington, DC 20515-6230

January 9, 1990

MEMORANDUM

TO: Congressman Don Young

FROM: Minority Staff

RE: Alaska House Joint Resolution No. 27

The following analysis was prepared in response to the request received from Representative Zawacki of the Alaska State Legislature.

Representative Zawacki indicates that there may be "Federal constitutional concerns with the language or the intent of the resolution." Staff can find no such Constitutional problems. A resolution of this nature is simply a request by the Legislature for the Federal government to take some action. The Constitution of the United States specifically allows citizens to petition the Congress; presumably, any citizen also has the right to contact the President, who is elected by the citizenry. Thus, the resolution itself seems to pose no problems.

There are, however, potential policy and legal difficulties with certain sections of the resolution. These will be addressed in the order in which they appear.

First, while the government of the United States can request other nations to submit to binding arbitration in order to recover damages from lost fish, those nations can refuse to do so and there is no legal means to compel them to do so. The United States no longer accepts the compulsory jurisdiction of the International Court of Justice (ICJ); therefore, any decision to take a case to the ICJ must be agreed to by both parties. Further, neither Korea nor Taiwan are recognized as nations by the ICJ and we could not bring any case involving these countries. While we have an arbitration agreement with Taiwan, it is not compulsory. An initial review by the Department of State indicates that there is not even a voluntary arbitration procedure available to the U.S. and Korea. Thus, there is no way for the Federal government to comply with the request of the Alaska Legislature, even if it chose to do so.

Second, the U.S. government can obviously seek to renegotiate treaties at any time. However, there is no requirement that the other treaty parties agree to new treaty terms. If these terms included a right of suit by private individuals beyond what is currently allowed under law, it is doubtful that the foreign government would participate in the treaty.

Third, there is a problem proving loss to Alaskan fishermen. As you are aware, the salmon enforcement cases currently being prosecuted by the U.S. government involve violations of the Lacey Act, not the Magnuson Fishery Conservation and Management Act (MFCMA). This is primarily due to the fact that it is nearly impossible to prove the continent of origin of a salmon found on the high seas. This was the rationale behind your amendment to the MFCMA establishing a rebuttable presumption regarding continent of origin of salmon. However, in order to collect damages from a foreign company, there is probably a need for a plaintiff to demonstrate a higher standard of proof.

Finally, the resolution requests the Congress to enact legislation to reimburse Alaskans for lost revenue. Congress has the power to do this if it chooses, although the lack of success in reimbursing those who arguably have suffered a greater loss calls into question the desire of Congress to consider such legislation. Further the proposed funding mechanism - a tariff on imported fish products - would most likely violate the General Agreement on Tariffs and Trade.

In sum, the resolution does not violate the Constitution of the United States but does pose problems in regard to federal and international law and policy.

FRANK H. MURKOWSKI
ALASKA

COMMITTEES:

VETERANS' AFFAIRS (RANKING MEMBER)
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FOREIGN RELATIONS
SELECT COMMITTEE ON INTELLIGENCE
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January 12, 1990

The Honorable Jim Zawacki
Alaska House of Representatives
Pouch V
Juneau, Alaska 99811

Dear Representative Zawacki:

Thank you for asking me to comment on HJR 27, relating to compensation for lost revenue and income caused by high seas interceptions of Alaskan salmon.

As was explained in telephone conversations between our staffs, I took the step of referring your questions on the constitutionality of the resolution to the specialists in international and domestic law at the Congressional Research Service of the Library of Congress.

I'm pleased to report that they find no specific constitutional problems with any of the three "resolve" clauses in the bill. There may, however, be other legal and practical difficulties.

The first clause asks the President of the United States to "bring an action before the appropriate international tribunal for recovery of damages on behalf of the State of Alaska and the fishermen of Alaska for revenue and income lost..." This poses a problem in that there appears to be no international standing tribunal that operates as a court in economic disputes of this nature. International claims tribunals can be established by agreement between two or more nations to address specific issues, but would of course require the consent and participation of the offending nation. In addition, such tribunals are rarely, if ever, established in such a way as to make their recommendations binding.

Another option might be the World Court, but its decisions are also non-binding. Further, the World Court is primarily involved in political, rather than economic disputes. Finally, approaching it with a case where few violators can positively be identified could leave the U.S. in a position of seeking damages from the foreign governments, and that would probably run counter to the generally recognized principles of sovereign immunity.

The second of the clauses asks that existing agreements with Japan, South Korea and Taiwan be renegotiated to provide procedures for the recovery of damages from foreign fishing companies. Although as a practical matter this might be somewhat difficult to accomplish, it presents no legal difficulty. However, it could be difficult to resolve technical questions such as quantifying losses from the activities of aspecific foreign company.

The final clause calls upon Congress to establish a fund to reimburse fishermen and the State for losses, and specifies that the fund should be financed by a tariff on fishery imports from nations whose fishermen intercept Alaska salmon. The establishment of a fund presents no legal problem. However, the imposition of a tariff might do so. Such a tariff would probably be considered a violation of the General Agreement on Trade and Tariffs. One could argue that the situation fits a GATT-provided exception for cases in which the preservation of a species is at risk, butwhether or not the Office of the U.S. Trade Representative would fell such an argument could prevail is open to question.

I hope this is helpful. Please let me know if I can be of any further assistance.

Sincerely,

Frank H. Murkowski
United States Senate

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

7 February 1989

Dr. David Harrison
Representative Jim Zawacki's Office
House of Representatives
P.O. Box V
Juneau, Alaska 99811

Dear Dr. Harrison:

As we discussed on the telephone on 3 February 1989, I am providing you with some information on the high-seas gillnet fisheries of the North Pacific Ocean and their interceptions of salmon originating in North America. No document contains all the information you wanted, and some of the information you want simply doesn't exist.

At the present time, three foreign fisheries are likely to intercept salmon of North American origin: (1) the Japanese high-seas mothership salmon fishery, (2) the Japanese land-based salmon fishery, and (3) the Japanese, Republic of Korea, and Taiwanese high-seas squid fisheries. The enclosed documents discuss how each of these fisheries operate and contain some information on their interceptions of North American salmon. The information is most complete for the Japanese mothership fishery. The next best information is for the Japanese land-based salmon fishery. Of the three, we know the least about the foreign high-seas squid fishery.

In the past, the foreign trawl fisheries in the U.S. Exclusive Economic Zone (EEZ) off the coast of Alaska for walleye pollock and bottomfish also intercepted some salmon of North American origin, but the directed foreign trawl fisheries have been excluded from the U.S. EEZ in the Gulf of Alaska since 1 January 1987 and in the Bering Sea and Aleutian Islands areas since 1 January 1988.

A directed foreign trawl fishery for Pacific whiting (hake) in the U.S. EEZ off the coasts of Washington, Oregon, and California still intercepts some salmon of North American origin, but it is unlikely that any are of Alaskan origin.

For specific details on the Japanese mothership or land-based salmon fisheries, I suggest you contact Dr. Michael L. Dahlberg, Auke Bay Laboratory, National Marine Fisheries Service (789-6002). He directs the NMFS program for monitoring and analyzing those fisheries.

For specific details on the foreign high-seas squid fisheries, I suggest you contact Mr. Steven E. Ignell, Auke Bay Laboratory, NMFS (789-6029). He directs the NMFS program for monitoring and analyzing the high-seas squid fisheries.

The Federal Government is working towards eliminating the high-seas interceptions of North American salmon. Since the early 1950's, the National Marine Fisheries Service (and its predecessor agency, the Bureau of Commercial Fisheries) has worked with Congress, the U.S. Department of State, the U.S. Coast Guard, and Alaska and the other Pacific Coast states to reduce the incidental harvest of North American salmon by the Japanese mothership and landbased high-seas salmon gillnet fisheries, particularly through our participation in the International North Pacific Fisheries Commission.

Since 1985, NMFS has been monitoring the foreign high-seas squid fisheries with particular interest in the incidental catch of salmon, steelhead, marine mammals, and sea birds. We have placed U.S. scientific observers aboard Japanese and Republic of Korea commercial squid fishing vessels as well as on Japanese, Taiwanese, Republic of Korea, and Canadian squid research vessels.

Also, since 1986, NMFS has been involved in domestic and international investigations involving high seas harvesting, transportation, and sale of salmon by vessels from Taiwan. As a result of our efforts, it appears that the flow of these fish into the United States has stopped. However, we have received reports indicating that salmon harvested illegally by Taiwanese vessels have been shipped elsewhere, notably to Singapore and Thailand, where they are canned and then shipped to Europe. In addition, Japanese enforcement officials recently uncovered an illegal salmon harvesting and shipping scheme involving Taiwanese vessels.

NMFS recently undertook several initiatives to improve the monitoring of illegal salmon harvesting and shipping activities. We launched a cooperative enforcement program with Japan by placing a NMFS Special Agent on board a Japanese enforcement vessel assigned to the North Pacific squid driftnet fishing area. We also were able to exchange information with Japanese and Soviet enforcement officials regarding the high seas fishing activities of Taiwanese driftnet vessels. We intend to expand these information exchanges in the future.

In the meantime, NMFS has worked with the Department of State to initiate talks with Japan and Korea and to request talks with Taiwan concerning the monitoring and enforcement agreements called for by the Driftnet Impact Monitoring, Assessment, and Control Act of 1987. Also, NMFS has contacted officials in Hong Kong, Singapore, Thailand, Japan, Korea, and Taiwan to request their assistance in providing information on possible illegal salmon shipping schemes. We hope that these initiatives will enhance our monitoring and enforcement capabilities.

Sincerely,

Aven M. Andersen

Aven M. Andersen, Ph.D.
Fisheries Management Biologist

Enclosures:

cc: Brad Pierce, House Research Agency

North American Journal of Fisheries Management 4:414–430, 1984

Yield Loss of Western Alaska Chinook Salmon Resulting from the Large Catch by the Japanese Salmon Mothership Fleet in the North Pacific Ocean and Bering Sea in 1980

RICHARD L. MAJOR

Resource Ecology and Fisheries Management Division
Northwest and Alaska Fisheries Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
2725 Montlake Boulevard East
Seattle, Washington 98112

ABSTRACT

The Japanese salmon mothership fleet, fishing with gill nets in the North Pacific Ocean and Bering Sea in 1980, took a record 704,000 chinook salmon (*Oncorhynchus tshawytscha*), an estimated 380,000 of which originated in western Alaska. On the basis of information coalesced from earlier studies, non-catch mortality of western Alaska chinook salmon (referring to fish that die at sea because of their encounter with the gill nets but are not taken aboard ship as part of the catch) also was set at 380,000 fish. Nearly all were 1, 2, or 3 years from maturity. By balancing growth against mortality over time to maturity, it was estimated that the survivors of western Alaska chinook salmon caught or killed at sea as a result of the gill-net fishery would have weighed 6.52 times (range 3.53–11.58) the original high-seas catch had they been allowed to mature and enter the coastal fisheries of western Alaska. This ratio is, by far, the highest yet reported for Pacific salmon. The aggregate 1980–1983 chinook salmon runs to western Alaska (catch plus escapement) were reduced by 5,712 t (range 1,986–13,288) because of the 1980 mothership fishery.

The record high catch of 703,798 chinook salmon (*Oncorhynchus tshawytscha*) by the Japanese salmon mothership fleet, fishing with gill nets in the North Pacific Ocean and Bering Sea in 1980, generated new interest in the possible effects of the high-seas fishery on the inshore runs of chinook salmon, particularly those originating in rivers that enter the Bering Sea through western Alaska (Fig. 1). This interest is based on findings summarized in the International North Pacific Fisheries Commission (INPFC) joint comprehensive report on chinook salmon (Major et al. 1978). The report showed that western Alaska chinook salmon predominate in the central Bering Sea, where large numbers are often taken by the mothership fishery, and occur elsewhere throughout the mothership fishing area. Asian chinook salmon, on the other hand (mostly from the USSR), predominate in the southern and western reaches of the mothership fishing area and occur less frequently in the central Bering Sea.[1] The report (Major et al. 1978) further showed that 80% or more of the mothership catch typically is made up of immature individuals 1–3 years from maturity. This, coupled with the knowledge that chinook salmon, the largest of all species of Pacific salmon, would grow from roughly 2.5 kg on the high seas to 9.5 kg inshore at time of maturity in western Alaska, suggests that the differential yield effect associated with high-seas harvesting of chinook salmon could be prodigious.

Assessing the effects of offshore fishing on the yield of Pacific salmon was originally a subject of wide interest in the 1960's and early 1970's. There emerged an impressive body of papers prepared by scientists of four nations (Canada, Japan, USA, and USSR) dealing with the five major species of salmon. Sockeye salmon (*Oncorhynchus nerka*), chum salmon (*Oncorhynchus keta*), and pink salmon (*Oncorhynchus gorbuscha*) were studied in terms of distant high-seas fisheries, while coho salmon (*Oncorhynchus kisutch*) and chinook salmon were examined in the somewhat different context of coastal troll fisheries.

Ricker (1976) reviewed, condensed, and in some cases extended the pertinent earlier works

[1] Fredin et al. (1977) provided comprehensive background information on Pacific salmon and the high-seas fisheries of Japan.

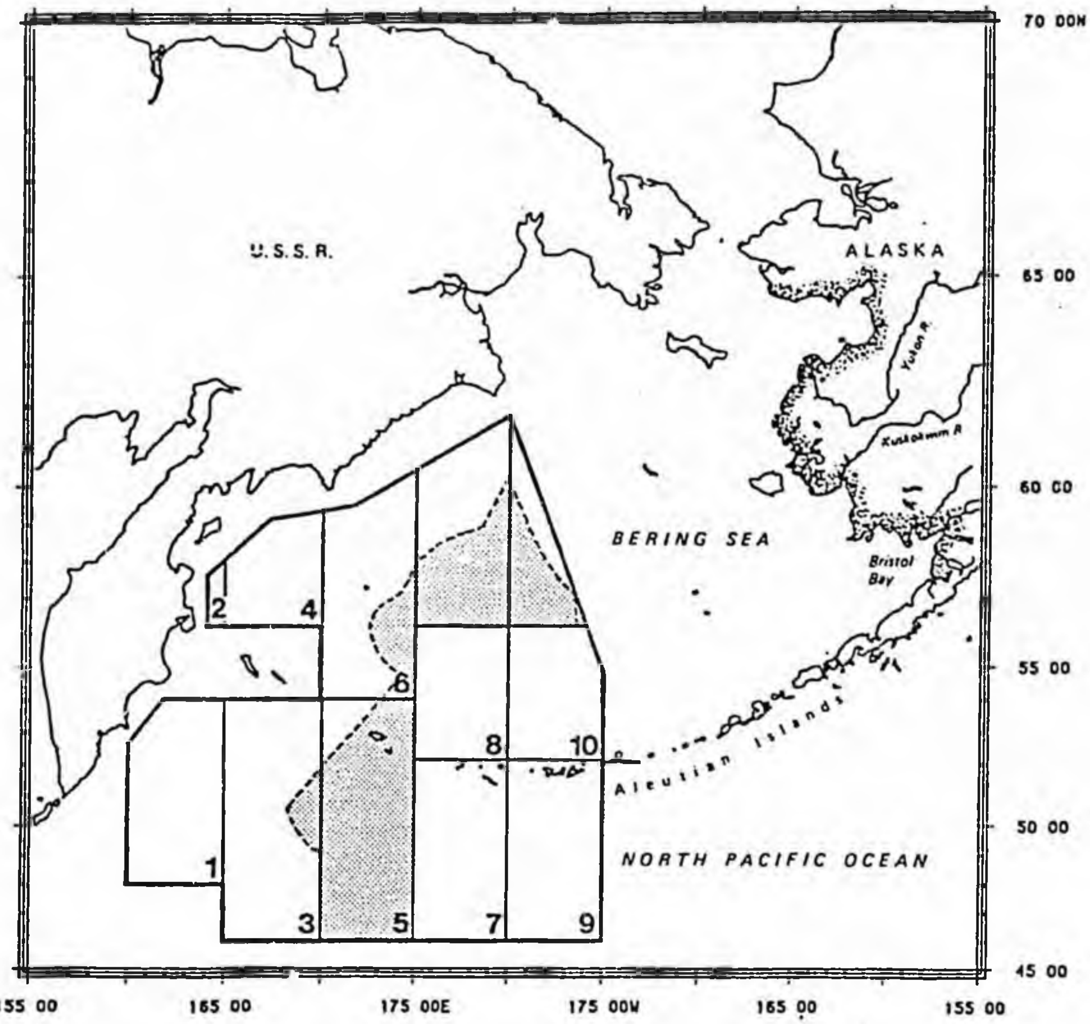

Figure 1. Geographic areas important to the study. The Japanese salmon mothership fishery prior to 1977 is identified by the bold outer margin; in 1978 and later years by the stippled inner area. 1977 was a transition year in which fishing was allowed in the stippled inner area, in subareas 7 and 9, and in the southern portions of subareas 8 and 10. Subareas are numbered in the lower right-hand corner of each block. Western Alaska, including the Bristol Bay, Kuskokwim and Yukon fishing regions, also is shown.

on growth, natural mortality, non-catch mortality, and yield of Pacific salmon. Of particular value were Ricker's conclusions on non-catch mortality (referring to fish that die at sea because of their encounter with fishing gear but are not taken aboard ship as part of the catch). For immature fish taken in a gill-net fishery on the high seas, he estimated that one is killed for every one landed; for mature fish in their final year, one fish dies for every three landed.

In this paper, I describe a process for estimating the potential yield loss of western Alaska chinook salmon resulting from the large Japanese mothership catch in 1980 and compare the results to estimates of yield loss reported earlier in studies of other species of Pacific salmon. The potential sources of error also are discussed, and the sensitivity of the yield loss estimate to changes in the various input parameters is examined.

CALCULATION OF YIELD LOSS

The effect of high-seas fishing on yield is measured as the potential change in mass between fish caught or otherwise dying at sea because of the fishing activity and survivors of the same fish if they had been allowed to move inshore to the coastal fishery. Because the weight of the survivors reaching the coast always exceeds the weight of the catch taken at sea, studies of yield effect are, in fact, studies of yield loss (Ricker 1976).

Yield loss can be expressed either in terms of total catch (the observed coastal catch (C) plus the added potential catch inshore of fish caught or otherwise dying at sea because of high-seas fishing activity (P) divided by the sum of the observed coastal catch (C) and the observed high-seas catch (H)), or in terms of the high-seas catch alone—(P) divided by (H), without consideration of the coastal catch. Because the inshore catch of chinook salmon involved in the 1980 high-seas fishing season was not complete until 1983 (after the present study was initiated), this analysis is in terms of the 1980 high-seas catch alone, hence (P/H). For example, a ratio of 1.14 would mean that the potential inshore catch is 1.14 times the high-seas catch (14% higher).

The format for computing the potential change in mass (Parker 1963) is essentially that in which growth and natural mortality are balanced over time:

$$m = e^{(g-q)t}$$

where

m = change in mass,
g = monthly instantaneous growth rate,
q = monthly instantaneous natural mortality rate,
t = time, in months, between the high-seas and coastal fisheries.

Change in mass in this study is calculated separately for 119 cells, each consisting of a unique combination of the following categories:

(1) month
(2) subarea
(3) maturity stage
(4) ocean age
(5) sex

} at time of capture in the high-seas fishery

(6) projected ocean age at time of return to coastal waters

This was done because the percentage of western Alaska chinook salmon in the Japanese salmon mothership fishery varies greatly by month and subarea and also because the biological data from the fishery are grouped by month and subarea. Each cell is weighted according to its representation in the total catch of western Alaska fish in the 1980 Japanese mothership fishery. Finally, potential change in mass is adjusted by the non-catch mortality factor. Hence, the equation becomes:

$$m = \sum_{c=1}^{119} f_c w_c e^{(g_c - q_c)t_c}$$

where the added considerations are: cell (c), weighting factor (w), and non-catch mortality (f).

Given the non-catch mortality factors provided by Ricker (1976), four additional bits of information are required:

(1) maturity, ocean-age, and sex composition of western Alaska chinook salmon in the 1980 Japanese mothership fishery by month and subarea,
(2) growth,
(3) natural mortality,
(4) maturity schedule.

The derivation of this information is presented in the following subsections. For each of the key variables involved (proportion of western Alaska fish in the high-seas catch, growth, natural mortality, maturity schedule, and non-catch mortality), the text discussion is developed in terms of average values or best estimates thereof. The sensitivity of the yield-loss estimate to changes in the five variables is discussed separately.

Area of Origin, Maturity, Ocean-Age and Sex Composition

The maturity, ocean-age, and sex composition of (1) the 1980 Japanese mothership catch of chinook salmon as a whole (without reference to area of origin), and (2) the western Alaska portion of the catch are presented in Table 1 by month and subarea. The subarea system was devised by Fredin and Worlund (1974) and also was used later in my own studies to determine the origin of chinook salmon taken on the high seas (Major et al. 1975, 1977a, 1977b). The subareas are shown in Fig. 1 as they pertain to the earlier studies and to the present study. The system of age designation, first appearing in Table 1 and then used throughout the rest of the paper, shows the number of annuli in fresh water by a figure preceding the dot and the number of annuli in the ocean by a figure following the dot. Thus, a

Table 1. Catch of chinook salmon in the Japanese mothership fishery in 1980 by month, subarea, maturity, ocean age, and sex.

Month and subarea	Total catch[a]								Proportion western Alaska[c]	Western Alaska catch							
	Mature, .2[b]		Immature .1		Immature .2		Immature .3			Mature, .2		Immature .1		Immature .2		Immature .3	
	Male	Female	Male	Female	Male	Female	Male	Female		Male	Female	Male	Female	Male	Female	Male	Female
June																	
3	29	0	0	0	307	315	40	79	0.320	0[d]	0[d]	0	0	98	101	13	25
5	1,058	11	0	0	11,195	11,514	1,446	2,882	0.345	0[d]	0[d]	0	0	3,863	3,972	499	994
6	58	1	0	0	617	634	80	159	0.250	15	0	0	0	154	159	20	40
8	450	5	0	0	4,773	4,908	616	1,229	0.655	295	3	0	0	3,126	3,215	403	805
10	124	1	0	0	1,315	1,352	170	338	0.945	117	1	0	0	1,243	1,278	161	319
July																	
3	30	1	24	13	3,362	3,499	175	348	0.183	0[d]	0[d]	4	2	615	640	32	64
5	954	29	756	424	106,116	110,448	5,519	11,004	0.103	0[d]	0[d]	78	44	10,930	11,376	568	1,133
6	195	6	46	26	6,206	6,460	464	926	0.665	130	4	31	17	4,127	4,296	309	616
8	543	16	358	201	83,582	86,993	4,851	9,674	0.690	375	11	247	139	57,672	60,025	3,347	6,675
10	0	0	1,102	617	99,798	103,872	3,157	6,296	0.910	0	0	1,003	561	90,816	94,524	2,873	5,729
					Total 703,798									Total 379,932			

[a] Total catch (number of fish) is allocated by maturity and ocean age on the basis of data reported by the Fishery Agency of Japan (1981a, 1981b). The numbers of males and females were determined from historical averages reported by Major et al. (1978).

[b] See text for explanation of term.

[c] Adapted from Major et al. 1977b (Fig. 1a and 1b).

[d] In accordance with the rationale of the earlier studies to determine continent of origin of chinook salmon taken in the Japanese mothership fishery (Major et al. 1975, 1977a, 1977b), all maturing fish taken in subareas 3 and 5 were assumed to be of Asian origin.

.3 fish is one whose scale reflects three annuli at sea (freshwater age unspecified), a 2. fish is one whose scale shows two annuli in fresh water (ocean age unspecified), and an age 2.3 fish is one with two annuli in fresh water and three at sea. Total age (year of life) is obtained by adding one to the sum of the freshwater and ocean ages. This system of age designation follows the recommendations of Koo (1962).

Estimates of the area of origin of chinook salmon in the mothership area are based on a combination of direct and indirect evidence. Tagging studies (Aro et al. 1971; Aro 1974, 1980; Fishery Agency of Japan 1981c) show conclusively that western Alaska chinook salmon range as far west as 172°E and Asian chinook as far east as 172°W in the North Pacific Ocean and Bering Sea north of 46°N. The mothership fishing area, which lies almost entirely within these two longitudinal boundaries, is the primary intermixing zone for chinook salmon from Asia and western Alaska. There is no evidence from tagging that chinook salmon from North American areas other than western Alaska occur in the present mothership fishing area.

Indirect estimates of the proportion of western Alaska chinook salmon present in the various sectors of the mothership fishing area are from studies with scales collected in 1966–1972 (adapted from Major et al. 1977b), the only such information available. In Table 1, these estimates are applied to the total catch to determine the catch of western Alaska chinook salmon taken by the mothership fishery in 1980. The proportions used in Table 1 are averages for 1966–1972. To allow for between-year variability, the maximum and minimum values observed in each month/subarea cell are used later in the sensitivity analysis section of this paper.

Most of the estimated 379,932 western Alaska fish were immature (99.8%) and in the .2 ocean-age group (92.7%). Sex ratios varied with ocean age, females being relatively scarce among the mature fish (all .2's) but increasingly abundant among the immature fish as ocean age increased.

Growth and Natural Mortality

There have been no definitive studies on the growth of chinook salmon in the ocean, particularly in terms of weight. Consequently growth, as estimated here, is the difference between the mean weight of a particular ocean-age and sex component of the high-seas catch and the mean weight of the surviving members of that same component as they appear in the inshore catch 1–3 years later. Instantaneous growth rates (g) required for yield-loss computations are estimated from the relationship:

$$g = (\text{Ln } W_t - \text{Ln } W_o)/t$$

where Ln W_t is the natural logarithm of the mean weight in kilograms of a particular ocean-age and sex group as they occur in the inshore fishery in mid-June, (t) months after their counterparts have been taken in the high-seas fishery. Ln W_o is the same statistic for the comparable group taken earlier in the high-seas fishery. The (g) values and the data from which they were computed are listed in Table 2. Growth (g) is on a per-month basis and (t) is the time elapsed from 15 June or 15 July (the midpoints of the two months comprising the high-seas fishing season) to 15 June (the peak of the inshore season) in ensuing years. The few mature fish taken on the high seas (0.2% of the total) were arbitrarily assigned $t = 0$, meaning that the survivors would move inshore directly after the high-seas fishery.

Similarly, as with growth, there is little information on the natural mortality of western Alaska chinook salmon in the ocean. Researchers working with stocks of chinook salmon from other spawning areas, however, have used annual instantaneous rates of from 0.1 to 0.69 (0.008–0.058 monthly) over varying periods of the oceanic life. Ricker (1980) used an annual rate 0.1 for fish age .2 and older, and asserts elsewhere (Ricker 1976) that 0.24 is probably somewhat too large. The value 0.2 (0.017 monthly) was used here.

Maturity Schedule

Thus far I have estimated the number of western Alaska chinook salmon taken by the Japanese mothership fishery in 1980 by month, subarea, maturity stage, ocean age, sex, and assigned growth and natural mortality rates to each category. However, because all fish in a particular category are not destined to mature at the same time, it was necessary also to approximate the schedule according to which immature fish at sea would have matured had they not been caught. This permits growth and mortality to be balanced, one against the other, over the appropriate span of months and for the appropriate number of fish.

The maturity schedule of immature age .1 chi-

Table 2. Statistics for computing growth rate of chinook salmon during the period between the Japanese mothership and western Alaska fisheries.

Japanese mothership fishery					Western Alaska fishery			
Ocean age	Month	Subarea	Sex	Mean[a] weight (kg)	Ocean age	Mean[a] weight (kg)	Elapsed time (months)	Growth rate
		Mature				All mature		
.2	June	6	M	2.97	.2	3.25	0[b]	0
		8	M	2.92	.2	3.25	0	0
			F	3.36[c]	.2	3.29	0	0
		10	M	2.36	.2	3.25	0	0
			F	2.71[c]	.2	3.29	0	0
	July	6	M	2.83	.2	3.25	0	0
			F	3.25[c]	.2	3.29	0	0
		8	M	2.53	.2	3.25	0	0
			F	2.91[c]	.2	3.29	0	0
		Immature						
.1	July	3	M	1.75	.2[e]	3.25	11	0.056
			F	1.43	.2	3.29	11	0.076
		5	M	1.75[f]	.2	3.25	11	0.056
			F	1.43[f]	.2	3.29	11	0.076
		6	M	1.28	.2	3.25	11	0.085
			F	1.28	.2	3.29	11	0.085
		8	M	1.28[g]	.2	3.25	11	0.085
			F	1.28[g]	.2	3.29	11	0.085
		10	M	1.28[g]	.2	3.25	11	0.085
			F	1.28[g]	.2	3.29	11	0.085
.2	June	3	M	2.60	.3	7.36	12	0.087
				2.60	.4	11.48	24	0.062
				2.60	.5	15.16	36	0.049
			F	2.61	.3	8.54	12	0.099
				2.61	.4	11.37	24	0.061
				2.61	.5	13.39	36	0.045
		5	M	2.55	.3	7.36	12	0.088
				2.55	.4	11.48	24	0.063
				2.55	.5	15.16	36	0.050
			F	2.47	.3	8.54	12	0.103
				2.47	.4	11.37	24	0.064
				2.47	.5	13.39	36	0.047
		6	M	2.00	.3	7.36	12	0.109
				2.00	.4	11.48	24	0.073
				2.00	.5	15.16	36	0.056
			F	1.81	.3	8.54	12	0.129
				1.81	.4	11.37	24	0.077
				1.81	.5	13.39	36	0.056
		8	M	2.01	.3	7.36	12	0.108
				2.01	.4	11.48	24	0.073
				2.01	.5	15.16	36	0.056
			F	2.04	.3	8.54	12	0.119
				2.04	.4	11.37	24	0.072
				2.04	.5	13.39	36	0.052
		10	M	1.99	.3	7.36	12	0.109
				1.99	.4	11.48	24	0.073
				1.99	.5	15.16	36	0.056
			F	2.04	.3	8.54	12	0.119
				2.04	.4	11.37	24	0.072
				2.04	.5	13.39	36	0.052
	July	3	M	2.74	.3	7.36	11	0.090
				2.74	.4	11.48	23	0.062
				2.74	.5	15.16	35	0.049
			F	2.76	.3	8.54	11	0.103
				2.76	.4	11.37	23	0.062
				2.76	.5	13.39	35	0.045

Table 2. Continued.

Japanese mothership fishery					Western Alaska fishery			
Ocean age	Month	Subarea	Sex	Mean[a] weight (kg)	Ocean age	Mean[a] weight (kg)	Elapsed time (months)	Growth rate
		5	M	2.97	.3	7.36	11	0.082
				2.97	.4	11.48	23	0.059
				2.97	.5	15.16	35	0.047
			F	2.85	.3	8.54	11	0.100
				2.85	.4	11.37	23	0.060
				2.85	.5	13.39	35	0.044
		6	M	2.09	.3	7.36	11	0.114
				2.09	.4	11.48	23	0.074
				2.09	.5	15.16	35	0.057
			F	2.00	.3	8.54	11	0.132
				2.00	.4	11.37	23	0.076
				2.00	.5	13.39	35	0.054
		8	M	2.12	.3	7.36	11	0.113
				2.12	.4	11.48	23	0.073
				2.12	.5	15.16	35	0.056
			F	2.08	.3	8.54	11	0.128
				2.08	.4	11.37	23	0.074
				2.08	.5	13.39	35	0.053
		10	M	2.23	.3	7.36	11	0.109
				2.23	.4	11.48	23	0.071
				2.23	.5	15.16	35	0.055
			F	2.20	.3	8.54	11	0.123
				2.20	.4	11.37	23	0.071
				2.20	.5	13.39	35	0.052
.3	June	3	M	4.29	.4	11.48	12	0.082
				4.29	.5	15.16	24	0.053
			F	4.17	.4	11.37	12	0.084
				4.17	.5	13.39	24	0.049
		5	M	4.08	.4	11.48	12	0.086
				4.08	.5	15.16	24	0.055
			F	3.97	.4	11.37	12	0.088
				3.97	.5	13.39	24	0.051
		6	M	3.76	.4	11.48	12	0.093
				3.76	.5	15.16	24	0.058
			F	3.70	.4	11.37	12	0.094
				3.70	.5	13.39	24	0.054
		8	M	3.55	.4	11.48	12	0.098
				3.55	.5	15.16	24	0.060
			F	3.66	.4	11.37	12	0.094
				3.66	.5	13.39	24	0.054
		10	M	3.67	.4	11.48	12	0.095
				3.67	.5	15.16	24	0.059
			F	3.62	.4	11.37	12	0.095
				3.62	.5	13.39	24	0.055
	July	3	M	4.35	.4	11.48	11	0.088
				4.35	.5	15.16	23	0.054
			F	4.18	.4	11.37	11	0.091
				4.18	.5	13.39	23	0.051
		5	M	3.98	.4	11.48	11	0.096
				3.98	.5	15.16	23	0.058
			F	4.11	.4	11.37	11	0.093
				4.11	.5	13.39	23	0.051
		6	M	3.51	.4	11.48	11	0.108
				3.51	.5	15.16	23	0.064
			F	3.79	.4	11.37	11	0.100
				3.79	.5	13.39	23	0.055
		8	M	3.58	.4	11.48	11	0.106

Table 2. Continued.

Japanese mothership fishery					Western Alaska fishery			
Ocean age	Month	Subarea	Sex	Mean[a] weight (kg)	Ocean age	Mean[b] weight (kg)	Elapsed time (months)	Growth rate
				3.58	.5	15.16	23	0.063
			F	3.68	.4	11.37	11	0.103
				3.68	.5	13.39	23	0.056
		10	M	3.37	.4	11.48	11	0.111
				3.37	.5	15.16	23	0.065
			F	3.39	.4	11.37	11	0.110
				3.39	.5	13.39	23	0.060

[a] Fishery Agency of Japan. Data for 1966–1972 now on file at the Northwest and Alaska Fisheries Center, NOAA, Seattle, Washington.

[b] All data originally collected by Alaska Department of Fish and Game. Data summaries for the Yukon River 1964–1968 and 1981 and for the Kuskokwim River 1964–1968 are now on file at the Northwest and Alaska Fisheries Center. Bristol Bay data (1964–1978) are from Meacham (1980). Data were weighted according to the following average run strengths compiled from Meacham and Arvey (1981): Yukon River 0.386, Kuskokwim River 0.263, and Bristol Bay 0.351. Lesser streams were ignored.

[c] Mature fish are assumed to move directly inshore.

[d] Among the data (footnote a above), there is little information on maturing .2 females in subareas 6, 8, and 10. When data from adjacent cells are pooled, the mean weight of the females is computed to be 1.15 that of the males. This ratio is used to estimate the mean weights of females in subareas 6, 8, and 10.

[e] Only the largest .1 immatures are taken in the mothership gill nets (Major et al. 1978). All are assumed to mature as .2's.

[f] Data from Subarea 3.

[g] Data from Subarea 6.

nook salmon can be surmised directly. Major et al. (1978) noted that only the very largest .1's are taken in the gill nets of the size fished by the Japanese fleet. Because the largest individuals of a particular ocean-age and sex group mature earliest (Parker and Larkin 1959; Grachev 1967), it can be reasonably assumed that all of the relatively few .1 chinook taken in the mothership fishery would have matured the following year at age .2.

The maturity schedule of .2 and .3 fish taken at sea is derived from the ocean-age composition of the coastal catches of western Alaska chinook salmon. This was achieved by adjusting the observed inshore data backward in time to account for the mortalities that have occurred between the oceanic and coastal fisheries. Ideally, both natural mortality and fishing mortality should be taken into account in making such an adjustment (there being fishing mortalities associated with the mothership fishery itself and with the groundfish fisheries). Because information on fishing mortality is lacking, however, adjustment here is for natural mortality only. The inability to correct for fishing mortality leads to overestimating the proportions of ocean-caught fish that are destined to mature at young ages and, conversely, to underestimating proportions of fish that will mature at older ages. At least partially offsetting this bias is the effect of gill-net selectivity on the ocean-age composition of the inshore catch, which is the original basis for estimating the maturity schedule of fish taken at sea. Inshore gill nets tend to capture fewer younger-maturing fish and more older-maturing fish.

The initial ingredient in the computation of the maturity schedule (the observed ocean-age composition of the mature catch) is from data collected in the major fishing regions of western Alaska (the Yukon, Kuskokwim, and Bristol Bay areas). Using catch data from the individual regions, as reported by Meacham and Arvey (1981) in conjunction with corresponding information on ocean-age composition (Meacham 1980) and sex ratio (unpublished data collected by Alaska Department of Fish and Game and now on file at the Northwest and Alaska Fisheries Center, NOAA, Seattle, Washington), the average ocean-age composition of chinook salmon caught in the commercial fisheries of western Alaska 1964–1978 is estimated as follows:

	Ocean age			
	.2	.3	.4	.5
Males	0.115	0.397	0.425	0.063
Females	0.002	0.165	0.718	0.115

From the inshore data, a maturity schedule was developed using the following expressions:

(1) Maturity schedule of .2's at sea

$$= \frac{PP_i}{\sum_{i=.3,\,.4,\text{ or }.5} PP_i}$$

(2) Maturity schedule of .3's at sea

$$= \frac{PP_i}{\sum_{i=.4\text{ or }.5} PP_i}$$

where

$PP_i = \frac{OP_i}{e^{-qt_i}}$ = proportion predicted to mature at ocean age (i),

OP_i = observed (inshore) proportion of ocean age (i),

q = monthly instantaneous natural mortality rate,

t = time, in months, between the high-seas and coastal fisheries.

The maturity schedule is presented in Table 3 and the ultimate composition (number and weight) of the 1980 Japanese mothership catch of western Alaska salmon by maturity, ocean-age, month, subarea, sex, and the projected ocean age at return is shown in Table 4.

Table 3. Maturity schedule for various ocean-age groups of immature western Alaska chinook salmon taken in the Japanese mothership fishery.

Months to maturity	Ocean age at capture					
	Males			Females		
	.1	.2	.3	.1	.2	.3
11 or 12ª	1.000	0.392	0.846	1.000	0.135	0.836
23 or 24ª		0.515	0.154		0.77[illegible]	0.164
35 or 36ª		0.093			0.1[illegible]	

ª Depending on whether the fish were captured at sea in June or July.

Yield Loss

Following the approach of Parker (1963), the elements required for the calculation of yield loss are arranged in Table 5. Yield loss (using immature fish as an example) was calculated as follows:

$$\text{Yield loss} = 2(0.00001e^{0.429} + 0.00016e^{0.429} + 0.00007e^{0.649} \text{ etc., for all of the remaining cells})$$
$$= 6.52$$

Hence, the potential inshore catch is 6.52 times the high-seas catch or, stated another way, the increase in yield would be 552%, assuming discontinuation of high-seas fishing and the existence of an inshore fishery capable of catching all fish available to it.

It is further instructive to describe yield loss in terms of total weight. Considering that the estimated weight of the western Alaska component of the 1980 Japanese mothership catch was 876 t (Table 4), the potential yield loss to western Alaska fishermen would be 5,712 t (6.52 × 876 t). More likely, yield loss would be some fraction of this potential, depending on the fraction of the total run harvested.

The yield-loss ratio of 6.52 reported above is for all western Alaska chinook salmon taken in the 1980 Japanese mothership fishery or otherwise dying at sea because of encounters with gill nets employed by the fishery. A few were mature but most were 1, 2, or 3 years from maturity. To facilitate comparison of these results to those obtained earlier for other species of salmon, it is necessary to express the yield-loss ratios of the three groups of immature western Alaska chinook salmon separately: 5.60, 6.92, and 7.04 for fish 1, 2, and 3 years from maturity, respectively.

In comparing the yield-loss ratios of salmon taken on the high seas one year from maturity, note that the value 5.60 for western Alaska chinook salmon greatly exceeds the closest values obtained for other species of salmon: 3.78 for chum salmon (Ricker 1964) and 3.36 for sockeye salmon (Parker 1963), after the latter values have been adjusted to reflect the non-catch mortality factor of 2.0 and the July 1 seasonal midpoint of the mothership fishery. Similarly, for salmon taken at sea 2 years prior to maturity, the yield-loss ratio 6.92 for western Alaska chinook salmon is much greater than the 3.96 reported for sockeye salmon (Fredin 1964). There are no examples to which the yield-loss ratio 7.04 for western Alaska chinook salmon taken at sea 3 years prior to maturity can be compared.

That yield losses stemming from high-seas fishing are much greater for western Alaska chi-

Table 4. The number, mean weight, and total weight of western Alaska chinook salmon taken in the Japanese mothership fishery in 1980 by maturity, ocean age at capture, month, subarea, sex, ocean age at maturity, and the proportion of the total weight taken in each cell.

Ocean age (Japanese mothership fishery)	Month	Subarea	Sex	Ocean age at maturity	Number of fish	Mean weight (kg)	Total weight[a]	Proportion of high-seas catch in weight
				Mature				
.2	June	6	M	.2	15	2.97	43	0.00005
		8	M	.2	295	2.92	861	0.00098
			F	.2	3	3.36	11	0.00001
		10	M	.2	117	2.36	277	0.00032
			F	.2	1	2.71	3	0.00000
	July	6	M	.2	130	2.83	367	0.00042
			F	.2	4	3.25	13	0.00001
		8	M	.2	375	2.53	948	0.00108
			F	.2	11	2.91	32	0.00004
				Immature				
.1	July	3	M	.2	4	1.75	8	0.00001
			F	.2	2	1.43	3	0.00000
		5	M	.2	78	1.75	136	0.00016
			F	.2	44	1.43	62	0.00007
		6	M	.2	31	1.28	39	0.00004
			F	.2	17	1.28	22	0.00003
		8	M	.2	247	1.28	316	0.00036
			F	.2	139	1.28	178	0.00020
		10	M	.2	1,003	1.28	1,284	0.00147
			F	.2	561	1.28	719	0.00082
.2	June	3	M	.3	39	2.60	100	0.00011
				.4	51	2.60	133	0.00015
				.5	9	2.60	24	0.00003
			F	.3	14	2.61	36	0.00004
				.4	73	2.61	190	0.00022
				.5	14	2.61	37	0.00004
		5	M	.3	1,514	2.55	3,861	0.00441
				.4	1,989	2.55	5,072	0.00579
				.5	359	2.55	916	0.00105
			F	.3	536	2.47	1,325	0.00151
				.4	2,872	2.47	7,094	0.00810
				.5	564	2.47	1,393	0.00159
		6	M	.3	60	2.00	121	0.00014
				.4	79	2.00	159	0.00018
				.5	14	2.00	29	0.00003
			F	.3	21	1.81	39	0.00004
				.4	115	1.81	207	0.00024
				.5	23	1.81	41	0.00005
		8	M	.3	1,226	2.01	2,463	0.00281
				.4	1,610	2.01	3,236	0.00369
				.5	291	2.01	584	0.00067
			F	.3	434	2.04	885	0.00101
				.4	2,324	2.04	4,741	0.00541
				.5	456	2.04	931	0.00106
		10	M	.3	487	1.99	969	0.00111
				.4	640	1.99	1,274	0.00145
				.5	116	1.99	230	0.00026
			F	.3	172	2.04	352	0.00040
				.4	924	2.04	1,884	0.00215
				.5	181	2.04	370	0.00042
	July	3	M	.3	241	2.74	661	0.00075
				.4	317	2.74	869	0.00099
				.5	57	2.74	157	0.00018
			F	.3	86	2.76	239	0.00027
				.4	463	2.76	1,278	0.00146
				.5	91	2.76	251	0.00029

Table 4. Continued.

Ocean age (Japanese mothership fishery)	Month	Subarea	Sex	Ocean age at maturity	Number of fish	Mean weight (kg)	Total weight[a]	Proportion of high-seas catch in weight
		5	M	.3	4,285	2.97	12,725	0.01453
				.4	5,629	2.97	16,718	0.01908
				.5	1,016	2.97	3,019	0.00345
			F	.3	1,536	2.85	4,377	0.00500
				.4	8,225	2.85	23,441	0.02676
				.5	1,615	2.85	4,604	0.00526
		6	M	.3	1,618	2.09	3,381	0.00386
				.4	2,125	2.09	4,441	0.00507
				.5	384	2.09	802	0.00092
			F	.3	580	2.00	1,160	0.00132
				.4	3,106	2.00	6,212	0.00709
				.5	610	2.00	1,220	0.00139
		8	M	.3	22,607	2.12	47,927	0.05471
				.4	29,701	2.12	62,966	0.07188
				.5	5,363	2.12	11,371	0.01298
			F	.3	8,103	2.08	16,855	0.01924
				.4	43,398	2.08	90,268	0.10304
				.5	8,524	2.08	17,729	0.02024
		10	M	.3	35,600	2.23	79,388	0.09062
				.4	46,770	2.23	104,297	0.11905
				.5	8,446	2.23	18,834	0.02150
			F	.3	12,761	2.20	28,073	0.03205
				.4	68,341	2.20	150,349	0.17162
				.5	13,422	2.20	29,529	0.03371
.3	June	3	M	.4	11	4.29	46	0.00005
				.5	2	4.29	8	0.00001
			F	.4	21	4.17	88	0.00010
				.5	4	4.17	17	0.00002
		5	M	.4	422	4.08	1,722	0.00197
				.5	77	4.08	313	0.00036
			F	.4	831	3.97	3,299	0.00377
				.5	163	3.97	647	0.00074
		6	M	.4	17	3.76	64	0.00007
				.5	3	3.76	12	0.00001
			F	.4	33	3.70	123	0.00014
				.5	7	3.70	24	0.00003
		8	M	.4	341	3.55	1,212	0.00138
				.5	62	3.55	221	0.00025
			F	.4	673	3.66	2,463	0.00281
				.5	132	3.66	483	0.00055
		10	M	.4	136	3.67	499	0.00057
				.5	25	3.67	91	0.00010
			F	.4	267	3.62	965	0.00110
				.5	52	3.62	190	0.00022
	July	3	M	.4	27	4.35	118	0.00013
				.5	5	4.35	21	0.00002
			F	.4	53	4.18	222	0.00025
				.5	10	4.18	44	0.00005
		5	M	.4	481	3.98	1,914	0.00218
				.5	88	3.98	348	0.00040
			F	.4	948	4.11	3,896	0.00445
				.5	186	4.11	764	0.00087
		6	M	.4	261	3.51	916	0.00105
				.5	48	3.51	167	0.00019
			F	.4	515	3.79	1,952	0.00223
				.5	101	3.79	38[illegible]	0.00044
		8	M	.4	2,832	3.58	10,136	0.01157
				.5	515	3.58	1,845	0.00211

Table 4. Continued.

Ocean age (Japanese mothership fishery)	Month	Subarea	Sex	Ocean age at maturity	Number of fish	Mean weight (kg)	Total weight[a]	Proportion of high-seas catch in weight
			F	.4	5,580	3.68	20,534	0.02344
				.5	1,095	3.68	4,029	0.00460
		10	M	.4	2,430	3.37	8,191	0.00935
				.5	442	3.37	1,491	0.00170
			F	.4	4,790	3.39	16,238	0.01854
				.5	940	3.39	3,185	0.00364
Totals					379,930		876,042	

[a] Rounded to the nearest whole number for presentation here; carried to 5 decimal places in the calculation of the proportion of each category in the total high-seas catch.

nook salmon than for the the other species of salmon, even when time to maturity is constant, can be attributed to the large size ultimately attainable by chinook salmon at maturity (9.5 kg vs. [illegible].5 kg or less for the other species of salmon).

Sensitivity Analysis

Studies such as this, dependent as they are on data collected for other purposes by other agencies, are susceptible to more than ordinary error. The growth rates calculated here are, for example, little more than first-order approximations. This assessment stems from the use of a common weight for all immature fish of a particular ocean-age and sex group taken at sea, regardless of their eventual ocean age at maturity. Parker and Larkin (1959) and Grachev (1967) have shown, on the contrary, that chinook salmon destined to mature at a young age are larger at a common earlier age than their counterparts who are destined to mature later. Thus, the growth of early-maturing fish, as calculated here, tends to be overestimated and that of the late-maturing fish to be underestimated. The extent to which one offsets the other in the final computation of yield loss is unmeasured.

Similarly, the natural mortality rate of chinook salmon at sea has received little study. The annual rate (0.2) used in the base run of the model may be too high or too low and is most likely not constant within or between seasons or for all ocean-age groups as assumed here.

The estimated maturity schedule, which affects the weighting of the various cells in the model, is also imperfect. Not only is the maturity schedule affected by the rate of natural mortality used to transform observed inshore ocean-age composition backward in time to the high-seas fishery, but also there is no basis for making a comparable adjustment for fishing mortality. The inability to adjust for fishing mortality leads to overestimation of the proportion of fish scheduled to mature at a young age and underestimation of those scheduled to mature later. The extent to which this is compensated for by the inshore fishery, which inadequately samples the younger fish in favor of the older, is unknown.

Finally, estimates of non-catch mortality are not well documented. Moreover, the estimates were developed for species of salmon other than chinook so the propriety of direct extrapolation between species is open to question.

Although the aforementioned errors surrounding growth, natural mortality, maturity schedule, and non-catch mortality are unmeasured, it is possible to estimate the relative impact of each variable on the model output. This is achieved by a sensitivity analysis wherein the variables are perturbed one at a time and the adjusted output is then measured in terms of the output obtained in the base run of the model. Results are expressed as:

$$\text{Relative sensitivity} = \frac{\text{Percent change in output}}{\text{Percent change in the variable}}$$

The advantage of the relative sensitivity measurement is that it minimizes the effect of different orders of magnitude which may exist among the tested variables and the outputs.

For the sensitivity analysis, growth is allowed to vary by ±10% and natural mortality by ±50%

(Kings)

Table 5. Information for calculating yield loss of western Alaska chinook salmon taken in the 1980 Japanese mothership fishery.

A	B	C	D	E	F	G	H	I	J	K	L
Ocean age (Japanese mother-ship fishery)	Month	Sub-area	Sex	Ocean age at maturity	Time (months)	Monthly instantaneous rate of change: Growth	Monthly instantaneous rate of change: Mor-tality	Monthly instantaneous rate of change: Mass (G–H)	Total change in mass (F × I)	Weight-ing factor	Non-catch mortality
						Mature					
.2	June	6	M	.2	0				0.000	0.00005	1.333
		8	M	.2	0				0.000	0.00098	1.333
			F	.2	0				0.000	0.00001	1.333
		10	M	.2	0				0.000	0.00032	1.333
			F	.2	0				0.000	0.00000	1.333
	July	6	M	.2	0				0.000	0.00042	1.333
			F	.2	0				0.000	0.00001	1.333
		8	M	.2	0				0.000	0.00108	1.333
			F	.2	0				0.000	0.00004	1.333
						Immature					
.1	July	3	M	.2	11	0.056	0.017	0.039	0.429	0.00001	2.000
			F	.2	11	0.076	0.017	0.059	0.649	0.00000	2.000
		5	M	.2	11	0.056	0.017	0.039	0.429	0.00016	2.000
			F	.2	11	0.076	0.017	0.059	0.649	0.00007	2.000
		6	M	.2	11	0.085	0.017	0.068	0.748	0.00004	2.000
			F	.2	11	0.085	0.017	0.068	0.748	0.00003	2.000
		8	M	.2	11	0.085	0.017	0.068	0.748	0.00036	2.000
			F	.2	11	0.085	0.017	0.068	0.748	0.00020	2.000
		10	M	.2	11	0.085	0.017	0.068	0.748	0.00147	2.000
			F	.2	11	0.085	0.017	0.068	0.748	0.00082	2.000
.2	June	3	M	.3	12	0.087	0.017	0.070	0.840	0.00011	2.000
				.4	24	0.062	0.017	0.045	1.080	0.00015	2.000
				.5	36	0.049	0.017	0.032	1.152	0.00003	2.000
			F	.3	12	0.099	0.017	0.082	0.984	0.00004	2.000
				.4	24	0.061	0.017	0.044	1.056	0.00022	2.000
				.5	36	0.045	0.017	0.028	1.008	0.00004	2.000
		5	M	.3	12	0.088	0.017	0.071	0.852	0.00441	2.000
				.4	24	0.063	0.017	0.046	1.104	0.00579	2.000
				.5	36	0.050	0.017	0.033	1.188	0.00105	2.000
			F	.3	12	0.103	0.017	0.086	1.032	0.00151	2.000
				.4	24	0.064	0.017	0.047	1.128	0.00810	2.000
				.5	36	0.047	0.017	0.030	1.080	0.00159	2.000
		6	M	.3	12	0.109	0.017	0.092	1.104	0.00014	2.000
				.4	24	0.073	0.017	0.056	1.344	0.00018	2.000
				.5	36	0.056	0.017	0.039	1.404	0.00003	2.000
			F	.3	12	0.129	0.017	0.112	1.344	0.00004	2.000
				.4	24	0.077	0.017	0.060	1.440	0.00024	2.000
				.5	36	0.056	0.017	0.039	1.404	0.00005	2.000
		8	M	.3	12	0.108	0.017	0.091	1.092	0.00281	2.000
				.4	24	0.073	0.017	0.056	1.344	0.00369	2.000
				.5	36	0.056	0.017	0.039	1.404	0.00067	2.000
			F	.3	12	0.119	0.017	0.102	1.224	0.00101	2.000
				.4	24	0.072	0.017	0.055	1.320	0.00541	2.000
				.5	36	0.052	0.017	0.035	1.260	0.00106	2.000
		10	M	.3	12	0.109	0.017	0.092	1.104	0.00111	2.000
				.4	24	0.073	0.017	0.056	1.344	0.00145	2.000
				.5	36	0.056	0.017	0.039	1.404	0.00026	2.000
			F	.3	12	0.119	0.017	0.102	1.224	0.00040	2.000
				.4	24	0.072	0.017	0.055	1.320	0.00215	2.000
				.5	36	0.052	0.017	0.035	1.260	0.00042	2.000
	July	3	M	.3	11	0.090	0.017	0.073	0.803	0.00075	2.000
				.4	23	0.062	0.017	0.045	1.035	0.00099	2.000
				.5	35	0.049	0.017	0.032	1.120	0.00018	2.000

Table 5. Continued.

A	B	C	D	E	F	G	H	I	J	K	L
						Monthly instantaneous rate of change					
Ocean age (Japanese mother-ship fishery)	Month	Sub-area	Sex	Ocean age at maturity	Time (months)	Growth	Mor-tality	Mass (G–H)	Total change in mass (F × I)	Weight-ing factor	Non-catch mortality
			F	.3	11	0.103	0.017	0.086	0.946	0.00027	2.000
				.4	23	0.062	0.017	0.045	1.035	0.00146	2.000
				.5	35	0.045	0.017	0.028	0.980	0.00029	2.000
		5	M	.3	11	0.082	0.017	0.065	0.715	0.01453	2.000
				.4	23	0.059	0.017	0.042	0.966	0.01908	2.000
				.5	35	0.047	0.017	0.030	1.050	0.00345	2.000
			F	.3	11	0.100	0.017	0.083	0.913	0.00500	2.000
				.4	23	0.060	0.017	0.043	0.989	0.02676	2.000
				.5	35	0.044	0.017	0.027	0.945	0.00526	2.000
		6	M	.3	11	0.114	0.017	0.097	1.067	0.00386	2.000
				.4	23	0.074	0.017	0.057	1.311	0.00507	2.000
				.5	35	0.057	0.017	0.040	1.400	0.00092	2.000
			F	.3	11	0.132	0.017	0.115	1.265	0.00132	2.000
				.4	23	0.076	0.017	0.059	1.357	0.00709	2.000
				.5	35	0.054	0.017	0.037	1.295	0.00139	2.000
		8	M	.3	11	0.113	0.017	0.096	1.056	0.05471	2.000
				.4	23	0.073	0.017	0.056	1.288	0.07188	2.000
				.5	35	0.056	0.017	0.039	1.365	0.01298	2.000
			F	.3	11	0.128	0.017	0.111	1.221	0.01924	2.000
				.4	23	0.074	0.017	0.057	1.311	0.10304	2.000
				.5	35	0.053	0.017	0.036	1.260	0.02024	2.000
		10	M	.3	11	0.109	0.017	0.092	1.012	0.09062	2.000
				.4	23	0.071	0.017	0.054	1.242	0.11905	2.000
				.5	35	0.055	0.017	0.038	1.330	0.02150	2.000
			F	.3	11	0.123	0.017	0.106	1.166	0.03205	2.000
				.4	23	0.071	0.017	0.054	1.242	0.17162	2.000
				.5	35	0.052	0.017	0.035	1.225	0.03371	2.000
.3	June	3		.4	12	0.082	0.017	0.065	0.780	0.00005	2.000
				.5	24	0.053	0.017	0.036	0.864	0.00001	2.000
			M	.4	12	0.084	0.017	0.067	0.804	0.00010	2.000
				.5	24	0.049	0.017	0.032	0.768	0.00002	2.000
		5		.4	12	0.086	0.017	0.069	0.828	0.00197	2.000
			F	.5	24	0.055	0.017	0.038	0.912	0.00036	2.000
				.4	12	0.088	0.017	0.071	0.852	0.00377	2.000
				.5	24	0.051	0.017	0.034	0.816	0.00074	2.000
		6	M	.4	12	0.093	0.017	0.076	0.912	0.00007	2.000
				.5	24	0.058	0.017	0.041	0.984	0.00001	2.000
				.4	12	0.094	0.017	0.077	0.924	0.00014	2.000
			F	.5	24	0.054	0.017	0.037	0.888	0.00003	2.000
		8		.4	12	0.098	0.017	0.081	0.972	0.00138	2.000
				.5	24	0.060	0.017	0.043	1.032	0.00025	2.000
			M	.4	12	0.094	0.017	0.077	0.924	0.00281	2.000
				.5	24	0.054	0.017	0.037	0.888	0.00055	2.000
		10		.4	12	0.095	0.017	0.078	0.936	0.00057	2.000
			F	.5	24	0.059	0.017	0.042	1.008	0.00010	2.000
				.4	12	0.095	0.017	0.078	0.936	0.00110	2.000
				.5	24	0.055	0.017	0.038	0.912	0.00022	2.000
	July	3	M	.4	11	0.088	0.017	0.071	0.781	0.00013	2.000
				.5	23	0.054	0.017	0.037	0.851	0.00002	2.000
			F	.4	11	0.091	0.017	0.074	0.814	0.00025	2.000
				.5	23	0.051	0.017	0.034	0.782	0.00005	2.000
		5	M	.4	11	0.096	0.017	0.079	0.869	0.00218	2.000
				.5	23	0.058	0.017	0.041	0.943	0.00040	2.000
			F	.4	11	0.093	0.017	0.076	0.836	0.00445	2.000
				.5	23	0.051	0.017	0.034	0.782	[illegible]	2.000

Table 5. Continued.

A Ocean age (Japanese mother-ship fishery)	B Month	C Sub-area	D Sex	E Ocean age at maturity	F Time (months)	G Monthly instantaneous rate of change: Growth	H Mor-tality	I Mass (G–H)	J Total change in mass (F × I)	K Weight-ing factor	L Non-catch mortality
		6	M	.4	11	0.108	0.017	0.091	1.001	0.00105	2.000
				.5	23	0.064	0.017	0.047	1.081	0.00019	2.000
			F	.4	11	0.100	0.017	0.083	0.913	0.00223	2.000
				.5	23	0.055	0.017	0.038	0.874	0.00044	2.000
		8	M	.4	11	0.106	0.017	0.089	0.979	0.01157	2.000
				.5	23	0.063	0.017	0.046	1.058	0.00211	2.000
			F	.4	11	0.103	0.017	0.086	0.946	0.02344	2.000
				.5	23	0.056	0.017	0.039	0.897	0.00460	2.000
		10	M	.4	11	0.111	0.017	0.094	1.034	0.00935	2.000
				.5	23	0.065	0.017	0.048	1.104	0.00170	2.000
			F	.4	11	0.110	0.017	0.093	1.023	0.01854	2.000
				.5	23	0.060	0.017	0.043	0.989	0.00364	2.000

(there being even less certainty about the natural mortality rate than the growth rate). Maturity schedule is examined in terms of the average ocean age at return projected for immature .2 and .3 fish in the high-seas catch. Maturity schedules are, in turn, based on the ocean-age composition of .3, .4, and .5 fish in the historical inshore catch, 1964–1978. Three such ocean-age compositions were used in the sensitivity analysis. The first (the 1964–1978 average) has al-

Table 6. Sensitivity analysis of growth, natural mortality, maturity schedule and non-catch mortality key variables are used in the model to compute yield loss of western Alaska chinook salmon resulting from the 1980 Japanese mothership fishery.

Variable	Base value	Test value	Output (yield loss)	Percent change: Variable	Percent change: Output	Relative sensitivity
Growth (annual instantaneous rate)	1.00[a]		6.52			
		0.90[a]	5.58	−10.00	−14.42	1.44
		1.10[a]	7.61	10.00	16.72	1.67
Natural mortality (annual instantaneous rate)	0.20		6.52			
		0.10	7.73	−50.00	18.56	−0.37
		0.30	5.48	50.00	−15.95	−0.32
Maturity schedule	3.88[b]		6.52			
		3.57[b]	6.24	−8.00	−4.29	0.54
		4.05[b]	6.62	4.38	1.53	0.35
Non-catch mortality						
Immatures	2.00					
Matures	1.33		6.52			
Immatures		1.50				
Matures		1.00	4.89	−25.00	−25.00	1.00
Immatures		2.50				
Matures		1.67	8.14	25.00	25.00	1.00

[a] Fish in each of the 119 cells have their own unique rate of growth. For the sensitivity analysis, the rate of growth for each cell used in the standard model run was assigned a value of 1.00 and allowed to vary by 10% in either direction; hence, the values of 0.90 and 1.10.

[b] Average ocean age at return projected for immature .2 and .3 fish in the high-seas catch.

ready been described and employed in the text run of the model. Average ocean age at return under this condition was 3.88 years. Ocean-age compositions also were selected that would minimize and maximize the average ocean-age at return. The resultant values, 3.57 and 4.05 years, respectively, are compared to the average age of 3.88 years in the tests. Finally, to demonstrate its direct impact on the yield-loss ratio, non-catch mortality is allowed to vary by ±25%.

The results of the sensitivity analysis are summarized in Table 6. Of the four variables examined, growth is clearly the most powerful element in the model. A decrease in growth rate causes an even larger decrease in output, and an increase in growth rate brings about an even larger increase in output.

Non-catch mortality is second in order of importance, exerting a direct 1:1 influence on the model output. For example, if the non-catch mortality factor doubles, the estimated yield-loss ratio will double; if the factor is halved, the yield-loss ratio is halved.

The maturity schedule exerts moderate influence on estimates of yield loss. When the immature .2 and .3 fish taken on the high seas are scheduled to return at younger ocean ages, yield loss decreases and when they are scheduled to return at older ocean ages, yield loss increases.

Natural mortality rate is the least important of the four variables tested to measure their effect on yield-loss ratio. The relationship is negative; as natural mortality increases, model output decreases and when natural mortality decreases, model output increases. A change in natural mortality rate exerts offsetting influences within the model. An increase in natural mortality would, for example, result in fewer fish reaching maturity (tending to reduce yield loss) but, by using the same increased mortality rate in the calculation of maturity schedule, the maturing fish (although fewer in number) would be older (tending to increase yield loss). As a result of these offsetting influences, a change in natural mortality rate does not bring about as large a change in output as a comparable change in growth rate, even though both variables are exponential. A 50% change in the natural mortality rate (Table 6) would bring about a smaller (15–20%) change in output, depending on the direction of the change.

If all four variables are taken to their extreme simultaneously, potential yield loss expressed as a ratio would vary from 3.53 to 11.58, with all but the very lowest values exceeding those computed earlier for other species of Pacific salmon.

Unexamined to this point is the proportion of the Japanese mothership catch that is initially identified as "western Alaskan." This variable does not affect yield loss expressed as a ratio, but it has a direct 1:1 effect when yield loss is expressed in terms of weight. When the proportion of western Alaska chinook salmon is set at the minimum and maximum values reported by Major et al. (1977b) and used in conjunction with the minimum and maximum ratios used above (3.53 and 11.58, respectively), the potential yield loss in terms of weight ranges from 1,986 to 13,288 t, thus providing some bounds to the estimate of 5,712 t obtained in the base run of the model.

Growth rate, the non-catch mortality factor, identification of western Alaska fish, maturity schedule, and natural mortality rate all emerge from the foregoing analysis as variables that exert substantial influence on estimates of yield loss of western Alaska chinook salmon resulting from high-seas fishing. Only the identification of western Alaska chinook stocks is presently being studied, with the Fisheries Research Institute, University of Washington, endeavoring to bring the earlier estimates up to date. The other elements in the r
catch mortali
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Japan's Pacific Salmon Fisheries and Trade, 1974-84

A. George Herrfurth

Introduction

Japan obtains Pacific salmon, *Oncorhynchus* spp. (Table 1), from four sources: 1) A coastal trap-net fishery (based on returns of salmon released from hatcheries), 2) a high-seas catch, 3) imports, and 4) cage culture. This salmon supply more than doubled between 1974 and 1984 (Table 2).

An increased salmon demand, a decreased high-seas catch, and the deisre to reduce dependence on salmon imports and help domestic fishermen, prompted the Japanese Government to expand the salmon hatchery program in 1979. Hatchery returns have grown steadily since, and accounted for 45 percent of Japan's salmon supply in 1983, according to the Japan Fisheries Agency (JFA).

Japan's annual salmon imports averaged 10,000 metric tons (t) in the middle 1970's, owing to lower demand and no 200-mile fishing zone restrictions. Since then, however, the United States has become Japan's leading salmon supplier and exports to Japan increased markedly during the past decade because of Japan's growing salmon demand and decreasing high-seas catches. Japanese imports of U.S. salmon were over 96,000 t in 1983, but were expected to be lower in 1984 because of an over-supply of salmon in Japan.

Japan's hatchery programs, however, cannot completely replace imports. Chum salmon, *Oncorhynchus keta*, is the primary species in the Japanese hatchery program, while most imported salmon is sockeye, *O. nerka*. The coho salmon, *O. kisutch*, is the primary cage-cultured species.

Table 1.—Names of the Pacific salmon.

English name	Japanese name	Scientific name
Cherry salmon	masu	*Oncorhynchus masou*
Chinook salmon[1]	masunosuke	*O. tshawytscha*
Chum salmon	sake	*O. keta*
Coho salmon[2]	gin-zake	*O. kisutch*
Pink salmon	karafuto-masu	*O. gorbuscha*
Redspot salmon	amenouo	*O. rhodurus*
Sockeye salmon[3]	beni-zake	*O. nerka*

[1]Also called king salmon.
[2]Also called silver salmon
[3]Also called red salmon; the land-locked form is called kokanee salmon.

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Table 2.—Japan's salmon supply, 1974-84[1].

Year	Catch (1,000 t)				Trade (1,000 t)			Total supply (1,000 t)
	Coastal[2]	High-seas[3]	Culture	Total	Imports	Exports	Balance	
1974	39.2	86.9		126.1	8.3	13.1	+ 4.8	121.3
1975	64.2	91.0		155.2	10.7	19.9	+ 9.2	146.0
1976	38.1	82.2		120.3	9.5	20.8	+ 11.3	109.0
1977	45.5	62.6		108.1	26.4	4.7	− 21.7	129.8
1978	59.1	41.5	0.1	100.7	57.9	4.2	− 53.7	154.4
1979	87.3	42.4	0.4	130.1	64.7	1.7	− 63.0	193.1
1980	79.9	42.5	1.9	124.3	48.7	1.3	− 47.4	171.7
1981	107.9	42.5	1.2	151.7	83.1	1.7	− 81.4	233.1
1982	101.5	42.4	2.1	146.0	117.7	0.5	−117.2	263.2
1983	120.6	42.5	2.9	166.0	108.5	0.9	−107.6	273.6
1984	N/A[4]	40.0	4.5E[5]	N/A	N/A	N/A	N/A	N/A

[1]Catch is given in live weight and trade statistics are in product weight. Since over 90 percent of all salmon imported in recent years was whole fresh or frozen, the total supply weight has only a small margin of error.
[2]The Japanese refer to this catch as the "hatchery returns" catch. In addition to the inshore coastal catch, the figures also include the inland salmon catch, but exclude a small cherry salmon and landlocked salmon catch.
[3]The Soviet-granted catch quota was 42,500 t from 1978 to 1983; in 1984, it was reduced to 40,000 t.
[4]N/A = Not available.
[5]E = Estimate.

The Fisheries

Japan catches salmon in both coastal and high-seas fisheries and farms them in coastal cages. Until the middle 1970's, most of Japan's catch was taken by the high-seas fleet. However, the Soviet declaration of a 200-mile fishing zone in 1976, and subsequent insistence that the Japanese reduce their high-seas catch of Soviet-origin salmon, sent Japan's high-seas catch to a low of 107,000 t in 1978.

The Government enlarged its hatchery program in 1979 to improve coastal harvests, and the program has been remarkably successful. Thus, the increasing coastal catch helped Japanese fishermen land a record 166,000 t of salmon in 1983. Several species of Pacific salmon are caught by Japanese fishermen, but most (>75 percent in 1983) are chum salmon (Table 3).

Table 3.—Japan's salmon catch, by species, 1974-83.

Species	Catch (t)									
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983[1]
Chum	80,146	99,485	78,417	71,931	74,069	101,468	96,920	120,801	111,760	
Pink	32,537	45,936	29,629	35,264	17,176	24,060	20,101	25,509	20,797	
Coho	9,713	8,161	7,697	3,757	5,755	2,708	3,634	3,285	5,022	
Sockeye	8,155	7,733	6,844	4,601	5,261	5,510	6,070	5,227	4,269	
Cherry	3,101	3,871	3,814	3,822	3,600	2,669	2,777	3,298	3,661	
Chinook	1,867	1,115	1,604	908	1,075	1,227	2,484	1,381	1,018	
Total[2]	135,519	166,301	130,005	120,283	108,956	137,640	131,986	159,499	148,527	166,000

[1]Preliminary estimate.
[2]FAO and Japanese catch statistics do not always agree (see "Total catch" in Table 2).

Coastal

Japan's coastal salmon fishery is conducted almost entirely with fixed gear. Trap nets are set in shallow coastal waters near the natal rivers where the hatchery-produced salmon return to

Table 4.—Salmon hatchery programs in Hokkaido and Honshu, 1974-87.

Year	Fry released (in millions)			Salmon returns[1] (1,000 t)		
	Hokkaido	Honshu	Total[2]	Hokkaido	Honshu	Total[2]
1974	485	272	757	35.1 (2.2)	4.0 (0.8)	39.2 (1.8)
1975	802	344	1,146	57.6 (2.7)	6.7 (0.9)	64.2 (2.2)
1976	523	287	810	32.1 (1.9)	6.0 (0.7)	38.1 (1.5)
1977	693	413	1,106	37.3 (2.3)	8.2 (0.8)	45.5 (1.7)
1978	779	433	1,212	48.0 (2.7)	11.2 (1.1)	59.2 (2.1)
1979	873	590	1,463	69.0 (2.4)	18.7 (1.5)	87.7 (2.1)
1980	1,146	750	1,896	56.4 (3.0)	25.4 (2.4)	81.8 (2.8)
1981	1,080	738	1,818	80.0 (3.2)	29.1 (1.9)	109.1 (2.7)
1982	1,108	864	1,972	73.1 (2.6)	30.4 (1.9)	103.6 (2.3)
1983	1,147	829	1,976	84.0 (2.6)	39.5 (1.8)	123.5 (2.3)
1984	1,179[3]	846[3]	2,025[3]	N/A[4]	N/A	N/A
1985	N/A	N/A	N/A	N/A	N/A	N/A
1986	N/A	N/A	N/A	N/A	N/A	N/A
1987	N/A	N/A	N/A	100.7 (2.5)E[5]	40.2 (1.9)E	140.9 (2.3)E

[1]Includes cage-culture production. Data in parentheses indicate percentage rates of return of salmon fry released 4 years earlier.
[2]Totals may not agree because of rounding.
[3]Releases planned for 1984.
[4]N/A = Not available.
[5]E = Estimated from salmon fry released in 1984.

Table 5.—JFA budget for the Salmon Culture Program, 1979-84.

Item	Budget (millions of yen)					
	1979	1980	1981	1982	1983	1984
Cost of governmental hatcheries	¥2,005	¥2,200	¥2,264	¥2,186	¥2,218	¥2,070
Subsidies to private hatcheries[1]	1,241	1,386	1,409	1,289	1,241	1,172
Total (millions of yen)	¥3,246	¥3,586	¥3,673	¥3,475	¥3,459	¥3,242
Total (millions of U.S. dollars)	$14.7	$15.9	$18.6	$13.9	$14.5	$14.1

[1]The 1951 "Aquatic Resources Conservation Law," obligates the Japanese Government to subsidize the expenses of privately managed salmon hatcheries, provided that coastal fishermen also bear part of the expenses.

spawn after being at sea 3-7 years.

The coastal fishery is also entirely dependent on the returns of hatchery-raised chum salmon. Those which escape this commercial fishery, and continue their migration upriver, are collected in weirs for delivery to hatcheries where they are spawned to complete the life cycle.

Japan's salmon hatchery programs have been exceptionally successful, and returns have increased steadily. The coastal catch of hatchery-produced salmon increased from 39,200 t in 1974 to 120,600 t in 1983, or by 200 percent (Table 2). The increased returns were especially pronounced during the early 1980's and were the result of the 5-year (1979-83) salmon culture program sponsored by the Japanese Government.

This program was carried out by 44 governmental and about 220 private hatcheries in Hokkaido and Honshu, and increased releases and new release methods reportedly insured the program's success. Although the salmon return 3-5 years after release, the JFA calculates the returns for an average 4-year period (Table 4).

Japan released nearly 2 billion salmon fry in 1983 (1.2 billion from government hatcheries and 0.8 billion from private hatcheries). Most (1.8 billion—94 percent) were chum fry. The Japanese also released small amounts of sockeye; pink, *O. gorbuscha*; cherry, *O. masou*; and kokanee, *O. nerka*, salmon fry in 1983. Japanese coastal fishermen expect to harvest 140,900 t, or about 38.6 million mature salmon in 1987.

The JFA has expressed concern about a new 5-year salmon hatchery program (1984-88) because of the long-term effect it might have on prices and the costs involved. If the 1987 projected hatchery returns are accurate and if salmon imports continue to increase, JFA officials believe that salmon supplies might exceed the demand, resulting in lower prices. The JFA is therefore considering a hatchery enhancement program for fry of such high-valued species as cherry and sockeye salmon (i.e., qualitative rather than quantitative hatchery enhancement). The JFA is also considering sponsoring new efforts to advance the return season of chum salmon to increase its oil content and value since the Japanese prefer a "fatty" salmon.

Financial problems are also affecting plans for a new 5-year salmon hatchery program. The Japanese Finance Ministry does not wish the JFA to continue assuming the large burden of financing the hatchery program and believes that coastal trap-net fishermen should contribute more to the hatchery program since they benefit most from the salmon returns. In 1983, Japanese fishermen paid only $5.5 million of the $20.0 million spent on the hatchery enhancement program, while the JFA salmon culture budget supplied the remaining $14.5 million (Table 5).

High-Seas

Japan's high-seas salmon fishery consists of mothership, drift-net, and long-lining operations in the North Pacific. Japan also depends on annual catch quotas granted by the U.S.S.R. for its high-seas salmon catch, about 90 percent of which was spawned in Soviet rivers[1].

Until 1977, Japan obtained most of its salmon from the high-seas (65 percent in 1974). By 1983, however, only 16 percent came from this fishery (Fig. 1), as the Soviet quotas were reduced more than 52 percent (from 83,000 t in 1974 to 40,000 t in 1984).

The most significant quota reduction occurred in 1978 when the U.S.S.R. proposed a total ban on the Japanese high-seas salmon fishing and, as a compromise, reduced Japan's salmon quota from 62,000 t to 42,500 t, where it remained through 1983. During the 1984 negotiations, the Japanese high-seas salmon quota was further reduced to 40,000 t.

The bilateral salmon agreement also requires Japan to pay fishery fees. These are paid in goods related to the enhancement of the Soviet Pacific salmon industry. Although Japan's annual high-seas salmon quota was constant between 1978 and 1983, Soviet fishing fee demands increased. In 1978 Japan paid Russia $8.5 million ($200/t), and in 1983 the fees had more than doubled to $17.9 million

[1]In addition to the U.S.S.R. salmon quota, established by a bilateral agreement, Japanese fishermen also operate under the terms of the International North Pacific Fisheries Convention (INPFC).

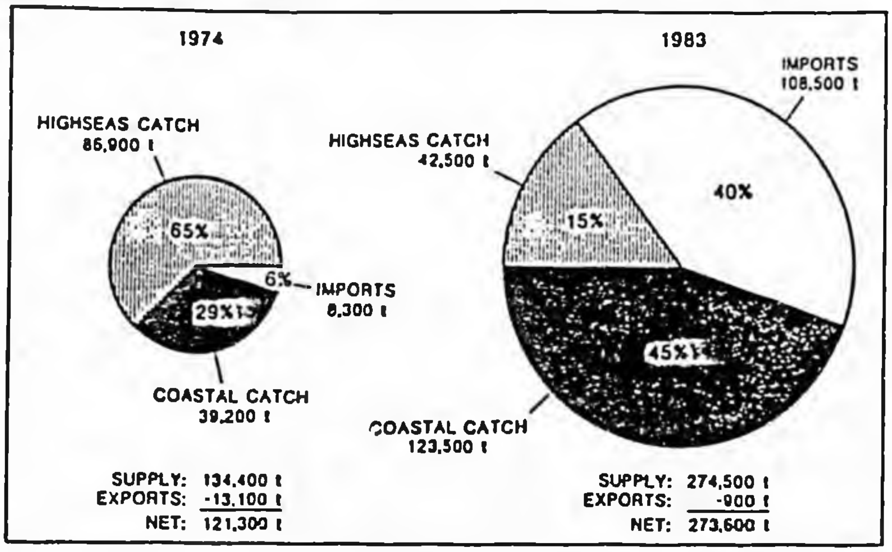

Figure 1.—Japan's salmon supply, excluding exports, 1974 and 1983.

Table 6.—The seven Japanese chum salmon gradings, after W. C. Atkinson (1984), "The Japan Salmon Market with Emphasis on the Market for Kotzebue Chum Salmon").

Grading	Description
Mepka	"Ocean bright" salmon taken in the high-seas catch; meat is firm, skin color is healthy.
Ginke	"Silver bright" salmon taken in the coastal catch; meat is firm, skin color is healthy.
Buna "A"	"Dark salmon" taken in the coastal catch; color of skin and flesh is slightly changed.
Buna "B"	"Dark salmon" taken in the coastal catch; skin and flesh colors have darkened.
Buna "C"	"Dark salmon" taken in the coastal catch. This is the darkest colored chum in the coastal catch.
River Buna	"River dark" salmon taken in rivers (inland catch); these are salmon taken just prior to spawning.
Marked	Damaged or wounded chum salmon.

($421/t). The Japanese Finance Ministry has criticized this fee because the Japanese fishing industry pays only 55 percent of it, while the remaining 45 percent is subsidized through the JFA budget.

Cage Culture

Japanese fish farmers raise only the coho or silver salmon in ocean cages. Salmon farming began in 1973 when 1 million coho eggs were imported from the United States for experimental freshwater culture. Japanese pen-farming operations switched to ocean-cage farming in 1975 because the salmon had a slow growth rate in fresh water.

Japan's coho production increased from 72 t in 1978 to 2,900 t in 1983 (Table 2) and all was consumed domestically. Japanese companies expected to harvest 4,500 t of farmed salmon in 1984 and as much as 8,000 t by 1990. More than half of the 1984 harvest will be produced by the Nichiro company (2,500 t), followed by Taiyo (1,000 t), Nichimo (500 t), and various smaller companies (500 t). The Japanese Government does not offer financial incentives to salmon farmers as they do to private salmon hatchery operations, and apparently prefers to "let the market decide."

Domestic Markets

Salmon is popular in the Japanese diet, especially as a holiday gift item. Consumption was minimal before 1960, however, and limited mainly to northern Japan where the fish were caught. Since then, salmon consumption has increased throughout Japan owing to population growth, extensive advertising, fluctuating supplies of other fishery products, and an increase in per capita income. Observers forecast that the Japanese salmon consumption will expand if prices do not increase significantly.

Japan's salmon market was over-supplied in 1983 by record coastal catches and large imports. This depressed salmon prices and, in some instances, resulted in their dumping. Although the JFA projected that the fall 1984 coastal catch would be lower than in 1983, observers believed that 1984 salmon imports would also decline.

Commodities

Most salmon in Japan is salted, smoked, or canned; the rest is consumed fresh. Although per capita consumption of salted and smoked salmon has increased greatly in recent years, fresh salmon consumption has increased only marginally, perhaps because the Japanese traditionally favor salted and smoked salmon over fresh salmon.

Salmon roe, a favored delicacy in Japan, is mostly cured, either as "sujiko" (in the membranous skein) or "ikura" (eggs separated from the skein). It is especially consumed during the New Year holidays (Oshogatsu).

Species

Chum salmon is the cheapest and most abundant salmon in Japan, and more of it is consumed there than any other salmon. Mostly salted or smoked, it is obtained from the coastal catch; only small quantities are processed from imports or the high-seas catch.

When landed, chums are systematically graded by age and condition. Those with bright skin, firm and "good color" flesh, and high fat content are rated highest, while old and spent or damaged salmon are rated among the lowest of the seven gradings (Table 6).

Chum salmon have long been popular gifts in Japan. However, Japanese wholesalers see a need to reassess the so-called "gift salmon" market since the 1983 record-high chum landings depressed market prices. Lower prices resulted in decreased demand as many Japanese consumers saw the low-priced and abundant product as an undesirable gift item. One Japanese wholesaler believes that Japanese consumers may switch from chum to sockeye as a gift item if there is an over-supply of chum in the future, since sockeye is not only more expensive, but is also thought to be a better tasting, fattier salmon with redder flesh.

Sockeye and pink salmon are also popular in Japan. Sockeye is the species

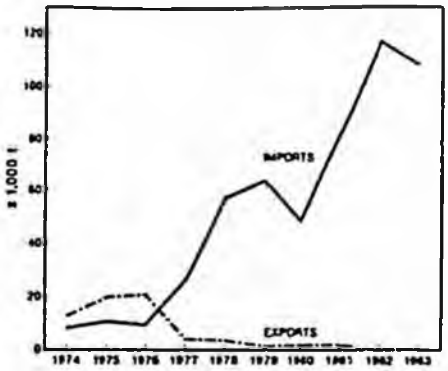

Figure 2.—Japan's salmon imports and exports (product weight), 1974-83.

Table 7.—Japan's salmon imports by commodity and country, 1977-84.

Commodity and country	Imports (t) 1977	1978	1979	1980	1981	1982	1983	1984
Fresh								
United States	50	27	74	6	38	206	1,272	5
Norway				2	29	33	78	179
Other countries	5	15	6	6	428	6	7	69
Subtotal	55	42	80	14	495	245	1,357	253
Frozen								
United States	14,834	40,833	48,030	33,019	60,212	93,063	86,669	80,271
Canada	3,706	7,053	4,720	2,641	5,157	10,834	3,837	5,178
Taiwan	31	5					3,687	2,413
North Korea	662	1,808	1,382	1,674	3,002	1,501	1,188	1,681
South Korea	12	7	25	6	359	1,362	1,928	1,962
U.S.S.R.			439	1,991	2,546	645	254	1,363
Other countries	34	32	15	1	65	73	283	110
Subtotal	19,279	49,738	54,610	39,331	71,341	107,478	97,848	92,978
Cured								
United States							7	695
Canada							121	563
North Korea							17	10
Subtotal							145	1,268
Roe								
Cured[1] (sujiko)								
United States	5,554	6,319	6,799	7,403	9,509	8,596	8,098	8,544
Canada	1,110	1,474	983	1,154	1,190	982	648	629
Other countries	18	10	9	43	33	59	36	33
Subtotal	6,682	7,803	7,791	8,600	10,732	9,637	8,782	9,206
Cured[1] (ikura)								
United States	80	35	50	50	10	2	77	19
Canada	4	2	9	negl.	2	negl.	4	2
China	32	17	8	3				
Other countries	5	7	9	1	1	negl.	1	5
Subtotal	121	61	76	54	13	2	82	26
Canned								
United States	214	213	1,547	345	294	121	93	20
U.S.S.R.	60	1	390	415	203	112	117	137
Canada	1	60	232	29	61	87	65	41
Other countries	negl.	negl.	1	1	3	1	2	4
Subtotal	275	274	2,170	790	561	321	277	[2]202
Grand total[3]	26,412	57,918	64,733	48,789	83,142	117,685	108,491	103,933

[1] "Sujiko" is cured roe in the skein. "Ikura" is cured roe separated from the skein.
[2] Japan's canned salmon imports were only available from January through November 1984.
[3] Totals may not agree because of rounding.

most imported, while the pink accounts for Japan's second-largest salmon catch. Both species are favored by Japanese buyers who prefer that fish be landed or imported in the "princess cut" style (head-on) so quality-conscious consumers can better evaluate it for eye clarity and proper handling.

Trade

Before 1977, Japan exported more salmon than it imported. Since then, however, increasing demand (especially for species less harvested by Japanese fishermen), combined with declining high-seas catches, have greatly increased salmon imports (Fig. 2, Table 2), i.e. 108,500 t were imported vs. 900 t exported in 1983.

Imports

Japan's salmon imports (primarily frozen) increased from 8,300 t in 1974 to 108,500 t in 1983, largely owing to the high-seas catch decline, growth in salmon demand by increasingly affluent consumers, and fluctuating exchange rates. For example, 1978 salmon imports more than doubled from 1977 because a strong yen made U.S. salmon purchases less expensive. Also, Japanese importers were concerned about future salmon supplies which seemed uncertain after the Soviet Union reduced Japan's salmon catch quota 32 percent (20,100 t).

As a result of the increased imports, Japan accumulated large inventories of frozen salmon in 1979, which overlapped into 1980, causing a 30 percent decrease in salmon imports. Then, during 1981 and 1982, salmon imports increased nearly 130 percent (from 48,700 t to 117,700 t) as domestic demand increased.

In 1983, Japan's salmon imports again decreased (to 108,500 t) as a result of the record domestic catch. This 1983 "glut" also depressed Japan's salmon prices 30-40 percent in the wholesale market, and by 20 percent in the retail market. Preliminary FAO estimates[2] forecast that Japan's 1984 imports of frozen salmon would be 70,000-75,000 t, a 30 percent drop from 1983 imports, which would adversely impact many U.S. salmon exporters.

Japan imports more salmon from the United States than from any other country (Table 7). Their 1983 imports totaled over 96,000 t, and accounted for 90 percent of Japan's total salmon imports by quantity. Frozen salmon was the largest commodity imported (86,700 t), followed by salmon roe (8,175 t), fresh salmon (1,272 t), and canned salmon (93 t).

The United States was the largest sup-

[2] FAO. "Infofish Trade News" (84/11). 16 June 1984.

Table 8.—Japanese imports of salmon products from the United States, by species, 1977-84.

Species	Imports (t)							
	1977	1978	1979	1980	1981	1982	1983	1984
Sockeye	N/A[1]	N/A	N/A	N/A	42,387	55,226	71,664	56,468
Chum	N/A	N/A	N/A	N/A	6,564	8,251	6,069	6,261
Chinook	N/A	N/A	N/A	N/A	2,548	1,432	2,465	1,172
Pink	N/A	N/A	N/A	N/A	1,061	12,876	1,556	10,167
Other[2]	N/A	N/A	N/A	N/A	16,303	22,503	12,729	11,920
Total[3]	15,594	41,418	44 596	30,914	68 863	100 288	94 483	85,988

[1]N/A = Not available.
[2]Unidentified salmon species; includes canned and filleted products and salmon roe.
[3]U.S. and Japanese trade statistics do not agree (i.e., 1983 U.S. Department of Commerce trade statistics indicate that the U.S. exported 94,483 t of salmon to Japan; Japanese trade statistics, however, showed U.S. exports of 96,217 t).

plier of fresh salmon to Japan in 1983, accounting for 1,272 t, or 93.8 percent of the total (Table 7). Norway was the second largest supplier (but of Atlantic salmon, *Salmo salar*), providing 77.5 t, or 5.7 percent of the total. Preliminary Japanese trade statistics through May 1984 indicated that Norway had already exported almost 94 t of fresh Atlantic salmon to Japan, 20 percent more than in 1983. Observers believe that Norway's farmed Atlantic salmon exports to Japan will continue to compete with U.S. fresh Pacific salmon exports.

Sockeye or red salmon has been the leading U.S. species imported by Japan in recent years (Table 8). In 1983, the sockeye accounted for over 75 percent by quantity and 70 percent by value of U.S. salmon shipments to Japan.

U.S. salmon exporters were not greatly affected by Japan's record salmon hatchery returns in 1983. U.S. shipments totaled over 96,000 t in 1983, a decline of only 5 percent from the nearly 102,000 t exported in 1982 (Table 7). This is because Japan released and harvested mostly chum salmon and not sockeye salmon—the primary U.S. export species.

Concern among U.S. salmon exporters may develop, however, if Japan expands hatchery efforts on sockeye salmon. In 1983, the JFA released 61,000 sockeye fry, and observers reported that the JFA planned to hatch and release 100,000 sockeye fry by 1985. If the sockeye returns are successful, the JFA may increase such releases in the future.

Exports

Japan enjoyed a favorable balance of trade in salmon products until 1976 (Table 2). However, salmon product exports have since declined (Fig. 2), especially in 1977 after the Soviets decreased Japan's high-seas catch quota. Expanded domestic salmon demand in recent years also contributed to the export reduction.

Both in 1982 and 1983, Japan exported less than 1,000 t of salmon products. However, Japanese trade statistics through May 1984 indicated that Japan's early 1984 salmon exports (1,000 t) had already exceeded 1983 exports, which observers indicate was due to the 1983 over-supply of salmon on the Japanese market.

Conclusions

The factors which continue to influence Japan's salmon supply include: 1) Coastal (hatchery-produced) chum catches, 2) salmon imports, and 3) high-seas catches. Japan must carefully balance these factors to meet the domestic demand while not over-supplying the market (as in 1983).

The high-seas catch represents an especially difficult problem since it depends on annual bilateral quota agreements with the Soviet Union. Japan has tried to convince Soviets to agree to a long-term salmon agreement that would assure economic stability for Japanese high-seas salmon fishermen and also assure domestic markets a specified portion of the total salmon supply for several years. So far the Soviets have been unwilling to agree to this proposal.

Japan will remain the largest foreign market for U.S. salmon exports. The amount of U.S. exports will depend, however, upon Japan's domestic demand for salmon. Some observers believe that Japanese consumers are developing a greater affinity for U.S. sockeye over the traditionally favored chum. Salmon prices will also influence U.S. exports, since the typical Japanese consumer is price-conscious about seafood.

Japan's salmon catches (both coastal and high-seas) will also influence U.S. exports. Furthermore, if Japan's high-seas salmon quota is reduced in the future, U.S. salmon exports would probably increase. (Source: IFR-84/79D)

Status of Mexico's Fisheries, 1983-84

Mexico's Fisheries Secretary Pedro Ojeda Paullada has announced that the Mexican Government's goal is to more than double the 1983-84 fisheries catch of 1.1 million metric tons (t) (data adjusted for the period 1 Sept.-31 Aug.) to 2.5 million t by 1988. While the 1983-84 harvest was less than in previous years (Table 1), the apparent decline probably reflects more accurate statistical reporting and the lingering results of the of the 1982-83 El Niño on the important Pacific Coast small pelagic fisheries . Secretary Ojeda's remarks came in a late 1984 briefing of the Mexican Congress on the status of the fisheries.

Mexico has a mixed economy and the three major economic sectors (private, cooperative, and public) each play an important role in the fishing industry. The private sector takes the largest quantity of fish, about 66 percent during 1983-84. Most of the private catch

Table 1.—Mexico's fish catch, recent and projected (1988).

Year[1]	Catch (1,000 t)
1975	487.5
1976	526.3
1977	610.8
1978	702.6
1979	877.0
1980	1,243.6
1981	1,564.8
1982	1,506.0
1983-84[2]	1,100.0
1988	2,500.0

[1]Calendar year.
[2]Sept.-31 Aug.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Auke Bay Laboratory
P. O. Box 210155, Auke Bay, Alaska 99821
907 789 6000
Western Union Telex II (TWX) 5101000492

February 14, 1989

Dr. Dave Harrison
c/o Rep. Jim Zawacki
Pouch V
Juneau, Ak 99811

Dear Dr. Harrison:

I am including estimates of salmon interceptions by the high seas salmon fisheries of Japan per your telephone request of this date. I estimated interceptions by the Japanese mothership fishery as follows:

Table 1.--Estimates of interceptions of North American salmon by the Japanese mothership salmon fishery in thousands of fish, 1980-1987.[1]

Year	Sockeye	Chum	Pink	Coho	Chinook	Total
1980	885	39	8	164	582	1,678
1981	668	28	2	154	69	921
1982	523	38	8	288	85	942
1983	513	44	2	74	68	701
1984	632	40	15	196	68	951
1985	410	15	<1	32	52	510
1986	142	29	<1	16	47	235
1987[2]	134	26	<1	9	32	211

[1]Source: Michael Dahlberg, NMFS, Auke Bay. April 27, 1988, Fredin, R.A., et al. 1977. Pacific Salmon and the high seas salmon fisheries of Japan. Proc. Rept. U.S. Dept. Comm. NOAA. Northwest and Alaska Fisheries Center. 324 pp. INPFC Documents 2489, 2607, 2739, 2866, 2988, 3132 and 3269. C. Harris, 1987, FRI, pers. comm.

[2]Preliminary

Estimates of interceptions by the Japanese landbased driftnet fishery were published in a paper by C. Harris; I include a copy of pertinent tables.

Sincerely,

Michael L. Dahlberg, Ph.D.
Mathematical Statistician

Table 14. Total catch and estimated catch of Western Alaska (including Canadian Yukon) chinook salmon (in thousands of fish) in Japanese high seas salmon gillnet fisheries, 1964-1988[a,b]

Year	Mothership Total Catch	Mothership W.AK Catch	Landbased Total Catch	Landbased W.AK Catch	Combined Total Catch	Combined W.AK Catch
1964	410	179	208	40	618	219
1965	185	106	102	20	287	126
1966	208	108	118	22	326	130
1967	128	71	115	22	243	93
1968	362	244	97	18	459	262
1969	554	367	88	17	642	384
1970	437	312	148	28	585	340
1971	206	132	139	27	345	159
1972	261	189	107	20	368	209
1973	119	56	165	31	284	87
1974	361	208	188	36	549	244
1975	162	108	137	20	299	407
1976	285	117	201	42	486	159
1977	93	55	146	31	239	86
1978	105	36	210	63	315	99
1979	126	69	160	45	286	114
1980	704	416	160	22	864	438
1981	88	30	190	55	278	85
1982	107	45	165	41	272	86
1983	87	31	178	44	265	75
1984	82	36	92	21	174	57
1985	66	25	101	22	167	47
1986	60	24	77	20[c]	137	44[c]
1987[d]	39	20	77	NA[e]	116	NA[e]
1988	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]	NA[e]

a Sources: 1964-83: Rogers, Donald et al., 1984. Origins of chinook salmon in the area of Japanese Mothership Fisheries. Fisheries Research Institute, University of Washington. 215 pgs. 1984-1987 WA catch estimate for mothership fishery: Mike Dahlburg, National Marine Fisheries Service, Juneau, AK.

b Western Alaska catches represent fish from Bristol Bay, Kuskokwim, Yukon River and Norton Sound areas.

c From Rogers, Donald. April 1987. Interceptions of Yukon Salmon by High Seas Fisheries, Fishery Research Institute, University of Washington, 34 pp. Dahlburg, Michael T. (NMFS) reported 9/27/86 an estimate of 24,000 west AK chinook salmon intercepted by mothership fleet. The difference between these two estimates results in the estimate of 20,000 western AK chinooks intercepted in the landbased fishery for 1986.

d Preliminary information.

e Data not available.

STATE OF ALASKA
1990 LEGISLATIVE SESSION

BILL VERSION: SCS CSHJR 27(Res)
PUBLISH DATE: 4/10/90

FISCAL NOTE

CC

REQUEST:

Revision Date:

Title: Compensation for Salmon Interceptions

Sponsor: Zawacki and Hanley

Requestor: House Rules

Agency Affected: Revenue

BRU: Income & Excise Audit

Component: Operating

EXPENDITURES/REVENUES: (Thousands of Dollars)

OPERATING	FY 90	FY 91	FY 92	FY 93	FY 94	FY 95
PERSONAL SERVICES						
TRAVEL						
CONTRACTUAL						
SUPPLIES						
EQUIPMENT						
LAND & STRUCTURES						
GRANTS, CLAIMS						
MISCELLANEOUS						
TOTAL OPERATING	-0-	-0-	-0-	-0-	-0-	-0-
CAPITAL	-0-	-0-	-0-	-0-	-0-	-0-
REVENUE	-0-	-0-	-0-	-0-	-0-	-0-

FUNDING: (Thousands of Dollars)

GENERAL FUND						
FEDERAL FUNDS						
OTHER						
TOTAL	-0-	-0-	-0-	-0-	-0-	-0-

POSITIONS: N/A

FULL-TIME						
PART-TIME						
TEMPORARY						

ANALYSIS: (Attach a separate page if necessary)

Updated fiscal note - attachment

Prepared by: Rep. Ben Grussendorf, Chairman
Phone: 465-3764
Division: House Rules Committee
Date:

Approved by Commissioner:
Date:
Agency:

Distribution (by preparer):
- Legislative Finance
- Legislative Sponsor
- Requestor
- Office of Management and Budget
- Impacted Agency(ies)

Changes in SCS CSHJR (Res) have no fiscal impact. This fiscal note is appropriate. Projections of no fiscal impact would continue through 1996.

HJR 27
Prepared by:
Steven E. Kettel
Department of Revenue
March 30, 1989

SJR 27 estimates high seas interception of salmon at 2,000,000 fish. To determine the fish tax lost as a result of interception we have made the following assumptions:

1) 15% of the fish are Western Alaska Chinooks with an ex-vessel value of $19.00 per fish.

2) 44% of the fish are Bristol Bay Sockeye with an ex-vessel value of $4.60 per fish.

3) 3% of the fish are Western Alaska chums with an ex-vessel value of $2.80 per fish.

4) 38% of the fish are Prince William Sound Coho with an ex-vessel value of $8.50 per fish.

5) All fish are processed by floating processors which pay a 5% raw fish tax.

6) No estimate of salmon enhancement tax losses are considered for purposes of this analysis.

Specie	# of Fish	Value/Fish	Total Value	Tax(5%)
Chinook	300,000	$19.00	5,700,000	285,000
Sockeye	880,000	4.60	4,048,000	202,400
Chums	60,000	2.80	168,000	8,400
Coho	760,000	8.50	6,460,000	323,000
	2,000,000		16,376,000	818,800

STATE OF ALASKA
1990 LEGISLATIVE SESSION

BILL VERSION: SCS CSHJR 27(Res)
PUBLISH DATE: 4/10/90

FISCAL NOTE

REQUEST:

Revision Date:
Title: Compensation for Salmon Interceptions
Sponsor: Zawacki and Hanley
Requestor: House Rules

Agency Affected: Revenue
BRU: Income & Excise Audit
Components: Operating

EXPENDITURES/REVENUES: (Thousands of Dollars)

OPERATING	FY 90	FY 91	FY 92	FY 93	FY 94	FY 95
PERSONAL SERVICES						
TRAVEL						
CONTRACTUAL						
SUPPLIES						
EQUIPMENT						
LAND & STRUCTURES						
GRANTS, CLAIMS						
MISCELLANEOUS						
TOTAL OPERATING	-0-	-0-	-0-	-0-	-0-	-0-
CAPITAL	-0-	-0-	-0-	-0-	-0-	-0-
REVENUE	-0-	-0-	-0-	-0-	-0-	-0-

FUNDING: (Thousands of Dollars)

GENERAL FUND						
FEDERAL FUNDS						
OTHER						
TOTAL	-0-	-0-	-0-	-0-	-0-	-0-

POSITIONS: N/A

FULL-TIME						
PART-TIME						
TEMPORARY						

ANALYSIS: (Attach a separate page if necessary)

Updated fiscal note - attachment

Prepared by: Rep. Ben Grussendorf, Chairman — Phone: 465-3764
Division: House Rules Committee — Date:

Approved by Commissioner: — Date:
Agency:

Distribution (by preparer):
- Legislative Finance
- Legislative Sponsor
- Requestor
- Office of Management and Budget
- Impacted Agency(ies)

Changes in SCS CS HJR (Res) have no fiscal impact. This fiscal note is appropriate. Projections of no fiscal impact would continue through 1996.

Anchorage Times
Nov. 3, 1989

U.S. seeks ban on drift netting

Sen. Ted Stevens
... initiated idea

By DANIEL R. SADDLER
Times Writer

The United States has introduced a resolution in the United Nations General Assembly seeking a global moratorium on the use of drift nets to harvest fish on the high seas.

The resolution asks all nations to voluntarily end use of the nets by June 30, 1992, and to cooperate in collection of scientific data on the impact of the fishing practice on marine life.

It also seeks an immediate ban on high-seas drift netting in the South Pacific to prevent irreversable damage to fish resources and to give time for development of fish management plans.

In recent years, fishing vessels from Japan, Tai-

See Ban, page A-6

Ban: High-seas drift netting

Continued from page A-1

wan, South Korea and China have increased their use of the nets. Stretched up to 40 miles through the international waters, the monofilament nets efficiently harvest many species of fish and squid, but also indiscriminately snare marine mammals, seabirds and other species.

The resolution echoes the concerns of fishermen and environmentalists in Alaska and elsewhere that improper use of driftnets represents a "strip mining" of the oceans.

"Large-scale pelagic drift-net fishing is an indiscriminate fishing method which threatens the effective conservation of living marine resources such as highly migratory and anadromous species of fish, birds and marine mammals," the resolution said.

In recent months the United States signed driftnet treaties with Japan, Taiwan and South Korea, requiring observers to gather data on catches and watch for fishing abuses, and in some cases, granting enforcement powers to the U.S. Coast Guard.

Alaska Sen. Ted Stevens proposed the idea for a U.N. resolution to Secretary of State James Baker several months ago, Jane Robbins, a Stevens aide, said Thursday.

"United Nations approval of this resolution would place tremendous worldwide pressure on the governments of Japan, Taiwan and South Korea to put an end to their high seas drift-net fleets," Stevens said in announcing the resolution.

Stevens hopes to build global pressure to bear against those Asian nations to end the practice and to make sure that any driftnets banned in one ocean don't end up in the North Pacific to compete with Alaska fishermen.

"There's been a move in the South Pacific to start a moratorium on drift nets down there, and Sen. Stevens is worried that the fleets that operate in the South Pacific were kicked out they might move to the North Pacific," said Robbins.

U.N. delegations from New Zealand and Australia co-sponsored the resolution, introduced in the General Assembly Thursday afternoon by Thomas Pickering, the U.S. ambassador to the United Nations.

The non-binding resolution will be referred to the U.N. Committee on Environment for consideration, and a vote could come by early December, Robbins said.

Salmon smuggler enters guilty plea

The Associated Press

SEATTLE — A Taiwanese fish broker arrested in an undercover sting operation last summer has pleaded guilty to conspiracy, smuggling and money-laundering charges related to pirated salmon. He faces up to 30 years in prison and $1 million in fines, officials said.

Patrick Lee, 41, entered the plea Monday and will be sentenced March 23.

Assistant U.S. Attorney Robert Chadwell said charges involving trade in smaller amounts of salmon were dropped as part of a plea agreement.

Lee was arrested last summer with five others following a six-month sting operation in which federal agents agreed to pay $1.3 million for salmon caught illegally by two Taiwanese fishing boats.

Such harvests have outraged Alaska fishermen, who charge the Taiwanese and other high-seas fishermen are taking salmon that otherwise would return to state waters to spawn. Scientist sampling of the high-seas salmon have found that some return to Asian spawning grounds, and some to North America.

The six men caught in the Seattle sting were charged with violating the Lacey Act, which prohibits commerce in illegally caught fish or wildlife. Taiwan has a law expressly forbidding its fishing boats from catching salmon since no salmon breed in its rivers.

Lee's name was noticed last spring when he placed ads in an international seafood journal for headed and gutted salmon.

Undercover investigators arranged to buy 500 tons of salmon for $1.3 million.

Lee and John Chin-Hong Wang, a naturalized American citizen who had just graduated from the Massachusetts Institute of Technology and whose father was a vessel owner, flew together from Taiwan to Seattle, investigators said.

According to a court filing, an undercover agent, code-named "Frambes," showed Lee $1.5 million in cash in a safe deposit box at Seafirst Bank, supposedly to cover the purchase.

Please see Page D-3, FISH

FISH: Taiwanese broker pleads guilty to salmon scam

Continued from Page D-1

Frambes contacted undercover agents on Redfin, a leased freighter, and confirmed they had rendezvoused with two Taiwanese squid boats on the high seas and had seen the salmon in their holds.

Lee and Wesley Meng Hsu, identified as Lee's Los Angeles agent, then went into a private room at Seafirst Bank where Frambes handed over an initial payment of $330,000.

Hsu and Lee were arrested outside the bank with the money in Hsu's briefcase.

Meanwhile, at sea, the captains of the two squid boats, Meng Gin Hsu and Chan Lon Lin, were invited on board the Redfin. Once aboard the U.S.-flagged vessel, they were arrested, with interpreter Jen Chu.

As a Coast Guard cutter arrived on the scene, the two Taiwanese vessels fled. In an ensuing chase, one boat es caped while the other wa boarded by the Coast Guar and Taiwanese authorities.

The arrests, combine with the conviction of tw major fish brokers earlie this year, has dried up th sale of pirated salmon in th United States, said Wayn Lewis, the special agent i charge of law enforcement a the National Marine Fishe ies Service.

But he said Taiwanes driftnet boats continue t pirate U.S. salmon.