INTERNATIONAL PACIFIC SALMON
FISHERIES COMMISSION

APPOINTED UNDER A CONVENTION
BETWEEN CANADA AND THE UNITED STATES FOR THE
PROTECTION, PRESERVATION AND EXTENSION OF
THE SOCKEYE AND PINK SALMON FISHERIES
IN THE FRASER RIVER SYSTEM

ANNUAL REPORT

1973

COMMISSIONERS

W. R. HOURSTON	THOR C. TOLLEFSON
RICHARD NELSON	DeWITT GILBERT
RODERICK HAIG-BROWN	DONALD R. JOHNSON

NEW WESTMINSTER
CANADA
1974

INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION

MEMBERS AND PERIOD OF SERVICE SINCE THE INCEPTION OF THE COMMISSION IN 1937

CANADA

William A. Found	1937-1939
A. L. Hager	1937-1948
Senator Thomas Reid	1937-1967
A. J. Whitmore	1939-1966 1968-1969
Olof Hanson	1948-1952
H. R. MacMillan, C.B.E., D.Sc.	1952-1956
F. D. Mathers	1956-1960
W. R. Hourston	1960-
Richard Nelson	1966-
Roderick Haig-Brown	1970-

UNITED STATES

Edward W. Allan	1937-1951 1957-1957
B. M. Brennan	1937-1942
Charles E. Jackson	1937-1946
Fred J. Foster	1943-1947
Milo Moore	1946-1949 1957-1961
Albert M. Day	1947-1954
Alvin Anderson	1949-1950
Robert J. Schoettler	1951-1957
Elton B. Jones	1951-1957
Arnie J. Suomela	1954-1961
DeWitt Gilbert	1957-
George C. Starlund	1961-1966
Clarence F. Pautzke	1961-1969
Thor C. Tollefson	1966-
Charles H. Meacham	1969-1970
Donald R. Johnson	1971-

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DIRECTOR — A. C. COOPER

ASSISTANT DIRECTOR — J. F. ROOS

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REPORT OF THE
INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION
FOR THE YEAR 1973

Two years ago at the Annual Meeting of the Commission in December 1971, the Commission announced its recommendation to the Governments of Canada and the United States for a $14 million development program of 12 spawning channels for sockeye and pink salmon. The nine sockeye projects would produce an average annual catch of 5.7 million sockeye, and with existing channels and natural spawning areas, would produce a total average catch of 10 million sockeye annually, or 1 million more than average catches from 1894 to 1913. The three pink salmon projects would produce a catch of 4 million pink salmon every other year, and would increase the average catch of this species to 8.9 million fish each cycle. The average annual value of the catch that would be produced by the 12 projects was calculated to be $14.7 million to the fishermen at 1971 prices.

The Commission based its recommendation on the results obtained from 3 years of returns to the Weaver Creek channel, 5 years of returns to the Pitt River channel and 4 cycles of returns to the Seton Creek channel. The two governments acknowledged the desirability of the program recommended. The United States Government passed an Authorization Bill in 1972 for its $7 million half share of the program. The Canadian Government stated that it was prepared to provide all the funds for the program, but did not wish to participate on an equal share basis as provided in the Sockeye Salmon Convention. As a consequence of lack of agreement between the two governments, the program has not been funded yet and the Commission has not been able to proceed. In December 1972 an understanding was reached authorizing the Commission to proceed with a small initial stage for a pink salmon channel on the Chilliwack River. Clearing of the site was completed in the spring of 1973, at which time the Canadian Government determined that further work could not be done except on the basis of Canada paying all costs, and because of lack of agreement of the two governments on this, the work had to be stopped. However, construction of the spawning channel on the Nadina River at the outlet of Nadina Lake was completed in 1973, on a joint basis, and the channel was put into operation in August.

Returns of sockeye and pink salmon in 1972 and 1973 to existing projects have reinforced the substantiation for the program proposed by the Commission. The 1973 sockeye run to Weaver Creek totaled 438,000 fish, the largest run recorded for this stock, and more than double the return in the brood year 1969. The spawning channel at Weaver Creek produced 88% of the 1973 return and gave the fishermen a catch of 341,000 sockeye. The five years of returns produced by the spawning channel have given a cumulative total catch of 610,900 sockeye with a cumulative value of $2,510,000 to fishermen at each year's prices. This benefit was produced by a capital investment of $281,000 in 1965.

Similarly, the seven years of returns to the Pitt River channel have produced a cumulative catch of 377,000 sockeye, with a value of $1,400,000 to fishermen at each year's prices. This return has been obtained from an investment of $74,000 in 1961-63.

The small first channel for pink salmon at Seton Creek has produced a cumulative catch of 466,000 pinks in 6 cycles with a cumulative value of $500,000 to fishermen at each year's prices. This channel cost $32,000 in 1961. The larger second channel at Seton Creek has produced a cumulative catch of 793,000 pinks in 3 cycles with a value of $1,004,000 to fishermen at each year's prices. This channel cost $217,000 in 1967.

The $14 million program recommended by the Commission was planned to be undertaken over a period of 16 years. Many of the projects would be undertaken in stages, to match the growth of the stocks. Under the schedule of construction proposed by the Commission, sockeye projects on Pitt River and Upper Adams River were to have been in operation in 1974 and on the Barriere River in 1975. Major sockeye projects on Horsefly River and McKinley Creek were to be in full operation in 1977, and the initial stages of projects on Lower Nadina, Ankwil Creek and Kazchek Creek were to be in operation in 1977, the next dominant cycle run to all these streams. It was expected that the Upper Pitt River project would reach full production in 1978, but the Horsefly River project would not reach full production until 1985, and the Lower Nadina River project would not reach full production until 1997 because of the limitations imposed by the rate of increase in stock abundance. Delays in proceeding with the program can only partially be compensated by increased initial expenditures, particularly in the case of sockeye projects if a dominant cycle run is missed for the initial stocking of a channel.

The Commission shares the concern of its Advisory Committee about the opportunities being foregone because of the delay in proceeding with the program. The Commission and its staff have the necessary proven biological and engineering background and expertise to ensure success of the program, as well as a record of prudent use of funds. The Commission urges the two governments to reach agreement so that the program can proceed and the benefits therefrom can be realized as soon as possible.

COMMISSION MEETINGS

The International Pacific Salmon Fisheries Commission held twenty-six formal and fifteen telephone meetings during 1973 with the approved minutes of these meetings being submitted to the Governments of Canada and the United States.

The first meeting of 1973 was held January 29, with Mr. Thor C. Tollefson serving as Chairman and Mr. W. R. Hourston, Vice-Chairman and Secretary. The Commission noted that United States Troll Fishermen representative, Mr. Frank Lowgren, would be unable to serve on the Advisory Committee. The Commission approved the appointment of Mr. Gerald Simmons as United States Troll Fishermen representative to the Advisory Committee.

The Commission met with the Advisory Committee regarding the tentative recommendation for regulatory control of the 1973 sockeye and pink salmon fishery in Convention waters, as submitted to the Committee by the Commission

on December 8, 1972. After certain revisions, the Commission approved the recommended regulations for submission to the two national governments. The Commission's Advisory Committee was composed of the following members for 1973:

Canada	*United States*
J. Lenic, Jr. (to Nov. 14) J. Brajcich (from Nov. 19) Purse Seine Fishermen	N. Mladinich Purse Seine Fishermen
L. Monk Salmon Processors	D. Franett Salmon Processors
F. Nishii Gill Net Fishermen	R. Christensen Gill Net Fishermen
H. Stavenes Purse Seine Crew Members	J. Brown Reef Net Fishermen
W. Edwards (to April 19) M. Ellis (from Nov. 19) Troll Fishermen	G. Simmons (from January 29) Troll Fishermen
H. English Sport Fishermen	E. Engman Sport Fishermen

On March 1, 1973 the Commission met representatives of the Pension Society, and also considered the budget and related administrative matters. The Commission also approved a limited program of gravel cleaning and egg planting in the Horsefly River in 1973 to offset possible loss in production due to prespawning mortality.

The third meeting of the year was held on April 18, 1973. The Commission approved the Annual Report for 1972, discussed administrative matters and received staff reports on the following subjects: 1. Algal growth, foam, and water coloration of Kamloops Lake and Thompson River, 2. Chilliwack and Nadina Spawning Channels, 3. Egg-to-fry survival on the Horsefly River, pertaining to last fall's egg plant, 4. Smolt studies at Cultus, Chilko and Shuswap Lakes, and 5. Methods of determining fry production at Weaver Creek and Pitt River.

On May 18, 1973 the Commission reviewed tenders received for the construction of the first stage of the Chilliwack River pink salmon spawning channel. The Commission approved acceptance of the lowest bid.

Twenty formal and fourteen telephone meetings were held from June 29 to October 12 for adjustment of fishery regulations. On June 29, the Commission reviewed the status of the Nadina and Chilliwack spawning channels with reference to policy statements of the Canadian Government. On July 24, the Commission reviewed its policy with respect to the division of catches during a strike, and pending discussion with the Advisory Committee, adopted an interim policy that

catches on scheduled days of fishing would count in division, but catches on additional days fishing allowed because of the strike would not count in division, with the understanding that the resulting theoretical division difference at the end of the season would be subject to practical limitations of management of the fishery. On August 31, 1973 the Commission, Advisory Committee members and representatives of industry and press toured the spawning grounds at Horsefly River.

The twenty-fourth formal meeting of the year was held on November 19th and 20th. The Commission approved four-year appointments of Canadian Advisory Committee members Capt. J. Brajcich and Mr. Merv Ellis, representing Purse Seine Fishermen and Troll Fishermen. The Commission had earlier received the resignations of Capt. J. Lenic, Jr. and Mr. W. Edwards as advisory members representing Purse Seine and Troll Fishermen in Canada. The Commission considered administrative matters affecting the Commission's operation and reviewed financial procedures. It also met with its Advisory Committee to discuss the Commission's policy with regard to division of catches during a strike, and also the serious problems encountered in both countries during 1973 in securing complete current catch information.

The twenty-fifth formal meeting of the year was held on November 30, 1973. The Commission considered the proposed regulations and predictions for the 1974 sockeye salmon run as well as other administrative matters.

The twenty-sixth and final formal meeting of the year was held on December 7 in Vancouver, B. C. when thte Commission met with its Advisory Committee, staff and approximately 450 representatives of industry, government and press. The catch and escapement statistics for the 1973 fishing season were presented by the staff. Reports were also presented on the following topics: 1. Production of sockeye and pink salmon from Commission spawning channels, 2. Summary of pollution investigations, 3. Results of recent prespawning mortality studies and 4. Lake productivity studies. Prospects for the 1974 fishing season were reviewed and tentative proposals for regulating the 1974 fishery were released subject to further consideration by members of the industry and their representatives on the Commission's Advisory Committee.

1973 REGULATIONS

Recommendations for regulations governing the 1973 sockeye and pink salmon fishery in Convention waters were adopted at a meeting of the Commission held on January 29, 1973 and submitted to the two national governments for approval and to the State of Washington for implementation on February 1, 1973. The recommendations for Canadian Convention waters were implemented by the Government of Canada by an Order-in-Council dated August 21, 1973 and for United States Convention waters by an Order of the Director of the Washington State Department of Fisheries on April 10, 1973.

The recommendations of the Commission were as follows:

Canadian Convention Waters

"The International Pacific Salmon Fisheries Commisison appointed pursuant to the Convention between Canada and the United States of America for the protection, preservation and extension of the Sockeye Salmon Fisheries of the Fraser River System, signed at Washington on the 26th day of May, 1930 as amended by the Pink Salmon Protocol signed at Ottawa on the 28th day of December, 1956, hereby recommends the regulations to the following effect, in the interests of such fisheries be adopted by Order-in-Council as amendments to the Special Fishing Regulations for British Columbia, for the season of 1973, under authority of the Fisheries Act, namely:

1. (1) No person shall fish for sockeye or pink salmon in the waters of the southerly portion of District No. 3 embraced in that portion of Area 20 lying westerly of a line drawn true south from Sheringham Point Lighthouse to the International Boundary line with nets from the 24th day of June, 1973 to the 21st day of July, 1973, both dates inclusive.

(2) No person shall fish for sockeye or pink salmon in the waters described in subsection (1) of this section with purse seines:

(a) From the 22nd day of July, 1973 to the 1st day of September, 1973, both dates inclusive, except from half past six o'clock in the forenoon to half past six o'clock in the afternoon of Monday and Tuesday of each week; and

(b) From the 2nd day of September, 1973 to the 15th day of September, 1973, both dates inclusive, except from seven o'clock in the forenoon to seven o'clock in the afternoon of Monday and Tuesday of each week.

(3) No person shall fish for sockeye or pink salmon in the waters described in subsection (1) of this section with gill nets:

(a) From the 22nd day of July, 1973 to the 1st day of September, 1973, both dates inclusive, except from:

(i) half past six o'clock in the afternoon of Monday to half past six o'clock in the forenoon of Tuesday; and

(ii) half past six o'clock in the afternoon of Tuesday to half past six o'clock in the forenoon of Wednesday of each week; and

(b) From the 2nd day of September, 1973 to the 15th day of September, 1973, both dates inclusive, except from:

(i) seven o'clock in the afternoon of Monday to seven o'clock in the forenoon of Tuesday; and

(ii) seven o'clock in the afternoon of Tuesday to seven o'clock in the forenoon of Wednesday of each week.

(4) No person shall fish for sockeye or pink salmon in the waters described in subsection (1) of this section with hook and line or trolling gear, except for the purpose of personal consumption and not for sale or barter, from the 22nd day of July, 1973 to the 15th day of September, 1973, both dates inclusive, except at the times that net fishing may be permitted within that area.

2. (1) No person shall fish for sockeye or pink salmon in the waters of the southerly portion of District No. 3 embraced in Areas 17 and 18, and in the Convention waters portion of District No. 1 by means of nets:

(a) From the 24th day of June, 1973 to the 14th day of July, 1973, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday of each week; and

(b) From the 15th day of July, 1973 to the 28th day of July, 1973, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Wednesday of each week; and

(c) From the 29th day of July, 1973 to the 15th day of September, 1973, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday of each week; and

(d) From the 16th day of September, 1973 to the 22nd day of September, 1973, both dates inclusive; and

(e) From the 23rd day of September, 1973 to the 13th day of October, 1973, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday of each week.

3. No person shall fish for sockeye or pink salmon with hook and line or trolling gear, except for the purpose of personal consumption and not for sale or barter, in the Convention waters of Canada lying easterly and inside of a straight line projected from Gower Point at the westerly entrance to Howe Sound to Thrasher Rock Light, thence in a straight line to Salamanca Point on the southerly end of Galiano Island, thence in a straight line to East Point on Saturna Island, thence in a straight line towards Point Roberts Light to the intersection with the International Boundary line, thence following the International Boundary line to its intersection with the mainland from the 12th day of August, 1973 to the 30th day of September, 1973, both dates inclusive, except at the times and locations that net fishing other than with chinook salmon nets may be permitted within that area.

All times hereinbefore mentioned shall be Pacific Daylight Saving Time."

United States Convention Waters

"The International Pacific Salmon Fisheries Commission appointed pursuant to the Convention between Canada and the United States of America for the protection, preservation and extension of the Sockeye Salmon Fisheries of the Fraser River System, signed at Washington on the 26th day of May, 1930, as amended by the Pink Salmon Protocol signed at Ottawa on the 28th day of December, 1956, hereby recommends to the United States Government that regulations to the following effect, in the interests of such fisheries, be adopted for the year 1973, and that an approved copy of said regulations be forwarded to the Director of Fisheries of the State of Washington for implementation by virtue of authority in him vested by Section 6 of Chapter 112 of the Laws of the State of Washington of 1949, namely:

1. (1) No person shall fish for sockeye or pink salmon in the Convention waters of the United States of America lying westerly of a straight line drawn from Angeles Point in the State of Washington across Race Rocks to William Head in the Province of British Columbia with purse seines:

(a) From the 24th day of June, 1973 to the 11th day of August, 1973, both dates inclusive, except from five o'clock in the forenoon to half past nine o'clock in the afternoon of Monday and Tuesday of each week; and

(b) From the 12th day of August, 1973 to the 15th day of September, 1973, both dates inclusive, except from five o'clock in the forenoon to nine o'clock in the afternoon of Monday and Tuesday of each week.

(2) No person shall fish for sockeye or pink salmon in the waters described in subsection (1) of this section with gill nets:

(a) From the 24th day of June, 1973 to the 30th day of June, 1973; from the 8th day of July, 1973 to the 14th day of July, 1973; from the 22nd day of July, 1973 to the 28th day of July, 1973; and from the 5th day of August, 1973 to the 11th day of August, 1973, all dates inclusive, except from seven o'clock in the afternoon of Monday to half past nine o'clock in the forenoon of Tuesday and from seven o'clock in the afternoon of Tuesday to half past nine o'clock in the forenoon of Wednesday of each week; and

(b) From the 1st day of July, 1973 to the 7th day of July, 1973; from the 15th day of July, 1973 to the 21st day of July, 1973; and from the 29th day of July, 1973 to the 4th day of August, 1973, all dates inclusive, except from seven o'clock in the afternoon of Sunday to half past nine o'clock in the forenoon of Monday and from seven o'clock in the afternoon of Monday to half past nine o'clock in the forenoon of Tuesday of each week; and

(c) From the 12th day of August, 1973 to the 18th day of August, 1973; from the 26th day of August, 1973 to the 1st day of September, 1973; and from the 9th day of September, 1973 to the 15th day of September, 1973, all dates inclusive except from six o'clock in the afternoon of Sunday to nine o'clock in the forenoon of Monday and from six o'clock in the afternon of Monday to nine o'clock in the forenoon of Tuesday of each week; and

(d) From the 19th day of August, 1973 to the 25th day of August, 1973, and from the 2nd day of September, 1973 to the 8th day of September, 1973, all dates inclusive, except from six o'clock in the afternoon of Monday to nine o'clock in the forenoon of Tuesday and from six o'clock in the afternoon of Tuesday to nine o'clock in the forenoon of Wednesday of each week.

(3) No person shall fish for sockeye or pink salmon in the waters described in subsection (1) of this section with commercial trolling gear from the 5th day of August, 1973 to the 15th day of September, 1973, both dates inclusive, except from twelve o'clock (midnight) Sunday to twelve o'clock (midnight) Friday of each week.

2. (1) No person shall fish for sockeye or pink salmon in the Convention waters of the United States of America lying easterly of a straight line drawn from Angeles Point in the State of Washington across Race Rocks to William Head in the Province of British Columbia with purse seines:

(a) From the 24th day of June, 1973 to the 11th day of August, 1973, both dates inclusive, except from five o'clock in the forenoon to half past nine o'clock in the afternoon of Monday and Tuesday of each week; and

(b) From the 12th day of August, 1973 to the 29th day of September, 1973, both dates inclusive, except from five o'clock in the forenoon to nine o'clock in the afternoon of Monday and Tuesday of each week.

(2) No person shall fish for sockeye or pink salmon in the waters described in subsection (1) of this section with reef nets:

(a) From the 24th day of June, 1973 to the 30th day of June, 1973; from the 8th day of July, 1973 to the 14th day of July, 1973; from the 22nd day of July, 1973 to the 28th day of July, 1973; and from the 5th day of August, 1973 to the 11th day of August, 1973, all dates inclusive, except from twelve o'clock (noon) Monday to half past nine o'clock in the afternoon of Monday, from five o'clock in the forenoon to half past nine o'clock in the afternoon of Tuesday and from five o'clock in the forenoon of Wednesday to twelve o'clock (noon) Wednesday of each week; and

(b) From the 1st day of July, 1973 to the 7th day of July, 1973; from the 15th day of July, 1973 to the 21st day of July, 1973; and from the 29th day of July, 1973 to the 4th day of August, 1973, all dates inclusive, except from twelve o'clock (noon) Sunday to half past nine o'clock in the afternoon of Sunday, from five o'clock in the forenoon to half past nine o'clock in the afternoon of Monday and from five o'clock in the forenoon of Tuesday to twelve o'clock (noon) Tuesday of each week; and

(c) From the 12th day of August, 1973 to the 18th day of August, 1973; from the 26th day of August, 1973 to the 1st day of September, 1973; from the 9th day of September, 1973 to the 15th day of September, 1973; and from the 23rd day of September, 1973 to the 29th day of September, 1973, all dates inclusive, except from twelve o'clock (noon) Sunday to nine o'clock in the afternoon of Sunday, from five o'clock in the forenoon to nine o'clock in the afternoon of Monday and from five o'clock in the forenoon of Tuesday to twelve o'clock (noon) Tuesday of each week; and

(d) From the 19th day of August, 1973 to the 25th day of August, 1973; from the 2nd day of September, 1973 to the 8th day of September, 1973; and from the 16th day of September, 1973 to the 22nd day of September, 1973, all dates inclusive, except from twelve o'clock (noon) Monday to nine o'clock in the afternoon of Monday, from

five o'clock in the forenoon to nine o'clock in the afternoon of Tuesday and from five o'clock in the forenoon of Wednesday to twelve o'clock (noon) Wednesday of each week.

(3) No person shall fish for sockeye or pink salmon in the waters described in subsection (1) of this section with gill nets:

(a) From the 24th day of June, 1973 to the 30th day of June, 1973; from the 8th day of July, 1973 to the 14th day of July, 1973; from the 22nd day of July, 1973 to the 28th day of July, 1973; and from the 5th day of August, 1973 to the 11th day of August, 1973, all dates inclusive, except from seven o'clock in the afternoon of Monday to half past nine o'clock in the forenoon of Tuesday and from seven o'clock in the afternoon of Tuesday to half past nine o'clock in the forenoon of Wednesday of each week; and

(b) From the 1st day of July, 1973 to the 7th day of July, 1973; from the 15th day of July, 1973 to the 21st day of July, 1973; and from the 29th day of July, 1973 to the 4th day of August, 1973, all dates inclusive, except from seven o'clock in the afternoon of Sunday to half past nine o'clock in the forenoon of Monday and from seven o'clock in the afternoon of Monday to half past nine o'clock in the forenoon of Tuesday of each week; and

(c) From the 12th day of August, 1973 to the 18th day of August, 1973; from the 26th day of August, 1973 to the 1st day of September, 1973; from the 9th day of September, 1973 to the 15th day of September, 1973; and from the 23rd day of September, 1973 to the 29th day of September, 1973, all dates inclusive, except from six o'clock in the afternoon of Sunday to nine o'clock in the forenoon of Monday and from six o'clock in the afternoon of Monday to nine o'clock in the forenoon of Tuesday of each week; and

(d) From the 19th day of August, 1973 to the 25th day of August, 1973; from the 2nd day of September, 1973 to the 8th day of September, 1973; and from the 16th day of September, 1973 to the 22nd day of September, 1973, all dates inclusive, except from six o'clock in the afternoon of Monday to nine o'clock in the forenoon of Tuesday and from six o'clock in the afternoon of Tuesday to nine o'clock in the forenoon of Wednesday of each week.

(4) No person shall fish for sockeye or pink salmon in that portion of the waters described in subsection (1) of this section lying easterly and inside of a fifteen fathom depth line, as measured at mean lower low water, projected from Partridge Point Light on Whidbey Island to the northwest corner of Deception Island to the Initiative 77 Marker on Fidalgo Island with nets from the 24th day of June, 1973 to the 28th day of July, 1973, both dates inclusive.

(5) No person shall fish for sockeye or pink salmon in that portion of the waters described in subsection (1) of this section designated as State Fishing Area No. 4 (Discovery Bay) with nets:

(a) From the 24th day of June, 1973 to the 21st day of July, 1973, both dates inclusive; and

(b) From the 22nd day of July, 1973 to the 8th day of September, 1973, both dates inclusive, except with nets having mesh of not less than 8 inches extension measure and at such times as authorized by the Washington State Director of Fisheries.

(6) No person shall fish for sockeye or pink salmon in that portion of the waters described in subsection (1) of this section lying westerly of a straight line drawn true south from the southeast tip of Point Roberts in the State of Washington (otherwise known as Lily Point) to the International Boundary line with nets from the 2nd day of September, 1973 to the 15th day of September, 1973, both dates inclusive.

(7) No person shall fish for sockeye or pink salmon in that portion of the waters described in subsection (1) of this section lying northerly and westerly of a straight line drawn from Iwersen's Dock on Point Roberts in the State of Washington to Georgina Point Light at the entrance to Active Pass in the Province of British Columbia with nets from the 16th day of September, 1973 to the 13th day of October, 1973, both dates inclusive.

3. (1) The foregoing recommended regulations shall not apply to the following United States Convention waters:

(a) State Fishing Area No. 7 including all Convention waters known as Bellingham Bay lying inside of a line extending from Point Frances through the Post Point Bell Buoy to the mainland, and

(b) That portion of State Fishing Area No. 3 lying easterly and inside of a line projected from Carter Point on Lummi Island to the most northerly tip of Vendovi Island, thence to Clark Point on Guemes Island including the waters of Samish Bay, and

(c) Preserves previously established by the Director of Fisheries of the State of Washington for the protection of other species of food fish.

All times hereinbefore mentioned shall be Pacific Daylight Saving Time."

Emergency Orders

In order to provide for adequate racial escapements of Fraser River sockeye and pink salmon and for an equitable share of the season's catch by the fishermen of Canada and the United States, the approved regulations as detailed above were later adjusted by the Commission as follows:

June 29, 1973—In the interest of adequate harvest of the Early Stuart run, the Commission recommended that all United States Convention waters open as scheduled for the week commencing July 1, but for three days instead of the scheduled two days, and Areas 17, 18 and District No. I of Canadian Convention waters open as scheduled, but for two days instead of the one day originally scheduled.

July 3, 1973—To provide further harvest of a large Early Stuart run, and in the interest of division of catch, the Commission recommended that 24 hours additional fishing be granted in the Canadian Convention waters Areas 17, 18 and District No. I, giving a total of three days fishing for the current week.

July 10, 1973—Due to the strike by Canadian fishermen and indications the Early Stuart escapement would exceed optimum requirements, the Commission recommended an additional 48 hours fishing in all United States Convention waters during the current week.

July 12, 1973—As the result of the continuation of the strike in Canada, and because the Early Stuart escapement would exceed the desired numbers, the Commission recommended an additional 24 hours in all United States Convention waters, for a total of five days fishing for the current week.

July 13, 1973—On the basis that more than optimum escapement had been obtained from the Early Stuart run, and with the likelihood of resumption of fishing by Canadian fishermen, the Commission recommended that those Canadian Convention waters encompassed in Areas 17, 18 and District No. I open for fishing from 6:00 p.m. Sunday, July 15 and until 8:00 a.m. Wednesday, July 18.

July 16, 1973—Due to the continued presence of Early Stuart sockeye in Convention waters, the Commission recommended 24 hours additional fishing in all Convention waters currently open to fishing.

July 24, 1973—In the interest of harvesting the early parts of the Horsefly and Late Stuart runs, the Commission recommended an additional 24 hours fishing in all Convention waters currently open to fishing.

July 27, 1973—In order to obtain additional Late Stuart and Horsefly sockeye escapement, the Commission recommended the opening in Areas 17, 18 and District No. I of Canadian Convention waters be delayed 24 hours with fishing commencing at 8:00 a.m. Tuesday, July 31 for a period of 24 hours.

July 31, 1973—To provide for harvest of Horsefly and Late Stuart runs, the Commission recommended an extension of 24 hours fishing time in all Convention waters.

August 1, 1973—In the interest of division of catch, the Commission recommended an additional 24 hours fishing in Area 20 of Canadian Convention waters, giving a total of four days, for the current week.

August 3, 1973—In order to secure sufficient escapement of Horsefly and Late Stuart sockeye, and because of the difference in division of catch, the Commission recommended that United States Convention waters not open for fishing as scheduled for the week commencing August 5.

August 7, 1973—In the interest of obtaining adequate harvest and to reduce the difference in division of catch, the Commission recommended the following adjustments in regulations: 1. That fishing in Area 20 of Canadian Convention waters be extended 24 hours making three days for the current week; 2. That Areas 17, 18 and District No. I of Canadian Convention waters open to fishing from 4:00 p.m. Thursday, August 9 until 8:00 a.m. Saturday, August 11; 3. That United States Convention waters be opened to fishing commencing August 8, for two days.

August 8, 1973—In view of the large catch in United States Convention waters on August 8, the Commission recommended in the interest of division of catch, that fishing in United States waters be limited to only one day rather than the scheduled two days.

August 10, 1973—In the interest of obtaining further escapement of the later segments of Horsefly and Late Stuart runs, the Commission recommended that all United States Convention waters and the Canadian Convention waters of Areas 17, 18 and District No. I not open as scheduled for the week commencing August 12.

August 13, 1973—The Commission recommended the following regulatory changes: 1. That all United States Convention waters open 24 hours later than the scheduled times for each gear and for one day only; 2. That all Canadian Convention waters in Areas 17, 18 and District No. I open for fishing for 24 hours starting 8:00 a.m. Tuesday, August 14.

August 14, 1973—The Commission recommended that all Convention waters have an additional 24 hours fishing, making three days in Area 20 of Canadian Convention waters and two days in the remainder of Convention waters for the current week.

August 17, 1973—The Director of the Washington State Department of Fisheries requested that State Fishing Area 4 except that portion in Discovery Bay southerly of a line from Cape George to Diamond Point be opened to fishing on the same basis as other United States Convention waters, to determine the accuracy of indications of a better than expected return of pink salmon stocks to Puget Sound waters. The Commission approved the opening on a one week basis.

August 21, 1973—In order to harvest both sockeye and pink salmon in Convention waters, the Commission recommended that an additional day's fishing be granted in Area 20 of Canadian Convention waters and in all United States Convention waters.

August 22, 1973—The Commission recommended the following regulatory changes: 1. That all United States Convention waters have 24 hours additional fishing, making four days fishing for the current week except State Fishing Area 4 which would be closed because of the small numbers of pink salmon in the area; 2. That Canadian Convention waters lying easterly of William Head line and westerly of the "Blue Line" be opened for 12 hours fishing commencing 8:00 p.m. Thursday, August 23 in order to harvest Weaver Creek sockeye and aid in the division of catch.

August 28, 1973—To provide additional harvest of delaying Weaver Creek sockeye in Georgia Strait, the Commission recommended 24 hours fishing in Areas 17, 18 and District No. I outside or westerly of the "Apex Line" starting 8:00 a.m., Wednesday, August 29.

August 30, 1973—In the interest of harvesting sockeye and pink salmon in Convention waters, the Commission recommended the following regulations: 1. That Area 20 of Canadian Convention waters open Saturday, September 1, for three days fishing; 2. That all United States Convention waters except the waters lying northerly and westerly of the Iwersen's Dock - Georgina Light line be opened for three days fishing commencing 12:00 noon Friday, August 31 for reef nets, 6:00 p.m. Friday, August 31 for gill nets, and 5:00 a.m. Saturday, September 1, for purse seines; 3. That Areas 17, 18 and District No. I outside the "Apex Line" open for 24 hours fishing commencing at 7:00 p.m. Monday, September 3; 4. That District No. I upstream of the Brunswick Cannery - Oak Street Bridge line open 7:00 p.m. Monday, September 3 for 24 hours fishing.

September 6, 1973—The Commission recommended the following regulations: 1. That Canadian Convention waters of Area 20 open to fishing September 9 for two days; 2. That United States waters be opened for fishing for two days with reef nets starting at 12:00 noon Saturday, September 8, gill nets Saturday evening and purse seines Sunday morning, with the area westerly of Lily Point line closed. In State Fishing Area 4, under State law, fishing not open until 12:01 a.m. September 10, and close at the same time as other United States Convention waters; 3. That in District No. I of Canadian Convention waters, fishing resume at 8:00 a.m. Monday, September 10 for 24 hours, but only in that portion of District No. I lying northerly and westerly of the "Apex Line". Areas 17, 18 and the balance of District No. I would be closed until further notice.

September 10, 1973—In the interest of harvesting the pink salmon run in Convention waters, the Commission recommended that fishing in Area 20 of Canadian Convention waters be extended by two days making a total of four days fishing for the current week. Fishing time in United States waters was also extended by one day, making three days fishing for the current week.

September 14, 1973—The Commission announced that in those United States Convention waters under Commission control, fishing start as scheduled for the week commencing September 16, except for a closure of the waters west of Lily Point line. In addition, it was recommended that Areas 17, 18 and District No. I outside the "Apex Line" in Canadian Convention waters open at 8:00 a.m. Monday, September 17 for 24 hours fishing. The Commission relinquished control of Area 20 of Canadian Convention waters and Area 2 of United States Convention waters effective September 16, as scheduled.

September 21, 1973—In the interests of division of catch of pink salmon, the Commission recommended that fishing resume in Areas 17, 18 and District No. I outside the "Blue Line" starting Monday, September 24 at 7:00 a.m. for 24 hours. To obtain further early run pink salmon escapement, the Fraser River easterly of the "Blue Line" would remain closed except for nets having a mesh not less than 8½ inches extension measure in the area easterly of the Brunswick Cannery - Oak Street Bridge boundary under regulation by the Regional Director of the Fisheries Service. With the declining abundance of pink salmon in the United States Convention waters, the Commission recommended that fishing in Area 1 for the week commencing September 23 be for two days only instead of the scheduled three days, and the area west of the Lily Point line be closed.

September 26, 1973—The Commission recommended in the interest of division of catch that Canadian Convention waters of District No. I, westerly of the "Blue Line" and Areas 17 and 18 be opened for 12 hours fishing commencing at 7:00 p.m. Wednesday, September 26.

September 28, 1973—Due to the small numbers of sockeye and pink salmon remaining in Areas 17 and 18 of Canadian Convention waters, and Area 1 of United States Convention waters, the Commission recommended that control of these areas be relinquished effective September 30, except for United States Convention waters northerly and westerly of the Iwersen's Dock line, which remain closed.

October 5, 1973—The Commission recommended that District No. I of Canadian Convention waters be open for fishing 8:00 a.m. Tuesday, October 9 for 24 hours instead of the scheduled opening on Monday, October 8.

Regulatory control of the remaining Convention waters still in the Commission's control was relinquished as scheduled Sunday, October 14, thus completing the Commission's regulatory obligations for Convention waters for the 1973 season.

SOCKEYE SALMON REPORT

The Fishery

The total 1973 Fraser River sockeye run was estimated at 6,914,000, compared with the pre-season forecast of 5,200,000. The run was the largest for this cycle since 1917. The number of Fraser sockeye entering Convention waters was 6,525,372 of which 5,181,376 (79.4%) were caught commercially, 162,903 (2.5%) were taken by the Indian fishery, and 1,181,093 (18.1%) were recorded on the spawning grounds (see Tables I to VI in Appendix). An estimated total of 25,175 non-Fraser sockeye, mainly from the run to Lake Washington in Washington State, were also caught in Convention waters. The estimated catches of Fraser River sockeye in non-Convention waters in Johnstone Strait and northern Strait of Georgia, and off the west coast of Vancouver Island were 339,000 and 50,000 respectively. The non-Convention waters catch of Fraser River sockeye migrating through Johnstone Strait was 6.1% of the total commercial catch of Fraser sockeye in all areas, and 4.9% of the total run. The latter figure may be compared with a catch of 9.1% of the total run in 1969, the preceding cycle year.

The total 1973 Convention waters catch of 5,206,551 sockeye was 1,944,839 larger than in the brood year 1969 and the total Fraser River sockeye run was 2,050,225 larger. In the Convention area, Canadian fishermen caught 2,578,970 sockeye (49.53%) and United States fishermen caught 2,627,581 (50.47%) (Appendix Tables I and II).

Canadian fishermen were on strike during the week commencing July 8 and during this period a total of 418,394 sockeye were caught by the United States net fishery, 186,489 of which were caught on three days of additional fishing time added in United States Convention waters during the week in an effort to obtain adequate harvest of the large Early Stuart run. Under the interim policy adopted by the Commission, the catches in these three additional days fishing were not to be included in calculating division of catch.

The Early Stuart race in recent years has shown dramatic improvement primarily as a result of conservation measures implemented annually since 1967. The 1973 Early Stuart run, estimated at 1,360,000 sockeye, was the largest return on record dating back to 1900 and very likely was the largest ever to the system. This run has grown spectacularly in two cycles from an escapement of only 23,045 spawners in 1965.

The Late Stuart run equaled the largest return since 1917 (approximately 1,500,000) and the return of sockeye produced in the Quesnel system, principally

the Horsefly River (1,750,000) was also the largest since 1917. In addition, the sockeye runs to Weaver Creek (440,000) and Birkenhead River (455,000) were the largest since records have been compiled for each population.

In Canadian Convention waters, 1,478,493 sockeye were taken in the waters westerly of William Head while 1,100,477 were caught easterly of William Head, mainly near or in the Fraser River. The total catch in the western area was the largest recorded for the cycle year. The percentage of the total catch (55.3%) taken in the Area 20 fishery was the highest yet recorded. The total catch and percentage of the catch taken by purse seines were the highest recorded on the cycle and the total gill net catch in 1973 was the highest since 1941 on the cycle.

In United States Convention waters, the purse seine catch was the largest recorded for the cycle whereas the percentage (53.68%) catch by this gear was the lowest on record for the cycle. The percentage caught by gill nets (40.94%) was the largest recorded for the cycle year and the total catch was also the largest recorded for this gear. Reef nets took 5.36% of the total catch, the highest percentage for the cycle since 1961 and total catch was the largest for the cycle since 1957.

The average weight of 4-year-old sockeye was 5.83 pounds, above the long-term average of 5.65 pounds. The average weight up to August 11 was 5.60 pounds, the same as the long-term cycle average. In the last week of August the average weight increased to about 6.5 pounds because of the abundant Weaver Creek sockeye, which averaged about 6.6 pounds.

One of the unusual characteristics of the sockeye run was the southerly migration pattern of the fish as they entered Convention waters. Not only did a high percentage of the total run enter Juan de Fuca Strait but a significant portion migrated down the United States side of the Strait, thereby reducing the availability of sockeye to the Canadian Area 20 fishery.

Escapement

The net escapement of 1,181,093 sockeye represented 18.1% of the 1973 Fraser run to Convention waters and 17.1% of the calculated total Fraser River run. Although several important spawning areas had escapements below the number recorded in the brood year, the total escapement to all areas exceeded the brood year escapement and was the largest on the cycle since 1961.

The escapement of 300,653 sockeye to the Early Stuart streams exceeded the optimum requirements and was a result of lack of fishing in the Fraser River area because of the strike by Canadian fishermen. Fortunately, the spawners were evenly distributed to all usable streams. The large escapement of 131,172 sockeye to the Driftwood River was the largest ever recorded, and was 43.6% of the total escapement to Early Stuart spawning areas. This exceptional escapement to the Driftwood River reduced the numbers of spawners in other Early Stuart streams, where overspawning would have occurred with the usual distribution of fish.

Escapement to the Bowron River was satisfactory but all streams in the Nechako District including the Nadina and Stellako Rivers produced returns considerably below brood year levels. From the escapement of 16,737 sockeye to the Late Nadina population, 8,786 were diverted into the newly completed spawning channel.

The escapements to Upper Pitt River, Seymour River and Raft River were less than half the number recorded in the brood year. Other stocks migrating at a similar time showed improvement in escapement compared with the brood year return. The early Scotch Creek population has shown remarkable growth and the 1973 escapement was the largest recorded. From only 75 spawners in cycle year 1945, the run has increased to 6,235 spawners in 1973.

Escapements to the major summer run populations into the Quesnel and Stuart Lake systems were very similar to brood year abundance. The Quesnel system had 278,057 spawners in 1973 compared with 278,962 in 1969 and Late Stuart escapement was 214,343 in 1973 compared with 204,969 spawners in 1969. Fortunately, the prespawning mortality in the Horsefly and Mitchell Rivers was

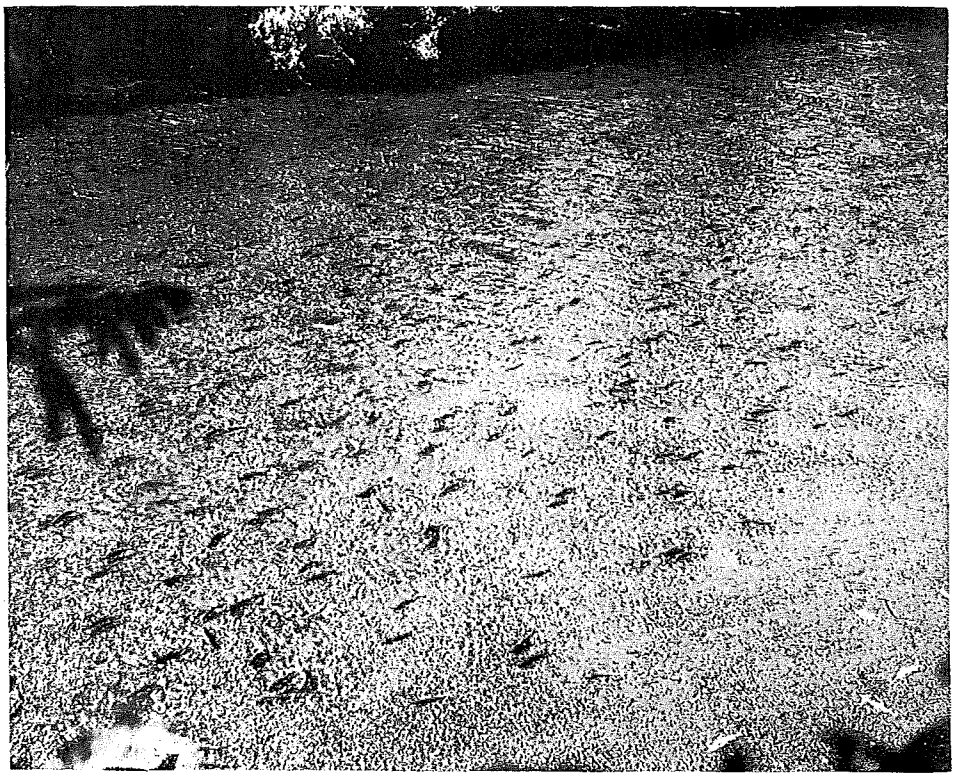

FIGURE 1. Sockeye spawners in the Horsefly River in 1973.

considerably less than that recorded in 1969. In the Horsefly River in 1973 (Figure 1), 72.9% of all female spawners successfully deposited their eggs. Total escapement to Mitchell River was the largest ever recorded and the success of spawning was 80.8%. Total egg deposition into the Quesnel system in 1973 was 100,000,000 more than in the brood year, 1969.

The Chilko escapement was considered satisfactory although it was somewhat below the brood year level. Success of spawning was excellent, as it was for all other summer run populations.

Escapement to the Birkenhead River was the largest ever recorded. Even though 59% were 3-year-old jacks, the adult escapement still exceeded the brood year adult escapement by over 20,000 spawners.

Late run escapements to Harrison River and Cultus Lake were well below those recorded in 1969. However, the escapement to Weaver Creek of 50,173 was almost equal to 1969 despite a more intense commercial fishery in 1973. Total sockeye escapement into the channel was 22,366, the largest number spawning in the channel to date.

The escapement to Adams River was less than in 1969, but there was a significant increase in escapement to Portage Creek and to the Lower Shuswap River. All these late run sockeye stocks were fished hard in 1973 due to the need to adequately harvest the Weaver sockeye produced by the spawning channel.

The total escapement of all runs gave the largest egg deposition for the cycle since 1957.

PINK SALMON REPORT

The Fishery

The total 1973 Fraser River pink salmon run was 6,753,000 fish. The run was about 12% higher than the pre-season predicted maximum run of 6,000,000 but lower than the revised prediction of 9,000,000 given in July, 1973 on the basis of weight of fish caught in the West Coast troll fishery. Since Fraser River pink salmon abundance is inversely related to size of fish, the small size of pink salmon in the troll fishery during the early summer indicated that the 1973 return would exceed the predicted run by a substantial amount. The average weight of pink salmon in the Convention waters troll fishery was the smallest on record dating back more than 20 years. Reasons for the discrepancy in the weight-run size relationship in 1973 are not known. The 1973 total Fraser run was slightly above the average of 6,050,000 for the period 1959 through 1971 and thus the recent pattern of a small run every other cycle since 1961 was broken, as is shown in the production table below. The marine survival of fry produced by the 1971 brood spawning was 2.8%, slightly below the average of 3.2% recorded for the previous five cycle years.

FRASER RIVER PINK SALMON PRODUCTION*

	Brood Year							
	1957	1959	1961	1963	1965	1967	1969	1971
Total Spawners (millions)	2.425	1.078	1.094	1.953	1.191	1.831	1.529	1.804
Female Spawners (millions)	1.423	.596	.654	1.217	.692	1.015	.961	1.103
Potential Egg Deposition (billions)	2.8745	1.0847	1.5692	2.4348	1.4878	2.1321	2.0182	1.923
Fry Production (millions)	—	—	143.6	284.2	274.0	237.6	195.6	245.0
Adult Return (Catch + escapement) (millions)	6.459	1.890	5.326	2.271	12.850	3.849	9.707	6.753
Freshwater Survival	—	—	9.2%	11.7%	18.4%	11.1%	9.7%	12.5%
Marine Survival	—	—	3.7%	0.8%	4.7%	1.6%	5.0%	2.8%

* Fry production data not available prior to 1961.

The total number of pink salmon entering Convention waters in 1973 was estimated to be 6,912,000 as shown in the table below, slightly below the 7,352,000 recorded in the brood year. Fraser River pink salmon constituted 5,516,000 or 79.8% of the total pink salmon run reaching Convention waters. The proportion of Fraser River pink salmon in the total run entering Convention waters in 1973 (79.8%) was similar to the brood year (81.1%). The remaining portion of the run was destined for Canada non-Fraser streams (219,000) and United States streams (1,162,000). In spite of special closures implemented during the 1973 season, the United States stock did not receive sufficient protection from the commercial fishery.

CALCULATED CATCHES AND PERCENTAGE HARVEST FROM PINK SALMON RUNS ENTERING CONVENTION WATERS IN 1973

	Source of Run			
	United States	*Fraser River*	*Canada Non-Fraser*	*Total*
Total Entering Convention Area	1,174,532	5,515,756	221,277	6,911,565
Catch in Canada Convention Waters				
Westerly of William Head	330,532	1,373,262	57,901	1,761,695
Easterly of William Head	—	296,988	1,996	298,984
Total	330,532	1,670,250	59,897	2,060,679
Per Cent Harvest	28.14	30.28		
Catch in United States Convention waters	95,107	2,048,113	81,704	2,224,924
Per Cent Harvest	8.10	37.13		
Total Catch in Convention Area	425,639	3,718,363	141,601	4,285,603
Per Cent Harvest	36.24	67.41		

The 1973 catch in Convention waters was 4,285,603 compared with 4,508,488 taken in brood year 1971 (Table XI). The United States share of the catch was 2,224,924 (51.92%), compared with 2,060,679 (48.08%) for Canada.

The catch of pink salmon by troll fishermen continued at a low level and the United States troll catch of 14,126 (Table X) or 0.64% of the United States total was only slightly better than the previous two brood years. In Canadian Convention waters, the troll catch was 418,574 pink salmon or 20.31% of total catch.

The United States gill net percentage catch was the highest (14.53%) of any year on record but was only slightly larger than the 1971 percentage catch. The catch by reef nets and purse seines was similar to other recent brood years. In Canadian Convention waters, purse seines caught 62.50% of the total pink salmon, the highest percentage catch by the gear since 1963. Gill nets took only 19.85% of the catch, the lowest percentage for this gear since 1963.

In 1973, 81.7% of the total Fraser pink run reached Convention waters compared with 61.4% in brood year 1971. It appears that a significantly higher percentage of the total run entered Convention waters through Juan de Fuca Strait in 1973 compared with 1971 when 33.6% of the total Fraser run was caught in Johnstone Strait compared with an estimated 13.0% in 1973.

A larger than desired number of Weaver Creek sockeye reached the mouth of the Fraser River in 1973 and it was necessary to harvest these surplus sockeye while at the same time afford maximum protection to pink salmon delaying in the Strait of Georgia. During the period from August 29th to the end of the sockeye fishing season on October 9th, a total of 103,672 sockeye of mainly Weaver Creek origin were caught. Even though special closed areas were utilized to protect pink salmon, a total of 257,077 pink salmon were caught at the same time but this harvest of pink salmon was not excessive. Without the use of the "Apex Line" a much larger catch of pink salmon would have been made and desired management objectives would not have been achieved.

Escapement

The total 1973 escapement of pink salmon to the Fraser River was 1,754,111 fish (Table XIV) or about 26.0% of the total run. Of the estimated total of 5,516,000 Fraser pink run reaching Convention waters, 31.8% reached the spawning grounds. The total escapement in 1973 was approximately 49,000 lower than the brood year escapement in 1971.

The escapement of the early runs was considered satisfactory although the portion spawning in the main Fraser River was the smallest since 1965. Approximately 30.4% of the total escapement to the Fraser River migrated to spawning areas above Hell's Gate. The total of 532,562 early run spawners recorded above Hell's Gate represented approximately 40.0% of the total early run escapement. In brood year 1971, the total escapement above Hell's Gate was 571,988 fish or just slightly higher than in 1973. The escapement to Seton Creek area in 1973 of 249,058, although almost 60,000 less than in the brood year, is still considered

to be greater than the optimum number of fish the area can accommodate. The escapement of 283,385 to the Thompson River represented an increase of about 25,000 spawners compared with brood year 1971.

The late run escapement totaled 423,109 fish, the largest escapement since 1963. The Harrison River escapement was 196,150, an increase of about 122,000 over the brood year. The escapement to the Chilliwack-Vedder River system was 210,799 fish, about 50,000 more than in the brood year.

The total escapement of 1,754,111 in 1973 was considerably less than that required to achieve a higher level of production of pink salmon in the Fraser River.

Water levels during spawning in the Fraser and Thompson Rivers were considered satisfactory. Flooding occurred in some of the late run spawning areas such as the Chehalis River and the Chilliwack-Vedder River and probably had an adverse effect on survival of eggs in these areas.

REHABILITATION

During the summer of 1973 the remaining construction at the Nadina River spawning channel was completed. This comprised a pipeline into Nadina Lake for temperature control, operator's residence, power plant and electrical services, water supply and disposal system, and fire protection system. The channel was placed in operation in advance of the arrival of sockeye at the adjacent spawning grounds. A temporary wire screen fence was placed across the river to divert fish into the channel and a large crane was brought in for use in brailing fish into the channel if necessary. The channel is 9,759 ft long by 20 ft wide and is designed to accommodate 29,000 sockeye spawners (Figure 2). It was anticipated that the Late Nadina run would be large enough to provide this escapement to the channel as well as sufficient spawners for the natural spawning ground. However, the total escapement of the run was only 17,000 fish, and out of these 8,786 entered the channel and spawned with 94% success of spawn. The brail was used on one or two occasions to test effectiveness of the method, but otherwise it was not needed, as the fish entered the channel readily and accepted the channel environment.

Fry production data for the 1972 spawning of sockeye at the three sockeye channels operated by the Commission are given in the following table.

SOCKEYE FRY PRODUCTION AT SPAWNING AND INCUBATION CHANNELS FROM THE 1972 BROOD YEAR SPAWNING

Channel	*Eggs Deposited*	*Fry Produced*	*Per Cent Survival*
Weaver Creek	26,380,000	15,210,000	57.7
Upper Pitt	3,792,000	2,997,000	89.2
Gates Creek	7,770,000	6,342,000	81.6

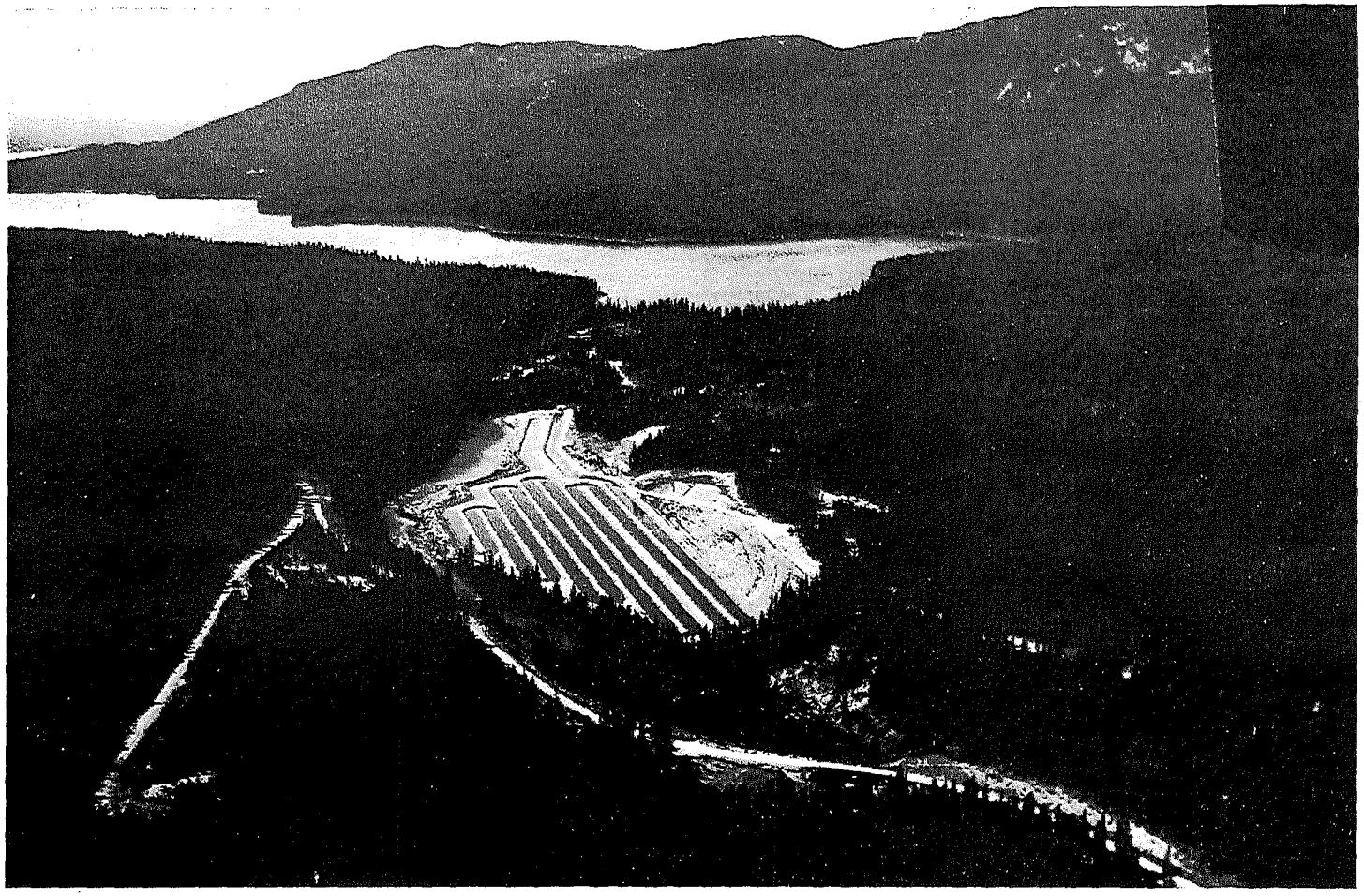

FIGURE 2. Sockeye spawning channel on Nadina River near the outlet of Nadina Lake.

The survival rate at Weaver Creek was the lowest recorded for eight years of operation. Since the survival for the 1969 brood was 89.5% for a total population of 19,681 fish (all species) compared to 23,707 fish (all species) in 1972, it is believed the principal cause of the decline was the accumulation of organic muck within the gravel in the channel, although the possibility of competition for space resulting from the large number of chum salmon (12,664) in the channel cannot be overlooked. In preparation for the 1973 spawning, the gravel in the channel was cleaned using the gravel cleaner developed by the Commission in 1972.

There were no fry produced at the two pink salmon channels at Seton Creek in 1973 as this is the off cycle. On the basis of observed condition of the gravel in the Upper Seton channel, which has been in operation since 1961, this channel was cleaned prior to arrival of the 1973 run.

The second generation of sockeye produced from the first spawning of sockeye in the Weaver Creek channel in 1965 returned to the channel in 1973. The total Weaver Creek run in 1973 was approximately 438,000 fish and 88% of it came from fish that spawned in the channel in 1969. Complete returns from the 1969 brood year will not be available until after the return of the five year old fish in 1974, but the return of 4 year old fish was 39.4 fish per female spawner in the channel, compared to only 2.2 fish per female spawner in Weaver Creek. The returns to date demonstrate the effectiveness of the spawning channel, where the rate of return per female spawner has been more than 10 times greater than from the adjacent natural spawning grounds in Weaver Creek, as shown in the following table.

AVERAGE ADULT SOCKEYE RETURN
PER EFFECTIVE FEMALE SOCKEYE SPAWNER AT WEAVER CREEK

Brood Years	*Weaver Creek*	*Weaver Channel*
1948-64	9.0	—
1965-69	3.7	41.7

Because of increasing numbers of chum salmon entering the Weaver channel each year, in 1973 a 3,000 square yard section of the channel was enclosed for the specific use of chum salmon and all but 500 chum were diverted to this area. All sockeye were diverted to the rest of the channel, comprising 18,300 square yards. A total of 22,366 sockeye spawned in this part of the channel, together with 822 pinks and 500 chums. This is the largest number of sockeye to spawn in the channel, an increase of 5,277 over 1969 and corresponds to the design capacity.

A second generation return of sockeye was also obtained from fry produced by the Upper Pitt River incubation channel. The 1973 run to Pitt River consisted of approximately 85% of 5 year old fish from the 1968 brood year. The total return of 4 and 5 year old fish from this brood year has been 25.4 fish per 1,000 eggs taken for the incubation channel, compared to only 1.9 fish per 1,000 eggs deposited in the Upper Pitt River and its tributaries. For the six brood years

with complete returns, the rate of return per 1,000 eggs has been more than 10 times greater from the incubation channel than from the natural spawning grounds, as shown in the following table.

AVERAGE ADULT SOCKEYE RETURN
PER 1,000 EGGS AT UPPER PITT RIVER

Brood Years	*Pitt River*	*Incubation Channel*
1948-62	1.3	—
1963-68	1.8	20.9

The 1973 run to Gates Creek is one of two subdominant cycles with only small runs. The return of 668 spawners to the Gates Creek spawning channel is approximately the same as in the brood year. Preliminary analysis indicates the rate of return from the channel was 15.1 fish per female spawner, compared to 32.7 for the previous year, whereas the rate of return from creek spawners increased 20% between the same years. Most of the difference in channel rate of return is attributed to the poor egg-to-fry survival for the brood year spawning because of silt accumulation in the channel gravel. This condition was rectified in 1972 by cleaning the gravel. Survival from the eggs deposited in 1972 was 81.6%.

The two spawning channels for pink salmon at Seton Creek produced a total return of approximately 512,400 fish in 1973, from which a catch of 379,300 was taken. The average rate of return from the channels for six cycles of operation has been 28.2 fish per female spawner, approximately 4 times larger than the 6.9 return per female spawner in Seton Creek. The channel return in 1973 was 32.4 per female spawner compared to a 2.8 return from creek spawners. The lower average rate of return from the pink salmon channels compared to the sockeye channels is attributable to the smaller egg content of the pink females (less than half the egg content of sockeye) and the lower egg-to-fry survival obtained in the pink salmon channels. Because the natural spawning grounds in Seton Creek are very productive and are among the best in the Fraser system, the difference in rate of return between the channels and the natural spawning area is not as great as it is for the sockeye runs to Weaver Creek and Upper Pitt River, where survival of eggs in the stream is often quite low. In 1973, approximately 54% of the pink salmon spawners in Seton Creek, Cayoosh Creek and Bridge River were produced by the spawning channels. The higher rate of return from the channels presents a problem in preventing overescapement to the Seton system without overfishing other early run stocks and consideration will have to be given to means of overcoming this situation.

The sockeye run to Quesnel Lake tributaries, primarily the Horsefly River and Mitchell River, is an outstanding example of the growth of a population made possible by the removal of the obstruction at Hell's Gate. The total run of these stocks in 1973 was the largest since 1917 and the growth from the residual of only 1,105 spawners in 1941 is shown in the following table.

QUESNEL LAKE SOCKEYE ESCAPEMENTS, CATCHES AND TOTAL RUN

Year	*Horsefly River* *Total Spawners*	*Mitchell River* *Total Spawners*	*Convention Waters*	
			Catch	*Total Run*
1941	1,065	40	—	4,400
1945	8,600	—	—	46,400
1949	20,000	350	—	100,000
1953	105,218	2,344	321,989	429,551
1957	226,378	2,677	308,553	537,608
1961	295,705	6,601	569,566	871,872
1965	359,232	5,335	763,627	1,128,194
1969	270,023	8,939	1,325,212	1,604,174
1973	253,384	24,673	1,501,332	1,779,389

Unfortunately, since 1957 substantial numbers of spawners have died on the spawning grounds before spawning. As discussed elsewhere in this report, the reasons for this prespawning mortality have not been determined although much research has been carried out since 1961. In the expectation that there would be a significant loss of spawners in 1973 also, and in the absence of any known cure, the Commission undertook practical measures in an attempt to offset the loss of spawners. Experience with spawning channels has shown that survival of eggs to fry can be greatly increased if the gravel used for spawning has all material less than ½ inch removed. Tests with apparatus similar to the gravel cleaner developed by the Commission last year, indicated material less than about ⅛ inch could be removed from natural spawning bed gravel by this method. Calculations, based on analysis of Horsefly River gravel indicate removal of this material could increase the expected survival of eggs about 3 times, and that the loss of eggs from prespawning mortality could be offset by cleaning an appropriate area of gravel. The gravel cleaner developed for spawning channels was tried initially, but it was not successful because boulders buried in the stream prevented the apparatus from being pulled through the gravel. Further tests indicated similar cleaning of the gravel could be achieved by using a track mounted Gradall type excavator to scalp the top foot of gravel and then letting the gravel fall through the flowing stream to flush out the fines. A total of 32,000 square yards of gravel in the Horsefly River was cleaned by this method, 5,300 square yards upstream from the town of Horsefly at the site used for the egg transplant in 1972, and the balance in the best spawning grounds above and below McKinley Creek. Sampling of eggs near the end of November indicates high survival in both cleaned and uncleaned gravel. Further sampling just prior to emergence will be done to determine the effectiveness of the cleaning. Analysis of gravel samples indicated the gravel cleaning method did not remove as much of the fine material as expected and better methods will have to be devised for future work. However, the total number of eggs deposited in 1973 was 100 million more than in the brood year, and with some improvement in survival rate, an even greater potential for the next cycle will be obtained.

The 4,000 square yards prepared spawning area in McKinley Creek below the temperature control structure at the outlet of McKinley Lake was also cleaned using the channel gravel cleaner, and 1,400 sockeye were confined in the area and spawned. In 1969, the year this area was constructed, sockeye would not remain in it to spawn.

The temperature control structure at McKinley Lake was operated again in 1973, from August 23 to September 18 and maintained a temperature of 50-54°F in the mixed flow below the structure. The temperature of the water increased to as high as 60°F at the mouth of McKinley Creek. The prespawning mortality in the 4,000 square yards channel just below McKinley Lake was 32%, and in the section of creek from this channel to the mouth, the mortality was 36% compared to 27.1% for spawners in the Horsefly River. In 1969 the average mortality of spawners in the creek was 65% compared to 48.5% for spawners in the Horsefly River.

Experimental rearing of sockeye continued at Cultus Lake with eggs collected from the 1971 brood. Eggs were treated with organic iodine when water hardened and again when eyed to prevent transmission of infectious hematopoietic necrosis (IHN) from adult to fry via the egg. The progeny were reared for about 9 months without evidence of IHN, but this disease occurred just before smoltation early in 1973 so the fish were destroyed. The source of IHN infection isn't known. Cultus Lake sockeye from the 1970 brood were reared without occurrence of IHN and 12,000 were released in the spring of 1972. Scales were examined from jacks returning to Cultus Lake in 1973 but there was no evidence of return of the experimental fish as jacks. Eggs collected from the 1972 Cultus Lake brood were treated with organic iodine when water hardened and when eyed. The fish produced were growing well during 1973.

RESEARCH

Research on the lacustrine biology of Fraser River sockeye was conducted mainly at Shuswap and Cultus Lakes in 1973. Sockeye fingerling abundance, distribution, growth, zooplankton standing crop, and such limnological parameters as water temperature, clarity and conductivity were examined.

The low standing crop of zooplankton in Shuswap Lake continues to be a cause for concern. As mentioned in previous reports, from 1954 to 1969 the standing crop of zooplankton appeared to be inversely related to the abundance of sockeye fingerlings in Shuswap Lake. However, since 1970, the standing crop of zooplankton has remained low even on years of very low sockeye abundance as well as when many sockeye were present in the lake. Despite lowered zooplankton abundance, the growth of sockeye fingerlings in Shuswap Lake has been good which suggests that the food supply was adequate for the numbers of sockeye present.

Echo sounding techniques have now been developed to the stage where estimates of the number of fish in the limnetic zone of a lake can be made. In 1971, '72 and '73 the Commission contracted with the Fisheries Research Institute, University of Washington, to conduct echo sounding surveys and population estimates in Shuswap Lake. The distribution of sockeye fingerlings in October

of 1971 and 1972 as determined from these surveys was described in the 1972 Annual Report. In 1973, with the offspring from only 7,200 sockeye spawners in the lake, the distribution of fingerlings was uniformly low over all of Shuswap Lake. The data from the three surveys have now been processed to provide estimates of population size. A comparison between numbers of spawners and the estimated number of juvenile fish present the following October for the three years is as shown in Figure 3. In estimating the indicated numbers of sockeye fingerlings, allowance was made for approximately 7 million young kokanee and other resident fish.

Survival of the 1970 brood seems quite low, and the 1971 brood appears to have done fairly well. The lower survival of the 1970 brood relative to the 1971 brood may be attributed to a number of factors. The survival from egg-to-fry apparently was much less than for the 1971 brood; the fry emerged two weeks prior to the first zooplankton bloom in Shuswap Lake, whereas the 1971 brood fry emergence coincided with the plankton bloom; and fry migrating up Little River to Shuswap Lake were less than half the weight of those from the 1971 brood. Now that suitable research methods are available, we propose to make a detailed study of the 1974 run from eggs right through to smolts to measure directly the survival during incubation, survival and growth during summer lake

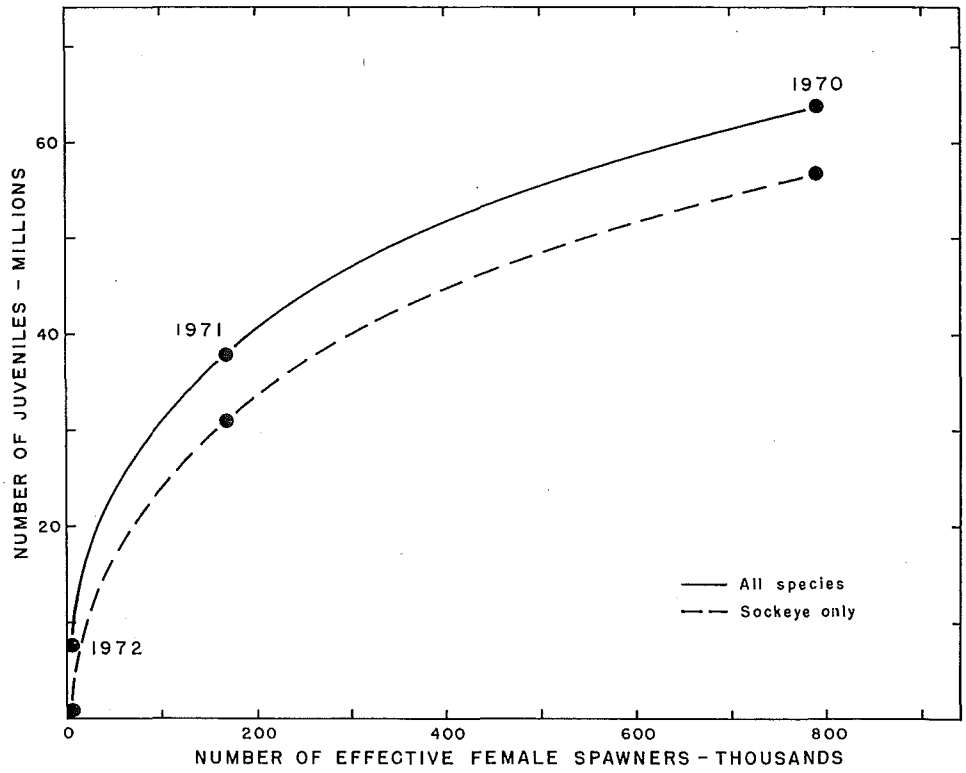

FIGURE 3—Comparison of numbers of effective female sockeye spawners in the Shuswap Lake system in brood years 1970, 1971 and 1972 with the acoustic estimates of numbers of juvenile sockeye and other species in Shuswap Lake in October of the following year.

residence, and over winter to smolts. This information will assist greatly in determining the reasons for large variations in sockeye smolt production in Shuswap Lake.

The sockeye fingerling population in Cultus Lake was also enumerated with aid of an echo sounder. Two estimates were made: one on January 16 and another on April 3 just prior to smolt emigration. The estimate for January 16 was 1,780,000 while the April 3 estimate was 1,026,000. The number of smolts counted through the counting fence by May 15 at the outlet of Cultus Lake was 1,079,000, only 5% greater than the April estimate made with the echo sounder.

Juvenile sockeye produced by the dominant 1972 Gates Creek run were studied in 1973 while they resided in Anderson and Seton Lakes. Previous information had indicated that Gates Creek sockeye migrated through Anderson Lake into Seton Lake, a turbid less productive lake, where they resided for one year. The 1973 fry migration out of the Gates Creek spawning channel occurred from mid-April to early May. A trap placed in Portage Creek between the two lakes produced moderate to large catches of sockeye fry throughout May. The apparent peak of fry movement down Portage Creek was about 3 weeks after peak emergence from the channel. Echo sounding surveys of the two lakes in the summer showed a fairly dense concentration of juvenile sockeye in Seton Lake. However, large numbers of juveniles still remained in Anderson Lake. Surveys in the spring of 1974 prior to smolt migration are planned to provide more information on the proportion of sockeye fingerlings in the two lakes.

Acoustic techniques were again utilized in estimating daily adult sockeye escapement. Echo sounders were operated in the lower Fraser River for 12 to 24 hours per day during the major migration period. Immediate processing of the echograms provided daily escapement estimates within 24 hours of data collection. These estimates were relatively reliable but the cumulative total estimate for the season was slightly higher than the recorded spawning ground escapements plus the Indian food fishery catches. The discrepancies in the daily estimates appeared to increase during the season. Post-season analysis showed that a portion of the discrepancy was due to the presence of other species of fish. Refinement of techniques to eliminate other species from the target counts and to obtain better estimates of the migration speed of sockeye are necessary to improve the reliability of the method.

Investigation of the causes of prespawning mortality continued in 1973. A comprehensive study involving a joint investigation by the Commission, the Fisheries Research Board Vancouver Laboratory and the University of Washington was undertaken. Horsefly and Late Stuart River sockeye were intercepted off the West Coast of Vancouver Island, at Lummi Island, upon arrival at the spawning grounds and during spawning. The Stuart fish were included since they migrate at the same time and would enable a comparative study. Samples were taken from the fish for bacteriology, histology, endocrinology and physiology studies. Processing of the samples will continue into 1974.

The Horsefly sockeye had a prespawning mortality of only 27.1% during 1973. The appearance of the run during spawning was very similar to the 1969 run; the bodies were clean and fish had very few gill lesions. In 1969 about 50%

of the Horsefly run died before spawning. The 1973 Horsefly run was much later than the 1969 run, and this appears to have been an important factor in the lower mortality in 1973. Comparison of data on timing and Fraser River temperature at Hell's Gate with the observed prespawning mortality for the year of data available indicates an apparent correlation between these factors (Figure 4). In contrast, prespawning mortality of the Late Stuart sockeye was less than 5%.

Microscopic examination indicated that *Chondrococcus columnaris* was very rarely present on gill tissue in 1973 but two other organisms were very abundant. One was a very large myxobacteria and the other was a short rod. Pathological examination of gill tissue has not been completed but at present it appears as if necrosis of gill tissue was more advanced among the unspawned dying fish than the vigorous fish.

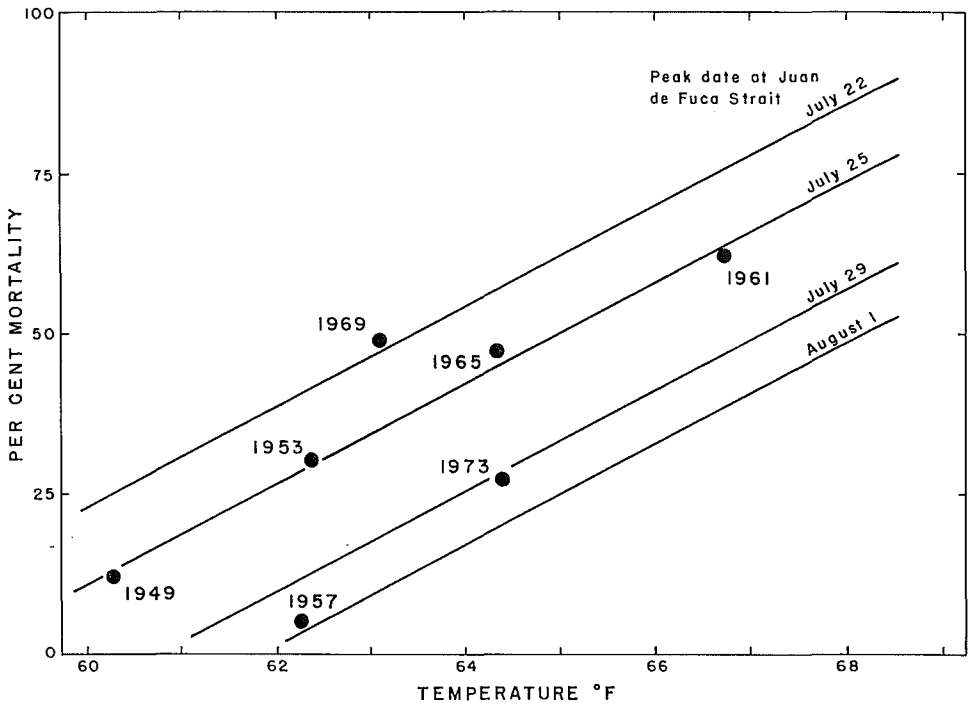

FIGURE 4—Prespawning mortality of Horsefly River sockeye in relation to the date of peak arrival at the entrance to Juan de Fuca Strait and average daily maximum water temperatures of Fraser River at Hell's Gate during migration of the run.

A study on the control of prespawning mortality with an oral administration of antibiotics (ampicillin and tetracycline) was carried out at Horsefly during 1973. There was no difference in the success of spawning between the treated and control fish.

During the 1973 Horsefly run there were approximately 43,000,000 eggs potentially available from dying females that had loose eggs. An investigation was carried out to determine whether eggs from these fish were viable. Moribund

males and females were collected and crossed with themselves and with mature healthy fish. The eggs were planted in the spawning channel in McKinley Creek and left for three weeks, at which time they were recovered and examined for success of fertilization. The data, shown in the following table suggested that eggs from dying females could be fertilized with a high degree of success providing healthy males were used.

SUCCESS OF FERTILIZATION OF HORSEFLY RIVER SOCKEYE USING BOTH DYING AND NORMAL FISH

Group	*% Success of Fertilization*
Good female and good male	98.1
Dying female and good male	90.6
Good female and dying male	16.5
Dying female and dying male	9.7

Some sockeye fry of the 1972 brood captured at Chilko River in May 1973 for experimental studies were suspected of having the virus disease, infectious hematopoietic necrosis (IHN). Apparently only some fish in the last quarter of the fry migration into Chilko Lake were affected. Sampling indicated a mortality of 0.44% for this segment of the population. Samples were forwarded to the Western Fish Disease Laboratory, Seattle, Washington, where it was confirmed that some fry were infected with IHN. Evidence obtained since the 1950's indicates this virus disease occurred among wild sockeye in Washington State and British Columbia. It is suspected that occurrence in the natural environment is cyclical. However, there is no evidence to indicate that the disease is a significant factor affecting survival of sockeye in the natural environment. Since fry and smolts are enumerated at Chilko it will be possible to determine whether survival is in the normal range for the 1972 brood.

Prediction, six months or more in advance, of the number of sockeye and pink salmon expected to return to the Fraser River has become an expected function of management. The forecast serves as a basis for formulating fishing regulations, but it is also used by the fishing industry and its suppliers to plan operations. The utility of the prediction for these purposes is no better than the reliability of the prediction.

The Commission's predictions for the sockeye runs to the Fraser River have been fairly reliable, although generally conservative. As more years of production data are accumulated some refinement of the predictions might be anticipated. Accuracy might be improved if the total yearly number of sockeye smolts emigrating to the sea was known. At present this information is available only for Cultus Lake and Chilko Lake, supplemented by indices of abundance at Quesnel and Shuswap Lakes. Acoustic methods now offer prospect that it will soon be possible to enumerate the smolts leaving all the major lake rearing areas. However,

data from a number of cycles would be needed before the method could be applied to predictions, and it still would be necessary to determine the relationship between survival and environmental variables, such as zooplankton abundance in the ocean.

The numbers of pink salmon fry emigrating from the Fraser River each cycle has been measured since 1962, and the number surviving to returning adults has been determined from catches and escapements.

FRASER RIVER PINK SALMON PRODUCTION

Year	*Millions of Pink Fry Emigrating*	*Millions of Adult Pinks Returning*	*Per Cent Return*
1962	143.6		
1963		5.326	3.7
1964	284.2		
1965		2.271	0.8
1966	274.0		
1967		12.850	4.7
1968	237.6		
1969		3.849	1.6
1970	195.6		
1971		9.707	5.0
1972	245.0		
1973		6.753	2.8

Much attention has been given to possible relationships between a number of environmental variables and the percentage of fry surviving to adults, with the expectation that controlling factors could be identified and their effects quantified. Because of the many environmental variables that could be involved, a number of years of data had to be accumulated before the most significant factors could be distinguished. As a consequence, prediction of the number of adult pink salmon returning to the Fraser River has lacked the desired reliability. Each year of additional data provided further insight into the significance of certain factors. Publications by LeBrasseur (1965) and Parsons (1972) also provided further insight into possible roles of zooplankton abundance in the estuary of the Fraser and in the Northeast Pacific Ocean.

LeBrasseur, R.J. Seasonal and Annual Variations of Net Zooplankton at Ocean Station P 1954-1964. Manuscript Report Series H.202, Pacific Oceanographic Group, Fisheries Research Board of Canada, Jan. 1965.

Parsons, T.R. The Influence of the Fraser River in the Productivity of the Strait of Georgia, B.C. Energy Board Provincial Power Study, V3 App. 1, Annex (X) April 1972.

Data from the 1973 return of pink salmon helped define the effects of the extremes observed for two environmental variables, and thereby improved the overall correlation with survival. With six cycles of survival data available, a hypothesis is emerging which offers prospect of greatly increased reliability of the pink salmon forecast. The hypothesis is concerned primarily with the availability of food at various stages of the pink salmon life cycle from fry to adults, and involves consideration of four factors:

1. The condition of the fry at Mission during their migration down the Fraser. Fry with a higher condition factor presumably would be more able to evade predators, more able to capture prey, and more able to survive food shortage during the trip down the river and possibly through part of the estuary.

2. The timing of the fry migration, migration early in May being more favorable than early in April. Presumably this is associated with the greater abundance of zooplankton in the Strait of Georgia in May than in April (Parsons 1972).

3. The volume of runoff from the Fraser River for the months April through July, low runoff being more favorable than high runoff. According to Parson's description of the physical and chemical components contributing to primary production in the Strait of Georgia, two aspects of the Fraser River outflow may be affecting the production of phytoplankton, which are the prey of zooplankton upon which salmon feed. First the silt carried into the estuary by the freshet may inhibit photosynthetic production because of reduced light penetration in the plume of the river water. The volume of this plume is approximately proportional to river discharge. Second, the increased flushing rate associated with higher outflows may dilute the growing cells and decrease their reproductive rate, thereby leading to lower production of phytoplankton, or conversely, reduced flushing associated with lower outflows may result in increased production during the months May to July.

4. The abundance of zooplankton in the sector of the Pacific Ocean frequented by the pink salmon as they grow from fingerlings to adults. Data obtained at Station P (LeBrasseur 1965; Longhurst et al. 1972) shows approximately a seven-fold range in the yearly maximum abundance of zooplankton, which generally occurs in May or June. It is presumed that such a variation in food supply in the areas frequented by salmon would be reflected in the growth and survival of salmon. Data on growth of sockeye salmon has been used as an index of the oceanic conditions, since data on zooplankton at Station P was not available for some recent years, and also since the data for the one station may not represent the entire area occupied by the salmon.

Using correlations of these factors for the last six cycles, estimates of the survival of pink salmon fry to adults have been calculated which correspond closely with the survival actually recorded.

FRASER RIVER PINK SALMON SURVIVAL FROM FRY TO ADULTS

Brood Year	1961	1963	1965	1967	1969	1971
Recorded Survival Per Cent	3.7	0.8	4.7	1.6	5.0	2.8
Calculated Survival Per Cent	3.6	0.9	4.5	1.3	5.1	2.9

It is recognized that the six years of data may not encompass the extremes of all variations that may occur. Since not all the necessary data is available for years prior to 1961, the method cannot be tested for these earlier runs and we must await future data to establish its reliability.

PROTECTION

The continued growth of population and industry within the Fraser River watershed, and the development of forest and mineral resources in formerly remote northern portions of the river system present ever increasing opportunity for potentially harmful changes in the aquatic environment which is so vital to perpetuation of the sockeye and pink salmon resources of the river system.

Pollution from discharge of wastes associated with man's activities is one potential change that could have very harmful effects on fish. The effects of these wastes may be sudden or they may occur gradually and become noticeable only after several years. To guard against such effects, emphasis has been placed upon in-plant control to reduce the quantity of wastes and upon treatment of wastes at the source to produce effluents that are not toxic to salmon. In this way dilution in the receiving water serves as a safety factor rather than a major feature of the waste disposal system.

During 1973 studies continued on the problem of pollution control at kraft pulp mills. There are five such mills on the Fraser watershed and each has an effluent treatment system. However, surveys demonstrated that some systems are more effective and dependable than others. In the interest of obtaining information applicable to upgrading effluent treatment and identifying specific toxic compounds, various studies have been conducted in cooperation with Department of the Environment and mill personnel.

The most recent study of this type was a 10 month project commencing in August 1972 and involving Prince George Pulp and Paper Co. Ltd. The study period encompassed mill operating conditions ranging from normal to upset. Results obtained using a bench-scale treatment unit indicated consistent detoxification was feasible and dependability increased with treatment time. The study

Longhurst, A. M. Colebrook, R. LeBrasseur, C. Lorenzen, P. Smith, The Instability of Ocean Populations. New Scientist June 1972.

also demonstrated that the practice of bypassing treatment facilities with effluents expected to be free of harmful contaminants is not acceptable since these were chronically lethal. Thus a report of the study recommended that all effluents undergo treatment.

Analyses of selected samples at the Pacific Environment Institute of the Department of the Environment indicated that resin acids and neutral compounds were major causes of toxicity of effluent at Prince George Pulp and Paper Co. Ltd. Discovery of the latter compounds was new information and was believed related to the species of wood being pulped. Juvenile sockeye exhibited different symptoms of distress when exposed separately to resin acids and neutral compounds. Thus the modes of toxic action for these two types of substances may differ. Likewise the relative amounts in effluent from various mills may vary depending upon the species composition of the wood supply. Analyses of effluent from the bench scale treatment unit indicated that resin acids and neutral compounds could be destroyed by biological treatment.

The 1972 Annual Report mentioned that more than 20 proprietary additives used in pulp mills to assist production processes had been bioassayed. The list of additives bioassayed has been expanded to 30 and the majority do not appear to pose a problem. One additive was detected in mill effluent but further study is needed to determine the relative importance of this result.

Progress made in projects of this type demonstrates the great value of a multi-discipline approach to study of complex pollution problems.

Northwood Pulp and Timber Co. Ltd., located at Prince George, participated in a survey of effluent detoxification concluded in 1972. It was evident from the survey that effluent treatment was in need of upgrading to obtain dependable performance. After evaluating various possibilities, mill management concluded that an aerated lagoon providing 5-day treatment was the best method available. The new lagoon will be operational in 1974.

During 1972 a 750 ton per day kraft pulp mill started operation at Quesnel and expansion of the mill at Kamloops from 250 to 1,250 tons per day was completed. Both of these mills utilize 4 to 5 day aerated lagoons for treatment. In order to obtain a close check on performance of effluent treatment systems, five daily samples per week for five weeks were forwarded to the Commission's Sweltzer Creek Laboratory for bioassay, in a joint survey with the mills and Department of the Environment. Results demonstrated that approximately 4 to 5 days treatment detoxified mill effluent. However, substandard detoxification coincided with spills of toxic process liquors at the Kamloops mill. Spills may occur for various reasons but in this case malfunction of mill process equipment appeared to be the primary cause.

The adverse effects of liquor spills on biological treatment of effluent can be avoided by diversion of liquor to an emergency spill pond. Although the Kamloops mill has such a pond, detection of spills poses problems. One means of detecting spills uses a network of conductivity probes situated at strategic points in the sewer system and such a network is planned for the Kamloops mill.

Removal of color by chemical precipitation using alum and polyelectrolytes was tested at the Kamloops mill. Trials indicated that color removal was not dependable for full-scale operation and bioassays showed detoxification was not satisfactory. Selective substitution of chemicals used at certain points in the bleaching sequence has shown promise of reducing color and will be tested in 1974.

The color, foaming and algal growths observed in the Thompson River and Kamloops Lake prompted an investigation of possible causes by a Federal-Provincial Task Force in 1973. Results of sampling in 1973 plus data obtained over the past several years in a monitoring program indicated color was attributable to pulp mill effluent and the joint report recommended remedial action. The causes of foam in the Thompson River, including North and South forks, were not determined. Algal growths may be explained by nutrients in the water but could not be attributed to any one source. Inspection of pink salmon spawning areas indicated algae, specifically diatoms, were growing on the gravel surface but were easily dislodged, exposing gravel beneath. Observations during spawning in autumn 1973 showed algae were removed by the digging action of spawning pink salmon, leaving a clean gravel surface.

An intensive study of the Thompson River system, extending into North and South forks is being conducted by the Federal-Provincial Task Force in an effort to explain the foam and algae. As its part in the overall study, Commission personnel will be documenting survival of pink salmon from eggs to fry in the upper part of the Thompson River where the heaviest growth of algae was observed in spring 1973. Insofar as possible effects on pink salmon are involved, the changes observed in the Thompson River in spring 1973 are cause for cautious concern and careful study. However, concern for the pink salmon run on the basis of observed algal growth must be tempered by the knowledge that fairly prolific growths of algae occur in spawning channels operated by the Commission, and egg-to-fry survival in them has been high.

The monitoring program in Kamloops Lake conducted by staff from the Weyerhaeuser Canada pulp mill has continued to provide a basis for comparison with data obtained before and after mill construction. Mill staff measure water quality and forward plankton samples to the Commission for measurement and analysis.

The 1972 Annual Report mentioned that chlorinated municipal sewage was lethal to sockeye and pink salmon and further work was planned on the chlorination-disinfection-toxicity problem. In 1973 joint study by the Greater Vancouver Sewerage and Drainage District, Department of Environment and the Commission demonstrated that the degree of chlorination required to disinfect sewage substantially increased toxicity of sewage, in spite of using a nominal one hour chlorine contact chamber. However, chlorine induced toxicity can be removed by storage or chemical dechlorination. Storage is suitable for small treatment plants where effluent can be retained in lagoons for several days. However, when large volumes of sewage are involved, chemical dechlorination appears most practical and although not widely used, has been adopted at a few installations in California. Therefore, the study has been extended into 1974 to test the practicality and effectiveness of full-scale chemical dechlorination.

The Commission collaborated with the Department of Environment in preparation of a submission to an inquiry on municipal waste disposal conducted by the Provincial Pollution Control Board. The submission cited information which indicated primary treatment does not detoxify municipal sewage whereas sewage was virtually detoxified by secondary treatment. Furthermore, since prospective daily discharges of treated municipal sewage and industrial effluents are expected to be similar in volume, the discrepancy that would exist if municipal and industrial effluents did not meet similar criteria for protection of fish and the aquatic environment could not be overlooked. Therefore, the submission recommended that municipal sewage receive secondary treatment to remove toxicity inherent in sewage followed by dechlorination to remove toxicity introduced by chlorination.

Diversion of additional water from the Nechako River system to the Kemano power plant is under study by B. C. Hydro and Power Authority as a potential source of future hydro power. The additional diversion of water could result in greatly reduced flows in the Nechako River, which in turn could result in elevated water temperatures harmful to sockeye during their migration up the river to spawning grounds in the Stuart and Stellako River systems. Tests were conducted in 1973 using Early Stuart sockeye to obtain additional data on the tolerance of adult salmon to high temperatures. However, temperatures lower than those directly lethal to sockeye are known to accelerate growth of some bacteria associated with prespawning mortality. Thus, lethal temperatures alone cannot be used to establish a suitable water temperature for migrating adult sockeye. In view of the association of elevated water temperature with prespawning mortality of sockeye, any increase in water temperature above the natural regime must be regarded as potentially harmful.

In December 1973, six rail cars carrying copper concentrate derailed and sank in deep water in Anderson Lake. The concentrates were insoluble and thus were not believed to be an immediate threat to sockeye in the lake. However, the lake will be monitored. Zooplankton productivity of Anderson Lake has been documented for several years by the Commission. These measurements will continue and samples will be collected for determination of copper content, as well.

Biological monitoring continued on the lower Fraser River at Mission, Steveston and in the North Arm until mid-May 1973. Measurements of dissolved oxygen and biochemical oxygen demand were also made at the foregoing points and at Cottonwood Reach. Exposing juvenile sockeye for a week at a time did not reveal any harmful conditions for survival of fry or smolts.

Through a continuing cooperative arrangement with the Fisheries Service and Environmental Protection Service, Canada Department of the Environment, numerous applications for effluent discharge permits were reviewed and recommendations for protection of sockeye and pink salmon were made.

During the 1972 migration of Gates Creek and Portage Creek sockeye up Seton Creek, it was found that the number of sockeye passing through the fishway at the diversion dam on Seton Creek was much lower than expected on the basis of known abundance of the fish in the commercial fishing area in the Fraser River

downstream from Mission. There was no evidence of a large loss of other sockeye populations migrating at the same time, and the Gates Creek fish had a high incidence of head injuries not observed anywhere else in the Fraser system. These observations indicated the tailrace of the Seton hydroelectric plant may have been responsible for the injuries and a study of the situation was initiated. A preliminary report on the findings was completed during 1973, in which it was concluded that the Gates Creek sockeye are subject to serious delay and injury in the Seton plant tailrace because of lack of adequate attractive flow to Seton Creek. The severe head injuries observed were attributed to attempts of the fish to swim into the draft tube.

At the time the Seton hydrodevelopment was being planned, certain minimum flows were specified in Seton Creek. It was recognized that the 400 cfs required during the period of sockeye migration might not be adequate, and it was agreed that suitability of the flows would have to be assessed after the plant was in operation. The 1972 run was the first time since the plant started operating in 1956 that there has been any indication of a serious problem for passage of sockeye in the tailrace of the plant. Study of the numbers of fish passing through the fishway at the Seton Creek dam, in relation to discharges in Seton Creek, indicated that substantially higher flows than 400 cfs in Seton Creek were necessary to attract fish from the tailrace to Seton Creek without long delay. The B. C. Hydro and Power Authority cooperated in tests to assess the effectiveness of increased flows during the 1973 sockeye and pink salmon migrations to Seton Creek. Preliminary evaluation of the results indicates discharges as high as 1,000 cfs improved the migration away from the tailrace of the power plant into Seton Creek, but delay and injury of fish in the tailrace still occurred. Studies will be continued to try and resolve the problem.

The possible harvesting of timber in the Nadina River watershed, as indicated by application for timber sale made to the B. C. Forest Service, is cause for concern for the future of the Nadina River sockeye populations.

There are two sockeye populations in the Nadina River, a Late run, which spawns just below Nadina Lake, and an Early run, which spawns primarily downstream from Popple (Tagetochlain) Creek. The spawning area available to the Late run is small and limits the run to about its present size. This year the Commission has put into operation a $720,000 spawning channel which, at full capacity, will produce seven to ten times as many fish as the natural grounds used by the Late run. The project was a first step in developing the full rearing capacity of Francois Lake.

The Early run spawns mostly in a 9 mile section of the river starting about 4 miles upstream from Francois Lake, but some spawn up to 25 miles upstream. Figure 5 shows a spawning area 8 miles from the river mouth in 1945 while the watershed was still in its natural state. This entire section of river contains an estimated 250,000 square yards of spawning ground. However, this part of the river was used for log driving from 1950 to 1966 and during this period extensive changes occurred in the river. Banks have been seriously eroded causing high cut banks, and spreading of the flow caused by log jams has resulted in divided channels, some of which dry up when the flow decreases (Figure 6). The Early

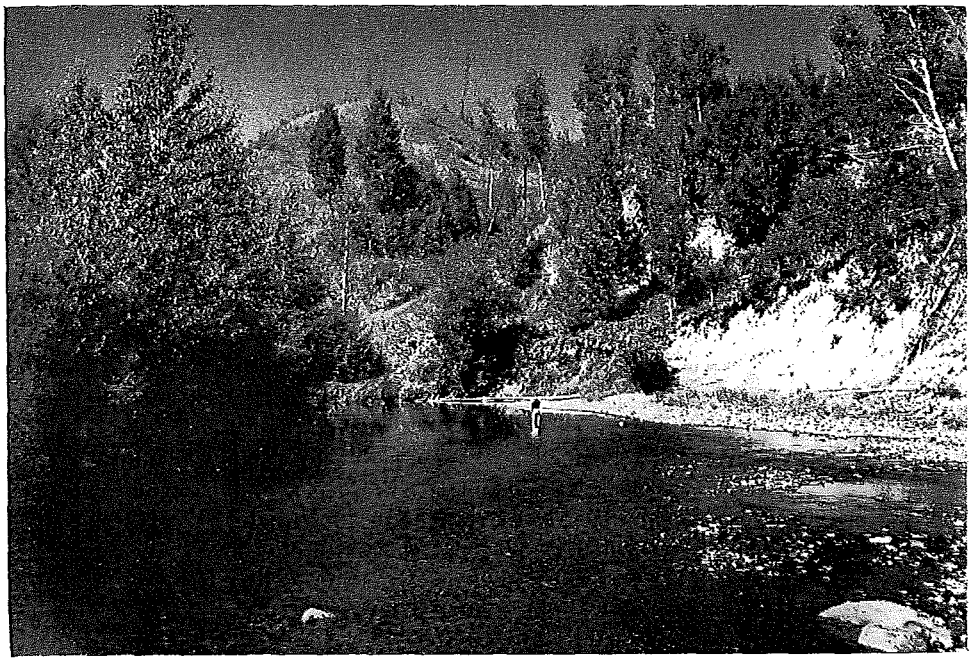

FIGURE 5—Sockeye spawning area in the Nadina River 8 miles from the river mouth in August 1945.

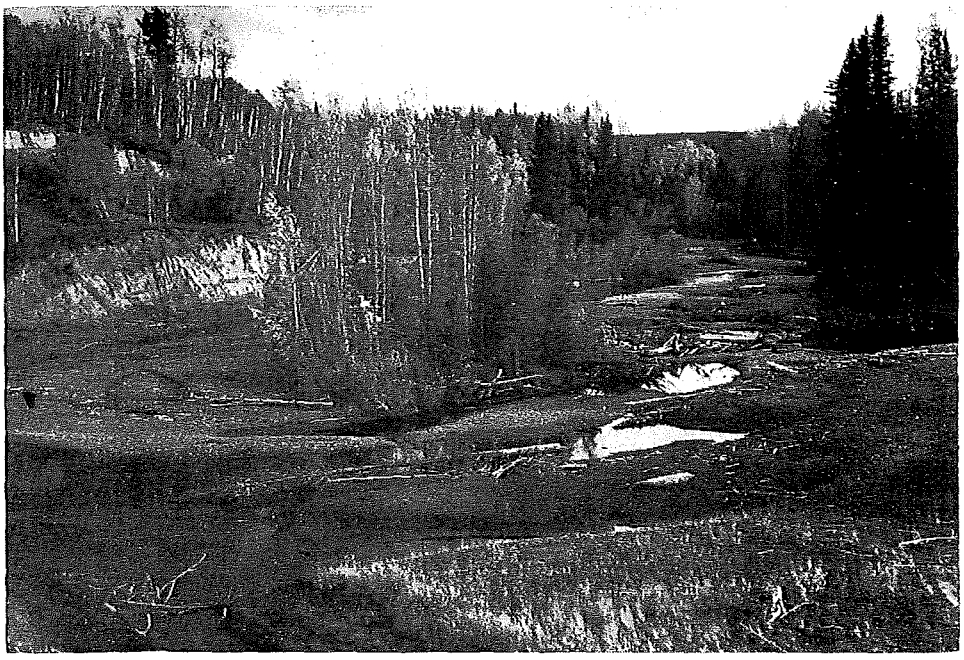

FIGURE 6—Nadina River 8 miles from the river mouth in October 1966.

run of sockeye has declined from 30,000 spawners in 1957 to about 2,000 in 1973, and it appears certain that some remedial action will be required to save this stock.

Further logging along the Nadina River and its tributaries adjacent to or upstream from the two spawning areas would cause additional damage to the spawning grounds. Silt from road building and logging activities, and erosion from logged areas would reduce the survival of the sockeye eggs. Removal of shade trees would increase water temperatures in the lower Nadina River and could result in serious prespawning mortality. The situation in this part of the river is already critical in warm years, for example 1961 when 86% of the females died without spawning due to temperatures of 68° to 69°F. The water supply for the existing spawning channel comes from Nadina Lake, and this could be affected adversely by logging around Nadina Lake and its tributaries. The rearing capacity of the westerly end of Francois Lake could also be reduced by muddy water which would reduce the food supply available to the fry when they enter the lake. This is a very critical period in the life cycle, and lack of food could nullify efforts to develop the stocks. In view of the potential of the Nadina River system and Francois Lake, which it is estimated could produce a catch of 5,230,000 each 4 years, the Commission has recommended that no further logging be allowed in the Nadina River system upstream from the sockeye spawning grounds until a detailed study has been made to determine where and how logging might be done without harmful effect on the sockeye runs.

The opening up of the Stuart River watershed by roads and railway and the imminent harvest of forests for pulpwood and timber could have serious effects on the many tributaries of this system used by the Early Stuart runs of sockeye, as well as the areas used by the Late Stuart run in Middle River, Tachie River, Kuzkwa Creek and Kazchek Creek. Takla, Trembleur and Stuart Lakes, where the sockeye from all these runs are reared, have the potential to produce an estimated catch of 15,000,000 sockeye every 4 years, and these three lakes contain 45% of all the current unutilized rearing capacity for sockeye in the entire Fraser River system. It is extremely important therefore that suitable practices be adopted in road building, river transportation and forest harvesting, to ensure preservation of the aquatic environment that is so vital to sockeye salmon.

TABLE I

SOCKEYE CATCH BY GEAR

Gear		1961	1965	1969	1973
United States Convention Waters					
Purse Seines	Units	273	169	270	156
	Catch	823,956	740,123	991,598	1,410,499
	Per Cent	59.76	72.13	62.51	53.68
Gill Nets	Units	574	388	519	739
	Catch	471,464	236,133	517,650	1,075,698
	Per Cent	34.20	23.01	32.64	40.94
Reef Nets	Units	77	55	44	50
	Catch	81,826	49,707	76,570	140,921
	Per Cent	5.94	4.84	4.83	5.36
Troll	Catch	1,146	155	358	463
	Per Cent	0.10	0.02	0.02	0.02
TOTAL CATCH		1,378,392	1,026,118	1,586,176	2,627,581
Canadian Convention Waters					
Purse Seines	Units	101	89	149	129
	Catch	352,883	85,914	340,187	1,126,314
	Per Cent	26.00	8.27	20.30	43.67
Gill Nets	Units	1,550	1,501	1,307	1,178
	Catch	991,972	944,266	1,268,525	1,395,085
	Per Cent	73.10	90.87	75.71	54.10
Troll	Catch	12,244	9,015	66,824	57,571
	Per Cent	0.90	0.86	3.99	2.23
TOTAL CATCH		1,357,099	1,039,195	1,675,536	2,578,970

NOTE: Gear counts represent the maximum number of units delivering sockeye on a single day near the peak of the run.

TABLE II

CYCLIC LANDINGS AND PACKS OF SOCKEYE FROM CONVENTION WATERS

	United States	*Canada*	*Total*
1973			
Total Landings (No. Sockeye)	2,627,581	2,578,970	5,206,551
Share in Fish	50.47%	49.53%	
Total Pack (48-lb Cases)	221,501	225,425	446,926
Share in Pack	49.56%	50.44%	
1946-1973			
Total Landings (No. Sockeye)	46,769,526	46,434,357	93,203,883
Share in Fish	50.18%	49.82%	
Total Pack (48-lb Cases)	4,099,196	4,049,170	8,148,366
Share in Pack	50.31%	49.69%	
1973 *Cycle Catch*			
1973	2,627,581	2,578,970	5,206,551
1969	1,586,176	1,675,536	3,261,712
1965	1,026,118	1,039,195	2,065,313
1961	1,378,392	1,357,099	2,735,491
1957	1,689,265	1,360,760	3,050,025
1953	2,032,437	1,992,343	4,024,780
1949	1,056,792	1,020,799	2,077,591
1945	706,464	969,444	1,675,908
1941	1,558,554	2,116,723	3,675,277
1937	897,022	1,075,986	1,973,008
1933	1,724,127	726,309	2,450,436
1929	1,334,141	725,037	2,059,178
1925	1,375,012	453,704	1,828,716
1921	1,199,929	486,312	1,686,241
1917	5,005,609	1,877,792	6,883,401
1913	21,736,398	9,606,641	31,343,039
1909	13,664,988	7,261,486	20,926,474
1905	10,330,277	10,350,959	20,681,236
1901	13,694,032	12,065,999	25,760,031

NOTE: Pack figures include all sockeye landed even though some were sold fresh and frozen.

TABLE III

DAILY CATCH OF SOCKEYE, 1961-1965-1969-1973 FROM UNITED STATES CONVENTION WATERS

	JULY				AUGUST				SEPTEMBER			
Date	1961	1965	1969	1973	1961	1965	1969	1973	1961	1965	1969	1973
1			6,906		128,699			242,792				12,031
2			4,731	110,423	75,733	3,137					4,142	7,085
3	47,926			80,632		1,445	122,566				3,683	3,912
4	43,037			75,761		52,146	77,758					
5	28,585	26,335				65,290	63,332					
6		21,773										
7			1,824							932		
8			1,931					249,821		358	18	
9			2,324	153,802		55,149				181	78	1,429
10	143,287			78,082	82,844	30,297					981	484
11	89,786			77,654		14,893	42,399				266	126
12		20,836		60,972			18,044					
13		15,456		47,993			15,558			62		
14			16,173				12,433	102,899		16		
15			9,948		18,748			39,203		0	191	
16				85,708	5,241	13,584				0	30	
17	49,754			40,820		8,584					2	49
18	43,233			43,260			17,370		22			22
19	34,815	43,747					23,237		10			
20		74,983						84,981	6	20		
21		84,674	221,188		11,491			58,765		23		
22			156,203		6,038			33,417		57	98	
23			182,627	120,363				10,132		40	699	
24	199,232			79,529							91	6
25	117,345			69,739		7,728	19,605		11		41	9
26	73,843					3,863	17,334		33			
27								30,423	10	43		
28		262,812	230,072					13,494		9		
29		172,566	201,102							10	1,004	
30			92,332	287,354						0	294	
31	161,484			279,495								
Totals	1,032,327	723,182	1,127,361	1,691,587	328,794	256,116	429,636	865,927	92	1,751	11,618	25,153
Troll	750	104	131	285	380	46	210	108		1	1	1
Monthly Totals	1,033,077	723,286	1,127,492	1,691,872	329,174	256,162	429,846	866,035	92	1,752	11,619	25,154
June and Oct. Totals									16,049	44,918	17,219	44,520
Season Totals									1,378,392	1,026,118	1,586,176	2,627,581

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TABLE IV

DAILY CATCH OF SOCKEYE, 1961-1965-1969-1973 FROM CANADIAN CONVENTION WATERS

	JULY				AUGUST				SEPTEMBER			
Date	1961	1965	1969	1973	1961	1965	1969	1973	1961	1965	1969	1973
1			10,842		109,677			140,333			1,272	2,157
2			10,654	77,811		206,017		108,960			709	1,489
3	36,879			27,430		79,921						25,190
4	7,930			16,248		29,092	178,581					
5		35,176					81,629		53			
6		8,184		Strike			51,902	264,462	18			
7				July 6-				50,062		133	286	
8				July 15				36,412		106	163	
9			5,363	32,772	28,636	20,830		150,843		59	177	97
10	109,597				23,368	63,820		61,480			287	11,213
11	27,730					24,820	34,096					70
12	34,089	19,440					62,362		7			37
13	46,966	5,750			52,261		15,882	57,682	4	27		
14			22,096		18,609			138,703		10		
15				26,786	21,972			105,299		9		
16				12,961	7,407	9,770				11		
17	86,946			8,966		26,163					45	7,972
18	44,527			10,905		4,618	8,471				16	4
19		73,372					4,830		2			7
20		22,946					13,310	93,807	3	4,335		
21		13,577	96,953		17,815			26,584	2	8		
22			30,593		5,898			26,578		3		
23				243,444				11,668			15	
24	217,241			150,685							35	2,595
25	153,593			112,045		6,790						22
26	98,121					1,481	5,907		11			13,637
27		179,102	368,974					31,894		18		
28		69,415	229,115		5,630			7,784	1	3		
29		76,955	160,326		1,831			11,313		3,182		
30		10,080	91,292	150,434		4,562	1,159				18	
31	179,254		79,400	215,403			1,160					
Totals	1,042,873	513,997	1,105,608	1,085,890	293,104	477,884	459,289	1,323,864	101	7,904	3,023	64,490
Troll	4,976	6,687	43,240	24,079	2,363	2,183	18,802	28,890	4,236	50	4,419	3,574
Spring Salmon Gill Nets			3,079						625	569	8,288	1,769
Monthly Totals	1,047,849	520,684	1,151,927	1,109,969	295,467	480,067	478,091	1,352,754	4,962	8,523	15,730	69,833
June, Oct. and Nov. Totals									8,821	29,921	29,788	46,414
Season Totals									1,357,099	1,039,195	1,675,536	2,578,970

TABLE V

INDIAN CATCH OF SOCKEYE BY DISTRICT AND AREA, 1969 and 1973

District and Area	1969 Catch	1969 No. of Fishermen	1973 Catch	1973 No. of Fishermen
HARRISON-BIRKENHEAD				
Skookumchuk and Douglas	381	8	575	10
Birkenhead River and Lillooet Lake	3,860	21	3,500	30
Harrison and Chehalis	900	15		
TOTALS	5,141	44	4,075	40
LOWER FRASER				
Below Chilliwack	6,290	51	18,996	212
Chilliwack to Hope	25,846	50	25,130	
TOTALS	32,136	101	44,126	212
MIDDLE FRASER				
Hope to Lytton	39,005	198	45,255	390
Lytton to Lillooet	11,205	124	5,000	200
Bridge River Rapids to Churn Creek	42,950	522	27,225	375
TOTALS	93,160	844	77,480	965
CHILCOTIN				
Farwell Canyon	639	22	1,495	92
Hances Canyon	327	10		
Alexis Creek	540	20		
Siwash Bridge	1,033	35		
Keighley Holes	578	13	200	
TOTALS	3,117	100	1,695	92
UPPER FRASER				
Churn Creek to Chimney Creek	4,063	82	8,700	172
Soda Creek	1,150	28		
Quesnel	950	36		
Shelley	163	18	735	30
TOTALS	6,326	164	9,435	202
NECHAKO				
Nautley and Stella Reserves	4,329	36	4,880	48
TOTALS	4,329	36	4,880	48
STUART				
Fort St. James	6,908	40	6,631	31
Tachie, Pinchi and Trembleur Villages	6,192	48	8,491	68
TOTALS	13,100	88	15,122	99
THOMPSON				
Main Thompson River	850	7	5,900	125
North Thompson River	560	27	65	5
South Thompson River	25	110	125	192
TOTALS	1,435	144	6,090	322
GRAND TOTALS	158,744	1,521	162,903	1,980

The Indian catch statistics detailed above are obtained from Canada Department of the Environment, Fisheries Service. Their officers control the taking of sockeye for food by the Indian population residing throughout the Fraser River watershed.

TABLE VI

SUMMARY OF THE SOCKEYE ESCAPEMENT TO THE FRASER RIVER SPAWNING AREAS, 1961, 1965, 1969, 1973

District and Streams	1973 Period of Peak Spawning	Estimated Number of Sockeye				Jacks	Sex Ratio	
		1961	1965	1969	1973		Males 4-5 Yr.	Females 4-5 Yr.
LOWER FRASER								
Cultus Lake	Dec. 1-4	15,428	2,532	6,739	858	217	318	323
Upper Pitt River	Sept. 12-15	11,162	6,981	24,905	11,928	33	7,039	4,856
Widgeon Slough	Oct. 31-Nov. 4	1,293	275	715	427	0	213	214
HARRISON								
Big Silver Creek	Sept. 20-25	398	596	85	270	0	124	146
Harrison River	Nov. 15-20	42,778	15,034	15,209	3,060	0	1,485	1,575
Weaver Creek	Oct. 15-25	4,383	11,162	58,922	50,173	1,632	22,813	25,728
LILLOOET								
Birkenhead River	Sept. 23-26	49,627	30,008	63,343	139,295	82,642	25,942	30,711
SETON-ANDERSON								
Gates Creek	Aug. 27-31	252	1,679	881	899	104	343	452
Portage Creek	Oct. 22-25	527	2,108	1,040	4,272	309	1,603	2,360
SOUTH THOMPSON								
Seymour River	Aug. 26-30	5,822	6,954	7,327	2,856	152	1,539	1,165
Scotch Creek	Aug. 23-27	598	1,910	3,395	6,235	0	3,177	3,058
Lower Adams River	Oct. 12-16	57,796	55,041	45,908	33,312	32,502	372	438
Little River	Oct. 20-24	8,253	3,236	6,775	6,689	6,499	132	58
South Thompson River	Oct. 18-22	254	192	630	545	531	7	7
Lower Shuswap River	Oct. 15-18	342	583	1,703	7,452	4,658	812	1,982
Misc. Sreams	——	——	439	214	11	0	5	6
NORTH THOMPSON								
Raft River	Aug. 28-Sept. 1	7,301	6,624	5,594	2,729	15	1,209	1,505
Barriere River	Aug. 25-29	335	104	40	22	0	11	11
North Thompson River	——	225	Present	——	0	0	0	0
CHILCOTIN								
Chilko River	Sept. 21-22	40,315	39,902	76,518	61,707	6,032	24,786	30,889
Taseko Lake	——	80	Present	Present	——	——	——	——
QUESNEL								
Horsefly River	Aug. 29-Sept. 2	295,705	359,232	270,023	253,384	0	113,805	139,579
Mitchell River	Sept. 13-18	6,601	5,335	8,939	24,673	0	10,856	13,817
NECHAKO								
Nadina River (Early)	Aug. 24-28	18,885	3,884	8,541	2,705	0	1,472	1,233
(Late)	Sept. 12-18	17,544	11,293	27,898	16,737	17	6,647	10,073
Nithi River	Aug. 23-26	146	34	140	54	0	25	29
Stellako River	Sept. 23-28	47,241	39,418	49,341	30,755	351	14,444	15,960
STUART								
Early Runs								
Ankwil Creek	Aug. 5-11	18,468	2,806	15,795	21,790	8	10,100	11,682
Bivouac Creek	July 31-Aug. 4	997	401	952	1,884	0	906	978
Driftwood River	Aug. 1-4	81,617	4,221	52,873	131,172	301	62,962	67,909
Dust Creek	Aug. 1-6	10,870	1,584	3,595	17,850	18	6,876	10,956
Felix Creek	Aug. 2-6	3,082	1,404	5,879	7,465	20	3,594	3,851
15 Mile Creek	Aug. 2-6	922	74	209	1,090	9	499	582
5 Mile Creek	Aug. 2-6	731	40	902	2,408	15	1,208	1,185
Forfar Creek	July 31-Aug. 6	13,599	2,221	9,922	18,924	37	10,064	8,823
Forsythe Creek	Aug. 2-6	5,836	553	2,248	10,907	8	5,320	5,579
Frypan Creek	Aug. 1-6	10,595	275	3,145	5,799	0	2,581	3,218
Gluske Creek	Aug. 1-6	5,652	2,200	4,660	19,450	39	9,550	9,861
Kynoch Creek	Aug. 1-6	16,170	2,885	12,380	22,485	135	11,256	11,094
Leo Creek	Aug. 1-6	1,624	121	571	1,390	14	562	814
Narrows Creek	July 31-Aug. 4	7,897	1,377	5,746	5,726	19	2,776	2,931
Paula Creek	Aug. 4-9	1,400	79	794	2,787	17	1,221	1,549
Rossette Creek	Aug. 1-5	4,993	1,165	1,566	4,156	58	1,962	2,136
Sakeniche River	Aug. 2-6	5,278	4	691	4,175	4	2,204	1,967
Sandpoint Creek	Aug. 2-6	3,523	706	693	3,178	0	1,493	1,685
Shale Creek	Aug. 2-6	2,392	79	706	3,260	0	1,463	1,797
25 Mile Creek	Aug. 3-7	1,663	229	0	744	0	343	401
Misc. Streams	Aug. 2-6	3,911	621	2,335	14,013	59	7,008	6,946
Late Runs								
Kazchek Creek	Sept. 5-10	15,676	3,292	178	2,909	1	1,228	1,680
Kuzkwa Creek	Sept. 5-10	39,245	10,000	8,370	20,124	16	8,933	11,175
Middle River	Sept. 5-10	177,516	139,186	111,322	91,879	17	38,797	53,065
Pinchi Creek	Sept. 12-15	527	Present	756	1,271	0	513	758
Sakeniche River	Sept. 5-10	1,094	11	0	232	0	98	134
Tachie River	Sept. 11-15	177,047	62,469	84,343	97,445	79	43,256	54,110
NORTHEAST								
Upper Bowron River	Aug. 28-31	7,460	2,660	3,872	4,700	0	2,115	2,585
TOTALS*		1,253,012	845,418	1,019,544	1,181,093	136,600	478,388	566,105

* Totals include small numbers of fish in small tributaries not listed in the table.

TABLE VII

DAILY CATCH OF SOCKEYE, 1958-1962-1966-1970 FROM UNITED STATES CONVENTION WATERS

	JULY				AUGUST				SEPTEMBER			
Date	1958	1962	1966	1970	1958	1962	1966	1970	1958	1962	1966	1970
1						25,695	131,250		170,818			31
2						16,883	104,089		326,983			6
3			CLOSED				104,338	79,718	218,732	142		
4					27,722		56,763	43,413	182,785	897		
5					17,753		73,479	35,355	255,742	553	8,986	
6					9,482	32,790			361,549	37,491	4,292	
7						33,759			278,614	17,758	9,196	549
8						42,145	76,199		251,967		4,756	301
9	CLOSED	CLOSED					66,840		270,105			671
10							40,168	70,672	99,657	331		275
11			2,317		47,540		45,066	55,718	83,545	4,921		
12			1,968		52,692		51,407	59,364	74,324	5,584	3,262	
13				4,133	48,236	41,499	26,894	67,530	71,025	542	980	
14				1,716		13,444		48,662	100,305		1,686	11,940
15							44,307		44,837		511	2,356
16							43,556	67,087	22,421			1,373
17							51,893	89,253	80,171			168
18			6,902				22,143	94,580	13,319	452		1,722
19			6,154				17,494	73,372	4,598	1,337	8,131	
20				14,399	51,984	30,235		52,020		160	11,012	
21	4,014			10,630	67,331	52,410					12,804	792
22	6,199			14,252	62,943		73,061		22,260		6,364	258
23	4,346	11,312		9,783			94,884		277,405			2,634
24		12,930							6,769			3,842
25		22,666	28,951		162,816				17,815	92		802
26		25,538	34,784		116,752					800	145	
27			41,679	47,077	156,081			234,354		93	186	
28	19,972			33,591	195,990			91,263			33	1,305
29	10,697			11,710	218,385	183,264			42,564		8	1,094
30	8,253	53,588			249,106		11,044		145,499		30	923
31		33,591			173,652	52,971	6,457	49				
Totals	53,481	159,625	122,755	147,291	1,658,465	525,095	1,141,332	1,162,410	3,423,809	71,153	72,382	31,042
Troll	26	388	75	57	1,092	426	287	365	109	23		1
Monthly Totals	53,507	160,013	122,830	147,348	1,659,557	525,521	1,141,619	1,162,775	3,423,918	71,176	72,382	31,043
June, Oct. and Nov. Totals									120,334	1,927	384	9,051
Season Totals									5,257,316	758,637	1,337,215	1,350,217

TABLE VIII

DAILY CATCH OF SOCKEYE, 1958-1962-1966-1970 FROM CANADIAN CONVENTION WATERS

	JULY				AUGUST				SEPTEMBER			
Date	1958	1962	1966	1970	1958	1962	1966	1970	1958	1962	1966	1970
1	831						227,815		385,773			933
2	1,695	2,469					102,476		466,479			167,484
3		6,116					44,215	84,815	401,799	85,937		
4			9,042		22,502		48,348	133,926	458,172	50,972		
5			9,990		7,241				175,892	8,832	438	
6					5,521	70,736				45,204	6,858	
7	7,239					20,880	134,957			1,806	174	107
8	4,918						81,319		159,126		105	5,627
9	7,149	22,160					57,790		199,470			61
10		11,310					76,573		141,025	53,283		
11		11,328	9,714		36,583		55,376	2316,05	145,470	624		8,248
12			2,539		13,238		102,303	185,031	130,616	349	174	105
13				5,562	14,050	5,801				173	16	139
14	14,098										511	239
15	11,789					33,515	46,027		2,486			
16	16,213	12,460					44,504		2,192			
17		12,708					48,046	94,112	1,974			
18			8,073					103,304	597	148		
19			5,050						307	172	760	
20				9,883	105,922	39,664					71	
21	12,140			5,225	241,232	28,275					903	
22	6,642				284,595		70,477		119			
23	9,276	22,916					48,119		74			
24		7,351							66	725		
25			40,159		196,072				35	715		
26			15,177		219,024				789	784	530	
27				71,450	339,029			27,577			56	
28	19,301			45,779	315,589	50,144		4,850			7,668	150,254
29	9,497			21,227	195,690	26,674			1,198			
30	11,443	68,666				33,735	1,689		391			
31		18,324				25,720	7,233	1,975				
Totals	132,231	195,808	99,744	159,126	1,996,288	355,144	1,197,267	867,195	2,674,050	249,724	18,264	333,197
Troll	350	790	2,603	11,353	3,373	4,417	18,950	134,009	1,131	291	35	51
Spring Salmon Gill Nets				1,025		1,424	2,970	5,222	263	1,540	3,810	
Monthly Totals	132,581	196,598	102,347	171,504	1,999,661	340,985	1,219,187	1,006,426	2,675,444	251,555	22,109	333,248
May, June, Oct. and Nov. Totals									433,931	47,261	6,511	30,593
Season Totals									5,241,617	836,399	1,350,154	1,541,771

TABLE IX

SUMMARY OF THE SOCKEYE ESCAPEMENT TO THE FRASER RIVER SPAWNING AREAS, 1958, 1962, 1966, 1970

District and Streams	1970 Period of Peak Spawning	Estimated Number of Sockeye			
		1958	1962	1966	1970
LOWER FRASER					
Cultus Lake	Nov. 15-20	14,097	27,070	17,464	15,149
Upper Pitt River	Sept. 14-17	10,385	16,585	20,867	6,657
Widgeon Slough	Nov. 2-5	1,152	599	884	364
HARRISON					
Big Silver Creek	Sept. 28-Oct. 1	—	490	329	261
Harrison River	Nov. 27-30	14,701	8,162	32,672	12,675
Weaver Creek	Oct. 24-28	36,199	15,962	20,416	11,096
LILLOOET					
Birkenhead River	Sept. 24-26	33,055	52,146	81,134	72,760
SETON-ANDERSON					
Gates Creek	Aug. 30-Sept. 1	81	1,046	592	803
Portage Creek	Oct. 31-Nov. 2	4,803	12,034	31,844	3,901
SOUTH THOMPSON					
Seymour River	Sept. 6-10	78,575	58,104	28,754	14,375
Eagle River	Sept. 8-11	31	169	338	23
Scotch Creek	Sept. 1-3	—	7	459	304
Anstey River	Sept. 8-11	—	77	—	196
Upper Adams River	Sept. 7-9	Present	85	63	4
Lower Adams River	Oct. 19-30	1,730,609	984,447	1,180,105	1,280,288
Little River	Oct. 19-30	409,480	115,881	105,288	222,393
South Thompson River	Oct. 19-30	123,864	19,152	10,586	5,891
Lower Shuswap River	Oct. 17-20	9,387	31,205	24,629	29,074
Middle Shuswap River	Oct. 19-22	499	457	1,872	4,559
Diverted Sockeye	—	1,006,177	0	0	0
NORTH THOMPSON					
Raft River	Sept. 10-12	10,215	7,613	6,250	4,474
Barriere River	Aug. 29-31	0	14	4	2
North Thompson River	Sept. 26-28	—	90	46	270
CHILCOTIN					
Chilko River	Sept. 22-24	137,081	92,467	226,702	145,049
Taseko Lake	—	7,538	657	353	Present
QUESNEL					
Horsefly River	Sept. 4-7	1,784	1,001	1,607	1,350
Mitchell River	—	65	5	142	23
Little Horsefly River	—	14	72	4	—
NECHAKO					
Endako River	—	522	236	5	0
Nadina River (Early)	Aug. 19-22	804	450	83	93
(Late)	Sept. 18-22	—	1,683	1,784	4,671
Nithi River	—	5	25	0	0
Ormonde Creek	—	210	47	5	0
Stellako River	Sept. 29-Oct. 2	112,273	124,495	101,684	45,876
STUART					
Early Runs					
Ankwil Creek	Aug. 4-6	461	290	86	220
Driftwood River	Aug. 2-4	1,897	374	140	1,983
Dust Creek	Aug. 3-5	3,017	1,035	178	963
Felix Creek	Aug. 2-9	515	1,600	979	2,866
25 Mile Creek	—	218	25	0	0
15 Mile Creek	—	105	25	0	0
5 Mile Creek	Aug. 2-4	111	11	0	108
Forfar Creek	Aug. 4-6	8,715	4,464	1,739	6,476
Frypan Creek	Aug. 3-5	57	243	58	130
Gluske Creek	Aug. 2-4	1,642	1,841	1,876	5,702
Kynoch Creek	Aug. 3-5	9,477	8,672	3,591	6,495
Narrows Creek	Aug. 4-6	1,823	666	322	144
Paula Creek	Aug. 3-5	333	405	0	565
Rossette Creek	Aug. 5-7	3,735	4,887	1,645	7,664
Sakeniche River	—	500	20	2	0
Sandpoint Creek	Aug. 1-3	875	243	0	358
Shale Creek	Aug. 2-4	657	306	50	34
Misc. Streams	Aug. 2-5	492	339	193	858
Late Runs					
Kazchek Creek	Sept. 16-18	369	77	144	74
Middle River	Sept. 20-24	7,762	11,706	4,917	12,115
Pinchi Creek	—	850	142	76	0
Tachie River	Sept. 20-23	13,738	6,764	3,600	2,776
NORTHEAST					
Upper Bowron River	Aug. 27-30	14,871	6,292	2,480	1,341
TOTALS*		3,815,826	1,622,960	1,919,336	1,948,171

* Totals include small numbers of fish in small tributaries not listed in the table.

TABLE X

PINK SALMON CATCH BY GEAR

Gear		1967	1969	1971	1973
United States Convention Waters					
Purse Seines	Units	315	270	218	268
	Catch	3,203,781	776,533	1,905,182	1,785,699
	Per Cent	83.71	82.10	80.30	80.26
Gill Nets	Units	505	236	507	624
	Catch	310,744	91,609	334,202	323,370
	Per Cent	8.12	9.69	14.09	14.53
Reef Nets	Units	50	9	48	53
	Catch	118,994	37,331	118,904	101,729
	Per Cent	3.11	3.95	5.01	4.57
Troll	Catch	193,521	40,324	12,863	14,126
	Per Cent	5.06	4.26	0.54	0.64
TOTAL CATCH		3,827,040	945,797	2,371,151	2,224,924
Canadian Convention Waters					
Purse Seines	Units	99	65	129	137
	Catch	2,289,207	277,592	939,737	1,246,204
	Per Cent	55.07	32.23	43.97	60.48
Gill Nets	Units	1,675	753	1,067	995
	Catch	892,447	366,005	775,663	395,901
	Per Cent	21.47	42.48	36.29	19.21
Troll	Catch	975,268	217,908	421,937	418,574
	Per Cent	23.46	25.29	19.74	20.31
TOTAL CATCH		4,156,922	861,505	2,137,337	2,060,679

NOTE: Gear counts represent the maximum number of units delivering pinks on a single day near the peak of the run.

TABLE XI

LANDINGS AND PACKS OF PINK SALMON FROM CONVENTION WATERS

	United States	*Canada*	*Total*
1973			
Total Landings (No. of Pinks)	2,224,924	2,060,679	4,285,603
Share in Fish	51.92%	48.08%	
Total Pack (48-lb Cases)	160,642	151,611	312,253
Share in Pack	51.45%	48.55%	
1957-1973			
Total Landings (No. of Pinks)	20,066,969	19,474,952	39,541,921
Share in Fish	50.75%	49.25%	
Total Pack (48-lb Cases)	1,427,200	1,398,916	2,826,116
Share in Pack	50.50%	49.50%	
1973 *Catch*	2,224,924	2,060,679	4,285,603
1971	2,371,151	2,137,337	4,508,488
1969	945,797	861,505	1,807,302
1967	3,827,040	4,156,922	7,983,962
1965	558,380	592,467	1,150,847
1963	4,426,232	4,173,288	8,599,520
1961	508,544	545,128	1,053,672
1959	2,427,535	2,312,906	4,740,441
1957	2,777,366	2,634,720	5,412,086
1955	4,685,984	4,129,063	8,815,047
1953	4,951,429	4,142,117	9,093,546
1951	5,086,284	2,885,514	7,971,798
1949	6,235,400	3,189,662	9,425,062
1947	8,801,595	3,491,416	12,293,011
1945	5,458,890	1,279,849	6,738,739

NOTE: Pack figures include all pinks landed even though some were sold fresh and frozen.

TABLE XII

DAILY CATCH OF PINK SALMON, 1967-1969-1971-1973 FROM UNITED STATES CONVENTION WATERS

	JULY				AUGUST				SEPTEMBER			
Date	1967	1969	1971	1973	1967	1969	1971	1973	1967	1969	1971	1973
1		13	1		7,164		240	4,907	145,934		78,550	360,059
2		36		100	8,084		4,882			124,314	90,063	330,814
3				140		2,689	3,215			161,294	201,457	206,254
4				152		1,941	1,946				189,407	
5			9			2,099			362,417		4,666	
6			9		199				261,626		328,841	
7		23	20		6,635				144,223		390,632	
8		25	4		10,666		55	14,294		2,418	262,261	
9	2	33		1,067			7,185			8,677		294,472
10	29			1,496			7,161			127,783		169,530
11	39		1	2,615		3,627	5,042		157,616	57,856		66,887
12			43	3,581		1,783	4,649		149,560			
13			62	3,818	24,236	2,521			124,201			
14		443	111		41,126	2,081	344	22,253	89,874		6,114	
15		362	67		45,622		7,238	15,311		42,946	144,795	
16	10			5,661	53,414		7,552			19,249	121,411	
17	322			3,799			6,577			1,072	91,232	59,485
18	209		34	2,908		17,014	6,006		96,316			21,161
19			563			22,877	5,056		48,221		11,796	
20			514				3,154	62,583	39,802		59,887	
21		967	732		133,050		45	59,992	17,651		59,521	
22		547			191,662		7,257	43,693		16,381	33,525	
23	275	665		6,729	140,804		9,171	20,293		19,181		
24	6,873			5,110	172,829		12,231			11,860		6,891
25	6,010		112	4,251		98,003	13,107		943	5,347		3,242
26	5,622		2,033			119,947	11,680		769		1,212	
27	5,952		1,438					249,269	323		19,789	
28		2,080	2,391					138,583			6,741	
29		2,565	2,837		483,011					4,461	7,948	
30	3,897	1,259		6,821	366,854		5,580			2,265	6,865	
31	10,619			5,114	262,997		92,273					
Totals	39,859	9,018	10,981	53,362	1,948,353	274,582	221,646	631,178	1,639,476	605,104	2,116,713	1,518,795
Troll	48,377	5,524	1,999	7,108	132,751	32,702	8,154	5,704	9,297	1,267	1,859	598
Monthly Totals	88,236	14,542	12,980	60,470	2,081,104	307,284	229,800	636,882	1,648,773	606,371	2,118,572	1,519,393
June, Oct. and Nov. Totals									8,927	17,600	9,799	8,179
Season Totals									3,827,040	945,797	2,371,151	2,224,924

TABLE XIII

DAILY CATCH OF PINK SALMON, 1967-1969-1971-1973 FROM CANADIAN CONVENTION WATERS

	JULY				AUGUST				SEPTEMBER			
Date	1967	1969	1971	1973	1967	1969	1971	1973	1967	1969	1971	1973
1		24	Strike		528		6,406	3,396		40,906	6,913	167,083
2		15	June 26-		474		5,243	3,452		35,463	15,269	157,615
3			July 10				5,988		117,540		27,028	157,578
4				1		5,777			134,138		13,692	
5			1			4,773			128,994		13,768	
6				Strike	10,829	5,684		24,136	65,626		33,997	
7				July 6-	14,045			14,643	93,898	91,986		
8			1	July 15	17,863			13,373	100,559	29,915	141,120	
9					20,326		20,059	2,572		25,639	81,037	39,434
10							17,280	1,481		17,039	86,916	50,859
11			3			6,345	15,145		218,008	108,797	58,168	36,599
12			5			3,674			136,118		46,851	27,396
13						4,641		23,520	73,745		31,098	
14		34			14,394			24,987	31,250		34,631	
15			20	40	108,014			38,368			26,718	
16				90	105,629		16,750					
17	8			84			9,010			11,653		58,070
18	7			59		25,980			29,284	10,891		12,299
19	4		31			12,711			16,313			7,441
20			51			414		79,374	10,361		14,866	
21		74			67,700			71,878			7,649	
22		85			150,862		23,135	125,369	54,442		172,256	
23				7,155	168,186		25,979	10,591		2,206	27,182	
24	328			5,601			17,141			2,196		31,267
25	266			4,415					10,133			1,191
26	308		192			1,074	73,040		6,294		47,551	34,996
27	454	273	57				90,929	178,434	4,998		8,392	
28		1,848	217		210,531			131,738			1,299	
29		2,315			293,634			28,293			29,454	
30		2,044		2,963	239,917	36,049	224,988			477	17,488	
31	1,037	1,324		3,472	221,137	49,946	145,573					
Totals	2,412	8,036	578	23,880	1,776,069	157,068	696,666	775,605	1,231,701	377,168	943,343	781,828
Troll	99,288	35,622	41,634	93,200	663,415	150,136	245,984	248,042	197,605	26,298	121,281	52,393
Spring Salmon Gill Nets										55,538	16,822	7,305
Monthly Totals	101,700	43,658	42,212	117,080	2,439,484	307,204	942,650	1,023,647	1,429,306	459,004	1,081,446	841,526
June and Oct. Totals									186,432	51,639	71,029	78,426
Season Totals									4,156,922	861,505	2,137,337	2,060,679

TABLE XIV

SUMMARY OF THE PINK SALMON ESCAPEMENT TO THE FRASER RIVER SPAWNING AREAS

District and Streams	1973 *Period of Peak Spawning*	*Estimated Number of Pink Salmon* 1967	1969	1971	1973
EARLY RUNS					
LOWER FRASER					
Main Fraser	Oct. 2-8	785,797	848,532	928,046	766,053
HARRISON					
Chehalis River	Oct. 10-16	5,625	7,147	32,178	14,300
FRASER CANYON					
Coquihalla River	Oct. 2-6	3,045	2,415	16,778	11,994
Jones Creek	Oct. 3-8	3,162	1,779	1,304	2,544
Misc. Tributaries	Oct. 2-15	2,395	450	3,298	3,549
SETON - ANDERSON					
Seton Creek	Oct. 11-16	225,351	198,854	297,968	211,337
Portage Creek	Oct. 12-17	7,822	1,092	1,456	13,983
Bridge River	Oct. 11-16	6,547	13,034	8,817	23,738
THOMPSON					
Thompson River and Tributaries	Oct. 4-10	450,487	247,896	258,203	283,385
TOTAL*		1,490,231	1,321,199	1,553,363	1,330,883
LATE RUNS					
HARRISON					
Harrison River	Oct. 14-20	64,576	96,390	73,881	196,150
Weaver Creek	Oct. 12-15	786	725	1,435	895
CHILLIWACK-VEDDER					
Chilliwack-Vedder River	Oct. 11-15	252,585	92,222	160,511	210,799
Sweltzer Creek	Oct. 16-20	19,586	18,923	13,122	15,265
TOTAL*		341,141	208,260	250,389	423,109
GRAND TOTAL*		1,831,372	1,529,459	1,803,752	1,754,111

* Totals may include small numbers of fish in small tributaries not listed in the table.

TABLE XV

SUMMARY OF THE PINK SALMON ESCAPEMENTS TO UNITED STATES AND CANADIAN NON-FRASER RIVER SPAWNING AREAS*

United States Spawning Areas	1967	1969	1971	1973
Nooksack	20,000	15,000	40,000	75,000
Skagit	100,000	100,000	300,000	250,000
Stillaguamish	105,000	75,000	200,000	35,000
Snohomish	95,000	70,000	125,000	110,000
Puyallup	22,000	16,000	40,000	12,000
Dosewallips	190,000	20,000	45,000	25,000
Duckabush	70,000	20,000	50,000	18,000
Dungeness	95,000	14,400	46,000	47,000
Elwha	10,000	1,500	4,000	9,600
Miscellaneous	19,000	8,200	22,000	13,400
TOTALS	726,000	340,100	872,000	595,000

Canadian Non-Fraser Spawning Areas	1967	1969	1971	1973
Jervis Inlet	25,000	31,000	47,600	10,830
Howe Sound	37,000	23,600	23,700	135,500
Burrard Inlet	13,000	8,500	35,000	75,000
TOTALS	75,000	63,100	106,300	221,330

* These data were provided through the courtesy of the Washington State Department of Fisheries and the Canada Department of the Environment, Fisheries Service.

COMMISSION PUBLICATIONS, 1973

1. Annual Report of the International Pacific Salmon Fisheries Commission for 1972.

2. Progress Report Number 27. Part I, Temperature Control During Sockeye Spawning Period in McKinley Creek in 1969 by A. C. Cooper, Part II, Investigation of the Prespawning Mortality of Sockeye in Horsefly River and McKinley Creek in 1969 by I. V. Williams.

3. Progress Report Number 28. Tests with Ni-Furpirinol (P7138) to Control Prespawning Mortalities of Fraser River Sockeye by I. V. Williams.

STAFF PUBLICATIONS IN OTHER JOURNALS

1. Parasitism on Juvenile Pacific Salmon *(Oncorhynchus)* and Pacific Herring *(Clupea harengus pallasi)* in the Strait of Georgia by the River Lamprey *(Lampetra ayresi)* by J. F. Roos, P. Gilhousen, S. R. Killick, International Pacific Salmon Fisheries Commission, and E. R. Zyblut, Department of the Environment, Fisheries Service. J. Fish. Res. Board Can. 30: 565-568.

2. Detoxification of Kraft Pulp Mill Effluent by an Aerated Lagoon by J. A. Servizi and R. W. Gordon. Pulp Paper Mag. Can. 74 (9) : T295 (Sept. 1973).

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