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

1949

COMMISSIONERS

EDWARD W. ALLEN
SENATOR THOMAS REID
ALVIN ANDERSON
(July to December)
MILO MOORE
(January to July)
A. J. WHITMORE
ALBERT M. DAY
OLOF HANSON

NEW WESTMINSTER,
CANADA,
1949

INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION

MEMBERS

AND PERIOD OF SERVICE

SINCE THE INCEPTION OF THE COMMISSION

IN 1937

CANADA		UNITED STATES	
WILLIAM A. FOUND	1937-1939	EDWARD W. ALLEN	1937-
A. L. HAGER	1937-1948	B. M. BRENNAN	1937-1942
SENATOR THOMAS REID	1937-	CHARLES E. JACKSON	1937-1946
A. J. WHITMORE	1939-	FRED J. FOSTER	1943-1947
OLOF HANSON	1948-	MILO MOORE	1946-1949
		ALBERT M. DAY	1947-
		ALVIN ANDERSON	1949-

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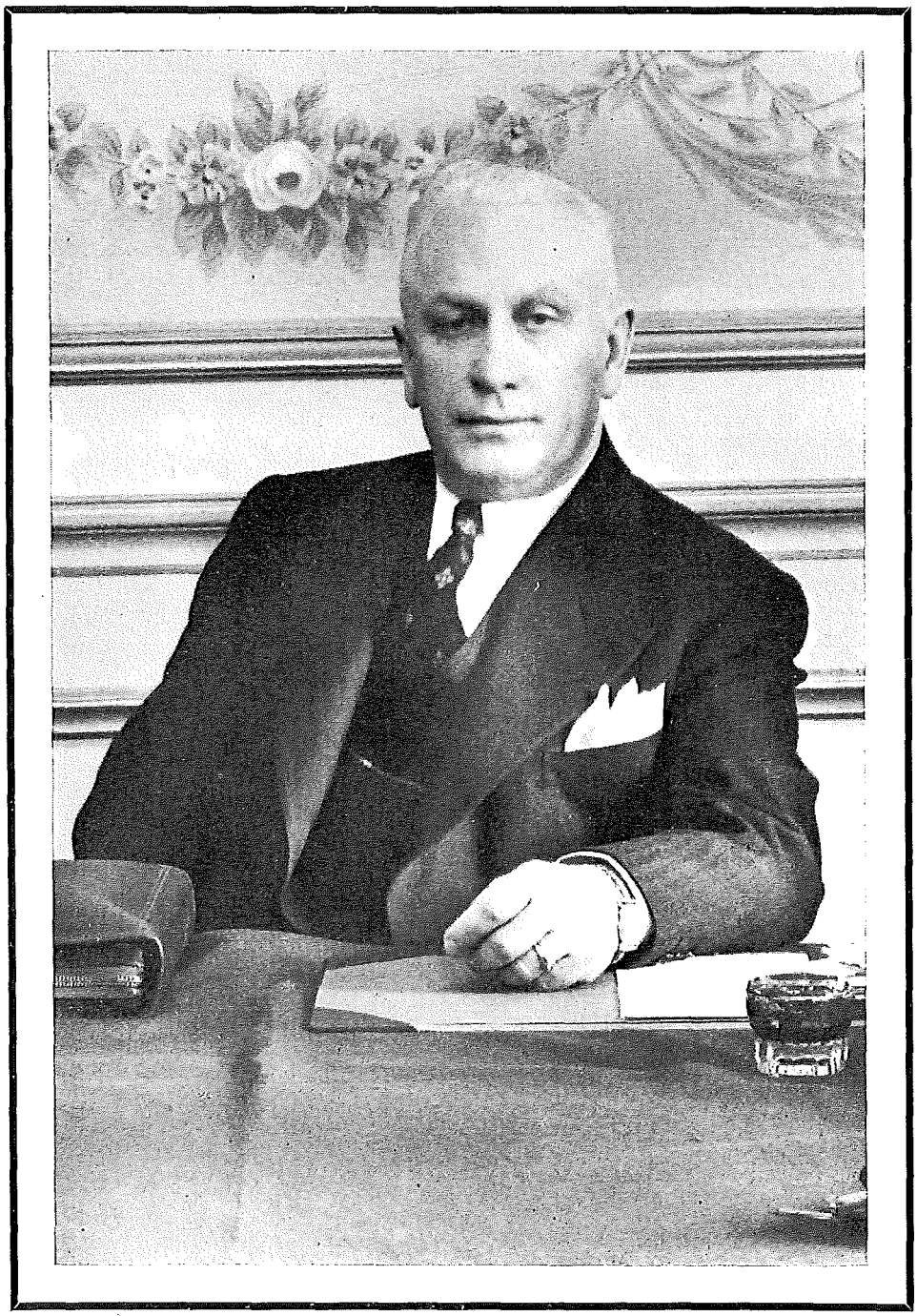
OFFICERS

LOYD A. ROYAL
Chief Biologist

MILO C. BELL
Chief Engineer

NEW WESTMINSTER,
CANADA,
1949



BERTRAM M. BRENNAN

Director of the International Pacific Salmon Fisheries Commission who passed away in August, 1949, after serving the Commission since its inception in 1937. Mr. Brennan was first elected Secretary, and then served a term as Chairman from 1940 to 1942. He was appointed Director of Investigations in 1943 and served in that capacity until his death. His strength of character helped the Commission over many a difficult obstacle in fulfilling the requirements of the Convention between Canada and the United States.

REPORT OF THE INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION FOR THE YEAR 1949

Under the provisions of the Convention ratified by the Governments of Canada and the United States on July 28th, 1937, the International Pacific Salmon Fisheries Commission was created and charged with the protection, preservation and extension of the sockeye salmon fishery of the Fraser River system. In accordance with the Treaty and with the Protocol of Exchange of Ratifications, fully described in previous annual reports, the Commission organized a scientific staff and commenced a searching investigation into the causes of the serious decline in the run of sockeye salmon to the Fraser River. Regulation of the fishery began in 1946, eight years after the inauguration of scientific investigation.

The cause and effect of the Hell's Gate obstruction, the effect of the Adams River and Quesnel dams, and natural obstructions at Bridge River Rapids and Farwell Canyon have likewise been fully described in earlier reports.

Scientific investigations and regulations are now directed primarily to the management of the species, to its rehabilitation and perpetuation. The primary objective of management is easily defined. It is the establishment, in advance, of the maximum catch which can be taken by the fishery while allowing for perpetuation of the population at the most productive level. To achieve this objective is not a simple accomplishment but requires all the ability and originality to be found in scientific research.

Salmon appear to have the capacity to withstand heavy mortalities at one stage of life *under natural conditions* as they tend to compensate for them by a higher survival rate at other stages. This compensatory survival or resiliency theoretically permits a limited fishery without disturbing the net productivity. However, the Fraser River sockeye population is made up of several races, each of which may have a varying ability to compensate for periodic mortalities. The history of the Fraser River fishery also reveals that the annual populations of a single race may differ somewhat consistently in their rate of survival under natural conditions.

The total catch of Fraser River sockeye is being measured or can be calculated within reasonable limits of accuracy. The method of enumerating spawning escapements is being perfected to the degree of accuracy considered sufficient for determining total escapement. Thus the success of one year's escapement in reproducing itself can be determined. The measurement of the total relationship between spawners and adults surviving is not sufficient, particularly in a case where the majority but not all of the races have populations of a size below those indicated in earlier years. It is only when a factor such as the fishery or the Hell's Gate obstruction affects a large number or all of the races that this relationship has a real value.

To accurately measure the resiliency of a race and the racial requirements for maximum productivity, the relationship between the spawning escapement and the success of reproduction for that race must be determined. This requires a knowledge not only of the racial escapement but of the related catch. Investigations to develop a usable method for measuring the catch of at least the most important races must be intensified.

With the success of return known for each race, all the natural limiting factors in that rate of reproduction may then be examined for their significance. It is well to point out that under natural conditions the original Fraser River sockeye population as indicated by the fishery was consistently larger than at present. *Natural* limiting factors may therefore be of minor importance until the population of any or all the races approaches its maximum limits. The latter should become evident in a declining or stabilized rate of productivity as measured in terms of the relationship between the number of spawners and the returning number of adults.

Historical records show that the natural block conditions, found by Commission investigators at Bridge River Rapids, had apparently existed for many years. In spite of the block, the races spawning above this point were able to compensate for the adverse effects to a degree which permitted the great run every four years up to and including 1913. It was the effects of an artificially created block at Hell's Gate from which the up-river runs could not recover. The Bridge River fishways are justified principally because the adult mortality will be eliminated at this point. This permits a more rapid rehabilitation of the depleted runs and perhaps eventually a greater catch in relation to the required escapement. An ineffective spawner can be an economic waste.

If an index of the success of reproduction can be obtained earlier than at the return of the adult from the sea, this is desirable. The fishing industry must rely at present on expected returns from known or estimated escapements to plan their operations. Either negative or positive variations from the expected size of the run actually entering the fishery upset the economy of that fishery. Proper distribution of the catch between the two countries is difficult to obtain by pre-established procedures. The maintenance of a desired catch-escapement ratio likewise is a serious problem.

Since sockeye tend to compensate for mortalities occurring at various stages in their early life history, the logical time to establish the success of reproduction index would appear to be when the young migrants leave their lake environment for their final maturing stage of life in the sea. The numerical limit in the population of some species of fish appears to be relatively fixed early in life. An index of growth or of population size established at this stage might be representative of previous competition and of the collective effect of any fluctuations in environment. An attempt to establish such an index appears to be worthy of serious effort.

While a detailed knowledge of early life history and of natural environmental influences might not always be required in the management of a fishery once an index of productivity is established, natural conditions may not always prevail. Artificial factors disturbing the normality of reproduction may occur. The fishery itself may be an artificial factor which can adversely affect the species. Selectivity by the fishing gear may change the size, age composition and sex ratio of the spawning population. Regulation can upset the arrival time on the spawning grounds. The Hell's Gate obstruction not only physically blocked large numbers of sockeye from reaching their spawning ground but upset the time of arrival of many that were able eventually to pass the obstruction. The disturbing of the virgin watershed by man in his logging operations, in the construction of dams and in the introduction of waste products not normal to the waterways, has a tendency to change the natural influences affecting reproduction. It is the natural influences that permitted the species to reproduce within certain limits and each race has adapted itself over many generations to those influences. Any artificial change in the environment may have disastrous effects on reproduction. A mortality may occur at any one stage in the life history for which compensation is not possible.

The existence of an artificial factor is not always easy to recognize and its effect cannot be measured unless the cause is understandable and its relationship to effect measured. To accomplish this, a knowledge of the early life history and a measure of the natural environment appear essential. It is only through a knowledge of both that the effect on the Fraser River sockeye population of any proposed development can be anticipated.

Thus as rehabilitation continues, the Commission is preparing to manage the fishery on a strictly scientific basis to the end that the catch can be maintained at the highest possible level consistent with the natural productivity of the individual races. An increasing demand for the development of other natural resources in the Fraser River basin presents many obstacles to the accomplishment of this program. The collection and application of biological data relating to sockeye is a necessary safeguard against the possible adverse effects of this development. The concept of development and the depth of perception used by those planning the general water use development of the watershed may eventually determine the total benefits to be derived from the Commission's efforts.

The Commission met seven times during the year. The first meeting was held in Vancouver, B. C., on January 21st, 22nd and 23rd. The discussions on January 21st were directed primarily to the problems which would arise with the actual construction of any of the hydro-electric projects being considered for the Fraser River basin. On January 22nd the Commission met with the Advisory Committee and considered the proposed fishing regulations for the 1949 season.

The following members of the Advisory Committee were present:

Group Represented	*Canada*	*United States*
Packers	R. Nelson	J. N. Plancich
Gill Net Fishermen	H. Stevens P. Jenewein*	C. Karlson
Purse Seine	M. Borozny*	N. Mladinich
Sports Fishermen	M. W. Black	———
Troll Fishermen	———	———

* Alternate.

The 1949 regulations were further considered on January 23rd and approved by official action.

The second meeting of the year was held in Seattle, Washington, on June 21st. General business was transacted but specific attention was given to the 1951 budget. The resignation of the previously elected Chairman, Milo Moore, was accepted and Edward W. Allen was elected to serve during the remaining part of Mr. Moore's term of office. Recognizing the possibility that a change in expected fishing intensity in the United States fishery might require modification of the regulations, the Commission agreed to meet in Bellingham, Washington, on July 30th.

In accordance with a previous agreement, the Commission met in Bellingham, Washington, on July 30th to consider any required modification in the 1949 regulations. The decision was made to delay action until August 3rd when additional catch figures would be available and to permit a discussion of the problem with the Advisory Committee. Mr. Alvin Anderson was welcomed as a new member of the Commission for the United States.

The Commission met with the Advisory Committee in Bellingham on August 3rd. To permit equal division in the catch between the two countries, an additional day of closure was placed in effect in United States waters on August 4th. An additional day of fishing was permitted in Canadian waters, effective August 5th.

Canada was represented on the Advisory Committee by R. Nelson, Packers; P. Jenewein, alternate member for the Gill Net Fishermen; H. Allison, alternate member for the Purse Seine Fishermen; M. W. Black, Sport Fishermen; and A. E. Carr, Trollers.

J. N. Plancich, Packers; C. Karlson, Gill Net Fishermen; and N. Mladinich, Purse Seine Fishermen, represented the United States on the Committee.

A meeting was held on August 17th in Everett, Washington, to pay tribute to the memory of the late B. M. Brennan, Director of Investigations. At a separate session, a resolution was passed ending all control over the taking of sockeye in Convention waters for the 1949 season, beginning August 20th. L. A. Royal, Chief Biologist, was temporarily charged with routine administrative responsibilities in addition to his normal duties.

The sixth meeting of the Commission was held in the office of the Director, New Westminster, B. C., on October 26th. The proposed public hearing by the Provincial Comptroller of Water Rights in Victoria, B. C., relative to the water right applications on the Nechako watershed by the Aluminum Company of Canada was discussed. An agreement was reached that any representations of the Commission in fulfilling its Treaty responsibilities would be made through the Fisheries Department of the Dominion of Canada. Preliminary reports of the 1949 catch and spawning escapements were detailed by staff members.

The seventh and final meeting of the year was held in Bellingham, Washington, on December 15th, 16th, 17th. The staff presented the final escapement figures for the year and a review of the 1949 catch statistics. L. A. Royal was appointed Acting Director of Investigations in addition to his duties of Chief Biologist. M. C. Bell, Chief Engineer, was authorized to serve in his absence. Discussions were held with the staff on December 15th regarding proposed regulations for 1950. On December 16th the Commission met with the Advisory Committee to review the 1949 escapement and catch statistics. Tentative 1950 regulations with supporting data were presented for consideration by the Committee.

Canada was represented on the Advisory Committee by R. Nelson, P. Jenewein and H. W. Martinick; alternates, M. W. Black and A. E. Carr.

J. N. Plancich, C. Karlson, N. Mladinich, K. McLeod and J. R. Brown, alternate, were the United States representatives.

General business was conducted on December 17th. P. Jenewein was appointed to represent the Gill Net Fishermen of Canada on the Advisory Committee. H. W. Martinick was appointed to represent the Purse Seine Fishermen of Canada on the same committee. J. R. Brown was named to represent the Trollers of the United States.

1949 REGULATIONS

Recommendations for the management of the fishery in Convention waters for the 1949 season were considered by the Commission at meetings held in Bellingham, Washington, and Vancouver, B. C. Recommendations for regulations were adopted on January 23rd, 1949, in compliance with Articles IV and

V of the Treaty, and were transmitted to the Departments of Fisheries for Canada and the State of Washington. They were accepted for Canadian Treaty waters by an Order-in-Council adopted on June 2nd, 1949, and for United States Treaty waters by order of the Director of the Washington State Department of Fisheries promulgated May 11th, 1949. The recommendations of the Commission were as follows:

Canadian 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 Honourable the Minister of Fisheries that regulations to the following effect, in the interests of such fisheries, be adopted by Order-in-Council as amendments to the Special Fisheries Regulations under authority of the Fisheries Act, namely:

1. That in the waters of Canada embraced in Paragraphs Nos. 2 and 3 of 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, in order to secure a proper escapement of sockeye salmon, no one shall fish for or take any kind of salmon by any gill net having a mesh of less than eight inches (8") extension measure when wet during the period in the spring or chinook salmon fishing season commencing June 30th, 1949, and ending at six o'clock in the forenoon of July 25th, 1949, and further that this limitation shall apply on gill nets in said waters whenever such waters may be closed prior to August 29th at 6:00 a.m. in compliance with the provisions of Regulation 5.

2. That in the waters of Areas 19, 20 and 21 in District 3 as defined in the Special Fishery Regulations for British Columbia and being within the waters embraced in Paragraph No. 2 of Article I of the said Convention, no one shall fish for or take sockeye salmon in 1949 before six o'clock in the afternoon of July 19th.

3. That in the waters of Canada embraced in Paragraphs Nos. 2 and 3 of Article I of the said Convention and not included in said Areas 19, 20 and 21 of District 3, no one shall fish for or take sockeye salmon by any means before six o'clock in the forenoon of July 25th, 1949.

4. That in the waters of Canada embraced in Paragraphs Nos. 2 and 3 of 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.

5. That in the waters of Canada embraced in Paragraphs Nos. 2 and 3 of Article I of the said Convention, a closing date for sockeye fishing may be recommended by the Commission through its Chairman pursuant to the provision of Article VII of the Convention.

6. That in the waters of Canada embraced in Paragraphs Nos. 2 and 3 of Article I of the said Convention there shall be a weekly closed time

of not less than 72 hours' duration, which further shall be subject to modification on the advice of the Commission through its Chairman.

7. 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.

8. Nothing contained herein shall apply to the taking of sockeye salmon in the waters of District 1 and those waters of the southern portion of District 3 as described in Paragraph one (1) hereof, by the International Pacific Salmon Fisheries Commission or its duly authorized representatives for the purpose of exercising its objects under the Fraser River Sockeye Convention.

One modification of the regulations as set forth for Canadian waters was recommended by the Commission in session on August 3rd, 1949. At this meeting the weekly closed period for the week ending August 7th was reduced by 24 hours. In waters included in Areas 19, 20 and 21 of District 3, the closure commenced at 6:00 p.m. on Friday, August 5th, and in District 1 the closure commenced at 8:00 a.m., Saturday, August 6th, both areas then remaining closed for 48 hours. The action was taken pursuant to the provisions of Article VII and was provided for in Recommendation No. 5 as detailed above.

Actual regulations in force in Canada during 1949 vary from these in that the hour of commencement of fishing where referred to in Regulations Nos. 1, 2 and 3 as being 6:00 o'clock in the morning was actually 8:00 o'clock in the morning as amended by an Order-in-Council issued on June 16th, 1949. This modification was pursuant to a general change in Fishery Regulations for British Columbia.

United States Waters

The International Pacific Salmon Fsheries Commission appointed pursuant to The Convention relating to the protection, preservation and extension of the Sockeye Salmon Fisheries between the United States 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 5 of Chapter 3 of the laws of the State of Washington of 1933, namely:

1. That in the waters of the United States embraced in Paragraph No. 2 of Article I of the Convention referred to above, no one shall fish for or take sockeye salmon commercially prior to 6:00 a.m. on the 19th day of July, 1949.

2. That in the waters of the United States embraced in Paragraph No. 2 of Article I of the said Convention, a closing date may be recommended by the Commission pursuant to the provisions of Article VII of the said Convention in order to assure equal division of the catch between the fishermen of the High Contracting Parties.

3. That in the waters of the United States embraced in Paragraph No. 2 of Article I of the said Convention, commencing on the 19th day of July, 1949, and continuing until the 21st day of August, 1949, there shall be a week-end closed period of 48 hours' duration for gill net gear and of 60 hours' duration for all other types of gear, and further that commencing on the 21st day of August, 1949, the week-end closed period for all types of gear shall be of not less than 36 hours' duration. This provision shall be subject to modification on the advice of the Commission through its Chairman.

4. That in the waters of the United States embraced in Paragraph No. 2 of Article I of the said Convention no one shall fish for or take any kind of salmon by any gill net having a mesh of less than eight inches (8″) extension measure when wet during the period in the spring or chinook salmon fishing season prior to July 19th, 1949, nor at any period after that date and prior to August 21st when the United States Convention waters may be closed for fishing for or taking of sockeye in accordance with the provisions of Paragraph two (2) above.

5. That in the waters of the United States embraced in Paragraph No. 2 of Article I of the said Convention it shall be unlawful to sell, purchase or possess sockeye salmon taken in United States Convention waters prior to 6:00 a.m. on the 19th day of July, 1949, or at any time prior to the 21st day of August, 1949, when United States Convention waters may be declared closed to sockeye fishing.

6. Nothing contained in any rules or regulations relating to fishing for or taking sockeye salmon shall apply to the taking of salmon within the waters of the United States embraced in Paragraph No. 2 of Article I of 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.

There was one modification of the above regulations during the fishing season. In accordance with recommended Regulation No. 2, fishing by gill nets for sockeye was prohibited from 6:00 a.m. Thursday, August 4th, 1949, to 6:00 a.m. Friday, August 5th, 1949, and the week-end closure was unchanged, while for reef nets and purse seines fishing for sockeye was prohibited from midnight, Wednesday, August 3rd, 1949, until 4:00 a.m. Friday, August 5th, 1949, and the commencement of this week-end closed period was delayed until midnight, Friday, August 5th, 1949 — the closed period thus becoming 52 hours' instead of 60 hours' duration.

THE UNITED STATES FISHERY

Price negotiations forestalled any intensive fishing operations in United States Treaty waters for several days after the legal opening of the sockeye season on July 19th. On July 25th these negotiations were completed and fishing operations by all types of gear began in all waters except the Swiftsure Banks area. The daily catch by United States gear was very good and total production through July 31st was considerably above that by Canadian fishermen. Because of increased fishing intensity and the unbalanced catch between the two countries, division appeared to be in jeopardy. Catches in early August continued

to be high and by August 2nd the total United States catch exceeded the total Canadian catch by over 100,000 sockeye. The trend at that time because of increased units of gear indicated that the Canadian catch at the end of the season would not equal that of the United States, consequently the Commission met with the Advisory Board on August 3rd to discuss modification of the existing regulations. The modification decided upon consisted of adding one day's restriction on United States fishermen effective August 4th and reducing the following week-end closed season in Canada by one day effective August 5th.

The adjustment desired by this modification in the regulation was the immediate elimination of the difference in the catches of the two countries. To accomplish this the adjustment had to be made when large numbers of sockeye were present. It was designed to have a minimum effect on the operations of the fishermen and packers. It was timed to eliminate any necessity of special closures during the pink salmon run. The late season catches by Canadian fishermen were anticipated to be of sufficient size to balance any inequalities which might develop after the short period of adjustment. Likewise it was thought that the daily landings by United States fishermen would continue to equal or exceed those by Canadian fishermen during the remaining period of the major run. A quick adjustment when large numbers of sockeye were present prevented a seriously unbalanced catch-escapement ratio for any individual race.

Temporary parity in the catch of the two countries was accomplished immediately upon termination of the adjustment period.

Fishing in United States waters during the middle and latter part of August was more effective than for the same period in recent cyclic years. This increased catch was caused by a substantial increase in the Stellako population combined with a sizeable run to the Birkenhead River. Both runs tend to peak during the middle part of August. By the end of August there was a difference in the total catch in favor of the United States fleet but later fishing operations reduced the difference to 1.8 per cent., a reduction anticipated at the time the catch adjustment was made.

Total landings for 1949 in the United States and Canada are recorded in Table I as compared with the landings for 1945 and 1941. Cyclic comparison of the daily catch in United States waters for 1949 is detailed in Table III.

TABLE I

LANDINGS AND PACK, 1945 AND 1949*

1945		*United States*	*Canada*	*Total*
Total Landings	(No. sockeye)	716,685	969,444	1,686,129
Total Pack	(48 lb. cases)	53,054½	79,781½	132,836
1949				
Total Landings	(No. sockeye)	1,058,117	1,020,799	2,078,916
Total Pack	(48 lb. cases)	80,547	80,629	161,176

* Nineteen canneries in the United States and eleven canneries in Canada received the sockeye caught in Convention waters.

Table I also shows the 1949 sockeye pack for each country as compared with previous cyclic years. It may be noted that the Canadian pack in 1949 is slightly larger than the United States pack although the Canadian catch of sockeye was the lesser of the two. One reason for this may be the possible selectivity of gill nets for larger fish. Since 84 per cent. of the 1949 catch in Canada was by gill nets, a selectivity of this gear for larger fish would tend to permit a larger pack than one resulting from the same number of fish taken by other gear.

A differential number of sockeye may be sold in the fresh fish markets of the two countries and packing methods vary somewhat. All of these possible reasons may contribute to the difference in pack as related to the number of sockeye taken.

THE CANADIAN FISHERY

Commercial gear operating at Sooke and in the Fraser River began to catch sockeye in fair numbers during the latter part of June. A total of 16,000 sockeye were taken prior to July 1st when a protective closure on early runs became effective. Although no sockeye were landed after July 1st until the opening of the official season on July 19th at Sooke and on July 25th in District No. 1, large numbers of sockeye were observed passing through the fishing area, especially during the first week of July. Such large numbers of sockeye had not been observed by fishermen at that time of year since 1913. Later observations at other points in the Fraser watershed indicated that these fish were principally of Stuart River origin, usually referred to as the "Early Stuart run".

When the season opened July 19th the Sooke operations reported good catches, but with the opening of District No. 1 on July 25th, gill net catches were below expectations. Production up to July 31st was considerably below that of the United States. By early August, catches in all fishing areas were picking up and after the week-end closed season following the day of extra fishing permitted on August 5th, Canadian catches approximated the average daily landings in United States waters. Table IV shows the daily landings and provides a comparison between those for 1949 and for previous cycles.

FISHING INTENSITY

Fishing effort was greater in both countries during 1949 than in recent cyclic years. Table II shows comparative figures for United States gear and indicates on the basis of licences issued that there was a decided increase over 1945 in all types of gear and a considerable increase over 1941.

TABLE II

LICENSED GEAR TAKING SOCKEYE IN UNITED STATES CONVENTION WATER

	Purse Seines	*Gill Nets*	*Reef Nets*
1945	101	78	51
1949	288	300	124

With a rapidly increasing number of fishermen each year the need for flexible regulation and periodic adjustment in fishing time increases in importance. Inflexible control endangers seasonal division between the two countries and tends to upset the proper balance between the catch and escapement of individual races.

In Canadian waters the trap net effort remains constant and the actual gill net effort usually varies only a small amount each cyclic year. The number of individual gill net boats operating during the season is difficult to calculate because of a constantly shifting fleet. Individual boat record cards indicate that in 1949 approximately 2000 gill net boats caught Fraser River sockeye as compared with 1700 in 1945.

Purse seine effort increased in Canadian Convention waters. Purse seining for sockeye in Areas 20, 21 and 22 did not commence until 1946. In 1949 these operations were intensified and more effective fishing methods developed. Approximately 100 purse seine boats fished the areas but in such a manner that not more than 60 were operating on any one day. This fishery was confined to the month of August and produced 9.7 per cent. of the total Canadian catch. In a special opening for purse seining in Area 17 during September a small number of sockeye were caught, comprising 1.2 per cent. of the total landings of this species.

TABLE III

DAILY LANDINGS OF SOCKEYE, 1941-1945-1949 FROM UNITED STATES TREATY WATERS SHOWING NUMBER OF SOCKEYE TAKEN DAILY AND CUMULATIVE PER CENT. OF SEASON TOTAL AS OF EACH DATE

	JULY						AUGUST					
	1941		1945		1949		1941		1945		1949	
Date	*Daily Sockeye*	*Cum. % Total*	*Daily Sockeye*	*Cum. % Total*	*Daily Sockeye*	*Cum. % Total*	*Daily Sockeye*	*Cum. % Total*	*Daily Sockeye*	*Cum. % Total*	*Daily Sockeye*	*Cum. % Total*
1	1,087	.07	2				111,086	60.48	45,394	73.22	111,921	38.22
2	723	.12	57	.01	185	.02			28,114	77.15	66,401	44.50
3	247	.14	287	.05			94,303	66.53	12,583	78.90	66,061	50.74
4	87	.14	213	.08			133,392	75.08	805	79.02	5	50.74
5	36	.15	946	.21			109,495	82.09	20,721	81.91	43,878	54.89
6	525	.18	793	.32			55,735	85.66	13,772	83.83	989	54.98
7	1,260	.26	49	.33	202	.04	27,338	87.42	10,841	85.34	1	54.98
8	1,999	.39	2,405	.66			21,700	88.81	11,969	87.01	69,837	61.58
9	1,757	.50	4,449	1.28	86	.04			7,446	88.05	52,301	66.53
10	1,402	.59	3,926	1.83	52	.05	21,295	90.17	6,277	88.93	31,271	69.48
11	1,759	.70	2,259	2.15			15,266	91.15	83	88.94	26,898	72.02
12	311	.72	1,359	2.34			12,995	91.98	5,437	89.70	29,957	74.85
13	4,820	1.03	641	2.43			12,727	92.80	4,769	90.36	276	74.88
14	8,513	1.58	495	2.49	30	.05	6,936	93.24	2,612	90.73	115	74.89
15	8,284	2.11	3,300	2.96			11,878	94.00	3,580	91.23	31,729	77.89
16	8,881	2.68	4,561	3.59					3,867	91.77	21,579	79.93
17	9,807	3.31	7,899	4.69			11,685	94.75	3,446	92.25	22,548	82.06
18	9,573	3.92	13,521	6.58	12	.05	10,266	95.41	18	92.25	22,228	84.16
19	375	3.94	10,599	8.06	26	.06	9,557	96.02	9,693	93.60	18,904	85.95
20	14,545	4.87	2,487	8.41	19	.06	10,305	96.68	9,354	94.91	1,456	86.09
21	25,053	6.48	52	8.41	18	.06	5,849	97.06	8,081	96.03	20,418	88.02
22	35,856	8.78	40,668	14.09	198	.08	5,295	97.40	6,997	97.01	15,308	89.46
23	47,973	11.85	58,445	22.24					3,417	97.49	17,389	91.11
24	60,168	15.71	29,628	26.38	8	.08	6,861	97.84	2,263	97.80	13,094	92.34
25	35,052	17.96	62,805	35.14	3,916	.45	5,302	98.18	89	97.81	10,518	93.34
26	767	18.00	32,460	39.67	43,196	4.53	4,889	98.49	2,006	98.09	13,536	94.62
27	84,809	23.44	29,380	43.77	116,793	15.57	3,663	98.73	1,826	98.35	572	94.67
28	87,698	29.06	3,522	44.26	82,161	23.33	3,329	98.94	1,760	98.60	9,268	95.55
29	87,028	34.64	28,938	48.30	45,167	27.60	3,511	99.16	1,153	98.76	7,045	96.21
30	141,289	43.69	64,273	57.27	463	27.65			766	98.86	6,170	96.80
31	151,002	53.37	68,978	66.89			971	99.22	2,179	99.17	8,755	97.62
Total	832,686		479,397		292,532		715,629		231,318		740,428	
May and June	84		461	.06								
September							11,566	.75	5,509	.77	25,157	100.00
October							517	.03				
Season Total							1,560,482	100.00	716,685	100.00	1,058,117	100.00

TABLE IV

DAILY LANDINGS OF SOCKEYE, 1941-1945-1949 FROM CANADIAN TREATY WATERS SHOWING NUMBER OF SOCKEYE TAKEN DAILY AND CUMULATIVE PER CENT. OF SEASON TOTAL AS OF EACH DATE

	JULY						AUGUST					
	1941		1945		1949		1941		1945		1949	
Date	*Daily Sockeye*	*Cum. % Total*	*Daily Sockeye*	*Cum. % Total*	*Daily Sockeye*	*Cum. % Total*	*Daily Sockeye*	*Cum. % Total*	*Daily Sockeye*	*Cum. % Total*	*Daily Sockeye*	*Cum. % Total*
1	192	.10	4	.11			109,312	41.66	68,497	57.85	63,270	25.85
2	1,030	.15	1,023	.21			135,307	48.05	59,389	63.97	114,632	37.08
3	1,319	.21	6,433	.88					50,579	69.19	73,466	44.28
4	1,384	.28	3,362	1.22			74,434	51.57	34,507	72.75	72,379	51.37
5	2,854	.41	8,882	2.14			136,935	58.04			59,175	57.17
6			11,962	3.37			140,533	64.68	20,155	74.83	39,614	61.05
7	1,784	.50	7,735	4.17			119,828	70.34	39,375	78.89	2,724	61.32
8	4,780	.72					90,875	74.63	13,784	80.31	37,892	65.03
9	5,529	.98	7,336	4.93			84,705	78.63	19,773	82.35	46,358	69.57
10	7,257	1.33	9,686	5.93					10,865	83.47	34,184	72.92
11	8,141	1.71	7,855	6.74			47,214	80.86	8,743	84.37	26,649	75.53
12	8,915	2.13	9,036	7.67			57,490	83.58			33,088	78.77
13			7,449	8.44			39,868	85.46	6,838	85.08		
14	3,158	2.28	7,809	9.24			36,728	87.20	8,987	86.01	1,117	78.88
15	15,447	3.01					22,083	88.24	4,158	86.43	13,812	80.23
16	12,214	3.59	5,757	9.84			29,907	89.65	7,016	87.16	25,729	82.75
17	15,974	4.34	16,554	11.54					3,857	87.56	12,415	83.97
18	7,718	4.71	11,877	12.77			13,987	90.31			18,757	85.81
19	9,873	5.17	19,733	14.81			26,474	91.57			13,253	87.10
20			15,893	16.44			10,124	92.04	5,000	88.07		
21	16,601	5.96	10,602	17.54	4,145	1.99	13,202	92.67	11,945	89.30	5,908	87.68
22	33,604	7.55					16,657	93.45	7,906	90.12	9,177	88.58
23	18,197	8.40	17,291	19.32			15,239	94.17	7,134	90.38	16,158	90.17
24	25,787	9.62	28,811	22.29					5,088	91.38	2,870	90.45
25	35,526	11.30	31,668	25.56	11,316	3.10	7,379	94.52			6,591	91.09
26	36,815	13.04	42,472	29.94	28,782	5.92	11,852	95.08			8,336	91.91
27			45,728	34.66	29,194	8.78	6,207	95.38	2,963	91.69	3,841	92.29
28	73,864	16.53	31,352	37.89	56,131	14.28	4,527	95.59	9,074	92.62	1,098	92.39
29	156,285	23.91			54,743	19.64	2,391	95.70	2,619	92.89	4,958	92.88
30	122,522	29.70	41,206	42.14	170	19.66	3,068	95.85	4,026	93.31	9,959	93.85
31	143,786	36.49	83,731	50.78			580	95.88	2,391	93.55	4,182	94.26
Total	770,556		491,247		184,481		1,256,906		414,669		761,592	
May and June	1,954	.09	1,038	.11	16,169	1.58						
September							79,925	3.77	56,455	5.83	56,907	99.84
October							7,382	.35	6,035	.62	1,650	.16
Season Total							2,116,723	100.00	969,444	100.00	1,020,799	100.00

INDIAN CATCH

The number of sockeye taken by Indians in the various districts of the Fraser River watershed was again recorded in 1949. These are shown in Table V with similar figures for 1945, the previous cycle year.

Since the tagging of sockeye at Hell's Gate was discontinued this year, tag ratios could not be used to compute the Indian catch. The figures for 1949 were obtained by counts of fish on the drying racks, and by verbal reports from the Indians.

The total catch for 1949 was 58 per cent. greater than in 1945. This larger catch resulted primarily from the increased run to the Stuart Lake district. The Indians in this area reported more fish were available to them than for any year since 1913.

TABLE V

THE INDIAN CATCHES OF SOCKEYE SALMON BY DISTRICTS AND THE AREAS WITHIN THESE DISTRICTS, 1945-1949

	1945		1949	
District and Areas	*Catch*	*No. of Fisher-men*	*Catch*	*No. of Fisher-men*
HARRISON-BIRKENHEAD				
Skookumchuck	102	4	500	—
Lillooet Lake	135	1	3,000	—
Birkenhead River	4,005	34	388	4
TOTALS	4,242	39	3,888	—
LOWER FRASER				
Seabird Island	502	7	1,368	8
Katz and Ruby Creek	500	—	560	6
TOTALS	1,002	—	1,928	14
CANYON				
Union and American Bars	728	4	549	3
Yale	2,352	10	3,687	12
Spuzzum	381	6	123	4
Lower Gorge	140	1	674	3
Upper Gorge	672	4	478	4
Boston Bar	98	3	19	1
Boothroyd	1,049	11	1,975	12
Cisco	3,676	21	3,540	25
TOTALS	9,096	60	11,045	64
LYTTON-LILLOOET	3,346	30	3,131	24
BRIDGE RIVER RAPIDS				
Lillooet	1,408	11	3,963	26
Rapids	7,581	31	8,101	34
Pavilion	1,057	18	241	8
TOTALS	10,046	60	12,305	68
CHILCOTIN				
Farwell Canyon	1,348	17	216	
Hance's Canyon	630	2	303	
Martins	166	6	93	
Anahim	195	3	0	
Alexis Creek	1,704	9	297	
Siwash Bridge	2,031	20	1,244	
Keighley Holes	1,398	12	211	
Henry's Crossing	172	3	0	
TOTALS	7,644	72	2,364	*
UPPER FRASER				
Alkali Creek to Shelley	990	—	5,021	
TOTALS	990	—	5,021	*
NECHAKO				
Nautley Reserve	1,424	7	5,500	10
Stella Reserve	225	4	2,200	8
TOTALS	1,649	11	7,700	18
STUART LAKE				
Fort St. James	1,811	16	9,000	16
Tachie Reserve	1,060	9	10,200	14
Trembleur and Takla Lakes	1,892	8	2,000	8
TOTALS	4,763	33	21,200	38
THOMPSON				
North Thompson River	56	4	294	2
South Thompson River	1,125	13	550	25
TOTALS	1,181	17	844	27
GRAND TOTAL	43,959		69,426	

* 154 fishing permits issued to Indians in these districts.

TABLE VI

SUMMARY OF THE SOCKEYE ESCAPEMENT TO THE FRASER RIVER SPAWNING AREAS, 1941, 1945, 1949

District and Streams	Periods of Spawning Arrival	Periods of Spawning End	Estimated No. of Sockeye Present 1941	Estimated No. of Sockeye Present 1945	Estimated No. of Sockeye Present 1949	1949 Sex Ratio (%) Males 3 yr.	Males 4-5 yr.	Females 3 yr.	Females 4-5 yr.
LOWER FRASER									
Cultus Lake	Oct. 1	Dec. 11	18,164	9,231	9,301	2.6	32.7	.03	64.7
Upper Pitt (incl. tributaries)			*	*	9,500		63.6		36.4
Widgeon Slough			——	1,200	650				
HARRISON									
Big Silver Creek	Sept. 2	Sept. 30	2,000	2,000	2,100		71.0		29.0
Douglas Creek	Sept. 2	Sept. 30	1,100	72	250		20.0		80.0
East Creek			0	27	50				
Harrison River	Nov. 1	Nov. 25	53,000	16,060	3,500				
Hatchery Creek	Oct. 6	Nov. 7	150	100	10				
Weaver Creek	Oct. 11	Nov. 17	9,200	12,944	12,520	.2	36.4		63.4
LILLOOET									
Birkenhead River	Sept. 5	Oct. 31	46,500	80,553	74,100	4.8	34.9		60.2
Upper Lillooet Streams	Oct. 14	Oct. 27	12,800	16,111	200				
SOUTH THOMPSON									
Seymour River	Aug. 11	Sept. 16	0	150	10,772		57.6		42.4
Scotch Creek	Aug. 10	Sept. 12	0	75	1,000		39.7		60.3
Adams Lake and tributaries			0	1,725	0				
Adams River	Sept. 24	Nov. 14	50	58,000	11,700	78.8	6.3	1.0	13.9
Little River, Little Shuswap Lake	Oct. 6	Nov. 14	0	6,000	9,600	92.5	3.2	.1	4.2
Shuswap Lake and tributaries			0	1,750	15				
South Thompson River	Oct.		——	——	5	100.0			
NORTH THOMPSON									
Raft River	Aug. 15	Sept. 20	250	3,300	5,900		41.4		58.6
CHILCOTIN									
Chilko River	Aug. 11	Oct. 24	280,000	186,337	59,000	.1	40.3		59.6
Chilko Lake			——	6,547	Present				
Taseko River	Aug. 15	Sept. 3	——	——	100		62.0		38.0
QUESNEL									
Horsefly River	Aug. 8	Oct. 1	1,050	3,000	11,900		33.9		66.1
Little Horsefly River			15	0	0				
Mitchell River			40	——	350		40.3		59.7
NECHAKO									
Endako River	Aug. 15	Sept. 15	45	80	1,100				
Francois Lake			——	——	——				
Nadina River	Aug. 5	Sept. 15	200	300	21,600		45.9		54.1
Nithi River	Aug. 20	Sept. 15	150	500	1,400				
Ormonde Creek	Aug. 15	Sept. 15	90	400	2,500				
Stellako River	Sept. 1	Oct. 25	5,230	20,826	104,800	.1	42.8		57.1
Uncha Creek			0	0	0				
STUART LAKE									
Ankwil Creek	Aug. 1	Aug. 31	25	0	750				
Bivouac Creek	Aug. 1	Aug. 31	0	0	12,900		54.1		45.9
Casimir Creek			——	0	300				
Driftwood River	Aug. 3	Sept. 6	25	——	450				
Dust Creek	Aug. 1	Aug. 31	150	4	7,800		39.2		60.8
Fifteen-Mile Creek	Aug. 1	Aug. 31	5	0	200				
Five-Mile Creek	Aug. 1	Aug. 31	5	0	600				
Flemming Creek			10	2	12				
Forfar Creek	July 20	Sept. 9	1,776	7,081	80,500				
Forsythe Creek	Aug. 1	Aug. 31	——	0	1,200				
Frypan Creek	Aug. 1	Aug. 31	——	0	750				
Gluske Creek	July 20	Sept. 9	500	2,783	106,000		51.7		48.3
Kazchek Creek	Sept. 1	Sept. 30	25	952	1,500				
Kynoch Creek	July 20	Sept. 9	2,474	9,304	185,400		47.1		52.9
Leo Creek	Aug. 1	Aug. 31	——	0	1,700		56.1		43.9
Middle River	Aug. 22	Sept. 30	4,500	22,804	126,400		44.9		55.1
Narrow Creek	Aug. 1	Aug. 31	150	109	20,700		56.0		44.0
Point Creek	Aug. 1	Aug. 31	——	0	100				
Rossette Creek	July 20	Sept. 9	1,066	6,808	152,900		49.5		50.5
Cruise Creek			——	0	150				
Sinta Creek	Aug. 1	Aug. 31	——	0	700				
Shale Creek	Aug. 1	Aug. 31	30	250	3,000				
Tachie River	Sept. 1	Oct. 6	900	751	5,000				
Twenty-Five Mile Creek	Aug. 1	Aug. 31	——	0	3,300				
NORTHEAST									
Upper Bowron River	July 24	Sept. 24	1,199	4,094	22,283		45.5		54.5

* Predominantly 5-year-old fish. No records of previous cycle years.

ESCAPEMENT

The sockeye runs of 1949 were watched with particular interest because they included the first returning progeny of fish using Hell's Gate fishways. It was already known that the block to ascending adults had been removed by the completion of the fishways in 1945 but the effect of its removal upon the survival of the up-river races could not be ascertained until a return from unblocked fish occurred. The Commission's expectations were realized when the 1945 escapement to all spawning districts above Hell's Gate except the one to Chilko produced at a very high rate (Table VI).

The Stuart Lake escapement including both the early and late run was the largest recorded since 1913. Many tributaries of Takla Lake received a good seeding where few if any fish had been observed since the start of the Commission's investigations in 1938. Preliminary data on the environmental characteristics of these adopted streams indicate that they may be suitable for this race of sockeye. If winter conditions are satisfactory during the period of incubation, these streams may become permanent producers of sockeye. Since the number of spawners actually taxed the physical capacity of the parent stream in this area, fishing operations may be permitted on the returning run in 1953.

The early escapement to the Stellako system numbering 26,562 sockeye was likewise encouraging. Most of these fish spawned in the Nadina River and were observed jumping the Nadina Falls near its headwaters. The early run to the Bowron and South Thompson River showed a substantial increase. The number of spawning sockeye in the Quesnel district increased 400 per cent. This second continuous increase to the Quesnel district in spite of an intense fishery indicates that this area is once again capable of producing a large run of sockeye.

The number of adult spawners at the outlet of Chilko Lake declined considerably for the second time on this cycle. The Chilko race of sockeye has developed until it and the Adams River race have become the backbone of the sockeye salmon industry. Like practically all the sockeye producing areas of the Upper Fraser River in the early days, both the Adams and Chilko systems, as they approach large production, tend to develop one year of high productivity out of four. This dominant year of productivity appears to be fully developed in the Shuswap area and the large run to the Chilko last year (1948) with a lesser run this year is apparently following this historic pattern. There is no indication of any reduction in the total productivity of the Chilko area, but it does appear probable that the 1948 cycle is emerging as the dominant one and that in this exceedingly valuable portion of the Fraser region, production appears to be approaching a stage of stability.

An understanding of the annual variation in the productivity of sockeye in each four-year period, which was very evident in 1913 and prior thereto in

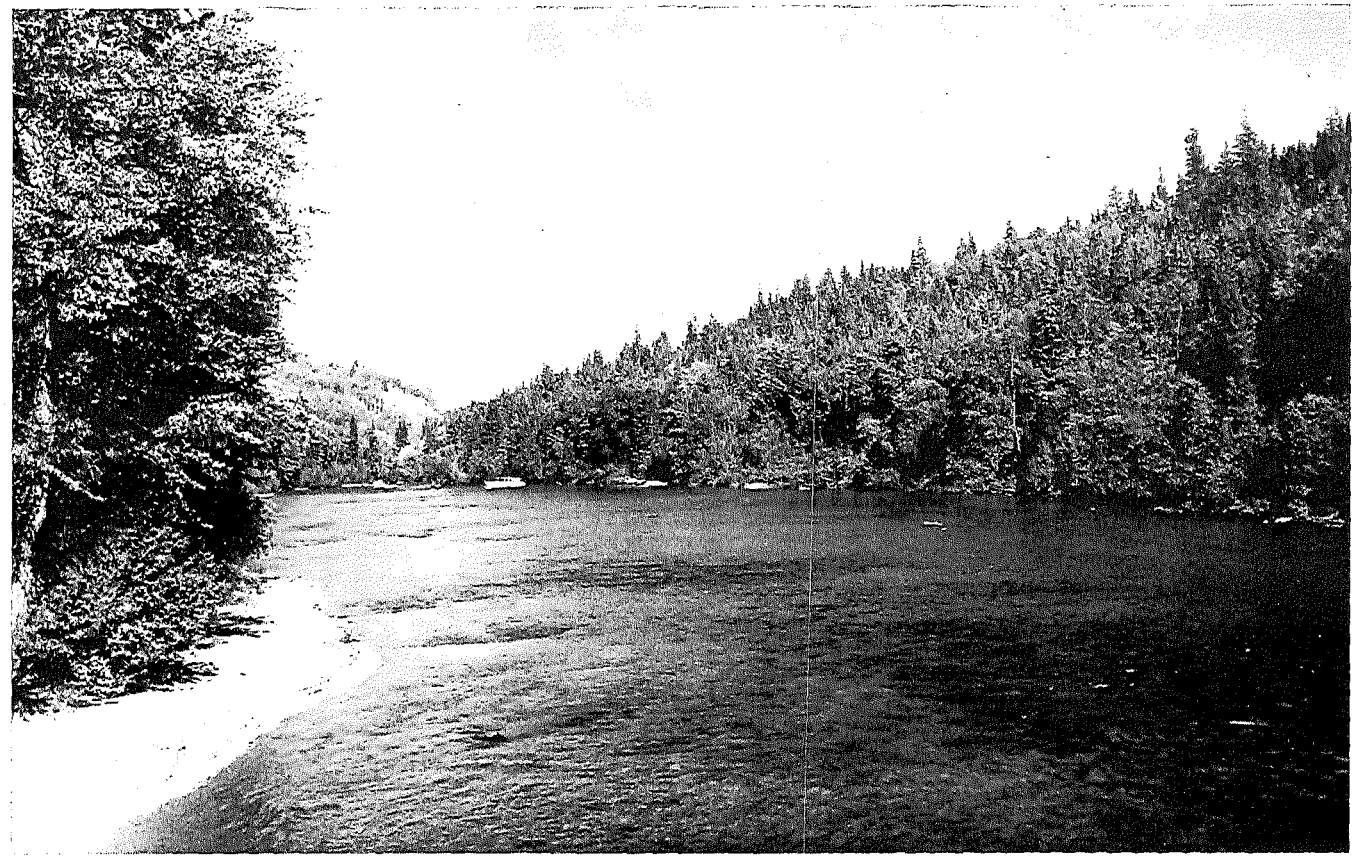


FIG. 1.—Part of the sockeye spawning grounds of the Stellako River just below the outlet of Francois Lake. The production of sockeye in this area is increasing rapidly on both the 1949 and 1950 cyclic years.

practically all of the up-river districts, depends upon research now being conducted by the Commission's staff.

While the normal adult escapement above Hell's Gate showed considerable increase in all areas except Chilko, the total escapement to the Lower River areas declined. This decline may be attributable to increased fishing intensity and to a differential rate of productivity between the two major districts. The decline in the early and late escapement to the Harrison system may indicate a danger point in the 1949 catch-escapement ratio. With a rapidly increasing fishing intensity, knowledge of racial fishing mortality becomes extremely important in the prevention of overfishing especially in the case of those races approaching their natural limits of total productivity.

THE 1950 CYCLE

The daily sockeye landings in Treaty waters for 1938, 1942 and 1946, are listed in Tables VII and VIII. These landings are presented for the convenience of the industry in following the comparative trends of the 1950 run as it arrives on the fishing grounds. The cyclic escapement figures are shown in Table IX to indicate the races expected to produce the major share of the catch.

From the data presented it appears that the Adams River district will be the major producer of sockeye in 1950 followed in importance by the Stellako and Birkenhead systems. All of these races migrate through Convention waters principally in August. The latter two races are available to the fishery before the Adams run which is most abundant between August 20th and September 1st in those waters lying away from the immediate discharge area of the Fraser River.

There has been a tendency for peak production from the Adams River run to be later in each of the successive cyclic years shown in the tables. This tendency is being watched with care by the Commission staff to determine its effect if any on the productivity of the race and the relationship if any between the timing of the escapement and the timing of the returning adult migration.

FIG. 2.—A school of sockeye waiting to spawn in Forfar Creek, Stuart Lake district. The number of sockeye spawning in this stream increased from 7,081 fish in 1945 to 80,500 fish in 1949.

TABLE VII

DAILY LANDINGS OF SOCKEYE, 1938-1942-1946 FROM UNITED STATES TREATY WATERS SHOWING NUMBER OF SOCKEYE TAKEN DAILY AND CUMULATIVE PER CENT. OF SEASON TOTAL AS OF EACH DATE

	AUGUST						SEPTEMBER					
	1938		1942		1946		1938		1942		1946	
Date	*Daily Sockeye*	*Cum. % Total*	*Daily Sockeye*	*Cum. % Total*	*Daily Sockeye*	*Cum. % Total*	*Daily Sockeye*	*Cum. % Total*	*Daily Sockeye*	*Cum. % Total*	*Daily Sockeye*	*Cum. % Total*
1	7,768	3.45	7,264	4.72	10,851	.47	11,265	91.71	180,185	91.66	53,804	75.77
2	5,124	3.82	11,097	5.09	8,879	.72	2,979	91.92	118,421	95.70	131,749	79.48
3	7,280	4.33	7,799	5.36	51	.72	625	91.97	10,618	96.06	92,579	82.09
4	14,576	5.37	12,749	5.79	12,163	1.06	2,605	92.15	906	96.09	71,241	84.09
5	21,501	6.89	14,735	6.30	7,745	1.28	5,255	92.52			62,452	85.85
6	62	6.90	21,761	7.04	15,543	1.72	1,872	92.66	378	96.10	79,725	88.09
7	35,646	9.43	24,290	7.86	34,751	2.70	7,139	93.16	7,262	96.35		
8	53,240	13.21			47,971	4.05	25,741	94.99	589	96.37	41,085	89.25
9	45,460	16.44	20,550	8.56	38,902	5.14	10,810	95.76	794	96.40	94,111	91.90
10	51,497	20.09	23,806	9.38			15	95.76	4,455	96.55	103,522	94.82
11	81,327	25.86	32,832	10.49	23,838	5.81	38,222	98.47	4,070	96.69	92,895	97.43
12	60,588	30.17	36,892	11.75	23,799	6.49	15,678	99.59			13,347	97.81
13			46,307	13.33	29,522	7.32	5,198	99.95	33	96.69	7,562	98.02
14	21,206	31.67	40,801	14.69	35,193	8.31	42	99.96	13	96.69		
15	14,812	32.72	8	14.69	34,903	9.29	12	99.96	13	96.69	8,342	98.25
16	12,009	33.57	17,408	15.29	43,047	10.50	6	99.96	20	96.69	8,598	98.50
17	5,642	33.97	24,080	16.11					144	96.70	21,893	99.11
18	8,803	34.60	52,395	17.89	27,381	11.27			124	96.70	9,173	99.37
19	15,646	35.71	74,633	20.43	43,713	12.50					11,005	99.68
20			88,366	23.44	63,070	14.28	10	99.96	77	96.70	705	99.70
21	68,834	40.60	162,510	28.98	64,503	16.10			250	96.71		
22	102,593	47.88	446	29.00	55,089	17.65	43	99.96	106	96.72	4,882	99.84
23	105,470	55.37	263,166	37.96	54,416	19.18	126	99.97	130	96.72	2,185	99.90
24	107,153	62.97	251,749	46.54					3,002	96.82	1,696	99.95
25	169,352	74.99	192,015	53.08	89,452	21.70	19	99.97	773	96.85	1,846	99.99
26	97,830	81.94	159,915	58.53	134,956	25.50	5	99.97				
27			302,628	68.83	290,642	33.68	4	99.97	1,350	96.89		
28	54,421	85.80	150,202	73.95	542,836	48.96	8	99.97	15,418	97.42		
29	37,242	88.45	1,089	73.99	366,879	59.29	4	99.97	16,468	97.98		
30	20,979	89.94	58,271	75.97	531,426	74.25	27	99.98	26,608	98.89		
31	13,738	90.91	280,408	85.53								
Month Total	1,239,799	90.91	2,380,172	85.53	2,631,521	74.25	127,710	99.98	392,207	98.89	914,397	99.99
To August 1	40,875	2.90	131,164	4.47	5,839	.16						
Total October 1-30							340	100.00	32,680	100.00	4	100.00
Season Total							1,408,724	100.00	2,936,223	100.00	3,551,761	100.00

TABLE VIII

DAILY LANDINGS OF SOCKEYE, 1938-1942-1946 FROM CANADIAN TREATY WATERS SHOWING NUMBER OF SOCKEYE TAKEN DAILY AND CUMULATIVE PER CENT. OF SEASON TOTAL AS OF EACH DATE

	AUGUST						SEPTEMBER					
	1938		1942		1946		1938		1942		1946	
Date	*Daily Sockeye*	*Cum. % Total*	*Daily Sockeye*	*Cum. % Total*	*Daily Sockeye*	*Cum. % Total*	*Daily Sockeye*	*Cum. % Total*	*Daily Sockeye*	*Cum. % Total*	*Daily Sockeye*	*Cum. % Total*
1	5,121	6.98	13,576	3.39	807	.06	57,523	55.35	70,126	20.24		
2	8,959	7.45			212	.06	59,640	58.49	105,974	22.34	27,736	23.66
3	8,555	7.90	5,231	3.49	278	.07	42,639	60.73	168,433	25.68	132,495	26.79
4	9,929	8.42	15,863	3.81				60.73	201,686	29.68	195,535	31.40
5	11,726	9.04	7,478	3.96	1,979	.11	9,606	61.24	162,469	32.90	144,446	34.81
6	12,279	9.69	8,812	4.13	333	.12	58,608	64.32			72,977	36.53
7		9.69	3,173	4.19	132	.12	87,697	68.94	24,692	33.38	70,348	38.19
8	9,035	10.16	10,235	4.40	5,823	.26	143,095	76.47	107,007	35.50		
9	16,779	10.47			7,759	.45	88,845	81.14	263,636	40.73	33,030	38.97
10	11,332	11.64	11,632	4.63	5,277	.57	108,551	86.86	430,156	49.25	89,516	41.08
11	9,239	12.13	27,324	5.17				86.86	283,396	54.86	586,175	54.91
12	6,571	12.48	15,721	5.48	26,515	1.20	86	86.86	304,744	60.90	94,753	57.14
13	14,752	13,25	20,064	5.88	36,177	2.05	810	86.90			313,429	64.53
14		13.25	10,834	6.09	27,586	2.70	814	86.95	366,669	68.17	80,770	66.44
15	6,344	13.59	13,336	6.36	23,584	3.26	1,017	87.00	458,173	77.24		
16	21,796	14.73			16,146	3.64	1,842	87.10	285,102	82.89	163,566	70.30
17	48,833	17.30	29,803	6.95	18,174	4.06	162	87.11	155,886	85.98	210,664	75.27
18	55,012	20.20	34,928	7.64					48,240	86.94	207,573	80.16
19	40,769	22.34	18,090	8.00	24,430	4.64			19,173	87.31	139,073	83.44
20	49,382	24.94	47,292	8.93	34,148	5.45					139,638	86.74
21		24.94	22,101	9.37	18,118	5.87						
22	12,530	25.60	33,916	10.04	27,241	6.52	8	87.11	373	87.32		
23	47,785	28.12			22,697	7.05			203	87.33	154,779	90.39
24	57,973	31.17	45,423	10.94	30,670	7.78	62	87.11	1,631	87.36	218,304	95.54
25	83,459	35.56	63,395	12.20		7.78					178,218	99.74
26	51,197	38.25	113,004	14.44	132,590	10.90			1,287	87.38	646	99.76
27	88,820	42.93	64,912	15.72	339,263	18.90	7	87.11			3,588	99.84
28		42.93	58,421	16.88	91,937	21.07			3,775	87.46	2,921	99.91
29	20,187	43.99	74,221	18.35	26,199	21.69						
30	93,848	48.93			28,957	22.37					135	99.91
31	64,514	52.32	25,415	18.86	26,964	23.01						
Month Total	866,726	52.32	794,200	18.86	973,996	23.01	661,012	87.11	3,462,831	87.46	3,260,315	99.91
To July 1	127,538	6.71	157,549	3.12	1,576	.04						
October 1 - November 30							244,944	100.00	633,019	100.00	3,735	100.00
Season Total							1,900,220	100.00	5,047,599	100.00	4,239,622	100.00

REHABILITATION OF BARREN AREAS

Where a race has been exterminated in a once-productive area, rehabilitation cannot be accomplished by regulation. A new race must be artificially established if that area is to become productive again. To meet this latter need for rehabilitation, the experimental Field Station has been established on the Quesnel watershed. It is not a substitute for natural propagation. The populations, if successfully transferred, are expected to maintain and increase themselves by natural propagation and not by artificial aids. The Commission believes it is a mandatory requirement that they attempt by the most careful scientific procedures to at least start runs in those once great producing areas where no vestige of a run now remains.

The Quesnel Field Station was placed in operation by the Commission despite the fact that it was not entirely completed. However, the unfinished units will all be available as needed. It was important that the operation begin this year since the 1949 sockeye cycle has a wide range of races, each in sufficient numbers to allow small egg transfers which is not yet possible on the other three cycles. The first experiment consisted of artificially fertilizing 302,000 native Horsefly River sockeye eggs which will be hatched, reared, marked by fin excision, and released back into the Quesnel system. The purpose of this experiment is to determine if native fish will return to their native spawning area when artificially propagated. If the experiment is successful it will serve as a control over transplantations from one stream to another. No direct attempt will be made to build up the present Quesnel run by artificial propagation since it is believed that it will rehabilitate itself fairly rapidly by natural methods. The spawning escapement this year was 12,250 fish from a previous spawning of 3,000 fish in 1945.

The second experiment consisted of transferring 158,000 sockeye eggs to the station from the Seymour River, a stream flowing into the Upper Shuswap Lake. The run to the Seymour River was not entirely destroyed by the effects of Hell's Gate and the few fish remaining are now increasing at a substantial rate. Over 10,000 sockeye spawned in this stream during the 1949 season and apparently the racial characteristics of the fish fulfill the requirements for transplantation to Upper Adams River, where only an occasional sockeye is found. At one time the Upper Adams River had a large early run but a combination of the Hell's Gate block and the Adams River Splash Dam destroyed the entire population. Both the Seymour and Adams Rivers drain the same general area, are semi-glacial in character and the spawning grounds are approximately the same distance from salt water. The Seymour race spawns at the same time that was recorded for the original Upper Adams River race, and the water temperature of the two rivers is similar in regard to a seasonal cycle. Adams Lake is non-productive at present since both the Lower Adams and the Seymour River races depend on Shuswap Lake for their lake existence. The Upper Adams run if again established would probably be non-competitive with existing runs to the Shuswap area.

Two requirements apparently not considered in the previous transplantation of sockeye in the Fraser River system might, if ignored, cause an experiment designed to establish self-maintaining runs to be a failure. These requirements are: 1. The water temperature at spawning time should be the same in both the parent and adopted stream, 2. The distance of migration from salt water to the spawning ground should be approximately the same. Sockeye do not feed after leaving salt water and rely on their stored energies to reach their spawning grounds. If the distance is greater than that which they are inherently capable of traversing, they might survive yet not reach their spawning grounds to fulfill the required purpose. If the water temperatures upon arrival are not suitable or similar to those of the parent stream, the productivity may be so lowered that even though the transplantation is successful, self-maintenance by natural propagation may be impossible. These two factors among others are being carefully considered in the Commission operations.

A further obstacle in the path of success is that even though a nucleus of a run is started in the adopted area, it must be of a character sufficiently suited to its fresh water environment to permit a normal rate of reproduction. A race transferred but not capable of a competitive rate of reproduction would be of little value to the economy of the Fraser River fishery. It is only by extreme care in following every scientific precaution in introducing a race to the adopted area that any hope of success can prevail. Failure from the use of any one method should not discourage the Commission from continuing its work in this connection.

TABLE IX

SUMMARY OF THE SOCKEYE ESCAPEMENT TO THE FRASER RIVER SPAWNING AREAS, 1938, 1942, 1946

District and Stream	*Period of Spawning* *Arrival* 1946	*End*	*Estimated No. of Sockeye* 1938	1942	1946
LOWER FRASER					
Cultus Lake	Sept. 22	Dec. 21	13,342	37,305	33,284
Upper Pitt	Aug. 29	Oct. 7	——	——	18,520
Widgeon Slough		Nov. 24	400	529	1,401
HARRISON					
Big Silver Creek			——	Present ——	——
Douglas Creek			——	67	——
East Creek			104+	——	200
Harrison River	Nov. 1	Dec. 1	0	Present	15,631
Hatchery Creek	Oct. 4	Nov. 7	1,950	875	1,000
Weaver Creek	Oct. 4	Nov. 23	21,500	19,000	36,036
LILLOOET					
Birkenhead River	Aug. 31	Oct. 31	11,000	87,116	90,100
Upper Lillooet Streams			14	14,750	Present
SOUTH THOMPSON					
Seymour River	Aug. 24	Oct. 10	——	1,950	2,619
Adams River	Sept. 25	Nov. 25	600,000	1,968,000	1,835,000
Adams Lake and tributaries	Sept. 25	Nov. 25	——	200,000	6,000
Little Shuswap Lake and Little River	Sept. 25	Nov. 25	200,000	Present in large numbers	419,000
Shuswap Lake and tributaries	Sept. 25	Nov. 25	1,130		36,000
South Thompson River	Sept. 25	Nov. 25	——		92,000
NORTH THOMPSON					
Raft River	Aug. 2	Sept. 16	500	450	3,000
CHILCOTIN					
Chilko River	Aug. 19	Oct. 25	6,000	34,109	58,638
Chilko Lake	Aug. 19	Oct. 25	——		350
QUESNEL					
Horsefly River	Aug. 12	Sept. 20	0	0	58
Little Horsefly River		Oct. 20	——	0	1
Mitchell River		Oct. 16	0	0	2
NECHAKO					
Endako River	Aug. 15	Sept. 20	65	309	368
Francois Lake			——	——	Present in large numbers
Nadina River	Aug. 25	Sept. 30	30	62	66
Nithi River	Sept. 1	Sept. 25	50	1	4
Ormonde Creek	Aug. 20	Sept. 30	8	54	193
Stellako River	Sept. 1	Oct. 31	3,077	48,604	245,172
Uncha Creek	Sept. 15	Oct. 30	0		148
STUART LAKE					
Driftwood River	Aug.		0	——	5
Flemming Creek			3	——	——
Forfar Creek	July 28	Aug. 31	2,608	3,244	1,822
Gluske Creek	July 25	Aug. 31	0	1,734	2,905
Kazchek Creek	Sept. 1	Sept. 20	2	1	60
Kynoch Creek	July 31	Sept. 1	1,575	1,949	1,843
Middle River	Sept. 5	Oct. 5	31	Present	488
Narrows Creek	Aug. 1	Aug. 31	64	100	277
Rossette Creek	July 25	Sept. 1	10	929	2,641
Shale Creek	Aug. 1	Aug. 31	——	50	61
Tachie River	Sept. 25	Oct. 20	——	——	14
NORTHEAST					
Antler Creek					
Upper Bowron	July 29	Sept. 16	1,305	1,826	6,951

GENERAL BIOLOGICAL INVESTIGATIONS

Regulation

The fishing effort in United States waters is undergoing a rapid change. The number of fishing boats is increasing annually with the inevitable result that division of catch as required by the Treaty, combined with the need for substantial escapements to allow for rehabilitation, is difficult to obtain. If the fishermen in United States waters exceed their proper share of the sockeye catch, equal division of the catch between the two countries can only be obtained by reducing the required escapement.

Prior to 1946, the United States fishermen had first access to the incoming runs of sockeye with the exception of a small number of fish taken at Sooke. In 1946 and again in 1949 Canadian purse seine fishermen demonstrated their ability to catch sockeye west of Sooke before they reached the fishing grounds in Puget Sound. There is every indication that an increasing number of sockeye will be taken in Canadian waters in future years before the fish become available to United States fishermen. Likewise there may be a tendency on the part of the fishermen of both countries to expand their operations to off-shore waters and along the West Coast of Vancouver Island.

A change in fishing efficiency and area of operation may not be important as long as the rehabilitation of the Fraser River sockeye is obtained and the allowable catch divided equally between the two countries as provided by the Treaty. These changes, however, greatly affect the established statistical relationships between the catch by gear and area, and the escapement to each producing area, and create other problems to the Commission. To solve these problems requires a detailed knowledge of the catches made by individual fishermen and the relationship of these catches to the size of the run passing through each fishing area. Individual log books are placed on the majority of fishing boats in which the fishermen record a continuing history of their fishing operations. The constantly changing size of the Fraser River gill net fleet requires that individual boat record cards be kept in order that their catch by area and number of fish be known. Daily catch statistics compiled by the fish buyers must be forwarded to the Commission offices within 24 hours. Between fishing seasons these data are being analyzed and applied in the formulation of regulations which will permit rehabilitation and the division of catch between the two countries. *Prompt compilation of the daily catches indicates any deviation from the pre-season calculations of the expected size of the run, the related catch by gear and by area, and the expected efficiency of the fishermen of the two countries, and guides the preparation of any necessary modifications of the fishing regulations.*

Selectivity of the Fishery

Experiments conducted in 1947 and again in 1948 demonstrated that each mesh size used in gill nets had a definite selective action on sockeye salmon, the smaller meshes taking mainly the smaller fish with females predominating,

the larger meshes up to 7½-inch mesh catching mostly the larger sockeye with males in the majority. Since a change from normal in the size and sex of the spawning escapement might affect the productivity of a race, data are now being collected to determine the total selectivity of the fishery and its effect on the size, sex and age composition of each spawning escapement.

The history of the Adams River run indicates that the nature of any restrictive regulation to obtain escapement may have an effect on the character of the spawning run, particularly as to time of arrival on the spawning beds. Observations are being made to determine the change if any in the normal character of the escapement and the influence of such a change on the productivity of the spawning population.

Environmental Factors Affecting Productivity

There are variable natural factors which are known to affect the productivity of sockeye in fresh water. Most, if not all of these, are not controllable but the tendency of the species to compensate for periodic mortalities tends to lessen any adverse effect within the maximum limits of productivity. A knowledge of these factors is essential, however, in recognizing the influence of any artificial change in the natural environment caused by man. Likewise a measurement of optimum natural environment is essential to measuring the effect of the fishery on the character of the spawning stock.

Through the co-operation of the engineering division, the *physical size and character of each spawning ground* is being measured. The distribution of spawning adults and changing water levels during the incubation period of the resultant spawn is being recorded at Chilko and Adams Rivers. This work is being expanded to all major areas as rapidly as possible. The data collected should be of aid in determining the numerical limits of the required escapement.

Temperatures taken on all the spawning grounds during 1949 indicate that the timing of the adult run may be related to the normal timing of the water temperature cycle in each reproducing area. Thus the distance of each spawning ground from the sea and the time of year that certain water temperatures normally occur may determine the time of passage of each race through the fishery. Records collected by the Commission staff since 1938 show that early arrivals on the spawning ground often suffer high mortalities before spawning when water temperatures are above normal. The effect of temperatures on developing eggs and larvae is being studied both at the University of Washington, through the co-operation of the School of Fisheries, and in the field. The first experiments are designed to determine the effect of sub-normal temperatures on the survival of eggs at various stages of development. These experiments may reveal the potential productivity of late spawning adults. Water temperature recording stations have now been established on an annual basis in four major spawning districts.

The physical and biological factors affecting the distribution of emerging fry are being studied at Adams and Chilko Rivers. Time and period of emergence and the size at emergence have been recorded. Changes in weight during migration and feeding habits were noted. The downstream and upstream distribution to lake rearing areas were observed and the effect of velocities and other physical factors on the distribution of fry were measured at Chilko. Methods for measuring the numbers of fry resulting from each annual deposition of spawn at Chilko are being considered and if a usable method is found it will be placed in operation in 1950. General observations of the distribution of fry from all spawning areas to related lake rearing areas are being made as time permits.

Many other miscellaneous measurements of variable environmental influences in fresh water are being developed for possible correlation with productivity.

Methods for measuring racial fishing mortality more accurately, for predicting adult survival in advance, and for determining the cause of an apparent consistency in the variation in racial productivity are being considered.

Preliminary Surveys

During the summer of 1949 district biologists made surveys of Beaver Lake, at the headwaters of Salmon River near Prince George, Pinchi Lake in the Stuart system, Tatla, Tsuniah and Taseko Lakes in the Chilcotin system, Mabel Lake in the South Thompson district and Chilliwack Lake in the Vedder River area to determine their potential as sockeye producers. A survey of the Blackwater River and its system of numerous small lakes was started and will be completed in 1950. Detailed reports including recommendations will be prepared at a later date.

Hell's Gate Investigations

All tagging at Hell's Gate has been discontinued since the fishways have been thoroughly checked as to their efficiency. A report on this study is being prepared for early publication. One man was retained in 1949 to dip fish according to an established procedure in an effort to determine the relationship of the catch per hour to the daily escapement past this point. The effect of any regulatory restriction to increase escapement is readily observable in the catch figures at Hell's Gate but the amount of error in calculating the actual number of fish passing upstream cannot be determined until more than one year's data is available. Such a measure of escapement if possible has a value in that it can be made five or six days after any restrictive closure on the river fishery.

ENGINEERING OPERATIONS

The general accomplishments throughout the year may be summarized under headings of: The repair work required by the unusual flood of 1948; construction of the final fishway at Farwell Canyon, Chilcotin River; construction activities at the Quesnel Field Station; publication of special reports con-

cerning the threat of power developments in the Fraser River system; co-operative survey work with the biological division towards the evaluation of the existing spawning and rearing grounds or potential spawning and rearing grounds; and the maintenance and operation of all existing fish protective devices.

Hell's Gate Canyon and Fishways

The damage caused by the flood conditions of 1948 has been reported upon. The repair work has, except for one item, been completed. The fishways were cleaned of all extraordinary debris deposited during the flood period. A new bridge has been constructed, with width and capacity to permit the transportation of mobile equipment to either fishway. This has eliminated the need of maintaining and repairing the cable-way transportation system installed during the construction period and damaged during the flood stage. A co-operative agreement was entered into between the Canadian National Railway and the Commission which permitted the placement of consolidated rip-rap from the deck level of the fishway to the level of the railroad track lying approximately 100 feet above the deck. The high water of 1949 left the new work undisturbed. At the close of 1949, preparatory work was started on the placement of a retaining wall which will complete the bank repair and will permit the future construction of the high level fishway without disturbing the embankment.

The fishway decks were drowned out on the 12th of May, 1949, and submerged under 22 feet of water on the 16th day of May on which date the flood crest occurred, corresponding to a gauge elevation of 75 feet. While the river this year produced a better than average flood crest, it did not approach the discharge of 1948 when on May 31st a gauge level of 108 feet was recorded, submerging the fishways under 55 feet of water. The fishways remained in operation throughout all periods of the sockeye runs.

Bridge River Rapids Fishways

The Bridge River Rapids fishways were cleaned of the extraordinary debris caused by the flood of 1948 and remained in operation throughout all the period of the major sockeye salmon runs which ascend the Fraser above its confluence with the Thompson River. Having experienced difficulties in the cleanup work in the spring owing to the lateness of the breakup of the ice conditions, repair and maintenance work began as the river dropped to minimum operating levels. A definite problem in maintenance is found to exist at these fishways as the only workable period for cleanout exists during the fall or spring. In the fall, icing conditions are found to correspond with the time when the river drops below operating levels which creates difficulties in moving deposited bed load materials. Experiments will continue to eliminate this operational difficulty.

Farwell Canyon Fishways

The fifth and final fishway at Farwell Canyon has been completed and is ready for operation in the spring of 1950. Construction difficulties were exper-

ienced in April caused by slides into the construction area. The four fishways previously constructed operated throughout the time of passage of sockeye runs through this reach. Sockeye in some numbers were visibly seen using the fishways during the peak of their passage.

Quesnel Field Station

This Station was placed in operation by the biological division on the 31st of August when eggs were placed in the hatching troughs. In addition to the pumping system an experimental water supply line has been laid and is in use from Dillabough Creek. This creek has not sufficient sustained flow to operate the entire plant. Based upon the results of the tests and further studies of the run-off, a decision will be made on whether it is practical to utilize the entire run-off of the creek by storage. Testing of the lake water supply remains to be done. The special construction features required for the extreme low temperatures existing at this Station will be tested during the winter season of 1949-50.

FIG. 3.—The Quesnel Field Station located on Horsefly Lake. The rearing ponds in the foreground were not completed when this picture was taken.

The Question of Multiple Use of the Fraser River Water

Applications by certain concerns have been filed to develop hydro-electric power from tributaries of the Fraser River. The advent of the development of power in the Fraser River watershed exists as an immediate and future threat towards the restoration of the Fraser River sockeye. Investigations are being conducted by other governmental agencies for the possibilities of storage dams for flood control. Such projects will have to be carefully followed and paralleled by fisheries investigations to forecast possible damage or destruction to either ascending spawning sockeye or descending sockeye salmon fingerlings. The use of water for mining purposes is increasing but at present has not reached major proportions. The Commission has issued a special report as to the possible effects of the complete diversion of the Chilko and Taseko Rivers to Bute Inlet on the Coast, which concludes that the continuing of the existing Chilko sockeye fishery requires that there be no interruptions, diversions, additions or obstructions to either the natural inflow or outflow of Chilko Lake or River. The Commission has also reported upon the possible effects of the diversion of the Nechako River to the two Governments and has co-operated with the Dominion Department of Fisheries of Canada by furnishing its preliminary findings to that Department for their use in connection with a hearing held by the Provincial Department of Lands, Water Rights Branch, on the issuance of a licence for such a power project. In order to secure the most effective co-operative approach to this problem, the Commission authorized its Chief Engineer to proceed to Ottawa for consultation with the Dominion Department of Fisheries.

The Commission is also conducting field surveys in areas in which it is known there are proposed multiple-use water projects to obtain the required basic information for the complete protection of the sockeye fishery in these areas. It is essential that all facts pertaining to the physical conditions of the various watersheds be known in order that the effects of proposed water diversions on the fishery may be properly evaluated.

DISTRIBUTION OF SOCKEYE SALMON SPAWNING GROUNDS IN THE FRASER RIVER WATERSHED

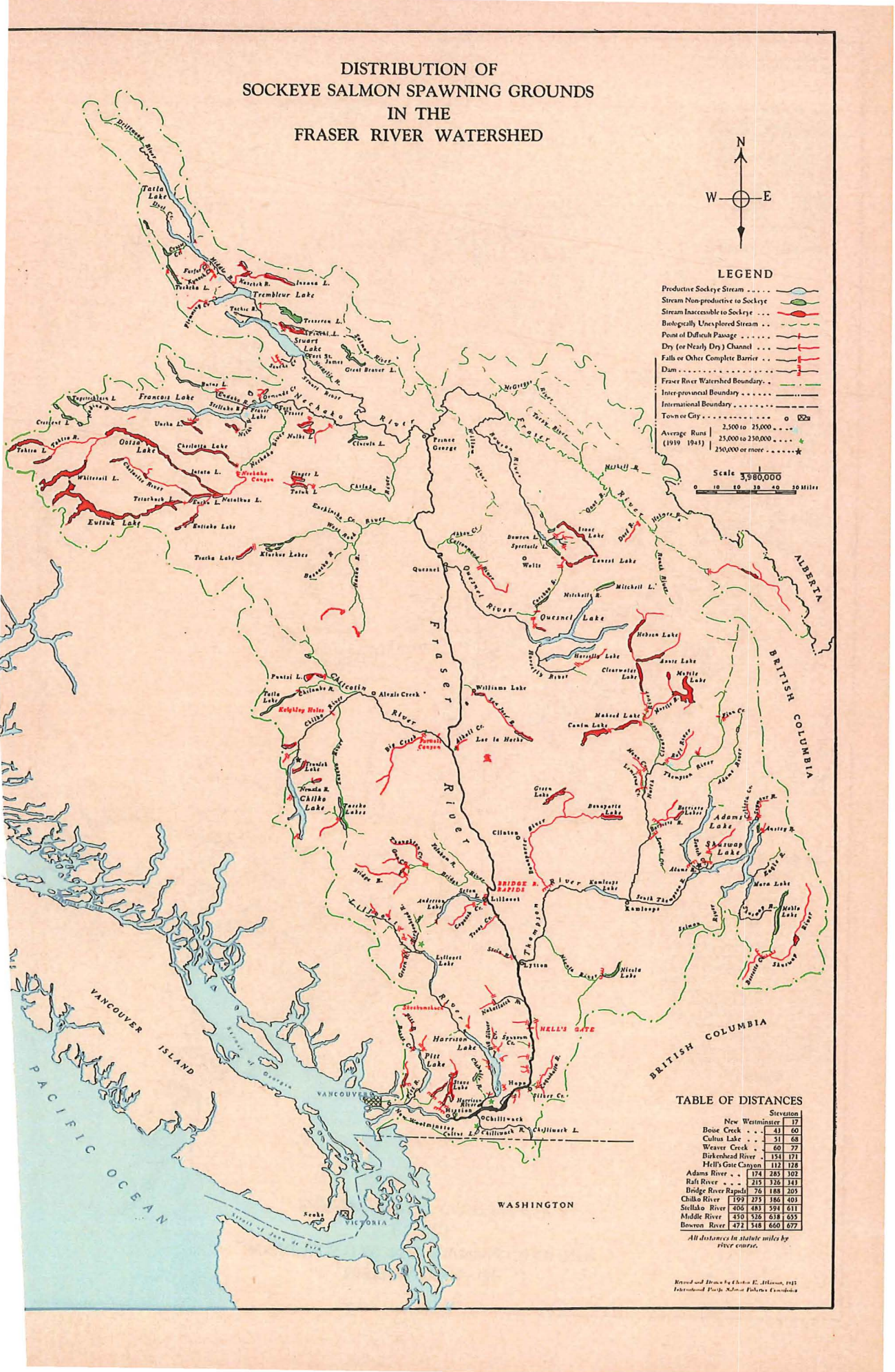


TABLE OF DISTANCES

			Steveston
		New Westminster	17
Boise Creek		43	60
Cultus Lake		51	68
Weaver Creek		60	77
Birkenhead River		154	171
Hell's Gate Canyon		112	128
Adams River		174	285	302
Raft River		215	326	343
Bridge River Rapids		76	188	205
Chilko River	199	275	386	403
Stellako River	406	483	594	611
Middle River	450	526	638	655
Bowron River	472	548	660	677

All distances in statute miles by river course.

Revised and Drawn by Charles E. Atkinson, 1943
International Pacific Salmon Fisheries Commission