INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION

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

ANNUAL REPORT
1951

COMMISSIONERS:

SENATOR THOMAS REID
ROBERT J. SCHOETTLER
OLOF HANSON
A. J. WHITMORE
ALBERT M. DAY
ELTON B. JONES

NEW WESTMINSTER
CANADA
1952

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-
A. J. Whitmore	1939-
Olof Hanson	1948-

UNITED STATES

Edward W. Allen	1937-1951
B. M. Brennan	1937-1942
Charles E. Jackson	1937-1946
Fred J. Foster	1943-1947
Milo Moore	1946-1949
Albert M. Day	1947-
Alvin Anderson	1949-1950
Robert J. Schoettler	1951-
Elton B. Jones	1951-

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A. J .WHITMORE
ALBERT M. DAY
EDWARD W. ALLEN
(January to December)
ELTON B. JONES
(December)

OFFICERS

LOYD A. ROYAL
Director

ROY I. JACKSON
Assistant Director

NEW WESTMINSTER
CANADA
1952

MEMBERS OF THE INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION

Left to right standing—Robert J. Schoettler (Secretary), A. J. Whitmore, Elton B. Jones.
Left to right seated—Olof Hanson, Edward W. Allen (retiring member), Senator Thomas Reid (Chairman), Albert M. Day.

REPORT OF THE
INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION
FOR THE YEAR 1951

Six years of regulatory action to rehabilitate and protect the Fraser River sockeye runs have now been concluded by the International Pacific Salmon Fisheries Commission in accordance with the terms of reference of a Convention between Canada and the United States, ratified on July 28, 1937. Regulatory control over the fishery started in 1946, one year after the first fishways were placed in operation at Hell's Gate where rock obstructions had been found to be the major cause for the continued low level in the abundance of Fraser River sockeye. Three returning cycles of runs using the fishways have now occurred in the years 1949, 1950 and 1951. Two cycles of runs which have benefited both from the Commission's regulations and from its efforts in providing fishways at Hell's Gate have now returned in 1950 and 1951. The status of the 1949 and 1950 runs has been outlined in previous reports to the governments of Canada and the United States. It is with the 1951 run that this report is concerned.

The 1951 cycle has tended to be the lowest producer of the four quadrennial runs since the early days of the fishery. For the above reason, severe restrictions were placed on the fishing industry in 1947, to enable the racial runs for the first time on this cycle to receive the full benefits offered by the fishways at Hell's Gate. Previous cycle escapements revealed that a few races were apparently extinct and several others almost so; hence it was deemed advisable to prevent fishing mortality whenever practical. The low fishing mortality and the increase in the escapement through the fishways are obvious in the records for 1947 as listed in the following table.

1951 CYCLE ESCAPEMENTS FOR CERTAIN SOCKEYE RACES PERIODICALLY AFFECTED BY THE HELL'S GATE OBSTRUCTION PRIOR TO 1945

District	*1939*	*1943*	*1947*	*1951*
Seymour River	250	200	10,000	24,400
Raft River	1,490	4,000	8,000	8,500
Chilko River	2,000	13,546	55,000	118,600
Nechako River	1,457	9,188	55,642	97,500
Stuart River	555	3,000	14,260	63,300
Bowron River	2,695	6,215	23,945	22,000
Total Escapement	8,447	36,149	166,847	334,300
Estimated Catch	22,000	105,000	10,000	1,337,200
Estimated Total Run	30,447	141,149	176,847	1,671,500

The tremendous increases in the size of the 1951 runs to the above areas not only allowed substantial increases in the escapements to these areas but permitted a total catch of sockeye during the year that exceeded that of any other cyclic catch since the year 1903, a period of 48 years. The record racial increases in certain of the 1951 sockeye populations have been duplicated on other cycles, but 1951 was the first annual cycle since 1945 from which a full seasonal harvest has been permitted. Other annual harvests can now be allowed within required limitations which should start a gradual increase in the economic strength and stability of the Fraser River sockeye industry.

The value of any increase in the productivity of the sockeye as represented by the outstanding 1951 run should not be ignored. It was the great decline in the once famous Fraser River sockeye fishery after 1913, which led to the Convention between Canada and the United States for the protection, preservation and extension of the sockeye salmon fishery.

Listed below are the total comparative values of the cyclic packs for 1939, 1943, 1947 and 1951 which include the catch from **all** races fished during these years.

	1939	*1943*	*1947*	*1951*
Pack (48 lb. cases) . . .	91,050	49,340	35,930	252,551
Wholesale Value	$3,459,900	$1,874,920	$1,365,340	$9,596,938

(1951 values used for all years)

From the above figures it readily can be seen that the 1951 sockeye pack has increased in value over that of the previous cycle in 1947 by $8,231,598 and over that of the 1939 cycle, the next largest, by $6,137,038. This dollar increase is substantial and represents in a small way the extent of the eventual economic advantages to be obtained from the scientific management of the sockeye fishery.

The 1951 cycle escapements for certain sockeye races, periodically affected by the Hell's Gate obstruction previous to 1945, have been presented for the period extending back to 1939. The increase in the escapements of these same races for the other three cycles is similarly promising. The escapement in 1950 was 276,000 sockeye as compared with 95,000 in 1942. The escapement for the same races in 1949 was 942,000 as compared with 299,000 in 1941 and in 1948 the escapement was 738,000 sockeye as compared with 320,000 in 1940. There are now substantial escapements for all four cycles in many of the large spawning areas which have been almost barren since 1913, the year of the disaster.

Each of the spawning and rearing areas above Hell's Gate, with minor exceptions, originally produced one exceptionally large run, one medium run, and two very small runs each quadrennial cycle. The stability of this

annual relationship in each of the four year cycles prior to 1913 is now well established. Historical records obtained through the courtesy of the Hudson's Bay Company in London, England, show that the cycles of dominant productivity in the Stuart Lake and the Fraser-Francois runs maintained themselves for the period of record extending back almost 100 years prior to 1913, the year the runs were practically destroyed at Hell's Gate. Since the fishways were built, with the delay and block to migration eliminated and the normal migration environment restored, the annual remnants of the races spawning in the once productive areas above Hell's Gate have all tended to reproduce at a high rate. Thus, as the annual racial escapements continue to increase substantially as they have done since 1945, there appears little doubt that an important adjustment will take place from now on in the annual size of each of the four reproductive populations. One annual run of exceptional size may emerge, while the other three cyclic runs may tend to decline, one to a relatively medium sized population, the other two to populations of almost negligible size. This was the original and natural condition before the Hell's Gate disaster and it may now return. Large escapements to Stuart Lake, Fraser-Francois Lakes, and other areas may suddenly produce smaller runs while a large escapement in another year may reproduce a much larger population. Total production over each four year period should, however, gradually approach that existing prior to 1913.

The late Adams run, least affected in recent years by the Hell's Gate obstruction, has already established its dominant year of productivity on a cycle a year later than the one in which it originally existed. The Chilko run tended to maintain its dominant year of productivity until 1941, when a substantial escapement was seriously blocked at Hell's Gate before the fishways were constructed. The dominant year of productivity at Chilko appears now to be shifting and forming on an earlier year, presumably the year before the original annual dominant cycle.

A distribution of the dominant years of racial productivity over the quadrennial cycle is economically desirable to the industry for it tends to equalize the size of the annual runs. It is well known that prior to 1913 the various races of sockeye spawning above Hell's Gate tended to produce at a dominant rate all in the same year. It was for this reason that the 1913 cycle produced more sockeye than the other three cycles combined. The industry, in an endeavour to maintain a maximum annual pack, was thus forced to expand its facilities to catch, process, and sell a number of sockeye that was only available every fourth year. The present tendency of certain races to shift their cyclic year of dominant productivity is a very desirable situation if they will stabilize on this new timing in future years.

The Quesnel runs were almost entirely destroyed because of excessive depletion, related in part to their particular timing at Hell's Gate. The run in the original dominant year is now strengthening rapidly and should soon be a run of major size since it has and should continue to increase in numbers

FIG. 1—The high level fishway at Hell's Gate, finished in 1951, to facilitate passage of early runs such as those destined for the Stuart, Bowron and Nadina Rivers. This fishway will begin operating as the lower level fishway becomes flooded by rising water.

at the same phenomenal rate shown by other races not so seriously decimated. One apparent obstacle forestalling a population increase to over a million sockeye by 1957 may be the fact that the timing of the Quesnel run through the fishery is the same as that of other races which should be fished. Special regulations to permit an increase in the escapement of the 1953 run and a related increase in the rate of rehabilitation are now being considered although rehabilitation appears assured even with the present fishing intensity but at a slower rate than may be thought desirable.

A second annual run is gradually building up in the Quesnel district following the one year of existing importance. A few pairs of native sockeye are now observed on the spawning beds during the off years. When these small runs of native fish are strengthened by three and five-year-old sockeye from the dominant run, productivity on a quadrennial cycle may change to normal apart from the aid of artificial propagation and transplantation. Experiments at the Quesnel Field Station have already demonstrated that transplanted sockeye will return to the Quesnel system so that the station is now available to aid the rehabilitation of the system. This aid does not appear necessary at present except in certain specific spawning areas of the system. The activities of the Quesnel Station will be concentrated in all areas of the Fraser basin where such activity is required.

The once important Adams Lake area, where the sockeye runs were entirely destroyed by a combination of the splash dam at the outlet of Adams Lake and the adverse conditions at Hell's Gate, has been selected for extensive restocking from Seymour River, tributary to Shuswap Lake. Upper Adams River and Seymour are exactly the same distance from the sea, and the environmental cycles in the two spawning streams appear identical in all respects. Two transplantation experiments have already been conducted in upper Adams River using fingerlings and eyed eggs. Naturally propagated fry of the 1951 brood will be transplanted during the spring of 1952 and current plans call for the release of 1,000,000 fingerlings of the 1952 brood.

Free access to the spawning and rearing areas of the Fraser River sockeye has been achieved. The potential productivity of these areas appears the same as that which originally existed prior to 1913. The current rate of reproduction since the fishways were built indicates the great resiliency of the residual stocks and their ability to increase to a size of great economic importance in two or three cyclic years. Difficult management problems concerning the maintenance of **maximum** productivity remain unsolved but the work of the entire scientific staff of the Commission is presently directed toward solving them. Variable and greatly increased fishing intensity expanding to new fishing areas is already occurring as the sockeye populations increase in size at their individual rates. The management of the entire fishery becomes a very complex problem, yet its application must be relatively simple in operation, to be practical.

While the gradual rehabilitation of the Fraser River sockeye now appears assured, a great threat to their future exists in the undeveloped hydro-electric power and other natural resources of the Fraser River basin. A development of these same resources in other river basins of the Pacific Coast region has resulted in a gradual and almost relentless destruction of the salmon resource being reproduced in those areas. A careful examination of the problem elsewhere reveals that the destruction of the salmon resource by reason of other natural resource developments has been caused in the past by several factors among which are:

1. Lack of proper co-ordination in resource development.
2. Lack of knowledge concerning the requirements for reproduction of the various species of salmon.
3. Lack of research in the design of adequate fish protective facilities at artificial obstructions built for power, flood control, and irrigation developments.
4. Lack of proper or adequate legislation for the protection of the fisheries resource and the unwillingness of many responsible persons or agencies to co-operate in the protection of the fisheries resource within practical economic limits.
5. Loss of required reproductive environment in the reproducing areas either by the diversion and storage of water, or by changes in the watershed cover, or by pollution of the waterways.

An examination of these factors results in the conclusion that with intelligent co-operative river basin development combined with adequate research, the salmon resources possibly can be maintained fairly successfully except where there is a destruction of the environment necessary to reproduction. When the latter occurs, providing for both resource development and fisheries protection will be difficult, if not impossible. An example of this type of possible development in the Fraser River system is best represented by the originally proposed Chilko Power Project already reported on by the Commission.

Fortunately, the Fraser River basin lends itself to considerable development which will require a minimum of fisheries protection. The timber resources are of such a nature that little change should take place in the watershed cover. Restricted pulping processes and proper pollution control should permit the utilization of British Columbia's timber resources for pulp production without injuring the valuable sockeye resource. We are of the opinion that large blocks of power can be developed in the Fraser River basin or in neighbouring areas with little or no damage to anadromous fishlife; especially sockeye. Approximately 2,000,000 horse-power is being developed currently by the Aluminum Company of Canada which, with practical co-operation on the part of the company, should permit the successful perpetuation of those valuable runs of sockeye salmon reproducing

in the Nechako watershed. There appears to be good reason to believe that a power site now has been selected for development on the North Fork of the Quesnel, where it is believed no damage to the sockeye resource will result, in preference to developing a site on the main Quesnel River which would have endangered the greatest sockeye producing potential, already re-establishing itself, in the Fraser River basin.

The Commission as an international agency has, by agreement between Canada and the United States, a responsibility to preserve, protect, and extend the sockeye fisheries of the Fraser River system. It is not otherwise directly concerned with the economic development of the region yet these two all-important matters are interwoven with each other. The Commission's responsibilities must include the finding of all the necessary facts and developing the necessary methods for protecting the sockeye resource whenever and wherever possible. Beyond this, its responsibilities end. These responsibilities are not to be taken lightly however, for never in the past have the proper methods or all the necessary facts been available for the adequate protection of a salmon resource in conjunction with full basin development. British Columbia is industrializing almost overnight. The Commission must, therefore, find the facts and develop methods for protecting the sockeye as quickly as possible or the demand for power and the trend for other developments may seriously impair or indeed eventually destroy this valuable resource. Failure on the part of the Commission, either by itself or with the help of others, to find these facts and, if possible, to develop methods of protecting the Fraser River sockeye means that the Commission would be derelict in its duties as defined in the terms of reference in the Treaty signed by Canada and the United States. Then, with the existence of these facts and methods for preserving the sockeye, they should be used to full economic advantage by all concerned with the development of the Fraser River basin.

COMMISSION MEETINGS

The first Commission meeting in the year 1951 was held at Vancouver, B.C. on February 2. A report was given by the Director on the co-operation of the Commission staff with the technical staff of the Canadian Department of Fisheries in the preparation of a technical publication entitled "Report on the Fisheries Problems Created by the Development of Power in the Nechako-Kemano-Nanika River Systems". After a thorough consideration of the purpose and contents of the report, it was unanimously agreed that a copy be forwarded to the Minister of Fisheries with an accompanying letter acknowledging approval of the conclusions contained therein and requesting that steps be taken by the Canadian Government, as provided in the treaty, to obtain proper safeguards for the protection and perpetuation of the sockeye reproducing in the Nechako watershed.

Tentative recommendations to the respective Governments for regulatory control over the 1951 fishing season were presented to and discussed with

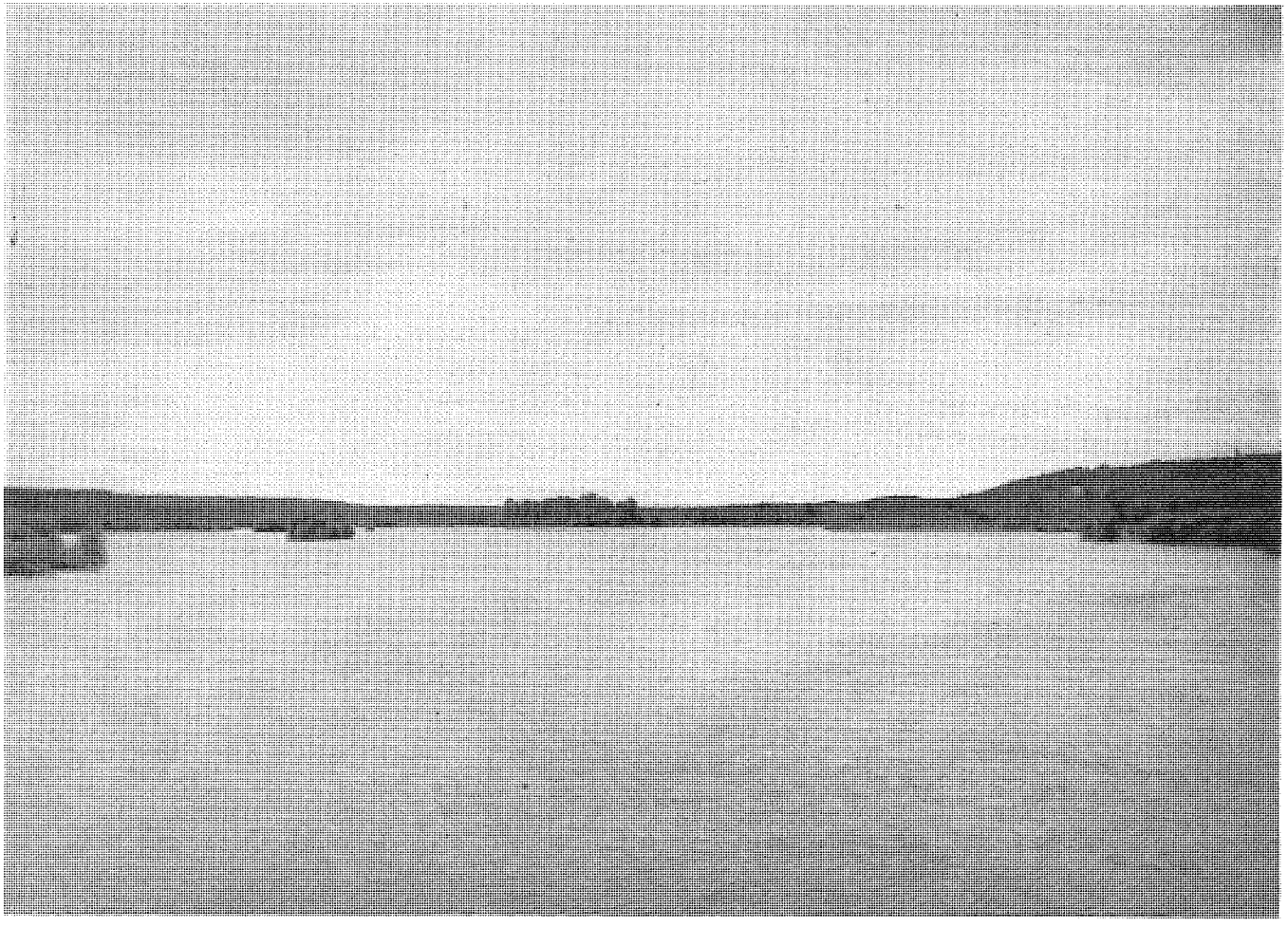

FIG. 2—Vanderhoof Reach in the Nechako River. Approximately 90 per cent of the existing flow shown above will be diverted to the Coast by the Aluminum Company of Canada, creating a serious salmon migration problem unless modified channelization and periodic discharges of water are provided.

the Advisory Committee. An agreement was reached by the Commission on the proposed regulatory recommendations with the exception of that pertaining to weekly closed periods in Convention Waters. A regulation was unanimously approved by the Commission with the majority approval of the Advisory Committee providing a weekly closed period for the taking of sockeye on the high seas to be effective from July 2 to August 26.

Members of the Advisory Committee which met with the Commission on February 2 were J. N. Plancich, salmon packers; John Brown, troll fishermen; Chester Karlson, gill net fishermen; and N. Mladinich, purse seine fishermen representing the United States, and R. E. Walker, alternate, salmon packers; M. Black, sport fishermen; W. J. Pitre, purse seine fishermen; A. E. Carr, troll fishermen; and Peter Jenewein, gill net fishermen representing Canada.

At the second meeting of the year, held in New Westminster, B.C., on April 7, Robert J. Schoettler was welcomed as a new Commissioner for the United States and by regular motion was appointed Secretary to succeed the late Alvin Anderson. Recommendations to the two Governments with respect to weekly closed periods for the taking of sockeye in Convention waters were presented to the Advisory Committee for discussion and were thereafter approved by the Commission.

Canada was represented on the Advisory Committee by Peter Jenewein, Richard Nelson, and G. T. Greenwell, alternate troll representative. The United States was represented by Chester Karlson, N. Mladinich, J. N. Plancich, and John Brown.

The Commission held its third meeting of the year at Seattle, Washington on June 13. The proposed budget for the 1952 fiscal year was examined and approved after the Commission voted to include $25,000 for the special study of migrant sockeye problems at dams. General business was considered. A valuable and historic album containing photographs of Hell's Gate, taken between 1913 and 1915, and containing other photographs of the Fraser River were presented to the Commission by Mr. A. J. Whitmore on behalf of Mr. John McHugh, former Resident Engineer of the Canadian Department of Fisheries.

The fourth and last meeting of the year was held at the Quesnel Field Station, Horsefly, B.C., on September 26, 27 and 28. The resignation of Milo C. Bell as Chief Engineer was accepted and the transmittal of a letter of commendation for his past services was approved. Mr. Bell was retained as an engineering consultant to the Commission and also to the Director of Investigations. The Assistant Chief Engineer, Roy I. Jackson, was appointed Assistant Director of Investigations.

An extensive progress report on the Commission's research program was detailed by the Director with the aid of the staff. An inspection of Chilko Lake spawning grounds was made and the method of enumeration

of spawners was observed in addition to a check of the operational activities of the Quesnel Field Station.

1951 REGULATIONS

Recommendations for regulations governing the management of the sockeye fishery in 1951 were considered during 1950 and 1951 at meetings held at Seattle, Washington, and Vancouver and New Westminster, British Columbia.

These recommendations were adopted at meetings in Vancouver, B.C., on February 2, 1951, and at New Westminster, B.C., on April 7, 1951.

The recommendations for regulations, as approved by the Commission, were transmitted to the Departments of Fisheries of Canada and of the State of Washington and to the Secretary of the Interior at Washington, D.C. They were accepted in substance for Canadian waters by an Order-in-Council adopted on June 7, 1951, and for United States waters by an Order of the Director of the Washington State Department of Fisheries promulgated May 7, 1951.

The recommendations of the Commission were as follows:

Canadian Convention Waters

The International Pacific Salmon Fisheries Commission appointed pursuant to the Convention relating to the protection, preservation, and extension of the Sockeye Salmon Fisheries between the United States of America and Canada signed at Washington on the twenty-sixth day of May, 1930, having approved them unanimously, hereby recommends to the Honourable, the Minister of Fisheries that regulations to the following effect, in the interests of such fishery, be adopted by Order-in-Council as amendments to the Special Fishery Regulations for British Columbia, for the Season of 1951, under authority of the Fisheries Act, namely:

1. That in the waters of Canada embraced in Article I of the Convention relating to the protection, preservation, and extension of the Sockeye Salmon Fisheries between the United States of America and Canada signed at Washington on the twenty-sixth day of May, 1930, the season for fishing for sockeye salmon shall commence at 8:00 a.m. on the second day of July, 1951.

2. That in those waters of Canada embraced in Paragraph 1 of Article I of the said Convention during the fishing season commencing on the second day of July, 1951 and continuing until the twenty-sixth day of August, 1951, there shall be a weekly closed season of forty-eight hours duration. This closure shall commence at 12:01 a.m. Saturday of each week and continue until 12:01 a.m. of the Monday following.

3. That in those waters of Canada embraced in Paragraph 2 of Article I of the said Convention and known as Areas 19 and 20, commencing on the second day of July, 1951, for all gear there shall be a weekly closed season of forty-eight hours duration each week until

and including August twenty-six, 1951. This closure shall be according to the following schedule:

The closure for purse seine gear shall commence at 12:01 a.m. Saturday of each week and shall continue until 12:01 a.m. Monday following; the closure for other gear shall commence at 6:00 p.m. Friday of each week and shall continue until 6:00 p.m. Sunday following.

4. That in those waters of Canada embraced in Paragraphs 2 and 3 of Article I of the said Convention, and known as Areas 17 and 18 and District 1, commencing on the second day of July, 1951, for all gear there shall be a weekly closed period of seventy-two hours duration. This closure shall be according to the following schedule:

The closure for purse seine gear shall commence at 12:01 a.m. Friday and shall continue until 12:01 a.m. Monday following; the closure for gill net gear in Area 18 shall commence at 6:00 p.m. Thursday and shall continue until 6:00 p.m. Sunday following; the closure for gill net gear in Area 17 and District 1 shall commence at 8:00 a.m. Friday and shall continue until 8:00 a.m. Monday following except in that part of District 1 lying above Pattullo Bridge at New Westminster where the closure shall continue until Monday noon.

5. That in the waters of Canada embraced in Article I of the said Convention no one shall buy, sell, or have in his possession any sockeye salmon taken by any gear during the times when fishing for or taking sockeye salmon is prohibited.

6. The Commission recommends that consideration be given to representations which may be made from time to time by the Commission, through its Chairman, to the Chief Supervisor of Fisheries for British Columbia respecting modification of the weekly closed time or additional closed periods for fishing for sockeye salmon.

7. Nothing contained in any Regulations made pursuant to the Fisheries Act shall apply to the taking of sockeye salmon in the waters of Canada embraced in Article I of the said Convention by the International Pacific Salmon Fisheries Commission or its servants or duly authorized agents acting pursuant to its directions for the purpose of exercising its objects under the said Convention.

The recommended weekend closure of 72 hours duration in District 1 was terminated by the Commission at a meeting held on September 26, 1951, at Horsefly, B.C. This action was taken by a resolution relinquishing control of sockeye fishing at midnight, September 27, 1951. Fishing had been further restricted by the Department of Fisheries by extending the regular weekly closure beginning September 21 in District 1 by twenty-four hours to commence on Thursday, September 20. This ninety-six hour weekly closure also was applied beginning Thursday, September 27. Further departmental orders set up five-day closures commencing on Wednesday, October 3, 1951, and on Wednesday, October 10. Weekly closures following October 15 to the end of the 1951 fishing season were of seventy-two hours duration. (These extra weekly restrictions after September 27 were applied by Canadian Department of Fisheries in the interests of salmon other than sockeye).

All of the weekly closures detailed above commenced at the same time of day in District 1 and the Gulf portion of Area 17 for the different gear as is set forth in Paragraph 4 of the Recommendations by the Commission.

United States Convention Waters

The International Pacific Salmon Fisheries Commission appointed pursuant to the Convention relating to the protection, preservation, and extension of the Sockeye Salmon Fisheries between the United States of America and Canada signed at Washington on the twenty-sixth day of May, 1930, hereby recommends to the Director of Fisheries of the State of Washington that regulations to the following effect, in the interests of such fisheries, be adopted by him 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. That in the waters of the United States of America embraced in Article I of the Convention relating to the protection, preservation and extension of the Sockeye Salmon Fisheries between the United States of America and Canada signed at Washington on the twenty-sixth day of May, 1930, the season for fishing for sockeye salmon shall commence at 4:00 a.m. on the second day of July, 1951.

2. That in the waters of the United States of America embraced in Article I of the said Convention there shall be a weekly closed period for all gear of not less than forty-eight hours duration. This closure shall be according to the following schedule:

The closure for purse seines and reef nets shall commence at 12:01 a.m. Saturday and continue until 12:01 a.m. Monday following; the closure for gill nets shall commence at 6:00 p.m. Friday and continue until 6:00 p.m. Sunday following.

3. That in the waters of the United States of America embraced in Article I of the said Convention it shall be unlawful to sell, purchase, or possess sockeye salmon during the times when fishing for or taking sockeye salmon is prohibited therein.

4. That consideration be given to representations which may be made from time to time by the Commission, through its Chairman, to the Director of Fisheries of the State of Washington respecting additional closed time for fishing for sockeye salmon.

5. Nothing contained in any rules or regulations relating to fishing for or taking sockeye salmon shall apply to the taking of sockeye salmon within the waters of the United States of America embraced in Article I of the said Convention by the International Pacific Salmon Fisheries Commission or its servants or agents acting pursuant to its directions for the purpose of exercising its objects under the said Convention.

In order to provide additional protection to certain races passing through the fishery at that time, there was one adjustment made to the Puget Sound fishing season. The duration of the weekend closure of August 11-12 was increased twenty-four hours by commencing that weekly closure at 12:01

a.m. August 10 for reef nets and purse seines, and at 6:00 p.m. August 9 for gill nets and continuing the period until the normal opening hours as set out in Paragraph 2 of the above recommendations.

High Seas

"Under the authority of the Convention hereinafter mentioned, the International Pacific Salmon Fisheries Commission at its meeting in Vancouver, B.C., on the second day of February, 1951, made and adopted the following order and regulation, namely:

> taking Sockeye Salmon on the High Seas described in paragraph numbered 1 of ARTICLE I of the Convention between the United States of America and the Dominion of Canada for the protection, preservation and extension of the Sockeye Salmon Fisheries in the Fraser River System, signed at Washington on the 26th day of May, 1930, is hereby prohibited from midnight Friday to midnight the following Sunday during each weekly period between July 2nd and August 26th, both dates inclusive, for the year 1951; provided that this Order and Regulation shall apply only to nationals and inhabitants and vessels and boats of the United States of America and the Dominion of Canada: this Order and Regulation being affirmatively voted for by a legal quorum of the Commissioners representing Canada and the United States."

The need for careful control of the expanding fishery with its increasing intensity and the improving efficiency of the gear has been detailed in previous annual reports. The total catch of Fraser River sockeye in 1951 has been carefully estimated at 82 per cent of the total run with 18 per cent escaping to spawn. The estimated catch includes those Fraser River sockeye taken by Indians and also by fishermen operating outside Convention waters. The latter catch has no economic significance under the Convention but must be considered in a biological measure of current productivity and in the formulation of regulations to obtain adequate escapement.

There is no scientific proof as yet that rehabilitation is not possible with this low ratio of escapement to the total run but the ratio could be approaching the danger point under a rehabilitation program and may already be too low for the maintenance of certain populations at a maximum level. The fluctuations in abundance in doubtful cases are being carefully studied before additional restrictive action is taken since there may be factors other than the size of the escapement which are controlling the rate of reproduction.

The rapidly increasing number of pink salmon available in offshore waters in early August coincident with a rapidly declining number of sockeye in both offshore and inshore waters greatly increased the attractiveness of fishing in the High Seas area. Because pink salmon were in considerable abundance and because the biological value of controlling the sockeye catch in these waters was greatly lessened by the small number of sockeye present, the weekly closed season in offshore waters was abrogated August 13, and

became effective August 18, instead of August 26, the terminal date originally specified.

THE UNITED STATES FISHERY

The fishery in Puget Sound commenced on July 2 with all types of gear operating in large numbers. Such an occurrence has not been observed in any year of record, except when the use of traps was legal. During each year of observation by the Commission staff, active fishing has been delayed for any of several reasons until about July 15. It is possible that the abundance of early run sockeye noted in 1949 and 1950, together with fair spawning counts in 1947, served to attract an increased number of fishermen. In any event, production was at an efficient level on the first day of the season and was maintained thereafter until the last half of August. Daily deliveries of comparable numbers of these early running sockeye by a fleet using only free floating gear are not observable at any time in the history of this cycle. The Early Stuart and Bowron races were the principal contributors to this successful early season fishery. A fairly steady production of sockeye without erratic peaks continued through the middle of August when catches in the United States declined rapidly. This steady rate of production was maintained primarily by the rehabilitating races which have been almost extinct on preceding cycles.

The daily sockeye catches in United States waters are recorded in Table III for the years 1939, 1943, 1947 and 1951.

Total sockeye production in Puget Sound for the year 1951 was greater than that in any year of this cycle except 1903 and 1911. Combined with the production from Canadian waters the total catch is greater than that of any year in the cycle since 1903. Table I lists the total landings and pack of sockeye for the year 1951 and also includes the total catch since the Commission commenced regulating the fishery. Table II lists the total individually licensed gear taking sockeye in Puget Sound during 1951 and the two preceding years of the cycle.

THE CANADIAN FISHERY

Sockeye appeared in Canadian waters in unusually large numbers during the last week of June and the first week of July. This phenomenon had occurred previously in 1949 but the sockeye fishery was restricted from operating at that time and no catches were recorded except those taken by 8-inch spring salmon nets. Both gill nets, having a minimum mesh size of 6½ inches, and traps caught an important number of sockeye in June, 1951 prior to the official opening of the sockeye control season on July 2. This unusually successful fishery continued through July and August. When purse seines began to operate in Area 20 on July 19 they too produced good catches. There are no statistical comparisons possible within the cycle for the purse seine fishery, but the combined fleet of all types of gear

produced a record breaking total catch, surpassed only by 1903 in this particular cycle. Production in each part of the 1951 season was superior to recent years of the cycle except for the period of September and October.

Total Canadian fishing effort was greater than in 1947 or 1943. Part of the increase arose from the presence of a purse seine fleet estimated at 49 individual boats operating in Area 20, and a larger number of gill net boats. During June and early July the gill net fleet actually fishing for sockeye was greater than in any similar period for any year observed by the Commission. Approximately 700 gill net boats were active immediately upon the opening of the sockeye season.

TABLE I

LANDINGS AND PACK OF SOCKEYE, 1946 – 1951

	United States	*Canada*	*Totals*
1946 – 1951 (6 year totals)			
Total Landings (No. Sockeye) . .	8,144,895	8,550,475	16,695,370
Share in Fish	48.78%	51.22%	
Total Pack (48 lb. cases) . . .	692,375	718,651	1,411,026
Share in Pack	49.07%	50.93%	
1947			
Total Landings (No. Sockeye) . .	88,219	355,035	443,254
Share in Fish	19.90%	80.10%	
Total Pack (48 lb. cases) . . .	6,760	29,170	35,930
Share in Pack	18.81%	81.19%	
*1951			
Total Landings (No. Sockeye) . .	1,136,791	1,288,162	2,424,953
Share in Fish	46.88%	53.12%	
Total Pack (48 lb. cases) . . .	118,151	134,400	252,551
Share in Pack	46.78%	53.22%	

* 21 Canneries in the United States and 13 canneries in Canada received the sockeye caught in Convention Waters.

TABLE II

LICENSED GEAR TAKING SOCKEYE IN UNITED STATES CONVENTION WATERS

	Purse Seines	*Gill Nets*	*Reef Nets*	*Drag Seines*
1943	150	75	58	0
1947	215	183	56	0
1951	301	204	120	1

TABLE III

DAILY CATCH OF SOCKEYE, 1939-1943-1947-1951 FROM UNITED STATES TREATY WATERS

Date	JULY				AUGUST				SEPTEMBER			
	1939	1943	1947	1951	1939	1943	1947	1951	1939	1943	1947	1951
1		2			8,042	5,690	9	57,324	10,693	1,858	2,952	
2				13,102	5,817	8,916	10	42,143	546	2,084	1,587	933
3				6,615	5,646	14,001	4	27,199	8,982	1,270	1,181	544
4				9,589	2,209	14,738	6		7,493		1,482	990
5				9,057	199	7,784	47		6,353	1,057	984	502
6				9,490	9,709	6,683	147	45,986	11,803	931		334
7		23			6,394	9,361	826	27,966	6,229	914	714	138
8		3			7,980	3,655	46	33,746	5,784	1,302	622	
9	31	1		23,677	10,581	4,282	352	20,411	4,330	1,022	246	262
10		25		10,244	9,643	5,582	1,100	56	3,084	1,168	406	1,254
11	38	16		8,156	4,758	10,510	526		1		316	33,599
12	82	66		6,570	762	10,436	559		1	210	248	6,580
13	19	178		5,418	12,888	5,386	5	56,686	26	357		290
14	7	417			14,150	95	37	40,432	3	346	805	138
15	191	442			15,361	8,398	45	40,912	1	232	107	
16	741	1,319		16,435	13,024	4,918	710	39,620	12	145	105	149
17	384	515		16,565	12,935	4,948	3	23,050	89	45	443	234
18	530	2,025		12,476	9,759	5,913	4,376	310	160		125	109
19	2,186	1,969		13,506	824	4,554	8,743	396	127	18	240	109
20	2,656	4,328		14,630	18,494	1,265	8,431	10,041	93	13		285
21	4,305	2,334	6		32,831	66	7,839	10,788	92	27	69	216
22	65	1,907	21		30,121	6,037	3,944	8,337	70	45	87	
23	3,633	1,723	9	58,796	39,537	7,699	79	5,758	1	20	272	38
24	6,950	2,428		59,917	44,963	6,250	8,119	2,214	55	8	57	9
25	7,187	5,548		54,748	17,349	7,424	4,953	83	2,476		36	14
26	6,814	5,248	8	45,817	537	5,017	5,894	4	1,206	3	42	7
27	7,532	3,241	14	42,981	25,856	2,276	6,234	2,471	40	8		1
28	5,890	4,050			21,300	6	5,536	7,489	36		13	2
29	2	5,903			17,624	3,849	3,097	2,334	43	3	6	
30	2,858	4,523		64,435	16,380	2,911	7	1,346		2	10	
31	6,857	157		79,869	10,239	1,497	3,314	859				
Totals	58,958	48,391	58	582,093	425,912	180,147	74,998	507,961	69,829	13,088	13,155	46,737
June Total		150										
Oct. Total									555		8	
Season Total									555,254	241,776	88,219	1,136,791

TABLE IV

DAILY LANDINGS OF SOCKEYE, 1939-1943-1947 AND DAILY CATCH OF SOCKEYE, 1951 FROM CANADIAN TREATY WATERS

	JULY				AUGUST				SEPTEMBER			
Date	1939	1943	1947	1951	1939	1943	1947	1951	1939	1943	1947	1951
1	2	176	23		8,077		451	34,757	11,507	4,361	190	
2		7	6	24,501	6,351	4,726	576	50,315	12,681	6,534	570	
3	45	14	17	16,133	4,858	10,868		14,127		7,556	135	32,250
4	12		3	13,850	3,880	8,481	74		2,483		351	15,955
5	1	134	21	14,078	3,850	7,593	220		26,852	20	383	12,617
6	160	44		1,500		4,129	191	63,292	30,325	3,532	289	10,681
7	3	46			4,972		612	30,490	37,372	13,550		
8	120	310	13		4,598		440	33,448	16,198	3,150	4,907	
9		102	2	20,406	4,693	4,666	772	29,668	7,003	3,015	11,693	
10	355	224	19	11,909	5,119	8,840		18,040		2,317	9,611	15,642
11	128		24	8,186	3,451	3,298	4		2,981		6,758	7,739
12	153	225	41	9,464	4,738	6,542	512		8,431	10	4,258	9,229
13	655	164		3,000		6,204	406	59,457	8,306	879	42	12,072
14	774	133	28		8,587		521	27,445	6,716	3,264		
15	773	781	50		14,670		104	13,579	4,306	1,677	7,130	
16		447	16	15,184	7,993	3,279	185	8,442	8,661	2,169	24,367	
17	1,474	961	121	10,116	6,229	9,811		2,453		3,652	33,077	40,948
18	2,367		87	10,134	3,686	9,894	441				47,184	27,599
19	2,483	1,900	51	13,384	3,913	9,746	1,915				27,377	19,424
20	2,923	3,699		1,580		8,653	1,399	24,353		8,059		367
21	2,267	3,655			3,972		2,014	10,325		27,562		
22	4,352	4,526	179		16,695		90	14,583		10,504	12,221	
23		3,494	157	38,081	15,178	2,114	199	16,428		8,194	32,029	
24	2,879	5,736	424	30,178	14,624	6,947	15	392		5,738	49,624	24,783
25	6,007		176	32,319	12,587	3,522	1,526		1,367		32,182	12,057
26	3,410	2,299	515	43,327	19,821	5,804	989		10,878		15,635	5,139
27	4,666	5,413		10,313		5,962	382	46,391	4,704	4,740		
28	3,250	4,828	67		8,715		976	23,673	4,669	17,769		
29	2,901	5,362	305		25,703		824	17,925	5,891	6,876	1,209	
30		4,794	315	76,209	11,796	1,544	877	20,425	779	5,325	5,224	
31	7,851		809	39,931	15,629	8,444	101	228				
Totals	50,011	49,504	3,469	443,783	224,385	141,067	16,816	560,236	212,110	150,453	326,446	246,502
May and June Total	534	511	1,096	31,021								
Oct. and Nov. Total									61,903	7,476	7,208	6,620
Season Total									568,943	349,011	355,035	1,288,162

THE INDIAN FISHERY

The estimated numbers of sockeye taken by Indians in their accustomed fishing grounds in the Fraser River watershed for the year 1951 are recorded in Table V. These records are compiled by the District Inspectors of the Canadian Department of Fisheries and are released here through the courtesy of that Department.

The Indian catch has increased continuously since the fishways were completed. It now represents a total approaching the number taken annually prior to 1913 except in the year of the dominant runs. There were 78,000 sockeye taken in 1951 as compared with 42,000 in 1943 and 27,000 in 1939. This increased catch provides a substantial source of food to the Indians and is a part of the general improvement in the economy of the region supported by the increasing number of sockeye returning to the Fraser River.

Commercial fishing on certain runs migrating simultaneously with other races not yet of significant size, is creating an occasional problem where the Indian fishery is selective on the escapement of the smaller populations. Fortunately there are substantial runs of sockeye in each Indian fishing area so that a reduction in the seasonal catch is not necessary to correct the situation. Temporary regulation of the fishing period or of certain Indian fishing areas should permit the continued rehabilitation of the smaller racial populations while permitting the taking of the needed fish supplies from the more abundant runs. An example of the problem and a possible means of correcting it is found in the 1951 Indian fishery located on the Fraser-Francois system. Indian fishing mortality on the early runs totalled 640 sockeye while the combined escapement to all the early spawning streams was only 1308. The later running Stellako run could have supplied the total Indian catch in each of the last four years without interfering with the rapidly increasing runs to the Stellako River. A restriction in the taking of sockeye in the Fraser-Francois system prior to August 25 in 1951 would have increased the escapement of early races by approximately 50 per cent and the total catch made could have been taken from the later Stellako run without seriously reducing the sizeable escapement of 96,000 sockeye.

The above problem is now being mutually considered by the Commission and the Department of Fisheries and it is to be hoped that the Indians will co-operate fully in arriving at a satisfactory solution.

ESCAPEMENT

The basis for the Commission's decision to commence harvesting all races migrating through the fishery in 1951 proved to be entirely sound. With few exceptions the upriver spawning grounds had greatly increased numbers of spawning sockeye in spite of the fact that a forty-eight year record cyclic catch was taken by an intense and efficient fishery.

TABLE V

THE INDIAN CATCHES OF SOCKEYE SALMON BY DISTRICTS AND THE VARIOUS AREAS WITHIN THESE DISTRICTS, 1947, 1951

District and Area	1947 *Catch*	1947 *No. of Fishermen*	1951 *Catch*	1951 *No. of Fishermen*
HARRISON-BIRKENHEAD				
Skookumchuck			1,154	—
Lillooet Lake	600	—		
Birkenhead River	5,500	—	11,814	
TOTALS	6,100		12,968	
LOWER FRASER				
Seabird Island	500	—	620	30
Katz and Ruby Creek	500	—	700	14
TOTALS	1 000		1,320	44
CANYON				
Union and American Bars	450	3	1,046	
Yale	2,500	12	5,014	
Spuzzum	500	3	1,833	
Lower Gorge	250	1	—	
Upper Gorge	200	3	800	
Boston Bar	200	1	—	
Boothroyd	3,000	10	1,166	
Cisco	4,000	16	2,710	
TOTALS	11,100	49	12,569	
LYTTON-LILLOOET	4,500	21	5,805	44
BRIDGE RIVER RAPIDS				
Lillooet	3,500	16	5,590	36
Rapids	7,500	27	9,130	62
Pavillion	1,500	9	4,025	22
TOTALS	12,500	52	18,745	120
CHILCOTIN				
Farwell Canyon			362	12
Hance's Canyon			375	9
Martins			—	—
Anahim	NO		—	—
Alexis Creek	FISHING		358	8
Siwash Bridge			3,224	38
Keighley Holes			240	4
Henry's Crossing			—	—
TOTALS			4,559	71
UPPER FRASER				
Shelly	600	5	210	13*
Alkali Creek	—	—	400	—
Chimney Creek	600	4	1,117	—
Soda Creek	600	5	305	—
Alexandria	35	1	150	—
Quesnel	250	2	290	—
TOTALS	2,085	17	2,472	
NECHAKO				
Nautley Reserve	600	5	1,777	7
Stella Reserve	600	3	2,072	8
TOTALS	1,200	8	3,849	15
STUART LAKE				
Ft. St. James	1,000	12	1,694	27
Tachie Reserve	800	8	1,100	20
Trembleur and Takla Lake	40	1	278	2
TOTALS	1,840	21	3,072	49
THOMPSON				
Nicomen Creek	—	—		
Ashcroft	1,000	—	1,385	
Deadman's Creek	—	—	850	15
North Thompson River	150	—	450	6
South Thompson River	800	—	10,261	35
TOTALS	1,950		12,946	
GRAND TOTALS	42,275		78,305	

* Number of permits issued to Indians in District.

TABLE VI

SUMMARY OF THE SOCKEYE ESCAPEMENT TO THE FRASER RIVER SPAWNING AREAS, 1939, 1943, 1947, 1951

District and Streams	Period of Peak Spawning	Estimated Number of Sockeye 1939	1943	1947	1951	3-yr. Jacks	Sex Ratio Males 4-5 yr.	Females 4-5 yr.
LOWER FRASER								
Cultus Lake	Nov. 21-26	73,189	11,875	8,898	13,143	466	3,002	9,675
Upper Pitt	Sept. 15-18	—	1946	18,520	37,837	0	19,043	18,794
Widgeon Slough	Nov. 9-12	—	293	750	745	81	294	370
HARRISON								
Big Silver Creek	—	29	Present		200	—	—	—
Douglas Creek	—	156	Present		20	—	—	—
East Creek	—	25	9		15	—	—	—
Harrison River	Nov. 20-23		1,114+	16,000	17,145	0	3,879	13,266
Hatchery Creek	—	107	77	500	100	—	—	—
Weaver Creek	Oct. 21-24	3,253	3,128	6,500	12,979	123	4,755	8,101
LILLOOET								
Birkenhead	Oct. 1-5	15,280	50,668	120,000	35,861	14,324	9,215	12,322
U. Lillooet Streams	—	1,130	Present	Present	50	—	—	—
SOUTH THOMPSON								
Seymour	Aug. 22-25	250	Present	10,000	24,344	24	12,026	12,294
Adams L. & trib.	—	—	—	0	0	—	—	—
Adams River	Oct. 14-16	16,200	10,000	185,000	135,000	1,080	53,190	80,730
Little River	Oct. 16-17	15,687	Present	15,000	9,690	523	4,497	4,670
South Thompson R.	Oct. 16-17	—	—	100	500	—	—	—
NORTH THOMPSON								
Raft River	Aug. 28-31	1,490	4,000	8,000	8,561	17	4,298	4,246
Barriere River	Aug. 30	—	—	—	108	0	—	—
SETON ANDERSON								
Portage Creek	—	—	—	50	30	—	—	—
CHILCOTIN								
Chilko River	Sept. 20-23	2,000	13,546	55,000	118,110	17,994	41,982	58,134
Taseko River	Sept. 5-9	—	—	—	500	—	—	—
QUESNEL								
Horsefly River	Aug. 26	—	—	6	51	0	28	23
NECHAKO								
Endako River	Aug. 30-Sept. 2	8	46	450	742	9	323	410
Nadina River	Aug. 26	—	—	90	326	18	158	150
Nithi River	Aug. 24	3	—	60	90	—	—	—
Ormonde Creek	Sept. 2-4	—	—	40	120	60	30	30
Stellako River	Sept. 28-Oct. 1	1,446	9,142	55,000	96,200	132	41,252	54,816
Uncha	—	—	—	2	30	—	—	—
STUART								
Ankwil Creek	Aug. 15	—	—	—	25	2	—	—
Driftwood River	—	—	—	0	50	—	—	—
25 Mile Creek	—	—	—	—	5	0	—	—
15 Mile Creek	—	—	—	0	7	2	—	—
Forfar Creek	Aug. 4-8	89	400	1,500	13,600	136	5,984	7,480
Frypan Creek	Aug. 15	—	—	—	50	0	—	—
Gluske Creek	Aug. 6-10	—	—	200	3,787	112	1,573	2,102
Kazchek Creek	Sept. 6-10	2	2	—	200	—	—	—
Kynoch Creek	Aug. 4-8	458	2,150	10,000	32,825	227	13,983	18,615
Middle River	Sept. 12-16	—	—	60	2,000	18	1,092	890
Nahounli Creek	Aug. 15	—	—	0	40	—	—	—
Narrows Creek	Aug. 12-16	6	5	—	400	22	141	237
Rossette Creek	Aug. 4-8	—	450	2,500	10,000	100	4,500	5,400
Shale Creek	Aug. 15	—	—	0	190	9	—	—
Sowchea Creek	Aug. 11	—	—	—	30	7	—	—
Tachie River	Sept. 12-16	—	—	—	100	—	—	—
NORTHEAST								
Bowron	—	2,695	6,215	23,945	21,770	39	10,359	11,372
TOTALS		133,503	113,120+	538,171	597,576			

———— No observation.

An examination of Table VI shows that Early and Late Stuart races, Early and Late Nechako, Chilko, Raft and Seymour races all had substantial increases in the number of sockeye on the spawning grounds. The escapement to Bowron declined about 8 per cent but there are some indications that the Bowron area may not maintain maximum production on continuing large escapements. Early historical records, although they are meagre, indicate that Bowron River has never been a large producer. This may be caused by the limitations in the size of the lake but further studies are necessary to assess and define the productive limitation of the area.

Three once barren or practically barren areas now appear to have native spawners on this cycle. The Barriere River, where the original runs of sockeye were finally destroyed by dams and hydro-electric power development, had a promising run of 108 sockeye in 1951. Since power operations have now ceased and the dams are to be removed, this run may serve as valuable seed stock for building up normal native runs to this once important spawning ground.

In Taseko Lake, tributary to the Chilcotin, over five hundred sockeye were observed spawning on the lake shore. This watershed is glacial in origin and as a result the accurate enumeration of spawners is difficult. There are no historical records of a run to this area so the potential of this rehabilitating population cannot be assessed at this time. Taseko Lake is about fifteen miles long with an estimated mean run-off of 1410 cfs. of water highly discolored in the summer and fall months from glacial silt in spite of the settling effect of Taseko Lake. No sockeye have been observed spawning in either the tributaries or the outlet of the lake. The spawning activity appears confined, as in the case of Cultus Lake, to the gravel beaches of the lake itself. The lake elevation is 4400 feet or almost twice the elevation of any other sockeye producing lake except Chilko, which lies at 3800 feet.

A run of 51 sockeye originating principally from marked fingerlings transplanted from Bowron appeared in the Horsefly River where no sockeye have been observed for many years on this cycle except for six fish counted in 1947.

The Adams River escapement declined at least 25 per cent, but since this off-year escapement is supported to a large extent by five-year-old fish produced in the preceding and dominant cycle the decline can be attributed to the serious decrease in the 1950 run.

A substantial decline was recorded in the escapement to the Birkenhead River, a lower river tributary below Hell's Gate. Only 21,000 normal adult fish were counted on the spawning grounds compared with 84,000 in 1947. Such failures have been recorded on other years, hence the decline may not necessarily have been caused by overfishing.

Escapements to other lower river spawning areas were normal or above normal for this cycle.

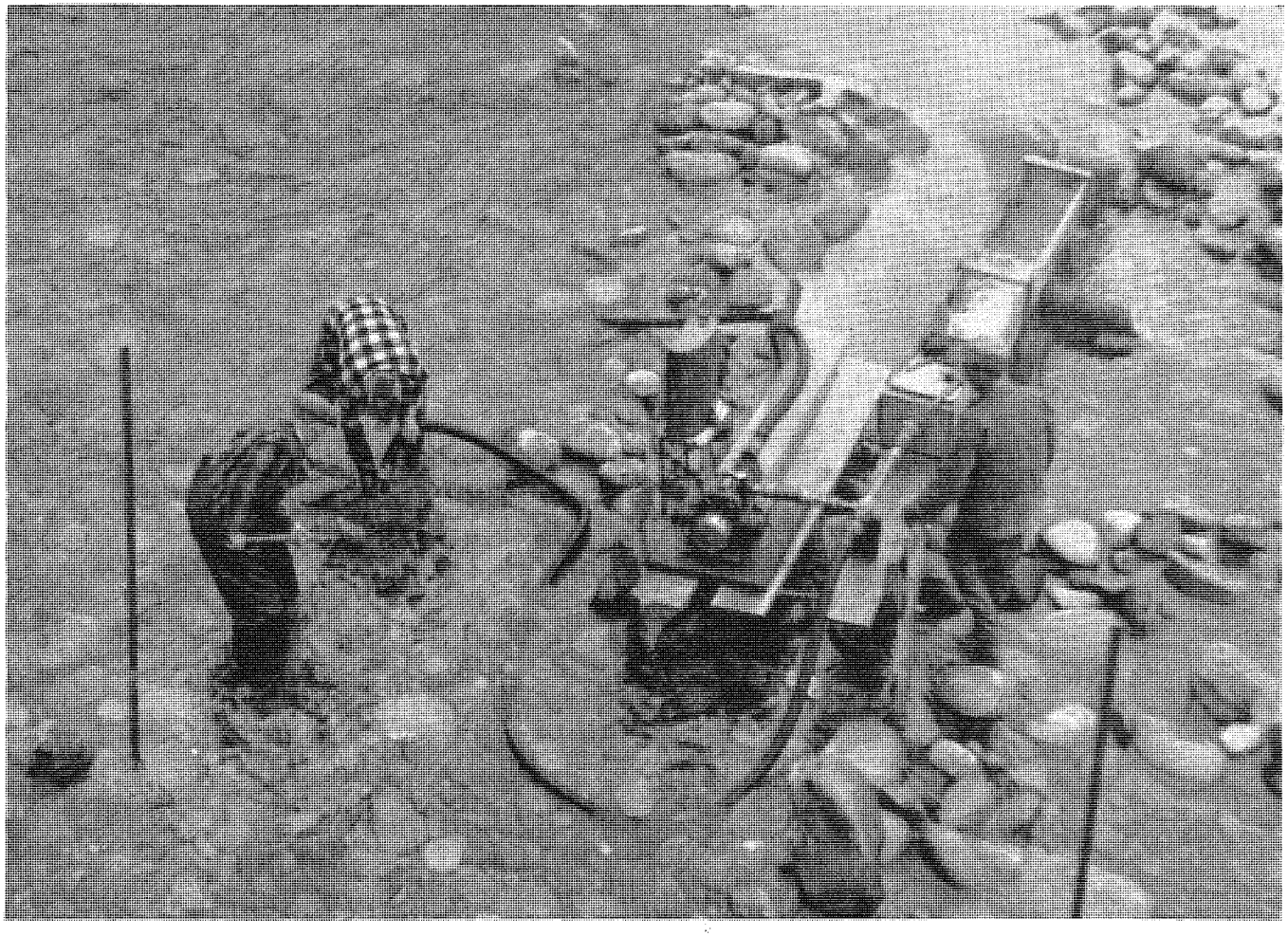

FIG. 3—Experimental equipment designed to recover deposited salmon eggs. Such equipment is necessary for measuring fertility in experiments relating to adequate sex ratio, optimum spawning gravel, stream velocity, etc.

THE 1952 CYCLE

An infallible method for determining the size of a surviving population in advance of its appearance in the fishery is difficult to obtain. There are many races of sockeye in the Fraser River possibly all being subjected, during their early life history, to different deviations from their optimum reproductive environment. In addition, several racial populations are reaching such a size in more than one annual cycle that an adjustment in the rate of productivity for each of these populations may be taking place. The collection and analysis of the tremendous amount of data required for determining one or more methods of accurately predicting survival is a slow and tedious task. Any method devised also must be subjected to a severe test before it can be used advantageously as an economic tool by the industry. The numerical size of the racial escapement has proven in the past to be an unreliable index of survival, although, within certain limits, the number of spawners is definitely important in the maintenance of the population.

A definite relationship was noted by Dr. C. H. Gilbert* between the number of four-year-old sockeye in each of the great quadrennial runs from 1901 to 1913 and the number of three-year-old sockeye appearing in the preceding year. In 1912, Dr. Gilbert estimated that 21.5 per cent of the entire sockeye run were three-year-old fish. The decline of the great 1913 cyclic run in both 1917 and 1921 was indicated by a similar decline in the number of three-year-old sockeye present in the preceding annual runs. No attempt was made by Dr. Gilbert to segregate the number of three-year-old sockeye by races hence the relationship between the number of three-year-old sockeye and the number of four-year-old fish appearing during the following year was only a general one.

A segregation during the past twelve years of the number of three-year-old sockeye and the related number of four-year-old sockeye by racial origin shows that the racial relationship of the two age groups is variable between races and not always consistent from year to year for each race. Certain races such as Pitt, Bowron, and Raft produce few, if any, three-year-old sockeye at present. The Adams and Birkenhead populations produce a highly variable number and other racial populations, having a relatively consistent relationship between three and four-year-old sockeye, may produce these age groups at a different ratio in different years as the races increase in numbers. Until the factor, or factors, influencing the production of three-year-old sockeye are known and assessed, the use of their abundance as a measure of the run to follow in the next year must be considered of uncertain value. While the number of three-year-old sockeye present in 1950 indicated both the unusual productivity of certain races and the decline in the productivity of others returning in 1951, the large number of three-year-old sockeye present in Adams River in 1950 was not followed by a large number of four-year-old fish in 1951.

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* Gilbert, C. H. British Columbia Fisheries Department Annual Reports, 1917, 1920.

TABLE VII

DAILY CATCH OF SOCKEYE, 1940 - 1944 - 1948 FROM UNITED STATES TREATY WATERS

	JULY			AUGUST			SEPTEMBER		
Date	1940	1944	1948	1940	1944	1948	1940	1944	1948
1	617	76		48,141	58,865	118,062	1,063	26	2,707
2	8			47,306	46,797	100,423	199		391
3	42	37			28,555	97,469	329	49	1,150
4	5	6		29,215	20,120	67,360	507	44	
5	341	5		36,389		60,700	805	65	1,297
6		24		57,375	9,374	68,962	419	55	3,799
7		65		31,172	6,913			19	1,692
8	131	46		29,494	9,228	115,926	93	6	404
9	36	133		22,492	3,860	101,997	131		333
10	52	169			3,149	38,878	170	21	134
11	77	98		8,231	5,786	17,288	257	39	
12	251	105		3,221			287	6	212
13		164		4,652	1,890		138		205
14	2,006	242		4,766	2,262			20	65
15	7,181			7,972	366		305	2	15
16	3,752	1,394		3,330	1,235		203		42
17	8,016	1,290		380	935		187	28	140
18	14,083	2,661	1,900	1,717	425		463	28	
19	15,761	3,641	2,469	3,057			175	3	193
20		8,989	6,348	1,236	1,395		93	5	88
21	28,836	8,187	8,622	333	1,618			17	20
22	22,302		5,671	89	224		116	4	24
23	13,152	11,780	5,142	71	79		128		13
24	24,060	14,489		24	11		55	6	16
25	22,406	11,484	17,524	617	75		58	1	
26	24,254	17,769	22,251	26			15	1	16
27		25,757	23,441	179	51		10	1	22
28	19,645	18,885	42,887	283	150			1	429
29	19,769		69,529	866	243		60		811
30	34,775	46,475	78,843	466	192		18		319
31	43,488	57,459			17				
Totals	305,046	231,430	284,627	343,100	203,815	787,065	6,284	447	14,537
June Total	1,388								
Oct. Total							894		2,831
Season Total							656,712	435,692	1,089,060

TABLE VIII

DAILY LANDINGS OF SOCKEYE, 1940 - 1944 - 1948 FROM CANADIAN TREATY WATERS

Date	JULY			AUGUST			SEPTEMBER		
	1940	1944	1948	1940	1944	1948	1940	1944	1948
1	258	73		27,313	120,977			692	1,217
2	27			25,111	93,421	13,246	1,209		2,572
3	41	92			93,186	58,405	4,280		2,354
4	381	206			90,654	55,578	2,442	218	
5	161	156		47,557	54,048	61,232	2,100	2,021	
6	326	445		81,503		57,044	770	1,871	184
7		171		43,828	36,570	5,850	921	2,575	3,087
8	956	604		41,506	54,881			1,382	610
9	2,254			44,356	31,471	47,075	165		436
10	2,360	490			32,209	88,175	1,306		349
11	3,122	1,704			22,011	54,451	942	22	
12	4,048	1,154		4,120	21,018	41,829	418	456	
13	5,626	1,911		18,464		32,863	716	311	181
14		1,436		10,828	5,509	985	25	368	2,159
15	6,101	1,748		9,577	10,170			578	1,235
16	9,783			5,749	4,972	11,188	509		1,785
17	9,971	2,557		8,799	8,246	23,947	1,320		1,473
18	15,289	4,168			8,421	22,614	473	619	
19	14,580	5,254		5,914	9,560	12,376	518	2,614	
20	13,985	7,448		18,686		10,614	575	3,352	591
21		4,921		6,026	4,637			1,115	2,989
22	20,561	12,328	3,845	8,314	12,051			1,285	539
23	23,854		637	7,025	4,785	3,669	2,654		744
24	26,642	16,213		5,726	3,121	13,616	8,120		754
25	34,371	26,734			3,028	7,239	3,539	1,279	
26	30,325	25,569	20	1,302		9,624	2,042	4,290	
27		20,554	75	5,098		5,725	1,544	805	998
28		12,855	6,334	2,564	3,350			434	4,928
29	34,495	7,681	13,555	1,841	7,046			852	2,486
30	60,726		15,764	501	750	519	1,195	341	2,521
31	28,281	70,865	13,991	1,113	1,280	2,246			
Totals	348,524	227,337	54,221	432,821	737,372	640,110	37,783	27,480	34,192
May and June Totals	807	398							
Oct. Total							47,063	11,131	23,289
Unassigned as to date of landing							166,002		
Season Totals							1,033,000	1,003,718	751,812

An examination of Table VI shows the number of three-year-old sockeye present on the spawning beds in 1951. The number present at Chilko is over twice that recorded in any year since the beginning of records in 1989. It is well to point out, however, that, if the same ratio of three to four-year-olds prevails in the 1952 cycle that occurred in the 1951 cycle, only 1,150,000 sockeye would return as adults in 1952. This would not be a very large return from the spawning population of 670,000 sockeye recorded in 1948, and believed to be the largest escapement to Chilko since 1909. A relatively large number of three-year-old sockeye appeared in the Birkenhead and Early Stuart runs, none, as usual, occurred in the Pitt run and a very small number appeared in the runs to Cultus Lake and Seymour River.

The daily sockeye landings in Treaty waters for 1940, 1944 and 1948 are listed in Table VII and VIII for the convenience of the industry. The escapements for the same years, by spawning areas, are detailed in Table IX.

The total cyclic pack of both Canada and the United States since 1913 has ranged between 90,000 and 153,000 full cases with the exception of the year 1936 when 244,000 cases were obtained. Production on this cycle has been maintained, at least in the earlier years of the cycle, by the lesser of the two important runs to Chilko Lake recurring every four years.

Peak production has usually started in previous cycles about the 27th of July or shortly thereafter. In 1936 and 1944 it was practically over by the 4th of August. Bimodal peaks of production occurred in 1940 and 1948 and the catches remained fairly good until the 9th or 10th of August. No catch of any significance was taken during any of the previous four cycle years after the main run had passed through the fishery.

The passage of the main run through Canadian waters in previous cycles has usually started a few days later than in the United States waters although the peak catches occurred on the same days in 1940 as they did in the United States fishery. Peak catches are usually made in Canadian waters commencing between July 30 and August 3 and continuing until August 8 to August 12. Very few fish were landed in any of the cycle years listed in the tables after the main run had passed, although some late catches of moderate size were landed after the passage of the main run in 1948. This was caused by the complete closure of the United States fishery on August 11 of that year.

Closures in 1948 during the passage of the seriously depleted early runs should provide for an increase in the daily sockeye catches during the first three weeks of July in 1952. Whether the 1952 pack is average or above average for the cycle depends to a considerable extent on the productivity of the escapement to Chilko Lake in 1948. The number of sockeye counted on the Chilko spawning grounds in 1948 apparently exceeded that for any year since 1909. Cycle productivity appears to be changing in this area, however, since by 1949, the original dominant cycle of 1937-1941 had become a year of low productivity. The 1936-1940 cycle was originally the second

highest annual cycle of productivity but by 1948 it had become the most productive of the two, and the 1947-1951 cycle, always a poor producing cycle in earlier years, indicated a substantial increase in its rate of productivity in 1951.

Escapements to the Pitt and Birkenhead Rivers, tributary to the Lower Fraser River, were of sufficient size in the previous cycle year to produce substantial runs if their rate of productivity is at a good level. Escapements in 1948 to other spawning streams were relatively low in number although it should be noted that this is the only cycle year that Silver Creek, tributary to Harrison Lake, produces any number of sockeye.

REHABILITATION OF BARREN AREAS

Activities during the past three years at the Quesnel Field Station located on Horsefly Lake have demonstrated that the station is well located for the incubation, hatching, and rearing of sockeye. Periodic mortalities have occurred in eggs and fry but in every instance these mortalities have been traced to human or mechanical error rather than to any environmental weakness in the water supply. Experiments to date have been on a small controlled scale to minimize any losses in those races being used as donor races for rehabilitation purposes, such losses usually being inherent during the "breaking in" period of a new hatchery. Now that the operating problems have been thoroughly examined, the activities of the station can be greatly expanded in order to accomplish its purpose of providing seed stock in barren areas as soon as possible.

First returns from experiments conducted at this station will be available in 1953 and every year thereafter as long as the station is operative. Preliminary experiments, however, using Bowron sockeye eggs eventually transplanted as fingerlings to the Horsefly River returned a run of more than 174 marked adults in 1951. Since this is the first scientifically recorded and successful transplant of a significant number of sockeye from one stream to another in that part of the Fraser watershed lying above Hell's Gate, the first objective of obtaining natural returns to barren areas by artificial propagation appears assured.

The natural rehabilitation of residual native stocks, even though starting from a few pairs of sockeye, is now taking place throughout the upper watershed. The high rate of rehabilitation being shown by these residual stocks is illustrated on page 3 of this report. To avoid possible interference with the almost astounding resiliency of these small native stocks by the introduction of foreign strains from other streams, the Commission has adopted a policy of transplanting eggs and fingerlings only when the host stream is devoid of spawning sockeye. The once great run to Adams River at the upper end of Adams Lake has been totally destroyed by the combination of the Hell's Gate obstruction and the splash dam at the outlet of Adams Lake. These obstructions have been eliminated and present rehabilitation plans call for the planting of at least 1,000,000 Seymour River fingerlings of the 1952 brood from the Quesnel Station into the Upper Adams River. A plant of this magnitude should definitely demonstrate the possibility of a quick rehabilitation of a totally barren stream by artificial methods.

TABLE IX

SUMMARY OF THE SOCKEYE ESCAPEMENT TO THE FRASER RIVER SPAWNING AREAS, 1940, 1944, 1948

District and Streams	*Estimated Number of Sockeye Present*		
	1940	1944	1948
LOWER FRASER			
Cultus Lake	74,121	14,200	13,086
Upper Pitt River (inc. tributaries)	1947	90,000	
Widgeon Slough	—*	1,050	—*
HARRISON			
Big Silver Creek	5,149	5,192	12,000
Douglas Creek	337	36	350
East Creek	28	65	45
Harrison River	11,000	73	26,000
Hatchery Creek	400	63	150
Weaver Creek	17,600	16,441	20,000
LILLOOET			
Birkenhead River	27,320	57,707	120,000
Upper Lillooet streams	5,800	11,404	—
SOUTH THOMPSON			
Seymour River	600	200	4,000
Adams Lake and Tribs.	—	—	—
Adams River	9,900	1,367	12,600
Little River, Little Shuswap Lake	1,700	200	2,400
Shuswap Lake and Tribs.	—	0	50
South Thompson River	100	—	100
NORTH THOMPSON			
Raft River	11,400	1,082	10,500
CHILCOTIN			
Chilko River	300,000**	328,655	670,000
Chilko Lake	Present	Present	Present
Taseko River	—	—	Present
QUESNEL			
Horsefly River	90	3	50
Little Horsefly River	—	2	0
Mitchell River	—	—	0
NECHAKO			
Endako River	8	1	0
Francois Lake	2	—	0
Nadina River	—	—	30
Nithi River	0	0	1
Ormonde Creek	36	15	150
Stellako River	2,600	3,294	16,000
Uncha Creek	—	—	0
STUART LAKE			
Driftwood River	—	—	—
Forfar Creek	90	46	1,500
Gluske Creek	0	—	1,500
Kazchek Creek	10	3	80
Kynoch Creek	195	350	7,500
Middle River	300	22	200
Narrows Creek	5	0	0
Rossette Creek	0	2	1,500
Shale Creek	—	—	—
Tachie River	—	—	20
NORTHEAST			
Upper Bowron River	4,625	1,700	25,218

* Fish may have been present but no observation was made.

** This figure adjusted from original figure published in 1940 because of error found in method of calculation.

Operational experiments in 1951 consisted of:

1. Planting 193,000 sockeye fingerlings of the 1950 brood year in Anderson Lake just above its outlet into Portage Creek. These fingerlings were obtained from late Adams River spawn and flown in the "green egg" stage to the Quesnel Station for incubation, hatching and rearing.

2. Planting 15,000 sockeye fingerlings of the lot and origin listed in item one above in Lac la Hache. It was intended that these fish be planted in Anderson Lake but flying hazards made it necessary to release the fish at the most convenient place. Lac la Hache and its related drainage system through the San Jose River once had a native sockeye run similar in its timing in spawning migration to that of the late Adams run so that the accidental stocking of this system may not be without merit.

3. Planting 120,000 Kokanee fingerlings (non-migratory sockeye) into Horsefly Lake near its outlet in the Little Horsefly River. A total of 53,000 of those released were marked by the excision of the adipose and right ventral fins. These fingerlings, which originated from Kokanee eggs of the 1950 brood, were taken in the Little Horsefly River and incubated, hatched and the fry reared at the Quesnel Station. This is an experiment to determine if an increased growth rate will stimulate land-locked sockeye fingerlings to migrate to sea and return as normal adults. Such a migration to the sea and a return of normal sized adult sockeye was obtained by the United States Fish and Wildlife Service operating on the upper Columbia River.

4. Planting 72,000 sockeye fingerlings, originating from eggs taken from the Stellako run in 1950, in the lower end of Horsefly Lake near its outlet into the Little Horsefly River.

5. Taking 625,000 sockeye eggs from the lower Adams River in 1951 for incubation, hatching, and eventual rearing at the Quesnel Station. The resultant fingerlings will be planted in Anderson Lake.

6. Taking 325,000 sockeye eggs from the Seymour River in 1951 for incubation, hatching, and eventual rearing at the Quesnel Station. The fingerlings from this experiment will be planted in Gates Creek at the head of Anderson Lake.

GENERAL INVESTIGATIONS

The collection, tabulation and analysis of data related to the problem of rehabilitating and preserving the Fraser River sockeye continued at an accelerated rate throughout the year. Several phases of the problem have been finely delineated but additional effort has been expended to broaden the analysis of each for the eventual benefit of other workers in the field of salmon investigations. It is the policy of the Commission not to publish its findings until they have a well defined and apparently sound application to management.

Records of origin and size of individual runs of Fraser River sockeye over the last 140 years are being obtained from the journals of the Hudson's Bay Company, London, England. In addition, a great volume of detailed historical information has been obtained from the files of the Departments of Fisheries of British Columbia and Canada. The relative rate of productivity of the four annual cycles reproducing in the Stuart and Fraser-Francois systems has been established for a period of over 100 years. The proper management of the fishery should insure that where the reproductive environments continue unchanged, the stocks of sockeye will return to their original numbers.

An analysis of the early catch records kept by various Government agencies and fishing companies is enabling the Commission to determine which races of sockeye contributed most to the annual catches of past years. When these data are combined with the best available estimates of escapements of those years, a much greater understanding of the potential annual productivity of the various spawning areas should result.

Intelligent regulation of the Fraser River sockeye fishery requires that each race be protected by, or fished under, regulations designed specifically to fit its annual timing and abundance. Identification of the various races as they are mixed in the fishery thus becomes a problem which must be solved. Tagging studies and fat content determinations have provided only partial answers to date. Identification by characteristic scale patterns in various races gives promise of success; especially in the case of certain races.

Studies of the day by day intensity and effectiveness of the fishery when combined with a knowledge of the time and availability of each race give promise of allowing the calculation of abundance of the stock, the current fishing mortality, and an estimate of the existing rate of escapement for each race. Studies of the intensity of the United States fishery and its related catch have given a close approximation of the escapement to date. However, as the fishery expands to the westward, this method may no longer be of value. An analysis of the gill net catch for specific areas before and after the weekly closed season may provide another method of estimating current escapements.

Accurate enumeration of the spawning populations of sockeye salmon must be carried out each year. Along with enumeration of spawners, the Commission determines sex ratios, success of egg deposition, relationship of the spawning period to specific conditions in the area and many other factors which have an influence on the rate of reproduction of the various races. Constant attempts are being made to improve methods of conducting such investigations and to reduce their cost.

Ultimate success of spawning may be measured in terms of fry production resulting from a given spawning. Experiments have been conducted on the Chilko River during the past two years in an attempt to evaluate the annual production of fry. This type of work will be continued until the optimum annual relationship between fry production and the number of spawning adults has been determined.

Limited studies have been made of the selectivity of fishing gear with respect to timing of the escapement, sex ratio and average size of sockeye of various races. This research has been nearly completed and has led to an investigation into the effects of selectivity of fishing gear on success of reproduction on the spawning grounds.

A broad program of investigation and research was carried on to determine the requirements for reproduction of sockeye on various spawning areas. Such factors as run-off, depth of water and gravel cover, and velocity have been measured in relation to the natural egg deposition and the survival of eggs and fry from known spawnings. In addition, extensive surveys and office studies of the principal spawning streams of the Fraser watershed have been continued.

Attempts were continued to find methods for predicting rates of survival for the various races expected to comprise a future year's run. The abundance of three-year-old jacks appears to bear a general but variable relationship to the abundance of four-year-old sockeye of the same brood which will spawn the following year. However, there are important exceptions which have not yet been explained. Studies of the freshwater period of scale growth were instituted. It appears that the development of the freshwater portion of the scale is correlated with the growth of the sockeye in freshwater and that such growth may possibly be related to the rate of survival to adult size.

With the co-operation and assistance of the State of Washington Department of Fisheries an intensive study was made of the effect of a high power dam on the survival rate of downstream sockeye migrants which either passed through the power turbines or over the spillway. This work will be continued and extended to other dams.

Rapid industrial development on the Fraser River basin has brought an increasing demand for water use projects of many types and sizes. The Commission continued to study the effect of these various proposals on the sockeye salmon of the watershed. In many cases it has suggested alternatives which would prove less damaging to the fisheries resource. Maintenance of the sockeye population of the Fraser watershed can be greatly assisted by a continued program of co-operation in water use.

Extensive field and office studies of the possible effects of the Aluminum Company of Canada's Nechako Project were carried out in collaboration with the Department of Fisheries of Canada. This project will divert the flow of the Nechako watershed above the Grand Canyon from its present course and carry it directly to tidewater via a tunnel through the Coast Range from Tahtsa Lake. The greatly reduced flow of the residual Nechako will pose major access problems for the large sockeye runs which pass through that river enroute to the spawning grounds of the Stellako and Stuart basins. At the end of the year a report was being prepared on the complex temperature problem expected in the residual river and the anticipated need for cold tempering water to prevent a serious mortality in the sockeye migrating to their spawning grounds. Discussions of the problem at a technical level were held by the Department of Fisheries with the Aluminum Company and the Commission.

An investigation was made into the effects of a proposed sulphate pulp mill on the sockeye of the Fraser watershed. A preliminary report was prepared by the technical staff of the Commission and the Department of Fisheries. This report will be broadened to provide for a more general application of the findings.

The Commission's program of lake sounding surveys was continued on a small scale. Bottom contour maps of Quesnel and Harrison Lakes were prepared using a rapid and economical system of sextant triangulations for horizontal control and a sonic depth recorder. If the plan for mapping the bottoms of Stuart, Trembleur, Takla, and Bowron Lakes can be fulfilled in 1952, the Commission will have completed this phase of its work in studying all the sockeye rearing lakes of the Fraser River watershed.

Surveys of spawning streams in connection with the fresh water environment studies were carried out on the Horsefly River and additional data concerning the selection and productivity of various types of spawning areas were gathered on the Chilko, Stellako, and Adams Rivers. Preliminary surveys by biologists and engineers were made on the Barriere, Salmon (tributary to Shuswap Lake), and Driftwood Rivers. Historical records indicate that these streams were once important spawning grounds for sockeye salmon. Reasons for their decline and estimates of their future potentialities are being sought.

A new type of demountable fence for counting or trapping adult sockeye was designed, constructed and installed at Sweltzer Creek, which drains Cultus Lake.

CONSTRUCTION AND MAINTENANCE

In December the Commission completed construction of a high level fishway on the left bank at Hell's Gate. The main left bank fishway, completed in early 1946, allows passage of sockeye from river gauge heights of 23 to 54 feet. The new fishway operates at gauge heights from 54 to 70 feet. Early runs of sockeye, passing Hell's Gate in July, have in the past encountered block conditions on this bank when river levels above 54 feet persisted into July. Such delays will now be eliminated.

The fishway employs the same principles which have proven so satisfactory in other fishways built by the Commission. The structure is 190 feet long and 9 feet wide. It contains 13 vertical baffles made of steel and filled with concrete. The fishway will operate without adjustment at all river stages between 54 and 70 feet. An auxiliary water supply is taken from the river, passed through a conduit under the floor, and discharged through a grating in the floor of the pool at the downstream end. This system provides extra water for discharge through the fish entrance which aids in attracting fish from the river.

Routine maintenance was carried on at the Hell's Gate, Bridge River Rapids, and Farwell Canyon fishways by the Commission's field crew during the year. No maintenance was required at the Farwell Canyon fishways, which operated without difficulty throughout the season. At Bridge River Rapids the access road was cleared of slide material in the spring, no work on the fishways being

required because of favorable river and climatic conditions, resulting in unusual freedom from slides and river-borne sediments. A late fall rise in the river allowed flushing of the Bridge River fishways at little expense, thus preparing them for the 1952 season. At Hell's Gate normal maintenance of camp, bridge, machinery and fishways was carried out. There was no excessive damage due to slides or high water. In the future, with construction of fishways completed and construction crews disbanded, maintenance can no longer be carried out in conjunction with construction operations. All fishways are necessarily located at points where natural hazards are great—high cliffs, narrow canyons, and turbulent flood flows provide a continual threat to proper maintenance and operation of the fishways. Emergency equipment and a skeleton crew must be ready at all times to insure free passage of sockeye.

1951 PUBLICATIONS

1. Annual Report of the International Pacific Salmon Fisheries Commission for 1950.

2. Research Bulletin Number IV

   A Study of the Spawning Populations of Sockeye Salmon in the Harrison River System, with Special Reference to the Problem of Enumeration by Means of Marked Members, by Milner B. Schaefer.