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

1942

COMMISSIONERS

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REPORT OF THE INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION FOR THE YEAR 1942

The work of the Commission during 1942 has been dominated by the need for removal of an obstruction in the Fraser River at Hell's Gate. Proof of the obstruction had been obvious during the season of 1941. With this proof it became necessary to prepare permanent remedial measures. Since the nature of these could not be determined without time-consuming research, temporary expedients were adopted to avoid possible disaster to the large run of 1942.

It is plain that a permanent remedy for this obstruction is necessary to the future effective action of the Commission in rehabilitating the run of sockeye into the Fraser River. This is true in each of the several phases of the task of the Commission, whether of investigations into natural history, propagation, or regulation.

The convention under which the Commission was appointed in the fall of 1937 provided specifically for a thorough investigation into (1) the natural history of the sockeye salmon, (2) methods of increasing propagation by both hatchery and natural means, and (3) the desirability of removing any obstructions to migration which might exist or occur. Corresponding powers and authority are given the Commission to make its findings effective by the conducting of fish-cultural operations, recommending the removal of obstructions, and regulating the fishery under such conditions as are set forth in the convention.

In all of these functions the obstruction at Hell's Gate plays a very important and basic part. In the natural history investigations the timing and characteristics of the runs to the spawning ground, the presence or absence of sockeye in various parts of the Fraser, and many other subjects of interest, are affected greatly by the obstruction. In systems of propagation it would appear hardly possible to save fish for spawning or increase the production of young if the spawners are lost en route. This would apply especially to those runs now depleted because they are most subject to block. The same can be said of regulation as of propagation. It seems imperative to remove this obstruction, not only for the sake of the fish lost each year, but for the sake of the future efficiency of the Commission in each of its various functions.

In the fall of 1941, even before the run of sockeye had passed, the facts as to the block in the river were laid before the Commission and plans were made for temporary remedial measures pending action of permanent character. Engineering surveys were begun on which to base construction of a temporary passage through the rocks. But this could not be cut until the fall of 1942 since the passage could only be blasted as the water fell from its high levels in May and June. To care for the runs in the meantime, fishing equipment was constructed to take salmon from the base of the cliff below the obstruction and to transport them through a flume to a point upstream from it. The urgency of this latter action was heightened by the fact that 1942 was the year of the large Shuswap Lake run. It was thought

proper to take every possible step to avoid disaster to this one of the few remaining large races.

The Commission met August 31, and September 1, 1942, in Vancouver. Plans for investigating this large run were discussed. The salvage measures necessary in case it was blockaded at Hell's Gate Canyon were studied.

The regular program was reduced to make certain that every possible remedial measure was taken. The salt water tagging was brought to a close with the exception of the work at Sooke. The experiment in evaluation of the spawning escapements, begun at Cultus and continued in the Birkenhead in 1941, was temporarily abandoned. The work of the Commission staff could not be further reduced without injury to the work at Hell's Gate because that which was left contributed directly to it. Comment on the valuable conclusions obtained by the study of the short period block and by the study of the uninterrupted run to the Shuswap region is given in the Director's report.

The Commission visited Hell's Gate Canyon on September 2, with the Advisory Board, to view progress made in construction of the fishing equipment and surveys.

The Commission met again on December 7, 1942, in Victoria, B. C. It again reviewed the situation at Hell's Gate. It was informed that the river there had become passable on September 1. Since the great run to the Shuswap district had begun about September 14, this valuable run had not been affected. The fishing gear installed at Hell's Gate had not been operated extensively prior to August 15, in part due to lack of fish prior to the opening of the river, in part due to wartime difficulties with materials and labor. The rock cut had been completed during the falling water but had not been of use in passing fish because the river had not risen again during the season into the levels for which it was built. Both fishing gear and rock cut were, however, ready for 1943. The Commission was also informed as to progress of studies on permanent remedial measures. These included surveys of the Canyon at and above Hell's Gate, and the construction of a model for engineering studies. The model, built on a scale of one to fifty on the grounds of the University of Washington, was viewed by some of the Commissioners on December 9.

During the year the Commission received a supplementary appropriation of $22,000 from each of the two Governments. This was expended on construction of a camp, roads, and a bridge at Hell's Gate; on construction of fishing equipment and flume for salvaging salmon; on the experimental model and on engineering surveys. The biological work at the obstruction and some of the engineering investigations were done under the regular annual appropriation. After the first steps in construction of the fishing gear and flume had been shown feasible, the actual completion of the equipment and its operation were sponsored as a salvage operation by the industry under a fund contributed by the canning companies of British Columbia and the Puget Sound district of Washington.

To summarize the year's work, the Commission has devoted its major attention to the problem of the obstruction at Hell's Gate. Those parts of the biological program which bear directly on the definition and removal of the obstruction have, of course, been emphasized. This includes the fresh-water tagging and the system of stream observations necessary to recovery of tags. The year's program also

included enumeration of escapement, tagging in salt water at Sooke, observation of the run at Cultus Lake, and such incidental biological work as was consistent with the main objectives for the year.

The report of the Director of Investigations follows.

INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION

REPORT ON THE INVESTIGATIONS OF THE INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION ON THE FRASER RIVER SOCKEYE FOR THE YEAR 1942

W. F. THOMPSON, *Director*

The program of the Commission during the year 1942 was dominated by the measures and investigations necessitated by the discovery of heavy mortalities due to an obstruction at Hell's Gate Canyon. The discovery of this and the first conclusions regarding it were dealt with in brief fashion in the report for 1941. To investigate and recommend the removal of such obstructions is one of the principal functions of the Commission under the treaty.

The need for an intensive investigation and immediate salvage operations at Hell's Gate was apparent in view of the heavy mortalities in 1941. As a result the salt water tagging program of the Commission was eliminated save for limited work at Sooke; and the next step in the experiments on evaluation of the spawning escapement, to be carried out in the Shuswap area, was abandoned for the time being. The program for 1942 became primarily that which was necessary to secure proper information on the block, including the fresh-water tagging and the observation of spawning grounds for tags, etc. Even so, this left a very good opportunity for further additions to our knowledge of life history, and gave an excellent opportunity for the observation of a large uninterrupted run to the Shuswap area.

The findings of the Commission, as expressed in the report for 1941 and in publicity since, need specific comment in several respects to prevent unjustified conclusions.

In the first place, the work of the Commission was directed above all toward a definite determination as to whether heavy mortality actually occurred, due to a block, and toward the measurement of its extent. That fish were delayed at this point and many others on the Fraser River has long been known and repeatedly stated in reports. It has not been known that the fish thus delayed, or any fraction of them, were prevented from reaching the spawning grounds. A simple delay would not justify action to remove the obstruction, but heavy mortalities would do so.

In the second place, the Commission recognizes that this block may be, at least in part, natural. The investigation has been thus far content to show the fact of its existence and the effect of mortality there without implying anything as to what caused the block. It is already known that mortalities occur at other points in the Fraser, such as that immediately above the entrance of Bridge River into the Fraser. It is thought that such hazards to adult migration contribute a normal fraction of the natural mortality of the species. But at the same time it is recognized as possible that the hazard at Hell's Gate was increased by rock slides in the Canyon.

In the third place, there is reason to believe that the effect of such blockades varies widely with the behavior of the river from year to year. The hazard is variable with the water levels. It must be expected that in thirty years those races most subject to it, particularly those which should pass Hell's Gate at the time it is closed to migrants, must have been eliminated or have altered their time of migration by adaptation to it. The expectation would be that certain runs might escape injury for a period of years and hence be built up but that they would be in danger of interruption. The runs may exhibit variability in success and an occasional disaster may set a run back severely. In expecting such variations, the Commission is frankly exceeding the limits of its experience, and before any positive conclusions can be reached much careful analysis of existing and future records must be made.

Finally, it must be borne in mind that experience in other fisheries indicates the ability of a species to reproduce at a higher rate as its numbers decrease. It may be possible, therefore, that the runs of sockeye to the Fraser River will increase whenever and wherever they are given a fair chance. With variable conditions these increases can be expected in an equally variable way. In the present state of our knowledge it is not yet possible to assign these variations to specific causes.

In the following report the staff members contributing were Dr. J. L. Kask, Assistant Director; Mr. Milo C. Bell, Engineer; Mr. C. E. Atkinson, in charge of river observers; Messrs. L. E. Whitesel, Gerald B. Talbot, James Mason, Gerald V. Howard, river observers; and Messrs. C. P. Idyll and Wm. Tomkinson, statisticians. The table of estimated spawning escapements to the various sections of the Fraser River was prepared by Mr. Atkinson and the stream observers. Data for Adams River should be received with particular caution.

1. Tagging of sockeye at the Sooke traps on the southern end of Vancouver Island was carried on as in former years. Splendid cooperation was obtained as always from the Dominion Fisheries Department and the trap operators.

This year a total of 1802 sockeye was tagged. Up to and including January 14, 1943, 735 or 40.8 per cent of these were recovered and returned. A comparison with previous years is given in the following table:

Year	*No. Tagged*	*No. Recovered*	*Percentage Recovered*
1938	980	431	44
1939	1051	547	51
1940	930	417	45
1941	849	485	58
1942	1802	735*	41

Tagging at the Sooke traps was not started this year until July 2. In past years numbers of the fish tagged prior to this date were taken in and near a variety of streams other than the Fraser, such as Nitinat, Skagit, etc. This year only three were taken in areas other than the Fraser or presumably en route to it. Of the three, one was caught at Nitinat and two in the Skagit estuary. All three were tagged on the first day of tagging, July 2.

*Tags returned up to and including January 14, 1943.

The United States commercial fishery returned 195 or 26.5 per cent of the total tags recovered. The rest were returned from Canadian sources as follows: The Canadian commercial fishery turned in 443, or approximately 60.3 per cent. One of these was returned from Rivers Inlet and one from Johnstone Strait. The Indian fishery between Mission and Hell's Gate yielded 24, or about 3.3 per cent; 68 or 9.3 per cent were from spawning areas above Hell's Gate, 63 of these were from the Shuswap spawning area alone. One was recovered in the Birkenhead River, and four tags were returned with doubtful recovery information.

It is interesting to observe the alternation of low returns in even years, with high in odd years. The odd years are those in which pink salmon are abundant.

2. No salt water tagging experiment was carried on this year, except that at Sooke.

3. The tagging experiments at Hell's Gate were again the outstanding feature of the work in 1942, as in 1941.

It will be remembered that there was a heavy mortality in 1941, during water levels at which the fish could not pass. The dangerous levels lasted from the last days of July to nearly the end of the period of sockeye migration. A brief opening about the first of September allowed the major part of the escapement for the season to the upriver spawning grounds, an escapement which, even as reduced, was considerable to certain districts.

It had long been known that sockeye were delayed in passage at various points in the river, and especially at Hell's Gate. The Commission itself had in 1938, 1939, and 1940 good evidence* of this delay in the recapture of fish at the point of tagging, etc. But there was no evidence that the fish did not later proceed, and no evidence of actual damage to the spawning. There was lacking necessary proof of the mortality which resulted. In 1941 this proof was supplied in conclusive fashion by concentration of the Commission's work upon an adequate tagging program, with a new technique of interpretation of the results. It was successful in proving the very high percentage of deaths among the delayed fish and in showing the manner in which it affected the individual races which passed Hell's Gate at the time of blockade.

Attention was immediately given to remedial measures. In fact, before the field investigation was complete in 1941, steps had been taken to put them in effect. Delay in doing so could be expected because of the magnitude of the engineering problem involved in any permanent alteration of the reach or of the conditions of passage. To care for the immediate future as well as possible, during this delay, it was decided to construct a small fish pass through the rock and around the obstruction on the east bank. The entrances to this could not be placed to collect the fish at all times because the exact point of block varied with the level of the river, nor could it be made of sufficient size to care for all levels and any anticipated number of fish. Hence it is not regarded as more than a partial solution at best.

A report was submitted to the two Governments recommending its construction. But even with this approval funds could not be secured in time for construction during the low water immediately following the run of 1941. It was, however,

*See Annual Reports of the Commission 1937 and 1938, p. 17; 1939, p. 10; 1940, p. 8; 1941, pp. 8 and 9.

FIGURE 1.—Showing how Fraser River is constricted, hence the name Hell's Gate.

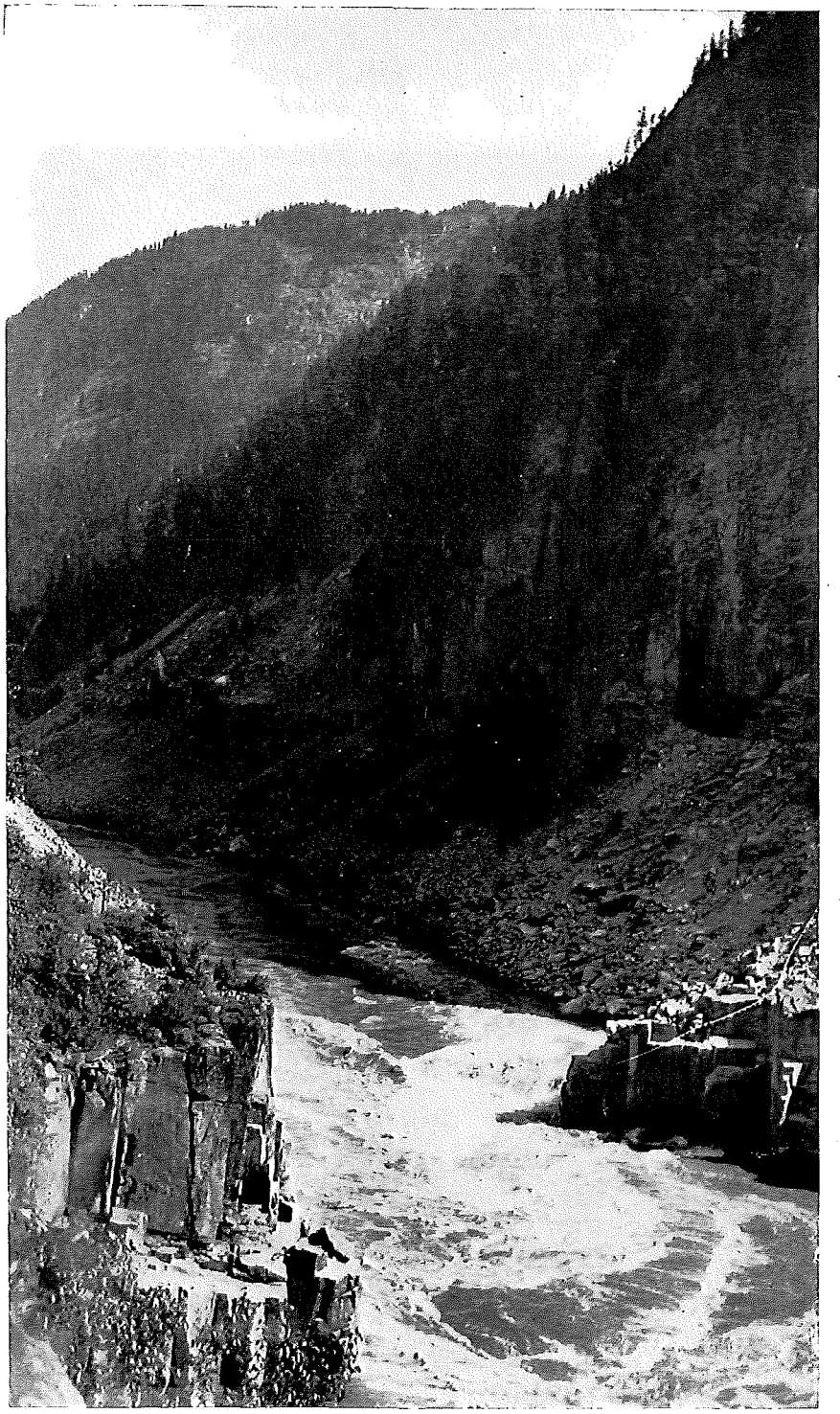

FIGURE 2.—The "Left Jutting Rock" which protrudes from the left bank at Hell's Gate marks the upstream limit of sockeye migration for stages from 26 to 55 feet. The swift turbulent downpour around the point at left center is the exact point where passage becomes impossible.

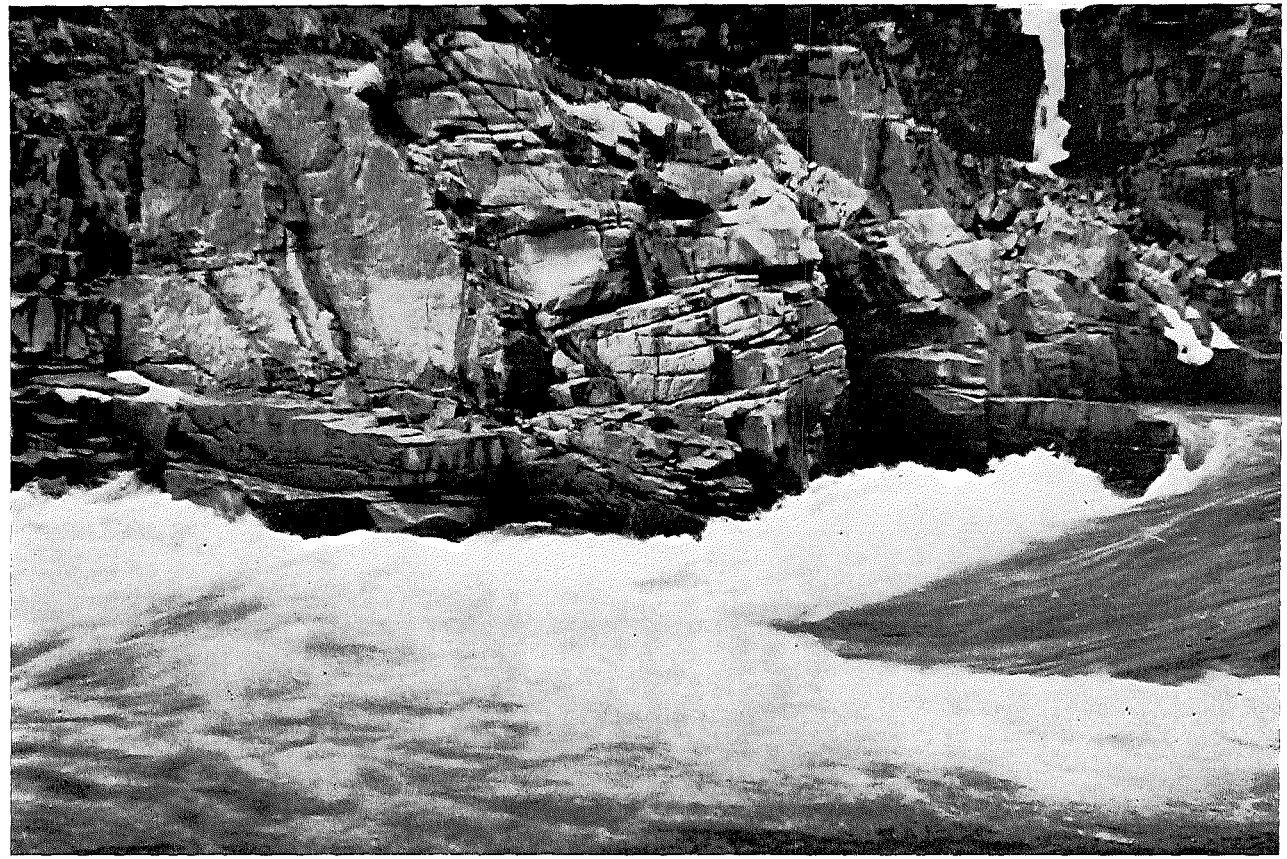

FIGURE 3.—March 21, 1943. Gauge 5.6. Eight foot fall around the "Right Jutting Rock" at low stage. The "Right Jutting Rock" marks the limit of upstream movement for sockeye on the right (west or C. P. R.) bank. Note the shattered and faulted bedrock.

FIGURE 4.—View depicting turbulent water conditions, Hell's Gate Canyon.

begun as the water level fell from a high in May and June to a low in the late autumn of 1942, and it was completed in that year, ready for the run of 1943.

The run of 1942 was in large part bound for the Shuswap district and was the largest of recent years, a recurrence of the four-year cycle which has grown up there since the '30s. It seemed imperative to provide some means of salvaging this run in case the river was blocked during its progress past Hell's Gate. The temporary rock cut could not be finished in time. In case a prolonged blockade developed, great mortality might be caused. Accordingly, the Commission considered methods of salvaging eggs from fish held below the block, and of transporting fish over it. It was finally decided to capture fish in the eddy immediately below the obstruction on the east bank. A large sized brail net was operated by a derrick, the fish were dropped into a tank and flushed down a flume opening 750 feet upstream. It was a procedure which could be very useful in case the sockeye accumulated in dense masses, but might not be so if they were sparse in number. Certainly but a small fraction of the total run could be handled. Yet it would exceed that which could be handled by taking fish for purposes of artificial propagation. This equipment was ready for use before the heavy run of the year commenced.

At the same time another extensive tagging experiment was carried out at Hell's Gate, over 8000 tags being placed. This was to further test the upper limits of the obstruction, and to determine any possible difference between opposite sides of the river which might indicate the necessity of remedial action on both sides.

It was also to provide a record of the mortality caused, especially if the period of the block happened to be short. It was obvious that in 1941 the period was exceptionally long, and the question might be raised fairly as to whether that was not a most unusual year. The possibility had to be faced that in a normal year, in fact in all but a few years, damage was nominal and not worth remedy. A test to see if mortalities were caused by an average or short period of dangerous river levels was badly need. With the technique developed this could be done.

Fortunately both for the run of fish and for the desired test, the river fell rapidly through the levels at which the block was present. It remained but 28 days between 40 and 25 feet on the gauge, and was below the dangerous levels by September 1. The great Shuswap run of fish went through without delay, the bulk subsequent to September 15, and a run to the Stellako district passed in early September. The fishing equipment and flume, while ready for use before the heavy run commenced, were operated very little and their efficiency remains to be determined by use.

In consequence, in 1942 the mortalities during a short period of block were determined, a large uninterrupted run to one main locality was observed, and the conditions to be remedied were given the necessary more detailed study.

The evidence now at hand must be analyzed in detail, but thus far it seems certain that there was a heavy mortality in the small run passing at the time the block was effective. This increased with the length of time the individuals were delayed. The delay began considerably above the 40 foot level, and the mortality was graduated in effect, not abruptly greater after twelve days or thereabouts of delay. Full analysis must be awaited as to these points before they can be stated precisely without reservation.

The tagged fish retaken at Adams and Little Rivers seem to indicate that the early fish in a run have a slower time of migration and a longer period on the grounds before death than the later fish. Indeed at the end of the run it was difficult to see how any delay could be endured without bringing death before reaching the grounds or before spawning. If this prove true on closer analysis, it can be expected that the results of delay will vary, not only with the time of year the block occurs but with the race which happens to be passing and with the early or late fish of the same race. It may, indeed, be worthy of investigation, to see whether the early running upriver races are not more seriously affected than the late runs, because the block usually occurs in mid-season and would affect the latter part of the early runs in one case and the first part of the runs in the other, with corresponding difference in effect.

Biological observations were also made at Bridge River Rapids and at the dam on the outlet of Adams Lake, in order to determine the difficulty of passage and possible mortality at each place. The obstruction at Bridge River is effective at low water, corresponding to the stage at which the water at Hell's Gate has fallen below the blocked levels and is passable.

4. A camp was constructed on the eastern side of the river at Gorge, a suspension bridge was built immediately below the narrowest part of Hell's Gate, and the site of future work was improved by blasting and road construction. Surveys were made as necessary for permanent remedial measures. The cost of these improvements and that of the fishway mentioned above were borne by an emergency appropriation made by the Governments of Canada and the United States.

During the year, detailed engineering surveys were made of Hell's Gate reach, and a model on the scale of one to fifty was constructed at the University of Washington where the nearest available facilities for such work were found. The model was constructed and tests run under the supervision of Professor C. W. Harris of the University of Washington, by Professors E. S. Pretious of the University of British Columbia, and Walter Hiltner of the former institution.

As a result of the tests run on this model, and of detailed studies made otherwise, it is hoped to make recommendations to the two Governments, Canadian and the United States, for complete and permanent remedies.

Engineering studies were also carried on during the year at Bridge River Rapids where a block exists at low water stages. These studies accompany biological observations and are designed to furnish definite recommendations for future action.

Studies were also made of the dam at the lower end of Adams Lake, on the outlet.

5. During 1942 there were three observers stationed at the canneries in Steveston, Bellingham, and Anacortes. They recovered tagged fish, took representative samples of sockeye, and collected statistics. Records of daily landings and pack were obtained; logbooks of seine boats were copied; and gill-net fishing record books were distributed to fishermen.

This is a phase of the activities of the Commission which must receive increased attention in future years. The division of the catch contemplated by the treaty will require accurate statistics, according to nationality, gear, and area. It will

require knowledge of the normal course of the catch and a measure of its abundance. Much of the work on migration will depend on an accurate knowledge of catch statistics.

6. During 1942 the survey of the spawning areas was made in a manner similar to that of the past seasons in order that a strictly comparable record might be available. Information on the size, times and distribution of the run on each spawning area was gathered, as well as notes on the success of spawning. Samples were collected for a study of the different races. Barren streams and obstructions were examined as time permitted. The Indian fishery was frequently contacted for catch statistics and recovery of tags. The results not only give data for comparison with other years but also add to our knowledge of the factors limiting the spawning populations.

The most difficult task, and yet most important, is the estimation of the escapement to the various areas. Even though our methods are becoming more accurate there are still a number of populations of which the counts are subject to gross errors that cannot yet be evaluated without a more detailed study. This year approximately half of the estimated escapement was counted under conditions which allowed the amount of possible error in the count to be defined by statistical methods.

The percentage of the total 1942 escapement going to the various important spawning areas is compared with 1940 and 1941 in the following table. In 1942 the bulk of the run entered the South Thompson region, while during the previous two years the Chilko area was most important.

	1940	*1941*	*1942*
Birkenhead	3.6	7.8	2.0
Chilko River and Lake	71.4	72.8	0.8
Cultus Lake	9.7	2.8	0.9
South Thompson	1.6	—	93.9
Other areas	13.7	16.6	2.4

The population of Adams River was determined both by a limited use of the tagging methods previously used at Cultus and Birkenhead and by a system of estimating the numbers in unit areas. But because of the limited experiments, the results obtained should be received with much caution and are shown within wide limits of what was probably there. Systematic observations were not made on a scale adequate to determine accurately the total run to the South Thompson area. For the same reason it is not possible to make a reliable comparison with the brood year, 1938.

The runs to the Stuart Lake and Bowron areas suffered a high mortality during migration in the upper Fraser between July 19 and 26, which possibly may be attributed to the abnormally high temperature of the water in the Fraser at that time. The escapement to other important spawning areas is a large increase over the brood year. Although these are all late runs, no speculation can be given as to the cause of the increase.

Stream	*1938*	*1942*
Birkenhead River	37,000	87,116
Chilko River	4,000—6,000	34,000
Cultus Lake	13,342	37,226
Stellako River	3,100	48,000

Several minor tagging experiments were conducted not only to evaluate the total runs, but to gain a better understanding of the dynamics of a spawning sockeye population. A summary of these experiments is given below:

Locality	*No. Marked*	*No. Recoveries*	*Per Cent Recoveries*
Adams River	2002	192	9.6
Adams River Dam	1040	421	40.5
Chilcotin (Farwell)	8	0	0
Kynoch Creek	100	83	83.0
Stellako River	581	382	70.6

Close cooperation was maintained at all times between the Dominion Fisheries officers and our field staff in the examination of spawning areas as well as contact with the Indian fishery.

Until checked by completion of the enumeration experiments described below (Section 9), the estimates of escapement given in the attached summary table are chiefly of comparative value. Made in the same way year after year, they should give an index to the changes in the escapements even though they do not give absolute numbers of high accuracy.

7. Since 1938 a part of each year has been devoted to a review and study of the past records pertaining to the Fraser River sockeye run. A vast amount of material has already been collected which has proved invaluable for the present sockeye studies. The plans for the 1942 work consisted of examining certain records in Vancouver as well as continuing the work in the library at the University of Washington.

8. During 1942 material for age determination and racial studies was reduced to the accumulation of lengths and scales from the commercial fishery in international waters and from the numerous tributaries of the Fraser River. As in previous years the work involved in examining this material is great and to date limited help and time have prevented a complete examination and analysis of the collected data. The material collected in 1942 will be compared with the previous years to see whether differences exist and whether they are persistent from year to year.

9. In successive years the Commission has carried out a series of experiments in evaluation of the spawning populations in various parts of the Fraser River. This began with a tagging experiment at Cultus Lake, where an accurate count through a weir could be made, during 1938 and 1939. It was succeeded by an experiment in the Harrison River system, a much larger area, in 1939, 1940, and 1941. In 1942 it was planned to extend the methods used and experience gained to the evaluation of the numbers in the great run of that year to Shuswap Lake. Unfortunately, the funds necessary were reserved to meet the emergency in fish

salvage which might have developed had a block occurred while this great run was passing Hell's Gate. Moreover, Mr. M. B. Schaefer, who had charge of the Harrison experiment, joined the armed services and no one with the requisite mathematical training was available. What was done in 1942 was consequently inadequate.

It will undoubtedly be necessary to determine the number of spawners more accurately than is done at present, if the effect of regulation and rehabilitation is to be known with any certainty. A renewal of the experiments seems inevitable.

10. The work at Cultus Lake was carried on as in former years. From January 3 to June 30, during which time gill-nets were operated, 5,209 predator fish were captured. From September 19 when the first adult fish arrived at the counting fence until January 8, when the last fish passed through, 37,305 sockeye salmon were counted into the lake. From March 25 to June 30, the downstream migration season, 1,752,551 yearling sockeye and 20,705 two-year-old sockeye were counted through the fry fence on their way to the sea.

11. The Quesnel River and its tributaries were at one time one of the most important spawning grounds of the Fraser system. While the run was injured by the construction of a dam with an inefficient fish ladder, this occurred some years prior to the blockade at Hell's Gate, and the effects of that disaster were catastrophic. There were, in 1941, but slightly more than 1000 sockeye, principally in the Horsefly River; and none at all in 1942. This contrasts with the count of over 4,000,000 in 1909, on the same cycle as 1941.

It is evident that the rehabilitation of the Quesnel run is one of the principal tasks confronting the Commission. To this end, special attention has been paid to it. Dr. Lauren Donaldson conducted a survey of the region in 1941 and 1942. Possible locations for hatcheries and ponds have been studied; the temperature and oxygen relations in Quesnel Lake have been observed; and the exact localities of present spawning have been determined. As soon as the work at Hell's Gate removes the obstruction there, the numbers of fish spawning in the district should be closely observed and the recovery of the run aided in every possible way.

12. Material and data for an analysis of changes in fat content were secured during the season. No acceptable findings are yet at hand.

SUMMARY OF THE ESCAPEMENT TO THE VARIOUS SPAWNING AREAS, 1942

District and Stream	Dates of Run		Estimated No. Sockeye Present			Sex Ratio (%)			
						Males		Females	
	Arrival	End	Minimum	Maximum	Probable	3 Yr.	4 and 5 Yr.	3 Yr.	4 and 5 Yr.
LOWER FRASER									
Cultus Lake [1]	9/19	1/8/43	37,305	37,305	37,305				
Lower Pitt River	11/1	11/31	529		529		40.0		60.0
Upper Pitt River [4]	9/1	10/20	2,048		7,500		49.1		50.9
HARRISON									
Douglas Creek	9/9	9/29	35	100	67				
Hatchery Creek	10/4	11/9	750	1,000	875	1.2	42.1		56.7
Harrison River Rapids	11/12	12/1			Present		47.2		52.9
Silver Creek	10/1		7		Present				
Weaver Creek [3]	10/14	11/23	12,395		19,000		42.6		57.4
LILLOOET									
Birkenhead River [3]	9/3	10/29	77,606	93,099	87,116	1.3	24.5		73.7
Upper Lillooet Streams					14,750				
CANYON									
Coquihalla River	8/6	9/30	5						
Emory Creek	7/28	11/2	23						
Silver Creek	8/10	9/20	Reported	These runs not included					
Spuzzum Creek	7/20	11/23	166	as they are result of			27.3		72.7
Sucker Creek		10/20	Reported	Hell's Gate blockade.					
SOUTH THOMPSON									
Adams River [2]	9/30	11/31	1,151,428	4,527,095	1,967,553				
Adams Lake and Tributaries			181,021	225,344	200,000		49.6		50.4
Anesty River	10/15	11/20	137		200				
Celista Creek	10/15	11/20	467		600				
Eagle River			30		200				
Little River			Present in large numbers.						
Scotch Creek	10/13	11/18	3,595		5,000				
Seymour River	9/10	10/5	1,775		1,950				
Shuswap River					2,000				
Shuswap Lakes			Present in large numbers.						
NORTH THOMPSON									
Raft River	8/6	9/25	377		450		42.9		57.1

SUMMARY OF THE ESCAPEMENT TO THE VARIOUS SPAWNING AREAS, 1942—(Continued).

District and Stream	Dates of Run		Estimated No. Sockeye Present			Sex Ratio (%)			
	Arrival	End	Minimum	Maximum	Probable	Males		Females	
						3 Yr.	4 and 5 Yr.	3 Yr.	4 and 5 Yr.
SETON-ANDERSON									
Portage Creek [1] (includes lake spawning)	9/1	11/17	507	507	507				
Seton Creek	9/25	11/5			1,337				
CHILCOTIN									
Chilko River and Lake [3]	8/12	11/1	29,017	39,314	34,109		50.0		50.0
QUESNEL									
All tributaries					0				
NECHAKO RIVER									
Bednesti Creek	9/25		147		150				
Endako River	8/25		278		309				
Nadina River	8/29		62		62				
Nithi River	8/13		1		1				
Ormonde Creek	8/16		39		54				
Stellako River [2]	9/7	11/10	46,786	57,053	48,064		36.0		64.0
STUART									
Dog Creek		8/31	6		6				
Fleming Creek	7/17				Reported				
Forfar Creek [3]	7/17	9/5			3,244	0.3	44.1		
Gluskie Creek	7/26	8/23	1,120		1,734				
Gravel Creek	7/20	9/1	94		185				
Hoy Creek		8/5	1		1				
Kynoch Creek	7/14	9/5	1,949	1,949	1,949	0.6	49.1		
Middle River	9/10	10/20			Present				
Narrows Creek	8/7	8/19	54		100				
Rossette Creek	7/25	8/17	929		929				
Shale Creek	8/7	8/19	25		50				
NORTHEAST									
Bowron River	8/4	11/1			1,646				
Moose Creek	8/13	9/19	83		180				

[1] All fish counted through weir.
[2] Population estimated by tagging program.
[3] Population determined on indices.
[4] Best figure by T. Eaton, former employee Dominion Department of Fisheries.