

**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
1953

COMMISSIONERS

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**NEW WESTMINSTER
CANADA
1954**



FIGURE 1.—Sockeye spawning scene on the Upper Horsefly River in August 1953, showing the remarkable "Rebirth" of the Quesnel sockeye run.

REPORT OF THE INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION FOR THE YEAR 1953

In the year 1937 the President of the United States of America and the Government of the Dominion of Canada, recognized that the *protection, preservation and extension of the sockeye salmon fisheries in the Fraser River system were of common concern* to the United States of America and the Dominion of Canada: that the supply of this fish in recent years *had been greatly depleted* and that it was of importance to the interests of both countries *that this source of wealth be restored and maintained*.

A Convention to the above effect was ratified on July 28, 1937, including therein specific terms of reference for accomplishing the protection, preservation and extension of the sockeye salmon fisheries in the Fraser River system and an equal sharing of the allowable harvest of the resource. The Commission, appointed under the Convention, has now functioned for the initial treaty period of sixteen years with the members appointed originally by Canada and the United States and with individual replacement members appointed later by each country as vacancies occurred. The functioning of this Commission throughout this initial period has been accompanied by complete respect for the principles of the Convention and strict adherence to these principles on the part of the nationals of both countries concerned. National sovereignty has been carefully recognized not only in the terms of reference of the Convention but throughout the operations conducted in accordance with these terms.

Scientific investigations conducted during the last sixteen years have isolated the major cause for the "Billion Dollar Loss" of Fraser River sockeye. That cause has been eliminated by the construction of fishways at Hell's Gate (1945). These same investigations have laid the foundation for regulatory control of the fishery so that the sockeye wealth could be restored, maintained, and shared equally by the fishermen of the signatory nations. During the first four years of regulatory control (1946-1949 inclusive) which were destined to initiate the rebirth of the Fraser sockeye fishery, the economy of the fishing industry was not seriously interfered with. The sockeye pack for the first four years of regulation was 961,000 cases as compared with 998,000 cases for the preceding four year period.

Record harvests have now been taken by the Fraser River sockeye fishery for three consecutive years. In 1953 the catch exceeded that of any previous cyclic years since 1917, and the escapement to the spawning grounds was the largest of the four-year-cycle since 1913. The 1952 sockeye run was the largest of any cycle-year since 1912. In 1951 the catch was the largest for that cycle since 1903 (Table II). The *increase* in this source of wealth during these three years over the three preceding cycle-years has been approximately \$18,000,000. Equal sharing in the fishery is illustrated by the fact that Canada has taken

50.89 per cent of the allowable catch and the United States has taken 49.11 per cent during the eight years of regulatory control under the Convention.

The operations of the International Pacific Salmon Fisheries Commission—its investigations, recommendations, and problems of management—have been carefully detailed in the fifteen previous annual reports to the two governments. A detailed report on its current operations is contained in the present report. It appears important at this time to re-examine the terms of reference of the Convention, especially so because the initial period of the Convention is now completed. In brief, the treaty calls for the restoration of the Fraser River sockeye, and equal division of the allowable harvest between Canada and the United States. The Commission established to accomplish this purpose was given powers to investigate the natural history of the Fraser River sockeye, to study and improve spawning grounds, to study and improve migration routes, and to construct and maintain hatcheries and other facilities for the propagation of sockeye salmon. It was granted the authority to limit or prohibit the taking of sockeye in respect to Convention waters after the completion of an eight-year period of investigation.

In conjunction with the powers granted to the Commission it was prohibited certain powers and functions. In the interest of preserving national sovereignty the Commission was prohibited from owning land, enforcing its regulations, authorizing fishing gear in territorial waters or from subdividing Convention waters for regulatory purposes except as specifically provided in Paragraphs 1, 2 and 3 of Article I.

The Commission is fulfilling the terms of the treaty. The sockeye resource of the Fraser River system is being restored, and the allowable harvest has been equally divided; this is a matter of record. National sovereignty has not been encroached upon. In fact, the Commission has refrained from making regulations in Convention waters except on the High Seas where control is not possible except by such regulations. Regulation has been accomplished during the past eight years through the process of recommending regulations to the respective governments. When the recommendations are accepted the regulations become of national concern and bear the approval of each respective government representing its respective nationals. In this way the *recommendations for regulation* are a matter of international as well as national concern but the *actual regulations* are of national concern only because they are made as well as enforced by the individual governments. In this way national sovereignty has been maintained beyond the specifications of the Convention.

The control of competition between nationals so that each country may receive an equal share of the harvestable resource is complicated in design but simple in its application and effect. Control of the individual initiative of each national to prevent overfishing or fishing that destroys productivity in the escapement is neither simple in design nor simple in application. Such control constantly involves the possibility of unintentional discrimination which must be avoided. This is especially true because several types of gear operate in the several sections of each nation's area of Convention fishing waters. The same situation may develop

in the future on the High Seas presently shared by the fishermen of both Canada and the United States.

In the design of its recommendations for regulation of sockeye fishing in Convention waters the Commission has adhered to several important principles in order to avoid unintentional discriminatory legislation and national criticism. These principles are:

1. Control of national intensity to obtain equal division of the catch.
2. Control of international intensity to obtain the desired racial escapements on a continuing basis throughout the season.
3. Control of sectional fishing, including the High Seas area, on the basis of equal escapement periods for each section.
4. Special control of any fishing area in which the character of the gear used is such as to interfere with the potential productivity of the escapement.

By operating on the above principles and avoiding interference with the taking of other species whenever and wherever possible the Commission has avoided national criticism of its recommendations for regulation during the past eight years.

Rapid evolutions in fishing gear are now taking place with an accompanying rapid change in the established relationship of fishing efficiency between gear. Newly designed fishing gear is permitting a rapid expansion of fishing to formerly unfished areas. Serious declines in certain fisheries elsewhere are focusing the attention of additional fishermen on the increasing Fraser River sockeye runs and the number of units of fishing gear is rapidly increasing in certain sections of Convention waters. All of these changes not only create uncertainty in the individual fisherman's mind but they also create new problems for the Commission. Even though remarkable increases are obtained in the sockeye runs of each year the monetary return to the individual fisherman may not increase or may be less than that of former less productive years because of increased competition. These changes are basically economic however, and, although they do complicate greatly the problem of fulfilling the Treaty terms of reference, they are not the official concern of the Commission.

As these changes continue to take place and the economic competition increases between fishermen and between fishing areas within a national section, national action by the Governments concerned or national recommendations for action may be required to control the changes in the national interest.

COMMISSION MEETINGS

The *first* meeting of the International Pacific Salmon Fisheries Commission for the year 1953 was held in Vancouver, B. C. on January 16. Mr. Howard Gray was appointed as a United States representative of the sports fishermen on the Advisory Committee replacing Mr. Ken MacLeod who, after fifteen years of

service on the committee, had resigned because of the pressure of personal business. A report reviewing the sockeye salmon problems created by the Alcan project in the Nechako River watershed was considered, and agreement was reached that the report should be forwarded to the Governments of Canada and the United States.

In accordance with established precedent the recommendations for the 1953 sockeye regulations, as presented to the Advisory Committee at an earlier meeting, were summarized and discussed with the Committee. After consideration of the representations of the individual members of the Advisory Committee the recommendations were prepared and approved for forwarding to the respective Governments.

Members of the Advisory Committee who met with the Commission on January 16 were William Pitre, purse seine fishermen; M. W. Black, sport fishermen; Morgan Berg, troll fishermen; R. Nelson, salmon packers; and Peter Jenewein, gillnet fishermen representing Canada and N. Mladinich, purse seine fishermen; Howard Gray, sport fishermen; John Brown, troll fishermen; J. N. Plancich, salmon packers; and Chester Karlson, gillnet fishermen representing the United States.

The *second* of the 1953 series of Commission meetings was convened at Seattle, Washington, on June 19 and 20. Staff reports were presented covering the following subjects: 1. Re-establishment of Natural Runs in the Taseko, Seton-Anderson, and Quesnel watersheds. 2. Future operations of the Quesnel Field Station. 3. Status of the Alcan Development on the Nechako River. 4. Problems of fisheries protection at the proposed power project to be built on Seton Creek by the British Columbia Electric Company, Limited. 5. Current experiments for the purpose of diverting or controlling the seaward migration of fingerling sockeye. 6. Proposed experiments to determine the value of electrical fields in guiding adult sockeye during their upstream migration. 7. A report by the Director on miscellaneous investigations.

Four specific reports covering individual research projects were approved for publication. The staff was directed to co-operate with the Canadian Department of Fisheries in the preparation of a report dealing with wastes from oil refineries and recommendations for the control of waste disposal at the proposed Kamloops Oil Refinery on the Thompson River which could be forwarded to the Governments of Canada and the United States.

Operations for the ensuing fiscal year were considered, and a budget to finance these operations was approved for submission to the respective Governments.

An *emergency* meeting was held in Bellingham, Washington, on July 29 to consider the need for additional restrictions on fishing by the United States fishermen to permit as nearly as practicable an equal division of the allowable catch. One additional "closed day" effective August 3 was recommended to and placed in force by the Washington State Director of Fisheries. In addition, reductions of eighteen to twenty-four hours in the next regular weekly closed periods for various areas in the Canadian fishery were considered and approved for the same purpose.

During the spawning of the large Quesnel sockeye run five members of the Commission and many representatives of the fishing industry made a survey of the spawning areas and studied the problems involved in the complete restoration of the population to its original abundance.

The *fourth* and last official meeting of the year was held in the Commission offices, New Westminster, on September 23. The Commission heard reports from its staff indicating that substantial progress had been made in working out the technical design problems of fish protection facilities at the Seton-Cayoosh Creek hydro-electric project proposed by the B.C. Electric Company. Conclusions regarding fish protective facilities reached in co-operation with engineers of the Federal Fisheries Department and the B.C. Electric Company were approved by the Commission's engineering consultant, M. C. Bell. An outline of the requirements for the proper protection of the Seton Creek sockeye runs was incorporated in a letter to the Honourable the Minister of Fisheries of Canada withdrawing Commission objections to the project if the specified facilities were approved by the Company.

1953 REGULATIONS

Recommendations for regulations governing the management of the sockeye fishery in 1953 were considered and adopted at a meeting of the Commission held with its Advisory Committee in Vancouver, B. C., on January 16, 1953.

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. The recommendations were accepted in substance for Canadian waters by an Order-in-Council adopted on May 7, 1953, and for United States waters by an Order of the Director of the Washington State Department of Fisheries promulgated April 29, 1953.

The recommendations of the Commission were as follows:

Canadian Convention Waters

The International Pacific Salmon Fisheries Commission appointed pursuant to the Convention between Canada and the United States of America for the protection, preservation, and extension of the Sockeye Salmon Fisheries in the Fraser River System, signed at Washington on the 26th 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 Fishery Regulations for British Columbia, for the season of 1953, under authority of the Fisheries Act, namely:

1. That in the waters of District No. 1 and in those waters of the southern portion of District No. 3 bounded on the west by the Forty-ninth Parallel, projected from the Vancouver Island shore in the vicinity of Florencia Bay (excepting all the waters of Barclay Sound eastward of an imaginary straight line drawn from Amphitrite Point to Cape Beale, and all the waters of Nitinat Lake and entrance thereto) and bounded on the north

by an imaginary straight line drawn from Welcome Point on Sechelt Peninsula, thence along an imaginary straight line drawn to Point Young on Lasqueti Island, thence in an imaginary straight line drawn to Dorcas Point on Vancouver Island, no one shall buy, sell, or have in his possession any sockeye salmon taken in those waters during the time fishing for such salmon is prohibited therein.

2. That in the waters of the said southern portion of District No. 3 embraced in Areas 21 and 23, but not including all the waters of Barclay Sound eastward of an imaginary straight line drawn from Amphitrite Point to Cape Beale, no one shall fish for sockeye salmon from one minute after twelve o'clock in the forenoon of Saturday of each week to one minute after twelve o'clock in the forenoon of the Monday following, commencing on June twenty-sixth, 1953 and continuing to and including July twenty-third, 1953; and provided further, no one shall fish for sockeye salmon from one minute after twelve o'clock in the forenoon of Friday of each week to one minute after twelve o'clock in the forenoon of the Monday following commencing on July twenty-third, 1953 and continuing to and including August third, 1953.

3. That in the waters of the said southern portion of District No. 3 embraced in Areas 19 and 20, no one shall fish for sockeye salmon from six o'clock in the afternoon of Friday of each week to six o'clock in the afternoon of the Sunday following commencing on June twenty-sixth, 1953 and continuing to and including July twenty-third, 1953 and again during the fishing season commencing on August third, 1953 and continuing to and including August twenty-third, 1953; provided that during the specific periods set forth herein no one shall fish by means of purse seines for sockeye salmon from one minute after twelve o'clock in the forenoon of Saturday of each week to one minute after twelve o'clock in the forenoon of the Monday following.

4. That in the waters of the said southern portion of District No. 3 embraced in Areas 19 and 20, no one shall fish for sockeye salmon from six o'clock in the afternoon of Thursday of each week to six o'clock in the afternoon of the Sunday following commencing on July twenty-third, 1953 and continuing to and including August third, 1953; provided that during the specified period set forth herein no one shall fish by means of purse seines for sockeye salmon from one minute after twelve o'clock in the forenoon of Friday of each week to one minute after twelve o'clock in the forenoon of the Monday following.

5. That in the waters of the said southern portion of District No. 3 embraced in Areas 17 and 18 no one shall fish for sockeye salmon by means of purse seines from one minute after twelve o'clock in the forenoon of Friday of each week to six o'clock in the forenoon of the Monday following commencing on June twenty-sixth, 1953 and continuing to and including July twenty-third, 1953 and commencing again on August thirteen and continuing to and including September twenty-second, 1953; nor shall anyone fish during such periods for sockeye salmon by means of gill nets in the said Areas 17 and 18 from eight o'clock in the forenoon of Friday of each week to two o'clock in the afternoon of the Monday following.

6. That in the waters of the said southern portion of District No. 3 embraced in Areas 17 and 18 no one shall fish for sockeye salmon by means of purse seines from one minute after twelve o'clock in the forenoon of Friday of each week to one minute after twelve o'clock in the forenoon of the Tuesday following commencing on July twenty-third, 1953 and continuing to and including August thirteen, 1953; nor shall anyone fish during such

period for sockeye salmon by means of gill nets from eight o'clock in the forenoon of Friday of each week to eight o'clock in the forenoon of the Tuesday following.

7. That in the waters of District No. 1 other than those above Pattullo Bridge at New Westminster, no one shall fish for sockeye salmon from eight o'clock in the forenoon of Friday of each week until two o'clock in the afternoon of the Monday following commencing June twenty-sixth, 1953 and continuing to and including July twenty-third, 1953 and again commencing August thirteen, 1953 and continuing to and including September twenty-second, 1953; nor shall anyone fish during such periods in those waters where commercial fishing is permitted above the Pattullo Bridge at New Westminster for sockeye salmon by means of gill nets from eight o'clock in the forenoon of Friday of each week until six o'clock in the afternoon of the Monday following.

8. That in the waters of District No. 1, other than those above Pattullo Bridge at New Westminster, no one shall fish for sockeye salmon from eight o'clock in the forenoon of Friday of each week until eight o'clock in the forenoon of the Tuesday following commencing July twenty-third, 1953 and continuing to and including August thirteen, 1953; nor shall anyone fish during such period in those waters where commercial fishing is permitted above the Pattullo Bridge at New Westminster for sockeye salmon by means of gill nets from eight o'clock in the forenoon of Friday of each week until noon of the Tuesday following.

9. The Chief Supervisor of Fisheries for British Columbia, consistent with authority vested in him, may implement recommendations which may be made by the International Pacific Salmon Fisheries Commission respecting additional close times for fishing for sockeye salmon in waters of District No. 1 and in those waters of the southern portion of District No. 3 described in section one hereof by posting a notice of any additional close time so recommended on the cannery or canneries adjacent to the area or areas thereby to be affected at least twenty-four hours before the commencement of such additional close time.

10. Nothing contained herein shall apply to the taking of sockeye salmon in the waters of District No. 1 and in those waters of the southern portion of District No. 3 described in section one hereof by the International Pacific Salmon Fisheries Commission or its duly authorized representatives.

11. These regulations shall be effective on and after June 26, 1953 and shall remain in force during the year 1953.

On a recommendation of the International Pacific Salmon Fisheries Commission one modification was made in the 1953 regulations governing sockeye fishing in Canadian Convention waters as approved by the Order-in-Council referred to above.

This modification consisted of a reduction of twenty-four hours in the weekend closed season immediately following July 30 for all gear in Areas 19, 20, 21 and 23, and eighteen hours in Areas 17 and 18 and District No. 1 of Canadian Convention waters to permit equalization of the catch taken by the fishermen of Canada with the catch taken by the fishermen of the United States. This reduction applied at the beginning of the weekend closed season in Areas 19, 20, 21 and 23

TABLE I
SOCKEYE CATCH BY GEAR

<i>United States Treaty Waters</i>										
<i>Year</i>	<i>Purse Seines</i>			<i>Gill Nets</i>			<i>Reef Nets</i>			<i>Total Catch</i>
	<i>Units</i>	<i>Catch</i>	<i>Percentage</i>	<i>Units</i>	<i>Catch</i>	<i>Percentage</i>	<i>Units</i>	<i>Catch</i>	<i>Percentage</i>	
1941	140	1,350,491	86.65	92	43,275	2.78	77	164,788	10.57	1,558,554
1945	91	605,962	85.78	46	32,245	4.56	39	68,257	9.66	706,464
1949	277	850,451	80.48	248	123,048	11.64	116	83,293	7.88	1,056,792
1953	247	1,355,734	66.70	322	427,836	21.05	96	248,867	12.25	2,032,437
<i>Canadian Treaty Waters</i>										
<i>Year</i>	<i>Traps</i>			<i>Purse Seines</i>			<i>Gill Nets</i>			<i>Total Catch</i>
	<i>Units</i>	<i>Catch</i>	<i>Percentage</i>	<i>Units</i>	<i>Catch</i>	<i>Percentage</i>	<i>Units</i>	<i>Catch</i>	<i>Percentage</i>	
1941	5	129,903	6.14	0	0	.00	1,559	1,986,820	93.86	2,116,723
1945	5	30,444	3.14	0	0	.00	1,333	939,000	96.86	969,444
1949	5	51,063	5.00	40	111,834	10.96	1,382	857,902	84.04	1,020,799
1953	4	60,071	3.01	66	600,449	30.14	1,482	1,331,823	66.85	1,992,343

NOTE: Gear counts represent the maximum number of units delivering on any single day when sockeye was the principal species being caught.

TABLE II
LANDINGS AND PACK OF SOCKEYE 1946-1953

	<i>United States</i>	<i>Canada</i>	<i>Total</i>
* 1953			
Total Landings (No. Sockeye).....	2,032,437	1,992,343	4,024,780
Share in Fish.....	50.50%	49.50%	
Total Pack (48 lb. Cases).....	178,323	176,097	354,420
Share in Pack.....	50.31%	49.69%	
1949			
Total Landings (No. Sockeye).....	1,056,792	1,020,799	2,077,591
Share in Fish.....	50.87%	49.13%	
Total Pack (48 lb. Cases).....	80,547	80,629	161,176
Share in Pack.....	49.97%	50.03%	
1946-1953 (8 year Totals)			
Total Landings (No. Sockeye).....	11,289,435	11,697,201	22,986,636
Share in Fish.....	49.11%	50.89%	
Total Pack (48 lb. Cases).....	985,336	1,010,562	1,995,898
Share in Pack.....	49.37%	50.63%	
1953 Cycle Pack.....	178,323	176,097	354,420
1949.....	80,547	80,629	161,176
1945.....	53,054	79,781	132,835
1941.....	110,605	159,279	269,884
1937.....	60,259	100,272	160,531
1933.....	128,518	52,465	180,983
1929.....	111,898	61,569	173,467
1925.....	112,023	35,385	147,408
1921.....	102,967	39,631	142,598
1917.....	411,538	148,164	559,702

* 22 Canneries in the United States and 11 canneries in Canada received the sockeye caught in Convention waters.

1952 Cycle Pack.....	114,638	115,814	230,452
1948.....	90,441	61,650	152,091
1944.....	37,379	88,150	125,529
1940.....	59,354	93,361	152,715
1936.....	59,505	184,854	244,359†
1932.....	81,188	65,769	146,957
1928.....	61,044	29,299	90,343
1924.....	69,369	39,743	109,112
1920.....	62,654	48,399	111,053
1916.....	84,637	32,146	116,783
1912.....	184,680	123,879	308,559

† Includes 16,609 cases from sockeye caught in Johnstone Straits. Sockeye taken in Convention waters only are included in pack figures for years after 1936.

1951 Cycle Pack.....	118,151	134,400	252,551
1947.....	6,760	29,170	35,930
1943.....	19,057	30,277	49,334
1939.....	43,511	47,539	91,050
1935.....	54,677	62,822	117,499
1931.....	87,211	40,947	128,158
1927.....	97,594	61,393	158,987
1923.....	47,402	31,655	79,057
1919.....	64,346	38,854	103,200
1915.....	64,584	91,130	155,714
1911.....	127,761	58,487	186,248
1907.....	96,974	59,815	156,789
1903.....	167,211	204,809	372,020

and at the end of the weekend closed season in Areas 17 and 18 and in District No. 1. In order to prevent a serious reduction in the escapement from that contemplated under the original regulations and yet allow a further increase in the Canadian catch, an additional twenty-four hour restriction on fishing by United States fishermen was recommended and placed in force for the same weekend.

Additional measures provided for the protection of pink salmon, implemented by the Chief Supervisor of Fisheries, provided additional protection for the minor autumn-migrating races of sockeye. These measures are detailed as follows:

1. The addition of forty-two hours in the weekly closed season for District No. 1 and Areas 17 and 18 immediately following September 10.
2. The closure of Areas 17 and 18 and District No. 1 from Friday, September 18, to October 14 to all salmon fishing except by linen gill-nets of 9-inch mesh and nylon gillnets of $9\frac{3}{4}$ -inch mesh on Thursday, September 24 only.

United States Convention Waters

The International Pacific Salmon Fisheries Commission appointed pursuant to the Convention between Canada and the United States of America for the protection, preservation, and extension of the Sockeye Salmon Fisheries in the Fraser River System, signed at Washington on the 26th 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 between Canada and the United States of America 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, there shall be weekly closed periods for all gear of forty-eight hours duration commencing on June twenty-sixth, 1953 and continuing to and including July twenty-third, 1953 and again commencing on August sixth, 1953 and continuing to and including August twenty-third, 1953. The said weekly closed periods for Purse Seines and Reef Nets shall commence at 12:01 a.m. Saturday of each week and continue until 12:01 a.m. on the Monday following and for Gill Nets the said closed periods shall commence at 6:00 p.m. Friday of each week and continue until 6:00 p.m. on the Sunday following.
2. That in the waters of the United States embraced in Article I of the said Convention there shall be weekly closed periods for all gear of seventy-two hours duration commencing on July twenty-third and continuing to and including August fifth, 1953. The said weekly closed periods for Purse Seines and Reef Nets shall commence at 12:01 a.m. Friday of each week and continue until 12:01 a.m. on the Monday following, and for Gill Nets the said closed periods shall commence at 6:00 p.m. Thursday of each week and continue until 6:00 p.m. on the 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 for anyone to buy,

sell or have in his possession sockeye salmon taken during the times when fishing for or taking sockeye salmon is prohibited therein.

4. 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.

5. The Commission further recommends that the Director of Fisheries for the State of Washington consistent with authority in him vested implement recommendations which may be made by the International Pacific Salmon Fisheries Commission, through its Chairman, respecting additional closed periods for fishing for sockeye salmon in those waters of the United States of America embraced in Article I of the said Convention.

The approved regulations as detailed above were in effect throughout the sockeye fishing season except as altered by two additional closures which were required to equalize as near as practicable the allowable catches by the fishermen of Canada and the United States. Closures of twenty-four hours on July 20 and August 3 were recommended to the Director of Fisheries of the State of Washington and were placed in force by him on those dates.

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 sixteenth day of January, 1953, 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 June 26th and July 23rd, both dates inclusive, for the year 1953, and further that in the same waters the taking of sockeye salmon is hereby prohibited from midnight Thursday to midnight the following Sunday during each weekly period between July 23rd and August 3rd, both dates inclusive, for the year 1953; 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 by at least two of the Commissioners of each High Contracting Party."

Patrol agencies of both the United States and Canada provide adequate equipment and officers for the enforcement of the High Seas regulation protecting the Fraser River sockeye. No violations were reported.

TABLE III
DAILY CATCH OF SOCKEYE, 1941-1945-1949-1953 FROM UNITED STATES TREATY WATERS

Date	JULY				AUGUST				SEPTEMBER			
	1941	1945	1949	1953	1941	1945	1949	1953	1941	1945	1949	1953
1	329	2		24,386	108,608	45,429	112,059		3,275		6,451	1,308
2	380			32,371		28,079	66,263		2,544	699	4,114	1,052
3	240	187		39,812	96,775	12,686	66,066	221	510	157		1,035
4	63	86			133,390			53,931	1,789	318	4,205	2,965
5		163			109,463	21,428	44,124	50,982	540	886	3,641	
6	525	324		48,620	55,733	13,760		25,206		577	2,198	1,115
7	1,260			69,419	27,338	10,841		25,184	2,303	270	1,447	782
8	1,723	2,431		54,566	20,464	11,967	70,581	2,478	343		907	760
9	1,728	4,439		57,435		7,446	52,300	1,288	171	1,035	580	897
10	1,394	3,919		32,395	22,514	6,354	31,270	37,018		635		509
11	1,943	2,255	CLOSED		15,214		27,103	32,769		448	453	606
12		1,336			12,993	5,502	30,028	22,964		34	334	
13	4,850	793		15,334	12,727	4,685		21,929		168	239	423
14	8,512			26,643	6,935	2,572		21,643		39	53	331
15	8,210	3,332		33,824	11,843	3,581	31,842	3,973			28	344
16	8,877	4,560		35,305		3,752	21,523	2,421		23	22	228
17	9,807	7,827		27,075	11,719	2,979	22,538	21,254		65		637
18	9,818	13,209			10,266		22,195	16,891		42	92	17
19		10,581			9,557	8,210	19,079	18,142			119	
20	14,646	2,484		4,598	10,305	8,018	1,266	11,411			94	60
21	25,053			177,652	5,848	6,808	20,407	16,507			41	22
22	35,830	40,316		114,464	5,295	6,360	15,265				16	
23	47,969	55,804		173,640		2,706	17,382	242			28	
24	60,166	31,730			6,860	1,854	13,054	14,743				
25	35,150	62,722	3,916		5,302		10,503	8,823			23	
26		33,934	43,196		4,889	1,920	13,471	7,081			25	
27	85,464	30,155	116,793	215,240	3,663	1,603	514	7,941			24	
28	87,698		82,812	148,085	3,329	1,624	9,326	6,628				
29	87,020	30,862	44,979	79,013	3,498	1,021	6,954	47				
30	141,289	64,272		92,199		653	6,118	2,611				
31	151,000	69,320			984	2,136	8,724	2,861				
Totals	830,944	477,043	291,696	1,502,076	715,512	223,974	739,955	437,189	11,475	5,396	25,134	13,091
June Total	18	20		80,006								
Balance of September Total									88	31	7	34
October Total									517			41
Season Total									1,558,554	706,464	1,056,792	2,032,437

TABLE IV
DAILY CATCH OF SOCKEYE, 1941-1945-1949-1953 FROM CANADIAN TREATY WATERS

Date	JULY				AUGUST				SEPTEMBER			
	1941	1945	1949	1953	1941	1945	1949	1953	1941	1945	1949	1953
1	1,244			33,417	149,380	59,066	154,935		7,281		4,683	4,397
2	1,609	5,973		36,323		52,659	83,461		3,921		772	4,038
3	1,619	4,429		2,287		41,900	68,945	91,326	3,127	7,168		4,797
4	2,552	8,109			196,510		63,618	54,171	4,110	5,005		246
5		14,153			137,792		50,283	48,526	7,177	2,010	5,622	
6		10,252		72,602	121,519	55,085	564	38,493		1,374	2,413	
7	8,357			36,926	100,234	16,660	539	6,820			1,704	6,321
8	6,168			22,165	86,324	16,845	73,872		13,884		1,302	5,136
9	6,007	11,869		27,665		12,530	35,418	474	5,941		177	6,556
10	7,970	9,223		2,500		10,395	24,834	20,889	3,191	8,740	43	7,067
11	8,340	8,130			94,842		36,180	60,670	3,010	5,635	71	89
12		8,415			38,462		1,696	37,370	3,458	5,891	3,811	
13		7,451		28,227	35,570	13,852	337	36,956		5,843	3,558	
14	16,551			16,936	30,733	6,845	177	19,232			5,437	32
15	13,077			21,295	31,534	5,884	32,850		5,307		4,373	14
16	14,696	20,257		24,817		3,705	16,564		2,626		2,934	14,700
17	9,519	12,869		4,809		490	15,140	31,843	2,187	1,125		8,126
18	11,453	17,045			34,968		15,358	13,370	1,480	409		2
19		16,599	2,043		11,696		5,255	10,734	1,887	333	2,084	
20		14,726	2,102	93,156	11,946	14,617	3,260	13,397		461	1,709	
21	44,137		1,443	128,664	17,111	9,556	3,484	7,066			1,689	
22	23,749		1,440	112,022	17,451	7,126	15,697		2,285		1,321	
23	23,966	41,465		87,223		5,379	7,780		1,580			
24	34,240	31,041	100			95	6,792	10,945	2,120	6,227		
25	64,072	39,986	38,191		18,301		6,699	4,916	3,127	2,836		
26		48,675	28,963		6,447		5,154	2,929		2,069	6,139	
27		36,153	49,822	40,629	4,185	11,212	2,321	4,860		1,308	1,544	
28	201,278		64,646	249,362	3,036	3,259	2,038	1,024			455	
29	128,526		4,564	130,898	3,585	4,076	12,778		2,265		1,266	
30	120,842	109,052		140,486		2,336	4,585		955			
31	125,952	75,422	1,756	7,932		21	4,189	6,869				
Totals	875,924	551,294	195,070	1,320,341	1,151,626	353,593	754,803	522,880	80,919	56,434	53,107	61,521
May & June Totals	2,047	2,088	16,169	85,333								
Balance of Sept. Oct. & Nov. Totals									6,207	6,035	1,650	212
Season Total									2,116,723	969,444	1,020,799	1,992,343

REPORT FOR 1953

TABLE V

THE INDIAN CATCHES OF SOCKEYE SALMON BY DISTRICTS
AND THE VARIOUS AREAS WITHIN THESE DISTRICTS, 1949, 1953

District and Area	1949		1953	
	Catch	No. of Fishermen	Catch	No. of Fishermen
HARRISON-BIRKENHEAD				
Skookumchuck and Douglas.....	500	—	960	—
Lillooet Lake.....	3,000	—	1,508	—
Birkenhead River.....	388	4	8,319	—
TOTALS.....	3,888		10,787	
LOWER FRASER				
Laidlaw to Vedder River.....			1,975	
Seabird Island.....	1,368	8	1,300	
Katz and Ruby Creek.....	560	6	820	
TOTALS.....	1,928	14	4,095	
CANYON				
Union and American Bars.....	549	3	704	—
Yale.....	3,687	12	3,891	—
Spuzzum.....	123	4	954	—
Lower Gorge.....	674	3	414	—
Upper Gorge.....	478	4	302	—
Boston Bar.....	19	1	995	—
Boothroyd.....	1,975	12)	
Cisco.....	3,540	25	2,154)	—
TOTALS.....	11,045	64	9,414	
LYTTON-LILLOOET				
Gates Creek.....	3,131	24	8,025	50*
TOTALS.....	3,131	24	8,025	50
BRIDGE RIVER RAPIDS				
Lillooet.....	3,963	26	3,834	
Rapids.....	8,101	34	14,018	
Pavillion.....	241	8	5,449	
TOTALS.....	12,305	68	23,301	135*
CHILCOTIN				
Farwell Canyon.....	216		632	12
Hance's Canyon.....	303		1,474	10
Martins.....	93		1,248	—
Anahim.....	0		—	—
Alexis Creek.....	297		2,048	29
Siwash Bridge.....	1,244		3,702	17
Keighley Holes.....	211		420	—
Henry's Crossing.....	0		—	—
TOTALS.....	2,364	—	9,524	
UPPER FRASER				
Shelley.....			220	8
Alkali and Canoe Creek.....			1,400	21
Chimney Creek.....			3,963	32
Soda Creek.....			1,255	11
Alexandria.....			425	4
Quesnel.....			920	5
TOTALS.....	5,021	—	8,183	81
NECHAKO				
Nautley Reserve.....	5,500	10	2,501	12*
Stella Reserve.....	2,200	8	1,480	19*
Nadina.....			210	3*
TOTALS.....	7,700	18	4,191	34
STUART LAKE				
Fort St. James.....	9,000	16	12,834	51*
Tachie Reserve.....	10,200	14	5,591	43*
Trembleur and Takla Lake.....	2,000	8	2,765	22*
TOTALS.....	21,200	38	21,190	116
THOMPSON				
Nicomen Creek.....			1,505	
Ashcroft.....			—	
Deadman's Creek.....			420	
North Thompson River.....	294	2	275	
South Thompson River.....	550	25	7,230	
TOTALS.....	844	27	9,430	
GRAND TOTALS.....	69 426		108,140	

* Number of Permits issued to Indians in District.

The Indian catch statistics detailed above are obtained principally from the Fisheries Inspectors of the Canadian Department of Fisheries. These inspectors control the taking of sockeye for food by the various Indian populations residing throughout the Fraser River Watershed.

ESCAPEMENT

The total calculated escapement of 1,274,346 sockeye in the Fraser River system during 1953 represents 23.6 per cent of the total run of 5,407,000 fish. The balance of the run was taken in the commercial fishery and by Indians fishing for food in their historically established fishing locations (Table V). The relative escapement of productive fish was even less than that indicated above. When the Adams River and other "jacks" are eliminated from consideration—these "jacks" have no significant value as a reproducing stock—the actual 1953 escapement of productive sockeye is reduced to 21.5 per cent of the run.

During the 1953 season the weekly gillnet closure in the Fraser River district was increased by six hours, also several extra-day closures of all fishing districts were imposed. Despite these additional protective closures the escapement was low. This may be considered as indicative of the danger to rehabilitation being created by increased fishing intensity, expanded fishing area, and improvement of gear efficiency. Since the catch is limited, any positive change in the ability of the fishery to catch sockeye can only result in additional restrictions of the fishery to obtain the minimum escapement required for increasing or maintaining the size of future runs and the future available catch.

Although the net escapement percentage in 1953 was well below expectation the actual number of spawners is considered to be satisfactory primarily because of the high rate of productivity resulting from several racial escapements in 1949. There is reason to believe that the cycle run returning in 1957 should show an increase in numbers over the good run of this year provided that the reproducing environment is similarly favorable. The principal justification for optimism in judging the potential productivity of the 1953 escapement is the fact that the spawning fish were well-distributed throughout the watershed. This was not the case in 1949, when approximately 50 per cent of the entire escaping run was destined for the small streams tributary to the lakes of the Stuart River system.

The escapement of the Early Stuart run declined from 580,000 sockeye in 1949 to 154,000 in 1953. This decline in escapement was the result of an intense fishery operating in 1953 whereas a complete fishing closure had been imposed in 1949. The 1949 closure resulted in over-spawning in the four major parent streams, and the crowding caused some of the fish to move into other tributaries apparently suited to the successful reproduction of this race of sockeye. The streams which were not overcrowded in 1949 produced more sockeye in 1953 than did the four "mother" streams which were seriously overpopulated in the brood year. The 1953 escapement to the Early Stuart streams is considered to be satisfactory by reason of its wide distribution but below the optimum for producing a maximum run. However, the number of spawners would have approached the optimum number if the Indians had not concentrated on this run to obtain their annual food supply. The increase in the Driftwood River escapement from 450 sockeye in 1949 to 8655 in 1953 was an outstanding contribution to overall rehabilitation. The Driftwood River, flowing into the head of Takla Lake, has

many miles of spawning grounds and appears to be capable of producing a sizeable run of sockeye.

The Late Stuart run was larger than any other racial run of the Fraser watershed in 1953. In spite of a serious mortality of unspawned fish in 1949 the productivity was extremely high for those sockeye that actually did spawn successfully. The 1953 escapement increased more than 100 per cent over the 1949 escapement, but early timing of the run and of the escapement again caused a mortality in potential spawners slightly in excess of 50 per cent. The mortality of unspawned fish of the Late Stuart run, resulting from early timing and concurrent warm water on the spawning ground is a serious problem. Unless the timing of the run changes eventually to a later date this run will remain biologically unstable and the size of future runs may vary considerably. Fortunately the number of actual spawners in 1953 exceeded the number in 1949 because of the increase in the size of the escapement. However, an important *potential* increase in both the 1953 and the 1957 runs has been lost because of an excessive mortality of unspawned fish.

In accordance with expectations, the 1953 Quesnel run increased substantially over the run of 1949. The escapement of 20,000 fish in 1949 produced a total run of over 500,000 and an escapement of 107,562 in 1953. Spawning conditions appeared to be favorable except for a small run in McKinley Creek where warm water conditions prevailed. Another important increase in the size of the Quesnel population appears to be probable in 1957.

An unexpected substantial increase occurred in the Chilko River escapement. The run of this cycle had declined in size since the Hell's Gate block of 1941 until it had become *relatively* unimportant by 1949. The 235 per cent increase in the 1953 escapement was due in part to large numbers of five-year-old fish produced by the 1948 brood stock.

Spawning populations in the Fraser-Francois system were relatively satisfactory. The early run to Francois Lake and its principal tributary, the Nadina River, increased from 23,000 sockeye in 1949 to 40,000 sockeye in 1953. No fishery operated on the 1949 run while in 1953 the fishery was very intense (more than 80 per cent efficiency). The Stellako run, reared in Fraser Lake, declined considerably from 105,000 sockeye in the brood year to 45,000. This decline was indicated, however, because no spawning system above Hell's Gate is capable of producing large runs every year. Good production is indicated for the 1954 cycle.

The runs of sockeye to the Thompson River were satisfactory except in the case of the Seymour River population which declined considerably from the population of the brood year. The Scotch Creek and Raft River runs increased in size as did the four-year-old run to the lower Adams River. A phenomenal run of jacks (three-year males) appeared in lower Adams River; this is believed to be the largest run of three-year-old sockeye ever observed in the area.

Several new runs of sockeye appeared in the Fraser River system in 1953, indicating the remarkable resiliency of the species. At Taseko Lake, tributary

TABLE VI
SUMMARY OF THE SOCKEYE ESCAPEMENT TO THE FRASER
RIVER SPAWNING AREAS, 1941, 1945, 1949, 1953

District and Streams	Period of Peak Spawning	Estimated Number of Sockeye				Jacks	Sex Ratio	
		1941	1945	1949	1953		Males	Females
							4-5 yr.	4-5 yr.
LOWER FRASER								
Cultus Lake.....	Nov. 18-26	18,164	9,231	9,301	13,000	1,457	6,253	5,290
Upper Pitt River.....	Sept. 8-12	—	—	9,500	18,693	20	8,472	10,201
Pitt Lake.....	Before Oct. 21	—	—	—	350	—	—	—
Widgeon Slough.....	Nov. 5-10	—	1,200	650	1,518	30	563	925
HARRISON								
Big Silver Creek.....	Sept. 12-15	2,000	2,000	2,100	432	2	214	216
Harrison River.....	Nov. 9-12	38,000	16,060	8,000	21,328	298	13,169	7,861
Weaver Creek.....	Oct. 18-21	9,200	12,944	12,520	9,530	388	3,564	5,578
Misc. Streams.....	Sept. 15-17	1,250	199	310	86	2	—	—
LILLOOET								
Birkenhead River.....	Sept. 24-26	59,300	96,664	74,300	53,111	12,573	17,422	23,116
SETON-ANDERSON								
Gates Creek.....	Aug. 22-27	—	—	—	78	—	—	—
Portage Creek.....	Oct. 12-18	—	—	—	200	150	25	25
SOUTH THOMPSON								
Seymour River.....	Aug. 25-27	0	150	10,772	5,947	238	2,617	3,092
Scotch Creek.....	Aug. 25-28	0	75	1,000	1,364	0	484	880
Lower Adams River.....	Oct. 10-15	50	59,725	11,700	177,000	173,607	1,096	2,297
Little River.....	Oct. 10-16	0	7,750	9,615	32,118	31,739	116	263
South Thompson River.....	Oct. 10-16	—	—	5	12,614	12,362	139	113
NORTH THOMPSON								
Raft River.....	Aug. 24-25	250	3,300	5,900	8,242	5	3,500	4,737
CHILCOTIN								
Chilko River.....	Sept. 16-18	280,000	192,884	59,000	197,660	499	94,377	102,784
Taseko Lake.....	Aug. 31-Sept. 4	—	—	100	4,422	—	1,447	2,975
QUESNEL								
Horsefly River.....	Aug. 27-29	1,065	3,000	20,000	105,218	10	47,369	57,839
Mitchell River.....	Sept. 2-5	40	—	350	2,344	—	—	—
NECHAKO								
Endako River.....	Aug. 27-Sept. 1	45	80	1,100	605	32	286	287
Nadina River.....	Aug. 25-28, Sept. 9-12	200	300	21,600	38,574	474	17,145	20,955
Nithi River.....	Aug. 23-28	150	500	1,400	1,208	2	561	645
Ormonde Creek.....	Aug. 23-26	90	400	2,500	956	104	426	426
Stellako River.....	Sept. 24-26	5,230	20,826	104,800	45,057	1,036	18,465	25,556
Uncha Creek.....	Aug. 31-Sept. 3	0	0	0	209	—	—	—
STUART RIVER								
EARLY RUNS								
Ankwil Creek.....	Aug. 5-8	25	0	750	5,913	—	2,483	3,430
Biyouac Creek.....	July 31-Aug. 4	0	0	12,900	8,994	—	4,137	4,857
Driftwood River.....	Aug. 10-14	25	—	450	8,655	—	3,635	5,020
Dust Creek.....	Aug. 2-5	150	4	7,800	16,891	—	7,094	9,797
Felix Creek.....	Aug. 5-8	—	—	—	805	—	338	467
15 Mile Creek.....	Aug. 5-8	5	0	200	794	—	333	461
5 Mile Creek.....	Aug. 5-8	5	0	600	2,632	—	1,105	1,527
Forfar Creek.....	July 31-Aug. 4	1,776	7,081	80,500	18,054	61	8,258	9,735
Forsythe Creek.....	Aug. 5-8	—	0	1,200	4,500	—	1,890	2,610
Frypan Creek.....	Aug. 5-8	—	0	750	4,566	—	1,918	2,648
Gluske Creek.....	July 31-Aug. 4	500	2,783	106,000	16,074	56	7,584	8,434
Kynoch Creek.....	July 31-Aug. 4	2,474	9,304	185,400	16,676	72	7,259	9,345
Leo Creek.....	Aug. 5-8	—	0	1,700	6,361	—	2,672	3,689
Narrows Creek.....	July 31-Aug. 2	150	109	20,700	20,604	35	8,627	11,942
Paula Creek.....	Aug. 5-8	—	—	—	1,406	—	591	815
Rossette Creek.....	July 31-Aug. 4	1,066	6,808	152,900	6,355	50	2,522	3,783
Sakeniche River.....	Aug. 5-8	—	0	150	3,382	—	1,420	1,962
Shale Creek.....	Aug. 5-8	30	250	3,000	3,809	—	1,600	2,209
25 Mile Creek.....	Aug. 5-8	—	0	3,300	2,167	—	910	1,257
Misc. Streams.....	Aug. 5-8	10	2	1,112	5,484	—	2,304	3,180
LATE RUNS								
Kazchek Creek.....	Sept. 2-5	25	952	1,500	7,903	2	3,682	4,219
Kuzkwa River.....	Sept. 15-18	—	—	—	3,686	5	1,703	1,978
Middle River.....	Sept. 11-15	4,500	22,804	126,400	235,572	71	109,753	125,748
Pinchi Creek.....	Sept. 15-20	—	—	—	72	—	36	36
Sakeniche River.....	Sept. 10-15	—	—	—	104	—	52	52
Tachie River.....	Sept. 15-18	900	751	20,000	107,506	215	49,633	57,658
NORTHEAST								
Upper Bowron River.....	—	1,199	4,094	22,283	13,517	240	6,782	6,495
TOTALS.....	—	427,874	482,230	1,116,118	1,274,346	235,835	476,031	559,415

to the Chilcotin River, 4422 sockeye were observed spawning on the lake shore. A population of 78 spawning sockeye was found in Gates Creek at the head of the Seton-Anderson Lake system. Also 50 spawners and 150 jacks were recorded in Portage Creek, which joins Anderson and Seton Lakes. A population estimated to be 350 sockeye was discovered by fisheries guardians as they were spawning on the gravel beaches of Pitt Lake.

Escapements to the lower river spawning areas were generally satisfactory primarily because of extended fall closures imposed by the Department of Fisheries for the protection of pink salmon. The escapement of those runs which were fished extensively, the Silver Creek and Birkenhead runs, declined considerably over that of the preceding cycle or brood year. Increased restrictions on the fishery for the runs migrating in mid-August and September is indicated as being necessary.

THE 1954 CYCLE

The Fraser River sockeye runs of the 1954 cycle have enjoyed almost full protection from the fishery during the month of July for the two preceding cycles. In 1946 the fishing season did not open in Convention waters until July 25 and the Fraser River was closed until August 8. The 1950 sockeye fishing season opened in all Convention waters on July 31. In spite of the July closures on two preceding cycle-years there is no evidence that the catch of sockeye will be very substantial during July of the coming season. Several important races appear to be establishing a high rate of productivity in other cycles, and, as a result of returning "quadrennial dominance", the productivity of these races is apparently being held at a low level on the 1954 cycle.

The Early Stuart run, which appears in the fishery during the last few days of June and the first ten days of July, is expected to be only a small fraction of the 1953 run which exceeded 1,000,000 sockeye. Productivity of the 1946 escapement was the lowest of the four annual cycles and the number of three-year-old jacks produced by the 1950 escapement of 60,000 sockeye was very small. However, it is important to note that the size of the 1950 Early Stuart escapement is sufficiently large to produce a sizeable run in 1954 if a high rate of productivity *was* obtained in the brood year.

There is some indication that the Bowron and Nadina runs, which follow the Early Stuart run, may show a high survival rate, but even so the two runs combined will not be of sufficient size to provide satisfactory catches. Little is known about the Pitt River run except that the escapement was small on the five-year-cycle brood year and the predominant age at maturity of these fish appears to be five years. Very few sockeye are expected in the Horsefly and Late Stuart runs because of very small escapements in the brood year. In respect to Chilko Lake, the 1954 cycle has the poorest rate of production of the four cycles. Very few three-year-old jacks were observed on the spawning grounds in 1953, and the downstream migration of 1950 brood yearlings was estimated at the low figure of approximately 500,000 fish. Other small races such as Seymour, Raft,

and Taseko are expected to contribute to the July catch in a minor degree, but not sufficiently so to provide a productive July fishery.

Contrary to the expectations respecting the size of 1954 July sockeye runs, all of the 1954 August runs with one exception appear to have a possibility of increasing in size over the runs of the 1950 brood year. The Stellako race, which normally appears in the fishery in early August but which may in certain years appear in the United States fishery in late July, shows indication of a high survival rate. The indications of a high survival rate in 1954 are: 1. The failure of the 1953 run; 2. A record number of three-year-fish on the spawning grounds in 1953; and, 3. An excellent escapement of 145,000 fish in the brood year.

The Birkenhead run, which follows the Stellako run, is the one exception to a generally expected improvement in the 1954 August fishery over that of the brood year. A decline in the Birkenhead population is possible.

The Adams River run, which has been the principal producer of this cycle since 1926, should have a definite increase in population size as compared with the size of the 1950 population. Spawning conditions in the brood year were excellent, the fry hatch was good, the seaward migrants showed signs of heavy food competition, and the run of jacks in 1953 is believed to be the largest on record. Some factors which indicate a possible limitation on population size are an increase in the ratio of jacks to adults over the past eight years and a decline in general productivity of the Adams River run for the past four years.

Late runs to the lower Fraser River are expected to be relatively good.

REHABILITATION OF BARREN AREAS

The first experimental tests involving the transplantation of sockeye were completed in 1953. Eggs artificially spawned in 1949 from a few individuals of the native Horsefly River spawning population were incubated and hatched, and the resulting fingerlings were raised in the Quesnel Field Station located on Horsefly Lake (Figure 2). The purpose of this experiment was to determine whether native fish would return to their original spawning area when artificially propagated. The experiment was not intended to assist in the rehabilitation of the area but was designed as a control study of artificial transplantations from one stream to another. If artificially propagated native fish would not return, the failure of the contemplated transplantation experiments might be due to the hatchery operation itself rather than to any adverse physiological or other disturbance created by the transplantation method.

In November of 1950, 94,000 fingerlings remaining from the original hatch of native Horsefly River eggs were transported by air to Quesnel Lake at the mouth of the Horsefly River. In order to identify any spawners returning from this plant, 64,500 of the fingerlings were marked by the excision of the adipose and right ventral fins. The number of marked fish was rechecked by weight at the time of planting, and it was ascertained that no fish had escaped the rearing facilities into Horsefly Lake between the time of marking in October and the time of planting in November.

TABLE VII
DAILY CATCH OF SOCKEYE, 1942-1946-1950 FROM UNITED STATES TREATY WATERS

Date	JULY			AUGUST			SEPTEMBER		
	1942	1946	1950	1942	1946	1950	1942	1946	1950
1	30			436	10,851	15,403	180,185	53,804	343
2				13,845	8,930	20,880	118,421	131,748	42
3	58			11,844		25,058	10,618	92,579	16
4	14			12,727	12,163		906	71,241	3
5	585			14,723	7,745			62,452	18
6	105			21,753	15,543	16,961	378	79,725	
7	563			24,290	34,751	34,588	7,262		968
8	225				47,971	48,134	589	41,085	713
9	588			20,550	38,902	41,470	787	94,111	
10	1,596			23,806		36,990	4,455	103,522	207
11				32,832	23,838		4,070	92,895	393
12	2,976			36,887	23,799			13,347	297
13	1,977			46,301	29,522	55,865	33	7,562	56
14	939			40,801	35,193	26,563	13		62
15	155				34,903	18,115	13	8,342	46
16	1,652			17,384	43,047	36,042	20	8,599	
17	1,579			24,075		52,889	144	21,893	898
18				52,395	27,381		124	9,173	483
19	4,220			74,633	43,713			11,005	2,427
20	2,874			88,366	63,070	138,217	77	705	365
21	10,993			162,510	64,503	153,568	250		124
22	5,232				55,089		106	4,882	67
23	9,551			263,589	54,416	100,173	130	2,197	
24	7,219			251,749		131,748	3,002	1,696	12
25		305		192,006	89,452	107,788	773	1,846	21
26	12,747	87		159,915	134,956				14
27	7,930			302,628	290,642	83,504	1,350		17
28	17,316	172		150,166	542,836	38,212	15,418		18
29	12,500	321			366,879		16,468		11
30	17,542	189		59,360	531,426	16,818	26,608		
31	9,167	4,302	14,286	280,408					
Totals	130,333	5,376	14,286	2,379,979	2,631,521	1,198,986	392,200	914,409	7,621
Oct. Total							32,680	4	
Season Total							2,935,192	3,551,310	1,220,893

TABLE VIII
DAILY CATCH OF SOCKEYE, 1942-1946-1950 FROM CANADIAN TREATY WATERS

Date	JULY			AUGUST			SEPTEMBER			OCTOBER		
	1942	1946	1950	1942	1946	1950	1942	1946	1950	1942	1946	1950
1	3,020			257	946	25,874	102,430		312	110,082		
2	2,277				947	26,390	170,801	67,498		93,082	828	4,531
3	4,054			18,857		30,775	202,875	146,709	120		285	1,290
4				8,899			164,307	190,107	19,760		223	1,172
5				7,276	72			144,135	12,062	109,738		1,296
6	12,080			6,169	230	11,031		93,529	26,320	86,284		
7	8,995			8,744	71	53,074	127,307		978	84,945	241	
8	8,877				14,075	31,653	269,416		150	46,755	221	
9	6,950				7,475	20,121	416,793	120,686		35,102	194	1,040
10	5,267			37,239		21,189	284,200	84,121	307		151	309
11				20,035		296	315,568	599,942	50		87	351
12				14,224	61,254			80,620	50	26,373		290
13	8,774	CLOSED	CLOSED	21,446	29,700	14,679		312,505	58	7,704		
14	2,533			21,348	21,513	49,953	559,614		16	6,616	560	
15	6,534				16,307	29,973	688,050		16	5,005	206	
16	5,264				18,042	32,366	85,579	327,366		4,126	226	117
17	4,623			45,661		38,300		218,704	16		194	70
18				25,344				162,323	15		102	49
19				43,370	53,008			151,372	15	1,588		59
20	14,721			33,322	22,382	71,775		82	15	799		
21	6,664			48,105	22,574	42,085	1,730		10	1,915	110	
22	9,316				27,513	29,217	217		8	1,402	53	
23	8,112				33,499	45,742	1,547	356,118		1,260	15	75
24	6,827			102,677		52,525		202,150			24	128
25		275		86,859		21,972		25	29,235		10	135
26		275		64,779	165,805				10,835	1,360		106
27	7,708			76,335	324,065	3,118			10,663	712		
28	7,312			70,688	89,112	40,252	3,775		4,980	1,211	3	
29	7,875	187			36,545	19,577		CLOSED		936	2	
30	10,257	188			29,361	13,918				466		94
31	11,670	188	31,679	86,985		7,737						5
Totals	169,710	1,113	31,679	848,619	974,496	733,592	3,394,209	3,257,992	115,991	627,461	3,735	11,117
8" Gill Nets		1,027			1,126							
May & June												
Totals	2,042	575	2,042									
Nov. Total										5,558	134	48
Season Total										5,047,599	4,240,198	894,469

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TABLE IX
SUMMARY OF THE SOCKEYE ESCAPEMENT TO THE FRASER
RIVER SPAWNING AREAS, 1938, 1942, 1946, 1950

District and Streams	Period of Peak Spawning	Estimated Number of Sockeye				Jacks	Sex Ratio	
		1938	1942	1946	1950		Males	Females
							4-5 yr.	4-5 yr.
LOWER FRASER								
Cultus Lake.....	Nov. 23-30	13,342	37,305	33,284	30,595	667	10,027	19,901
Upper Pitt.....	Sept. 11-14			18,520	42,800		23,369	19,431
Widgeon Slough.....	Nov. 3	400	529	1,404	600		349	251
HARRISON								
Big Silver Creek.....		—	7+	—	25	—	—	—
Douglas Creek.....		—	67	—	100	—	—	—
East Creek.....		104+	—	200	100	—	—	—
Harrison River.....	Nov. 6-10	0	112	15,631	33,860	819	14,711	18,330
Hatchery Creek.....		1,950	875	1,000	150	—	—	—
Weaver Creek.....	Oct. 16-18	21,500	19,000	36,000	30,700	190	13,720	16,790
LILLOOET								
Birkenhead River.....	Oct. 3	11,000	87,000	90,000	72,567	8,128	19,956	44,483
Upper Lillooet Streams.....		—	—	—	200	—	—	—
SOUTH THOMPSON								
Seymour River.....	Aug. 24-Sept. 5	—	1,950	2,600	12,000	1,368	5,772	4,860
Scotch Creek.....		—	—	—	0	—	—	—
Adams Lake & tributaries...	Oct. 16-20	—	200,000	6,000	2,000	—	—	—
Adams River.....	Oct. 16-20	600,000	1,968,000	1,835,000	848,500	19,515	430,190	398,795
Little River.....	Oct. 16-20	175,000	400,000	419,000	376,900	15,830	182,535	178,535
Shuswap Lake.....	Oct. 16-20	1,130	Present	36,000	29,100	—	—	—
South Thompson River.....	Oct. 16-20	—	Present	92,000	41,500	—	—	—
NORTH THOMPSON								
Raft River.....	Aug. 25-Sept. 5	500	450	3,000	6,400	—	2,989	3,411
CHILCOTIN								
Chilko River.....	Sept. 20	6,000	34,100	58,600	29,800	8,677	9,223	11,900
Chilko Lake.....		—	—	350	Present	—	—	—
Taseko River.....		—	—	—	500	—	—	—
QUESNEL								
Horsefly River.....	Aug. 25-27	0	0	58	400	—	119	281
Little Horsefly River.....	Oct. 10	—	0	—	6	—	—	—
Mitchell River.....		0	0	2	0	—	—	—
NECHAKO								
Endako River.....	Sept. 1	65	309	368	900	8	412	480
Nadina River.....	Aug. 23	30	62	66	1,950	—	995	955
Nithi River.....	Aug. 16	50	1	4	125	—	47	78
Ormonde Creek.....	Aug. 19	8	54	193	732	3	346	383
Stellako River.....	Sept. 30-Oct. 1	3,077	48,064	245,200	145,100	87	58,954	86,059
STUART								
Ankwil Creek.....	Aug. 16	—	—	—	67	—	—	—
Bivouac Creek.....	Aug. 8-12	—	—	—	2,320	—	—	—
Driftwood River.....	Aug. 23	0	—	5	144	—	—	—
Dust Creek.....	Aug. 16	—	—	—	1,125	—	—	—
25 Mile Creek.....	Aug. 16	—	—	—	521	—	—	—
15 Mile Creek.....	Aug. 16	—	—	—	54	—	—	—
5 Mile Creek.....	Aug. 16	—	—	—	162	—	—	—
Fleming Creek.....		3	—	—	—	—	—	—
Forfar Creek.....	Aug. 8-12	2,608	3,244	1,822	10,259	33	4,981	5,245
Forsythe Creek.....		—	—	—	2	—	—	—
Frypan Creek.....	Aug. 16	—	—	—	69	—	—	—
Gluske Creek.....	Aug. 8-12	—	1,734	2,905	11,007	15	4,466	6,526
Kazcheck Creek.....		2	1	60	243	—	—	—
Kynock Creek.....	Aug. 8-12	1,575	1,949	1,843	24,644	192	12,534	11,918
Leo Creek.....	Aug. 16	—	—	—	97	—	—	—
Middle River.....	Sept. 14-15	31	Present	488	2,600	—	1,368	1,232
Narrows Creek.....	Aug. 16	64	100	277	2,265	—	—	—
Point Creek.....	Aug. 16	—	—	—	42	—	—	—
Rossette Creek.....	Aug. 8-12	10	929	2,641	6,260	40	2,903	3,317
Sakeniche Creek.....	Aug. 16	—	—	—	234	—	—	—
Shale Creek.....	Aug. 16	—	50	61	628	—	—	—
Tachie River.....		—	—	14	200	—	—	—
NORTHEAST								
Bowron River.....		1,305	1,826	6,951	16,266	—	7,938	8,328
TOTAL.....		839,754	2,807,718	2,893,027	1,786,819			

A total of 6829 three-year-old mature adult sockeye returned to the Horsefly spawning grounds in 1952. Of this number 2228 fish were observed carefully for marks but no marked fish were found. All of the tributaries of Quesnel and Horsefly Lake were checked for adult sockeye; one unmarked male was found in Mitchell River, tributary to Quesnel Lake, and two unmarked males were observed in the Little Horsefly River. Thirteen three-year-old sockeye, nine of which were marked, were taken at the outlet of the rearing ponds in Horsefly Lake. Since no sockeye had been observed previously at this point and since nine of the fish caught were marked and were known to have originated from the fish planted at the mouth of the Horsefly River, all of the fish are considered to be returns from this plant of 94,000 fingerlings.

In 1953, 105,000 four-year-old adult sockeye returned to the Upper Horsefly River. Of this number 46,917 were observed for marks and only one marked fish was observed. All other tributaries of Quesnel and Horsefly Lake were again observed for marked fish with negative results. Both marked and unmarked fish returned to the hatchery outlet pipe, 203 marked and 66 unmarked being taken between August 22 and September 3. In addition, fifteen marked fish were recovered dead and spawned-out in that area of the Horsefly River lying just upstream from the confluence of the Little Horsefly River which drains Horsefly Lake. The markings of the fingerlings obviously did not increase the mortality rate during the three years intervening between the marking and the return of the adult fish.

It may be concluded that all of the surviving marked fish returned to the hatchery or to that portion of the Horsefly River lying adjacent to the hatchery drainage stream, the Little Horsefly River. These fish did not, with one known exception, return to the spawning grounds of their parents. The return to the hatchery is rather remarkable since these fish as fingerlings had not migrated down the Little Horsefly River or the Horsefly River in gaining access to Quesnel Lake where, based on an examination of their scales, they spent from November until the following spring in company with the naturally-produced fingerlings before proceeding seaward. The journey to Quesnel Lake had been by air, and yet the major portion of surviving adults returned to the hatchery via the Horsefly and Little Horsefly Rivers.

Obviously there was some attractive force originating while the fish were eggs or fingerlings at the hatchery which caused the adults to return to the area where they were incubated and reared rather than to the spawning grounds of their ancestors. Furthermore, it seems that this force, whether it be an olfactory reaction or otherwise, is the controlling influence over the behavior of the returning adult sockeye as they approach the area of influence. Whether the same influence functioned all the way from the sea to the Horsefly River is not known. There is evidence to the contrary in the unpublished transplantation records on other species of salmon in the State of Washington. In the Washington experiments it was proved conclusively many times that coho salmon *O. kisutch* and spring salmon *O. tshawytscha* fingerlings would return as adults to the point of release—not the stream in which they were reared. However, in these cases the fingerlings

were not incubated or reared in the same watershed in which they were planted. The watershed where the fish were reared and the watershed where they were planted had separate confluences with the sea in all cases. In some cases the separate confluences were less than fifteen miles apart and the watershed of the rearing stream was on the marine route of adult migration to the planting watershed. If the rearing and planting areas in the Washington experiments had been on separate tributaries of the same watershed the results of the Horsefly experiment indicate that the fish might have returned to the rearing area rather than to the planting area.

Whatever the guiding force may be that influenced the return of the sockeye to the Quesnel Station on Horsefly Lake, the changed environment had no changing influence on the timing of the return migration. *The marked adults returned and spawned at precisely the same time as the natural run up the Horsefly River.* The timing of the run may be inherent but the destination of the run obviously can be changed. Therefore, it remains that two requirements, (1) equal migration distance from the sea of the donor and stocking areas, and (2) similar environmental conditions in the two areas, must be met if a population capable of successful natural reproduction is to be established in the stocking area. These requirements were assumed without proof at the beginning of the transplanting experiments and the above results justify the logic of the original assumption.

The total returns from the experiment are calculated to be 302 three-year-old and four-year-old adults to the spawning grounds and 875 to the fishery giving a total survival of 1177 adult sockeye or 1.25 per cent of the original plant.

The second completed test involved the transfer by air of "green" Seymour River sockeye eggs to the Quesnel Station in the fall of 1949. These eggs were incubated and the resulting fry were reared in exactly the same manner as the Horsefly eggs and fry. In November, 1950, coincident with the planting of the 94,000 Horsefly fingerlings in Quesnel Lake, 84,000 Seymour River fingerlings originating from the green eggs taken in 1949 were flown to Adams Lake and planted in the current of the Upper Adams River. A total of 30,000 fingerlings of this lot were marked by the excision of the adipose and left ventral fins.

No examination of the Upper Adams River for the possible return of three-year-old sockeye was made in 1952 but a very careful examination of this stream and all the tributaries of Adams and Shuswap Lakes was undertaken during August and September of 1953. No sockeye, either marked or unmarked, returned to the tributaries of Adams Lake, and no marked sockeye were found in the tributaries of Shuswap Lake. The spawning populations of Kokanee in the various tributaries of Adams Lake were likewise observed for marked fish to partially eliminate the possibility of the planted fish adapting themselves to fresh water environment and maturing there. No marked Kokanee were found, and of course no marked adults returned to either the Seymour River, the brood stream, or to Horsefly, the watershed where the fingerlings were incubated as eggs and reared prior to planting. Since no positively identifiable marked fish of this test group were recovered in the commercial catches, and 26 of the Horsefly group were observed from spot observations of the commercial catch



FIGURE 2. Commissioner Thomas Reid observing a marked sockeye, one of 203 which returned to the Quesnel Field Station where the fish were reared.

it appears logical that the planted fish may not have survived the effects of transplanting or perhaps the remaining period of their fresh water existence.

A group of Seymour fingerlings handled in the same manner as in the above experiment except for improved transplanting methods are expected to mature in 1956. In 1954 a return also may be expected from an "eyed" egg planting of 667,000 Seymour eggs in Upper Adams River. Experiments involving the transfer of naturally hatched fry and mature adults will be undertaken in the future in an attempt to obtain a successful return of spawning sockeye and thus bring Upper Adams River and Adams Lake back as a natural sockeye producing area. There is as yet no reason to be pessimistic about the possibility of accomplishing such a feat by one method or another.

A study of the problems involved in constructing artificial spawning grounds was started in 1953 at the Quesnel Field Station. A small spawning ground utilizing forced sub-surface percolation of water was constructed in one of the rearing ponds, and a portion of the marked adult sockeye returning to the hatchery were introduced into the area. Spawning was reasonably successful, and the naturally incubated eggs will be observed periodically during the winter of 1953-54 to determine possible faults in the design of the experiment. Several lakes in the Fraser system apparently have not been productive in the past because of the lack of natural spawning grounds. Horsefly Lake is one of these natural rearing areas and should be capable of supporting several millions of sockeye fry if a natural spawning area could be artificially constructed at a reasonable cost which would require little or no maintenance.

WATERSHED PROTECTION

During 1953 the problem of maintaining and protecting the fresh-water environment of the Fraser sockeye continued to expand in importance and complexity. Population growth and industrial development in the watershed raise new problems in effective co-operative water use. The ability of the river system to produce salmon in abundance depends on the continued existence of many environmental characteristics. Factors such as temperature, turbidity, velocity, depth and degree of pollution, can be varied only slightly without reducing the productivity of the important spawning and rearing areas. In the important task of maintaining and protecting the environment the Commission has no direct authority; it works closely with the Canadian Department of Fisheries, which enforces the laws for protection of the fisheries resource.

A dam proposed for construction on Seton Creek by the B.C. Electric Company provides an example of the co-operative approach of the Department of Fisheries, the Commission, the developers of the project, and the various other agencies concerned with the resulting fisheries problem. The dam, now under construction below the outlet of Seton Lake, will have a head of about 25 feet and will serve to divert the outflow of Seton Lake into a canal and through a turbine operating under 138 feet of head on the bank of the Fraser River 2.5 miles away. Pink salmon, spring salmon, coho salmon, and steelhead spawn in the two-mile length of Seton Creek between the damsite and the Fraser River.

Sockeye must pass through Seton Creek enroute to their spawning areas in Portage and Gates Creeks farther upstream in the watershed.

In a series of meetings between representatives of the various fisheries agencies and the B. C. Electric Company, four major problems in fisheries protection at this project were defined. These problems are:

1. Avoidance of a situation wherein the salmon would be attracted to the tailrace outflow and therefore not progress upstream. Adult salmon ascending the Fraser to enter Seton Creek will encounter a large volume outflow (4500 cubic feet per second) of Seton Creek water at the power plant tailrace some four thousand feet downstream from the comparatively insignificant outflow of the natural stream mouth.
2. Provision of a guaranteed minimum flow in Seton Creek for successful spawning and rearing of spring salmon, coho salmon, and steelhead, and sufficient flow for the migration of sockeye and other species through the creek to the upper tributaries.
3. Provision of adequate fishways to enable sockeye and other species enroute to spawning grounds above the dam to surmount the dam.
4. Passage to sea of year-old sockeye without significant mortality in the power turbine.

A series of technical meetings and technical investigations produced recommended procedures for fisheries protection at the project. These recommendations were approved by the Commission and accepted by the Company by agreement with the Canadian Department of Fisheries. These recommended procedures are:

1. Intermittent operation of the power plant which will result in periods of no flow in the tailrace and thus allow any salmon collected there to be attracted upstream to the natural creek mouth.
2. Release of a minimum flow of 200 cubic feet per second through a special outlet works at the dam at all times to assure spawning, rearing, and migration flow in the creek below the dam. This flow will be increased to 400 cubic feet per second during the months of migration and spawning.
3. Year-round operation of a vertical-baffle type fishway in the dam, eight feet wide and 380 feet long, having a drop of nine inches between pools. Flow through the fishway will provide part of the required minimum flow in the creek channel.
4. Carrying out of yearling sockeye turbine mortality tests. Experiments conducted on a turbine at Ruskin Dam identical with the unit to be installed at Seton Creek indicate that turbine mortality rates for yearling sockeye passing through were approximately 10 per cent. Tests must be conducted at the Seton turbine when it is completed but it is judged

that a low mortality rate may exist, which will obviate the necessity for construction of expensive protective devices.

Large scale dynamic hydraulic model studies were made by the fisheries agencies at the University of British Columbia to guide the design of the fishway and the channel water-supply facilities at the dam. It is noteworthy that these studies not only served to modify and affirm the design of these structures but that observations made during these investigations resulted in an arrangement whereby Commission engineers were engaged to make model studies of the entire complex energy dissipation system on the spillway apron.

Co-operation of this type—carried on before and during the planning of a water-use project involving fisheries—cannot fail to lead to the most effective and economical multiple use of water with advantage to all concerned.

Pollution problems arising from waste disposal at an oil refinery nearing completion on the Thompson River were met in a similar way. The waste materials from this 5000-barrels-per-day refinery will be lagooned after treatment to allow oxidation, percolation, and evaporation to reduce the quantity and toxicity of the effluent. The water supply intake will be screened to prevent loss of fry or fingerlings. The Department of Fisheries, the Fisheries Research Board of Canada, and the Commission collaborated in the issuance of a report dealing with wastes from oil refineries wherein recommendations for their disposal were made.

Sockeye successfully passed upstream through the portions of the Nechako River reduced in flow by closure of the Kenney Dam in October, 1952. The successful passage of the Nadina, Stellako, Early Stuart, Late Stuart and other lesser races in 1953 was greatly aided by the wet season and cool climatic conditions existent in the area during the migration season. As a result of the climatic conditions the residual flows from the watershed area lying below the dam were high, and water temperatures remained below lethal levels. It was unnecessary to release water from the specially-constructed Cheslatta reservoir to augment flow during the 1953 sockeye migration period. However, a continuous release of 400 cubic feet per second was required by the Department of Fisheries for spring salmon migration, and approximately 100 cubic feet per second is being released throughout the winter and spring for the incubation, emergence, and residence of spring salmon fry. Arrangements for fisheries protection at this project also are being conducted by the Department of Fisheries with the Commission active to the extent compatible with the provisions of the Treaty under which it operates.

An aftermath of the closure of Kenney Dam occurred in the Nautley River in 1953. This half-mile-long stream drains Fraser Lake into the Nechako River. The Nadina and Stellako races of sockeye must pass through it enroute to their spawning grounds. The lowering of the level of the Nechako River after closure of the dam increased the flow gradient of the Nautley River. When the Nautley flow increased seasonally in the spring and summer of 1953, the stream bed would not support the increased gradient, and rapid erosion began. The erosion

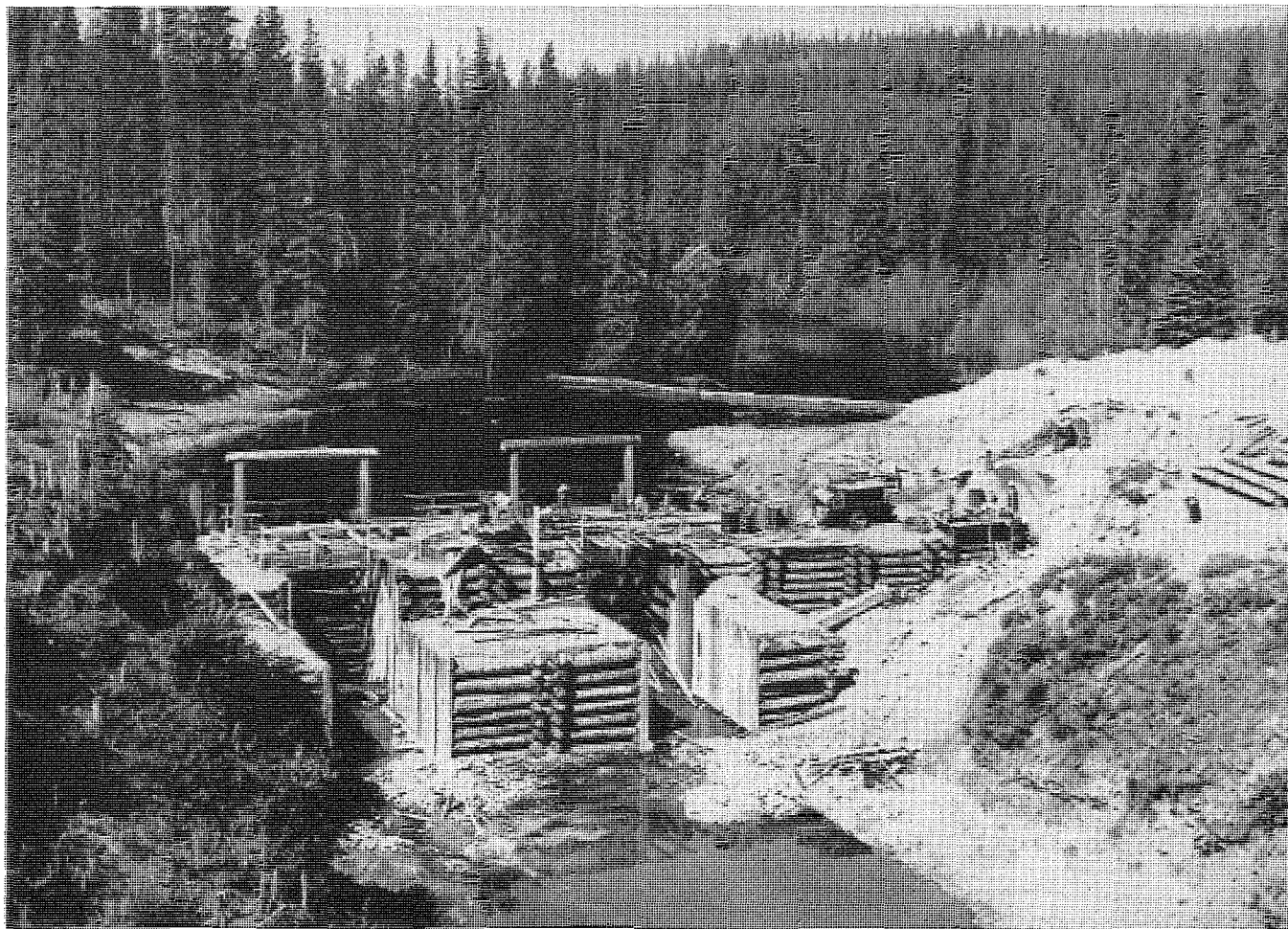


FIGURE 3. Storage Dam at the outlet of the Cheslatta Lake system built by the Aluminum Company of Canada Ltd. to supply auxiliary water for migrating salmon during the low flow periods of the residual Nechako River.

proceeded rapidly upstream, threatening destruction of the bridge on Trans-Provincial Highway 16 and threatening to lower the level of Fraser Lake as much as eight to ten feet. Since this important sockeye rearing lake is already very shallow, having a mean depth of 46 feet, there was urgent need to control the erosion.

The Aluminum Company of Canada, builders of Kenney Dam, acted quickly to plan and construct a controlled-drop section in the Nautley River using heavy quarried rock. The structure is 175 feet long and will allow the river to fall as much as 10 feet on a grade of 5.7 per cent. Neither the erosion-control ability of the structure under flood conditions nor its passability by salmon have yet been tested. Emergency action to save the bridge and maintain lake level was necessary—modification, if required for the passage of fish, can be made with the assurance that the rearing ability of Fraser Lake is unimpaired.

Detailed studies of the movements of fish in the entire Nechako system in relation to water temperatures and discharge rates will again be undertaken in 1954. Spill from the reservoir behind Kenney Dam may be available in time to aid the salmon runs of 1955. The time of availability of this spill depends upon the rapidity with which the 19.6 million acre-foot capacity reservoir is filled.

Early in the summer the Commission installed an 18-inch-diameter steel siphon at the outlet of Weaver Lake. The siphon, 210 feet long, will draw a maximum of 15 cubic feet per second of water from storage in the lake to augment reduced flow in Weaver Creek and make possible the migration and spawning of sockeye on schedule. Without auxiliary flow, in occasional years thousands of spawning sockeye were delayed or perished while waiting to enter the creek. The prevalence of wet weather during the late summer and early fall of 1953 made operation of the siphon unnecessary. The siphon is entirely automatic in operation except for an initial priming operation which requires the use of a portable auxiliary pump. Reconnaissances were made and reports are being prepared concerning the relationship of all potential water-uses—especially power, irrigation, and fisheries—in the Clearwater, Bonaparte, and Salmon River (tributary to Shuswap Lake) watersheds. None of these systems supports sockeye salmon at present, although the Salmon River was an important spawning area before 1913. It has been suggested that the Clearwater system can be developed to supply hydro-electric power for the central interior of British Columbia, including the communities of Prince George, Quesnel, and Kamloops. From the viewpoint of the Commission, with its responsibility for fisheries, this development is to be highly commended because it offers a large block of centrally-located economical power and a minimum of hazards to salmon. A detailed report presenting and supporting this view will be available shortly.

The program of sounding and mapping all of the sockeye rearing lakes in the Fraser River watershed was completed in 1953. The maps, showing bottom contours as determined with a Bendix depth recorder, will be incorporated into a contemplated reference work cataloging the physical environment of the Fraser River sockeye.

Fishway maintenance work proceeded without unusual incident in 1953. Silt and gravel accumulated during high water was removed in late autumn, protective gratings were repaired and painted, and all other routine maintenance tasks were completed. The left bank main fishway at Hell's Gate receives an unavoidable battering on its deck gratings each winter. Rock, spalled by ice and snow from the towering cliffs above, may fall as far as 600 feet before hitting the gratings or deck. The structures are designed to resist such blows, but superficial damage is unavoidable.

An artificial spawning area was constructed by modification of a rearing pond at the Horsefly hatchery. A perforated pipe grid supplies water which flows upward through a gravel bed. Different rates of flow were supplied to each of three separate sections of the spawning bed. Two hundred and three of the sockeye which had returned to the hatchery, as described elsewhere in this report, were introduced into the artificial enclosure where they spawned successfully. The results from this experiment and from others conducted on a laboratory scale will be used in assessing the possibility of constructing spawning areas above lakes which are suitable for rearing sockeye but which have no natural spawning tributaries.

Each year the Commission notes an increase in the trend toward pollution in the Fraser River watershed. The many potential sources of pollution—domestic sewage, oil refinery wastes, pulp mill, brewery, steel mill effluents, and many others—are inevitable results of growth of the Province, and all will affect the maintenance and increase of the fishery resources of the Fraser River basin. An accelerated program of investigation and acquisition of technical knowledge, and a continuance of the close and efficient liaison between the Commission, the Department of Fisheries, other regulatory agencies, and the developers of all industrial projects is vital to continued success in safeguarding the Fraser River sockeye without interference with industrial development.

MANAGEMENT RESEARCH

The management pattern established by the Commission in 1946 was essentially one involving racial protection in the fishery. This was a primary necessity for restoring once-great populations of sockeye from numerical strengths of only a few fish to numbers sufficiently great to permit continued rehabilitation of these populations while still allowing them to undergo the effects of an intense fishery. Through protection from the fishery, coupled with the benefits of the Hell's Gate fishways, many of the races of sockeye responded astoundingly well—so well, in fact, that a new policy of management was inaugurated in 1951 which permitted, with occasional exceptions, a fishery on all races throughout the migration season. In spite of this almost even fishing pressure rehabilitation has continued and escapements have increased. *Only one known race of sockeye is extinct*; this is the upper Adams River race which was decimated even prior to the Hell's Gate slide by a logging splash dam—now removed. The attempts to restore this run have been discussed in previous annual reports and elsewhere in this report.

The essential formulas for obtaining maximum rehabilitation and providing full protection through regulation to produce maximum sustaining runs are far from complete. Aside from the serious and continuing responsibility of obtaining increasing racial escapements and dividing the allowable catch, research must continue at a concentrated pace so that these formulas can be provided as soon as possible. Without such formulas a serious danger exists that mistakes may be made in the regulatory recommendations which could actually decrease productivity and forestall the benefits of maximum catches. Research is being continued along well-established paths detailed briefly as follows:

1. Statistics

Analysis of catch statistics is being done on both a current and a historical basis. This is essential to measuring racial fishing mortality each year and assessing, at least approximately, the original sizes of the racial populations based on the daily catch by time in the earlier years. The success of this investigation depends on isolation of races by time and numbers in the fishery. The most promising method of accomplishing this isolation is through the study of scales.

2. Scale Study

Daily scale samples are taken from the fishery and from each spawning ground to assess racial timing, racial fishing mortality by age and sex, and the racial escapement by age and sex. In addition, the fresh-water growth pattern is being observed as a possible means of predicting the effect of fresh-water growth conditions on adult survival. Related to this study is the enumeration of spawners.

3. Spawning Enumeration

Each racial escapement is enumerated by tagging, by proven live-count indices, or in some cases by weirs—thus establishing the magnitude, age composition, and size of fish of each spawning population. Success of spawning and factors related thereto are included under another study concerning environment.

4. Environmental Study

Established sampling methods are followed to determine the number of eggs incubated by all spawning populations; and the related environmental factors such as water temperature and river discharge are recorded. In some instances the fry hatch, fry distribution, and number of seaward migrants are recorded annually. The possibility of the fishery affecting productivity is also studied.

5. Selectivity of the Fishery

Since the fishery is capable of taking almost 100 per cent of the run, unless restricted periodically, the effect of the fishery on the timing of the escapement is being observed in the case of large populations. The change in size, sex, and age composition of the escapement caused by the fishery is likewise being observed, and the effects of such selectivity

on the productivity of the escapement is measured by controlled experiments. The required closed seasons are being determined in part by another study of spawning ground limitations.

6. Spawning Grounds Study

The physical sizes of the available spawning grounds are being surveyed and the various areas are classified by depth of water, gravel size, and velocity of flow. The distributions of spawners of various numbers are charted annually in some cases so that a maximum limitation in the number of spawners can be assessed pending the discovery of a relationship between numbers of spawners and maximum productivity. It should be noted that most of the Fraser River spawning areas are capable under natural conditions of producing only one large run every four years. This is known as "quadrennial dominance."

7. Dominance Study

The relationships of food abundance, competitors, predators, and parasites are being studied in two large lake systems so that the cause of quadrennial dominance may be eventually understood. Associated with this study is the need for establishing the proper catch-escapement ratios in the low years of productivity when the entire run may not ever be sufficient to seed the available spawning grounds.

All of the above investigations are related to each other, and before any of them can be *fully* completed they must all be completed. For this reason progress is slow; the integration of all of the data collected over a number of years is a difficult task. When the task is completed the management of the fishery will be an administrative function complicated only by the continuing potential adverse effects of industrial development of the Fraser Watershed. The latter is in itself a major challenge.

1953 PUBLICATIONS

1. Annual Report of the International Pacific Salmon Fisheries Commission for 1952.
2. A Report on the Wastes from Oil Refineries and Recommendations for Their Disposal (Mimeographed). Prepared by the Technical Staffs of the Department of Fisheries of Canada, the Fisheries Research Board of Canada and the International Pacific Salmon Fisheries Commission.

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