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

1976

COMMISSIONERS

DONALD R. JOHNSON
WILLIAM G. SALETIC
DONALD W. MOOS
W. R. HOURSTON
RICHARD NELSON
RODERICK HAIG-BROWN

NEW WESTMINSTER
CANADA
1977

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 1966-1976
Roderick Haig-Brown 1970-1976
Richard A. Simmonds 1976-

UNITED STATES

Edward W. Allen 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 1957-1974
George C. Starlund 1961-1966
Clarence F. Pautzke 1961-1969
Thor C. Tollefson 1966-1975
Charles H. Meacham 1969-1970
Donald R. Johnson 1971-
William G. Saletic 1974-
Donald W. Moos 1975-

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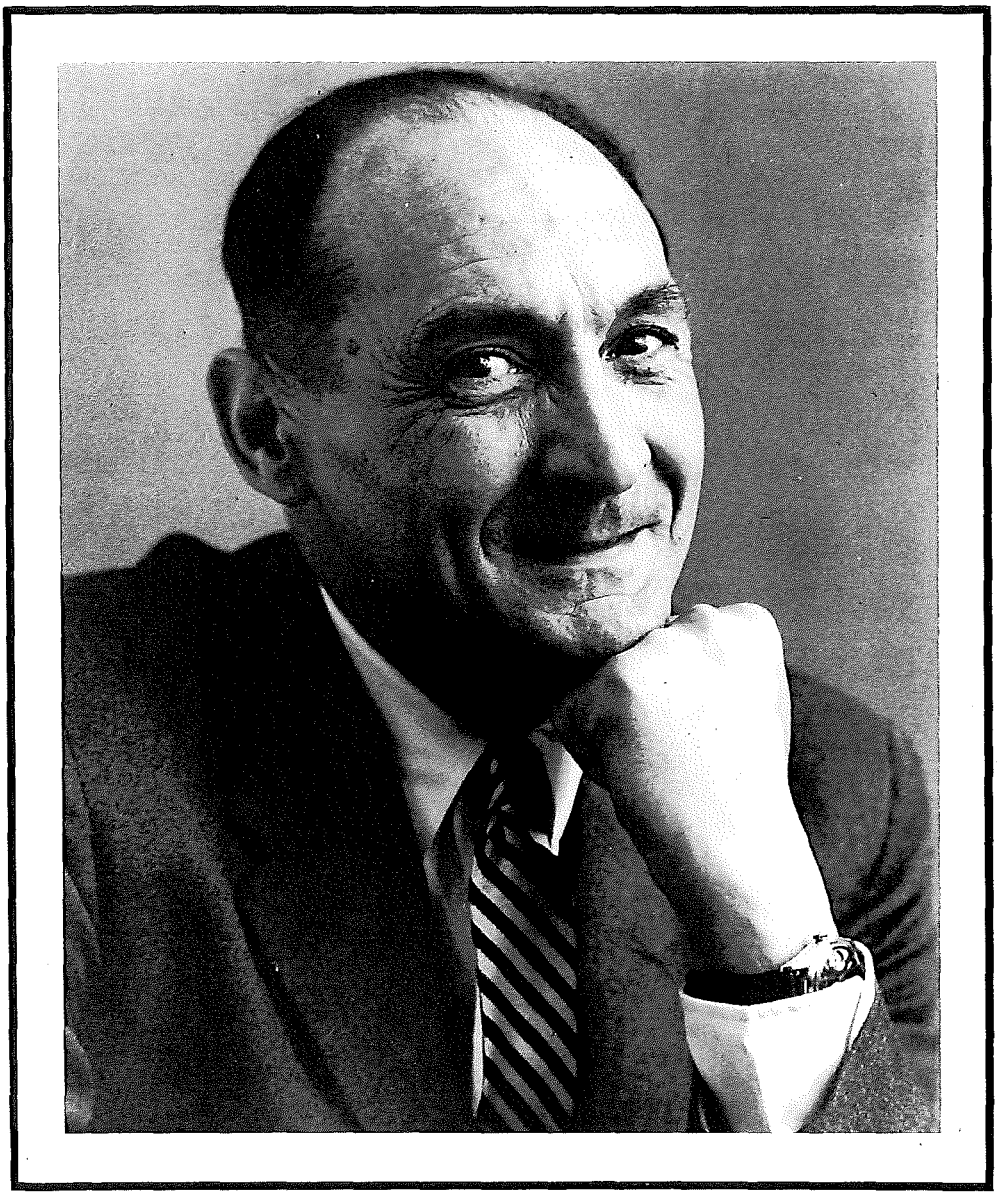
DIRECTOR - A. C. COOPER
ASSISTANT DIRECTOR - J. F. ROOS

NEW WESTMINSTER
CANADA
1977

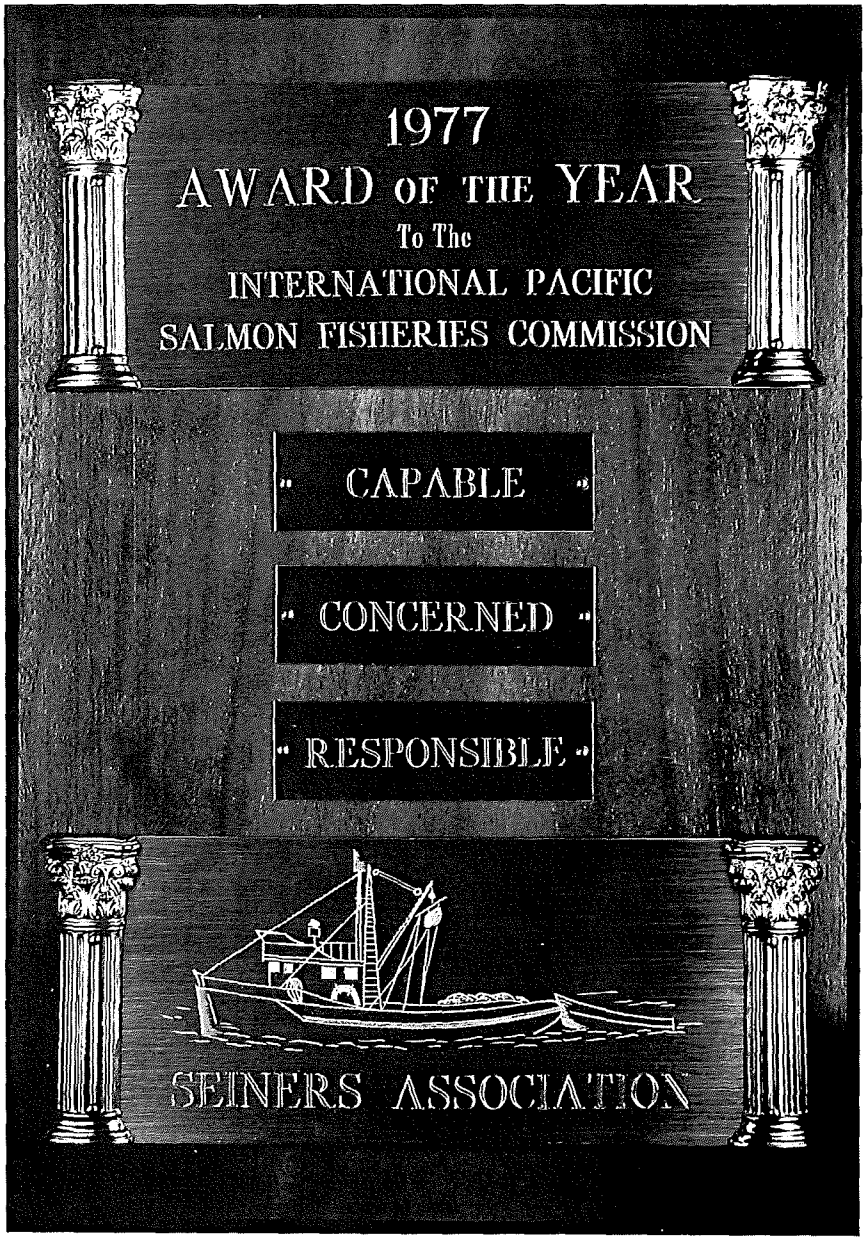
PACIFIC SALMON

River-born fugitives, red muscled under sheathing silver,
Alive with lights of ocean's changing colors,
The range of deeps and distances through wild salt years
Has gathered the sea's plenty into your perfection.
Fullness is the long return from dark depths
Rendering toll of itself to the searching nets
Surging on to strife on brilliant gravel shallows
That opened long ago behind the failing ice.
In violence over the gravel, under the burn of fall,
Fullness spends itself, thrusting forth new life
To nurse in the stream's flow. The old life,
Used utterly, yields itself among the river rocks of home.

—RODERICK HAIG-BROWN



Roderick L. Haig-Brown, member of the International Pacific Salmon Fisheries Commission from 1970 to 1976, who died suddenly on October 9, 1976. Dr. Haig-Brown enjoyed world-wide recognition for his interest and concern for salmon wherever they occur. The objectives of the Commission were a vital concern to him, and he pursued these objectives with integrity of thought and tenaciousness to principle. His presence will be missed greatly by Commissioners, Advisors and the staff.


1977
AWARD OF THE YEAR
To The
INTERNATIONAL PACIFIC
SALMON FISHERIES COMMISSION
" CAPABLE "
" CONCERNED "
" RESPONSIBLE "
SEINERS ASSOCIATION

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REPORT OF THE INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION FOR THE YEAR 1976

During 1976, the search for future sources of electrical energy for British Columbia intensified and possible projects within the Fraser River system were being examined in great detail by the British Columbia Hydro and Power Authority. Interest at present is focused on use of the Hat Creek coal deposits for a thermal plant or alternatively, diversion of the McGregor River to the Peace River. Expansion of the diversion of the Nechako River through the Coast Mountains to the Kemano power plant was also under consideration. The Commission commented publicly on these power sources at its Annual Meeting at Bellingham on December 10, 1976, and further comment is included in this report.

Twenty-eight years have passed since the flood of 1948, and the dykes which are the primary defence for low lands adjacent to the Lower Fraser still have not all been built to the standard required to contain the river at the levels of the 1894 flood. In view of the oft-expressed grave concern about the damages that could result when another 1894 flood occurs, 28 years seems an inordinately long time to complete the dykes. Throughout this period there has been continuing examination of upstream storage for flood control purposes. Recent studies show that of the projects in the System E studied by the former Fraser River Board, all but the lower McGregor diversion had costs greater than the benefits. The recent studies show that the McGregor diversion could lower water levels at Mission by 0.6 to 0.8 feet, but even with this capability, the designated level of 26 feet at Mission would be exceeded by the 600 year flood. The effectiveness of flood control reduces to a question of probabilities of risk, but risk cannot be completely eliminated. Is the certain loss of salmon fisheries production, a common property resource, justified to reduce the risk of loss to property on lands subject to flooding?

The growth in demand for electrical energy, if it continues as forecast, threatens to consume every available source of hydroelectric energy in B.C. in a comparatively short time in relation to future human generations. It seems inevitable that, before long, some other source of energy will have to be utilized. In this context, the use of hydroelectric sources in the Fraser River merely delays for a while the decision that eventually will have to be made as to future supplies. The question again arises, is the certain loss of salmon fisheries production, a common property resource, justified to delay a decision on future power sources?

These are as much political and social decisions, as they are technical. Dr. Haig-Brown summed it all up eloquently in the conclusion of an article he wrote on the Moran Dam proposal as follows:

> "To discuss all this factually and dispassionately is in some ways a betrayal of the salmon and their meaning. The Pacific salmons are almost the last of the North American continent's mighty manifestations of abundance. They are an abundance that man, by taking thought, can live with, maintain, use and enjoy. They provide bodily sustenance, recreation and an individual way of life that many men find rewarding and satisfying, both in spite of and because of its hardships and uncertainties. Their abundance is at once continuing evidence that the province's waters are in relatively good condition and a compelling reason for keeping them so. Man has responded to the salmon runs, from earliest times, with a sense of wonder and gratitude that adds to his own stature; and each new understanding of their sensitivity and complexity expands him and enhances his concept of the world that sustains him and, thus far, tolerates him.

"To set against all this power "needs" that can be better met in other ways is an aberration, an insensate arrogance, that has no place in modern thinking. Moran would satisfy some three or four years of increasing power demand and then the "need" would have to be satisfied elsewhere. The Fraser salmon runs have served mankind for ten thousand years. If we give them a chance they can last as long as mankind, perhaps longer. It is their triumph that they will not fit conveniently into man's shallow technological concepts, a triumph of life and individuality that deserves to endure for its inspirational and emotional as well as its intrinsic values. To destroy them would be an act of vandalism that British Columbia cannot afford, Canada cannot afford and the world cannot afford. It would leave a burden of guilt that the collective conscience of the nation cannot sustain. To preserve them is an act of faith in the future."[1]

COMMISSION MEETINGS

The International Pacific Salmon Fisheries Commission held seventeen formal and seven telephone meetings during 1976 with the approved minutes of these meetings being submitted to the Governments of Canada and the United States.

Commissioner R. Nelson resigned at the end of 1975 but continued to serve as Commissioner until Richard A. Simmonds was appointed in December 1976. Commissioner Roderick L. Haig-Brown died suddenly on October 9, 1976. At the end of 1976, the Commission membership was as follows:

United States	*Canada*
Donald R. Johnson	W. R. Hourston
William G. Saletic	Richard A. Simmonds
Donald W. Moos	

Mr. Nick Carr was appointed to the Advisory Committee on January 30, 1976 representing Canadian Purse Seine Crew Members. Mr. Lloyd Monk was reappointed on June 4, 1976 as Canadian member of the Advisory Committee representing Processors. Mr. N. Mladinich resigned as United States representative of Purse Seine Fishermen after 30 years of service. Mr. Wallace K. Green was appointed on July 30 to replace Mr. Mladinich. Mr. Howard English and Mr. Robert Christensen were reappointed as members on December 3, 1976. At the end of 1976, the membership of the Advisory Committee was as follows:

United States	*Canada*
W. Green Purse Seine Fishermen	J. Brajcich Purse Seine Fishermen
D. Franett Salmon Processors	L. Monk Salmon Processors
R. Christensen Gill Net Fishermen	F. Nishii Gill Net Fishermen
G. Schuler Reef Net Fishermen	N. Carr Purse Seine Crew Members
G. Simmons Troll Fishermen	M. Guns Troll Fishermen
E. Engman Sport Fishermen	H. English Sport Fishermen

The first meeting of 1976 was held January 30 with Mr. Donald R. Johnson serving as Chairman and Mr. W. R. Hourston as Vice-Chairman and Secretary. The Com-

[1] The Fraser Watershed and the Moran Proposal. *Nature Canada*, Vol. 1, No. 2, 1972.

mission approved the appointment of Mr. N. Carr to the Advisory Committee representing Purse Seine Crew Members. The budget for fiscal year 1977-78 was approved by the Commission. The Commission met with the Advisory Committee regarding the tentative recommendations for regulatory control of the 1976 sockeye salmon fishery in Convention Waters, as submitted to the Committee by the Commission on December 12, 1975. After certain regulatory revisions were approved, the regulations were moved for adoption, but failed to get the required approval of the Commission. A telegram was sent to the two national governments advising them of the situation.

On March 4, the Commission approved the previously amended regulations for 1976, for submission to the two national governments with the addition of the following phrase under the Exceptions: "Insofar as the foregoing regulations prescribe the type of gear to be used during the times open to fishing for sockeye and pink salmon, such regulations shall be implemented to the extent permissible under the laws of the Parties." It was reported that the recent flood in the Vedder River, between Vedder Crossing and the B.C. Railway Bridge, had a drastic effect on the gravel bed, and digging failed to find any live pink salmon eggs or alevins in certain areas of the river.

The Commission met on June 4 and approved the reappointment of Mr. L. Monk to the Advisory Committee representing Canadian Processors. The draft for the 1975 Annual Report was also approved. Reports were presented on the following topics: 1. Restoration of the division of flow in the Adams River. 2. Fry and smolt migrations during the spring of 1976. 3. Review of the status of the flood on the Vedder River. 4. Discussion of fish passage options at Seton Creek. Administrative and budgeting matters were also discussed.

During the period July 30 to October 4 inclusive, the Commission held eleven formal and seven telephone meetings for adjustments of fishing regulations to achieve the desired escapement and, as nearly as practicable, equitable division of the allowable catch of Fraser River sockeye salmon.

At the meeting on December 3, the Commission welcomed Mr. R. A. Simmonds as the new Canadian Commissioner replacing Mr. R. Nelson. The Commission also paid tribute to Dr. Roderick L. Haig-Brown, remembering his untimely death on October 9, 1976. Dr. Haig-Brown had served as a Canadian Commissioner since 1970. The Commission approved the reappointments of Mr. R. Christensen representing United States Gill Net Fishermen and Mr. H. English representing Canadian Sport Fishermen to the Advisory Committee.

The seventeenth and final formal meeting of the year was held December 10, in Bellingham, Washington, when the Commission met with its Advisory Committee, staff and approximately 400 representatives of industry, government and press. The catch and escapement statistics for the 1976 sockeye season were presented by the staff. Reports were also presented on the following topics: 1. Production of sockeye salmon from Commission spawning channels. 2. Summary of pollution investigations. 3. Effects of the Nechako and McGregor diversions. 4. Summary of the even year pink salmon study and lake productivity studies. 5. Studies of methods to improve forecasts of sockeye and pink salmon runs. Prospects for the 1977 fishing season were reviewed and tentative proposals for regulating the 1977 fishery were released subject to further considerations by members of the industry and their representatives on the Commission's Advisory Committee.

1976 REGULATIONS

Recommendations for regulations governing the 1976 sockeye salmon fishery in Convention Waters were adopted at a meeting of the Commission held on March 4, 1976 and were submitted to the two national governments for approval on March 16, 1976. The recommendations for Canadian Convention Waters were implemented during the fishing season under the Fisheries Act, British Columbia Fishery Regulations and subsequently by Order-in-Council dated October 7, 1976. The recommendations for United States Convention Waters were approved by the Department of State on April 12, 1976 and were implemented by an Order of the Director of the Washington State Department of Fisheries on June 2, 1976.

The recommendations of the Commission were as follows:

Canadian 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 that, in the interests of such fisheries, the following Fraser River Sockeye and Pink Salmon Fishery Regulations for the season of 1976 be adopted by Order-in-Council pursuant to Section 34 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 in that portion of Area 20 lying westerly of a line drawn true south from Sheringham Point Lighthouse to the International Boundary with nets from the 27th day of June, 1976 to the 24th day of July, 1976, 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 from the 25th day of July, 1976 to the 21st day of August, 1976, 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.

(3) No person shall fish for sockeye or pink salmon in the waters described in subsection (1) of this section with gill nets from the 25th day of July, 1976 to the 21st day of August, 1976, both dates inclusive, except from half past six o'clock in the afternoon of Sunday to half past six o'clock in the forenoon of Monday and from half past six o'clock in the afternoon of Monday to half past six o'clock in the forenoon of Tuesday of each week.

(4) No person shall troll commercially for sockeye or pink salmon in the waters described in subsection (1) of this section from the 25th day of July, 1976 to the 21st day of August, 1976, both dates inclusive, except at times that net fishing may be permitted within that area.

2. No person shall fish for sockeye or pink salmon with nets 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:

(1) From the 27th day of June, 1976 to the 17th day of July, 1976, both dates inclusive, except for those sockeye or pink salmon taken in gill nets having mesh of not less than 8½ inches extension measure as authorized for the taking of chinook salmon by the Director of the Pacific Region, Department of the Environment, Fisheries and Marine Service, and pursuant to the provisions of the British Columbia Fishery Regulations; and

(2) From the 18th day of July, 1976 to the 31st day of July, 1976, 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

(3) From the 1st day of August, 1976 to the 30th day of September, 1976, 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 gill nets in the Convention Waters portion of District No. 1 from the 1st day of October, 1976 to the 9th day of October, 1976, 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.

4. No person shall troll commercially for sockeye or pink salmon in that portion of the waters described in section 2 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 toward Point Roberts Light to the intersection with the International Boundary, thence following the International Boundary to its intersection with the mainland, from the 15th day of August, 1976 to the 30th day of September, 1976, both dates inclusive, except at the times and locations that net fishing may be permitted within that area.

5. Insofar as the foregoing regulations prescribe the type of gear to be used during times open to fishing for sockeye and pink salmon, such regulations shall be implemented to the extent permissible under the laws of the Parties.

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 1976, 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. No person shall fish for sockeye or pink salmon with nets in the Convention Waters of the United States of America from the 27th day of June, 1976 to the 17th day of July, 1976, both dates inclusive.

2. (1) No person shall fish for sockeye or pink salmon with purse seines 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:

(a) From the 18th day of July, 1976 to the 14th day of August, 1976, 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 15th day of August, 1976 to the 21st day of August, 1976, both dates inclusive, except from five o'clock in the forenoon to nine o'clock in the afternoon of Monday and Tuesday.

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

(a) From the 18th day of July, 1976 to the 24th day of July, 1976, and from the 1st day of August, 1976 to the 7th day of August, 1976, 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

(b) From the 25th day of July, 1976 to the 31st day of July, 1976, and from the 8th day of August, 1976 to the 14th day of August, 1976, 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

(c) From the 15th day of August, 1976 to the 21st day of August, 1976, both 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.

(3) No person shall fish for sockeye or pink salmon with commercial trolling gear in the waters described in subsection (1) of this section from the 18th day of July, 1976 to the 21st day of August, 1976, both dates inclusive, except from Monday through Friday of each week on those days when purse seine fishing is permitted within that area.

3. (1) No person shall fish for sockeye or pink salmon with purse seines 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:

(a) From the 18th day of July, 1976 to the 14th day of August, 1976, 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 15th day of August, 1976 to the 11th day of September, 1976, 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 with reef nets in the waters described in subsection (1) of this section:

(a) From the 18th day of July, 1976 to the 24th day of July, 1976, and from the 1st day of August, 1976 to the 7th day of August, 1976, all dates inclusive, except from three o'clock in the afternoon 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 to three o'clock in the afternoon of Wednesday of each week; and

(b) From the 25th day of July, 1976 to the 31st day of July, 1976, and from the 8th day of August, 1976 to the 14th day of August, 1976, all dates inclusive, except from half past ten o'clock in the forenoon 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 to half past ten o'clock in the forenoon of Tuesday of each week; and

(c) From the 15th day of August, 1976 to the 21st day of August, 1976, and from the 29th day of August, 1976 to the 4th day of September, 1976, all dates inclusive, except from three o'clock in the afternoon 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 to three o'clock in the afternoon of Wednesday of each week; and

(d) From the 22nd day of August, 1976 to the 28th day of August, 1976, and from the 5th day of September, 1976 to the 11th day of September, 1976, all dates inclusive, except from half past ten o'clock in the forenoon 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 to half past ten o'clock in the forenoon of Tuesday of each week.

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

(a) From the 18th day of July, 1976 to the 24th day of July, 1976, and from the 1st day of August, 1976 to the 7th day of August, 1976, 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

(b) From the 25th day of July, 1976 to the 31st day of July, 1976, and from the 8th day of August, 1976 to the 14th day of August, 1976, 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

(c) From the 15th day of August, 1976 to the 21st day of August, 1976, and from the 29th day of August, 1976 to the 4th day of September, 1976, 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 22nd day of August, 1976 to the 28th day of August, 1976, and from the 5th day of September, 1976 to the 11th day of September, 1976, 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 with nets in that portion of the waters described in subsection (1) of section 3 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 from the 5th day of September, 1976 to the 18th day of September, 1976, both dates inclusive.

5. Insofar as the foregoing regulations prescribe the type of gear to be used during times open to fishing for sockeye and pink salmon, such regulations shall be implemented to the extent permissible under the laws of the Parties.

6. The foregoing recommended regulations shall not apply to the following United States Convention Waters:

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

(2) 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

(3) State Fishing Area No. 4, and

(4) 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 escapement of Fraser River sockeye salmon and for an equitable share of the season's catch by the fishermen of the United States and Canada, the approved regulations as detailed above were later adjusted by the Commission as follows:

July 30, 1976—To provide additional escapement of Chilko River, Gates and Nadina sockeye, in United States Convention Waters, the Commission approved a 24 hour delay in the scheduled opening with only 1 day of fishing, and a delay of 24 hours in the scheduled opening of Areas 17, 18 and District No. 1 of Canadian Convention Waters.

August 3, 1976—Due to the small incidental catches of sockeye and pink salmon in the ocean troll fishery of United States Convention Waters west of the Bonilla-Tatoosh Line, the Commission relinquished regulatory control of these waters effective midnight August 3, 1976, and approved an additional 24 hours fishing in the United States Convention Waters east of the Bonilla-Tatoosh Line, making a total of two days for the current week.

In the interest of clarification, the Commission amended the exceptions to its regulations by the addition of the underlined words in the following quote from the regulations:

"Insofar as the foregoing regulations prescribe the type of gear to be used during times open to fishing for sockeye and pink salmon in those parts of Convention Waters open to net fishing east of the Bonilla-Tatoosh Line, such regulations shall be implemented to the extent permissible under the laws of the Parties."

August 6, 1976—In the interest of division of catch and to provide additional escapement of Chilko River sockeye, the Commission approved the following regulatory changes: 1. That United States Convention Waters open 24 hours earlier than scheduled, for two days fishing. 2. That Areas 17, 18 and District No. 1 of Canadian Convention Waters not open as scheduled.

August 9, 1976—In the interest of division of catch, the Commission approved 24 hours additional fishing in United States Convention Waters, making a total of 3 days for the current week.

August 10, 1976—To conserve for escapement the sockeye delaying in the Strait of Georgia of Canadian Convention Waters, the Commission approved the implementation of the troll closure line previously scheduled for August 15, to be advanced and be effective at 12:01 a.m. August 11.

August 13, 1976—In order to secure sufficient escapement of Chilko River sockeye, the Commission approved closure (until further notice) of United States Convention Waters and of Areas 17, 18 and District No. 1 of Canadian Convention Waters for the week commencing August 15.

August 15, 1976—In the interest of division of catch, the Commission approved 24 hours fishing in Areas 17, 18 and District No. 1 of Canadian Convention Waters, effective 8:00 a.m. August 18.

August 20, 1976 – In view of the indicated abundance of Weaver and Birkenhead sockeye in Juan de Fuca Strait, the Commission approved the following regulatory changes: 1. That control of Area 20 of Canadian Convention Waters and United States Convention Waters between Bonilla-Tatoosh Line and Port Angeles-William Head Line not be relinquished as scheduled. 2. That Area 20 of Canadian Convention Waters open for 2 days fishing with gill nets starting 6:30 p.m. August 22 and purse seines 6:30 a.m. August 23.

August 24, 1976 – In the interest of division of catch and harvest of late run sockeye, the Commission approved an additional 41 hours fishing in Areas 17, 18 and District No. 1 of Canadian Convention Waters from 3:00 p.m. August 25 to 8:00 a.m. August 27.

August 27, 1976 – In the interest of division of catch and the declining numbers of sockeye in Juan de Fuca Strait, the Commission approved the following regulatory changes: 1. That control of Area 20 of Canadian Convention Waters and Areas 4B, 5, and 6C of United States Convention Waters be relinquished effective 12:01 a.m. August 29. 2. That Areas 17, 18 and District No. 1 westerly of the Brunswick Cannery-Oak Street Bridge line of Canadian Convention Waters open 6:00 p.m. September 1 to 8:00 p.m. September 3.

September 2, 1976 – The Commission approved the following regulatory changes: 1. That regulatory control of United States Convention Waters lying southerly and easterly of the Lily Point line be relinquished effective 12:01 a.m. September 7, and the remainder of United States Convention Waters under Commission control remain closed. 2. That control of Areas 17 and 18 of Canadian Convention Waters lying westerly of a line from Reception Point to Thrasher Rock to Law Point on Gabriola Island to Josef Point, thence in a straight line to Cordero Point on Valdez Island and along the easterly shoreline of Valdez Island to Vernaci Point, thence in a straight line to Race Point on Galiano Island and along the easterly shoreline of Galiano Island to Burrill Point, thence in a straight line to Georgina Point on Mayne Island, thence along the easterly shoreline of Mayne Island to Campbell Point, thence in a straight line to Winter Point on Saturna Island, thence along the easterly shoreline of Saturna Island to East Point, thence due south in a straight line to the International Boundary, be relinquished effective 12:01 a.m. September 5. 3. That District No. 1 and the remaining portion of Areas 17 and 18 of Canadian Convention Waters under Commission control open 8:00 a.m. September 7 for 24 hours fishing. 4. That District No. 1 west of the Brunswick Cannery-Oak Street Bridge line and that portion of Areas 17 and 18 of Canadian Convention Waters under Commission control commence fishing 6:00 p.m. September 8 to 8:00 a.m. September 10.

September 7, 1976 – In the interest of division of catch, the Commission approved the following regulation changes: 1. That those waters lying southerly and easterly of Iwersen's Dock-Georgina Point Light line in United States Convention Waters still controlled by the Commission, be relinquished effective 12:01 a.m. September 8, and the remaining United States Convention Waters under the Commission's control remain closed. 2. That the emergency order of September 2 pertaining to Areas 17 and 18 and District No. 1 be changed to provide fishing from 6:00 p.m. September 8 to 8:00 a.m. September 9, instead of to 8:00 a.m. September 10 as previously scheduled.

September 10, 1976 – The Commission approved the following regulation changes: 1. That the remaining waters under Commission control in Areas 17 and 18 of Canadian Convention Waters be closed for the week. 2. That waters westerly of the "Blue Line" in District No. 1 of Canadian Convention Waters be opened for fishing 8:00 a.m. September 13 for 24 hours.

September 17, 1976 – In the interest of securing escapement of Weaver Creek sockeye, the Commission approved the following regulatory changes: 1. That fishing in District No. 1 outside the "Blue Line" in Canadian Convention Waters open for 24 hours at 8:00 a.m. September 20. 2. That Areas 17 and 18 of Canadian Convention Waters under Commission control remain closed.

September 24, 1976 – The Commission approved the following regulation changes in District No. 1 of Canadian Convention Waters: 1. That fishing westerly of the "Blue Line" open 8:00 a.m. September 27 for 24 hours. 2. That fishing easterly of the Brunswick Cannery-Oak Street Bridge line be permitted from 8:00 a.m. to 7:00 p.m. September 27 with nets having a mesh size not less than 8½ inches extended measure under regulation by the Fisheries Service.

October 1, 1976 – In order to secure adequate escapement of Weaver Creek sockeye, the Commission approved the following changes in Canadian Convention Waters: 1. That the Commission relinquish control of the remaining waters of Areas 17 and 18 as scheduled. 2. That control of the waters westerly

of the "Blue Line" in District No. 1 be relinquished effective 12:01 a.m. October 3. 3. That the remaining portion of District No. 1 under Commission control be closed.

October 4, 1976 – Due to the declining abundance of sockeye, the Commission relinquished regulatory control of the remaining Canadian Convention Waters still in the Commission's control effective October 7, three days earlier than scheduled, thus completing the Commission's regulatory obligations for Convention Waters for the 1976 season.

SOCKEYE SALMON REPORT

The Fishery

The total 1976 Fraser River sockeye run was estimated at 4,337,000, compared with a preseason forecast of 3,000,000. It was possibly the largest run for the cycle since 1900. The number of Fraser sockeye entering Convention Waters was 3,743,000 of which 2,687,000 (71.8%) were caught commercially, 228,798 (6.1%) were taken by the Indian food fishery, and 827,250 (22.1%) were recorded on the spawning grounds (see Tables I to VI in Appendix). An estimated 17,000 non-Fraser sockeye, mainly from the run to Cedar River 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 coastal waters north of Convention Waters, were 491,000 and 102,000 respectively. The non-Convention Waters catch of Fraser sockeye migrating through Johnstone Strait was 11.3% of the total run, compared with 14.3% in 1972, the preceding cycle year.

The total 1976 Convention Waters catch of sockeye was 495,113 larger than in the brood year and the total Fraser River sockeye run was 629,000 larger. The total catch was the largest on the cycle since 1912 and the catch by Canadian fishermen of 1,382,484 (51.1%) sockeye was the largest on the cycle since 1936 and the catch by United States fishermen of 1,322,038 (48.9%) was the largest on the cycle since 1912.

In Canadian Convention Waters, 713,568 (51.6%) sockeye were taken in the waters westerly of William Head while 668,916 (48.4%) sockeye 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 (49.6%) taken in the Area 20 fishery was the highest yet recorded for the cycle. The total catch (605,101) and percentage (43.8%) of the catch taken by purse seines was the highest recorded on the cycle. The gill net catch (741,049) was the lowest on the cycle since 1964 and the percentage removal by gill nets (53.6%) was the lowest ever for the cycle.

In United States Waters, the purse seine catch increased significantly in 1976 to 669,322 fish, the highest on the cycle since 1960 (843,850). The percentage taken by purse seines in 1976 (50.6%) was lower than that recorded in any cycle year except 1972. Catch by gill nets (628,411) and percentage harvest (47.5%) were the largest recorded for the cycle. The catch by reef nets was 23,869, the lowest on the cycle since 1936. The percentage catch of only 1.8% by reef nets was the lowest for any cycle year and the lowest percent in any year since 1938.

Fishing effort in United States Convention Waters has been increasing steadily on the cycle since 1964 as shown in the following table. The increased fishing capacity in 1976 resulted in only nine days of fishing compared to 17 days in 1972 on a smaller run.

UNITED STATES CONVENTION WATERS
MAXIMUM DAILY GEAR DELIVERIES

Year	*Purse Seines*	*Gill Nets*	*Reef Nets*	*Total*
1964	96	337	48	481
1968	88	396	34	518
1972	117	565	46	728
1976	193	789	45	1,027

In Canadian Convention Waters, there was a substantial reduction in the number of gill nets fishing in 1976 as shown below. However, the number of purse seines fishing increased significantly from 47 in 1972 to 101 in 1976 and this increase is reflected in the increased catch by that gear. Overall, there was a reduction in total units of gear fishing in 1976 compared with the three previous cycles.

CANADIAN CONVENTION WATERS
MAXIMUM DAILY GEAR DELIVERIES

Year	*Purse Seines*	*Gill Nets*	*Total*
1964	27	1,357	1,384
1968	31	1,410	1,441
1972	47	1,004	1,051
1976	101	722	823

For the first time in the Commission's experience, a major portion of the Chilko sockeye run migrated up the west side of San Juan Island. There was concern as to whether or not the sockeye were migrating continuously on through to the Fraser River. It was determined from tagging at Lummi Island that some Chilko sockeye delayed off the mouth of the Fraser River for up to three weeks before migrating upstream. These events associated with over-fishing in United States Convention Waters resulted in an unprecedented closure of the United States fishery from August 11 to September 8. A lengthy closure was also required in the Fraser River area from August 4 through August 17.

Late run stocks milling in Areas 17 and 18 of Convention Waters have become increasingly attractive to the Canadian purse seine fleet since 1974. In 1976, 107 purse seines fished the area and caught 104,212 sockeye mainly in early September, whereas only one seine fished the area in 1972 and total season's catch was 1,570. Because of the larger than anticipated catch in 1976, very little additional fishing was permitted in the Fraser River fishery because of escapement requirements for the Weaver Creek run, and closures of Areas 17 and 18 were necessary to prevent further exploitation of the delaying stocks.

The total Chilko run in 1976 was estimated at 2,000,000 compared with a predicted return of 1,600,000. The actual return could have been considerably larger if the total smolt migration in 1974 had not been reduced by about 10,000,000 migrants as a result of a large loss of fry in the spring of 1973 caused by IHN virus.

Several races had excellent returns in 1976 such as the Birkenhead River and Gates Creek runs which were the largest on record. The total returns to Pitt River, Fennell Creek, Seymour River, Weaver Creek and Stellako River populations were the largest ever on the cycle.

The average weight of 4-year-old sockeye in 1976 was 5.82 pounds, slightly below the cycle average of 5.92 pounds.

Escapement

The net escapement of 827,250 sockeye represented 22.1% of the 1976 Fraser run to Convention Waters and 19.1% of the calculated total Fraser River run. Even though some serious management problems developed during the fishing season, the total escapement reaching the various spawning grounds was near the preseason target of 900,000.

The escapement of 16,445 sockeye to Early Stuart streams was more than three times larger than in the brood year and was the largest escapement on the cycle since 1956.

The Bowron River escapement of 2,250 was just slightly more than half as large as in 1972. On this cycle this race historically has had much larger escapements, such as in 1948 and 1952 when escapements were 25,218 and 18,672 respectively. The return in 1976 was considerably lower than desired.

The Early Nadina River escapement continued the decline on the cycle that started in 1968. The total escapement of 101 in 1976 was the lowest on the cycle since 1948. The decline in the Early Nadina run has also occurred in recent years on all other cycle years. Escapement to the Late Nadina River spawning area was 1,673 in 1976, down from the 2,702 recorded in 1972. Out of the escapement of 1,673 in 1976, a total of 1,394 (83.3%) sockeye spawned in the spawning channel. The egg deposition from these spawners was augmented by the planting of an additional 4,500,000 fertilized eggs of Stellako River origin crossed with sperm from Late Nadina and Stellako River male sockeye.

The escapement to Gates Creek of 17,744 was the largest since 1964 and more than double the brood year escapement (8,569). A total of 14,855 sockeye was diverted into the spawning channel, the largest number of any year, and the total egg deposition in the creek and channel of 31,000,000 should result in further improvement of this population in 1980.

A very noticeable decrease in Late Stuart escapement occurred in 1976 with only 3,000 spawners compared with 8,564 in 1972.

The Stellako River escapement increased for the second consecutive year. In 1964, 1968 and 1972, the escapements ranged between 30,000 and 37,000. In 1976 the escapement was 150,741, the largest on record for the cycle.

Escapement to the Upper Pitt River was 36,530 fish, the largest on the cycle since 1952. The return in 1976 showed considerable improvement compared with the brood year escapement of only 13,412 sockeye. In total, 4,500,000 eggs were taken for the incubation channel.

The Chilko escapement of 388,101 sockeye was below the previous two cycle returns. However, the number of spawners returning is considered sufficient to maintain the dominance of the Chilko run on this cycle. Another substantial escapement was observed in the beach spawning area located at the south end of Chilko Lake. This run, which appears to be a distinct population, totaled an estimated 23,156 fish. Other races migrating at a similar time as Chilko such as Seymour River, Fennell Creek and Momich River, had escapements about two to three times larger than in the brood year. The Seymour River and Fennell Creek escapements were the largest ever for the cycle and the Momich return was the largest on record. The Raft River escapement declined from 11,151 in 1972 to 8,684 in 1976.

At Birkenhead River the escapement of 108,121 adults and jacks in 1976 was just slightly below the brood year return of 113,097. However, the adult escapement of 77,305 in 1976 was an increase from the 54,516 in 1972. The increase in adult production noted for the Birkenhead run was also apparent at Weaver Creek. Fry from both of these spawning areas rear in Harrison Lake. The total escapement to Weaver Creek in 1976 was 51,078 fish, the largest ever for the cycle and almost double the brood year escapement. The escapement into the spawning channel of 28,211 sockeye was the largest of any year and a very significant increase compared with the 11,043 channel spawners in 1972. In total, the channel accommodated 38,277 salmon of all species.

The late runs to Lower Adams River (5,013) and Portage Creek (3,800) were larger than in the brood year, however the Cultus escapement (4,450) was less than half the brood year return (10,660).

Success of spawning was excellent in all spawning areas. At Gates Creek there is usually only 65 to 70 percent success of spawning on this cycle, but 84.6% of all females spawned successfully in 1976.

In the brood year 1972, approximately 38 million eggs were deposited in the three sockeye channels then in operation and an estimated 397,000 adult sockeye returned in 1976 from that deposition. In 1976, at four channels, approximately 103 million eggs were deposited, giving almost three times greater potential.

The Indian subsistence catch of 228,798 sockeye was the largest ever made on the cycle and second largest of any year to date. In 1972 the catch totaled only 134,268 sockeye. The Commission communicated with the Minister of Fisheries and Environment in December regarding the increased catches by the Indian subsistence fishery. These fish are not included in division of catch and the increasing catches are a concern in management of the runs.

The total escapement of 827,000 was very similar to the brood year escapement of 830,000, but the 1976 escapement was better distributed amongst the various races as Chilko River formed only 44.0% of the total in 1976 compared with 68.0% in 1972.

Escaping adult sockeye salmon were enumerated by echo sounding in the Fraser River for the fifth consecutive year. Data were obtained near Cottonwood and at Mission to examine the pattern of escapement through the lower river and to obtain comparative daily estimates. Data from the two sites enabled identification of a delay of Chilko sockeye in the lower river near the end of July. The 1976 echo sounding estimate of escapement was about 10% less than the recorded spawning ground escapement and Indian fishery catch. Echo sounding at Mission is now considered to be a necessary component of the sonic enumeration because of variations in sockeye migration patterns and speed of migration through the lower Fraser River.

SPAWNING CHANNEL OPERATIONS

Fry production data for the 1975 spawning of sockeye and pink salmon at channels operated by the Commission are given in the following table. At each channel, except Upper Seton, the fry are enumerated by a 5% sampler. Enumeration at the Upper Seton channel is now done by release and recovery of marked fry.

FRY PRODUCTION AT SPAWNING AND INCUBATION CHANNELS FROM THE 1975 BROOD YEAR SPAWNING

Site	*Species*	*Eggs Deposited*	*Fry Produced*	*Percent Survival*
Upper Pitt	Sockeye	4,554,000	4,119,000	90.4
Weaver Creek	Sockeye	41,780,000	25,682,000	61.5
Gates Creek	Sockeye	3,472,000	2,137,000	61.6
Nadina River	Sockeye	18,880,000	12,113,000	64.2
Upper Seton	Pink	9,300,000	7,632,000	82.1
Lower Seton	Pink	24,500,000	16,327,000	66.6

The number of fry from the Upper Pitt channel was the second largest in 13 years of operation, and the second time when more than 4 million have been produced. The number of fry from the Weaver channel was the largest for the cycle, and was over five times greater than on the previous cycle. At Gates Creek, the number of fry was almost ten times greater than on the previous cycle. The number of fry from the Nadina channel was also the largest yet. At both Upper and Lower Seton channels, the number of fry was the largest yet obtained.

The adult returns from the Upper Pitt, Weaver and Gates Creek channels in 1976 totaled 397,472 sockeye, from which a catch of 312,206 sockeye was obtained.

The return of the Pitt River sockeye run was 186,834, of which 70,687 was produced from the channel, and this was the largest recorded total return (Figure 1).

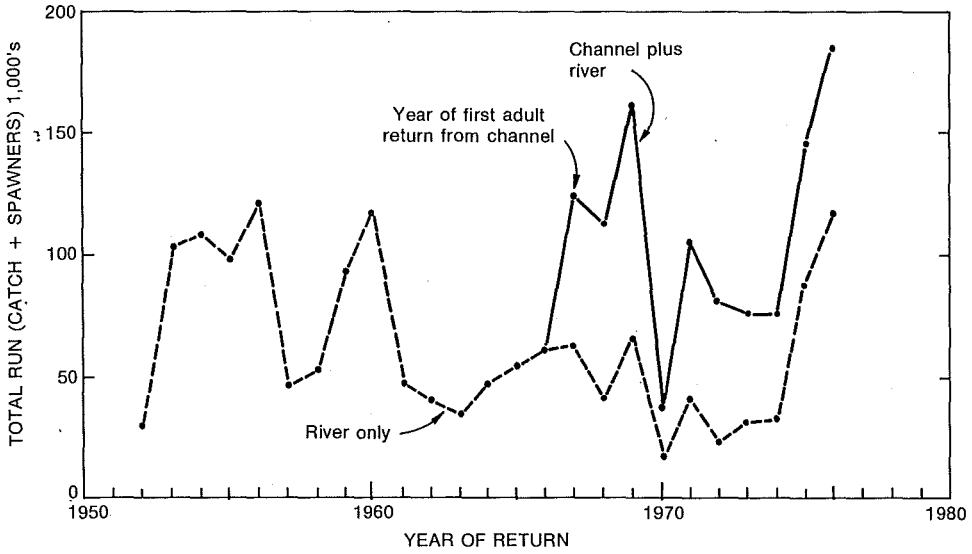

FIGURE 1. Sockeye production from Pitt River and Pitt River incubation channel.

The return of the Weaver Creek sockeye run, totaling 253,441, was the largest recorded on the cycle and continues the trend of increasing runs evident since the channel started operating (Figure 2). The channel produced 199,236 sockeye, or 79% of the run, and this was the third largest return produced by the channel and the largest on this cycle (Figure 3).

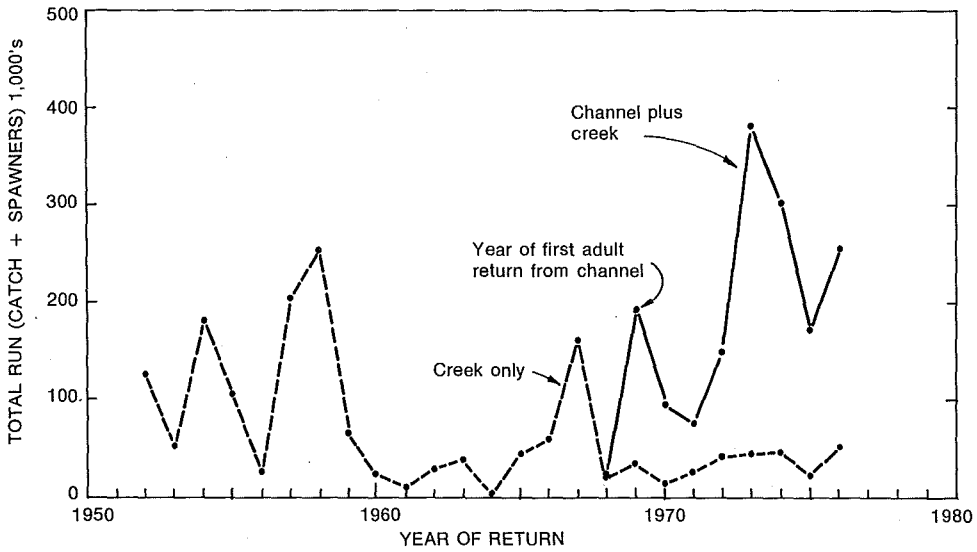

FIGURE 2. Sockeye production from Weaver Creek and Weaver Creek channel.

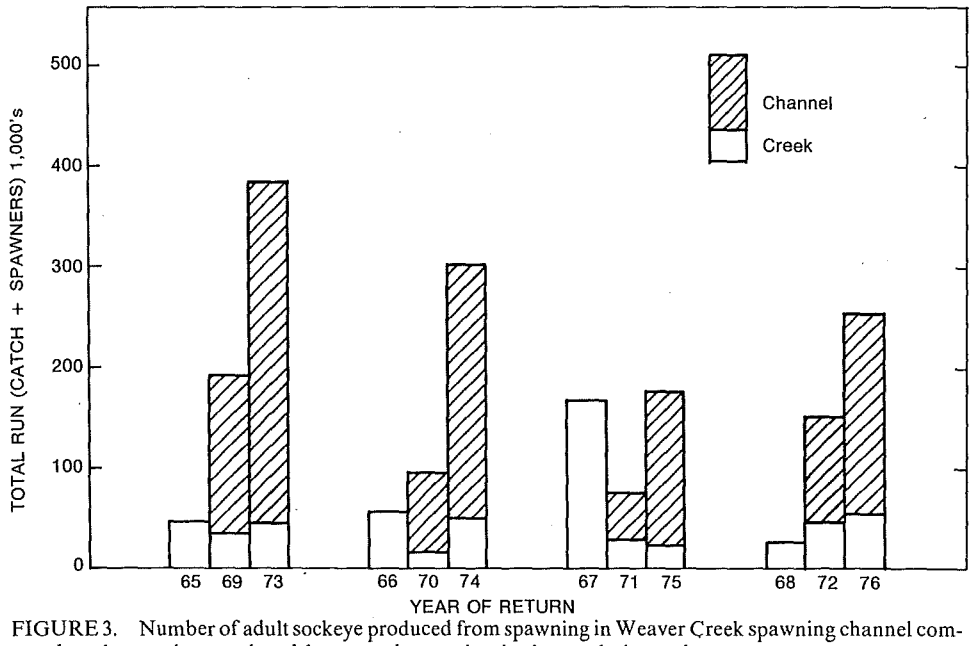

FIGURE 3. Number of adult sockeye produced from spawning in Weaver Creek spawning channel compared to the number produced by natural spawning in the creek, by cycle years.

The return of the Gates Creek run, totaling 127,549 sockeye, was the largest recorded, and 93.2% of the run was produced by the channel.

The rates of return from these three sockeye channels compared to the adjacent natural spawning grounds, given in the following table, show the very definite advantage of the channels, even before they have reached full capacity.

COMPARATIVE PERCENTAGE RETURN OF ADULT SOCKEYE FROM EGGS DEPOSITED AT WEAVER CREEK, PITT RIVER AND GATES CREEK CHANNELS AND NATURAL SPAWNING GROUNDS

Location	*Channel*	*Stream*	*Ratio*
Weaver	1.17	0.13	9.17
Pitt	1.75	0.18	9.87
Gates	1.10	0.21	5.09
Average	1.29	0.15	8.60

A detailed report on all the channels now operated by the Commission will be published early in 1977.

REHABILITATION

As mentioned in the 1975 Annual Report, the scope of work in rehabilitation has been limited because of lack of agreement between the two countries in funding of the Commission's proposed development program.

The attempt to establish a hybrid stock of sockeye in the lower Horsefly River using a cross of Stellako eggs and Horsefly jack males has not been successful. There was no evidence of returning adults in 1976. No sockeye spawned on the lower Horsefly spawning grounds and there was no significant increase in spawners on the upper spawning grounds. This program was not pursued further in 1976.

The 1974 transplant of Seymour River eggs to the Upper Adams River looks very promising. It is estimated from counts at the outlet of Adams Lake and also from catches in the fry traps at the lower end of Adams River close to Shuswap Lake, that approximately 108,000 sockeye smolts emigrated from Adams Lake in the spring of 1976. The indigenous stocks accounted for only about 13,000 of these smolts, the balance of 95,000 being produced by the Upper Adams transplant. This represents a survival of 6.9% from eyed-eggs planted in 1974. Smolts from the second transplant in 1975 will be counted in the spring of 1977.

Additional activities to restore the Early Nadina sockeye run are described in the report of the Engineering Division.

RESEARCH

In accordance with the purpose of the Commission, that is, to protect, preserve and extend the sockeye and pink salmon fisheries of the Fraser River system, biological investigations have been conducted on a wide variety of areas involving both sockeye and pinks.

Concern over sockeye production in the various lakes throughout the Fraser system prompted the Commission to engage in an intensive lake studies program. During the past few years these investigations have centered around the Shuswap system, the fresh water rearing area of the large Adams River sockeye population.

The comprehensive investigations of the 1974 and 1975 brood stocks of Adams River sockeye continued during 1976.

Hydraulic sampling estimates of survival and population size were made while eggs and alevins were in the gravel. A mark-recapture program provided estimates of the emergent fry populations as they entered Shuswap Lake. Acoustic assessments of sockeye in the limnetic areas of Shuswap Lake indicated the distribution and survival of the fry to the fingerling stage.

The subdominant 1975 brood population reflected mortality trends similar to the dominant 1974 brood population. However, the eggs from the 1975 brood survived better in the gravel than did the 1974 brood, consequently the overall egg-to-fry survival rate was 19% in 1975-76 compared to 15% for the 1974 brood.

Zooplankton abundance was measured in Shuswap Lake during the period of fry entry and residence. The abundance of zooplankton is used as an indication of lake productivity, and although changes in the micronutrient supply or in phytoplankton abundance are not measured, changes in these parameters are probably reflected as changes in abundance and species composition of the zooplankton.

It has become apparent that the zooplankton standing crop alone cannot be used as an indication of growth and survival of sockeye. The low survival of sockeye fry in 1971 coincided with a low standing crop of zooplankton. The 1975 standing crop was only 60% of that in 1971 and yet the fish grew better in 1975 than in 1971. The large sockeye population in 1975 does not appear to have influenced the 1976 standing crop of zooplankton as there was more than in any previous cycle year measured. The detailed examination of zooplankton species composition and distribution being carried out on the samples from 1975 and 1976 should assist in understanding the relationship between zooplankton abundance, and growth and survival of sockeye in Shuswap Lake.

A study of the interaction of predators with sockeye in Shuswap Lake was carried out in 1975 and 1976. Monofilament gill nets were fished close to the shore of Shuswap Lake where most sockeye fry of the Adams River run spend the initial 4-6 week period of lake residence. Species of fish caught, in decreasing order of abundance, were peamouth, suckers, squawfish, lake char, lake whitefish, burbot, mountain whitefish, rainbow trout, Dolly Varden trout and carp. Major predators on the large 1975 dominant year fry population were rainbow trout, burbot, squawfish, Dolly Varden trout, lake char and two species of whitefish. In 1976, with considerably fewer fry,

no fry were found in mountain whitefish, Dolly Varden trout or small squawfish, and the fry content in the stomachs of other predators was much reduced. The percentage of empty stomachs was higher in 1976 in every predator species.

It appears that predation can account for a substantial loss of young sockeye during early lake residence. However, contrary to expectations based on the generally accepted hypothesis on the effect of predators in Shuswap Lake, the rate of predation on the 1976 fry was similar to the 1975 rate.

Acoustic estimates of the sockeye population in Shuswap Lake were made three times during the year: early in August when the sockeye had moved away from the onshore areas, in mid-October, and at the end of November. Samples of the sockeye were collected and measured to assess growth of the fish at each survey. Analysis of the data collected during 1975 and 1976 is almost complete and comparisons between the two years can now be made. Despite the fact that almost five times as many fry entered Shuswap Lake in 1975 as in 1976, the survival rates from fry emergence until the sockeye entered the limnetic zone were almost identical. In both years initial mortality was high, but once sockeye were in the mid-lake areas, mortality was much reduced with fingerlings of the 1975 subdominant brood experiencing slightly better survival until mid-October (Figure 4). Between mid-October and the end of November these fish of the subdominant (1975) brood apparently experienced poorer survival than did the fish of the 1974 dominant brood. Over the whole season, from fry emergence until the end of November, there was very little difference in survival between sockeye of the 1975 and 1976 broods. There was no evidence of any overall compensatory or depensatory mortality in these years, despite a five-fold difference in sockeye population size. This may not apply to extremely large fry populations such as those that were probably produced prior to 1913, but within the range of fry abundance levels measured in these studies, this seems to be the case.

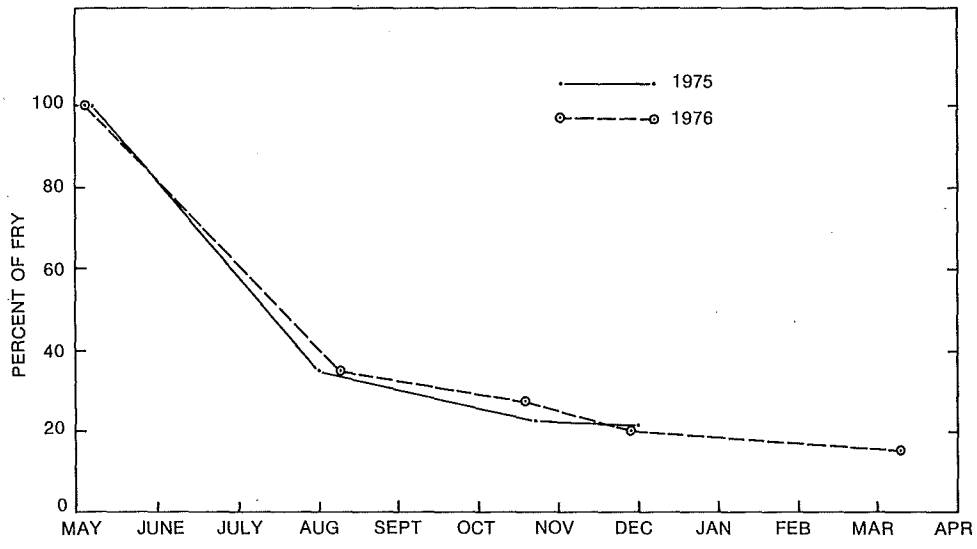

FIGURE 4. Survival of underyearling sockeye (as percent of estimated fry production) in Shuswap system 1975 and 1976.

While survival for the two brood years was similar, the growth of sockeye in Shuswap Lake was quite different between 1975 and 1976. Sockeye sampled on a given date in 1975 were only about two-thirds as large as those sampled on a similar date in 1976. This is probably because the very large population in 1975 had almost the same standing crop of food (zooplankton) as did the smaller population in 1976.

The study of the 1974 and 1975 Adams River broods indicates that whatever the cause of the relatively poor production of smolts from the 1970 brood Adams River sockeye, the effect did not carry over into the 1974 and 1975 broods. No abnormally high mortalities occurred at any stage of the life cycle up to the fingerling-smolt stage and production of smolts was considered good.

The behavior, growth and survival of Gates Creek sockeye fry in the Seton-Anderson Lakes system was investigated in 1976. Previous studies indicated that only some fry from Gates Creek utilize Anderson Lake, the majority migrating into Seton Lake within one month of emergence. Little, if any, growth occurred during this month and trap catches in Portage Creek indicated a substantially reduced population. The relationship between depth distribution of sockeye and their food supply indicated that in 1976 the sockeye fry occupied depth zones in Anderson Lake where zooplankton abundance was relatively high. Therefore lack of availability of food could not account for the interlake migration or the small size of the fish. It was calculated that the biomass of kokanee in Anderson Lake was about 35kg per hectare, which indicates that the standing stock in this lake is one of the highest found in the sockeye rearing lakes within the Fraser system. It is possible that competition with kokanee may be partly responsible for the few sockeye which do remain in Anderson Lake for a full year.

Zooplankton sampling and acoustic surveys were carried out on all the major sockeye lakes in the Fraser River watershed. No major changes in mean yearly plankton volumes were detected in any of the lakes sampled. The data on sockeye production are now being analyzed.

A detailed feeding behavior study was carried out on Cultus Lake during 1976. Acoustic surveys were carried out in conjunction with simultaneous zooplankton sampling and trawling. These surveys were done frequently throughout the growing season at various times during the day and night. Stomachs of the sockeye captured are being analyzed to evaluate food selected by sockeye, and plankton samples are being analyzed to determine the availability of the food used by the sockeye.

Recent work at Great Central Lake by the Pacific Biological Station indicates the possibility for increasing sockeye production in an oligotrophic lake with low plankton abundance by introducing nutrients to stimulate zooplankton production. The Commission is analyzing the data for all the sockeye rearing lakes in the Fraser system to evaluate the possible benefits from lake fertilization. Zooplankton production in most of these lakes is not as low as reported in Great Central Lake and thus the margin for improvement is not as great.

During the prespawning mortality investigations on the 1973 Horsefly population, eggs from dying females were successfully fertilized and held to the eyed-egg stage. A study was initiated in 1976 to investigate more thoroughly the survival and quality of fry from moribund female sockeye. Approximately 300,000 eggs were taken from moribund Gates Creek female sockeye, fertilized with apparently healthy males,

and planted in a fenced-off portion of the upper channel. The survival of eggs to fry will be determined in the spring of 1977. Simultaneously, eggs from moribund Gates Creek sockeye were planted in gravel incubators at the Sweltzer Creek Research Laboratory. The survival of eggs appears to be excellent in eggs from healthy control fish and from moribund fish. The quality of fry produced from moribund females will be compared to fry produced from healthy females. If these fry are of similar quality, this method may prove to be a practical way of alleviating some of the loss due to prespawning mortality at Gates Creek and other sites where the problem occurs.

The Commission has been examining various aspects of the biology of pink salmon and methods of expanding the stock of pink salmon. An investigation was carried out in 1976 at the Sweltzer Creek Laboratory to examine the feasibility of short term rearing of pink salmon in fresh water. If effective, this could be incorporated into the operation of the pink salmon spawning channels and could benefit the pinks by improving their survival due to increased size and also more favorable seaward migration timing. Pinks were reared for 3 to 6 weeks in fresh water. They were fed frozen plankton with some commercially prepared diet mixed in. Health problems caused very high mortalities during this period, including invasion of gills by bacteria and parasites. Although the apparently healthy fry had a 47% increase in weight at the end of six weeks, the numbers remaining for release were too small to allow any measurement of their survival to returning adults. It appears that intensive culture, even for a short term, is not suitable for a production application for pinks at this time.

The effort to produce an even year pink salmon stock for the Fraser River is continuing. The difficulties experienced in the attempt to rear a stock of pinks in sea water have been reported previously. The work was continued in fresh water at the Sweltzer Creek Laboratory. The fish encountered serious health problems probably due to the combination of a lack of suitable diet for fish, the freshwater environment and the extension of their normal life by one year. Problems included kidney disease, fungus and heavy copepod infestation. In the fall of 1976, 32 mature 3-year-old female pinks were spawned with 84 mature 3-year-old male pinks. These fish produced approximately 12,000 eggs, of which 55% were blank. There was a fairly high mortality at hatching, with approximately 2,000 apparently healthy fry produced. These fish are being reared in a normal two-year photoperiod cycle. In addition, a second brood stock of fry are being reared in an extended photoperiod. A better diet and means of eliminating copepods are being studied.

Sockeye fry from the Nadina spawning channel and from the Chilko River spawning grounds were collected in the spring of 1976 and tests showed no evidence of IHN. There was also no indication of IHN in Adams River sockeye fry or any other fry population that was observed. In the fall of 1976, IHN was detected in Weaver Creek sockeye in samples examined by the Pacific Biological Station.

The release of 67,807 hatchery-reared sockeye into Sweltzer Creek in 1974 produced a return of 656 adults to the counting fence in 1976. Determination of the total run requires further analysis of the commercial catch data. However, preliminary analysis on the basis of the return of hatchery and wild sockeye to Cultus Lake suggests the survival of the hatchery fish was about the same as, or a little more than, the wild fish, even though the hatchery smolts were twice the weight of the wild smolts. Further examination of the data is required to determine if there is any economic advantage in the method.

Examination of environmental factors for possible relationships to the survival of pink salmon fry and sockeye smolts continued during 1976. In the 1973 Annual Report, a hypothesis about factors affecting the survival of pink salmon fry was presented, and this has been used to predict the 1975 and 1977 pink salmon adult returns. A relationship has also been found between salinity at Amphitrite Point on the west coast of Vancouver Island and survival of pink salmon fry, which accounts for 92% of past variations. In conjunction with other factors, this relationship indicated the same forecast of survival for the 1977 return as the above method, and gave similar although not identical results for past years. At this time there is no way of determining which, if either, of the two methods of prediction indicates the actual causative factors.

Statistical analyses of a number of environmental factors have indicated correlations with the survival of Chilko sockeye smolts, and a combination of five of these factors accounts for 90% of the past variation. There are no obvious biological explantions for some of these factors and they will be treated cautiously until given support by future returns, and hopefully by better theoretical understanding. As mentioned in the 1975 Annual Report, growth in the first marine year as shown by scales on jack sockeye provides supportive information for three out of the four cycle years.

Using the methods developed by Dr. W. P. Wickett of the Pacific Biological Station, it appears possible to make a reliable prediction of the proportion of the sockeye run that will return via Johnstone Strait. The method uses the early summer Fraser River discharge and mean sea level at Tofino in the spring and early summer, and thus provides an evaluation just prior to the arrival of the sockeye runs. Since 1971 the predicted values of percent migration through Johnstone Strait have been within 1 to 4 percent of the actual. This information is useful in assessing run size during the fishing season.

ENVIRONMENT PROTECTION

The first phase in a program to upgrade effluent treatment at Prince George Pulp and Paper Company Limited and Intercontinental Pulp Company Limited was completed during 1976 when mechanical clarifiers were put into operation. The second phase consists of an aerated lagoon to provide treatment in excess of four days for the combined flow from the two mills. This will replace the high rate activated sludge treatment originally provided. The second phase is to be completed in 1977 and all five mills on the Fraser River watershed will then be utilizing aerated lagoons to provide four days or more of treatment.

The B.C. Pollution Control Branch conducted hearings on pollution control objectives for the forest products industry. The Commission participated with Environment Canada in preparation and presentation of a brief. New areas of environmental concern were identified and effluent objectives were recommended. Research topics were also suggested to develop new and practical technology for controlling the undesirable effects on the environment brought about by the forest products industry. The brief noted that improvements in pollution control are now possible in light of changing technology and emphasized that the objectives should focus on limiting the release of pollutants at their source.

Effluent at Cariboo Pulp and Paper Limited at Quesnel frequently failed to meet detoxification objectives and regulations. A ruptured pipeline and spill of pulping

liquor and fiber were part of the problem, but an inadequate spill basin and resulting overloading of the treatment lagoon and shutdown of one evaporator for overhaul also contributed.

The Canadian Forest Products hardboard plant in New Westminster discharged approximately 1.9 million U.S. gallons per day to the Fraser River until December when effluent was diverted to the municipal sewer tributary to Annacis Island sewage treatment plant. Bioassays showed that the effluent was more toxic than typical primary pulp mill effluent. A cooperative project was started with the Pacific Environment Institute and the Commission to identify the substances causing toxicity. Although toxic resin acids were present, studies had not progressed to a point where conclusion could be drawn concerning complete makeup of the toxic constituents. Although the hardboard plant effluent is being discharged to the municipal sewer, it is doubtful that detoxification occurs during passage through the Annacis Island treatment plant, since it is designed to remove settleable solids and does not detoxify soluble substances.

Tall oil is a by-product of the kraft pulp industry and is obtained from resin-acid soaps. The tall oil plant at Prince George receives resin-acid soaps from several mills, and liquor remaining after soaps are extracted is returned to the Intercontinental Pulp mill for processing in the recovery system. Thus there is no liquid effluent from the tall oil plant, and the pulp mills avoid the problem of disposing of resin-acid soaps by burning or effluent treatment. Ideally the systems operate in balance, but during the past year the tall oil plant was unable to accept all of the resin-acid soaps which the mills could supply. On some occasions resin-acid soaps were returned to mills for disposal, and excessive resin-acid soap concentrations in effluent from one of the mills was believed related to this problem. Prospects for improvements in the situation are good with resolution of the problems at the tall oil plant.

A report on color, foaming and algae growths in the Thompson River and Kamloops Lake was completed by a federal-provincial task force. The report concluded that as an increase in phosphorus loading to the Thompson River was the cause of increases in benthic algae growth, a major reduction in phosphorus input was necessary to reduce the growth.

To reduce the nutrient load to the Thompson River, the Weyerhaeuser Canada Limited pulp mill stopped adding phosphorus and nitrogen to the aerated lagoon during 1976. Detoxification of effluent was unaffected since nutrient needs were satisfied for other sources in the mill. Phosphorus was also removed from Kamloops municipal sewage effluent by precipitation with alum.

It is estimated that municipal sewage contributes about 36% of the wastewater discharged to the Fraser River below Hope. Since toxicity of municipal sewage to salmon was not well documented, a study was conducted in 1974 to measure acute toxicity and relate it to constituents of sewage. The results, presented in 1976 in Progress Report 33, showed acute toxicity of primary treated sewage in the absence of chlorine varied from one treatment plant to another, but was lethal to salmon in 96 hours when diluted to 17 to 30% v/v. Analysis of data indicated acute toxicity of primary treated sewage was correlated with the amount of ammonia and detergents present, but these two substances accounted for only a portion of the toxicity. Cause of the remaining toxicity was not identified.

Similar studies were started in September 1976 at Annacis Island treatment plant in cooperation with Greater Vancouver Sewerage and Drainage District, Environmental Protection Service, and Pacific Environment Institute. In addition to methods used in previous studies, advanced chemical procedures are being used to identify toxic substances.

In 1974 the Greater Vancouver Sewerage and Drainage District appealed a Provincial Cabinet Order to upgrade treatment at Annacis Island from primary to secondary. Following extended consideration by several committees, the following steps were announced by the Cabinet at the beginning of September, 1976: a) The pollution control permit for Annacis Island sewage treatment plant is to be amended to lower the toxicity. b) Greater Vancouver Sewerage and Drainage District is to undertake action to reduce disposal of toxic materials to municipal sewage. c) The Greater Vancouver Sewerage and Drainage District is directed to conduct testing of chemical and biological secondary treatment alternatives to determine the most economic process to achieve the effluent requirement.

In Progress Reports 29 and 30, the acute toxicity of chlorine residuals and damage to gill tissues of sockeye salmon were reported. Recent studies by others have demonstrated adverse impact on blood of salmonids exposed to sublethal chlorine residuals. In addition, the 1975 Annual Report noted that chlorinated organic substances toxic to fish were formed during chlorination but were not removed by dechlorination using sulfur dioxide. Owing to the growing volume of information concerning some of the detrimental features of chlorination, this process, including the need for disinfection, has come under review. The U.S. Environmental Protection Agency, in reviewing effluent limitations, noted that present policy inadvertently encourages the use of chlorine, whereas alternative means of disinfection and disinfectant control (dechlorination) must be considered where public health hazard and potential adverse impact on the aquatic and human environments co-exist. One alternative means of disinfection which may prove suitable is ozone. Ozone disinfection is scheduled for full-scale testing at three sewage treatment plants in the United States.

Construction of a copper mine, concentrator and smelter was started by Afton Mines Ltd. at a site eight miles west of Kamloops on benchland about 3.6 miles south of the Thompson River and Kamloops Lake. Operation is expected to commence in late 1977. Ore from the mine will be processed using conventional methods to obtain copper concentrates and the concentrates will be smelted to produce blister copper. The tailings pond will be similar to those at other mines on the Fraser River watershed and will employ recirculation of supernatant and seepage water to the ore concentration process as a water pollution control method. Gaseous emissions from the concentrator and smelter are to be treated before discharge, but mercury, lead, zinc, cadmium and arsenic are expected to be present after treatment. Pollution Control Branch permits were issued to Afton in spring 1976, but were appealed by citizen groups. After an appeal hearing, the Pollution Control Board concluded that operation of the proposed copper mine-mill-smelter did not constitute a threat to the environment of the Kamloops area and that it was in the public interest that the permits be issued. However, the Board expressed concern for the effects which airborne contaminants may have on the surrounding environment and directed the Pollution Control Branch to review the air monitoring program and to include sampling of soil, vegetation and aquatic fauna in the program. The Board made particular reference to mercury emissions and instructed the Branch to determine if a further reduction

below that allowed in the permit could be achieved, and to ensure that the plant operated to minimize emission of mercury.

The B.C. Hydro and Power Authority is studying a proposal to construct a 2 million kilowatt coal-fired generating plant using fuel from coal fields in the Hat Creek valley about 50 miles west of Kamloops. Although detailed designs for reclamation and reuse of water have yet to be prepared, the conceptual design of the mine and generating plant proposes no aqueous discharge to receiving waters. Proposals relevant to water pollution control at the project will be subject to review and approval by governmental agencies to insure protection of the aquatic environment, both during construction and operation. Gaseous emissions from burning coal would be discharged to the atmosphere. These emissions would contain many of the trace metals present in the coal but the major contaminants would be oxides of sulfur and nitrogen. The dispersion and possible effects of the gaseous emissions are the subjects of studies involving B.C. Hydro and various governmental agencies. If these emission and waste problems can be resolved satisfactorily, the problems of protection of Fraser River sockeye and pink salmon would be considerably less complex than those associated with hydroelectric proposals also under consideration.

Water monitoring and baseline studies were continued. Samples of plankton obtained by Weyerhaeuser Canada from Kamloops Lake were forwarded to the Commission for measurement using methods applied to samples from throughout the watershed. Measurements of turbidity, pH and conductivity of the Fraser River at Hell's Gate were continued. Measurements of water quality characteristics in the Nadina River and tributaries were continued to obtain baseline data prior to commencement of logging in 1977 or 1978. These water samples have been low in turbidity and suspended solids, two characteristics important to preservation of good quality spawning grounds.

ENGINEERING INVESTIGATIONS

A report on possible effects on sockeye salmon of further hydroelectric development of Nechako River was completed in cooperation with the Department of Environment, Fisheries Service. This report was prepared for the British Columbia Hydroelectric and Power Authority in connection with their studies of the feasibility of a second stage of development of the Nechako-Kemano diversion. As its part of the two-year study sponsored by B.C. Hydro, the Commission investigated the problems of increased water temperature and nitrogen supersaturation in Nechako River upstream from the confluence with the Stuart River. The study showed that water temperatures would reach critical levels during the period of migration of the sockeye runs to Fraser and Francois Lakes. River temperatures could be controlled by release of cooling water from the Nechako reservoir but supersaturation of dissolved gases in this cooling water would reach levels that would impose a stress on sockeye which could result in death. Thus there is no clear resolution of the sockeye fisheries problems that would arise within the Nechako River system. Possibly of even greater concern are the effects that would occur downstream in the Fraser River which would be cumulative if other diversions such as the proposed McGregor diversion are also undertaken.

The McGregor River diversion is being investigated by B.C. Hydro as a possible power source for production as early as 1984. The McGregor River enters the Fraser above Prince George, about 500 miles upstream from the estuary. In this proposal, all of the flow of the McGregor River would be diverted over the Fraser-Peace Divide into the Parsnip River for power generation at W.A.C. Bennett Dam and other dams on the Peace River. The average discharge of the McGregor is about 8% of the average discharge of the Fraser River at Hope. Its flow ranges from 760 to 68,600 cfs and these extremes contribute 2.6% and 16% respectively to the corresponding flows at Hope. No sockeye or pink salmon spawn in the McGregor River system. However, reducing the flow of the Fraser River by diverting the McGregor out of the Fraser system could affect both sockeye and pink salmon in a number of ways that can be foreseen:

1. A statistical relationship between the survival rate of Chilko sockeye smolts and the weighted mean discharge of the Fraser River at Hope 15 days after the smolts leave Chilko Lake has been used for a number of years as one indicator of expected adult returns. The higher the discharge the higher the expected percentage return. The addition of data for recent years has lowered the statistical correlation, and it is now obvious that other factors are also involved. However, a relation between discharge and numbers of returning adult chinook salmon has also been reported for the San Joaquin River in California. A satisfactory hypothesis for the effect of discharge on the survival of Chilko sockeye is not known, although it is possible that the timing of the change from fresh to sea water may be involved.

The average contribution of the McGregor River to the above weighted mean discharge has been approximately 17,000 cfs. The above correlation indicates the removal of this flow would reduce the survival of Chilko smolts from an average of 8.6% to an average of 7.6%. This is a reduction of 11.6% in the survival rate, and allowing for the same levels of escapement as at present, the reduction in harvest of the stock would be 15%. The Chilko stock of sockeye is the only large population for which sufficient data on survival is available to permit statistical evaluation. However, on the basis of present knowledge it must be presumed that all other stocks of sockeye would be affected in a similar manner, although perhaps not identically so because of differences in time of the migrations. Thus the reduction in spring runoff that would occur if the McGregor River is diverted could reduce the present average annual catch of 4 million Fraser sockeye by 15%, and the future potential catch of 9 million sockeye or more could be similarly reduced.

2. During July and August when adult sockeye of many races are migrating upstream to their respective spawning grounds, water temperatures in the Fraser River can significantly affect the subsequent survival of the spawners. Death due to thermal shock occurs at temperatures of 24°C (75°F) and higher (Servizi and Jensen, 1977). Temperatures in the range of 18°C (64°F) to 24°C can cause stress which lead to infection and subsequent death. The prespawning mortality of the Horsefly sockeye run has been correlated to average maximun daily water temperatures in the Fraser at Hell's Gate during the period of the adult migration (IPSFC, 1974). Data for other runs to the Stuart and Nechako systems show a similar, though less obvious, relationship.

Servizi, J. A. and J. O. T. Jensen. 1977. Resistance of Adult Sockeye Salmon to Acute Thermal Shock. Int. Pac. Salmon Fish. Comm. Prog. Rept. 34.

IPSFC. 1974. Annual Report for 1973.

It is not possible to predict very precisely how large a change in water temperature at Hell's Gate would be created by the McGregor diversion. Using the observed maximum temperatures at various river discharges, it is estimated that the removal of the flow from the McGregor, amounting to an average of 8% of the Fraser flow in July and August, could increase the daily maximum temperature at Hell's Gate by about 0.74°F. Such a change could increase the prespawning mortality of the Horsefly sockeye run by about 5.6%, and increases in the loss for other races such as Early Stuart and Early Nadina must be presumed. A significant reduction in the allowable harvest of the affected sockeye runs would result.

The metabolic rate and swimming speed of salmonids is affected by water temperatures, reaching a maximum near 16°C (61°F). At higher temperatures the active metabolic rate and swimming speed are reduced. Consequently, increased temperatures in July and August during the upstream adult sockeye migration could reduce their swimming speed and increase the time taken to reach the spawning grounds. Sockeye are dependent upon their body stores of fat and protein for the energy required to reach the spawning grounds, and most of the summer races do not have much excess in energy stores over the amount required for a normal migration time. Consequently, the additional migration time required because of higher water temperatures may result in failure to reach the spawning grounds, or in insufficient energy to complete the spawning, or in the addition of sufficient stress that the fish are susceptible to infection which results in premature death.

3. The volume of Fraser River runoff from June 1 to September 15 has been shown to affect the duration of the entry of the Adams River sockeye into the Fraser River, with low discharge resulting in extended duration of the run (Gilhousen, 1960). Later arrival of the fish on the spawning grounds would make them less productive because of the reduced egg survival when low water temperatures occur too early in the development of the egg. Extended retention of eggs and fertilization at low temperature may also reduce viability of the eggs.

It is estimated that the reduction of Fraser River discharge due to the McGregor diversion would extend the Adams River sockeye run by about five days. The effect of this extension on subsequent survival would depend on the timing of the run and water temperatures along the migration route and at the spawning grounds. However, the extension of the run would increase the possibility of lower survival and reduced production of this major sockeye run.

4. The reduction in discharge in the Fraser River below Hope would lower water levels on the large pink salmon spawning grounds between Hunter Creek and the Vedder Canal by an average of about 0.6 feet at spawning time and about 0.2 feet during the winter months when the eggs are incubating. It is possible such changes could reduce the spawning ground available to pink salmon. Navigation in this part of the Fraser may also be adversely affected, resulting in additional requirements for dredging, which in turn could affect production of pink salmon.

5. Reduced discharge in the Fraser River would provide less dilution of wastes discharged to the river, and would thereby reduce the safety factor against toxic effects on salmon that are now provided by dilution in the river. The effect would be most

Gilhousen, P. 1960. Migratory Behavior of Adult Fraser River Sockeye. Int. Pac. Salmon Fish. Comm. Prog. Rept. 7.

pronounced near Prince George and Quesnel where there are now four pulp mills in operation discharging treated wastes to the river. In a high freshet discharge year such as 1972, the McGregor River flow in June constituted about 29% of the flow in the Fraser River above the Nechako River confluence, and in a low winter flow year such as March 1969, the McGregor constituted about 15% of the Fraser flow at that point.

6. Reduced discharge at the mouth of the Fraser River could affect the environment in what appears to be a very critical stage in the life cycle of both sockeye and pink salmon. As previously mentioned, it is possible that timing of entry into sea water may be a factor in the survival of sockeye smolts. On the other hand, comparison of the survival of pink salmon fry with environmental factors suggests that lower discharge during the period of pink fry emigration is favorable to higher survivals. In the case of both sockeye and pink salmon, there are other environmental relationships with survival which suggest that river discharge may be only one of many factors affecting survival. Until the relationship between estuarial environment and survival of sockeye and pink salmon is fully understood, a full evaluation of the effect of a permanent reduction in discharge of the Fraser is not possible.

7. The joining of the McGregor River system to the Peace River system may allow the transfer of parasites, such as the tapeworm *Triaenophorus crassus,* and fish diseases to the Fraser system which could have serious consequences to Fraser River salmon stocks. Governments exercise control over artificial transfers of fish and eggs as a precaution against transfer of fish diseases because of the potentially great hazard to indigenous stocks, and such hazard could be created by the McGregor diversion.

Both the Nechako diversion and the McGregor diversion would result in substantial environmental changes which would have complex interactions on the survival of sockeye and pink salmon stocks of the Fraser River. In view of the known sensitivity of these salmon to environmental change, the diversions constitute a substantial threat to the maintenance of productive stocks of sockeye and pink salmon, which are the backbone of the Fraser River commercial fishery.

Following the flood in the Chilliwack-Vedder River in December 1975, provincial and federal authorities met to consider the action for future flood protection. A three-phase plan was decided upon and approved by the Federal-Provincial Fraser River Joint Advisory Board. The first phase involved immediate repair of the existing dykes to provide protection during the 1976 spring freshet. Little effect on the pink salmon spawning grounds was expected from this work, since test digging showed that nearly all the eggs from the 1975 brood year spawning had already been lost during the December flood.

The second phase of action was to remove accumulated gravel from the stream bed below Vedder Crossing and to strengthen and increase the height of the existing dykes to provide protection during the freshets in the 1976-77 winter. This phase was agreed to by Fisheries Service, Canada Department of Environment with certain reservations and conditions, the main condition being that a third phase should be included in the overall plan to provide set-back dykes so that the river could carry greater floods with a minimum of gravel removal. The part of the Vedder River below Vedder Crossing had about half a million square yards of gravel area used by pink salmon spawners, about 30% of the total useful spawning ground in the Chilliwack-Vedder system. It remains to be seen how acceptable the new river bed will be to

pink salmon in the fall of 1977. Because of the potentially harmful effects of gravel removal on the pink salmon runs, the Commission made a survey in 1976 to locate possible sources of the gravel that is deposited below Vedder Crossing. Aerial photographs were taken of the 25.5 mile section of river between Chilliwack Lake and Vedder Crossing, and the 6.6 mile reach immediately upstream from Vedder Crossing was accurately mapped so that the amount of erosion could be determined by comparing these maps with similar maps made in previous years. The results showed that between 1956 and 1976, 135 acres of forested or developed land were eroded from the river banks largely in the first five miles above Vedder Crossing. The flood in late 1975 accounted for 60 acres of this erosion. The total bank volume contained in the 135 acres eroded since 1956 was estimated to have been about 1,000,000 cubic yards. Action to prevent further erosion in this area would improve the effectiveness of the dykes and reduce the necessity for gravel removal with other attendant harmful effects on pink salmon spawning grounds. This action would also help to stabilize the bed of the Vedder River.

In connection with feasibility studies for the proposed Hat Creek thermal plant, British Columbia Hydroelectric and Power Authority is investigating possible water sources for up to 40,000 gpm to make up losses from the recirculating cooling water system. Current studies indicate that the Thompson River immediately upstream from Ashcroft would be the most practical source. Since very large numbers of sockeye smolts and pink salmon fry migrate past this potential intake site, technical staff discussions have been held to ensure that these fish will not be adversely affected. In addition, the efficiency of a similar existing intake in the Thompson River near this location was studied during the 1976 migration of pink salmon fry. It is considered that if the proposed intake is designed in accordance with accepted specifications and practice for fish screens on the Fraser watershed, both sockeye and pink salmon should be adequately protected.

The results of seven years of observations and studies of the migration of adult sockeye at the Seton Creek hydroelectric plant were analyzed in 1976 and a report was submitted to the Department of Environment and British Columbia Hydroelectric and Power Authority for the purpose of obtaining action to rectify a serious fish-passage problem at this location. Resolution of this fish-passage problem requires that a continuous flow attracting fish to Seton Creek be provided at the farthest upstream point that the fish can reach in the tailrace channel. B.C. Hydro is now examining the report's recommendations with a view to implementing remedial measures as soon as possible.

The program of gravel cleaning in spawning areas was continued in 1976. The Weaver and Gates Creek spawning channels, which constitute a total spawning area of 7 acres of gravel, were cleaned in preparation for the 1976 spawning populations in these channels. The previously described technique developed by the Commission for cleaning of spawning channels has proved efficient and economical.

Tests were also continued in 1976 to investigate the feasibility of cleaning the gravel in natural spawning areas. Two methods have proved satisfactory – the vibrated-bucket technique and the velocity-segregation technique.

In 1976, another 2,000 square yards of the natural spawning area in Nadina River was cleaned as part of a continuing program to restore the river and stop the

decline in the Early Nadina run. This brings the total area cleaned to 9,000 square yards. High water this year reduced the speed of the work and made the operation less effective because the greater depths and velocities restricted visibility. However, an improved model of the gravel cleaner was tested and proved more rugged than the equipment previously used.

After the fish had spawned this year, areas of the stream bed that had been cleaned last year were surveyed to measure the extent of erosion and the amount of fine material deposited in the cleaned areas by the severe spring freshet in 1976. Although the amount of displacement of the stream bed was not severe in any of the areas tested, the maximum erosion in the areas surveyed was about 3 inches in the uncleaned parts of the stream and 9 inches in the cleaned areas. The amount of deposition on top of the 1975 stream bed was about the same in all areas. A large volume of fine sand and gravel was carried along the bed of the stream during the 1976 freshet and some of this fine material collected in the pores in the cleaned gravel. After cleaning in 1975, the gravel contained virtually no particles finer than one-half inch, whereas about 40 percent of the uncleaned gravel consisted of material finer than one-half inch. After 12 months, the gravel in the area that had been cleaned contained about 25 percent of particles finer than one-half inch.

Another improvement to the Nadina River done in 1976 was the removal of log jams over a three-mile section of the river making good spawning gravel available for next year. Some of the logs in these jams had been dumped in the river for log driving many years ago. Since logs in the stream deflect the water and cause scouring of the bed and banks, the stream improvement work will help to stabilize the river channels.

Extensive further logging of the Nadina River watershed has been planned for several years, although road building and other preparations that had been expected in 1976 was not done. Discussions have been held with the Department of Environment, Fisheries Service, and the B.C. Forest Service in efforts to protect the Nadina River sockeye populations from possible adverse effects. Water samples are being taken regularly from several locations in the river and from major tributaries to establish water quality characteristics under pre-logging conditions.

Through cooperative arrangement with the Fisheries Service and Environmental Protection Service, Canada Department of the Environment, numerous applications for effluent discharge permits, placer mining leases, water licences, dredging, gravel removal and construction on waterways were reviewed, and recommendations for protection of sockeye and pink salmon were made.

TABLE I

SOCKEYE CATCH BY GEAR

Gear		1964	1968	1972	1976
United States Convention Waters					
Purse Seines	Units	96	88	117	193
	Catch	284,209	464,544	533,179	669,322
	Percent	55.94	52.43	47.26	50.63
Gill Nets	Units	337	396	565	789
	Catch	177,767	354,760	506,406	628,411
	Percent	34.99	40.05	44.88	47.53
Reef Nets	Units	48	34	46	45
	Catch	45,827	66,404	88,304	23,869
	Percent	9.02	7.50	7.83	1.81
Troll	Catch	284	162	303	436
	Percent	0.05	0.02	0.03	0.03
TOTAL CATCH		508,087	885,870	1,128,192	1,322,038
Canadian Convention Waters					
Purse Seines	Units	27	46	47	101
	Catch	7,409	13,805	281,532	605,101
	Percent	1.44	1.50	26.04	43.77
Gill Nets	Units	1,357	1,410	1,004	766
	Catch	503,690	869,162	784,405	741,049
	Percent	97.89	94.46	72.55	53.60
Troll	Catch	3,449	37,125	15,280	36,334
	Percent	0.67	4.03	1.41	2.63
TOTAL CATCH		514,548	920,092	1,081,217	1,382,484

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*
1976			
Total Landings (No. Sockeye)	1,322,038	1,382,484	2,704,522
Share in Fish	48.88%	51.12%	
Total Pack (48-lb Cases)	114,118	123,849	237,967
Share in Pack	47.96%	52.04%	
1946-1976			
Total Landings (No. Sockeye)	52,117,090	50,961,333	103,078,423
Share in Fish	50.56%	49.44%	
Total Pack (48-lb Cases)	4,583,318	4,476,974	9,060,292
Share in Pack	50.59%	49.41%	
1976 *Cycle Catch*			
1976	1,322,038	1,382,484	2,704,522
1972	1,128,192	1,081,217	2,209,409
1968	885,870	920,092	1,805,962
1964	508,087	514,548	1,022,635
1960	1,198,969	1,255,195	2,454,164
1956	906,872	894,836	1,801,708
1952	1,113,475	1,154,383	2,267,858
1948	1,089,091	752,691	1,841,782
1944	435,443	1,003,826	1,439,269
1940	654,091	1,033,000	1,687,091
1936	453,025	2,126,074	2,579,099
1932	853,406	733,735	1,587,141
1928	630,457	311,226	941,683
1924	772,056	442,250	1,214,306
1920	677,690	532,039	1,209,729
1916	909,425	376,891	1,286,316
1912	2,005,869	1,357,425	3,363,294
1908	1,879,268	870,612	2,749,880
1904	1,506,137	892,934	2,399,071

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

TABLE III

DAILY CATCH OF SOCKEYE, 1964-1968-1972-1976 FROM UNITED STATES CONVENTION WATERS

	JULY				AUGUST				SEPTEMBER			
Date	1964	1968	1972	1976	1964	1968	1972	1976	1964	1968	1972	1976
1						95,135	104,974		378			
2		749					78,450		377	3,109		
3		223			79,585		57,077	188,368		2,239		
4		24			73,612		229	107,849		1,796	106	
5					59,668	3,291				1,076	213	
6						69,286					190	
7						68,089	96				52	
8						50,987	26,887	312,686	163			754
9						57,251	264,096	220,219	152	772		235
10							100,648	112,490	83	702		407
11							67,670			146		
12						82,039				143		
13	3,118				25,336	24,597					53	381
14	1,463	28				3,519	3,632		314		6	50
15		2,662				357	28,126		28		5	91
16		4,530	1						104	46		
17		5,079	2,861		15,456				143	88		
18			2,990		12,122					83	35	
19			4,696	92,800	5,160	12,075				59	24	
20	6,956			50,093		9,103	2,809					96
21	8,672	2,170				3,314	23,404		50			21
22	16,773	44,615				35	17,222		49			3
23		40,911	6,394				252		61	108		2
24		39,630	58,086		5,773				13	24		
25		44,582	44,344		1,845					14	31	
26			53,366	152,359	1,205	3,182				10	89	
27	79,632		50,708	82,055		4,458					879	
28	54,204					2,172	137		22		211	1
29	53,412	15,711				33	65		6			1
30		96,552	7,840				55		4	20		
31		86,860	116,110		681							
Totals	224,230	384,326	347,396	377,307	280,443	488,923	775,829	941,612	1,967	10,435	1,894	2,042
Troll	165	90	111	332	113	66	182	98				
Monthly Totals	224,395	384,416	347,507	377,639	250,556	488,989	776,011	941,710	1,967	10,435	1,894	2,042
June, Oct. and Nov. Totals									1,169	2,030	2,780	647
Season Totals									508,087	885,870	1,128,192	1,322,038

TABLE IV

DAILY CATCH OF SOCKEYE, 1964-1968-1972-1976 FROM CANADIAN CONVENTION WATERS

	JULY				AUGUST				SEPTEMBER			
Date	1964	1968	1972	1976	1964	1968	1972	1976	1964	1968	1972	1976
1		875					108,624		1,684			26,461
2		1,761					66,001	114,159	103	1,823		34,117
3		2,481			114,881			331,770		5,017		
4					42,299					655	185	
5					22,772	233,366				584	5,783	
6						57,248					35	
7							217,308		2,491			51,294
8							76,235		664			12,709
9							84,294	101,107	23	748		
10								84,325		3,800		
11										206	2,184	
12					102,832	88,114	38,626					
13	2,441				28,793	25,694	153,479					3,512
14						2,774	15,165		9			
15		3,565				83,013			9			
16		2,078						32,817		39		
17			4,546		35,135			18,006		2,360		
18			4,142		15,025			54,068		13	8,694	
19				19,499	5,341	49,457						
20	6,922			11,614		4,318						1,806
21	8,331					3,426	49,742		1,393			
22		29,390					15,006					
23		24,249					3,317	58,676	1	1,614		
24			76,873		20,527			5,154	1	610		
25			71,895		7,093		13,362	23,660	3			
26				165,363	953	698		17,274				
27	49,543			124,928		518						
28	13,561					10,970	22,240					
29	12,826	160,129					1,531					
30		44,117					617	30,411		2,269		
31		28,164			4,927		5,376	486				
Totals	96,624	296,809	157,456	321,404	400,578	559,596	870,923	871,913	6,381	19,738	16,881	129,899
Troll	1,775	25,627	7,005	13,101	1,637	10,841	7,540	20,357	15	107	627	2,781
Spring Salmon Gill Nets	675	268	768	282					565		1,999	3,557
Monthly Totals	96,074	322,704	165,229	334,787	402,215	570,437	878,463	892,270	6,961	19,845	19,507	136,237
June, Oct. and Nov. Totals									9,298	7,106	18,018	19,190
Season Totals									514,548	920,092	1,081,217	1,382,484

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TABLE V

INDIAN CATCH OF SOCKEYE BY DISTRICT AND AREA, 1972 and 1976

	1972		1976	
District and Area	*Catch*	*No. of Fishermen**	*Catch*	*No. of Fishermen**
HARRISON-BIRKENHEAD				
Birkenhead River and Lillooet Lake	4,285	45	7,500	1
Harrison and Chehalis	—	—	—	—
TOTALS	4,285	45	7,500	1
LOWER FRASER				
Below Hope	34,391	143	50,289	430
TOTALS	34,391	143	50,289	430
MIDDLE FRASER				
Hope to Lytton	33,825	590	77,526	1,132
Lytton to Churn Creek	28,425		32,000	
TOTALS	62,250	590	109,526	1,132
CHILCOTIN				
Farwell Canyon to Siwash Bridge	15,400	134	39,466	199
Keighley Holes	2,000		4,357	
TOTALS	17,400	134	43,823	199
UPPER FRASER				
Churn Creek to Quesnel	3,950	165	8,565	160
Shelley	250	28	640	30
TOTALS	4,200	193	9,205	190
NECHAKO				
Nautley and Stella Reserves	4,142	53	5,702	74
TOTALS	4,142	53	5,702	74
STUART				
Fort St. James-Pinchi Village	650	24	1,046	47
Tachie Takla & Trembleur Villages	525	56	1,185	65
TOTALS	1,175	80	2,231	112
THOMPSON				
Main Thompson	6,200	435	500	10
North Thompson	225	20	—	—
South Thompson	—	190	22	60
TOTALS	6,425	645	522	70
GRAND TOTALS	134,268	1,883	228,798	2,208

* Number of permits issued to Indians in district.

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, 1964, 1968, 1972, 1976

District and Streams	1976 Period of Peak Spawning	Estimated Number of Sockeye				Jacks	Sex Ratio Males 4-5 Yr.	Sex Ratio Females 4-5 Yr.
		1964	1968	1972	1976			
LOWER FRASER								
Cultus Lake	Nov. 15-20	11,143	25,736	10,660	4,450	15	1,551	2,884
Upper Pitt River	Sept. 10-15	13,804	16,988	13,412	36,530	5	16,946	19,579
Widgeon Slough	Nov. 1-4	667	1,552	302	1,391	25	644	722
HARRISON								
Big Silver Creek	Sept. 14-16	3,926	1,090	2,552	1,642	0	987	655
Harrison River	Nov. 12-15	2,202	5,391	1,399	5,130	0	2,155	2,975
Weaver Creek	Nov. 6-10	1,370	2,606	15,505	22,867	333	9,652	12,882
Weaver Channel	Oct. 26-28	—	1,910	11,043	28,211	813	10,873	16,525
LILLOOET								
Birkenhead River	Sept. 23-28	69,939	83,750	113,097	108,121	30,816	25,962	51,343
SETON-ANDERSON								
Gates Creek	Aug. 25-31	19,971	4,005	1,762	2,889	100	1,092	1,697
Gates Channel	Aug. 27-Sept. 2	—	6,284	6,807	14,855	511	5,617	8,727
Portage Creek	Nov. 5-8	9	173	1,460	3,800	2,758	266	776
SOUTH THOMPSON								
Seymour River	Sept. 3-5	2,784	3,957	2,889	8,489	183	3,387	4,919
Lower Adams River	Oct. 20-22	716	3,983	4,325	5,013	423	1,640	2,950
Little River	Oct. 20-25	0	0	81	175	15	57	103
Scotch Creek	Sept. 3-5	0	126	47	41	7	14	20
Upper Adams River	Sept. 3-5	162	—	31	40	0	16	24
Momich-Cayenne Creek	Sept. 2-5	823	617	1,003	1,998	0	850	1,148
NORTH THOMPSON								
Raft River	Sept. 3-7	5,201	8,121	11,151	8,684	19	4,672	3,993
Barriere River	Sept. 8	85	275	94	85	0	34	51
Fennell Creek	Aug. 30-31	146	954	1,931	4,090	0	1,612	2,478
North Thompson River	Sept. 25-30	38	—	465	500	0	275	225
CHILCOTIN								
Chilko River	Sept. 22-29	238,601	414,446	564,465	364,311	2,559	146,424	215,328
Chilko Lake-South end	Sept. 18-22	Present	Present	2,132	23,156	518	5,821	16,817
Taseko Lake	—	433	—	2,287	634	4	255	375
QUESNEL								
Horsefly-McKinley Creek	Sept. 15-20	15,315	5,686	3,385	2,064	1,766	93	205
Mitchell River	Sept. 15-20	169	4	85	101	94	3	4
Little Horsefly River	Sept. 25-30	217	73	18	32	32	0	0
NECHAKO								
Endako River	Aug. 30-31	7	18	27	40	0	20	20
Nadina River—(Early)	Aug. 27	1,397	902	827	101	3	46	52
(Late)	Sept. 25-28	232	1,496	2,702	279	8	127	144
Nadina Channel	Sept. 18-22	—	—	—	1,394	40	632	722
Nithi River	—	13	20	58	0	0	0	0
Ormonde Creek	Aug. 30-31	180	81	54	30	0	15	15
Stellako River	Sept. 29-Oct. 3	31,047	30,420	36,771	150,741	7	76,158	74,576
STUART								
Early Runs								
Forfar Creek	Aug. 10-14	27	149	835	1,624	35	591	998
Gluske Creek	Aug. 9-13	218	18	591	1,257	91	427	739
Kynoch Creek	Aug. 9-13	1,147	833	2,534	8,745	337	3,683	4,725
Narrows Creek	Aug. 9-11	22	41	104	318	33	108	177
Rossette Creek	Aug. 9-13	952	518	834	2,717	345	841	1,531
Takla Streams	Aug. 9-13	37	0	143	1,456	271	436	749
Misc. Streams	Aug. 9-13	18	28	15	328	40	120	168
Late Runs								
Kazchek Creek	Sept. 23	0	33	65	33	9	10	14
Middle River	Sept. 23	743	288	972	330	10	130	190
Tachie River	Sept. 23	1,157	149	7,527	2,637	83	1,036	1,518
NORTHEAST								
Upper Bowron River	Sept. 4-6	1,500	3,634	4,138	2,250	0	1,069	1,181
TOTALS*		426,459	626,706	830,128	827,250	42,678	327,605	456,967

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

TABLE VII

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	CLOSED						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 VIII
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 IX

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			
		1961	1965	1969	1973
LOWER FRASER					
Cultus Lake	Dec. 1-4	15,428	2,532	6,739	858
Upper Pitt River	Sept. 12-15	11,162	6,981	24,905	11,928
Widgeon Slough	Oct. 31-Nov.4	1,293	275	715	427
HARRISON					
Big Silver Creek	Sept. 20-25	398	596	85	270
Harrison River	Nov. 15-20	42,778	15,034	15,209	3,060
Weaver Creek	Oct. 15-25	4,383	11,162	58,922	50,173
LILLOOET					
Birkenhead River	Sept. 23-26	49,627	30,008	63,343	139,295
SETON-ANDERSON					
Gates Creek	Aug. 27-31	252	1,679	881	899
Portage Creek	Oct. 22-25	527	2,108	1,040	4,272
SOUTH THOMPSON					
Seymour River	Aug. 26-30	5,822	6,954	7,327	2,856
Scotch Creek	Aug. 23-27	598	1,910	3,395	6,235
Lower Adams River	Oct. 12-16	57,796	55,041	45,908	33,312
Little River	Oct. 20-24	8,253	3,236	6,775	6,689
South Thompson River	Oct. 18-22	254	192	630	545
Lower Shuswap River	Oct. 15-18	342	583	1,703	7,452
Misc. Streams	—	—	439	214	11
NORTH THOMPSON					
Raft River	Aug. 28-Sept. 1	7,301	6,624	5,594	2,729
Barriere River	Aug. 25-29	335	104	40	22
North Thompson River	—	225	Present	—	0
CHILCOTIN					
Chilko River	Sept. 21-22	40,315	39,902	76,518	61,707
Taseko Lake	—	80	Present	Present	—
QUESNEL					
Horsefly River	Aug. 29-Sept. 2	295,705	359,232	270,023	253,384
Mitchell River	Sept. 13-18	6,601	5,335	8,939	24,673
NECHAKO					
Nadina River (Early)	Aug. 21-28	18,885	3,884	8,541	2,705
(Late)	Sept. 12-18	17,544	11,293	27,898	16,737
Nithi River	Aug. 23-26	146	34	140	54
Stellako River	Sept. 23-28	47,241	39,418	49,341	30,755
STUART					
Early Runs					
Ankwil Creek	Aug. 5-11	18,468	2,806	15,795	21,790
Bivouac Creek	July 31-Aug. 4	997	401	952	1,884
Driftwood River	Aug. 1-4	81,617	4,221	52,873	131,172
Dust Creek	Aug. 1-6	10,870	1,584	3,595	17,850
Felix Creek	Aug. 2-6	3,082	1,404	5,879	7,465
15 Mile Creek	Aug. 2-6	922	74	209	1,090
5 Mile Creek	Aug. 2-6	731	40	902	2,408
Forfar Creek	July 31-Aug. 6	13,599	2,221	9.922	18,924
Forsythe Creek	Aug. 2-6	5,836	553	2,248	10,907
Frypan Creek	Aug. 1-6	10,595	275	3,145	5,799
Gluske Creek	Aug. 1-6	5,652	2,200	4,660	19,450
Kynoch Creek	Aug. 1-6	16,170	2,885	12,380	22,485
Leo Creek	Aug. 1-6	1,624	121	571	1,390
Narrows Creek	July 31-Aug. 4	7,897	1,377	5,746	5,726
Paula Creek	Aug. 4-9	1,400	79	794	2,787
Rossette Creek	Aug. 1-5	4,993	1,165	1,566	4,156
Sakeniche River	Aug. 2-6	5,278	4	691	4,175
Sandpoint Creek	Aug. 2-6	3,523	706	693	3,178
Shale Creek	Aug. 2-6	2,392	79	706	3,260
25 Mile Creek	Aug. 3-7	1,663	229	0	744
Misc. Streams	Aug. 2-6	3,911	621	2,335	14,013
Late Runs					
Kazchek Creek	Sept. 5-10	15,676	3,292	178	2,909
Kuzkwa Creek	Sept. 5-10	39,245	10,000	8,370	20,124
Middle River	Sept. 5-10	177,516	139,186	111,322	91,879
Pinchi Creek	Sept. 12-15	527	Present	756	1,271
Sakeniche River	Sept. 5-10	1,094	11	0	232
Tachie River	Sept. 11-15	177,047	62,469	84,343	97,445
NORTHEAST					
Upper Bowron River	Aug. 28-31	7,460	2,660	3,872	4,700
TOTALS*		1,253,012	845,418	1,019,544	1,181,093

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

TABLE X

DAILY CATCH OF PINK SALMON, 1969-1971-1973-1975 FROM UNITED STATES CONVENTION WATERS

	JULY				AUGUST				SEPTEMBER			
Date	1969	1971	1973	1975	1969	1971	1973	1975	1969	1971	1973	1975
1	13	1				240	4,907			78,550	360,059	
2	36		100			4,882			124,314	90,063	330,814	280,698
3			140		2,689	3,215			161,294	201,457	206,254	
4			152		1,941	1,946				189,407		
5		9			2,099					4,666		
6		9								328,841		
7	23	20		307						390,632		
8	25	4		308		55	14,294		2,418	262,261		53,910
9	33		1,067	324		7,185			8,677		294,472	32,018
10			1,496			7,161			127,783		169,530	
11		1	2,615		3,627	5,042		19,933	57,856		66,887	
12		43	3,581		1,783	4,649		16,127				
13		62	3,818		2,521							
14	443	111		1,066	2,081	344	22,253	23,762		6,114		146,806
15	362	67		840		7,238	15,311		42,946	144,795		132,744
16			5,661			7,552			19,249	121,411		57,264
17			3,799			6,577			1,072	91,232	59,485	
18		34	2,908		17,014	6,006		55,608			21,161	
19		563			22,877	5,056		52,909		11,796		
20		514				3,154	62,583	53,815		59,887		
21	967	732		8,328		45	59,992			59,521		
22	547			5,047		7,257	43,693		16,381	33,525		
23	665		6,729			9,171	20,293		19,181			12,387
24			5,110			12,231			11,860		6,891	4,707
25		112	4,251		98,003	13,107			5,347		3,242	
26		2,033			119,947	11,680		137,643		1,212		
27		1,438					249,269	91,649		19,789		
28	2,080	2,391		12,707			138,583			6,741		
29	2,565	2,837		8,891					4,461	7,948		2,431
30	1,259		6,821	7,998		5,580			2,265	6,865		866
31			5,114	8,130		92,273						
Totals	9,018	10,981	53,362	53,946	274,582	221,646	631,178	451,446	605,104	2,116,713	1,518,795	723,831
Troll	5,524	1,999	7,108	7,881	32,702	8,154	5,704	11,946	1,267	1,859	598	956
Monthly Totals	14,542	12,980	60,470	61,827	307,284	229,800	636,882	463,392	606,371	2,118,572	1,519,393	724,787
June, Oct. and Nov. Totals									17,600	9,799	8,179	3,149
Season Totals									945,797	2,371,151	2,224,924	1,253,155

TABLE XI

DAILY CATCH OF PINK SALMON, 1969-1971-1973-1975 FROM CANADIAN CONVENTION WATERS

	JULY				AUGUST				SEPTEMBER			
Date	1969	1971	1973	1975	1969	1971	1973	1975	1969	1971	1973	1975
1	24	Strike				6,406	3,396		40,906	6,913	167,083	33,756
2	15	June 26-				5,243	3,452		35,463	15,269	157,615	61,793
3		July 10				5,988				27,028	157,578	
4			1		5,777			470		13,692		
5		1			4,773			199		13,768		78,851
6			Strike		5,684		24,136			33,997		74,730
7			July 6-	50			14,643		91,986			50,627
8		1	July 15				13,373		29,915	141,120		58,485
9				11		20,059	2,572	186	25,639	81,037	39,434	
10						17,280	1,481	70	17,039	86,916	50,859	
11		3			6,345	15,145		165	108,797	58,168	36,599	
12		5			3,674			121		46,851	27,396	
13					4,641		23,520			31,098		
14	34			18			24,987			34,631		62,355
15		20	40				38,368			26,718		45,604
16			90			16,750						33,961
17			84			9,010			11,653		58,070	29,163
18			59		25,980			6,347	10,891		12,299	58,966
19		31			12,711			11,200			7,441	
20		51			414		79,374	9,559		14,866		
21	74			243			71,878	14,836		7,649		
22	85			130		23,135	125,369	9,634		172,256		45,221
23			7,155			25,979	10,591		2,206	27,182		2,800
24			5,601			17,141			2,196		31,267	
25			4,415	Strike				96,884			1,191	10,910
26		192		July 25-	1,074	73,040		85,765		47,551	34,996	14,358
27	273	57		Aug. 24		90,929	178,434	94,303		8,392		
28	1,848	217		712			131,738			1,299		
29	2,315			382			28,293			29,454		11,317
30	2,044		2,963		36,049	224,988			477	17,488		508
31	1,324		3,472		49,946	145,573						
Totals	8,036	578	23,880	1,546	157,068	696,666	775,605	329,739	377,168	943,343	781,828	659,047
Troll	35,622	41,634	93,200	72,114	150,136	245,984	248,042	56,040	26,298	121,281	52,393	99,598
Spring Salmon Gill Nets									55,538	16,822	7,305	14,358
Monthly Totals	43,658	42,212	117,080	73,660	307,204	942,650	1,023,647	385,779	459,004	1,081,446	841,526	773,003
June and Oct. Totals									51,639	71,029	78,426	23,448
Season Totals									861,505	2,137,337	2,060,679	1,255,890

TABLE XII

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

District and Streams	*1975 Period of Peak Spawning*	*Estimated Number of Pink Salmon*			
		1969	1971	1973	1975
EARLY RUNS					
LOWER FRASER					
Main Fraser	Oct. 7-12	848,532	928,046	766,053	315,049
HARRISON					
Chehalis River	Oct. 10-12	7,147	32,178	14,300	2,356
FRASER CANYON					
Coquihalla River	Oct. 4-8	2,415	16,778	11,994	5,933
Jones Creek	Oct. 3-6	1,779	1,304	2,544	2,645
Misc. Tributaries	Oct. 3-15	450	3,298	3,549	948
SETON-ANDERSON					
Seton Creek	Oct. 13-16	180,011	267,079	181,027	209,734
Upper Seton Channel	Oct. 13-16	3,975	6,007	6,708	7,995
Lower Seton Channel	Oct. 13-16	14,868	24,882	23,602	23,874
Portage Creek	Oct. 18-21	1,092	1,456	13,983	28,454
Bridge River	Oct. 13-16	13,034	8,817	23,738	10,803
THOMPSON					
Thompson River and Tributaries	Oct. 5-15	247,896	258,203	283,385	480,350
TOTAL*		1,321,199	1,553,363	1,331,002	1,088,341
LATE RUNS					
HARRISON					
Harrison River	Oct. 16-19	96,390	73,881	196,150	180,052
Weaver Creek	Oct. 15-20	525	1,141	255	411
Weaver Channel	Oct. 15-19	200	294	640	1,201
CHILLIWACK-VEDDER					
Chilliwack-Vedder River	Oct. 17-20	92,222	160,511	210,799	81,137
Sweltzer Creek	Oct. 23-27	18,923	13,122	15,265	16,121
TOTAL*		208,260	250,389	423,109	278,922
GRAND TOTAL*		1,529,459	1,803,752	1,754,111	1,367,263

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

COMMISSION PUBLICATIONS, 1976

1. Annual Report of the International Pacific Salmon Fisheries Commission for 1975.

2. Progress Report 33. Acute Toxicity at Three Primary Sewage Treatment Plants by D. W. Martens and J. A. Servizi.

3. Tailrace Delay and Loss of Adult Sockeye Salmon at the Seton Creek Hydro-electric Plant.

STAFF PUBLICATIONS IN OTHER JOURNALS

1. Chemical Characteristics and Acute Toxicity of Foam on Two Aerated Lagoons by J. A Servizi, R. W. Gordon, J. H. Rogers and H. W. Mahood. J. Fish. Res. Board Can. 33(6): 1284-1290.

2. A Natural Epizootic of Infectious Hematopoietic Necrosis in Fry of Sockeye Salmon *(Oncorhynchus nerka)* at Chilko Lake, British Columbia by I. V. Williams and D. F. Amend. J. Fish Res. Board Can. 33: 1564-1567.

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HELL'S GATE FISHWAYS
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GATES CREEK CHANNEL
SETON CREEK CHANNELS
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