PROVINCE OF BRITISH COLUMBIA

REPORT

OF THE

COMMISSIONER OF FISHERIES

FOR THE YEAR ENDING DECEMBER 31ST, 1919

WITH APPENDICES

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

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1920.

To Colonel the Honourable EDWARD GAWLER PRIOR,

A Member of the King's Privy Council for Canada,

Lieutenant-Governor of the Province of British Columbia.

MAY IT PLEASE YOUR HONOUR:

I beg to submit herewith a report reviewing the operations of the Provincial Fisheries Department for the year ending December 31st, 1919, with Appendices.

WILLIAM SLOAN,

Commissioner of Fisheries.

Provincial Fisheries Department,

Commissioner of Fisheries' Office,

Victoria, British Columbia, March 31st, 1920.

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FISHERIES COMMISSIONER'S REPORT FOR 1919.

Value of Canadian Fisheries and the Standing of Provinces.

The value of the fishery products of Canada for the year ending December 31st, 1918, totalled $60,250,514, as against $52,312,044 for the preceding year, notwithstanding that the latter was considerably greater than in any preceding year.*

During the year 1918 British Columbia contributed fishery products of a total value of $27,282,223, or 45 per cent. of the total for the Dominion.

As in recent years, British Columbia again led all the Provinces of Canada in the value of her fishery products. Her output for the year 1918 exceeded in value that of Nova Scotia by $12,139,157, and exceeded that of all the other Provinces combined by $9,456,968.

The following statement gives in the order of their rank the value of the fishery products of the Provinces for the year ending 1918:—

	1918.	Increase or Decrease compared with 1917. (Inc. + ; Dec. —.)
British Columbia	$27,282,223	+$5,763,628
Nova Scotia	15,143,066	+ 674,747
New Brunswick	6,298,990	+ 155,902
Quebec	4,568,773	+ 1,154,395
Ontario	3,175,111	+ 308,692
Manitoba	1,830,435	+ 287,147
Prince Edward Island	1,148,201	— 638,109
Saskatchewan	447,012	+ 126,774
Alberta	318,913	+ 134,904
Yukon	37,820	— 29,580
Totals	$60,250,544	$7,938,500

The Species and Value of Fish caught in British Columbia.

The total value of each species of fish taken in British Columbia for the year ending December 31st, 1918, is given in the following statement:—

Salmon	$17,207,245 00
Halibut	5,196,539 00
Herring	1,742,757 00
Whales	1,382,278 00
Cod	426,239 00
Pilchards	413,853 00
Black cod	285,034 00
Flounders	145,385 00
Soles	92,471 00
Crabs	54,660 00
Clams and quahaugs	48,200 00
Red cod, etc.	43,422 00
Grayfish	29,607 00
Oysters	26,926 00
Smelt	26,075 00
Shrimps	23,930 00
Skate	16,565 00
Perch	11,252 00
Oolachans	8,476 00
Trout	5,025 00
Carried forward	$27,185,059 00

* The data used here are derived from the Dominion Bureau of Statistics, 1918.

THE SPECIES AND VALUE OF FISH CAUGHT IN BRITISH COLUMBIA—*Continued.*

Brought forward	$27,185,059 00
Fur-seals	3,320 00
Hake and cusk	3,097 00
Shad	2,700 00
Octopus	2,321 00
Sturgeon	1,690 00
Whiting	1,451 00
Bass	249 00
Mixed fish (not including any kinds mentioned elsewhere)	168 00
Eels	72 00
Tomcod	18 00
Fish-oil	53,380 00
Fish-offal	9,775 00
Scrap and fertilizer	8,423 00
Guano	10,500 00
Total	$27,282,223 00

THE SALMON-PACK OF 1919.

The salmon-pack in the Province for the year 1919 totalled 1,393,156 cases. It was 223,000 cases less than in the record year 1918. The catch of sockeye in all the waters of the Province totalled 369,445 cases, as against 276,459 cases in 1918 and 330,209 cases in 1917. The catch of red, white, and pink spring salmon totalled 100,551 cases, as against 107,354 cases in 1918 and 76,276 cases in 1917. The pack of pink salmon totalled 346,639 cases, as against 527,745 cases in 1918 and 486,759 in 1917. The pack of chum salmon totalled 372,035 cases, as against 497,615 cases in 1918 and 476,273 cases in 1917.

THE 1919 SALMON-PACK BY DISTRICTS.

The Fraser River.—The total pack of all grades of salmon in the Fraser River District in British Columbia waters in 1919 totalled but 163,123 cases, as against 210,851 cases in 1918, 402,538 cases in 1917, 127,472 cases in 1916, 320,519 cases in 1915, and 349,294 cases in 1914. The catch of sockeye totalled but 34,068 cases, or 38½ per cent. less than that of its brood-year, 1915.

The season's pack of sockeye in the State of Washington waters of the Fraser River District in 1919 totalled 64,346 cases, as against 87,465 cases in the previous fourth year, 1915.

The pack of sockeye in the entire Fraser River system in 1919 totalled only 98,414 cases, as against 178,595 cases in 1915, the brood-year of the 1919 run, a decline for that cycle of over 50 per cent., and an additional demonstration that the runs of sockeye to the Fraser River system are "perilously near extermination."

The Salmon-catch of Northern Waters.

The Skeena River.—The salmon-pack on the Skeena River in 1919 totalled 398,877 cases, or 24,561 cases more than the record pack on that river made in 1918. The principal gain was in the pack of sockeye, the catch for the year being 184,945 cases, the largest pack of sockeye ever made on that river, with the exception of the record pack of 187,246 cases made in 1910. The run of sockeye to the Skeena this year is to be attributed to the hatches of 1914 and 1915, because it has been demonstrated that the runs to that river consist of both four- and five-year-old fish. The sockeye-catch in 1914 consisted of 136,166 cases and that of 1915 of 116,533 cases, the catch in both of those years being well over the average for that river. It is to be noted that the reports from the spawning area of the Skeena in both these years indicated abundant spawning. It has long been recognized that the nature of the fishing-grounds of the Skeena, due to numerous reefs of rock and snags, affords the fish entering the river a greater natural protection than is afforded the fish running to any other stream in the Province. The catch of springs and chums on the Skeena shows slight increases over 1918. The catch of pinks shows a decrease.

Rivers Inlet.—The catch of salmon on Rivers Inlet totalled 80,367 cases, the smallest made there since 1913. The run of sockeye there this year, as usual, consisted of both four- and five-year-old fish; hence it is to be credited to the spawning of the years 1914 and 1915. As in both

of the latter years the catch was well above the average for the inlet and the reports from the spawning-grounds indicated abundant spawning, the catch of sockeye at the inlet this year was most disappointing. Weather conditions were favourable to good catches. Some close observers at the inlet state that the fish were so much smaller than usual that they were enabled to pass through the meshes of the nets, and that large numbers did so. Fishery Overseer A. W. Stone, who has inspected the spawning-grounds of Owikeno Lake at the head of the inlet annually for the past eight years, reports that in point of numbers the sockeye found there this year equalled the average of good-year runs, but that in all sections the fish were smaller in size than usual.

The Nass River.—The salmon-catch in the Nass River District totalled 97,512 cases. It was the smallest catch since 1914. The catch of sockeye produced a pack of 28,295, and, though some thousands larger than in the two preceding seasons, it shows a decline from that made in 1914 and in 1915. The catch in 1914 totalled 31,327 cases and in 1915 39,349 cases. The operation of salmon-traps on the islands in American waters at the entrance of Portland Canal and Observatory Inlet, through which the sockeye seeking the Nass River must pass, apparently is a drain on the Nass sockeye run. The establishment of the traps has created conditions there somewhat similar to those on the Fraser River system which destroyed the sockeye run to the latter river. Hereafter their drain on the run of sockeye to the Nass River must be given full consideration.

The Vancouver Island Section.

The pack of salmon from Vancouver Island waters, with the exception of the sockeye salmon taken in the traps in Juan de Fuca Strait that are credited to the Fraser pack, since they are known to be running to that river, totalled 272,114 cases, as against 389,815 cases in 1918 and 325,723 in 1917. Previous to the latter year the salmon-catch from Vancouver Island waters was not shown separately, but included in the catch credited to outlying districts. The 1919 return shows a remarkable decline from that of the two previous years in the catch of chums. In 1917 the pack of chums totalled 240,381 cases and that of 1918 a total of 251,266 cases, while 1919 catch gave a pack of but 128,368 cases. The pack of pinks in 1919 was 14,080 cases less than in 1918 and 112,368 cases less than in 1917. The catch of springs in 1919 shows a material gain over both 1918 and 1917. Owing to unusually rough seas off the west coast of the Island in 1919, the fleet of trolling-boats engaged in salmon-fishing was unable to operate in the open sea as much of the season as in the two previous years. In consequence their catch was smaller.

REPORTS FORM THE SALMON-SPAWNING AREAS OF THE PROVINCE IN 1919.

As usual, the Department conducted investigations of the spawning area of the Fraser, Nass, and Skeena Rivers and Rivers and Smith Inlets. The detailed reports of the officers who conducted the investigation are reproduced in the Appendix to this report.

The Fraser River.—The spawning-grounds of the Fraser River basin were again inspected by John P. Babcock, Assistant to the Commissioner. He was assisted by Inspector of Fisheries C. P. Hickman and Fishery Overseer Wm. Newcombe, who returned from France in time to again take up the work. In the report made by Mr. Babcock it is shown that the number of salmon that reached Hell's Gate Canyon, above Yale, was very much smaller than in any year since annual inspections were inaugurated in 1901, and that in consequence there were less salmon on all the spawning-beds north of that canyon, which includes the major portion of that vast river-basin, than in any former year.

In order to obtain data as to the number of sockeye that reached the Thompson and Quesnel Rivers, the Department attempted to catch sockeye in both those streams by means of anchored gill-nets. Two nets were maintained in the Thompson near Spences Bridge from August 18th to August 29th. The number of salmon taken by the nets totalled but six, all of which were males. The officers in charge of the nets kept a close watch at the rapids of the river both below and above the nets, and record that they saw no salmon except three taken by Indians and those secured by the set-nets. The nets were operated during the time that in former years the run was at its height. A month later Officers Hickman and Newcombe, acting separately and on different dates, inspected the waters of Shuswap and Adams Lakes and found no evidence of sockeye having reached there, and but few were noted by others at later dates.

The record on the Quesnel River discloses a condition as disastrous in its results as that on the Thompson. Not a single sockeye was taken in the gill-net set in the Quesnel River from

August 28th to September 9th. Following the practice begun by the Department in 1903, a watchman was placed on the dam at the outlet of Quesnel Lake, who acted throughout the past season. He reports that but three sockeye, two males and one female, were seen in the clear waters of the Quesnel River below the fishway and the dam at the outlet of the lake. Former reports issued by the Department record that over 4,000,000 sockeye entered Quesnel Lake through the fishway during the fall of 1909, and that some 557,000 sockeye entered that lake in the fall of 1913. This year, as stated, but three sockeye were seen there during the entire season. More conclusive evidence could not be produced to establish the practical extermination of the runs of sockeye to the Fraser than is presented by these records from two of its largest tributaries.

There was a larger run of sockeye to the Birkenhead River, at the head of the Harrison-Lillooet Lakes watershed, this year than in any recent year. The run there was so much larger than even in 1915 that Mr. Babcock concludes that it cannot altogether be attributed to the fact that the Indians were not permitted to fish at the Little Portage at the foot of Lillooet. The collection this year of 30,000,000 sockeye-eggs at the Pemberton Hatchery conclusively proves that the run was unusually large. The collection of eggs in 1918 totalled 11,960,000; in 1917, 5,270,000; in 1916, 25,750,000; and in 1915, 25,250,000. The collection this year exceeded that made in the brood-year of this season's run (1915) by 5,000,000. Mr. Babcock is convinced that the run to the Birkenhead River this year was due to the successful operations of the hatchery in 1915.

The run of sockeye to Harrison Lake and to the lower section of the Fraser River this year was larger than in any year since 1915. Mr. Babcock also attributes this run to the successful operation of the hatcheries.

The Situation in the Fraser River at Hell's Gate Canyon, above Yale.

Mr. Babcock in his report has this to say of conditions in the Fraser River at Hell's Gate Canyon, above Yale:—

"Considerable concern has again been exhibited by those interested in conditions existing on the Fraser River at Hell's Gate Canyon. The statement made that the river-channel there is still so blocked as to prevent the passage of sockeye to the waters above, and that the sockeye that reached there this year did not get through the canyon, is untrue. The rocks that blocked the channel in 1913 were entirely removed in 1914-15 and the old channel fully restored. All the sockeye that reached there this year passed through the canyon without more delay than often occurred in the years before the slide of 1913. Conditions at Hell's Gate since 1914 have been and are now as favourable to the passage of all species of salmon as they were previous to the slides of 1913 and 1914. The Department has had the channel there under close observation every season since 1901. The rapids at Hell's Gate are the first real obstacle which the sockeye encounter in their ascent of the Fraser River. Until they reach there they have had no rapids of importance to overcome, and consequently are inexperienced in passing through such swift and broken currents. The result is that even at the most favourable stages of water they make repeated attempts before they succeed in finding their way through the Gate. This year, as in the years before the slide of 1913, there were short periods, in certain unfavourable stages of water, during which few (if any) salmon passed. On two occasions this season the run was delayed for several days, but all the salmon eventually succeeded in passing, so that the delay was not of material importance. The rapids at Hell's Gate are not more difficult of ascent at times than the rapids in the Fraser above the mouth of Bridge River, and are not nearly as difficult at all times as the rapids and falls at 'the Hole' on the Chilko River, some miles above the mouth of the Whitewater River, yet the sockeye on reaching those places experience less delay than at Hell's Gate. At Hell's Gate and at the Bridge River Canyon all the sockeye apparently make the ascent close to the surface on either bank, and the same is true at Fish Canyon on the Chilcotin River, but at 'the Hole' on the Chilko all apparently hug the rocks on the bed of the stream and none of them pass close to the surface. After viewing a run at Hell's Gate and then observing the sockeye at Fish Canyon on the Chilcotin River one cannot help being impressed by the certainty with which they attack and overcome the last-mentioned rapids. They show much more expertness in overcoming rapids and falls by the time they reach the latter rapids. From studying the conditions at Hell's Gate since 1901 I am of the opinion that the situation there does not offer a serious obstacle to the ascent of sockeye."

Spawning-grounds of the Northern Section of the Province.

Rivers Inlet.—Fishery Overseer A. W. Stone again inspected the spawning-beds of the Rivers Inlet sockeye run this year. It was his eighth consecutive annual inspection. This report shows that the spawning-beds were as abundantly seeded as in 1914 and more abundantly seeded than in 1915, the brood-years of this year's run to Rivers Inlet. The catch of sockeye at Rivers Inlet has already been shown to have been far below the average of the past ten years. The poor catch Mr. Stone attributes to the unusually small size of the fish that ran this year. He found that the size of the fish on all the spawning-beds was much less than in former years, and because he found the numbers on the beds as numerous as in the brood-years he concludes that the run to the inlet this year was an average one, and that, in consequence of the beds having been so abundantly seeded, the hatch of the 1919 spawning will produce an average run in the years of their return at maturity.

Smith Inlet.—Fishery Officer A. W. Stone also inspected the spawning-beds of the Smith Inlet sockeye run. He found the beds as abundantly covered by spawning sockeye as in any one of the last six years that he has inspected them. The number there this past season compared favourably with the year 1914, when the numbers on the beds were greater than usual. Referring to conditions on the fishing and spawning-beds at Smith Inlet this year, Mr. Stone says:—

"The comparatively small pack of sockeye salmon at the two canneries at Smith Inlet this year, amounting approximately to 16,000 cases, and contrasting it with the big pack of 38,000 cases in 1914 and 35,000 cases in 1915, calls for some explanation as to why more fish were not caught on the fishing-grounds this year, since the spawning-beds are shown to have been so abundantly seeded. The poor catch this season was due to the fact that some of the gill-net fishermen forcibly restrained the operations of the drag-seines in Qualla Creek, the entrance to their spawning-grounds. I am reliably informed that during the four or five days the seines were not in use a vast number of sockeye passed through the creek, all of which reached the spawning-beds."

Because he found the spawning-beds of Smith Inlet were so abundantly seeded this year, Mr. Stone anticipates a large number in that inlet in 1923.

Nass River.—An inspection of the spawning-beds of the Nass River was jointly made by Inspector of Fisheries C. P. Hickman and Dominion Fishery Overseer J. Maxwell Collison. They visited the Meziadin Lake section and the tributaries in the vicinity of Ayansh. They found very few sockeye in Meziadin Lake or River or on the main spawning tributaries of the lake. In all that section there were many less sockeye than had previously been found there. They found very few sockeye in any of the tributaries of the Nass near Ayansh, but were told by the Indians that the early run had been up to the average of recent years. Summarizing the results of their inspection, Messrs. Hickman and Collison say:—

"We wish to call attention to the very few sockeye on the Meziadin spawning-beds this year. It is apparent that something very vital has happened to the sockeye of the Nass because of such a shortage. As the pack at the canneries at the mouth of the Nass this season was only an average pack, plenty of sockeye should have reached the spawning-grounds had there been an average-sized run. The only explanation that we can give for such a shortage is the operation of traps in South-eastern Alaska, there having been fourteen or more traps in operation between Cape Fox and Tongas Islands. What number of Nass sockeye were taken in those traps we are unable to say, but from reliable information we believe they intercepted Nass River sockeye."

The Inspectors found that the lower end of the fishway at Meziadin Falls had been seriously damaged by high water; the lower end of the natural rock wall between the river's channel and the channel of the fishway having been partly carried away, and the upper end shows signs of giving way. The crib-work that guarded the upper end of the fishway had also been washed out. The channel of the fishway was, however, but slightly interfered with and still afforded a free passage for the fish that reached there. There is urgent need of taking additional steps to prevent further damage to the outer wall and also to the crib-work on the land side of the fishway, several of the supports that sustain the crib-work and that rested on the rock wall opposite having been carried away, and the others need attention. Chief Inspector of Fisheries Lieut.-Colonel F. H. Cunningham has advised the Commissioner that steps will be taken to place the fishway in working-order for the 1920 run of salmon, and that permanent repairs will be made as soon as the trail leading from Stewart to Meziadin Lake permits of getting in cement.

Skeena River.—Fishery Overseer W. A. Wisley inspected the principal area of the spawning-beds of the Skeena River in September. He reports all the beds as being well covered. The run to all sections is believed to have been as great as in any former year. The Babine Hatchery was filled with sockeye and some 6,000,000 eggs were taken and shipped to the Stuart Lake Hatchery, a tributary of the Fraser River. Mr. Wisley was advised that in July last vast numbers of yearling seaward migrants of sockeye passed out of Babine Lake. Adult sockeye entered Lakelse Lake this year as early as June 3rd to 9th, proving that an early run of sockeye entered the Skeena River before the fishing season commenced.

THE HALIBUT-FISHERY.

The halibut-catch landed at Provincial ports during 1919 totalled 19,198,565 lb., as against 16,697,000 lb. in 1918. Prince Rupert again leads in the landing, with a total of 16,476,270 lb. to Vancouver's 2,722,395 lb.

As a result of the investigations and deliberations of the American-Canadian Fisheries Conference of 1918, a treaty has been signed by the high contracting parties and is now before the United States Senate awaiting action. Its important provisions include a closed season on halibut-fishing by Canadian and American vessels from November 16th to February 15th and reciprocal port privileges. The effect of such a closed season as that suggested is doubtful in the judgment of William F. Thompson, the expert employed by this Department to investigate the halibut-fishery and who in his report published in 1916 has this to say on the subject:—

Close Season.

"Recognizing the urgency of the situation, there has been, among fishermen and dealers, a strong sentiment in favour of the imposition of a close season of two months, December and January. This has been perhaps the most widely approved measure of any proposed, and in view of the widespread adoption of closed seasons in conserving other species is worthy of careful consideration.

"To be worthy of adoption, however, it is imperative that a measure be shown capable of conserving the numbers of the species as a whole or in threatened areas, or adequate to increase the number of spawning fish where it has fallen below the margin of safety. The question in any case is simply one of ensuring the existence of a sufficient number of breeding males and females in those large areas now lacking them.

"It is a serious question whether the closed season would not simply result in a more intense fishery during the open portions of the year. It must be remembered that the cold-storage facilities now available render it possible to deliver a supply of halibut all the year round, with or without a close season. There is no question, then, of an interruption of the demand from the consumer, with a consequent lessening of the total called for; and there is, as we shall see, every reason to believe that this demand will be satisfied, whether there is a close season or not.

"The cost of catching is but a small part of the cost of transporting, preserving, and marketing. It could increase manifold before being felt greatly. If the fish may be purchased on the docks in Seattle at 5 cents per pound, as has been done, and sold by the retailers at 25 cents, then an increase of 2½ cents, or 50 per cent. of the original cost, would be but 10 per cent. of the retail price. Something essentially similar to this has taken place in the fishery, the length of a voyage, and with that the expense of obtaining a cargo, having increased by about 100 per cent. in the ten years between 1904 and 1914. That means that the yield per vessel has fallen to a half, yet the total catch landed by the fleet has steadily increased in response to the demand. Such being the case, it is hardly to be expected that the reduction of the fishing-time by a sixth would have much effect even if it were capable of being accepted at its face value.

"The apparent value of the close season during the winter is greatly modified by certain considerations. One of the most prominent of these is the fact that during the two months of December and January the catch is but half that prevailing during the summer months, as is shown on the chart. That is, the effectiveness of such a close season would be half that of a similar one in the summer. Furthermore, the decrease in total catch is in accordance with the diminished catch per unit of gear, and indicates with it the fact that the two proposed months are the most expensive. Providing the far greater consideration of the future of the banks were not in question, there would be no possible objection to legislating away the unprofitable part

of a business year. But, aside from the fact that it is not the *bona-fide* object of the proposed legislation to increase the immediate prosperity of the industry, it can be shown to have a really detrimental effect on the condition of the banks. The proposed close season would surely put vessels on a better financial basis, encouraging the building of more and rendering them capable of profitable operation on smaller summer catches than is now the case. This would mean the enlargement of the fleet and the closer fishing of the banks, including those considered the least profitable.

"Fishing on these more depleted southern banks off the coast of British Columbia is prevalent mostly in summer, because the catch per unit of gear is at that time highest, and the reliance is on young fish almost entirely. It has been shown that it is these banks which need protection, and if they are to have it, it must come while fishing is being done on them. Instead of that, as has been pointed out above, a winter close season will intensify the fishery, the more so as the most depleted banks are nearer to market than the less depleted.

"Cold-storage plants play an important part in intensifying this result of the closure. They not merely maintain the demand, but tend to counteract the extensive natural increase in price in winter and the decrease during the summer. This results from the absorption of surplus fish in summer for freezing and its sale during seasons of scarcity. There is in the winter, nevertheless, a considerable catch of fresh fish with which the frozen product must compete. The elimination of this catch during several months would without the cold-storage plants apparently stop the consumption, but with them could simply force the laying-by of more extensive stocks of fish frozen during the summer. It is obvious that this has a tendency to impel still better prices in summer and poorer in winter. In other words, there would ensue a more profitable summer fishery, hence a more intensive one. It should be observed in this connection that the near-by banks off the coast of British Columbia yield a medium of small-sized immature fish ('chicken halibut') very suitable for freezing. These banks are those fished most intensely in summer and need better, not poorer, protection. A certain measure of the harm might, it is evident, be averted by forbidding the sale of cold-storage halibut during the close season.

"The most generally held reason for supporting a winter close season is that it is designed to protect the halibut during its spawning period. The assumption is that the fleet resorts to 'spawning-grounds' on which are to be found spawning fish congregated from other localities, and that the catch consists to an unusual degree of such fish. However reasonable this may sound, it is impossible to find any basis of scientific fact behind it. On the contrary, so-called spawning-banks are those less depleted than others because less accessible, or because it pays to resort to them only during the winter seasons. It has been demonstrated that at one time the banks now characterized by small immature fish had a population of large, undoubtedly mature, fish, and that their absence is due to the effects of commercial fishing. We therefore come to the anomalous conclusion that protection is proposed for banks which show exhaustion least, as they have a more nearly adequate supply of breeding fish.

"If, however, the claim had been that within the confines of each bank winter fishing was carried on in areas characterized by spawning fish, more weight might be given it. As a matter of fact, however, no proof of such congregation has been found, and observation has not yet disclosed any annual change in average size in one portion of a bank which did not take place in another. The shift in the fishing-grounds, according to season, is something entirely different from this, being a removal of the fleet to other banks far distant. It is a fact worthy of every emphasis that no such extensive movement on the part of the fish is to be found, whether there is some possibility of a limited and local movement or not.

"It would seem certain that the closure would not protect spawning fish especially, and there would be little utility in extending protection to halibut spawning and immature alike at the cost of more intensive fishing during other seasons. As has been indicated, the depleted banks are characterized by a lack of mature fish and a predominance of immature. If the latter are caught, it is a matter of indifference at which season it is done, as all succeeding spawning periods are eliminated, anyway. This is also true of the mature halibut. There is no reason why capture a week before spawning-time should be more disastrous than capture six months previously, all the remaining periods of spawning being eliminated, anyway. If the number of fish caught by the fleet remains the same, prohibition of fishing during such a season would mean naturally that of those fish usually caught during spawning the more intense fishery would cause just as many to be captured before the season as would be caught later because of the protection.

As a result the number of fish present each spawning-time would be unaltered. As a matter of fact, the areas now needing protection are those in which halibut rarely have a chance to reach maturity, and to allow them to do so the only method available is to give them a better chance of escaping capture. It is not sufficient merely to alter the time of year at which they are caught.

"Among other reasons advanced is one implying that fish caught during winter are of poorer quality, with larger heads and leaner bodies, than those taken during summer. Regarding this it should suffice to state that the observed difference is due rather to the fact that in summer immature fish from banks with rapidly growing fish are utilized, while in winter mature slow-growing fish are obtained. These mature poor-quality fish come from undepleted northern, or outside, banks naturally characterized by large-headed fish, and it is extremely improbable that they change their appearance greatly with the season. It is just as well that these fish are utilized to some extent at least. The difference between banks in so far as quality is concerned is far greater than can be assigned to seasonal differences. It is not to be denied that there is such a seasonal difference, but it cannot be assigned the importance given it. This is the more true as it has no immediate bearing on the all-important objective of preservation of the banks."

An Extension of the Close Season.

Mr. Thompson states: "Despite the fact that there are cogent reasons against the adoption of a close season during two winter months, it is possible that certain modifications of it might be feasible; for instance, an extension to four months. But if not disastrous to the fishery and to the fishermen because of its length, the objection previously held that the already depleted banks would be subject to a still greater strain would apply to an even greater degree. The restraint on the fishery would be accomplished principally, perhaps, by forcing vessels and men to lose a third of their time. It is possible that some other fishery could be developed to supplement that for the halibut during that season, but at present none offers itself; and even if such were the case, the objection to the changed concentration of the fishery still remains. So it is hardly conceivable that such a measure could meet with unqualified approval.

A Summer Close Season.

"A course, on the other hand, which might obviate the most dangerous features of the close season would be to place it in the summer. One summer month would be the equivalent of two winter months. Such action would result in discouraging the capture of small immature fish, of which spring and summer catches mainly consist on the older banks, and would encourage winter fishing. The influence of cold-storage firms would not in such a case be adverse. But the serious question would still remain as to whether the total catch from any bank would be sufficiently decreased. If the demand overcame the handicap of an increase of the voyage length of 200 per cent. within ten years, would it not overcome one of a decrease in available fishing-time of even 30 per cent.? Although it is probable that what the banks need is a total cessation of fishing in view of the great rate of depletion, yet such a measure as closure during summer months would be certainly effective in its nature, in contrast to the winter close season."

In lieu of a winter closed season for halibut-fishing, Mr. Thompson suggests that one for all waters should be provided, and states:—

"I. The banks should be divided into districts of such areas as: (1) Those off the Oregon and outer Washington coasts; (2) the coast of British Columbia; (3) between Icy Strait and Dixon Entrance; (4) between Icy Strait and Cape Cleare; (5) between Cape Cleare and the entrance to Bering Sea; (6) any subsequently discovered banks not properly attached to the foregoing, including Bering Sea.

"Areas 1, 5, and 6 are those least depleted; Area 2 has been shown to be badly exhausted. Areas 3 and 4 are presumably also depleted, the latter less so.

"II. Areas 2 and 3 could be alternately closed and opened, 2 closed for five years, then 3 for the next five, and so on alternately. Areas 1, 4, 5, and 6 could be closed at the same time as either 2 or 3, their closure being subject to the discretion of conferees appointed by the two Governments; provided that, unless otherwise agreed upon by these conferees, Areas 1, 3, and 5 would be closed together, and Areas 2, 4, and 6. Each area would thus be closed five out of every ten years.

"This arrangement would allow sufficient latitude of time to overcome any differences in the productive power of the areas, and at the same time make the closures automatic if the times of their inauguration were not agreed upon. It would also obviate any danger of placing any particular port under a disadvantage.

"III. To cover the period of adjustment and to render protection immediately available to the most badly depleted regions, a special programme for the first ten years might be formulated. Thus Area 2 could be closed for five years, its opening to be simultaneous with the closure of Areas 4 and 3. Subsequent to the first ten years, the provisions of section II. could apply. This programme would be felt very slightly during the first five years, more in the second, and fully in the third, allowing in the meantime the exploitation of the least-depleted banks and protecting those in the worst condition. It would be advisable to close Area 2 for more than the five years during this first decade.

"IV. There should be an emergency clause enabling a further closure of any area upon mutual consent of the conferees, a closure solely in addition to the prescribed minimum.

"V. Provision could be made for the collection by each Government of data from the official log-books of the fishing-vessels, it being made compulsory for the masters of such vessels to supply in these books, over their signatures, the following information:—

"(*a.*) Place and date of each fishing operation.

"(*b.*) Amount of gear utilized and its nature (size of net, or space between hooks on long line.)

"(*c.*) Number and approximate dressed weight of halibut taken in each place. This should be collected by each Government and placed at the disposal of the other at the conclusion of each year, it being expressly stipulated that such data be placed in the hands of the scientific departments of both Governments, and that it be formulated by them, and in a way mutually agreed upon by the conferees. This should be the case in order that the latter could utilize the information obtained in making their decisions regarding the times of closure.

"The discretionary power vested in the officers designated as conferees should lead the fishermen to furnish this information willingly, in the interests of their trade.

"It appears to the writer that the principal objection which will arise will be one of inadequate amount of protection, but it is difficult to see how any other precaution than the granting of discretionary powers to the appointed officials could be taken. The objection is one which would apply to any measure.

"There may be some injury worked to vessels unable to fish outside the three-mile limit, or those with limited cruising radius. This might be greatly magnified by opponents of the measure, but does not seem important in looking over the list of vessels. It must follow on the exhaustion of the banks in any case, or on the imposition of any other regulation."

THE SALMON-FISHING REGULATIONS OF THE PROVINCE.

In December the Commissioner submitted a memorandum to the Hon. C. C. Ballantyne, Minister of Naval Service, having in charge the Dominion Fishery Service, setting forth his views as to the salmon-fishing regulations of the Province. After reviewing the history of the salmon-fisheries of the Province and the reports of the many Royal Commissions that have investigated their conditions, the Commissioner suggested "that the time has come for a complete and radical change in the policy of handling our fisheries." "It is time," he stated, "that the Government stepped in to seriously protect the fish, eliminate all useless competition, overequipment, and waste, *to the end that the people may be able to obtain at a fair price one of the natural food* products of the Province. To permit of utter depletion of the salmon-fisheries of the Province would be a 'policy which could only be characterized as a criminal policy.' The fish of the Province, notwithstanding the depletion of both the salmon and the halibut, are still one of its greatest food assets. With judicious handling the fisheries can be maintained for all time. The depleted fisheries can be built up, but they cannot be maintained if the present methods are to continue. The Fraser River fishery demonstrates what will happen if things are to go on as they have been going. We have overdone the thing. We have drawn, and are drawing, too heavily upon our supply of salmon and halibut. What we need is a complete and radical change of policy, a departure altogether different from past and existing methods. . . . Instead of licensing existing and new companies and individuals to take and handle our salmon-fisheries the Government should take them over and handle them. By so doing the fish will be given full

protection. There will be a radical reduction in equipment and consequent reduction in overhead expenses that will materially reduce the retail price of both fresh and canned salmon. The Governments of Great Britain and the United States took over the fur-seal industry because it was essential to the preservation of the fur-seal. Corporate and individual enterprise was killing them off. The Governments took them over and adopted a policy that has materially increased the numbers in the herds of fur-seals."

The Commissioner suggests that the Government should assume the sole control of the entire salmon industry and manage it in the interest of the people of Canada. "The policy proposed," he states, "is a practical and sane business thing for the Government to undertake. It is a business that will pay dividends in a greater supply of fish, and at a cheaper price, not only to the people of to-day, but to our people that are to come after. Government control and operation is, in my opinion, the solution of this great economic question."

The Commissioner's memorandum will be found in the Appendix of this report.

CONTRIBUTION TO THE LIFE-HISTORY OF THE SOCKEYE SALMON.

Dr. Gilbert's sixth contribution to the reports of the Department on the life-history of the sockeye salmon, which is issued herewith, contains an analysis of the sockeye runs to the principal waters of the Province for the year 1919. We now have a complete history of the runs for eight years, and in consequence are enabled to make comparisons that are of economic value.

The outstanding feature of the examination of the scales collected from the 1919 run of sockeye to the Fraser was the remarkable series that passed in procession during the season. Sockeye having a defined type of scale-structure made its appearance on a given date, would occupy the stage for a time to the practical exclusion of any other type, and then, on another date, would suddenly be supplanted by another type of structure, which was so sharply distinguished from the first that it could not conceivably be found in company with it on any spawning-ground. The run in 1919 was peculiar in comparison with previous years in the distinctness of these components of the run. Apparently fewer types were represented than has been the case in other seasons, or if represented, then by fewer individuals, which could not confuse the characteristics of the race which was dominant in that part of the run. Whereas during other seasons it has been a rare occurrence to find in any period of the run a race unmixed with any other and appearing homogeneous, the impression during 1919 was a succession of such occurrences, in each of which one race strongly predominated, even if not wholly without mixture. Apparent paucity of races can only find explanation in the practical extermination of the run to certain tributaries, which even in the depleted condition of the river during the last decade have until now furnished their quota. Not only did the migration waves exhibit each its characteristic structural peculiarities, it possessed also its own distinctive proportionate representation of age-groups. The succession of racial forms which appeared in the main run, either in the sea approaches to the river or in the main channel of the latter, are most readily detected by characteristics shown in the central or nuclear area of the scales. It is this area which records the growth of fry and fingerlings in fresh water—a growth which takes place in a number of lakes scattered widely through the river-basin, varying extensively in their climatic conditions and in the character and amount of food which they offer. The growth in these lakes differs materially, and the size of the yearlings, when they migrate seawards in the early spring, is an index of the favourable or unfavourable conditions under which the different lots have been nourished. The fingerling groups of smaller size will have at migration smaller scales, and these will be marked by fewer rings. In the adult salmon, therefore, the size of the nuclear area, which represents the entire scale of the fingerling migrant, and the number of rings which this nuclear area contains, serves as a measure of the size of the fingerlings, and thus enables us to sort out the races which have differed in amount of growth during the first year. Not all races may have differed in this respect. But they frequently do so, and where this is the case an examination of the nuclear area gives data of high value.

One fact which emerges clearly from the tables giving the lengths and weights contained in the paper is the small size of the sockeye of each group of the 1919 run as compared with previous years. The run of 1919 produced the smallest sockeye of which we have any record on the Fraser.

In his analysis of the data collected at Rivers Inlet during the run of 1919, Dr. Gilbert finds that the present conditions there are fast developing into one of pronounced danger. He shows that the productivity of the river has fallen during the past four years to little more than half its previous magnitude, and that we are no longer justified in classing the recent poor years with those occasional fluctuations which occurred in previous cycles.

For comparison the history of the Rivers Inlet sockeye-catch is divided into successive four-year periods, as follows:—

1904-1907, average pack of 98,589 cases.
1908-1911, „ „ 99,142 „
1912-1915, „ „ 98,717 „
1916-1919, „ „ 53,948 „

In commenting on general conditions at Rivers Inlet, Dr. Gilbert states: "Unless the intensity of the fishing is at once diminished, unless we decrease the total number of sockeye taken annually from this watershed, we are in danger of repeating there on a smaller scale the tragic history of the Fraser River."

The eight years of study of the sockeye runs to Rivers Inlet show that the average size of the sockeye within their own group was so nearly constant during the first years of the investigations that any considerable change in this respect becomes immediately apparent. Such a change undoubtedly occurred in the runs of the last three years. There is no present reason to allege in support of an assumption that there is a casual connection between the size of the individual fish and the magnitude of the run. The coincidence during the last three years may be only chance association. But against this hypothesis Dr. Gilbert states we have our observations of other exceptionally poor runs in the rivers of the Province during the years 1913 and 1917, when, as stated in the Department's report for 1917, "We have extremely poor packs of sockeye in all the large rivers of the Province, and we have these poor runs consisting everywhere of undersized fish."

At present there is no explanation for the extensive annual fluctuation in the size of the runs in our northern salmon-streams. Neither the Nass, the Skeena, nor in Rivers Inlet has it been established that there was any relation between the size of the run in any given year and the size of the broods from which it has been derived. How can this lack of relation between the two be explained? Of course, it may be contended that the apparent lack of relation is due to incorrect estimates of the size of the runs during some or all of the seasons. Estimates have been made on the apparent abundance of the fish and the size of the commercial catches. Failure by this method, due to exceptional conditions, may indeed occur now and then. But quite generally it has been noted that seasons of good fishing correspond with successful seasons on the spawning-grounds, as these are established by direct observation. So, while we may admit occasional lapses of method, it must be agreed that years of apparent abundance are correctly so characterized and correspond with seasons in which the spawning-beds are abundantly seeded. As Dr. Gilbert submits, "the conclusion that the relative amount of seeding of the beds has comparatively little influence on the size of the resulting runs becomes palpably absurd if pressed to the limit. If the number of eggs deposited in the beds be sufficiently reduced, it must have a paramount influence on the magnitude of the run. When the variation in the annual production of eggs is of lesser amount, no greater than has occurred in the Nass, the Skeena, and on Rivers Inlet in the last ten years, there is the possibility that other factors which limit the production of salmon are of greater importance than egg production, within the limits of variation of the latter, and have a dominating influence in producing the annual fluctuation so evident even in streams that are not overfished. Where overfishing has occurred the case would be different. By overfishing we mean that so great a reduction of the spawning stock has been made that insufficient eggs are produced year by year to maintain the maximum of the run. In pronounced cases of overfishing a correlation is well established between egg production in a given year and the size of the resulting run. The relation has repeatedly been shown in the decline in the Fraser."

Dr. Gilbert concludes his discussions of this question as follows: "Obviously, the occurrence of undersized fish characterizing each of a series of conspicuously poor years does not exclude the possibility of overfishing as a contributory cause for the decreased runs. When the experience of a series of years indicates unmistakably that the productivity of a stream is declining to a lower level, the common-sense treatment of the situation is to modify favourably the only factor

over which we exercise control. We should increase the spawning reserve and thus seek to augment the egg production. Egg production must, after all, be fundamentally most important. As a constant factor, in the long run it will dominate the situation."

In dealing with the run of sockeye to the Skeena in 1919, Dr. Gilbert points out that "the catch of the year produced a pack of 184,945 cases, and was the next to the largest known in the history of the river. It was exceeded only by the take in 1910, which reached the total of 187,246 cases. The occurrence of two favourable seasons in succession, those of 1918 and 1919, bring a certain amount of needed reassurance concerning the general condition of the salmon-supply in the Skeena River. The previous occurrence of two extremely poor years in succession, 1916 and 1917, had occasion for grave forebodings, lest they might indicate that the salmon-supply of the river was being drawn on more heavily than in the long run would prove safe. This question has not yet received a conclusive answer. Annual fluctuations often conceal the sequence of events. Only by resorting to averages which cover periods of years can we ascertain with some degree of certainty whether the supply is on the whole diminishing. With this object in view, we have ascertained the average pack on the Skeena River in four-year cycles from 1903 until 1919:—

Average pack from	1903 to 1906	78,868	cases.
„ „	1907 to 1910	130,851	„
„ „	1911 to 1914	101,664	„
„ „	1915 to 1919	91,477	„

"Considering these averages in connection with the fact that the number of canneries and the amount of fishing-gear employed in this district have been relatively constant during the greater part of the period under consideration, and the further fact that latterly the increase in canneries and the high price obtained by the fishermen has encouraged them to make every effort, we cannot escape apprehension that we are slowly but certainly encroaching on our capital supply of fish. It would seem that, on the average, the productivity of the river is declining. Until this question has received a satisfactory decision the situation on the Skeena should receive most careful and conservative treatment. The intensity of the fishing should be diminished and not increased."

Dr. Gilbert's studies of the Nass River sockeye runs of the last eight years show that each run is very complex, but that it is a well-ordered complexity: "Different age-groups appear and develop in orderly sequence, and are marshalled as distinctly in assemblages with determinate numerical ratios as though they had schooled separately at sea and were returning each under migration laws peculiar to itself. Furthermore, the system pursued by the age-groups in 1919 is identical with that of former years . . . and testifies to the delicacy of the adjustments which govern so rigidly the migration behaviour of the different age-groups. Adjustments of this nature in other animals escape our observation, for we have ordinarily no means of grouping individuals in accordance with the important facts in their life-history. The categories themselves are unrecognized and unsuspected, and no possibility is presented of delving far beneath the surface. Formerly this condition obtained with the salmon also, for nothing in the external appearance, the size, or the structure makes it possible to distinguish one group from another. As they pass before our unaided eyes during the fishing season the impression is given of a homogeneous assemblage. Not until we learn to decipher their autobiographies as inserted on their own scales do we become aware of the play of forces and the responses, and aware of the diverse elements, each governed by its own laws, and each articulating perfectly with the main body of the run."

The following statement of the salmon-eggs placed in the hatcheries of the Province in 1919 is furnished by Lieut.-Colonel F. H. Cunningham, Chief Inspector of Fisheries for the Dominion:—

STATEMENT SHOWING TOTAL NUMBER OF EGGS PLACED IN VARIOUS HATCHERIES IN BRITISH COLUMBIA, 1919.

Name of Hatchery.	Sockeye.	Cohoe.	Springs.	Pinks.	Chums.	Steelheads.	Atlantic Salmon.	Redfish.	Kamloops Trout.	Rainbow Trout.	Cut-throa Trout.
Anderson Lake	8,100,000										
Babine Lake	9,670,000										
Cowichan Lake		1,784,000	1,310,306			37,000					188,200
Cultus Lake	10,522,000				112,000						
Gerrard								1,100,000	1,402,600	10,000	
Harrison Lake	7,549,000	190,000	3,574,000	4,248,000	573,000						
Kennedy Lake	8,463,000	33,000									
New Westminster		230,000		*450,000		31,000	†360,000				32,000
Pitt Lake	3,868,500	265,000	28,000								
Pemberton	31,665,000										
Rivers Inlet	11,720,000										
Stuart Lake	7,400,000										
Totals	98,957,500	2,502,000	4,912,300	4,698,000	685,000	68,000	360,000	1,100,000	1,402,600	10,000	220,200

* Taken from Courtenay River, Vancouver Island. † Received from the East.

NOTE.—No eggs placed in Skeena River or Seton Lake Hatcheries, 1919.

THE SOCKEYE SALMON-PACK* OF THE FRASER RIVER DISTRICT FROM 1900 TO 1919, INCLUSIVE.

Year.	Fraser River.	Puget Sound.	Totals.
1900	229,800	228,704	458,504
1901	928,669	1,105,096	2,033,765
1902	293,477	339,556	633,033
1903	204,809	167,211	372,020
1904	72,688	123,419	196,107
1905	837,489	847,122	1,684,611
1906	183,007	182,241	365,248
1907	62,617	96,974	159,591
1908	74,574	155,218	229,792
1909	585,435	1,005,120	1,590,555
1910	150,432	234,437	384,869
1911	62,817	126,950	189,767
1912	123,879	183,896	307,775
1913	736,661	1,664,827	2,401,488
1914	198,183	336,251	534,434
1915	91,130	64,584	155,714
1916	32,146	78,476	130,622
1917	148,164	411,538	559,702
1918	19,697	50,723	70,420
1919	38,845	64,346	103,191

* Given in cases—forty-eight 1-lb. cans to case.

SOCKEYE EGG-TAKE AT FRASER RIVER HATCHERIES FROM 1901 TO 1919.

1901	15,741,000
1902	72,034,000
1903	13,464,000
1904	9,469,000
1905	97,656,000
1906	51,121,000
1907	53,952,000
1908	46,709,000
1909	98,000,000
1910	37,343,000
1911	22,937,000
1912	38,500,000
1913	86,000,000
1914	28,589,000
1915	68,476,000
1916	40,203,000
1917	31,004,000
1918	20,581,500
1919	61,004,500*

* 7,400,000 of these eggs were collected from the Skeena River and hatched at Stuart Lake.

APPENDICES.

THE SPAWNING-BEDS OF THE FRASER RIVER.

Hon. Wm. Sloan,
Commissioner of Fisheries, Victoria, B.C.

SIR,—I have the honour to submit the following report of my annual inspection of the salmon-fishing and of the spawning area of the Fraser River District during 1919:—

The catch of all species of salmon from the Provincial waters of the Fraser River District this season produced a total pack of 163,123 cases, one of the smallest ever made. Of the thirty-seven canneries heretofore operated in the district, but twelve were operated this year. Their combined pack consisted of 34,068 cases of sockeye, 39,253 cases of pinks, 39,223 cases of springs, and 15,941 cases of steelheads. The catch of sockeye this season was 57,067 cases less than it was in its brood-year, 1915. The catch of pinks in Provincial waters was close to 100,000 cases less than the catch of 1917, the brood-year of this season's run.

The catch of both sockeye and pinks in the State of Washington waters of the Fraser District was equally unsatisfactory and unproductive. The pack of sockeye totalled but 64,346 cases, as against 87,456 cases in 1915, the brood-year, and the pack of pinks totalled but 421,215 cases, as against 1,124,884 cases in the brood-year 1917.

The total pack of sockeye in the Fraser River District this year was but 98,414 cases, as against 144,532 cases in 1915, and the total pack of pinks was but 460,468 cases, as against 1,256,326 cases in 1917. The fact that the prices paid this year for both sockeye and pinks were considerably higher than in any former year, and the further fact that the amount of gear used was as great as in 1917, leads inevitably to the conclusion that the small catches in the district were due to the small run.

During the season I personally inspected the principal spawning area of the Fraser River basin. It was my eighteenth annual inspection. I was again assisted by Inspector of Fisheries C. P. Hickman and Fishery Officer W. A. Newcombe, the latter having returned from France in May. The result of our inspection conclusively shows that there were even less sockeye on the spawning-beds of the Fraser River than in any former year, notwithstanding the fact that a greater number of sockeye reached the waters at the head of Lillooet Lake than for many years.

The number of sockeye that reached Hell's Gate Canyon, above Yale, was very much smaller than in any year since annual inspections were inaugurated in 1901; consequently there were less sockeye on all the spawning-beds north of that canyon, which includes the entire upper section of that river-basin, than in any previous year.

The Dominion Government issued an order in July prohibiting the Indians from fishing for sockeye above the commercial fishing boundary at Mission Bridge. Heretofore the Indians have been permitted to fish for their own needs at any point they desired. They had conducted extensive operations at Hell's Gate, at Bridge River Canyon above the village of Lillooet, and at many points on the Thompson, Chilcotin, and Upper Fraser. In former seasons the Department obtained valuable data as to the size of the run by counting the sockeye taken by the Indians and hung on their drying-frames. Because the Indians were not permitted to fish this year no such data could be obtained.

In order to obtain data on the number of sockeye that reached the Thompson and Quesnel Rivers, and because Dr. Gilbert especially desired scales from the families of sockeye that frequent those rivers, the Department attempted to catch sockeye in both those streams by means of nets. Two gill-nets of 5¾-inch mesh were set in the Thompson River at Spences Bridge, one on each side of the river, in water through which sockeye pass in ascending. These nets were maintained there day and night from August 18th to August 29th. The number of salmon taken by the nets totalled six and were all males. The officers in charge of the nets kept a close watch on the rapids of the river both below and above the nets, and record that they saw no salmon except three taken by Indians and those taken by the nets. Had there been sockeye in numbers passing up the river at that time they would have been seen at the rapids,

and no doubt many would have been taken in the nets. These nets were operated during the time that in former years the run was at its height. A month after they were removed Officers Hickman and Newcombe, acting separately and on different dates, inspected the waters of Shuswap and Adams Lakes and found no evidence of sockeye having reached there, and very few were noted there by others at later dates.

The record on the Quesnel River discloses a condition as disastrous in its results as that on the Thompson. Not a single sockeye was taken in the gill-net set in the Quesnel River from August 28th to September 9th. Following the practice begun by the Department in 1903, a watchman was placed on the dam at the outlet of Quesnel Lake who acted throughout the past season. He reports that but three sockeye, two males and one female, were seen in the clear waters of the Quesnel River below the fishway and the dam. Former reports issued by this Department record that over 4,000,000 sockeye entered Quesnel Lake through the fishway during the fall of 1909, and that some 557,000 sockeye entered that lake in the fall of 1913, notwithstanding the blockade at Hell's Gate Canyon that season, which blockade was illustrated and described in the Department's reports of 1913 and 1914. This year, as stated, but three sockeye were seen there during the entire season. More conclusive evidence could not be produced to establish the practical extermination of the runs of sockeye to the Fraser than is presented by these records from two of its largest tributaries.

That there was but a small run to the Chilcotin River this year was established by an inspection of that river by me and from reports from the Indians at the head of the river at the outlet of Chilko Lake. At the time of my inspection I was told by Chilcotin Indians that, notwithstanding the order prohibiting them from fishing for salmon, dip-nets were used at several favourable points without capturing any sockeye. Dr. Gilbert's examination of the scales obtained from the run of sockeye at Hell's Gate Canyon by Overseer Newcombe in August discloses that it consisted of a perfectly homogeneous lot that were bound for the Chilcotin. (*See* Dr. Gilbert's report, page 47.)

Late in October and early in November a few hundred sockeye entered Seton Lake. There was no run there in August and September. Because a sufficient number of sockeye did not reach Seton Lake to warrant the operation of the hatchery it again remained closed.

Unquestionably there was a larger run of sockeye to the Birkenhead River, at the head of the Harrison-Lillooet Lakes watershed, this year than in any recent year. The run was so much larger than even in 1915 that it cannot altogether be attributed to the fact that the Indians were not permitted to fish at the Little Portage at the foot of Lillooet Lake. Fishery and Indian Agent Grant, who is an authority on the subject, and who has been stationed at the portage during the salmon run for a number of years past, states that a far greater number of sockeye passed through the rapids at the portage this season than at any time in recent years. The collection this year of 30,000,000 sockeye-eggs at the Pemberton Hatchery conclusively proves that the run was unusually large. The collection of eggs in 1918 totalled 11,960,000; in 1917, 5,270,000; in 1916, 25,750,000; and in 1915, 25,250,000. The collection this year exceeded the collection made in the brood-year of this season's run (1915) by 5,000,000 eggs. The fish came early and ran late. I am convinced that the run there this year was due to the successful operation of the hatchery in 1915. Conditions there are ideal for hatchery propagation. Superintendent T. W. Graham and the Department are to be congratulated upon such a satisfactory showing.

The run of sockeye to Harrison Lake and to the lower section of the Fraser River this season was larger than in any year since 1915. The number of sockeye that entered the trap at the entrance of the small stream from the retaining-pond at the hatchery at Harrison Lake contributed 4,000,000 eggs to the collection made for that hatchery this year. As the stream is an artificial one, consisting of the waters used in the hatchery, and no salmon have ever spawned there, naturally the run this year must be credited to the fry incubated in the hatchery and liberated through the retaining-ponds. The run to that small stream this year was far greater than to any of the natural streams tributary to Harrison Lake, save the Lillooet River, and the run to the latter passed on to the Birkenhead River. It is evident that the sockeye that entered the creek at the Harrison Hatchery and also the Birkenhead River must be credited to the successful operation of the hatcheries in past years. It is a most satisfactory showing.

Considerable concern has again been exhibited by those interested in conditions existing on the Fraser River at Hell's Gate Canyon. The statement made that the river-channel there is

still so blocked as to prevent the passage of sockeye to the waters above, and that the sockeye that reached there this year did not get through the canyon is untrue. The rocks that blocked the channel in 1913 were entirely removed in 1914-15 and the old channel fully restored. All the sockeye that reached there this year passed through the canyon without more delay than often occurred in the years before the slide of 1913. Conditions at Hell's Gate since 1914 have been and are now as favourable to the passage of all species of salmon as they were previous to the slides of 1913 and 1914. The Department has had the channel there under close observation every season since 1901. The rapids at Hell's Gate are the first real obstacle which the sockeye encounter in their ascent of the Fraser River. Until they reach there they have had no rapids of importance to overcome, and consequently are inexperienced in passing through such swift and broken currents. The result is that even at the most favourable stages of water they make repeated attempts before they succeed in finding their way through the Gate. This year, as in the years before the slide of 1913, there were short periods, in certain unfavourable stages of water, during which few (if any) salmon passed. On two occasions this season the run was delayed for several days, but all the salmon eventually succeeded in passing, so that the delay was not of material importance. The rapids at Hell's Gate are not more difficult of ascent at times than the rapids in the Fraser above the mouth of Bridge River, and are not nearly as difficult at all times as the rapids and falls at "the Hole" on the Chilko River, some miles above the mouth of the Whitewater River, yet the sockeye on reaching those places experience less delay than at Hell's Gate. At Hell's Gate and at the Bridge River Canyon all the sockeye apparently make the ascent close to the surface on either bank, and the same is true at Fish Canyon on the Chilcotin River, but at "the Hole" on the Chilko all apparently hug the rocks on the bed of the stream and none of them pass close to the surface. After viewing a run at Hell's Gate and then observing the sockeye at Fish Canyon on the Chilcotin River one cannot help being impressed by the certainty with which they attack and overcome the last-mentioned rapids. They show much more expertness in overcoming rapids and falls by the time they reach the latter rapids. From studying the conditions at Hell's Gate since 1901 I am of the opinion that the situation there does not offer a serious obstacle to the ascent of sockeye.

I have, etc.,

JOHN PEASE BABCOCK,

Assistant to the Commissioner.

Victoria, B.C., November 1st, 1919.

THE SPAWNING-BEDS OF RIVERS INLET.

Hon. Wm. Sloan,
Commissioner of Fisheries, Victoria, B.C.

SIR,—I have the honour to submit my report on the inspection of the spawning-beds of the Rivers Inlet watershed for the year 1919.

Since Dr. C. H. Gilbert's investigations have determined that the race of sockeye that frequent the waters of Rivers Inlet and spawn in the tributaries of Owikeno Lake consist of four- and five-year-old fish, the numbers of fish found there this year are compared with the numbers found there in the years 1914 and 1915.

Leaving Rivers Inlet Cannery on September 19th, I proceeded to the head of the lake. The three tributaries at this section are early-running salmon-streams, from which I am able to record very satisfactory results.

In Indian River, which was examined first, the salmon showed up remarkably well. The rapids all the way to the falls, half a mile distant from the mouth, contained large numbers of sockeye salmon corresponding very closely in numbers to the run here in 1914. In size they were under the average. No log-jams or other obstructions interfered with the movement of the fish up-stream.

Proceeding next to the Washwash River, situated on the other side of the lake, it was satisfactory to note a big run of sockeye salmon. The spawning-beds for a distance of two miles were literally crowded with fish. It is necessary to recall the exceptionally big run which spawned in this tributary in 1914 and 1915—the brood-years from which the present run resulted—to approach the numbers observed on these spawning-beds this year. The males and females were equally represented and came well up to the average in individual size. A few small grilse were seen.

The work of clearing the log-jams from the mouth of this river by Engineers of the Dominion Department of Fisheries, under the direction of Mr. McHugh, in the spring of this year calls for most favourable comment. Where in former years it was difficult to follow the course of the stream owing to the log-jams which obstructed the mouth, these have now been removed and permit the salmon to reach the extended beds above. It is to be hoped that the good work undertaken by them will be repeated each year. An example of how quickly a freshet will destroy labour of this description is shown by a log-jam which completely obstructed a small branch stream situated on the right side of the Washwash, leading into the main river above; while thousands of sockeye salmon were spawning on the beds, a very large number were congregated below the recently formed obstruction unable to proceed farther.

The Cheo River, lying midway between the Washwash and Indian Rivers, received its full complement of sockeye salmon this year. The spawning-beds were thickly covered with spawning fish. Judging from the numbers observed below the falls, the removal of the log-jam permitted the sockeye to reach this part of the river. The run there this year compared very favourably with the brood-years 1914 and 1915. In size the fish were not, however, up to the average.

On returning from the head of the lake inspection was made of Sunday Creek. With the exception of a few sockeye swimming around on the spawning-beds at the mouth, there was nothing to indicate abundant seeding. The numbers did not compare favourably with the runs of 1914 and 1915. This creek had again changed its course.

There were no salmon to be seen as we proceeded through the Narrows, the high stage of the lake preventing observations of the gravel-beds. The approach to the Sheemahant River, the most productive salmon-stream of the lake, was crowded with sockeye and prepared me for the unquestionably large run of fish which were making full use of the eighteen miles of spawning area at their disposal. The males appeared to outnumber the female sockeye salmon in the proportion of four to one, indicating that spawning had just begun. In point of size they were below the average. There are no obstructions of any kind in the stream to interfere with the movement of the fish. The inspection was conducted too early to arrive at any conclusion in regard to the run of cohoe salmon.

The Dominion Department of Fisheries, in effecting a clearance of the log-jams in Jeneesee Creek, are to be congratulated on the results achieved. The spawning-beds which have now been opened up to the salmon permitted the remarkable run which came in to seed the beds to their full capacity, the hatcherymen obtaining a total of 3,000,000 eggs from this creek.

In no other years, with the exception of 1913 and 1914, have so many fish been found in Jeneesee Creek. As in 1915 few sockeye salmon entered this stream, it suggests a theory in favour of a run of five-year sockeye; the salmon again were larger than those encountered at other streams in the Owikeno watershed this year.

The number of sockeye salmon which reached the spawning-beds of the Machmell River was again every difficult to estimate. This stream with its thick muddy water prevented all efforts to observe the fish in the river-bed, but in the shallows farther up a few sockeye were seen breaking water, indicating that there were fish there. The quiet waters of the Nookins River, a tributary to the Machmell, evidently attract the greater portion of the run of sockeye. In the clear water for a distance of three or four miles the fish were seen spawning on the beds in exceptionally large numbers, and in the lower portion of the river big schools were noted, evidently waiting until they were in a ripe condition. The inspection revealed a run equal to those of 1914 and 1915. No log-jams obstruct this river.

In making the inspection of Asklum River every facility was afforded to obtain an uninterrupted view of the river-bed all the way to the falls, due to the low stage of the stream. In the clear water thousands were observed spawning on the gravel-beds, but in estimating the numbers of sockeye to be seen here it was noticeable that the run did not compare with the big runs recorded in 1914 and 1915. There is no doubt, however, that the beds were being bountifully seeded. In size the fish were smaller than in former years, the males outnumbering the females four to one. The log-jams referred to in previous reports have received attention from the Department of Fisheries and no longer seriously interfered with the run.

The Dalley River, situated about six miles from the mouth of the lake and directly opposite Quap, was well supplied with sockeye salmon. The spawning-beds did not contain many fish, but large schools were observed waiting below in the clear water; in some places the river was literally black with them. I have no hesitation in recording a run equally as great as the number which made their appearance here in 1914 and 1915. In size the fish represented only a fair average. No obstructions of any kind interfere with the spawning-beds, which should produce a big run from this season's spawning.

From the Quap the hatcherymen secured 14,000,000 sockeye-eggs. They could, I am advised, have taken double that number had they desired. After they stopped taking eggs a vast number of fish were permitted to ascend the stream. The work of the Dominion Fishery Engineer, Mr. McHugh, in the removal of the log-jams from this creek's bed, cannot be too highly commended, since it has restored the entire creek-bed to spawning fish.

The gravel-bars at the mouth of the lake and situated around the Indian rancherie were not overstocked with salmon on my first visit, but an improvement was shown on my return; the sockeye were beginning to cover the spawning-beds in large numbers. It is usual for these fish to drop back from the lake when they are ready to spawn.

The Owikeno River was too discoloured to estimate the number of spring salmon, but evidence was not lacking that the run of this species of fish was well up to the average. The cohoe run was exceptionally large in point of numbers, but they arrived after the fishing season and too late for the canneries to reap the benefit.

Taking into consideration the comparatively poor pack obtained by the canneries at Rivers Inlet this season, it is surprising that the spawning-beds did not show a correspondingly poor seeding. The exceptionally large number of sockeye salmon observed spawning on the beds, and noted in tens of thousands schooled up in the deeper portions of the various tributaries, precludes the opinion generally expressed by the canning fraternity that the run this year was a small one. My inspection showed that the spawning-beds were as abundantly seeded as in 1914 and more so than in 1915. As the sockeye, generally speaking, did not reach an average standard in size, the poor catch may be attributed to their having passed through the nets. Fishermen whom I interviewed during the fishing season time and again deplored their luck in seeing hundreds of salmon pass completely through their nets.

The extension of the weekly closed time had its effect. Because I found the spawning-beds on the tributaries of Owikeno Lake so abundantly seeded this year, I look for a favourable return in the runs four and five years hence.

In conclusion, I wish to express my thanks to G. L. Johnston, of Rivers Inlet Cannery, Captain Hamer, of the Dominion Hatchery, and the various officials connected therewith, to whom I am indebted for many attentions.

I have, etc.,

ARTHUR STONE,

Fisheries Overseer.

Rivers Inlet, B.C., November 8th, 1919.

THE SPAWNING-BEDS OF SMITH INLET.

Hon. Wm. Sloan,
Commissioner of Fisheries, Victoria, B.C.

SIR,—In pursuance of instructions from the Department to make an inspection of the watershed at Smith Inlet, I have the honour to submit the following report for the year 1919:—

Proceeding to Smith Inlet at the conclusion of my visit of inspection to Lake Owikeno, arrangements were made with Indians, after which departure was made for the spawning-beds situated at Long Lake, four miles and a half from salt water.

The peculiar characteristics displayed by the Rivers Inlet race of sockeye salmon, in that they represent practically four- and five-year fish, is demonstrated in the race which return to Smith Inlet to spawn; consequently, in making comparisons, it will be necessary to refer to the 1914 and 1915 runs—the brood-years from which the present run of sockeye resulted.

Long Lake is about sixteen miles in length and contains two rivers and one small creek, which, with the exception of some fine gravel-beds situated along the shores at the head of the lake, comprise the only spawning-grounds for the salmon.

The Docee River (the overflow to the lake) afforded every facility to estimate the number of sockeye salmon, since the water was very low and clear. The run here is well up to the average of former years, large numbers being noted both in the river and along the shores at the mouth of the lake.

Arriving at Quay Creek, situated about seven miles from the mouth of Long Lake, an inspection was made of the spawning-beds. The exceptionally big run which I am able to record compares very favourably with the number seen here in 1914.

The spawning-beds both inside and outside the creek were well covered with spawning fish. In a deep pool at the foot of the falls a very large number of salmon were congregated, making futile efforts to surmount the insuperable barrier which at present bars them from reaching a small creek above leading to a lake half a mile inland. If this barrier could be removed by building a fish-ladder and blasting out a log-jam which has formed at the foot of the falls, great advantage to the fish would result. It is apparent that this creek only receives the sockeye in exceptional numbers every fourth and fifth year, the three following years having shown comparatively poor returns, but this should not prevent an effort being made to clear the obstruction referred to.

Conditions at the head of the lake, where the greater portion of the sockeye-spawning beds are situated, was practically a repetition of that which was recorded in 1914 and 1915. The gravel-bars at the mouth of the Geluch River (or Smoke-house Creek, as it is termed by the Indians) was crowded with sockeye salmon. Going up the river to the falls about three miles and a half distant, the fish were observed in dense masses lining the beds; the small mountain streams emptying into this river all bore the same tale; every foot of available spawning-ground had been utilized for the propagation of spawn. In numbers the males appeared to be in greater proportion than the female salmon and in size attained a fair average. The river-bed is free from any obstructions;. consequently the fish should experience no difficulty in providing sufficient seed to produce a run four and five years hence equal to the present one.

The fine gravel beach which lies at the entrance of the Delabah River and along the shores of the lake did not show anything like the number of sockeye salmon recorded here in 1914. It will be recalled that a milling mass was the description applied to the vast numbers in that year. The run of 1915 describes more accurately the situation here, although evidence was not lacking that eventually a very big run would reach this section, since the lake appeared to be well stocked with salmon to judge by the numbers breaking water.

From the mouth of the Delabah River to the falls one mile and a half distant tens of thousands of sockeye crowded the spawning-beds, while in the deep pools schools were noted bunched together waiting. The scene presented a close parallel to the extraordinary number recorded in 1914. No log-jams or other obstructions prevented the fish enjoying full possession of the spawning-beds at their disposal. The only drawback to successful propagation of spawn would be in the nature of the river-bed, composed principally of rocks and pebbles; otherwise I have no doubt the thousands which will seed the beds will provide for an equally big run when the fish return as adults from this season's spawning.

A number of small mountain streams were examined on the way back to the mouth of the lake, and at the entrance to each small bunches of sockeye were in evidence.

One or two small schools of cohoe salmon were noted making their way up the Docee River to the lake; no comparison, however, can be made with the number seen last year, but this may be attributed to their late arrival from salt water, since I noted large numbers breaking water in Smith Inlet on our way back to the cannery. The humpback run was very small and corresponded closely to the numbers recorded at Rivers Inlet this season. The dog-salmon, on the other hand, arrived in considerable numbers, and from this species a good run may be expected from the results of this season's spawning.

The comparatively small pack of sockeye salmon put up by the two canneries at Smith Inlet, amounting to about 16,000 cases, when contrasted with the big pack of 28,000 cases in 1914 and 35,000 cases in 1915, calls for some explanation as to why more fish were not caught on the fishing-grounds this year, since the spawning-beds have been shown to have been so abundantly seeded. The answer may be summed up as follows: The action of some of the gill-net fishermen in forcibly restraining the Wallace Fisheries from fishing their seine-nets during the height of the sockeye run permitting tens of thousands to escape capture. I am given to understand that during the four or five days the seines were not in use a milling mass of fish occupied the seining-grounds which lie inside the gill-net fishing boundary, having successfully negotiated the large number of gill-nets distributed over the inlet; all these fish in consequence reached the spawning-beds.

Summing up the results of the inspection to this watershed, I have every reason to look forward optimistically to a big run which will return here as adults from this season's spawning, since the spawning-beds received a run closely resembling the vast numbers recorded in 1914.

I have, etc.,

ARTHUR W. STONE,
Fisheries Overseer.

Rivers Inlet, B.C., November 8th, 1919.

THE SPAWNING-BEDS OF SKEENA RIVER.

Hon. Wm. Sloan,
Commissioner of Fisheries, Victoria, B.C.

SIR,—In accordance with instructions, I made a tour of inspection of the spawning-beds of the Skeena River, and beg to submit the following report thereon:—

On September 7th last I arrived at Donald's Landing, which is thirty miles from the head of Babine Lake. The following day I went to 15-Mile Creek; here I met Mr. Crawford, Superintendent of the Stuart Lake Hatchery, who was engaged in spawning sockeye-eggs for the Stuart Lake Hatchery. He informed me that he had commenced spawning here on September 2nd and up to this date he had obtained approximately 1,400,000 eggs; he intended to get a supply of 3,000,000 eggs altogether from this creek. I was informed before I left Babine that he was successful. Mr. Crawford also informed me that he had started spawning at Pierre Creek on August 19th and had obtained approximately 3,400,000 sockeye-eggs. From the two creeks he expected to collect his full supply for the Stuart Lake Hatchery, amounting to 7,500,000 eggs.

There was a large run of sockeye in 15-Mile Creek, and from all reports obtained I would say that they were up to the average of any previous years. This creek will be seeded abundantly; the males and females were evenly balanced. There were twelve Indian families from Stuart Lake putting up their winter supply; they were having no difficulty in obtaining all they wanted, as they were given a large number of the salmon that were spawned by Mr. Crawford. Their racks and smoke-houses were well filled. The Indians catch rainbow trout, which congregate at the mouth of this creek, feeding on salmon-eggs.

I then called in at 4-Mile Creek, which was almost dry, but there were a number of sockeye at the mouth and some were spawning in the gravel that had been washed down when the water was high. It was impossible for the salmon to get up owing to the lack of water. I was informed by the Dominion Guardian that a few had been able to get up a short distance before the creek subsided, and that in all probability the eggs which were left would be lost.

I then proceeded on to Beaver Creek. At the mouth the water was very dark and I could not see any salmon, so went up the creek a considerable distance expecting the water would be clearer. At times I could see sockeye, but not in large numbers. I was informed that the first sockeye were seen here on July 25th, and that this is considered one of the early spawning creeks of Babine. There are many obstructions of log-jams and beaver-dams. The Indians informed me that when the water gets low the salmon have great difficulty in getting over these obstructions, and when the dams are broken down the beaver rebuild them. Five Indian families from Stuart Lake attempted to obtain their winter supply from this stream, but they were unsuccessful and had to go to 15-Mile Creek to procure the quantity required.

On September 9th I visited Pierre Creek and saw very few live sockeye salmon, but large numbers of dead ones, which I presume had been spawned by Mr. Crawford. On going up the creek the number of dead salmon increased and the stench was unbearable. Mr. Crawford informed me that there was a very large run of sockeye here when he was spawning on August 19th, and that it would be well seeded. This is the earliest creek on Babine Lake for the sockeye spawning. There were no Indians putting up salmon at the time of my visit. This creek could be improved greatly by clearing out a number of the log-jams. On returning to the mouth I saw quite a number of sockeye, which were spawning in the fine gravel that had been washed out from the creek. On proceeding down the lake I saw sockeye close inshore; they were jumping and playing around. I went over to see if there was any creek near by, but there was none for miles on either side. From what I could observe through the dark water they were spawning in the fine sand of the lake-shore.

I arrived at Salmon Creek on the afternoon of September 10th and proceeded up to the Babine Hatchery, a distance of two miles and a half. In this creek I saw great numbers of sockeye, also cohoes, which were beginning to run. There is a good gravel bottom the whole length of the creek and several very deep holes. On arriving at the hatchery I met Mr. Gibbs, the Superintendent, who showed me his barricade at the entrance to Morrison Lake, where eggs are collected. All along the barricade were large sacks of hay, placed there in order to protect

the salmon when they jumped. In jumping they would strike the sacks and fall back into the water uninjured. Mr. Gibbs informed me that he would easily get his supply of sockeye-eggs there. He intended to take 8,000,000 eggs. Although the hatchery has a capacity of 10,000,000, he finds better results are derived from giving them plenty of space. There are several retaining-ponds where the fry are retained for three months, and sometimes longer, until they are well fitted to protect themselves from their enemies. The sockeye appeared to me to be much larger in size in this creek than in any other tributary of the lake. Upon mentioning this to Mr. Gibbs he agreed with me, and said that there was quite a difference, but could not account for it. There were three distinct runs to this creek; the first two the males and females were equal, but on the third run Mr. Gibbs thought the males would be in excess by four to one. The run to this creek will average as well as in any previous year. After the supply of eggs is taken for the hatchery there will be sufficient left to seed the creek by natural propagation. Mr. Gibbs further informed me that the hatchery had been in operation on this stream for fourteen years and that he had never seen a larger run of sockeye there. On the morning of September 11th, as I was leaving, the hatchery crew commenced to take spawn. On returning to the mouth I saw a number of humpbacks jumping. There was one Indian family putting up their winter supply, which they had almost secured.

On September 12th I went down the Babine River about eleven miles. On this stretch of water, where there are good spawning-beds, the sockeye were not numerous, but there were humpbacks in large numbers; the water was alive with them and especially at the old barricade site. They were not endeavouring to go any farther up and were spawning in the river. It is on this stretch of water that the Babine Indians get their principal supply of salmon. There were ninety-five families represented here; all their smoke-houses and drying-racks were well filled; they were able to secure their supply with little difficulty. Upon making inquiries as to what would constitute a reasonable supply for one family, I would estimate it to be from 1,000 to 1,200 salmon per family. The number of salmon that will be smoked this season by Babine and Stuart Lake Indians will amount to approximately 130,000, which will consist mostly of sockeye, and the number of cohoes that they secure for feeding their dogs. The Dominion Government supplies each family with 125 feet of gill-net; they stake their nets out in the evening and take them up in the morning. There is a weekly close season from 6 a.m. on Saturday until 6 p.m. on Sunday. The Indians are permitted to use nets there in place of the barricades formerly built across the river. The substitution is a beneficial one. There is now no waste and an abundance of sockeye are permitted to enter Babine Lake to stock all its tributaries. There are two Dominion Fishery Guardians who patrol the lake and see that the Indians do not get their nets across the creeks and prevent the salmon from going up. I was informed by the Fishery Guardians that the first salmon appeared in Babine Lake on July 21st, which is one day earlier than last year, and that between the end of July and the first week of August the Babine River was a solid mass of fry on their journey to the sea. Nilkitkwa Creek is very small and runs into the Babine River; the humpbacks were in large numbers, also a few cohoes.

On September 13th I proceeded to Tachek Creek and arrived there on September 14th. On going up the creek a considerable distance I saw sockeye in large numbers, all spawning. This is a very fine tributary of the Babine Lake, as there are a few miles of fine gravelly bottom. The sockeye were well distributed all over the creek. I did not see many salmon at the mouth, although the water was quite clear; I was informed they usually run up at night. There were three Indian families here from Stuart Lake putting up their supply; they told me they had about 800 per family, but were complaining of not catching many, as the water was clear and the salmon could see their nets. From information received I would say that the run in this creek was up to the average of previous years. On questioning the Indians here and elsewhere as to the general run of salmon to Babine Lake this year in comparison with other years, they said: "Lots of salmon this year."

This was the last point of interest on Babine Lake. I returned to Donald's Landing on September 15th, leaving the next day for the Indian village, Awillgate, three miles from the old town of Hazelton, arriving on September 19th. Twenty-five families reside there. I was informed by the Indian Agent and also by the Dominion Fishery Guardian that 80 per cent. of the Indians, who were in the habit of catching salmon at the Bulkley Canyon, had now abandoned the practice and have adapted themselves to living by cultivating their gardens and other means. On looking around the old smoke-houses in the vicinity I was able to substantiate

this report. I only saw four smoke-houses that had been in operation; two had a fair quantity of dried salmon and from the other two the salmon had been removed. There were eight or nine smoke-houses abandoned. At the time of my visit there were no Indians taking salmon; their method of catching them here is basket-trap, dip-net, and spearing. They have platforms on the side of the canyon, where they stand, and when the salmon endeavour to pass through they spear them. I saw no salmon as the water was very discoloured, but was informed by the Dominion Fishery Guardian that they were in large numbers about August 15th and that the average was up to that of previous years.

I left Hazelton on September 21st and arrived at Lakelse Lake in the evening. I met Mr. Catt, Superintendent of the new hatchery.

The following day I visited Blackwater Creek, but did not see many sockeye; Mr. Catt informed me that they went up early in August. I saw evidence of dead salmon on the banks which were taken out by bears and eagles. This creek has a gravelly bottom and I believe was well seeded. On returning to the mouth I saw a number of humpbacks which were spawning. I then proceeded to Williams Creek, which is a short distance from Blackwater; here I saw humpbacks and a few sockeye. This is considered the important spawning creek of Lakelse Lake and has a good gravelly bottom for a mile and a half. Mr. Catt also informed me that the sockeye run up this creek early in August and in very large numbers; the males and females were evenly balanced. The sockeye that enter Lakelse Lake stay in the lake for about six weeks until they are ready for spawning, and then proceed up the creeks to spawn. The first salmon were seen in Lakelse Lake this year on June 3rd, which is earlier than in previous years, as they generally appear on June 8th or 9th. A large number entered the lake this year before the fishing opened on the Skeena River. In the afternoon of September 22nd I visited Lakelse River. From the lake to the old hatchery the channel was literally filled with a mass of spawning humpbacks. From the old hatchery to the Skeena River, a distance of twelve miles, I was told there were vast numbers of spawning humpbacks. Lakelse River is a fine gravelly spawning-bed; the water is very clear and salmon are very easily seen, but I saw very few sockeye there. I went up Coldwater Creek; the humpbacks were there in large numbers, but no sockeye. I was informed that sockeye never go up Coldwater Creek.

On September 23rd I went up the four small tributaries of Granite Creek; they all branch off about a mile and a half above the lake. There were no salmon above that point, as the creek-bed is very rough and filled with large rocks and boulders. I saw a fair number of sockeye below the forks. Bears do great damage to the salmon in these tributaries; it is not the number they eat, but the number that they destroy, as they generally take one bite and then fish for another one. The salmon are at their mercy, as the creeks are narrow and shallow; I was told the bears destroy thousands.

I then proceeded to Scallabuchan Creek; the sockeye run here early in August. I saw a fair number spawning, but from information received I believe this creek was well seeded. Mr. Catt expects to take all his spawn here next year, as the new hatchery will then be ready for operation. The new hatchery is situated a mile and a half from the lake on Granite Creek, just above where the four small tributaries branch off. The water there is very clear and cold. At present the foundations are laid; they are of concrete, 120 feet in length and 40 feet wide, including a drain in the centre, 6 feet wide and 18 inches deep, running the whole length. It will be used as a retaining-pond for young fry. The hatchery will not be built until spring and is expected to be in operation in September, 1920. The delay in construction was caused by the strike last summer. Its capacity will be 10,000,000 eggs. The Dominion Government has built a road from the hatchery to the lake in order that they may have easy access to either end when collecting their eggs.

I wish to express my appreciation of the kind assistance proffered me by the Hatchery Superintendents and also Mr. Norrie, Dominion Overseer, to whom I am indebted for valuable information and assistance. From the facts at my disposal I have without hesitation to say that the tributaries of the Skeena River were well seeded this year, fully up to the average of any previous years.

I have, etc.,

WILLIAM A. WISLEY,

Fisheries Overseer.

Prince Rupert, B.C., September 17th, 1919.

THE SPAWNING-BEDS OF THE NASS RIVER.

Hon. Wm. Sloan,
Commissioner of Fisheries, Victoria, B.C.

SIR,—In obedience to instructions from the Department to inspect the salmon-spawning beds of the Nass River, I beg to inform you that in company with J. Maxwell Collison, of the Dominion Fisheries Department, I visited the Meziadin Lake basin and the salmon-streams in the Ayansh District. We respectfully submit the following report:—

MEZIADIN LAKE DISTRICT.

We left Arrandale, at the mouth of the Nass River, on the Dominion Fisheries patrol-boat "Thos. Crosby" for Stewart on September 11th, taking with us two Indian packers. Arriving at Stewart on the night of the 11th, we proceeded to get our outfit together and left that place on the morning of the 13th, having pack-horses to take our outfit as far as possible. The outfit was packed to the Government cabin on the west side of the Bear River Glacier, and we shouldered our packs for the trip into the interior. We encountered many difficulties and obstacles on the way in owing to the trail being overgrown with dense brush and all of the bridges having been washed away. The trail at the side of the Bear River Glacier is also in very bad shape, it having entirely disappeared for about a distance of 400 or 500 yards, which compelled us to get right on to the ice to get across. This is rather dangerous work when you have a heavy pack on your back, as the ice is smooth and shelving. After overcoming the difficulties of the glacier we proceeded on down the Beaver River, which empties into Meziadin Lake at its westerly end. The trail down the Beaver is in very bad shape owing to the river having changed its course and washing out the trail completely in places, and compelling us to cut our way through the dense brush. We also had to ford the Surprise River, which empties into the Beaver about four miles from its mouth. Surprise River was very high at the time of our visit, and in fording it we were waist-high in the water. On reaching the head of Meziadin Lake we had to build a raft to take us down the lake, there being no canoe to be found. After completing the raft we started down the lake along the north shore. For a distance of about a mile and a half from the head a few spawning sockeye salmon were to be observed, but were much less in numbers than were seen on previous trips at this particular place. Very few salmon were leaping in the lake. We reached McBride Rapids, Meziadin River, about a quarter of a mile below the outlet of the lake, in the evening; unloading our outfit, we run the rapids with the raft, then camped for the night. It rained hard. In the morning we continued on our way. At the foot of McBride Rapids there is a splendid spring-salmon spawning-ground, but there were not as many spawning spring salmon there this year as we noted in previous years. We also run the second rapids in the Meziadin River with the raft. These rapids are about a mile above the fishway. We arrived at the fishway and falls at noon on September 19th. We inspected the waters in this vicinity in the afternoon. Very few salmon were to be seen at any place here, either in the basins of the fishway or immediately below the lower or upper falls. As it was a very cloudy day we were not able to take any photos. The next morning was very fine and we proceeded to make a thorough inspection of conditions. At the falls and fishway there was a great scarcity of salmon, very few to be seen at any place, and during the whole time that we were there we only saw one salmon try to leap the fall. There were not more than ten salmon in the pockets of the fishway at any one time. It has been usual in the past, and at this time of the year, to see at least 200 salmon in the pockets of the fishway, and also to see hundreds congregated below both the main and second fall, and continually leaping in their eagerness to reach the waters above, but this season there were so few salmon that only a trained eye would know that it was a salmon-stream. On our return trip up the lake we inspected McLeod Creek and Hanna River for a considerable distance, but did not see a single salmon. We next crossed over the lake to the south side, following this shore up. For a distance of about four miles a few spawning sockeye were to be observed in places. At the extreme head of the lake at the south-west corner a considerable number of spawning sockeye were to be seen; in fact, this was the only place in the Meziadin watershed where salmon were to be observed in anything like the numbers as reported on previous visits of inspection. At the time of our visit the waters of the lake were very high, much higher than usual.

Conditions at the Fishway.—In making an inspection of the fishway we noticed that some great changes had occurred since last we were here two years previously. The large dump of rock that was on the outer side of the retaining-wall of the fishway has all been washed away, also the retaining-wall for one-third of its length and 10 feet in width has gone. At the present time the retaining-wall is 40 feet in length and 5 feet in width. The outer part of the retaining-wall is composed of rock in formation and gravel, and the inner side is of rock. The nature of the rock is slate and is very badly checked for its entire length. The main river is now running alongside of the outer wall, and the river is seeping right through the wall into the fishway in places. The wing-dam that was in the main river above the intake of the fishway has been displaced and is now lying along the river-bank. There are two trees resting on the wing-dam, and right across the intake of the fishway. The main wall of the fishway, where the crib-work is, has also suffered by flood. Two of the braces that shored up the crib-work two years ago are gone. They were toed into the retaining-wall and carried away when its lower end was destroyed.

There is also a quantity of rock displaced, which has dropped into the third pocket of the fishway. It has made quite a gouge in the wall and has taken away the support for the crib-work at this place. The old crib-work is also showing signs of decay and dry-rot. At the time the fishway was built there were four pockets. The first or lower pocket is pretty well filled up with rock from the washed-out dump. Below the fishway there is a quantity of rock deposited in the river, which was a part of the dump before mentioned. It is possible that the high water that caused the damage to the fishway came shortly after our trip of inspection in 1919, as all of the Upper Nass was visited with great floods in the fall of that year, washing some of the Indian villages completely out of existence.

After finishing up our inspection of the Meziadin watershed we had to repair to the Ayansh District. As all of the bridges and cables for crossing rivers had been washed away between Meziadin and Ayansh, it was necessary for us to go into this district by way of the mouth of the Nass; therefore returning, we arrived at the town of Stewart on September 24th. Owing to the uncertainty of means of travel in these unsettled districts it was necessary for us in order to get to Arrandale to take a steamer to Prince Rupert, then change boats for Arrandale. Arriving there we paid off the two packers that we had, procured some more provisions, and obtained passage on an Indian's motor-boat for Ayansh. The distance from Kincolith, at the mouth of the Nass, to Ayansh is over seventy miles, and the waters are very swift, making very slow travel on the upward journey. We left Kincolith on the afternoon of September 30th, and after a slow and tedious trip arrived at Ayansh on the evening of October 2nd.

AYANSH DISTRICT.

On Friday, October 3rd, we obtained an Indian guide and inspected the Saskinisht River on the 3rd and 4th. This river empties into the Nass two miles above Ayansh. We went up the Saskinisht as far as the falls. The salmon that enter this stream are spring, cohoe, dog, and steelhead. Humpback have been seen here, but there were not many this year. It is impossible for salmon to ascend above the falls. At the time of our visit there were no salmon congregated below the fall, but from information gleaned from the settlers in this district there was a good run of spring salmon this year. In the lower reaches of the river there was quite a fair number of cohoe and dog salmon, and for the size of the stream we consider that it was well seeded by the specie of salmon that enter it. The distance of the river from its mouth to the falls is about seven miles, and some splendid spawning-grounds were to be seen for the whole distance.

SEAKS RIVER.

On Monday, October 6th, we commenced our inspection of the Seaks watershed. This river empties into the Nass about four miles above the canyon and about the same distance below the village of Ayansh. We started our inspection at the mouth of the river and continued our way up to the falls, which by the irregular course of the river is a distance of some ten miles. The salmon that enter this river are sockeye, spring, cohoe, dog, and steelhead. The sockeye do not continue on up the Seaks to the falls, but head off up a creek known to the Indians as the Ginglith Creek, which flows into the Seaks about two miles from its mouth. We followed the Ginglith up for several miles and no spawning salmon were to be seen at the time of our visit, but there was considerable evidence that there had been a fairly good run, as quite a number

of dead fish were strewn along the creek-banks. From information obtained from the Indians, this stream in former years had been a good sockeye-stream, but in later years the run had greatly diminished; however, the conditions this season were much better, they said, and compared favourably with the good runs of former years. We were also informed that the sockeye that enter this stream are the first that come into the Nass, which statement was practically verified by the fish having all been spawned out by the time we reached there. It is an ideal spawning-ground for sockeye salmon and was free from any obstruction.

After having inspected the Ginglith we continued our way up the Seaks, arriving at a small lake about six miles from the mouth, this lake being formed by the flow of lava, which forced the river against a high bank of rock, thus forming a narrow canyon with a lake at the upper end. This lake, known as the "Tamdeathal," was literally alive with cohoe salmon, which were on their upward journey. There were numbers of spawning spring salmon in the river and at the outlet of this lake. Continuing up, we finally reached the falls, they being from 15 to 20 feet in height, making it impossible for the salmon to ascend any higher. The nature of the river above the fall is not in our opinion suitable for spawning salmon, as the river-bed is formed of lava and rock. We did not at the time of our visit see any salmon at the foot of the fall, it being too early for the cohoe, which were then working their way up. From information from the Indians of the district, the salmon go up the river as far as the fall, remaining there for a short while, then return to the lower reaches of the river, which are exceptionally good for spawning.

SUMMARY.

In making a summary of our inspection, we wish to call your attention to the very few sockeye salmon on the Meziadin spawning-beds this season. It is apparent that something very vital has happened to the sockeye of the Nass to cause such a shortage. As the pack at the canneries at the mouth of the Nass this season was only an average pack, plenty of sockeye salmon should have reached the spawning-grounds had there been an average-sized run. The only explanation that we can give for such a shortage is the operation of traps in South-eastern Alaska, there having been this season fourteen or fifteen traps in operation between Cape Fox and Tongas Island. What number of Nass sockeye were taken in those traps we are unable to say, but from reliable information they intercepted Nass sockeye.

The salmon-streams in the Ayansh District appeared to have a fair amount of spawning fish in them, and the watercourses were in good condition up to the falls, which is as far as salmon can get up. There was also a good supply of fresh-run cohoe and dog salmon coming up the Nass River while we were there. It is impossible for us to compare the run of salmon to these streams this season with former years, as this is our first inspection of this watershed.

In reference to the present condition of the fishway, it is important that steps should be taken to put it into good condition as soon as possible. A considerable amount of work will have to be done here, and we would advise that work of a permanent nature be put in, so that the fishway will hold for all time. Before any permanent work can be commenced on the fishway it will be necessary to have the trail put into condition, so that an outfit can get in on pack-horses to the head of the lake from Stewart. At present it is not possible to take horses any farther than the Government cabin on the west side of the Bear River Glacier.

Yours obediently,

CHAS. P. HICKMAN,
Inspector of Provincial Fisheries.

J. MAXWELL COLLISON,
Dominion Fishery Officer.

New Westminster, B.C., November 6th, 1919.

CONTRIBUTIONS TO THE LIFE-HISTORY OF THE SOCKEYE SALMON.
(No. 6.)

BY CHARLES H. GILBERT, PH.D., PROFESSOR OF ZOOLOGY, STANFORD UNIVERSITY.

I. THE FRASER RIVER SOCKEYE RUN OF 1919.

(1.) THE AGE-GROUPS AND THE SUCCESSION OF RACES.

Now that the Fraser River sockeye run has apparently established itself in a state of decline, it is interesting to ascertain what effect (if any) this impoverishment of the school will have on its internal structure. During the period of violent oscillations between relatively good years and bad, there were, as we have noted previously in these reports, corresponding fluctuations in the composition of the runs. Good runs in this basin usually have been signalized by a high percentage of four-year fish, and conspicuously poor years by a high percentage of five-year fish. But whenever the run becomes stabilized, at a low level, the reasons for these fluctuations have disappeared, and the average percentages of four-year and five-year fish re-establish themselves in the relations they occupied before the run had suffered impairment.

In this discussion we give consideration only to the prevailing Fraser type of sockeyes, which are characterized by the fact that after hatching, and before seeking the sea, they spend one year and only one year in fresh water. Our method of determining percentages of age-groups during the run lacks strict accuracy, but can be depended on for approximate results, which are available for purposes of comparison between the years. Samples are taken at nearly uniform intervals throughout the run. The earlier and later samples represent few fish, as the run was then weak, while comparatively few samples in the middle of the series may represent a majority of all the fish of the season. We cannot obtain data which would enable us to weight our figures in accordance with the state of the run when they were obtained, but commonly reach results which are very similar to the conditions obtaining at the height of the run. As long as this is the case we cannot go far wrong.

In 1919 the lowest percentage of four-year sockeyes running at any time was 23 per cent. and the highest was 100 per cent. The midway point between these was reached (as shown in Tables I. and II.) during the latter half of July, just prior to the period when usually the Fraser run of sockeyes is at its maximum. During the next period, from August 1st to 15th, the percentage of four-year fish had risen from 65 to 82. Somewhere between these two must lie the true percentage of four-year fish for the year, and inasmuch as the August sockeyes which run during the first half of the month are ordinarily more abundant than those appearing during the latter half of July, the true percentage lies doubtless nearer to 85 than to 65. Following the usual sampling method which we have employed, we reach the result 76 per cent. for the seasonal proportion of four-year sockeyes (one-year-in-lake group) and 24 per cent. for the five-year sockeyes of this group. It would seem that these figures must closely approximate the true values.

Comparing them with previous years, we find the results very similar to those obtained in 1916 (*see* Report for 1917, page 34), when 76 was the percentage of four-year fish running during the height of the season, from July 27th to August 10th. In both of these years the runs were sadly depleted, with a total pack on both sides of the boundary of little more than 100,000 cases. Another season, belonging to the recent precipitous decline of the Fraser fisheries, and worse than either 1916 or 1919, was 1918. During this year, when less than 72,000 cases represented the total pack of Fraser sockeyes, the percentage of four-year fish was 77. The results obtained during these three years, therefore, are practically identical, and can be contrasted with those similarly obtained during 1912, 1914, and 1915, which are the initial years of the four-year cycles, to which belong 1916, 1918, and 1919.

	Cases.	Per Cent.
1912	325,451	90
1914	555,557	85
1915	155,714	61
1916	116,783	76
1918	71,572	77
1919	103,200	76

Another instance of extreme variation was in 1911, when with a pack of 155,714 cases the four-year fish were present in only 54 per cent. of the total run of their group. The experience in 1919 serves as further confirmation of the following conclusion, stated in 1918 (*see* Report for 1918, page 37): "Striking changes in the relative proportions of age-groups in successive years accompany violent alternations of good and bad years. In such cases we find the poor years in such a series are signalized on the Fraser by a high percentage of five-year fish. But when the runs have declined almost uniformly to a low level, as seems now to be the case, the age-groups regain their normal relations and remain about the same from year to year."

We give below the proportion of the two principal age-groups on the Fraser for each of the dates on which samples were taken in 1919.

Table I.

	June 9.	June 17.	June 26.	July 2.	July 15.	July 20.	July 25.	July 28.	July 30.	Aug. 4.	Aug. 8.	Aug. 12.	Aug. 15.	Aug. 21.	Aug. 24.	Aug. 26.	Aug. 29.	Sept. 3.
Per cent. four-year fish	23	43	85	73	61	64	57	64	77	67	82	87	87	97	98	97	100	94
Per cent. five-year fish	77	57	15	27	39	36	43	36	23	33	18	13	13	3	2	3	0	6

An interesting comparison can be made between the above table and a similar table prepared for the run of 1916 and included in the Report for 1917 (Table II., page 34). The earliest dates recorded by us in 1916 (May 26th to June 8th) were characterized by the presence of a certain element in the run, no trace of which occurred in any of our samples taken in 1919. This element consisted of a race of very small sockeyes, with light-coloured flesh, poor in oil, bound for spawning-grounds unknown to us. The nuclei of their scales were of small size, containing but few rings, which averaged about ten in number. Whether this race failed entirely in 1919, or whether it had already passed at the time our first sample was taken, we cannot know. It was characterized in 1916 by a very high percentage of four-year fish, which ran uniformly 88, 88, and 80 during the three days of record in which this race was running. When it gave place to another form, as shown by the sample taken June 15th of that year, the percentage of four-year fish dropped suddenly to 24, and remained near that level during the latter half of June. It is interesting to observe, in our 1919 table, that 24 per cent. of four-year fish were found in the run of June 9th.

Careful inspection of our table for 1919 shows that the run can be divided roughly into certain periods on the basis of the percentages which characterize them. Thus the latter half of July, with four-year percentages ranging from 57 to 64, stands sharply distinguished from the week of August 8th to 15th, when the percentages reached 82 to 87; and this period in turn gives way abruptly to the condition obtaining during the last ten days of August, when the percentages ran from 97 to 100. The change is not a gradual and continuous one. On the contrary, for a week or two a certain level is maintained with remarkable regularity, then, either abruptly or with one or more days of transition, a new level is reached, and again continues unmodified for a longer or shorter period. The impression received is strongly that of a succession of migration waves, differing in the relative proportions of their age-groups, the vanguard of one mingling more or less with the rear-guard of the preceding one.

That this impression is justified appears in evidence derived from another source—in the grouping of our samples on a wholly different basis, which was performed in total disregard of any considerations derived from the relative abundance of age-groups.

While passing in review under the microscope the scales of all the Fraser River samples collected in 1919, taking them up in the order of their appearance in the run, I was again struck by the remarkable series that passed in procession. A certain type of scale-structure would make its appearance on a given date, would occupy the stage for a time to the practical exclusion of any other type, and then, on another date, would rather suddenly be supplanted by a second type of structure, which was so sharply distinguished from the first form that it could not conceivably be found in company with it on any spawning-grounds. The season of 1919 was peculiar in comparison with previous years in the distinctness of these components of the run. Apparently, fewer types were represented than has been the case in other seasons, or if

represented, then by few individuals, which could not confuse the characteristics of the race which was dominant in that part of the run. Whereas during other seasons it has been a rare occurrence to find in any period of the run a race unmixed with any other and appearing homogeneous, the impression during 1919 was of a succession of such occurrences, in each of which one race strongly predominated, even if not wholly without admixture. The apparent paucity of races can only find explanation in the practical extermination of the run to certain tributaries, which even in the depleted condition of the river during the last decade have until now furnished their quota.

Dividing the run into a number of sections or periods, each of which was characterized by the predominance of a certain race, we have the following: June 9th and 17th; June 26th and July 2nd; July 15th, 20th, 25th, 28th, and 30th; August 4th, 8th, 12th, and 15th; August 21st, 24th, and 26th; August 29th and September 3rd. Examining in view of this group our previous table of percentages, a series of remarkable correspondences is shown to exist. Not only did the migration waves exhibit each its characteristic structural peculiarities, it possessed also its own distinctive proportionate representation of the age-groups. Some of the spawning districts, when these races reached them, must have found themselves populated almost exclusively by four-year fish; while in other districts a much heavier proportion of the older and larger fish were present.

Rearranging our table of percentages in accordance with this approximate racial grouping, we have the following:—

Table II.

	June 26, July 2.	July 15, 20, 25, 28, 30.	Aug. 4, 8, 12, 15.	Aug. 21, 24, 26.	Aug. 29, Sept. 3.	June 9, 17.
Per cent. four-year fish	77	65	82	96	97	31
Per cent. five-year fish	23	35	18	4	3	69

The significance of this grouping as conditioning the size and more particularly the number of nuclear rings will appear in later tables.

The succession of racial forms which appeared in the main run, either in the sea approaches to the river or in the main channel of the latter, are most readily detected by characteristics shown in the central or nuclear area of the scales. It is this area which records the growth of fry and fingerlings in fresh water, a growth which takes place in a number of lakes scattered widely through the river-basin, varying extensively in their climatic conditions and in the character and amount of food which they offer. The growth in these lakes differs materially, and the size of the yearlings, when they migrate seawards in the early spring, is an index of the favourable or unfavourable conditions under which the different lots have been nourished. The fingerling groups of smaller size will have at migration smaller scales, and these will be marked by fewer annular rings. In the adult salmon, therefore, the size of the nuclear area, which represents the entire scale of the fingerling migrant, and the number of rings which this nuclear area contains, serves as a measure of the size of the fingerling, and thus enables us to sort out the races which have differed in amount of growth during their first year. Not all races may have differed in this respect. But they frequently do so, and where this is the case an examination of the nuclear area gives data of high value.

In the following table the number of nuclear rings found on the scales of all four-year individuals are grouped according to the period of the run in which they appeared, these periods having been first determined by a general study of the succession of events within the run. It will be noted in the table that the sockeyes running during the first period were characterized by small nuclear areas in their scales and by few nuclear rings. Evidently they were nourished in some spawning district relatively unfavourable for fingerling-growth. When they left the lake to descend the Fraser to the sea, they were notably smaller than the fingerlings from other districts with which they found themselves associated.

During the second period, June 26th to July 2nd, there was no very sharp distinction from the first period. But the range of number of nuclear rings was greatly increased, and there were other minor characteristics which made it seem advisable to tabulate separately the individuals running on those dates. They obviously do not represent a transition period between

the second and third groups, for if individuals of the third group had been included it is not credible that they would have been limited to such as had the smaller nuclei. Furthermore, in other respects they did not resemble the strongly marked third group.

An interval of nearly two weeks elapsed, from July 2nd to July 15th, during which no samples were secured. During this interval an entirely new race had made its appearance and was running practically unmixed with other forms. The nucleus was large, regular, and sharply defined, recalling the characteristics of the Morris Creek and Harrison Lake form. A few individuals were present which resembled the preceding lot, having small, poorly defined nuclei, and frequently a small second year's growth during the first year at sea; but these were not at all numerous.

With August 4th, which has been considered the starting-point of a new group, another element became evident. The prevailing form of the preceding period continued to run strongly, but with it there occurred a form with small scale nucleus, less sharply set off from the sea-growth surrounding it, and with the first year of this sea-growth relatively small in amount. The resemblance was so close to the Pemberton or Birkenhead race that I entertained no doubts concerning its identity. The numbers increased from August 4th to 15th, until on the latter date there were few of the Morris Creek type remaining. This period was then a mixed one, but with the two types strongly contrasting and easily distinguished.

By August 21st the transition period has passed and only the form with small nuclei remained. An occasional individual of the previous type straggled along with the others, but even these had disappeared by August 29th.

Table III.—Nuclear Rings in Fraser River Sockeyes, Four-year Males and Females, One-year-in-lake Group, from South Shore of Vancouver Island, arranged by Dates of Capture.

Number of Rings.	Number of Individuals observed.					
	June 9, 17.	June 26, July 2.	July 15, 20, 25, 28, 30.	Aug. 4, 8, 12, 15.	Aug. 21, 24, 26.	Aug. 29, Sept. 3.
6	..	4	..	..	..	..
7	..	3	2	2	1	3
8	2	4	1	5	5	7
9	5	7	..	8	7	5
10	1	9	2	5	8	4
11	2	2	8	14	4	7
12	5	5	12	21	6	2
13	2	3	9	13	11	1
14	..	4	12	16	5	..
15	1	5	9	14	1	2
16	..	3	13	7	3	1
17	..	1	10	11	2	1
18	..	3	8	11	3	..
19	..	..	6	9	1	..
20	..	..	6	6	2	..
21	..	..	1	2	1	..
22	..	..	5	6	2	..
23	..	..	3	3	1	..
24	..	..	2	1	1	..
Average number	10.8	11.3	15.6	14.5	13.1	10.3

Table IV.—Nuclear Rings in Fraser River Sockeyes, Five-year Males and Females, One-year-in-lake Group, from South Shore of Vancouver Island, arranged by Dates of Capture.

Number of Rings.	Number of Individuals observed.			
	June 9, 17.	June 26, July 2.	July 15, 20, 25, 28, 30.	Aug. 4, 8, 12, 15.
6	1	1	1	..
7	3	1	1	..
8	4	2	3	1
9	8	1	2	2
10	9	..	2	2
11	1	1	1	1
12	4	1	2	2
13	1	1	5	1
14	1	..	6	2
15	..	1	7	5
16	..	..	4	8
17	..	..	6	3
18	..	2	7	1
19	..	..	1	1
20	..	..	1	4
21	..	..	..	1
22	..	..	..	1
23	..	..	..	..
24	..	..	..	1
Average number	9.6	11.4	14.2	15.6

Table V.—Nuclear Rings in Fraser River Sockeyes, One-year-in-lake Group, from South Shore of Vancouver Island, during Entire Season, 1919.

Number of Nuclear Rings.	Number of Individuals.	
	Four Years old.	Five Years old.
6	4	3
7	11	5
8	24	10
9	32	14
10	29	16
11	37	5
12	51	11
13	39	9
14	37	9
15	33	13
16	27	16
17	25	9
18	25	11
19	16	3
20	14	5
21	4	1
22	13	1
23	7	..
24	4	1

We include also the following two tables, in which are given for four- and for five-year individuals the lengths segregated within the period of the run in which they belonged. In general, the average length increases throughout the season, although near its close there is a noticeable falling-off, due to the disappearance or reduction in numbers of the exceptionally large individuals. All the data concerning average lengths and weights of sockeyes running during the periods we have outlined are given in Table VIII.

Table VI.—Fraser River Four-year Male Sockeyes, One Year in Lake, from Vancouver Island Traps, 1919, arranged by Dates and by Lengths.

Length in Inches.	June 9, 17.	June 26, July 2.	July 15, 20, 25, 28, 30.	Aug. 4, 8, 12, 15.	Aug. 21, 24, 26.	Aug. 29, Sept. 3.
20	..	1	1	..	..	..
20½	..	..	..	..	..	..
21	..	1	2	..	..	..
21½	1	..	..	..	..	..
22	1	3	6	1	1	..
22½	..	5	1	..	1	1
23	2	9	5	12	8	5
23½	..	7	3	9	9	6
24	2	2	19	21	8	6
24½	1	4	10	31	16	2
25	..	2	10	23	12	4
25½	..	..	..	10	2	4
26	..	..	2	3	2	5
26½	..	..	..	3	..	..
Average length	23.1	23.1	23.9	24.4	24.1	24.3

Table VII.—Fraser River Four-year Female Sockeyes, One Year in Lake, from Vancouver Island Traps, 1919, arranged by Dates and by Lengths.

Length in Inches.	June 9, 17.	June 26, July 2.	July 15, 20, 25, 28, 30.	Aug. 4, 8, 12, 15.	Aug. 21, 24, 26.	Aug. 29, Sept. 3.
20	..	..	3	..	..	..
20½	..	1	2	..	..	..
21	3	1	5	1	3	..
21½	1	2	4	..	3	..
22	3	15	8	5	13	3
22½	5	8	6	15	18	5
23	3	10	9	9	16	6
23½	..	3	7	18	12	6
24	..	3	5	14	7	1
24½	..	1	1	3	1	..
25	..	..	1	3	1	1
Average length	22.1	22.5	22.4	23.3	22.8	23.0

Table VIII.—Average Lengths and Weights of Fraser River Sockeyes, One-year-in-lake Group, from South Shore of Vancouver Island, grouped by Dates of Capture.

Dates, 1919.	Length in Inches.				Weight in Pounds.			
	Four Years old.		Five Years old.		Four Years old.		Five Years old.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
June 9, 17	23.1	22.1	26.2	24.8	4.4	4.3	6.7	5.6
June 26, July 2..	23.1	22.5	25.3	24.9	5.1	4.8	7.1	5.9
July 15, 20, 25, 28, 30	23.9	22.4	26.1	25.2	5.7	4.8	7.2	6.9
Aug. 4, 8, 12, 15	24.4	23.3	26.5*	25.4	6.5	5.6	8.0*	6.7
Aug. 21, 24, 26..	24.1	22.8	26.6*	24.5*	6.1	5.2	8.3*	6.5*
Aug. 29, Sept. 3	24.3	23.0	None	25.3*	6.4	5.1	None	5.0*

* Numbers too limited to give reliable estimates.

Another subject of interest in connection with the changes that occur in the constitution of the run during the course of the season is the relative numbers of males and females in the different portions of the run. In other river-basins we have usually found that the males precede the females to the extent of running in largest numbers at the beginning of the season, and in the same manner the five-year fish take precedence over the younger members of their tribe. The following table indicates that the above-mentioned order of precedence is not adhered to in the Fraser:—

Table IX.—Percentages of Four-year Males and Females, Fraser River Sockeyes, One-year-in-lake Type, running on Southern Shore of Vancouver Island on a Succession of Dates.

	June 9 to 17.	June 26 to July 2.	July 15 to 30.	Aug. 4 to 15.	Aug. 21 to 26.	Aug. 29 to Sept. 3.
Four-year males	32	44	54	62	44	60
Four-year females	68	56	46	38	56	40
Five-year males	56	43	60	58	33	50
Five-year females	44	57	40	42	67	50

(2.) Lengths and Weights of the One-year-in-lake Type.

During the season of 1919 material to determine the constitution of the main run was obtained from the southern shore of Vancouver Island and from Steveston, at the mouth of the Fraser. The Vancouver Island series is the most extensive, covering a succession of dates at frequent intervals from June 9th to September 3rd. The Steveston series is limited to the period of heaviest run, between July 23rd and August 14th.

In Tables X. and XI. are given the length-distributions of the one-year-in-lake group from these two localities, comprising all the material gathered during the season. The differences between the two tables are striking, especially so as regards the four-year group. The Steveston series form a symmetrical frequency curve, but wholly lack the smaller sizes, which form so large a part of the Vancouver series. From Steveston there are no four-year males less than 23½ inches long. In the Vancouver series 21 per cent. of the four-year males are below 23½ inches. The discrepancy is even more striking with the female four-year-olds, as 49 per cent, of the Vancouver material is smaller than any of the individuals examined at Steveston. There is a similar but less-marked difference in the five-year group, as will be seen on comparing the average lengths at the foot of the columns in the two tables.

Two possible explanations of these differences suggest themselves. The Vancouver series represents approximately the entire run, with early-running as well as late-running fish, while the Steveston lot are composed exclusively of late-running fish, which average larger in size, as we have already seen. But in column five of Tables VI. and VIII. of this report we find segregated the males and females of this group, which were running along the Vancouver Island shore during the same period which is covered by the Steveston material. The Vancouver males and females were larger than those running at any other date in this locality, the males averaging 24.4 inches and the females 23.3. But they were decidedly smaller than the Steveston fish running on the same dates, for in these the males averaged 25.1 and the females 24.1 inches.

Another possible explanation lies in different methods of capture in the two localities, the fishing in the Vancouver District being carried on by pound-nets of fine mesh, and in the Steveston District by gill-nets which permit the smaller sizes to escape.

Table X.—Fraser River Sockeyes from Vancouver Island Traps, Run of 1919, One Year in Lake, grouped by Length, Age, and Sex.

Length in Inches.	Number of Individuals.			
	Four Years old.		Five Years old.	
	Males.	Females.	Males.	Females.
20	2	3	..	..
20½	..	3	..	..
21	3	13	..	1
21½	1	11	..	1
22	13	55	..	..
22½	10	65	..	2
23	43	65	1	..
23½	42	49	..	3
24	69	30	4	8
24½	70	6	2	11
25	54	7	18	16
25½	18	..	7	20
26	13	..	27	19
26½	4	1	11	5
27	..	..	15	2
27½	..	..	9	..
28	..	..	5	..
Total individuals	342	308	99	88
Percentages of each group	41	37	12	10
Average size in inches	24.1	22.8	26.1	25.1

Table XI.—Fraser River Sockeyes from Steveston, Run of 1919, One Year in Lake, grouped by Length, Age, and Sex.

Length in Inches.	Number of Individuals.			
	Four Years old.		Five Years old.	
	Males.	Females.	Males.	Females.
20	..	..	..	..
20½	..	..	..	..
21	..	..	..	..
21½	..	..	..	..
22	..	..	..	..
22½	..	..	..	..
23	..	12	..	..
23½	9	15	..	..
24	18	24	..	..
24½	24	18	2	3
25	26	15	2	7
25½	30	2	3	9
26	23	1	5	13
26½	6	..	6	7
27	6	..	9	4
27½	..	..	5	1
28	..	..	5	1
28½	..	..	3	..
29	..	..	2	..
29½	..	..	1	..
Average length	25.1	24.1	26.9	25.9

Table XII.—Fraser River Sockeyes from Vancouver Island Traps, Run of 1919, One Year in Lake, grouped by Weight, Age, and Sex.

Weight in Pounds.	Number of Individuals.			
	Four Years old.		Five Years old.	
	Males.	Females.	Males.	Females.
3	..	1	..	..
3½	1	4	..	..
4	12	38	..	1
4½	18	72	..	3
5	43	77	1	4
5½	42	51	7	14
6	83	42	10	16
6½	54	12	16	12
7	40	8	18	18
7½	29	2	24	12
8	17	..	13	5
8½	2	..	6	3
9	1	..	2	..
9½	..	..	1	..
10	..	..	1	..
10½	..	..	1	..
Average weight	6.1	5.1	7.2	6.5

One fact that emerges clearly from the preceding tables of lengths and weights is the small size of the sockeyes of each group for the season of 1919 as compared with the previous year. In 1918 much material was obtained from traps along the Vancouver Island shore, samples being taken at short intervals throughout the season. Measurements were made by the same observer during both seasons, and the results should be open to strict comparison. The averages for the two years follow:—

Table XIII.

	Length in Inches.		Weight in Pounds.	
	1918.	1919.	1918.	1919.
Four-year males	24.9	24.1	6.5	6.1
Four-year females	23.8	22.8	5.7	5.1
Five-year males	26.3	26.1	7.5	7.2
Five-year females	25.4	25.1	6.7	6.5

Previous records show that 1918 was wholly normal in the size of the fish. Table XI., page 45, of our Report for 1915 gives average lengths for the four years from 1912 to 1915. With the exception of 1913, these years show average sizes slightly larger even than 1918. The year 1913 was recognized generally as an unfavourable season, in which salmon sizes were abnormally low. Yet the lengths of four-year males and females for 1913 were 24.5 and 23.8 inches, decidedly larger, therefore, than the fish of 1919. The latter year must now be regarded as having produced the smallest sockeyes, class by class, of which we have any record in the Fraser watershed.

(3.) The Two-years-in-lake Type.

Our previous discussion has limited itself to the one-year-in-lake type, which comprises a very high percentage of the annual runs to the Fraser. The two-years-in-lake type is of varying importance in different years. In 1916 (Report for 1917, page 51) sockeyes of this type ran numerously during the latter half of June, when they comprised from 10 to 15 per cent. of the run; they almost disappeared during July, and became again numerous after August 10th (9 to 10 per cent.). In 1919 they were conspicuously present during June and the early half of July. After July 15th only stragglers appeared until August 8th, and after this date they were wholly lacking. The percentages are as follows: June 9th, 10 per cent.; June 17th, 18 per cent.; June 26th, 16 per cent.; July 2nd, 11 per cent.; July 15th, 10 per cent. After July 15th a single individual only was observed in our material on each of the following dates: July 20th, 25th, and 30th; August 4th and 8th.

Table XIV.—Fraser River Sockeyes, Two Years in Lake, from Vancouver Island Traps, 1919, grouped by Length, Age, and Sex.

Length in Inches.	Number of Individuals.			
	Five Years old.		Six Years old.	
	Males.	Females.	Males.	Females.
20	..	..	..	..
20½	..	1	..	..
21	..	2	.. ..	..
21½	..	..	..	..
22	..	1	..	..
22½	1	4	..	1
23	1	3	..	1
23½	1	3	..	..
24	4	1	..	1
24½	4	1	..	1
25	3	..	1	..
25½	1	..	1	..
26	..	..	1	..
26½	..	..	1	..
Average length	24.2	22.7	25.8	23.5

Table XV.—Fraser River Sockeyes, Two Years in Lake, from Vancouver Island Traps, 1919, grouped by Weight, Age, and Sex.

Weight in Pounds.	Number of Individuals.			
	Five Years old.		Six Years old.	
	Males.	Females.	Males.	Females.
3	..	..	..	..
3½	..	1	..	..
4	2	4	..	..
4½	..	6	..	1
5	1	3	..	1
5½	5	2	..	1
6	4	..	2	1
6½	2	..	..	..
7	..	..	2	..
7½	1	..	..	..
Average weight	5.7	4.5	6.5	5.3

(4.) THE SEA-TYPE.

The only remaining group of Fraser River sockeyes are those which proceed to sea shortly after hatching, instead of remaining for one or more years in fresh water. We have designated this the "sea-type," since practically the entire life is spent in the ocean. The omission of the year in the lake hastens the development and maturity by one year. Instead of maturing at the age of four and five, as in the case of the one-year-in-lake type, sea-type individuals mature at the age of three and four. The four-year class is usually more numerously represented than the three-year group, and the latter often contains a disproportionate representation of males, while the four-year group contains a corresponding excess of females. But in 1919 the three-year individuals of this group outnumbered the four-year class, and it consisted of males and females in about equal numbers.

In our Report for 1917 (page 50) and for 1918 (page 30) we have discussed the appearance of sea-type individuals in different parts of the run, and have shown that they are largely confined to the period between the middle of July and the middle of August, being most numerous during the first week in August. The earliest date on which any were observed in 1916 was July 17th, and in 1918 on July 14th. In 1919 one three-year individual appeared June 9th, and this must be considered a highly exceptional occurrence. None others were included in our collections of June 17th and 26th, nor on July 2nd. One was found among fifty other specimens on July 15th, which is the regular time for them to appear, and they were present throughout the remainder of July and during all of August, being most numerously represented in our collections of July 30th and August 4th. The sea-type appeared in larger numbers during 1919 than in other recent years, the percentages of their occurrence being as follows:—

	Per Cent.		Per Cent.
June 9	2	Aug. 8	6
July 15	2	„ 12	6
„ 20	6	„ 15	6
„ 25	8	„ 24	2
„ 28	12	„ 26	3
„ 30	16	„ 29	2
Aug. 4	15		

The only spawning-grounds for the sea-type sockeyes known to us within the Fraser basin are found in a slack-water stretch of the Harrison River below Harrison Lake and a short distance below the mouth of Morris Creek. No lake exists below these spawning-beds, either in the Harrison or in the Fraser River.

Table XVI.—Fraser River Sockeyes, "Sea-type," Vancouver Island Traps, 1919, grouped by Length, Age, and Sex.

Length in Inches.	Number of Individuals.			
	Three Years old.		Four Years old.	
	Males.	Females.	Males.	Females.
20	..	..	..	..
20½	1	1	..	..
21	1	2	..	..
21½	2	3	..	..
22	1	4	..	..
22½	3	1	..	..
23	4	1	..	1
23½	..	..	..	2
24	1	1	2	4
24½	1	..	..	2
25	1	..	..	2
25½	..	..	..	2
26	..	1	2	..
26½	..	..	..	..
27	..	..	..	..
27½	..	..	..	..
Average length	22.6	22.2	25.0	24.3

Table XVII.—Fraser River Sockeyes, "Sea-type," Vancouver Island Traps, 1919, grouped by Weight, Age, and Sex.

Weight in Pounds.	Number of Individuals.			
	Three Years old.		Four Years old.	
	Males.	Females.	Males.	Females.
3	..	1	..	..
3½	1	1	..	..
4	1	2	..	..
4½	3	6	..	1
5	3	1	..	..
5½	2	1	1	4
6	3	2	1	2
6½	..	..	..	2
7	1	..	..	4
7½	1	..	1	..
8	..	..	1	..
Average weight	5.3	4.8	6.8	6.1

(5.) THE FRASER RIVER CANYON.

An interesting collection of scales with data concerning sex and length of the individuals was made in the canyon of the Fraser River at Hell's Gate during the first half of August and on September 25th and 26th. Inasmuch as undoubted changes occurred in the constitution of the run within that period, we have divided the material by date of capture into three groups: the first extending from August 1st to the 11th; the second from the 12th to the 17th; and the third including the September fish. No doubt could exist concerning the distinctness of the latter group. As shown in Table XVIII., the nuclear areas of their scales were larger and were furnished with more numerous rings than was the case with the August fish. If the run to Seton Lake and the Quesnel had not been practically exterminated, I should have considered seriously the possibility that they were bound for one or both of those tributaries. They were certainly not headed for the Chilcotin. On the other hand, the August run presented all the characteristics of Chilcotin fish.

Table XVIII.—Nuclear Rings in Sockeyes from Fraser River Canyon at Hell's Gate, One-year-in-lake Group, Age undetermined, arranged by Dates of Capture.

Number of Nuclear Rings.	Number of Individuals observed.		
	Aug. 1 to 11.	Aug. 12 to 17.	Sept. 25, 26.
7	6	3	..
8	10	4	1
9	9	4	1
10	5	3	2
11	8	4	2
12	7	3	7
13	4	2	8
14	..	2	12
15	..	2	11
16	..	1	8
17	..	..	3
18	..	1	..
19	..	..	3
Average number	9.7	10.9	14.1

Table XIX.—Sockeyes from Fraser River Canyon at Hell's Gate, 1919, grouped by Date, Length, and Sex (Age undetermined).

Length in Inches.	Number of Individuals observed.					
	Aug. 1 to 11.		Aug. 12 to 17.		Sept. 25 and 26.	
	Males.	Females.	Males.	Females.	Males.	Females.
19½	..	..	..	..	..	1
20	..	..	..	..	..	1
20½	..	..	..	..	..	..
21	..	2	..	..	..	..
21½	..	2	..	..	1	..
22	..	5	..	5	..	2
22½	..	7	..	5	..	5
23	..	1	3	2	..	20
23½	..	1	2	1	1	9
24	2	3	3	2	3	4
24½	..	..	1	..	2	..
25	..	..	..	..	2	..
25½	..	1	..	..	4	..
26	..	..	..	..	1	..
26½	..	2	1	..	2	..
27	..	1	..	..	1	..
27½	..	..	..	..	..	..
28	..	..	..	..	1	..
Average length	24.0	23.1	23.9	22.8	25.1	22.9

(6.) THE CULTUS LAKE RACE.

The run to Cultus Lake appears to have been larger than usual during the season of 1919. Certain it is that the size of the individual fish was far larger than we have observed it in previous years. The Cultus Lake race has been counted one of the most diminutive in the Fraser basin. The tables of measurements given on pages 47 and 48 of our Report for 1917 show this distinctly. But in 1919, as indicated in Table XX., which follows, the males especially were among the largest fish of which we have record during this year. Comparing Table XX. with Table X. of this report, it will be seen that the Cultus Lake males range in length very closely with the five-year fish from the Fraser basin. We have no means of determining the age of the Cultus Lake specimens, as the scales are too seriously eroded. But we have doubtless represented in Table XX. both four- and five-year individuals, with the five-year-olds, perhaps, quite largely in excess. It may be that in 1916 the smaller size depended on the practical absence of five-year fish.

Table XX.—Fraser River Sockeyes, Run of 1919, from Cultus Lake Spawning-grounds, grouped by Length and Sex (Age undetermined).

Length in Inches.	Number of Individuals.	
	Males.	Females.
21	..	1
22	..	20
23	2	77
24	19	49
25	58	5
26	58	1
27	12	..
28	1	..
Average length	25.4	23.3

Table XXI.—Number of Nuclear Rings on Scales of Fraser River Sockeyes from the Cultus Lake Spawning-grounds, 1919.

Nuclear rings	7	8	9	10	11	12	13	14	15	16	17	18
Individuals	2	6	7	9	9	12	4	6	3	2	2	1

Average, 11.5.

(7.) FINGERLING MIGRANTS IN THE QUESNEL.

A valuable series of migrating fingerlings was obtained in the outlet to Quesnel Lake from April 19th to May 16th, 1919. Much credit is due to Fisheries Overseer A. W. Stone for the efficient manner in which he performed the difficult task of securing this material.

Two hundred and fifty-seven specimens were obtained. Five of these, taken in April, were fry of the year, ranging from 26 to 35 mm. (1 to 1.3 inches) in length, and in none of these were any traces of the scales to be found. Had they survived, scales would have developed after reaching the sea, and would have represented in their markings the method of growth characteristic of sea-life. But as we have failed to detect above the Fraser River Canyon any adult sockeyes which had gone down to the sea as fry, we are compelled to assume that practically all up-river fry which migrate at this diminutive size perish early.

The remainder of the Quesnel specimens are fingerlings which have completed their first year and are descending the river in their second spring. When these should reach maturity the minute scales with which they are now covered would constitute the centres or nuclei of the adult scales. The size of the adult nucleus will be precisely the size of the present scale, and the fine rings with which the fingerling-scales are marked will be unaltered in number and character during subsequent growth of the scale in salt water. Fingerlings of this character, when they return to the river at maturity, constitute the one-year-in-lake type, which always predominates in the Fraser River drainage.

Males and females were in about equal numbers throughout the month when the collections were being made. The total numbers are 122 males and 130 females. The males range in length from 66 to 105 mm., with the average at 87 mm. Females range from 70 to 101 mm., with the average at 87.4 mm. This difference is too slight to possess any significance. We are justified in stating that at this time males and female fingerlings were in equal numbers and of equal average size.

An interesting comparison is now possible between the 1919 migrants and those obtained in 1915. An account of the latter is found in our Report for 1915, page 39. In 180 specimens examined in 1915 61 per cent. were males, while in 1919 only 48 per cent. were males. The average size is almost identical, the range in both sexes in 1915 being from 74 to 114 mm., the males averaging 89.5 and the females 87.7 mm. During two years, then, which were four years apart, Quesnel Lake produced two schools of fingerlings of identical size.

In other respects, also, complete agreement was found in the product of these two years. No fingerlings of the two-year type were present in either lot, while a limited number were found in 1915 among fingerlings from an adjacent tributary, the Chilcotin. But it will be recalled that Chilcotin adults often include a considerable percentage of individuals of the two-year-in-lake type. We have unfortunately no adequate data from adults running in the Quesnel. We have attempted to obtain such data, but the run to the Quesnel is now nearly extinct.

Another respect in which Quesnel fingerlings of 1915 and 1919 stand in agreement is in their failure to initiate the new growth of the year prior to migrating. Doubtfully, in a few individuals in 1919, the outer ring on the scale showed a slightly widened interval separating it from the preceding ring, and possibly indicating a renewal of growth. In 1915 some 5 per cent. of the Quesnel fingerlings showed traces of growth, while in the Chilcotin migrants of the same year more than 50 per cent. had begun the new growth of the season when they were captured.

The Quesnel fingerlings obtained in 1915 and 1919 agree closely in another very important respect. The number of rings on the scales—and these will constitute the nuclear rings of the adult scale—were alike in their range and in their average. The range in 1915 was from 10 to 22, with the average at 14.6. The range in 1919 is from 9 to 19, with the average at 14.9. No two lots during the same year could be expected to show more complete agreement than do these two series taken four years apart.

The following tables give the length-distribution of males and females and the number of scale-rings for both sexes:—

Table XXII.—Lengths of Quesnel Migrant Fingerlings in 1919.

Length in Millimetres.	Males.	Females.	Length in Millimetres.	Males.	Females.
66	1	..	86	9	9
70	1	2	87	7	7
71	1	..	88	5	12
72	1	1	89	8	12
73	..	1	90	9	6
74	1	..	91	11	1
75	1	1	92	4	7
76	4	2	93	2	7
77	1	1	94	3	6
78	1	3	95	6	7
79	3	1	96	3	3
80	2	3	97	3	1
81	6	2	98	2	2
82	3	8	99	3	..
83	12	7	101	..	3
84	4	6			
85	4	9	Average length	87	87.4

Table XXIII.—Scale-rings of Quesnel Lake Yearling Fingerlings, 1919.

Number of rings	9	10	11	12	13	14	15	16	17	18	19
Number of individuals	1	2	3	8	15	28	27	31	18	9	2

Average rings, 14.9.

In order to ascertain whether any changes occurred in average size of fingerlings during the month in which the migration was under observation, we have divided this period as follows:—

Table XXIV.—Average Lengths of Quesnel Lake Migrant Fingerlings on a Succession of Dates, 1919.

Dates, 1919.	Length in Millimetres.		
	Males.	Females.	
April 19th to 23rd	87.5	84.3	(Average scale-rings, 14.2).
April 24th to May 2nd	87.4	87.7	(Average scale-rings, 14.8).
May 5th and 6th	88.5	89.1	(Average scale-rings, 15.1).
May 7th to 16th	82.9	84.1	(Average scale-rings, 13.6).

There is a slight but progressive increase in size from the beginning of the migration to April 5th and 6th, when it was at its height. Then at the latter end of the migration smaller sizes prevail, and the average drops sharply to below the level of the initial stages of the run. The scale-rings follow the size and are a delicate index of it.

Table XXV.—Number of Scale-rings in Quesnel Lake Yearlings, grouped according to Lengths of Individuals.

Length in Millimetres.	Number of Scale-rings.												Average No. of Rings.
	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	
60 to 69	1	..	..	..	..	..	..	..	..	..	..	..	9.0
70 to 79	1	4	7	8	6	..	1	..	..	..	..	..	11.7
80 to 89	..	..	1	8	21	34	20	13	3	1	..	..	14.3
90 to 99	..	..	..	..	..	4	13	25	18	6	2	1	16.1
100 to 109	..	..	..	..	..	..	..	..	..	2	..	..	18.0

NOTE.—This table may be compared with a similar table in our Report for 1915, Table XXI., page 40.

II. THE RIVERS INLET SOCKEYE RUN OF 1919.

The Rivers Inlet sockeye run of 1919 produced a pack of only 56,258 cases and was no improvement over the three very poor years which preceded it. The average for the four years, 1916 to 1919, is 53,948 cases. For comparison we divide the history of the Rivers Inlet District into successive four-year periods, and present below the average sockeye-pack for each of these periods:—

1904 to 1907, average pack of 98,589 cases.
1908 to 1911, „ „ 99,142 „
1912 to 1915, „ „ 98,717 „
1916 to 1919, „ „ 53,948 „

The present situation is fast developing into one of pronounced danger. The productivity of the river has fallen during the past four years to little more than half its previous magnitude. We are no longer justified in classing the recent poor years with those occasional fluctuations which have occurred in previous cycles. Such fluctuations have been exceptional occurrences and have been preceded and followed by runs of normal size. Thus the pack of 64,352 cases in 1908 was associated with packs of 87,874 and of 89,027 cases, and the phenomenally poor record of 1913 (61,745 cases) was preceded by 112,884 and followed by 89,890 cases. The averages for the four-year periods permit no doubt on this score. But the present condition of the Rivers Inlet sockeye run properly gives cause for serious uneasiness. Unless the intensity of the fishing is at once diminished, unless we decrease the total number of sockeyes taken annually from this watershed, we are in danger of repeating here on a smaller scale the tragic history of the Fraser River.

(1.) THE AGE-GROUPS.

The Rivers Inlet run of 1919 was composed almost exclusively of two age-groups, which had had the same early history during their single year's residence in their native lake, and differed only in the number of years they had spent in the sea before becoming mature. Both of these groups spent something more than a year in fresh water, and migrated seawards as fingerlings in the spring of their second year. One group became mature and sought its spawning-grounds during its third summer in the sea, while in the fourth year of its age. The other group delayed its spawning until in its fifth year.

The four- and five-year fish with the above history always constitute the great majority of the Rivers Inlet run. An occasional individual is found which remained as fingerling two years in fresh water before migrating. Three such individuals were included in our 1919 material, all of them captured on July 7th. Each of these had remained over three years feeding at sea, and re-entered the Owikeno River when in its sixth year.

Another type, always sparsely represented in this basin, passes to sea immediately on the absorption of the yolk, and thus has practically its entire history in the sea. One individual of this class was taken July 10th, having returned to spawn in its fourth year.

The two principal classes, four- and five-year fish that spent one year in the lake after hatching, are present during different years in widely varying proportions at Rivers Inlet. We have determined these proportions for the runs of the last eight years, from 1912 to 1919, during which time the four-year age-group has varied from 13 to 80 per cent. of the whole. But the five-year group is nearly always in the majority in this river-basin, the average for the eight

years being 39 per cent. belonging to the four-year class and 61 per cent. to the five-year group. A tendency was early apparent toward an increase in the relative numbers of five-year fish during the seasons of the largest runs. Thus in 1912, when the season's pack amounted to 112,884 cases, there were 21 per cent. four-year-olds and 79 per cent. five-year-olds; and in 1915, with a pack of 130,350 cases, the corresponding percentages were 13 and 87. These are the two years with largest packs since our investigations began, and it is noteworthy that they also have the largest percentages of five-year fish. And while this rule does not hold rigidly and presents some marked exceptions, it is yet true that the three lowest percentages of five-year fish, 20, 43, and 54 per cent., occurred during 1913, 1918, and 1919, three of the poorest seasons of which we have record.

In the following table we give the percentages of four-year and of five-year sockeyes for each of the eight years during which the Rivers Inlet runs have been examined. In the right-hand column are indicated for each season the two brood-years, one of which produced the four-year and the other the five-year fish of that year. Thus in 1919 the five-year fish had been hatched from eggs deposited in 1914; and in 1914 the run appears to have been of normal size, inasmuch as it produced a pack of 89,890 cases. Similarly, the four-year fish, running in 1919, had developed from eggs laid down in the fall of 1915, a year notable as having furnished the largest pack (130,350 cases) known in the Rivers Inlet District. We see from this that the antecedents of the 1919 run were in appearance highly favourable, and if such evidence could be depended on as a basis for prediction, we should have been justified in anticipating more than an average pack in 1919. But it is clear from the failure of 1919, and from other similar occurrences indicated in the following table, that evidence of this nature has thus far been wholly unreliable in Rivers Inlet. We now know that we cannot form any estimate of the probable size of the run in 1920, although we know that the four-year fish will be descendents of the run of 1916 (44,936 cases), and the five-year fish will be derived from the run of 1915 (130,350 cases). We are not even certain that these facts will give us reliable indication concerning the relative proportions of four-year and five-year fish which will be observed during the season of 1920. But the results during 1920 will possess more than usual interest, for in the two brood-years of that season we find contrasted, as above indicated, the very poorest and the very richest years of which we have record. It will be most interesting to observe whether the five-year age-group will appear in 1920 in overwhelming proportions.

Table XXVI.—Percentages of Four- and Five-year Rivers Inlet Sockeyes in Runs from 1912 to 1919, with the Broods from which they were derived.

Run of the Year.	Percentage. Four and Five Years old.	Brood-year from which derived.
1912 (112,884 cases)	5 yrs. 79% 4 yrs. 21%	1907 (87,874 cases). 1908 (64,652 cases).
1913 (61,745 cases)	5 yrs. 20% 4 yrs. 80%	1908 (64,652 cases). 1909 (89,027 cases).
1914 (89,890 cases)	5 yrs. 65% 4 yrs. 35%	1909 (89,027 cases). 1910 (126,921 cases).
1915 (130,350 cases)	5 yrs. 87% 4 yrs. 13%	1910 (126,921 cases). 1911 (88,763 cases).
1916 (44,936 cases)	5 yrs. 76% 4 yrs. 24%	1911 (88,763 cases). 1912 (112,884 cases).
1917 (61,195 cases)	5 yrs. 67% 4 yrs. 33%	1912 (112,884 cases). 1913 (61,745 cases).
* 1918 (53,401 cases)	5 yrs. 43% 4 yrs. 57%	1913 (61,745 cases). 1914 (89,890 cases).
1919 (56,258 cases)	5 yrs. 54% 4 yrs. 46%	1914 (89,890 cases). 1915 (130,350 cases).

* The relative proportions of four- and five-year fish for the year 1918 were by accident reversed in our previous report. The correction is here made.

In previous reports we have pointed out that the relative sizes of the four-year group and the five-year group are not constant throughout any season, but vary widely when a succession of samples are taken on different days during the run. This variation is ordinarily not a chance, haphazard affair, but proceeds in orderly sequence throughout the season. In 1915 (*see* Report for 1915, page 42) the five-year group was smallest at the beginning of the season and increased regularly in a succession of dates from 79 to 94 per cent. In 1916 and 1917 (Report for 1917, pages 58 and 68) the sequence of events was the reverse of the above. The five-year group in each of these years appeared in greatest relative numbers at the opening of the season, the percentages decreasing in a series of dates rather uniformly from 93 or 94 at the beginning to 53 or 44 at the close. In 1918 (Report, page 43) another complete reversal occurs. The five-year group was almost absent at the opening of the season, increased from 7 to nearly 70 per cent. near the middle of the run, and then declined slightly towards the end. Similar data for the year 1919 are given in the following table:—

Table XXVII.—Percentages of Five-year Rivers Inlet Sockeyes occurring at Different Dates in the 1919 Run.

Dates, 1919.	Percentages of Five-year Fish.	Number of Specimens examined.
July 7	65	71
„ 10	47	74
„ 15	66	74
„ 18	67	75
„ 22	52	75
„ 26	55	75
„ 31	55	75
Aug. 2	32	74

The year 1918 was signalized in a previous report as highly exceptional in its age-groups. It had not only the lowest average percentage of five-year fish observed since 1913, but the sequence of events with regard to this group was the reverse of what had been observed in 1916 and 1917. A comparison with 1919 is of special interest, as during this year also the percentage of five-year fish was extraordinarily low. The early records are unfortunately lacking for 1919, so we have no knowledge whether, as in 1918, the five-year group was markedly deficient at the beginning of the run. The data for the two years are combined in the following table and may be directly compared. It is evident that they were strikingly similar.

Table XXVIII.—Comparison of 1918 and 1919 in the Percentages of Five-year Sockeyes appearing at Different Dates.

Date.	1918.	1919.
June 27	7	..
„ 29	19	..
July 2	25	..
„ 4	32	..
„ 7	..	65
„ 10	37	47
„ 12	64	..
„ 15	..	66
„ 16	59	..
„ 18	..	67
„ 19	69	..
„ 22	..	52
„ 23	44	..
„ 26	59	55
„ 30	54	..
„ 31	..	55
Aug. 2	..	32

(2.) DISTRIBUTION OF THE SEXES.

The year 1919 furnished no exception to the rule at Rivers Inlet, according to which four-year males are greatly in excess of the four-year females, while the conditions are reversed in the five-year group. A striking agreement in these proportions for the last four years is shown in the following table. The four-year males are about three times as numerous as the four-year females, and the five-year females half again as numerous as the five-year males. Usually the total males in the run are in excess of the females, and this was notably true in 1918. But in 1919 the females were slightly more abundant.

Table XXIX.—Average Percentages of Males and Females, Rivers Inlet Sockeye, throughout the Seasons from 1916 to 1919.

Year.	Four Years old.		Five Years old.		Total	Total
	Males.	Females.	Males.	Females.	Males.	Females.
1916	74	26	40	60	52	48
1917	75	25	42	58	53	47
1918	74	26	49	51	66	34
1919	77	23	41	59	49	51

We have shown in the above table that the average proportions of the sexes in each of the two year-groups are fairly constant during a series of years. But that is true only of the average for each season. The proportions for different parts of the same season vary widely. As a rule, males are relatively most abundant in the early part of the run and decrease with some regularity as the season advances. This is equally true in the case of the four-year males, which compose the greater part of their age-group, and of the five-year males, where the reverse is the case.

Thus in 1915 the four-year males decreased from 76 per cent. of their group at the opening of the season to 60 per cent. at the close; while the five-year males during the same period decreased from 53 to 24 per cent. of the total five-year fish. A similar sequence of events was recorded in 1916 and 1917, the four-year males decreasing from 100 per cent. at the beginning to 61 and 56 per cent. at the close; and the five-year males from 67 and 59 per cent. in the early season to 23 and 19 per cent. at the end. The year 1918, exceptional in so many respects, was unusual also in the appearance of the sexes. Both four-year and five-year males exhibited relative increase toward the middle of the season, to be followed by the usual reduction toward the latter end of the run.

The following table shows again a marked similarity between 1918 and 1919 in their exceptional features. In 1919 the maximum number of four-year males was not reached until past the middle of July, beyond which point there was a rapid decline. The five-year males show less regularity in their occurrence, but the maximum percentage recorded was on July 15th, whence there was a consistent decrease until July 31st, to be followed by a spasmodic increase on the last date of record, August 2nd. The four-year males also showed an increased percentage August 2nd, after having reached their lowest ebb on July 31st.

Table XXX.—Percentages of Males and Females in Rivers Inlet Sockeyes occurring on Different Dates, Season of 1919.

	July 7.	July 10.	July 15.	July 18.	July 22.	July 26.	July 31.	Aug. 2.
Four-year males	84	82	88	100	92	76	53	58
Four-year females	16	18	12	..	8	24	47	42
Five-year males	48	43	55	42	42	39	20	71
Five-year females	52	57	45	58	58	61	80	29

(3.) LENGTHS AND WEIGHTS.

The tables which follow give the length and weight distribution of all the individuals examined, grouped by age and by sex. As in similar tables, prepared for previous years, it appears that the females average smaller than the males of their own age and exhibit a narrower range of variation. Thus, although the females average less in size, a few of the males of the same age are smaller than any of the females, while some, of course, are larger.

The five-year always average larger than the four-year fish, but the overlapping is considerable. On the table of lengths the overlap includes slightly more than half the range in size for each age. All the individuals examined during the season of 1919 which were less than 22 inches long were four years old, and all in excess of 25 inches were five years old. The relative proportions of four- and of five-year fish observed within the scope of the overlap—that is, from 22 to 25 inches long—is shown below:—

Table XXXI.

Length in Inches.	PROPORTION.	
	Four Years old.	Five Years old.
	Per Cent.	Per Cent.
22	98	2
22½	86	14
23	65	35
23½	34	66
24	19	81
24½	5	95
25	8	92

Table XXXII.—Rivers Inlet Sockeyes, Run of 1919, grouped by Length, Age, and Sex.

Length in Inches.	NUMBER OF INDIVIDUALS EXAMINED.			
	Four Years old.		Five Years old.	
	Males.	Females.	Males.	Females.
19½	1	..	..	..
20	3	..	..	..
20½	8	1	..	..
21	18	1	..	..
21½	29	14	..	..
22	38	15	1	..
22½	39	17	6	3
23	35	10	9	15
23½	22	3	17	31
24	12	1	16	38
24½	3	..	14	38
25	3	1	16	33
25½	..	..	14	15
26	..	..	14	8
26½	..	..	14	6
27	..	..	5	2
27½	..	..	3	..
28	..	..	1	..

Table XXXIII.—Rivers Inlet Sockeye, Run of 1919, grouped by Weight, Age, and Sex.

Weight in Pounds.	Number of Individuals examined.			
	Four Years old.		Five Years old.	
	Males.	Females.	Males.	Females.
3	1	..	..	...
3½	1	1	..	..
4	25	8	..	..
4½	64	25	4	2
5	52	17	12	30
5½	32	6	19	44
6	12	2	20	34
6½	2	..	16	32
7	1	..	18	16
7½	..	..	9	4
8	..	..	7	2
8½	..	..	2	..
9	..	..	1	1

The average size of Rivers Inlet sockeyes within their own group was so nearly constant during the first years of our investigation that any considerable change in this respect becomes immediately apparent. Such a change has undoubtedly accompanied the reduction in the size of the runs during the last three years. We have no present reason to allege in support of an assumption that there is a casual connection between the size of the individual fish and the magnitude of the run. The coincidences during the last three years may be only chance associations. But against this hypothesis we have our observations of other exceptionally poor runs in the rivers of the Province during the years 1913 and 1917, when, as stated in our Report for 1917 (page 77), "We have extremely poor packs of sockeyes in all the large rivers of the Province, and we have these poor runs consisting everywhere of undersized fish."

This is a subject which will well repay further investigation. At present we are without any explanation for the extensive annual fluctuations in the size of the runs in our principal salmon-streams. Neither in the Nass, the Skeena, nor in Rivers Inlet have we been able to establish any relation between the size of the run in any given year and the size of the broods from which it has been derived. How can we explain this lack of relation between the two? We may contend, of course, that the apparent lack of relation is due to incorrect estimates of the size of the runs during some or all of the seasons. Our estimates are based on the apparent abundance of the fish and the size of the commercial catches. Failures by this method, due to exceptional conditions, may indeed occur now and then. But quite generally it has been noted that seasons of good fishing correspond with successful seasons on the spawning-grounds, as these are established by direct observation. So while we may admit occasional lapses by our method, we must agree that years of apparent abundance are correctly so characterized and correspond with seasons in which the spawning-beds are abundantly seeded.

Are we then forced to the conclusion that the relative amount of seeding of the beds has comparatively little influence on the size of the resulting runs? Such a conclusion becomes palpably absurd if pressed to the limit. If the number of eggs be sufficiently reduced, no one can deny that this will have a paramount influence on the magnitude of the run. But when the variation in the annual production of eggs is of lesser amount, no greater in fact than has occurred in the Nass, the Skeena, and on Rivers Inlet in the last ten years, we must now, in view of all the facts, contemplate the possibility that other factors which limit the production of salmon are of greater importance than egg production, within the normal limits of the variation of the latter, and have a dominating influence in producing the annual fluctuations so evident in the salmon-supply, even in the case of those streams which are not overfished.

Where overfishing has occurred, obviously the case would be different. This is apparent from the very definition of the term. By overfishing we mean so great a reduction of the spawning stock that insufficient eggs are produced year by year to maintain the run at its maximum productivity. In pronounced cases of this kind a correlation may well be established

between egg production in a given year and the size of the resulting run. Such correlation has been repeatedly demonstrated during the decline of the great Fraser River fishery.

Our failure to find such correlation in the Nass, the Skeena, and in Rivers Inlet possibly may be due to the fact that these streams, during the period when those broods have been produced whose progeny we have later examined, have not been seriously overfished. It may be that even during their poorer years there was approximately adequate egg production, while during some of their better years there may have been even useless excess of eggs. The fluctuations in the size of the runs would then be due to other causes than the annual variations in the number of spawning fish. Conceivably, the poor runs may be due to unfavourable conditions during the growing period in fresh water or in the sea—unfavourable conditions which would cause widespread mortality and a stunting of the remnant of the brood. Any evidence, then, of habitual or frequent stunting during years of diminished supply will throw much-needed light on this question.

Obviously, the occurrence of undersized fish characterizing each of a series of conspicuously poor years does not exclude the possibility of overfishing as a contributory cause for the decreased runs. When the experience of a series of years indicates unmistakably that the productivity of a stream is declining to a lower level, the common-sense treatment of the situation is to modify favourably the only factor over which we exercise control. We should increase the spawning reserve and thus seek to augment the egg production. Egg production must, after all, be fundamentally most important. As a constant factor, in the long run it will dominate the situation.

Undoubted evidence in this direction is furnished by the runs of the last three years in Rivers Inlet. Both males and females of four- and five-year fish show corresponding decreases in both length and weight. Prior to 1917, we could state that the lengths of four-year males averaged 22.9 inches, with such inconsiderable variations in successive years that these might well be attributed to imperfections of our method. In similar manner, the four-year females averaged 22.8 inches, the five-year males 25.9 inches and the five-year females 25.1 inches. But the averages for 1917, 1918, and 1919 have been for four-year fish 22.4 and 22.3 inches, and for five-year fish 24.9 and 24.4 inches. In similar manner, the average weights preceding 1917 were for four-year fish 5.4 and 5.1 pounds, and for five-year fish 7.4 and 6.7 pounds; while during 1917, 1918, and 1919 the averages have been for four-year fish 4.9 and 4.9 pounds, and for five-year fish 6.5 and 6.3 pounds. The data for the last eight years are given in the following table:—

Table XXXIV.—Average Length in Inches of Rivers Inlet Sockeyes for Eight Successive Years.

	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.
Four-year males	23.2	22.9	23.0	22.9	22.9	22.5	22.3	22.4
Four-year females	22.8	23.0	22.8	22.8	22.8	22.3	22.5	22.3
Five-year males	25.8	25.9	25.9	26.0	25.8	25.0	24.9	24.8
Five-year females	24.6	25.2	25.2	25.1	25.0	24.4	24.5	24.4

Table XXXV.—Average Weight in Pounds of Rivers Inlet Sockeyes for Six Successive Years.

	1914.	1915.	1916.	1917.	1918.	1919.
Four-year males	5.4	5.3	5.5	5.0	4.9	4.9
Four-year females	5.2	5.1	5.0	4.9	5.1	4.8
Five-year males	7.3	7.3	7.6	6.6	6.7	6.3
Five-year females	6.8	6.6	6.7	6.2	6.7	5.9

The fishing season at Rivers Inlet lasts for about six weeks, and this is practically coextensive with the run, as is shown by the very limited boat-catches at the beginning and at the end of the season. The latest fish to appear may well have had six weeks longer in which to feed and grow than have those which were first to arrive. A comparison of the average sizes in each group is given below for a series of dates. The number of individuals in our samples was too limited to furnish wholly reliable results, especially in the four-year

females and the five-year males, which on certain dates were present in very small numbers. But in each of the groups a small but unmistakable growth is evidenced during the season until at the latter end, when the average size in all groups again diminishes.

Table XXXVI.—Average Lengths and Weights of Rivers Inlet Sockeyes on a Succession of Dates.

	Length in Inches.				Weight in Pounds.			
	Four Years old.		Five Years old.		Four Years old.		Five Years old.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
July 7, 10	21.9	22.0	24.3	24.5	4.6	4.6	5.6	5.9
„ 15, 18	22.4	22.3	24.9	24.6	5.0	4.7	6.4	6.1
„ 22, 26	22.6	22.7	25.0	24.8	4.9	5.1	6.7	6.2
„ 31	22.9	22.6	25.3	24.0	5.1	4.8	6.3	5.7
Aug. 2	22.4	21.9	24.3	23.7	4.8	4.5	5.7	5.3

III. THE SKEENA RIVER SOCKEYE RUN OF 1919.

(1.) General Characteristics and the Age-groups.

The commercial take of sockeye salmon in the Skeena River in 1919 amounted to 184,945 cases, and was the next to the largest known in the history of the river. It was exceeded only by the take in 1910, which reached the total of 187,246 cases. The occurrence of two favourable seasons in succession, those of 1918 and 1919, bring a certain amount of needed reassurance concerning the general condition of the salmon-supply in the Skeena River. The previous occurrence of two extremely poor years in succession, 1916 and 1917, had been occasion for grave forebodings, lest they might indicate that the salmon-supply of this river was being drawn on more heavily than in the long run would prove safe. This question has not yet received a conclusive answer. Annual fluctuations often conceal the sequence of events. Only by resorting to averages which cover periods of years can we ascertain with some degree of certainty whether the supply is on the whole diminishing. With this object in view we have ascertained the average pack on the Skeena River in four-year cycles from 1903 until 1919.

Average pack from 1903 to 1906..... 78,868 cases.
„ „ 1907 to 1910..... 130,851 „
„ „ 1911 to 1914..... 101,664 „
„ „ 1915 to 1919..... 91,477 „

Considering these averages in connection with the fact that the number of canneries and the amount of fishing-gear employed in this district have been relatively constant during the greater part of the period under consideration, and the further fact that latterly the high price obtained by the fishermen has encouraged them to make every effort, we cannot escape apprehension that we are slowly but certainly encroaching on our capital supply of fish. It would seem that, on the average, the productivity of the river is declining. Until this question has received a satisfactory decision the situation on the Skeena should receive most careful and conservative treatment. The intensity of the fishing should be diminished and not increased.

We have elsewhere called attention to the insuperable difficulties we have encountered in attempting to correlate seasons of scanty supply with poor brood-years from which they had been derived. We are unable to establish any relation between the two. No basis for prediction as to the size of the pack in any given year can be found in the apparent size of the runs four and five years before, yet practically all the individuals which will comprise the run will have developed from eggs deposited in those two seasons. Our estimate of the relative abundance of fish during the brood-years is based on the number of cases packed during those years. While this method is not strictly accurate, there is no reason to be alleged why in general it should not furnish reliable data. We have reason to believe that, on the average, commercially successful years are characterized by a relatively large number of salmon escaping to the spawning-grounds and by a relatively large deposition of eggs. That increased egg production should not result in recognizably larger runs under such conditions as have obtained in the Skeena River basin is a conclusion that has been forced on us by such evidence as is presented in the following table:—

Table XXXVII.—Percentages of Four- and Five-year Skeena River Sockeyes that spent One Year in Lake, in Runs of Successive Years.

Run of the Year.	Percentage. Four and Five Years old.	Brood-year from which derived.
1912 (92,498 cases)	5 yrs. 43%	1907 (108,413 cases).
	4 yrs. 57%	1908 (139,846 cases).
1913 (52,927 cases)	5 yrs. 50%	
	4 yrs. 50%	1909 (87,901 cases).
1914 (130,166 cases)	5 yrs. 75%	
	4 yrs. 25%	1910 (187,246 cases).
1915 (116,553 cases)	5 yrs. 64%	
	4 yrs. 36%	1911 (131,066 cases).
1916 (60,923 cases)	5 yrs. 60%	
	4 yrs. 40%	1912 (92,498 cases).
1917 (65,760 cases)	5 yrs. 62%	
	4 yrs. 38%	1913 (52,927 cases).
1918 (123,322 cases)	5 yrs. 59%	
	4 yrs. 41%	1914 (130,166 cases).
1919 (184,945 cases)	5 yrs. 69%	
	4 yrs. 31%	1915 (116,553 cases).

As we have shown on previous pages in connection with Rivers Inlet, there is also in the Skeena an apparent relation between the size of the run in any year and the proportion of five-year fish of which it is partially composed. In general, but with many exceptions, the larger the run, the greater the preponderance of five-year over four-year fish. Arranging the eight years from 1912 to 1919 of the preceding table in the order of their size, as shown by the pack figures, beginning with the largest, we have the corresponding percentages of five-year fish appearing in the following order: 69, 75, 59, 64, 43, 62, 60, 50. It will be noted that all but one of the first four percentages are larger than any of the last four.

The preceding table includes only the one-year-in-lake class, which in the Skeena basin always comprises the greater part of the run. But a variable number of fingerlings in this basin always linger for a second year's residence in the lake. What causes the wide variation in this respect is not known. During certain years practically all the brood of the previous year pass down to the sea on the approach of spring. In other years as high as 25 or 30 per cent. may tarry until their second spring. The percentages of this class occurring in the runs of the last six years are here shown: 1914, 7 per cent.; 1915, 15; 1916, 27; 1917, 14; 1918, less than 1 per cent.; 1919, 13.

The following table indicates the relative abundance of the age-groups belonging to the two classes. It will be noted that the four-year group that had spent one year in the lake increase in relative abundance toward the latter end of the season, while the five-year fish of the same class are most abundant at the opening of the run. The two-years-in-lake class agrees with the five-year fish above mentioned in becoming less abundant throughout the greater part of the season. But at the close of the run, during the month of August, a sudden increase appears and characterizes all the final days of the run. This was first observed in 1916 and in 1917 (Report for 1917, page 73), when on August 4th (1916) and on August 3rd (1917) remarkable increases in the fish of this class became apparent. In 1918 we have no August record, and the two-years-in-lake class becomes less and less numerous throughout the month of July. In 1919 our series is unusually complete, with five records in August. The change manifests itself suddenly on August 1st.

Table XXXVIII.—Percentages of Different Age-groups, Skeena River Sockeyes, found to constitute the Run on a Succession of Dates, Season of 1919.

Dates, 1919.	One Year in Lake.		Two Years in Lake.	
	Four Years old.	Five Years old.	Five Years old.	Six Years old.
June 23	12	75	8	5
„ 27	14	65	17	4
„ 30	20	68	10	2
July 4	15	71	9	5
„ 7	20	63	12	5
„ 11	22	71	5	2
„ 14	22	69	4	5
„ 18	22	72	4	2
„ 21	37	53	9	1
„ 25	39	55	4	2
„ 28	32	57	6	5
Aug. 1	23	58	16	3
„ 5	38	50	9	3
„ 8	40	46	7	7
„ 13	39	45	10	6
„ 15	36	41	15	8
Totals	27	60	9	4

The preceding table confirms a generalization we have previously stated concerning the effect of the extra year spent in the lake on the individuals comprising the two-years-in-lake group. The effect is not in the direction of increasing their size, for, as will be shown later, the five-year fish of this group are no larger than the four-year fish of the one-year-in-lake group; and, similarly, the six-year fish of one are no larger than the five-year fish of the other group. But the extra year of life in the Skeena race, as has been previously noted elsewhere, exercises a certain influence in accelerating development. Were this not the case we should find the same numerical relations between the five- and six-year fish of one group that we find between the four- and five-year fish of the other. If five-year fish of the one-year-in-lake type greatly exceeded in numbers the four-year fish of this group, as is constantly the case in the Skeena, we might expect the six-year fish of the two-years-in-lake type similarly to outnumber the five-year fish of the same class. But this is what we never find. The accelerating effect of age strongly modifies the results. The tendency of the Skeena race to spend four seasons feeding and growing at sea is met by an opposing tendency to mature at the age of five. The final outcome is well illustrated by the statistics of the 1919 run. The sea-feeding habit so far triumphs that no individual of the two-years-in-lake group mature at the age of four and the ages at which individuals of this group may mature is advanced an entire year. The sea-feeding habit thus predominates in its effect. But the age-maturing habit is not without an appreciable influence. For in 1919, whereas in the one-year-in-lake group 31 per cent. matured after three years sea-feeding and 69 per cent. after four years in the sea, the proportions were reversed in the two-years-in-lake group, in which 69 per cent. matured after three seasons in the sea, while only 31 per cent. had tarried at sea for an additional year.

The same tendency is manifest in those individuals which spend three years in fresh water. While the sea-feeding requirements prevent the maturity of these fish in either their fourth or their fifth years, the age requirement almost wholly prevents the continuation of life into their seventh year. Fish of this class mature almost exclusively in their sixth year. Only in streams which enter Bering Sea have we found many seven-year individuals of this class. But the retarding influences of the cold north on development are well known.

Table XXXIX.—Relative Numbers in One-year-in-lake and Two-years-in-lake Groups, Skeena River Sockeyes, 1919, on a Succession of Dates.

Dates, 1919.	One Year in Lake.	Two Years in Lake.
June 23, 27, 30	85	15
July 4, 7, 11	88	12
July 14, 18, 21	92	8
July 25, 28, Aug. 1	86	14
Aug. 5, 8, 13	86	14
Aug. 15	77	23

Table XL.—Percentages of Skeena River Sockeyes on Different Dates during the Season of 1919, having Equal Number of Years on the Sea-feeding Grounds.

Dates, 1919.	Three Years in Sea, Four and Five Years old.	Four Years in Sea, Five and Six Years old.
June 23, 27, 30	27	73
July 4, 7, 11	26	74
July 14, 18, 21	33	67
July 25, 28, Aug. 1	40	60
Aug. 5, 8, 13	48	52
Aug. 15	51	49

The above table divides the run according to the length of time spent at sea, where the major part of the growth occurs. Those individuals that had spent four years at sea showed a marked tendency to enter the river early in the season. Some of these are five years old, having spent but one year in fresh water; others are in their sixth year, having lived two years in the lake before migrating seawards.

(2.) RELATIVE NUMBERS OF MALES AND FEMALES.

During the season of 1919 samples were examined on sixteen different days, about evenly spaced throughout the run; 1967 sockeyes were included in these samples, 49 per cent. being males and 51 per cent. females. While the proportions of the sexes vary widely during different portions of the run, sometimes the males and at other times the females being largely in excess, the total numbers during the entire run are always approximately equal. There seems to be no constant total excess of males or of females, the apparent slight disparity of numbers being in some years in favour of the males and in others in favour of the females.

Table XLI.—Percentage of Males and Females, One-year-in-lake Group, Skeena River Sockeyes, 1919, on a Succession of Dates.

Dates, 1919.	Four Years old.		Five Years old.	
	Males.	Females.	Males.	Females.
June 23, 27, 30	58	42	46	54
July 4, 7, 11	65	35	49	51
July 14, 18, 21	59	41	46	54
July 25, 28, Aug. 1	55	45	46	54
Aug. 5, 8, 13	44	56	43	57
Aug. 15	40	60	47	53

Although the total number of males in any annual run approximately equals the total number of females, this is by no means true for each of the age-groups which together comprise the run. The four-year males of the dominant type (one-year-in-lake class) always exceed the four-year females of their group, but the disparity in numbers of four-year males and females in the Skeena basin is less pronounced than in Rivers Inlet. The average percentages in the Skeena for the past eight years are 61 per cent. four-year males and 39 per cent. four-year females. The Rivers

Inlet averages for the past seven years are 72 per cent. four-year males and 28 per cent. four-year females. This difference in the two basins may stand related to the fact that in Rivers Inlet a larger percentage of individuals mature at the age of five than is the case in the Skeena, the average for seven years in Rivers Inlet being 67 per cent.; for eight years in the Skeena, 60 per cent. Theoretically, we should expect to find that a race maturing largely at the age of five would retard the development of the precocious males from their third to their fourth year. In such a race we might anticipate an almost total absence of three-year male grilse and a correspondingly larger proportion of four-year males. We have been unable to examine the occurrence of grilse in Rivers Inlet and the Skeena, as fishing in these waters is carried on solely by gill-nets, through the coarse meshes of which the grilse would readily pass.

Table XLII.—Relative Numbers of Males and Females in Different Year-groups, Skeena River Sockeyes, in a Series of Years.

Years.	One Year in Lake.				Two Years in Lake.			
	Four Years old.		Five Years old.		Five Years old.		Six Years old.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
1912	54	46	42	58	..	..	..	..
1913	69	31	47	53	..	..	..	..
1914	60	40	47	53	..	..	..	..
1915	55	45	45	55	..	..	..	..
1916	70	30	43	57	56	44	54	46
1917	65	35	48	52	65	35	58	42
1918	63	37	46	54	61	39	56	44
1919	53	47	46	54	52	48	45	55

(3.) Lengths and Weights.

The lengths of the Skeena River sockeyes in 1919 were so close to the averages for the previous seven years that the fish must be considered normal in that respect. The four-year males and females of the predominating one-year-in-lake type were slightly larger than the previous averages, and the five-year males and females of the same type were slightly smaller.

	Four Years old.		Five Years old.	
	Males.	Females.	Males.	Females.
Average lengths, 1912 to 1918	24.0	23.3	25.9	25.0
Average lengths, 1919	24.3	23.4	25.7	24.8

The differences are so small in amount they might be considered due to errors associated with our method of sampling, but it may be significant that the two classes vary in opposite directions, while the males and the females of each class vary together. Using the averages from 1912 to 1918, it is seen that the four-year males increase their length by 7.9 per cent. during the next year and the females increase their length by 7.3 per cent.

Comparing in the same way the average weights for five years, from 1914 to 1918, we find that during their fifth year males of the dominant Skeena type increase their weight by 22 per cent. and females by 20 per cent.

Table XLIII.—Average Lengths of Skeena River Sockeyes, One Year in Lake, for Eight Successive Years.

	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.
Four-year males	24.6	23.5	24.2	24.2	23.9	23.6	24.1	24.3
Four-year females	23.5	22.9	23.4	23.5	23.6	23.2	23.3	23.4
Five-year males	26.4	25.5	26.2	25.9	26.2	25.5	25.9	25.7
Five-year females	25.2	24.7	25.1	25.0	25.0	24.7	25.0	24.8

Table XLIV.—Skeena River Sockeyes, Run of 1919, One Year in Lake, grouped by Length, Age, and Sex.

Length in Inches.	Number of Individuals examined.			
	Four Years old.		Five Years old.	
	Males.	Females.	Males.	Females.
21	1	..	1	..
21½	1	2	..	..
22	1	17	1	..
22½	13	32	..	4
23	29	53	5	19
23½	35	55	8	37
24	55	47	27	105
24½	53	25	43	123
25	46	13	93	152
25½	28	1	109	112
26	13	1	114	59
26½	4	..	79	17
27	1	..	41	5
27½	..	..	21	2
28	..	..	1	..
28½	..	..	1	..
29	..	..	1	..
Totals	280	246	545	635
Average length	24.3	23.4	25.7	24.8

The following table gives average lengths of sockeyes which remained two years in the lake before migrating seawards. Like the one-year-in-lake group, these spend three and four seasons in the sea before maturing and seek the spawning-grounds when in their fifth and sixth years instead of in their fourth and fifth years, as in the previous group. But the extra year spent in the lake has not increased their final stature. The 1919 average lengths compare as follows:—

One-year-in-lake four-year males, 24.3; four-year females, 23.4.
Two-years-in-lake five-year males, 24.3; five-year females, 23.4.
One-year-in-lake five-year males, 25.7; five-year females, 24.8.
Two-years-in-lake six-year males, 25.8; six-year females, 24.7.

Table XLV.—Average Lengths of Skeena River Sockeyes, Two Years in Lake, for Four Successive Years.

	1916.	1917.	1918.	1919.
Five-year males	24.1	23.9	23.9	24.3
Five-year females	23.8	23.8	23.4	23.4
Six-year males	26.2	25.4	25.2	25.8
Six-year females	24.8	25.0	24.7	24.7

Table XLVI.—Skeena River Sockeyes, Run of 1919, One Year in Lake, grouped by Weight, Age, and Sex.

Weight in Pounds.	Number of Individuals examined.			
	Four Years old.		Five Years old.	
	Males.	Females.	Males.	Females.
3½	1	..	..	..
4	2	3	1	1
4½	7	26	1	3
5	33	67	7	40
5½	51	66	27	97
6	78	53	81	199
6½	61	22	115	153
7	25	6	125	94
7½	19	3	85	39
8	2	..	66	7
8½	1	..	26	2
9	..	..	7	..
9½	..	..	3	..
10	..	..	1	..
Totals	280	246	545	635
Average weight	6.1	5.5	7.0	6.2

Table XLVII.—Average Weights, Skeena River Sockeyes, for Six Successive Years.

	1914.	1915.	1916.	1917.	1918.	1919.
One year in lake—						
Four-year males	5.9	5.7	5.4	5.3	5.8	6.1
Four-year females	5.3	5.2	5.1	5.0	5.3	5.5
Five-year males	7.2	6.8	7.1	6.4	6.9	7.0
Five-year females	6.3	6.2	6.3	6.0	6.4	6.2
Two years in lake—						
Five-year males	..	5.9	5.8	5.5	5.7	6.1
Five-year females	..	5.2	5.4	5.2	5.3	5.4
Six-year males	..	6.6	7.1	6.3	6.6	6.9
Six-year females	..	6.0	5.9	5.8	6.1	6.3

IV. THE NASS RIVER SOCKEYE RUN IN 1919.

(1.) General Considerations.

In our discussion of the Nass River run of 1916, we said (Report for 1917, page 76): "While there is reason to fear that the other principal streams in the Province are beginning to experience the effects of overfishing, the lower levels of the fluctuations in the runs becoming lower and the higher levels less high, there seems to be no indication so far that the Nass River has suffered." That statement is still valid after the season of 1919, though with less certainty concerning favourable conditions on the Nass. Dividing the period in the history of the river since 1903 into groups of four years each, we find the total pack of sockeyes from 1903 to 1906 to be 70,066 cases; from 1907 to 1910, 104,453 cases; from 1911 to 1914, 128,265 cases; and from 1915 to 1918, 114,764 cases. During the war period, from 1915 to 1918, when every effort was being made to increase food production to the utmost, the output of the Nass in sockeye salmon was distinctly less than for the preceding four-year period. For two years within the war period, 1917 and 1918, the sockeye-packs were less than they had been since 1917, while the average for the four years is less than that for the last decade. This unfavourable history gives cause for uneasiness, but does not yet furnish demonstration that injury has been done to the Nass River run. It does, however, counsel extreme caution in the handling of this industry.

The 1919 pack of 28,259 cases of sockeyes, while a gratifying improvement over the two very poor years which preceded, is again not equal to the average for the last decade. Extreme interest will attach to the history of the next three or four years on this river.

(2.) THE AGE-GROUPS.

The wide diversity in type in Nass River sockeyes is a continuing feature and is a definite constant characteristic of the race which inhabits this watershed. Every run since 1912 has been analysed by us and the results put on record. In no season have we failed to find four main groups represented: (1) The sea-type (three and four years old); (2) the one-year-in-lake type (four, five, and six years old); (3) the two-years-in-lake type (five and six years old); (4) the three-years-in-lake type (six and seven years old). We have then one three-year age-group; two of four years; two of five years; three of six years; and one of seven years. Thus nine different age-groups occur in this river-basin. Several of them are subsidiary and comparatively of little commercial importance. From the following table, giving the distribution of all the individuals examined in 1919, the relative importance of the different groups is seen at a glance. These individuals, it is believed, give us a fair cross-section of the entire run. They were taken at random, without selection, from piles of salmon on the cannery floor, and samples of this kind were taken on the average every other day throughout the fishing season from June 30th to August 18th. The total number of Nass River sockeyes for the season of 1919 thus examined and assigned to their appropriate groups is 1,724.

Table XLVIII.—Nass River Sockeyes which ran in 1919, grouped by Age, Sex, and Size, and by their Early History.

Length in Inches.	Number of Individuals.													
	One-year-in-lake Type.				Two-years-in-lake Type.				Three-years-in-lake Type.				No Year in Lake (Sea-type).	
	Four Years old.		Five Years old.		Five Years old.		Six Years old.		Six Years old.		Seven Years old.		Four Years old.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
22	1	1	..	..	..	..	..	..	..	..	..	..	..	..
22½	..	1	..	..	..	..	..	..	..	..	..	..	..	..
23	4	7	..	2	1	4	..	..	..	..	..	..	..	1
23½	3	10	2	5	1	5	..	..	..	..	..	..	..	1
24	6	12	6	30	4	15	..	2	..	..	..	..	..	..
24½	10	9	6	22	9	36	..	2	..	..	..	..	..	3
25	13	7	23	47	25	104	3	5	..	..	..	..	1	2
25½	10	4	22	29	54	103	1	3	..	..	..	..	3	1
26	8	2	37	28	95	144	5	4	..	..	1	..	4	2
26½	2	..	32	13	96	105	3	5	..	1	2	..	1	1
27	1	..	23	9	120	69	2	11	1	..	..	..	1	1
27½	2	..	13	4	54	10	5	6	..	..	..	1	..	..
28	..	..	9	1	42	..	14	5	1	..	3	1	1	..
28½	..	..	2	..	5	2	4	..	..	..	..	1	..	..
29	..	..	1	..	..	..	14	5	..	..	..	..	..	..
29½	..	..	..	..	1	..	..	..	1	..	..	..	..	..
30	..	..	1	..	..	..	5	..	..	..	..	..	..	..
Total No.	60	53	177	190	507	597	56	48	3	1	6	3	11	12
Ave. length	24.9	24.1	26.2	25.2	26.5	25.8	27.9	26.7	28.2	26.5	27.2	28.0	26.1	25.1
Ave. weight	6.0	5.5	6.6	5.9	6.7	6.1	7.8	6.7	7.7	7.0	7.1	7.5	6.4	5.7

It will be noted in the table that the great majority of the Nass sockeyes, in 1919 as in all former years, fall within the first and second types—they spent either one year or they spent two years in their native lake before undertaking the downward migration to the sea. Four different groups are included under these two types. Taken together, they always constitute the bulk of the run, but among themselves they exhibit through the years considerable variation in their relative importance. Always the two five-year groups greatly exceed in numbers the other two, and usually the five-year group which belongs to the two-years-in-lake type is more numerously represented than the five-year group of the one-year-in-lake type.

Considering only the four groups above mentioned and disregarding for the moment the other groups of inconsiderable commercial value, we find the run of 1919 consisted of the following: Four-year fish (one-year-in-lake type), 7 per cent.; five-year fish (one-year-in-lake type), 22 per cent.; five-year fish (two-years-in-lake type), 65 per cent.; six-year fish (two-years-in-lake type), 6 per cent.

The following table contains similar data for each of the eight years during which the sockeye run of the Nass has been under investigation. The percentages for 1919 diverged remarkably little from the average percentages for the eight years.

Table XLIX.

Year.	Percentage of Individuals that spent			
	One Year in Lake.		Two Years in Lake.	
	Four Years old.	Five Years old.	Five Years old.	Six Years old.
1912	8	27	63	2
1913	15	12	71	2
1914	4	41	45	10
1915	19	14	59	8
1916	9	17	66	8
1917	10	15	71	4
1918	30	16	45	9
1919	7	22	65	6
Averages	13	21	60	6

In Table L., which follows, we present the percentages of the different year-groups that were present in 1919 during each of the dates on which the run was sampled. The percentages for any given day are of necessity based on very limited material, and many of the minor variations in these percentages from day to day are to be ascribed to this fact. The table indicates, however, beyond question, during what part of the run any given group had its maximum representation, when it began, and when it ended.

It appears from the table not only that the run is very complex, but that it is a well-ordered complexity. The different groups appear and develop in orderly sequence, and are marshalled as distinctly in assemblages with determinate numerical ratios as though they had schooled separately at sea and were returning each under migration laws peculiar to itself. Furthermore, the system pursued by the age-groups in 1919 is identical with that of former years. A comparison with similar tables which we have presented in previous years makes this evident, and testifies to the delicacy of the adjustments which govern so rigidly the migration behaviour of the different age-groups. Adjustments of this nature in other animals escape our observation, for we have ordinarily no means of grouping individuals in accordance with the important facts in their life-history. The categories themselves are unrecognized and unsuspected, and no possibility is presented of delving far beneath the surface. Formerly this condition obtained with the salmon also, for nothing in the external appearance, the size, or the structure makes it possible to distinguish one group from another. As they pass before our unaided eyes during the fishing season the impression is given of a homogeneous assemblage. Not until we have learned to decipher their autobiographies, as inscribed on their own scales, do we become aware of the play of forces and the responses and aware of the diverse elements, each governed by its own laws and each articulating perfectly with the main body of the run.

Table L.—Percentages in each Class of Nass River Sockeyes running at Different Dates in 1919.

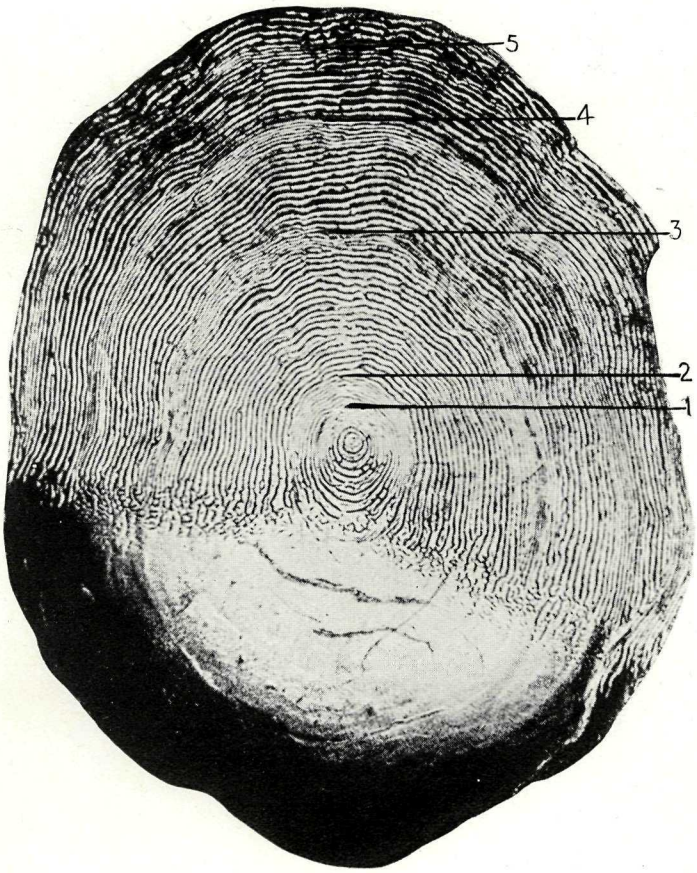
	One Year in Lake.		Two Years in Lake.		Three Yrs. in Lake.		Sea-type.	Number of Individuals examined.
	Four Years old.	Five Years old.	Five Years old.	Six Years old.	Six Years old.	Seven Years old.	Four Years old.	
June 30	2	30	52	2	..	..	14	50
July 1	..	37	56	2	..	..	5	48
„ 2	2	42	50	..	..	..	6	50
„ 4	..	41	56	..	..	..	3	39
„ 5	..	48	45	..	..	..	7	46
„ 7	..	44	56	..	..	..	..	45
„ 8	4	36	58	..	..	..	2	50
„ 10	2	44	50	2	..	..	2	50
„ 11	2	58	40	..	..	..	..	50
„ 12	..	56	44	..	..	..	..	50
„ 14	4	48	48	..	..	..	..	50
„ 15	6	63	28	3	..	..	..	35
„ 17	14	51	29	6	..	..	..	99
„ 19	13	37	45	5	..	..	..	60
„ 21	18	17	61	4	..	..	..	130
„ 26	8	10	75	6	..	1	..	120
„ 28	4	5	87	3	..	..	1	130
Aug. 1	3	6	82	9	..	..	..	123
„ 5	6	6	83	5	..	..	..	124
„ 8	..	1	83	13	..	3	..	70
„ 9	..	9	85	6	..	..	..	35
„ 11	3	2	77	16	..	2	..	95
„ 13	1	7	67	19	2	4	..	88
„ 15	4	..	74	20	2	..	..	50
„ 18	..	..	77	18	5	..	..	22
„ 21	..	..	83	17	..	..	..	12

Table LI.—Nass River Sockeyes, Average Lengths of Different Classes from 1912 to 1919.

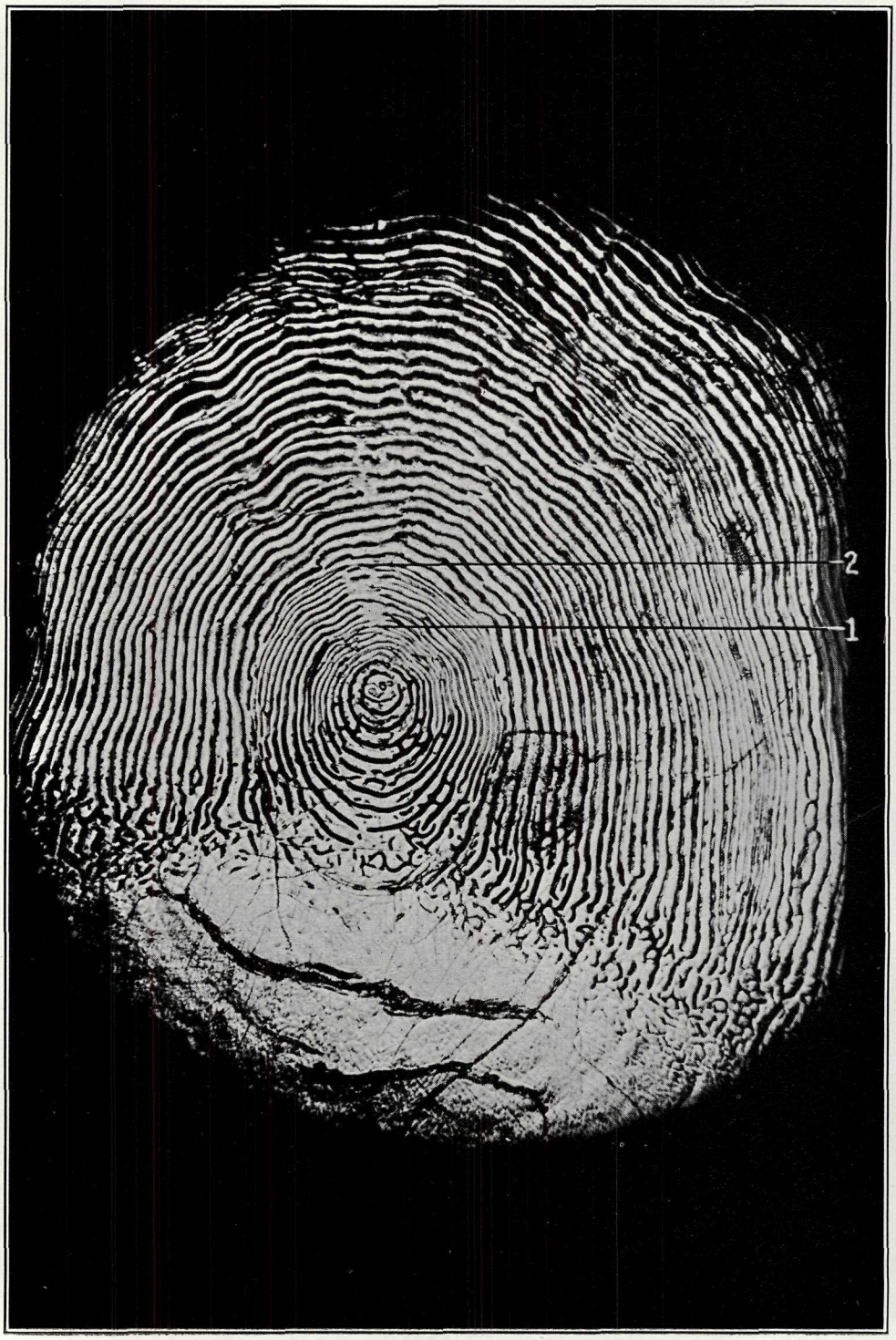
	One Year in Lake.				Two Years in Lake.			
	Four Years old.		Five Years old.		Five Years old.		Six Years old.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
1912 (inches)	24.6	23.3	26.5	25.1	26.2	25.4	27.0	25.6
1913 „	24.1	23.5	25.6	24.8	26.0	25.2	26.0	26.6
1914 „	24.6	22.7	26.1	25.1	26.3	25.5	26.9	25.6
1915 „	24.0	23.5	25.9	25.2	26.5	25.9	26.6	25.3
1916 „	24.5	23.3	26.4	25.0	26.5	25.6	27.9	25.7
1917 „	23.4	23.2	25.5	24.7	25.3	24.7	26.5	25.5
1918 „	25.0	24.3	25.7	24.7	25.9	25.0	27.2	25.2
1919 „	24.9	24.1	26.2	25.2	26.5	25.8	27.9	26.7

Table LII.—Nass River Sockeyes, Average Weights of Different Classes from 1912 to 1919.

	One Year in Lake.				Two Years in Lake.			
	Four Years old.		Five Years old.		Five Years old.		Six Years old.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
1913 (pounds)	5.5		6.3		6.5		6.7	
1914 „	6.2	5.0	7.4	6.5	7.2	6.5	7.9	6.8
1915 „	5.6	5.2	6.9	6.4	7.0	6.6	7.2	6.5
1916 „	6.0	5.3	7.2	6.3	7.2	6.2	8.1	6.4
1917 „	5.3	5.3	6.8	6.2	6.3	5.8	7.3	6.4
1918 „	6.3	5.8	7.2	6.3	7.2	6.4	8.3	6.7
1919 „	6.0	5.5	6.6	5.9	6.7	6.1	7.8	6.7

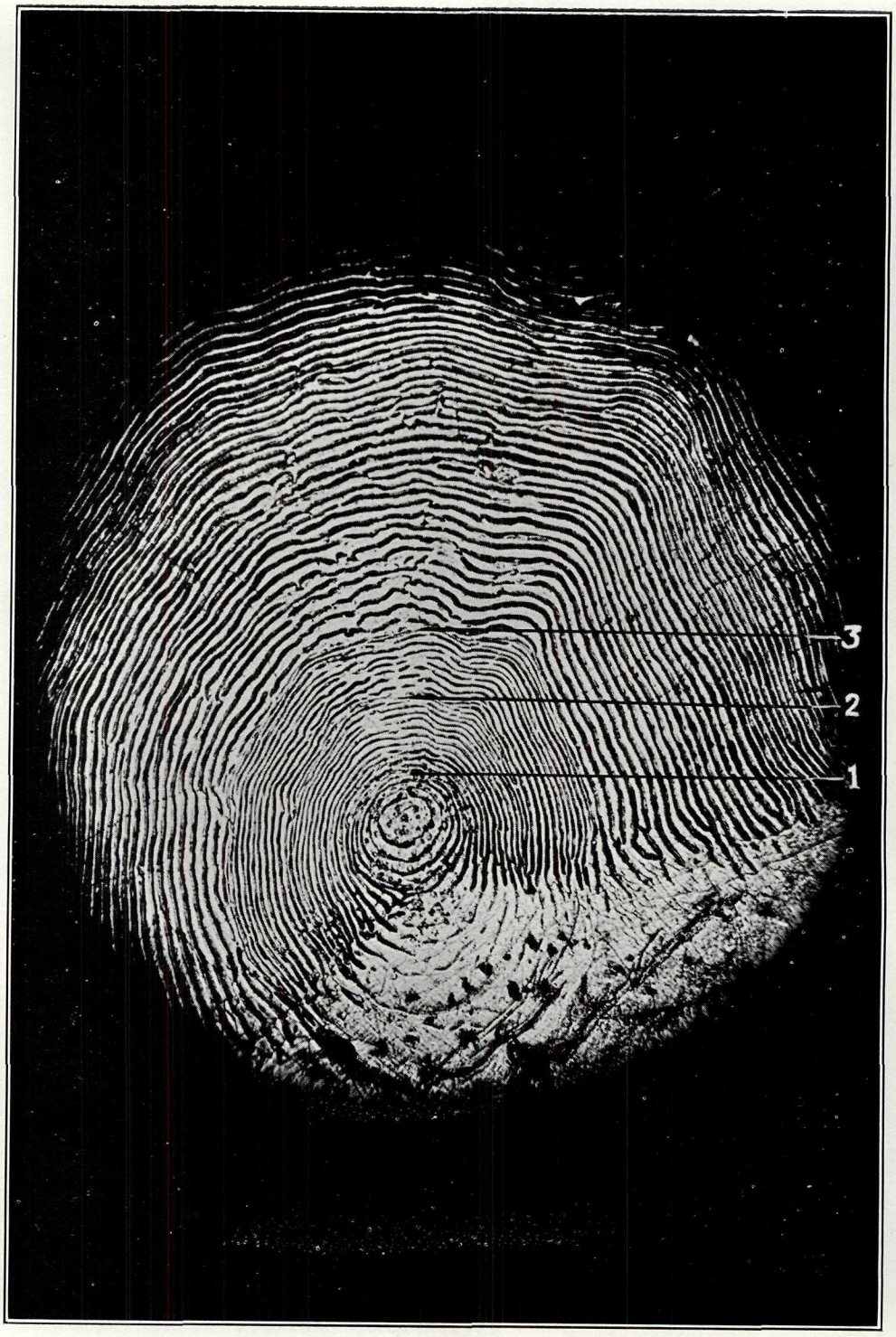


Two-years-in-lake type of Nass River sockeye in sixth year.

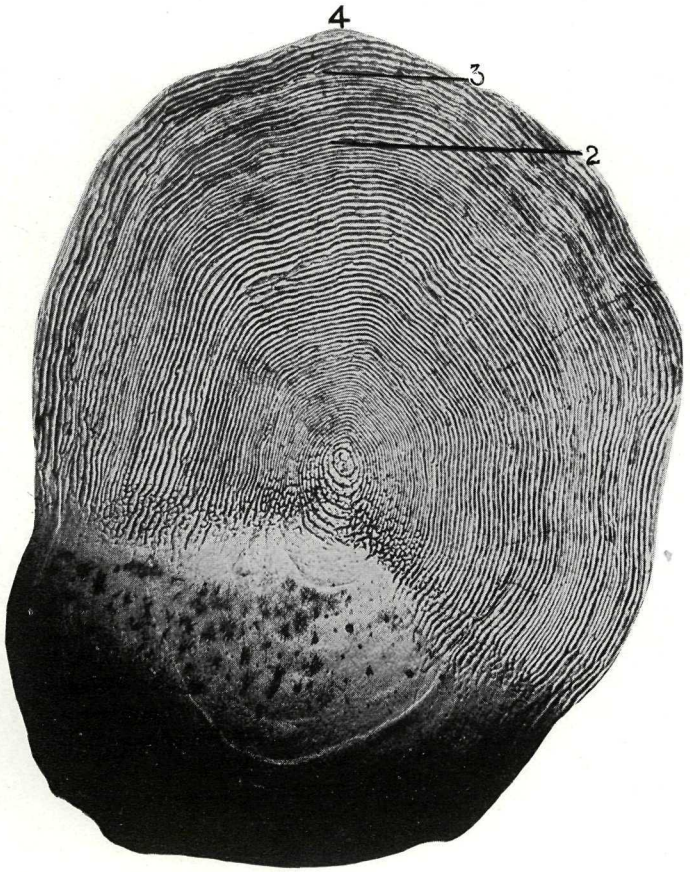


Centre of scale shown in preceding figure.

Three-years-in-lake type of Nass River sockeye in sixth year.



Centre of scale of three-years-in-lake type of Nass River sockeye.



Sea-type of Fraser River sockeye in fourth year.

Fraser River sockeye in fifth year.

MEMORANDUM RESPECTING SALMON-FISHERY REGULATIONS FOR THE PROVINCE OF BRITISH COLUMBIA.

BY HON. WILLIAM SLOAN, FISHERIES COMMISSIONER FOR PROVINCE.

The question of conserving the supply of salmon in our waters has long been one of keen interest. The 1905-07 Dominion Fisheries Commission, after a long investigation, recommended that "effective measures for securing some limitation of the exploitation of the northern waters of British Columbia be adopted." Acting on that report the Minister at Ottawa in 1908 set forth that no additional canneries would be licensed and that the number of boats in each section would be limited. The Dominion-Provincial Boat Rating Commission of 1910 reported against any increase in canneries or boats, and no increase was made until 1912, when an additional cannery licence was granted on the understanding that only white labour would be employed in operating the plant and in catching the fish; an understanding that was never carried out. Further cannery licences were granted in 1913, 1916, 1917, and 1918. There are now some ten more salmon-canneries in the North than there were in 1908, and many more gill and purse nets, and the deadly drag-seines are being operated, and traps have been installed in some localities. In 1917 the Dominion Commission, following hearings held throughout the North, reported that in their judgment "neither the ambitions of an individual nor the business strategy of a company is in itself sufficient ground for a change of public policy, and we do not regard the general result of the Department's change in policy which began in 1912 as having improved the situation from the public point of view, and we believe that the removal of all restrictions, under the present conditions as to the supply of salmon, would only open the way towards inefficiency and loss."

It should be the first policy of the Government to prevent depletion, to ensure continuance, and at the same time to eliminate useless competition and excessive overhead charges. The policy suggested by me is a move in that direction. If adopted it will conserve the supply and increase the earnings of the individual fishermen. There is abundant evidence that the salmon of the North and of Vancouver Island are rapidly being depleted. Unless they are given far more protection than is now afforded them they will go the way of the salmon of the Fraser. There is no doubt of that. The Fraser was once the greatest salmon-river of the world. The vast schools of salmon that used to seek its waters annually have been fished out. (*See* statement made to the American-Canadian Fisheries Commission, pages 53 and 54, British Columbia Fisheries Report, 1918; copy attached—Exhibit 1.) As a salmon-stream it is now in the third or fourth place in the salmon-streams of this Province. There has been no limitation placed on the fisheries of the Fraser, except a modest weekly closed period. They have been open to all that wished to engage. There are thirty-two canneries on the Fraser, but twelve of which have opened their doors this year, and combined they packed but 34,000 cases of sockeye salmon, and in almost every case they operated at a loss.

At the present time the canning plants on the Skeena and Nass Rivers and Rivers Inlet could have this year put up the entire pack in less than twelve days of eight hours each, whereas they were operated for over sixty-five days. Fixed charges were needlessly heavy because of the numerous plants, and have resulted in such high prices as to seriously affect the public interest. A further increase in the number of plants and the amount of gear employed on those waters will not better conditions.

I believe that the withdrawing of restrictions in the fishing regulations, as proposed, will most certainly have a disastrous effect upon the runs unless at the time of amendment most drastic additions are made to the present weekly and annual closed seasons. If the fishing is to be thrown open to all-comers, it will result in placing on the fishing-grounds of the North and Vancouver Island the now unused Fraser River fleet of fishing-boats. Depletion will surely result unless the present weekly close season of forty hours is extended to at least seventy-two hours, and to a further and material restriction of the present commercial fishing areas. To provide such an extension of closed hours will make it extremely difficult for fishermen to earn a weekly living wage without such a material increase in the price paid for fish as will add greatly to the cost of the product.

I suggest that the time has come for a complete and radical change in the policy of handling our fisheries. It is time that the Government stepped in to seriously protect the fish, eliminate

all useless competition, overequipment, and waste, to the end that the people may be able to obtain at a fair price one of the natural food products of this Province. To permit a further depletion of the salmon-fisheries of the Province would be a "policy which could only be characterized as a criminal policy." The fish of this Province, notwithstanding the depletion of both the salmon and the halibut, are still one of its greatest food assets. They are one of the greatest assets the Province possesses. With judicious handling the fisheries can be maintained for all time. The depleted fisheries can be built up, but they cannot be maintained if the present methods are to continue. The Fraser River fishery demonstrates what will happen if things are to go on as they have been going.

We have overdone the thing. We have drawn, and are drawing, too heavily upon our supply of salmon and of halibut. (*See* attached excerpt from House of Commons Debates, January 19th, 1907, page 1722—Exhibit 2.) What we need is a complete and radical change of policy; a departure altogether different from past and existing methods. The time has come when the Government should step in and take over our salmon-fisheries and administer them for the benefit of the people as a whole and for all time. They should step in and take over the salmon-fisheries just as the British and United States Governments have taken over the fur-seal fisheries of the North Pacific. Instead of licensing existing and new companies and individuals to take and handle our salmon-fisheries the Government should take them over and handle them. By so doing the fish would be given full protection. There will be a radical reduction in equipment and a consequent reduction in overhead expenses that will materially reduce the retail price of both fresh and canned salmon. And at the same time the Government, being serious in its desire to help returned men, can do so by taking control of the salmon-fisheries and install returned men to operate them.

The Governments of Great Britain and the United States took over the fur-seal industry because it was essential to the preservation of the fur-seal. (*See* excerpt from Hansard, February 27th, 1908, page 3954, attached—Exhibit 3.) The fur-seal was threatened with extinction. Corporate and individual enterprise was killing them off. The Governments took them out of the hands of corporations and individuals and adopted a policy that has materially increased the numbers in the herds of fur-seals.

There is no inherent difficulty in taking over the salmon-fisheries. The existing operating companies in the salmon-fisheries have no operating rights beyond those granted them from year to year. The Government is under no obligations to renew the licences formerly granted to them. I suggest that the Government should assume the sole control of the entire salmon industry, even though that may mean compensation where it can be shown that compensation is due. Many of the salmon plants on the Fraser are at present a liability and not an asset of the owning companies. The plants of Northern British Columbia will in a short period be as valueless as the plants on the Fraser if the existing policy of depletion is continued. The history of the Fraser will be repeated. The salmon-fisheries of British Columbia will be depleted as Alaska is being depleted. (*See* attached statement of Charles D. Garfield, Alaska Fish Commissioner, Fishing Gazette, New York, December, 1919, page 28—Exhibit 4.) The Government should bear this in mind in taking over existing plants that may be found necessary for the work under Government control. The Government can, by combining its efforts, reduce overhead expenses by several hundred per cent. It can in consequence sell cheaper. It can put up as good, if not a better and more uniform pack. Being a Government-guaranteed product, it will be in greater foreign demand. And what is of greater importance, it will ensure the continuance of the salmon runs.

Government owned and operated fisheries, and I do not confine the suggestion that Government ownership be confined to the salmon-fisheries alone, for I would include trawl-caught fish, which together with the salmon would prove a valuable adjunct to the two transcontinental railway-lines owned and operated by the Government. (*See* report of Select Committee appointed to deal with schemes and suggestions made with a view of rehabilitating soldiers, Journals of British Columbia Legislature, pages 172-4, 1919; copy attached—Exhibit 5.) By the addition of large freezing and cold-storage plants at or near Prince Rupert and Vancouver, the Pacific terminal ports of Government-owned railway-lines, the Government will be in a position to supply the North-west Provinces and Eastern Canada with fish at cheap prices, employ returned men, and to dominate the local fish-food markets, to the immediate and lasting benefit of the fish and the people.

The fish of the Province belong to the people of Canada. They constitute one of their greatest natural assets. When our minerals and our timbers are drawn upon they are lessened to that extent. Minerals cannot be replaced. Our forests may, at great expense, be restored by reforestation, but they then will not be available for several generations. Our fisheries, on the other hand, will last for all time if they are properly handled. Depleted runs can be restored. The runs of former years may even be enlarged. All that is necessary to maintain our salmon-supply is to ensure that a sufficient number of fish reach the spawning-grounds. If the beds are well seeded there will be a certain return. The fish will do all the work necessary, provided the Government gives them a chance to do so. They will perpetuate themselves without cost. They will entirely disappear if left to corporate and individual control.

The policy here advocated will meet with the approval of the people of Canada, since it means that the fisheries will be maintained in their interest, and that they may have fish at a cheaper price.

The policy proposed is a practical and sane business thing for the Government to undertake. It is a business that will pay dividends in a greater supply of fish, and at a cheaper price, not only to the people of to-day, but to our people that are to come after. Government control and operation is, in my opinion, the solution of this great economic question.

The Privy Council decided that the right to administer the fisheries of this Province rested with the Dominion, and that the right to fish was a public right subject to regulation by the Dominion. Provided the Dominion Government is not prepared to accept the policy here advocated, and operating our fisheries, I maintain that the Dominion should surrender that right to British Columbia.

We are facing rapidly changing conditions, and the time is opportune to assure the conservation of the Pacific Coast fisheries for the present and the future benefit of the whole people of Canada rather than sacrifice this great Provincial and national asset to satisfy the shortsighted greed of a small minority.

Victoria, B.C., December 29th, 1919,

(EXHIBIT 1.)

STATEMENT SUBMITTED TO THE AMERICAN-CANADIAN FISHERIES COMMISSION BY THE HON. WILLIAM SLOAN, COMMISSIONER OF FISHERIES, AT THE VANCOUVER MEETING, 1918.

GENTLEMEN OF THE COMMISSION,—As the Commissioner of Fisheries for the Province of British Columbia, I desire to comment briefly on the present precarious condition of the sockeye-salmon fishery of the Fraser River. The watershed of that river and its channels lie wholly within the Province. From its watershed have came all but a fraction of the sockeye that have been taken in the waters contiguous to the International Boundary-line which separates the Province of British Columbia and the State of Washington. From that watershed must continue to come the seaward migrants of sockeye which produce the commercial runs of sockeye to those waters, because there is no other watershed tributary to those waters which affords sufficient spawning and rearing waters for sockeye salmon. The vast runs of former big years demonstrate the extent and the value of the runs that that watershed can produce. It is the greatest sockeye-producing watershed known. No other watershed has produced such vast numbers of sockeye. That watershed is to-day as capable as ever of producing the vast run of the past. It has not been contaminated. Settlement, power, and irrigation have not injured it in any way. It needs only to be protected to produce the great runs of the past. Its produce has been lessened—almost destroyed—because a sufficient number of spawning sockeye has not been permitted to reach it. The runs in the three last years have steadily decreased because too few of the adult salmon have escaped capture in Dominion and State waters; because of excessive fishing too many have been captured. The run of the big year was further destroyed by a rock-slide blocking the river-channel at Hell's Gate in 1913.

That the runs in the three last years have been almost wiped out by commercial fishing and that the run in the big year has been alarmingly decreased has been ably demonstrated by statements already submitted to you. It is unnecessary here to more than call your attention to the evidence of depletion already in your hands. I do, however, accentuate the fact that the

evidence submitted to you by our Department is founded upon scientifically ascertained facts. The watershed of the Fraser and the fishing areas supplied by it have been under close scrutiny since 1901. No other has been so carefully observed. The history of the race of sockeye that frequent the Fraser is better known than that of any other district. The facts are no longer questioned. *The run of sockeye to the Fraser is perilously near to extermination. They will be exterminated if conditions remain as they are, and in so short a period as to wipe out all interests of both fishermen and canners.* In view of the evidence there is, in my judgment, but one thing to do. Adopt measures that will ensure to the watershed all the sockeye that still survive. To that end I would suggest that the toal prohibition of sockeye-fishing in the waters frequented by those produced in the Fraser River until such time as they have recovered from their depleted condition. I suggest this though it does involve compensation to resident fishermen and canners who can establish that they are entitled to compensation by their respective Governments. It is fruitless to rely upon concurrent regulations in British Columbia and the State of Washington waters. That has been tried and failed. Such efforts will continue to fail. Present commercial and monetary considerations must be eliminated. It must be in an international way, because it is an international question. It is one of the greatest fishery questions in which Canada and the United States are now concerned. The only adequate, the only permanent solution of this question, I submit, is the acquisition by Canada and the United States of all the rights in this fishery of which they may not now be in possession. That being established, the waters should be closed to sockeye-fishing for such a period of time as is necessary to restore the runs to the abundance of former big years. When that has been accomplished, let fishing be resumed under supervision and for the benefit of the two nations until such time as they have been recouped for their expenditures, and thereafter in such manner and to the end that the supply may not again become depleted.

I submit, gentlemen, that the Governments of Canada and the United States should recognize that the conditions confronting them demand such treatment. There is no gainsaying the evidence. The watershed of the Fraser River will, when adequately protected, produce more sockeye salmon than any known watershed. It produced in 1913 2,300,000 cases. In the three following lean years it produced an average of but 267,000 cases per year. Being in possession of a watershed capable of producing 2,300,000 cases a year, can any Government be content with conditions by which but 267,000 cases are produced, and the continuance of which will entirely destroy any production whatever? The evidence in the case is conclusive—it is undisputed; the fishery is in a precarious condition. There is, however, a difference of opinion as to the remedies to be applied. I submit that those best qualified to speak have made it plain that no temporary measures will produce desired results. The races of sockeye that frequent the Fraser cannot be restored by any half-way measure. To allow the destruction of the sockeye-fisheries of the Fraser River would be an unnatural, immoral, and unpatriotic policy.

The questions here involved are similar to those in the fur-seal case. They are international in character, and not Provincial or State questions, and must be dealt with upon broad national lines and in the interests of the people of Canada and the United States.

Faithfully yours,

WM. SLOAN,

Commissioner of Fisheries for British Columbia.

[NOTE.—Since the above representations were made we have had two seasons' fishing on the Fraser River and results have shown the decline in pack to be even more serious than predicted. The run of 1918 produced but 70,000 cases and that of 1919 will not be greater.]

(EXHIBIT 2.)

HOUSE OF COMMONS DEBATES. MR. SLOAN, COMOX-ATLIN.

(Hansard, January 18th, 1907, page 1722.)

"Dixon Entrance, more especially that portion to the south of the line and approaching Graham Island, is the most valuable halibut-fishery ground which we have, is being daily invaded by American fishermen, and unless prompt measures are taken to effectively patrol these waters the constant inroads will seriously deplete this very valuable territory. *The halibut-fishing in Dixon Entrance is carried on without regard to the spawning season or the observance of conditions necessary to a continuous supply, and it is being urged that regulations be enacted and*

enforced with a view to prolonging and maintaining unimpaired the present commercial value of these very important fisheries."

[NOTE.—No special consideration was given to this warning at that time, with the result that Dixon Entrance is now valueless, being completely denuded of halibut. The halibut-catch of 1918 was 14,000,000 lb. less than that of 1917, and not a pound of the 1918 catch was caught in Dixon Entrance.]

(EXHIBIT 3.)

HOUSE OF COMMONS DEBATES. MR. SLOAN, COMOX-ATLIN.

(Hansard, February 27th, 1908, page 3957.)

"I have shown the value to the world of the fur-seal fisheries of the North Pacific Ocean.

"I have pointed out the urgency of action being taken to save this valuable animal from total extinction.

"I have suggested the Hague Tribunal as competent and unbiased to deal with this question.

"In conclusion, Mr. Speaker, the destruction of the fur-seal species would be unwarranted; furthermore, it would be *an unnatural, immoral, and unpatriotic policy.*

"*The protection and conservation of the fur-seals of the North Pacific Ocean is an obligation due posterity by the nations of to-day, who are directly responsible and directly interested.*

"This question is not one that can be settled on lines of selfish consideration. It can only be settled by compromise and generous broad patriotic statesmanship."

[NOTE.—This long-outstanding and contentious question was finally adjusted without reference to the Hague Tribunal, and mainly along lines indicated at that time, and with most satisfactory results to the preservation of the fur-seals.]

(EXHIBIT 4.)

EXCERPTS FROM THE FISHING GAZETTE, NEW YORK, DECEMBER, 1919, PAGE 28.

"Charles D. Garfield, Alaska Fish Commissioner, recently told cannerymen that the fishing industry in the territory would be *completely demoralized within a very few years unless drastic restrictions are immediately placed in effect to allow sufficient fish to escape to the spawning-streams.* Mr. Garfield's address was given at a hearing conducted in the assembly-room of the Seattle Chamber of Commerce by the Department of Commerce on proposed legislative measures designed to exclude fishing in all of the streams and lakes of Alaska and in waters tributary to their mouths.

"For the last fifteen years the Government has been endeavouring to replenish the supply by building hatcheries and distributing salmon-fry. So far not a single instance has been recorded where these fish return to propagate in the waters in which they were released, and the fact seems well established that the efforts of the Government have proved a failure.

"It took 100,000,000 salmon to complete the packs of Alaska's 135 canneries during the years 1917 and 1918. *Within a few years these institutions will for the most part be scrapped and the industry ruined unless strict protective measures are adopted.*"

(EXHIBIT 5.)

Nos. 32 & 33.

VOTES AND PROCEEDINGS OF THE LEGISLATIVE ASSEMBLY OF BRITISH COLUMBIA.

FRIDAY, 14TH MARCH, 1919.

Mr. McGeer presented an interim report from the Select Committee appointed under Resolutions of the 20th and 24th days of February, 1919, to deal with schemes and suggestions made with a view to rehabilitating soldiers, as follows:—

MR. SPEAKER:

Your Select Committee was attended by Deputy Commissioner of Fisheries Babcock; and upon hearing Mr. Babcock and upon making further investigation, your Select Committee is of the opinion that in formulating measures for the rehabilitating of soldiers full consideration should be given to the fisheries, for two main reasons, the first being that your Committee

believes that the fishing industry, if properly developed, would provide employment for a large number of returned men, and the second was that by the proper development of that industry the high cost of living problem would be solved in a measure in at least one of its many phases. While your Committee made some investigation into the possibilities of the returned soldier engaging in what is known as the "salmon-fishing industry" in such places as the Fraser River and elsewhere, your Committee is not of the opinion, in view of the condition of that industry, that it presents the best possibilities for the successful employment of returned men, the reason for such conclusion being that it is the opinion of your Committee that a policy of conservation is at once necessary to re-establish that industry so that it may be made one of profitable possibilities for those engaging in it. For instance, your Committee ascertained the fact that in 1918 the total catch of sockeye salmon in the Fraser River was 75,000 cases, as compared with 553,000 cases which were captured in 1914, the brood-year of the 1918 run. *It is the opinion of your Committee that similar depletions are being made on the Nass River, Rivers Inlet, and most of the minor sockeye waters.*

Your Committee also ascertained that in connection with the halibut-fishing carried on on this Coast the 1918 catch shows a decrease of 14,000,000 lb. Your Committee, in view of the provisions of the "British North America Act" and subsequent legal interpretation of that Act, making it obligatory that the Dominion Government assume the full protection and encouragement of the fisheries of this Province, and in view of the fact that a direct revenue during the past ten years has been collected by the Dominion Government of between $45,000 and $50,000 a year, and under the new provisions as provided in the regulations recently issued by the Dominion Government that revenue is to be increased to $250,000 a year, deems it advisable that the Government of the Province of British Columbia should recommend to the Dominion Government in definite terms the necessity of developing the fishing industry in the Province of British Columbia along lines which will *mean the engaging of large numbers of returned men, and at the same time amply protect that industry from depletion and ultimate destruction.*

With reference to deep-sea fishing, your Committee ascertained that deep-sea trawling had been conducted out of the ports of British Columbia in 1917 and 1918 on a profitable basis, and that the operations afforded evidence of an ample wealth of food-fish to provide the possibilities of the development of an industry as yet practically unexploited. The extent of possible profitable employment in such an industry is evidenced by the facts shown by the operation of a trawler known as the "James Carruthers." This trawler was operated out of Prince Rupert in 1918, and made a total of forty-nine trips, making in all 151 days. The approximate catch was 2,000,000 lb., consisting of flounders, sole, witch, brill, and other fish. The amount which each fisherman received for the season's work was approximately $2,000 during the operation of the boat. It is understood that the boat was inactive for a period of six weeks owing to the fact that *no cold-storage facilities were available to handle the catch.*

Your Committee also found that a considerable amount of training is necessary before a man should engage in this particular occupation, and that more vessels of a suitable type would be necessary.

In the light of the above facts, your Committee humbly recommends that the Government of the Province of British Columbia urge upon the Dominion Government the establishment on the Pacific Coast of a trawling-school for the training of men to engage in deep-sea trawl-fishing by providing a number of suitable vessels equipped for deep-sea fishing officered by experienced navigators, engineers, and fishermen, who would act in the capacity of instructors, and to whom returned soldiers could be apprenticed for instruction in navigation, the operation of steam and gas engines, care, casting, and hauling of trawling-nets, and the dressing, storing, curing, packing, and shipment of fish; the men during their apprenticeship to be paid a proper living wage and to be given a bonus from the ship's earnings after capital expenditure had been provided for. It is believed by your Committee that, well managed, such an operation would be sufficiently profitable to furnish the means of operation and maintenance, and create a sinking fund that would reimburse the Government and permit the vessel to be transferred to organizations of the men who would be desirous of operating on their own behalf in the course of time. It is the opinion of your Committee that at the present time there is room for ten such training-ships on the Pacific Coast of Canada, each of which could provide training for at lease twenty-five apprentices. Such a school, it is believed by your Committee, could be directed and operated in connection with the Naval Training School now established at

Esquimalt. In further connection with the deep-sea fishing industry, it is the opinion of your Committee that the Dominion Government should establish at suitable places in the Province, such as Prince Rupert, Vancouver, and Victoria, fish curing, packing, and marketing schools for the practical training of overseas men in the curing, packing, and marketing of fish, and through which the catches of the trawlers could be distributed. Your Committee is of the opinion that such a proposal, if established, would mean the development of an industry through which it would be possible to distribute fish not only in the Province of British Columbia, but throughout the North-west, as far as and including the Province of Manitoba.

Your Committee further recommends that, in the event of the Dominion Government not seeing its way clear to inaugurate and maintain such a training-school or to lay down some broad lines for the *development along lines of conservation*, the Dominion Government be *requested to turn over the entire fisheries of the Province of British Columbia to the Government of the Province of British Columbia*, by way of leasing such fishing grounds or areas to the Province; and in the event of such being done by the Dominion your Committee humbly recommends that the Government of this Province take into its consideration the advisability of laying down a policy embracing the putting into effect and the carrying-out of the recommendations hereinbefore made.

G. G. MCGEER.

The report was received.

Ordered, That the report be considered on Tuesday next.

[NOTE.—This important resolution received unanimous support of the British Columbia Legislature. It points out urgent necessity for conservation, deals with inadequate cold-storage facilities, lays down proposals to assist returned soldiers by engaging in trawling industry. So far as known, no consideration has yet been given this resolution.]

THE FRASER RIVER SALMON SITUATION: A RECLAMATION PROJECT.

BY JOHN PEASE BABCOCK.

The sockeye-salmon fishery of the Fraser River system was formerly the world's greatest salmon-fishery. The run of salmon in those waters was greater every fourth year than in any other waters. This fishery is no longer a great fishery. A discriminating study of the significant facts in the development and decline of this fishery demonstrates the necessity of dealing with them at once in an international way. These facts have been fully established, are no longer questioned, and should be more generally understood.

The restoration of the sockeye-salmon fishery of the Fraser River system is the greatest, and at the same time the least expensive, reclamation project in which Canada and the United States can jointly engage, and if adequate measures are adopted its success is certain.

It is the purpose of this paper to briefly set forth what the sockeye-salmon fishery of the Fraser River system was, what it is to-day, and what it may again become by judicious conservation.

The prominent facts in the history of the sockeye-fishery may be stated as follows:—

(1.) The waters of the Fraser River system as defined in the treaty between Great Britain and the United States include all the fishing-waters in the Province of British Columbia and in the State of Washington which are frequented by sockeye salmon in their migration from the Pacific Ocean to the spawning-beds of the Fraser River basin. They include Juan de Fuca, Rosario, and Haro Straits, and the other American estuary waters leading into the Gulf of Georgia, and the waters of that gulf as well as the channels of the Fraser River up to Mission Bridge in British Columbia.

(2.) Fishing for sockeye began commercially in the channels of the Fraser in British Columbia in 1876. It was extended to the waters of the Gulf of Georgia immediately outside the mouths of the river in 1890. Fishing for sockeye began in the State of Washington waters in 1891, with the installation of traps in the vicinity of Point Roberts. Traps became an important factor in 1897. Purse-nets came into use in American waters in 1901 and in recent years have greatly increased in number. During the period of 1900 to 1918, when the industry was at its height, the catch of sockeye in Canadian waters produced a pack of 5,030,730 cases. During the same period the catch in American waters gave a pack of 7,382,343 cases. A combined total pack of 12,413,073 cases, of which the Canadians produced 40 per cent. and the Americans 60 per cent.

(3.) Dr. C. H. Gilbert, of Stanford University, in his "Contributions to the Life-history of the Sockeye" (*see* British Columbia Fisheries Reports, 1913 to 1918), has demonstrated by scale-reading that the sockeye that run in the Fraser River system are hatched in the watershed of that river in British Columbia, live for the first year or more of their lives in its lake waters, then migrate to the sea, where they remain and grow until the summer of their fourth year, and then seek to return to the Fraser River basin in order to spawn, and after spawning die.* Dr. Gilbert's findings are unquestioned by any authority.

(4.) The Fraser River basin formerly produced more sockeye salmon every fourth year—known as the "big year"—than any other known river-basin, and even in the following years—known as the "small years"—produced runs of commercial importance.

* There are, however, exceptional cases in which fish proceed to sea immediately on hatching, and there are certain proportions which return in their third and fifth year.

The following statement gives the entire pack of sockeye in American and Canadian waters of the Fraser River system for the years 1891 to 1919, inclusive:—

SOCKEYE-SALMON PACK OF FRASER RIVER SYSTEM, 1891 TO 1919, INCLUSIVE.

Year.	Canadian Waters.	American Waters.	Total.
	Cases.	Cases.	Cases.
1891	176,954	5,538	182,492
1892	79,715	2,954	82,669
1893	457,797	47,852	505,649
1894	363,967	41,791	405,758
1895	395,984	65,143	461,127
1896	356,984	72,979	429,963
1897	860,459	312,048	1,172,507
1898	256,101	252,000	508,101
1899	480,485	499,646	980,131
1900	229,800	228,704	458,504
1901	928,669	1,105,096	2,033,765
1902	293,477	339,556	633,033
1903	204,809	167,211	372,020
1904	72,688	123,419	196,107
1905	837,489	847,122	1,684,611
1906	183,007	182,241	365,248
1907	62,617	96,974	159,591
1908	74,574	155,218	229,792
1909	585,435	1,005,120	1,590,555
1910	150,432	234,437	384,869
1911	62,817	126,950	189,767
1912	123,879	183,896	307,775
1913	736,661	1,664,827	2,401,488
1914	198,183	336,251	534,434
1915	91,130	64,584	155,714
1916	27,394	78,476	105,870
1917	148,164	411,538	559,702
1918	19,697	50,723	70,420
1919	34,068	64,346	98,414
Totals	8,493,436	8,766,640	17,260,076

The foregoing table gives a complete record for six four-year cycles and for the first two years of the present cycle. The outstanding features therein shown are: (1) The great packs made every fourth year; (2) the comparatively small packs made in the three intervening years; (3) the gradual but pronounced decline in the runs in the small years; and (4) the startling decline in the pack in the last big year, 1917.

As far back as written records exist, a phenomenally big run of sockeye to the Fraser is shown every fourth year. All the early explorers record it, and quote the Indians as saying it had always existed. It has been a characteristic peculiar to the Fraser and unknown in any other river. Up to 1917 the Fraser River District produced more sockeye every fourth year than the combined catches made in Alaskan waters during all but one of those years, as the following statement shows:—

THE SOCKEYE-SALMON PACK OF THE FRASER RIVER SYSTEM AND IN ALASKA.

Year.	Alaska.	Fraser River System
	Cases.	Cases.
1901	1,319,335	2,033,765
1905	1,574,428	1,684,611
1909	1,705,302	1,590,555
1917	2,484,881	559,702

(5.) The sockeye-salmon runs to the Fraser River system in the big years have been alarmingly depleted, and the runs in the small years are no longer of commercial importance. Both are threatened with extinction.

Complete records exist of conditions on both the fishing and the spawning grounds of the Fraser system since 1900. The record of the pack shows the catch, because the entire catch is marketed in tins. The number of fishermen employed and the amount of gear used are also recorded. There are adequate data also for a comparison of conditions on the spawning-beds since 1900. Dr. Gilbert, in "The Sockeye Run on the Fraser River,"* says: "No other sockeye-stream has received such close and discriminating study. Annual inspection has been made of the spawning-beds of the entire watershed, and predictions of the run four years hence have been fearlessly made. It is a matter of record how consistently these prophecies have been fulfilled." The observations of conditions on the spawning-beds have been made by the same observer since 1900.

The records for the fishing-grounds show that the runs of sockeye to the Fraser River system in the big years 1901, 1905, 1909, and 1913 produced an average pack of 1,927,602 cases, and that in 1917, the last year in the cycle of big years, it produced a pack of but 559,732 cases, or 70 per cent. less than the average of the four preceding big years. The startling decrease in 1917 is due to the fact that the great spawning runs of 1913 did not reach the spawning-beds of the upper section of the Fraser basin, for the reason that the river's channel at Hell's Gate was blocked by a great slide of rock following the construction of the Canadian Northern Pacific Railway through the canyon of the Fraser. A tunnel was driven through the rock cliff that overhangs the narrow channel immediately above Hell's Gate. During the spring of 1913 the action of frost caused a section of that cliff, including a portion of the tunnel, to slide into the river's channel, which formed an obstruction that the main portion of the run of fish could not get over. After frantic and continued efforts to surmount the obstruction the fish became exhausted, and were swept down-stream by the rapid current, where they died in the channels below without having spawned.

The British Columbia Fisheries Report for 1913 states that the number of sockeye that escaped capture on the fishing-grounds, and that later reached Hell's Gate that year, was fully as great, if not greater, than in the four preceding big years. The conditions created at the principal spawning-beds of the Fraser by the obstruction is told in the following excerpt from the report of John P. Babcock, in the British Columbia Fisheries Report for 1913:—

"I feel fully justified from my investigations in concluding that the number of sockeye which passed above the fishing limits was as great this year as any preceding big year of which we have a record, and I think even greater. The sockeye made their appearance in the canyon above Yale in June, and during the high waters of that month and July large numbers passed through to Quesnel and Chilko Lakes. The greater proportion of the run of sockeye in late July, and in August and September, was blockaded in the canyon by rock-obstructions placed in the channel, incident to the construction of the Canadian Northern Pacific Railroad, so that few were able to pass through during that time. No humpbacks succeeded in passing through the canyon. The blasting of temporary passage-ways enabled a large proportion of the sockeye run of October and November to pass through the canyon. In August sockeye were seen drifting down-stream, between Hell's Gate and Yale; the movement was very pronounced in September, and continued until the middle of October. The streams which enter the Fraser between Hell's Gate and Agassiz were filled with sockeye from the middle of August until the end of October, while they had not been observed in those streams in previous years. Very few sockeye spawned in any of these streams and most of them died without spawning. Great numbers of dead sockeye, which had died without spawning, were found on the bars and banks of the Fraser between Yale and Agassiz in September and October. The number which reached Quesnel Lake was little more than an eighth of the number which entered that lake in 1909. The run to Chilko Lake was equally small. The sockeye run to Seton Lake was 30,000, as against 1,000,000 in 1909. The August and September run of sockeye to Shuswap and Adams Lakes was much less than in any former big year, and the October and November run was also less. The sockeye-eggs collected there this year totalled but 9,000,000, as against 27,500,000 four years ago and 18,000,000 in 1905. The run to Lillooet Lake was less than in any recent year. Finally, the run to Harrison Lake was slightly better than in 1909.

"These facts, in my opinion, warrant the conclusion that the number of sockeye which spawned in the Fraser River watershed this year was not sufficient to make the run four years hence even approximate the runs of either 1905, 1909, or 1913."

* British Columbia Fisheries Report, 1917.

The disastrous effect of the 1913 blockade was manifested on both the fishing and spawning grounds in 1917, since the run in the latter year was the product of the 1913 spawning. The catch of 1917 produced a pack of but 559,732 cases as against 2,401,488 cases, or 76 per cent. less than in 1913, notwithstanding the fact that more fishermen and more gear were employed than in 1917 and the price paid for fish was higher.

Small as was the catch of 1917, too great a proportion of the run of that year was captured. That is, a sufficient number of fish were not permitted to reach the spawning area. In place of the millions of sockeye that reached Hell's Gate in 1913, only hundreds of thousands reached there in 1917. The obstructions having been removed, the fish had no difficulty in passing through to the spawning-beds above. The numbers that passed through in 1917 were far less than in 1913, notwithstanding the blockade of the latter year. In place of the 4,000,000 that entered Quesnel Lake in 1909 and the 552,000 that entered its waters in 1913, less than 27,000 passed into that great spawning area in 1917, and the numbers that reached all the other great lake sections were proportionately less than in 1913.* The number of sockeye that reached the Fraser basin in 1917 was not, in most sections, greater than in some recent small years. The result of the spawning in 1917 will not produce in 1921 a run even approximately as great as that of 1917. In other words, it may be expected to be very much less. The great run of the big years was destroyed by the 1913 blockade. The remnant of that run cannot withstand the drain made upon it in 1917. It is already so small that it must hereafter be classed with the runs in the small years. And like the runs in the small years it will be completely wiped out if present conditions shall continue.

The runs of sockeye to the Fraser system in the small years are no longer of commercial importance. Dr. Gilbert, in his article entitled "The Sockeye Run on the Fraser River,"† says:—

"The history of the Fraser River sockeye runs show unmistakably that the three small years of each four-year cycle were overfished early in the history of the industry. During the early years, when fishing was confined to the regions about the mouth of the river and drift-nets alone were employed, no evidence exists of overfishing. The last cycle in which these conditions obtained was 1894-96. During each of the small years of that cycle (1894, 1895, and 1896) there were packed approximately 350,000 cases on the Fraser River and about 60,000 cases in Puget Sound. During each of those years, therefore, about 5,000,000 sockeye were taken from the spawning run and used for commercial purposes. It should have been considered at that time an open question whether enough salmon to keep the runs going had been permitted to escape to the spawning-grounds. Apparently, however, a third of a million cases a year could be safely spared, for the following cycle shows no decrease. If from the beginning the pack had been limited to a third of a million cases for each small year, apparently the runs would still have continued in their primitive abundance.

"During the following period of four years (1897, 1898, 1899, and 1900) the traps on Puget Sound became an important matter. While the British Columbia pack shows little or no reduction, it was met by a pack on Puget Sound which nearly equalled it. The total captures during the three off-years of this cycle nearly doubled those of the preceding years and exacted an average toll of about 10,000,000 fish from the spawning run of those years. The total pack of the three small years of this cycle was over 2,000,000 cases.

"The result was quickly apparent. If 5,000,000 fish could be safely spared, this figure nevertheless must have been near the upper limit of safety, for when 10,000,000 fish were abstracted the small years of the following cycle showed such a marked decline as to indicate that we had far overstepped the line of safety. It was then during the cycle of 1897-1900 that the first serious damage was done to the sockeye run of the Fraser River. By doubling the pack of the three small years, not only was the surplus fully taken, but the necessary spawning reserve was seriously encroached on, with the result that in the small years of the following cycle (1902, 1903, and 1904), in spite of the increased amount of gear employed, the pack was cut in half, while the spawning-beds at the same time were but sparsely seeded.

"The inevitable and disastrous trend of events should have been evident to the dullest. But the parties in interest refused to hold their hands and proceeded with the slaughter of the spawning remnant. The result was quickly apparent. In 1902, 1903, and 1904 the total sockeye-pack of the Fraser (river system) was cut to 1,200,000 cases, and in succeeding years

* British Columbia Fisheries Report, 1917, page 21.
† British Columbia Fisheries Report, 1917, pages 113-14.

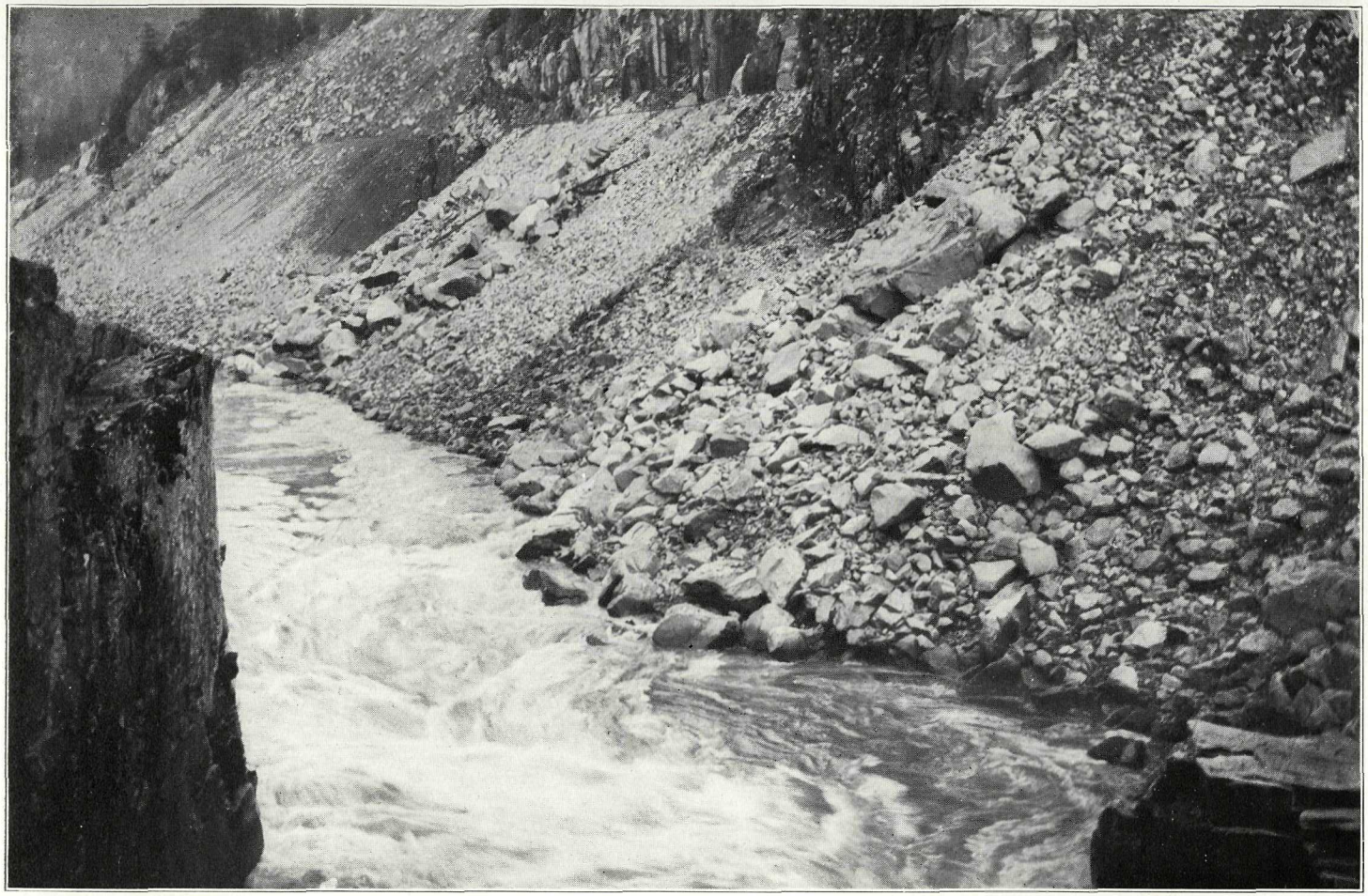
it has suffered still further reduction. The pack of the three small years never again equalled 1,000,000 cases. In 1906-8 it was 750,000 cases; 1910-12, 880,000 cases; in 1914-16, 796,000. And with each year the amount of gear employed has increased by leaps and bounds. The small years of the present cycle may be expected to register a smaller total than any which have gone before."

The total catch of sockeye in the Fraser River system in the past two small years of the present cycle demonstrates the correctness of Dr. Gilbert's forecast. The catch of 1918 produced a pack of but 70,420 cases, as against 534,434 cases in the preceding fourth year; and the catch in 1919 gave a pack of but 84,063 cases, as against 155,714 cases in 1915.

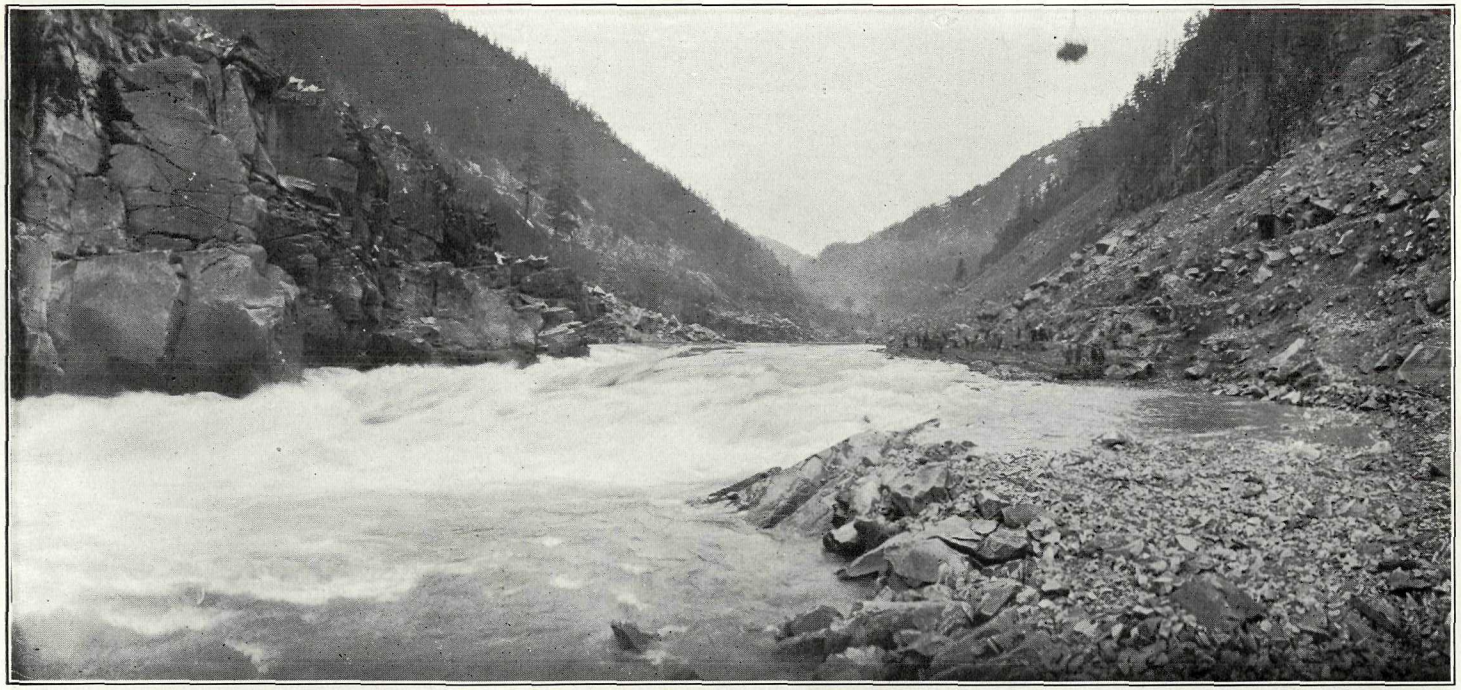
The evidence of the decline in the runs of sockeye in the Fraser River system is overwhelming. The runs in all years have already become so depleted that it is evident that under existing conditions the sockeye will be exterminated within a short period.

(6.) The Fraser River basin has an area of 90,903 square miles. It contains sixteen great lakes that have a total area of 2,351 square miles. No other river on the Pacific Coast drains so extensive an area of lake-water adapted to the propagation and rearing of sockeye. In the past it has produced greater runs of sockeye than any other river because this great spawning area was abundantly seeded every fourth year. It has been shown that sockeye spawn in streams tributary to lakes and on the shoals of lakes, and that their young remain in the lake-waters for a year or more after hatching and then migrate to the sea. Knowing that the sockeye were bred in the watershed of the Fraser, we therefore know that the great runs of sockeye in the big years 1901, 1905, 1909, and 1913 originated there. The runs of those years produced an average pack of 1,927,602 cases and at the same time afforded in the first three named years a sufficient number to seed the entire spawning area. Therefore the amount of the average pack of the big years 1901, 1905, 1909, and 1913 may be safely taken from the run without an overdraft, whenever the spawning-beds are as abundantly seeded as they were in 1901, 1905, and 1909. The spawning area of the Fraser has not been lessened or injured. Its spawning-beds have not been damaged or interfered with by settlement, factories, mining, or irrigation. Its gravel-beds and shoals are as extensive and as suitable for spawning as they ever were. Its lake-waters are as abundantly filled as ever with the natural food for the development of young sockeye. The channels of the Fraser are open and free to the passage of fish. All that is required to reproduce the great runs of the past is a sufficient number of spawning fish to seed the beds as abundantly as they were seeded in 1901, 1905, and 1909, and in former big years. The fishery cannot be restored in any other way.

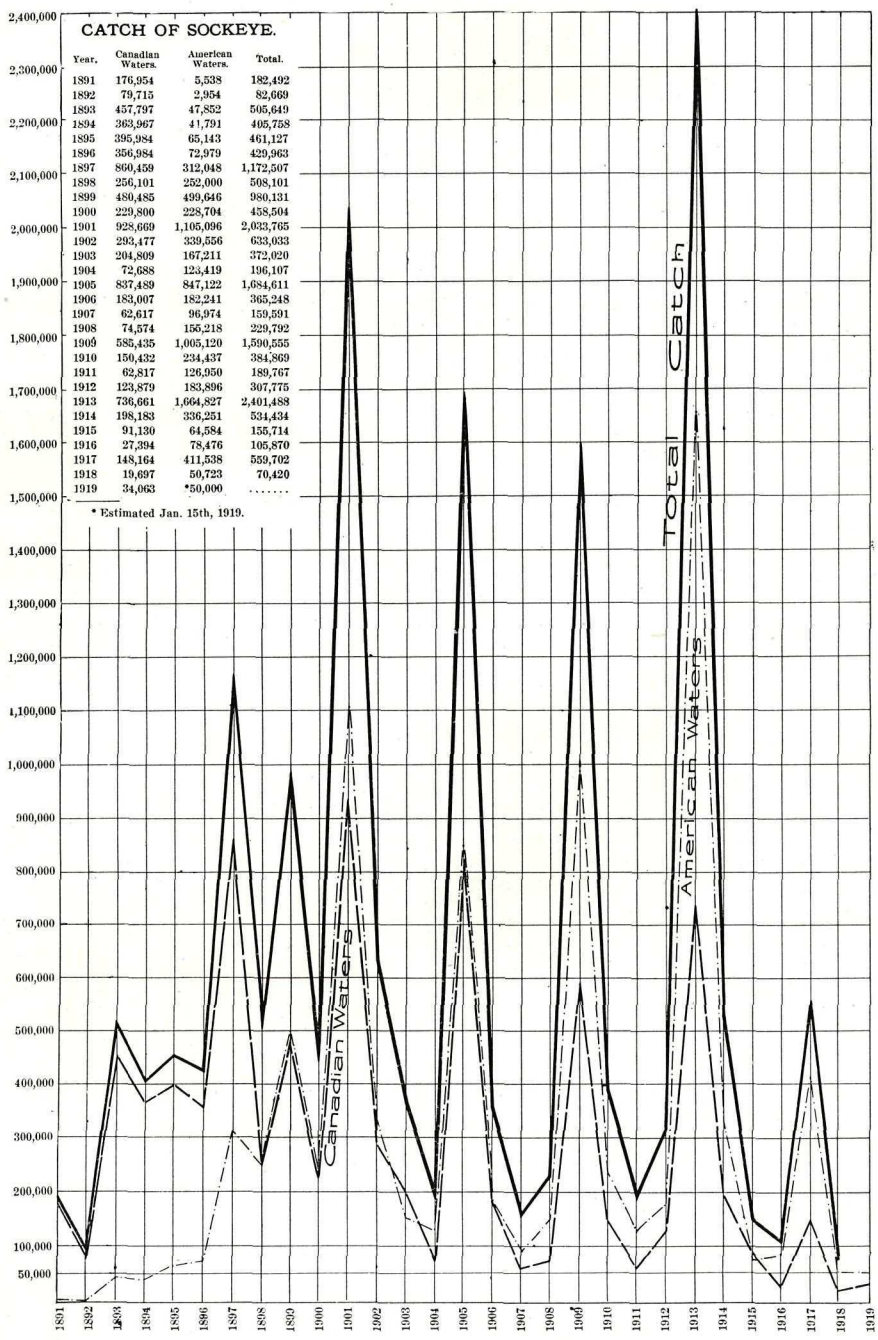
Neither Canada nor the United States acting singly can provide measures that will ensure the seeding of the spawning-beds of the Fraser. That can only be done by concurrent action. Joint and uniform regulations that will afford free passage for the fish through both Canadian and American waters must be provided and made effective. Sufficient fish must be permitted to pass through the fishing-waters and to reach and seed the beds. The interests of both Canada and the United States in this question are great. It is not alone a Canadian question. It is not alone an American question. It is an international question, and cannot be dealt with except in an international way. Recognizing these facts, both Great Britain and the United States, as far back as 1908, signed a convention dealing with the Fraser River situation. This convention failed to receive the approval of the United States Senate and was withdrawn. But, as we have already seen, in the years that followed matters went from bad to worse, and in 1918 an International Commission was established, consisting of the Honourable Sir J. D. Hazen, Chief Justice of New Brunswick, G. J. Desbarats, Deputy Minister of Naval Service, Ottawa, and William A. Found, Superintendent of Fisheries for the Dominion of Canada, representing Great Britain; and the Honourable Wm. C. Redfield, Secretary of Commerce and Labour of the United States, Edward F. Sweet, Assistant Secretary of Commerce and Labour, Washington, D.C., and Dr. Hugh M. Smith, Commissioner of Fisheries for the United States, representing the United States. The Commission held sittings in Seattle, Wash., and Vancouver, B.C., during the summer of 1918, and in the fall of that year embodied in a report to their respective Governments their unanimous findings, which resulted in the convention of 1919. That convention provides for "the times, seasons, and methods of sockeye-salmon fishing in the Fraser River system" and for "the conduct of investigations into the life-history of the salmon, hatchery methods, spawning-ground conditions, and other related matters" by an International Fisheries Commission, to consist of four persons, two to be named by each of the high contracting



Hell's Gate Canyon, Fraser River. Spring of 1914. Showing the condition produced by the rock-slides of 1913 and 1914. The channel was restored in 1914. (*See* following illustration.)



Hell's Gate Canyon, Fraser River, 1915. The rock thrown into the channel of the Fraser by the rock-slides of 1913-1914 has been removed and the original channel entirely restored.



CATCH OF SOCKEYE SALMON.

Fraser River System, 1891 to 1919, inclusive.

parties, and that the convention shall remain in force for fifteen years, and thereafter for two years from the date when either shall give notice of desire to terminate it. The convention has been signed by both Governments, approved by the Canadian Government, and is now awaiting the approval of the United States Senate.

The American Government up to 1918 had expended $125,000,000 on capital account to reclaim 1,100,000 acres of arid lands. The 100,000 persons that lived on the 25,000 farms of that area in 1917 produced a crop worth $50,000,000. The lake-waters of the Fraser River basin cover an area of 1,514,000 acres that when seeded by spawning sockeye as abundantly as they were seeded in 1897, 1901, 1905, and 1909 will produce annually a run of sockeye salmon from which may be taken sufficient fish to fill 1,927,602 cases, worth $30,000,000, without an overdraft on the run. The 1,514,000 acres of spawning area of the Fraser River basin are now almost as non-productive as were the 1,100,000 acres of arid lands of the United States before that Government expended $125,000,000 to bring them under cultivation. The spawning area of the Fraser basin requires no expenditure to bring it into bearing. Appropriations for capital expenditure and upkeep are not required. The workers do not require dwellings or implements. Cultivation is unnecessary. If permitted to reach the beds the fish will seed them, the young will feed themselves, furnish their own transportation to and from their feeding and maturing ranges in the open sea. The fish will do all the work necessary to produce a crop worth $30,000,000 a year, provided the Governments of Canada and the United States will furnish to a sufficient number of them safe passage through the fishing-grounds of the Fraser River system.

We repeat, in conclusion, that the restoration of the sockeye-salmon fisheries of the Fraser River system is the greatest reclamation project in which Canada and the United States can jointly engage, and that, too, with the least expense and most certain results.

PACK OF BRITISH COLUMBIA SALMON, SEASON 1919.

COMPILED FROM DATA FURNISHED THE DEPARTMENT BY THE B.C. SALMON CANNERS' ASSOCIATION.

Names.	Sockeyes.	Red Springs.	Pink and White Springs.	Bluebacks and Steelheads	Cohoes.	Pinks.	Chums.	GRAND TOTALS (Cases).
*FRASER RIVER DISTRICT—								
B.C. Packers' Association	14,274	8,073	2,870	5,633	11,478	14,665	45	57,038
J. H. Todd & Sons	2,615	752	77	332	2,648	4,524	1,410	12,358
J. H. Todd & Sons (Esquimalt)	4,405	.....	.....	.....	.....	.....	.....	4,405
Quathiaski Canning Co., Ltd.	1,613	.....	.....	.....	.....	.....	.....	1,613
Gulf Islands Fishing & Can. Co., Ltd.	618	.....	.....	.....	.....	.....	.....	618
Sidney Canning Co., Ltd.	801	.....	.....	.....	.....	.....	.....	801
Sooke Harbour F'g. & Pk. Co., Ltd.	1,789	.....	.....	.....	.....	.....	.....	1,789
Gosse-Millerd Packing Co., Ltd.	3,859	767	1,025	175	5,870	2,131	7,820	21,647
M. DesBrisay & Co.	1,442	690	36	1,047	501	669	.....	4,385
St. Mungo Canning Co., Ltd.	1,593	997	.....	.....	5,854	4,174	.....	12,618
Great West Packing Co., Ltd.	1,535	297	78	717	3,335	1,932	210	8,104
Glen Rose Canning Co., Ltd.	1,491	734	.....	.....	3,148	3,300	409	9,082
Griffin Canning Co., Ltd.	147	40	10	7,318	41	129	18	7,703
Defiance Pack. Co., Ltd., Liqn.	1,029	589	200	335	6,239	2,114	1,103	11,609
Canadian Fishing Co., Ltd.	1,643	1,580	.....	384	139	5,725	4,703	14,174
Totals.	38,854	14,519	4,296	15,941	39,253	39,363	15,718	167,944
SKEENA RIVER DISTRICT—								
B.C. Packers' Association	36,689	4,271	2,266	1,177	10,424	23,508	7,260	85,595
Anglo B.C. Packing Co., Ltd.	28,686	1,538	1,024	353	2,396	14,755	8,598	57,350
J. H. Todd & Sons	10,949	7,305	1,026	.....	12,625	12,092	874	44,871
Kildala Packing Co., Ltd.	13,140	596	169	231	1,156	5,640	910	21,842
B.C. Canning Co., Ltd.	15,377	1,331	261	106	3,864	11,004	542	32,485
Northern B.C. Fisheries, Ltd.	16,919	938	332	315	1,505	11,884	1,501	33,394
Cassiar Packing Co., Ltd.	11,780	702	299	.....	448	6,074	353	19,656
Wallace Fisheries, Ltd.	24,602	619	.....	238	1,631	10,852	802	38,744
Canadian Fish & Cold Stor. Co., Ltd.	10,597	1,602	804	.....	1,085	7,141	2,932	24,161
Gosse-Millerd Packing Co., Ltd.	16,206	759	99	252	1,425	14,353	7,685	40,779
Totals.	184,945	19,661	6,280	2,672	36,559	117,303	31,457	398,877
RIVERS INLET DISTRICT—								
B.C. Packers' Association	15,510	288	58	.....	1,428	383	2,400	20,067
Anglo B.C. Packing Co., Ltd.	5,489	.....	85	.....	54	40	76	5,744
J. H. Todd & Sons	5,883	12	.....	.....	262	109	79	6,345
Provincial Canning Co., Ltd.	5,387	363	204	.....	3,678	1,446	1,741	12,634
B.C. Canning Co., Ltd.	7,247	79	55	.....	1,325	30	519	9,404
Kildala Packing Co., Ltd.	5,187	110	43	.....	1,255	5	1,204	7,804
Gosse-Millerd Packing Co., Ltd.	4,262	40	16	2	6	289	353	4,968
Wallace Fisheries, Ltd.	7,293	75	50	.....	1,030	4,236	717	13,401
Totals.	56,258	967	475	2	9,038	6,538	7,089	80,367
NASS RIVER DISTRICT—								
B.C. Packers' Association	5,893	693	442	280	1,488	2,197	961	11,954
Anglo B.C. Packing Co., Ltd.	8,399	286	236	200	1,265	9,760	8,313	28,459
Northern B.C. Fisheries, Ltd.	6,232	472	354	221	2,331	4,478	2,779	16,867
M. DesBrisay & Co.	4,692	900	.....	.....	4,521	11,342	10,610	32,065
Western Salmon Packers, Ltd.	3,043	57	134	88	1,295	2,172	1,378	8,167
Totals.	28,259	2,408	1,166	789	10,900	29,949	24,041	97,512
VANCOUVER ISLAND DISTRICT—								
J. H. Todd & Sons	.....	5,075	1,170	.....	12,000	14,900	2,200	35,345
Wallace Fisheries, Ltd.	2,498	1,808	343	.....	7,552	.....	38,030	50,231
Quathiaski Canning Co., Ltd.	.....	622	425	4,191	3,004	3,871	7,024	19,137
C. L. Packing Co., Ltd.	1,379	66	69	479	155	10,467	1,896	14,511
Clayoquot Sound Canning Co., Ltd.	2,565	1,010	87	.....	1,220	.....	3,353	8,235
Nanaimo Canning & Packing, Ltd.	.....	.....	.....	95	170	.....	7,411	7,676
Redonda Canning & Cold Storage Co.	.....	404	752	1,634	1,352	1,216	4,650	10,008
Gulf Islands Fishing & Can. Co., Ltd.	.....	88	195	2,246	1,161	596	1,719	6,005
Sidney Canning Co., Ltd.	.....	451	208	.....	3,231	3,488	3,744	11,122
Lummi Bay Packing Co., Ltd.	10	775	344	.....	363	69	11,355	12,916
Nootka Packing Co., Ltd.	.....	9,446	1,672	.....	3,179	.....	35,642	49,939
Gosse-Millerd Packing Co., Ltd.	.....	7,604	1,553	.....	2,088	28	6,889	18,162
Sooke Harbour F'g. & Pk. Co., Ltd.	.....	212	533	.....	8,295	8,514	1,729	19,283
Bamfield Fisheries, Ltd.	.....	915	186	.....	1,214	37	2,371	4,723
Totals.	6,452	28,476	7,537	8,645	44,984	43,186	128,013	267,293
OUTLYING DISTRICTS—								
B.C. Packers' Association	20,616	806	3,886	19	8,391	15,233	9,629	58,580
Anglo B.C. Packing Co., Ltd.	821	.....	2,522	.....	4,647	7,432	26,741	42,163
Gosse-Millerd Packing Co., Ltd.	2,892	567	.....	32	2,714	26,694	21,772	54,671
Kildala Packing Co., Ltd.	1,261	75	19	283	1,127	2,764	13,709	19,238
Wallace Fisheries, Ltd.	7,169	404	.....	.....	747	786	3,643	12,749
Northern B.C. Fisheries, Ltd.	8,016	71	249	370	7,578	18,226	33,757	68,267
Western Packers, Ltd.	13,902	59	.....	.....	5,508	38,104	10,533	68,106
Maritime Fisheries, Ltd.	.....	3,058	224	63	.....	639	25,012	28,996
Ocean Packing Co., Ltd.	.....	.....	.....	.....	358	.....	16,287	16,645
H. B. Babbington	.....	800	.....	.....	256	.....	.....	1,056
Preston Packing Co., Ltd.	.....	1,308	718	.....	3,610	422	4,634	10,692
Totals.	54,677	7,148	7,618	767	34,936	110,300	165,717	381,163
Grand Totals	369,445	73,179	27,372	28,816	175,670	346,639	372,035	1,393,156

* Pack of sockeye credited to Fraser River run.

STATEMENTS SHOWING THE SALMON-PACK OF THE PROVINCE, BY DISTRICTS AND SPECIES, FROM 1904 TO 1919, INCLUSIVE.

FRASER RIVER.

	1919.	1918.	1917.	1916.	1915.	1914.	1913.	1912.	1911.	1910.	1909.	1908.	1907.	1906.	1905.	1904.
Sockeye	38,854	19,697	148,164	32,146	91,130	198,183	719,796	123,879	58,487	150,432	585,435	74,574	59,815	183,007	837,489	72,688
Springs, Red	14,519	15,192	10,197	17,673	23,228	11,209	3,573	15,856	7,028	1,018	1,428	1,903	3,448	7,523	5,507	9,482
Springs, White	4,296	24,853	18,916	11,430	5,392	15,300	49	9,826	6,751	8,925	.....	2,263	557	.....	.....	.....
Chums	15,718	86,215	59,973	30,934	18,919	74,826	22,220	12,997	47,237	52,460	8,687	415	63,530	15,543	3,304	1,066
Pinks	39,363	18,388	134,442	840	138,305	6,272	20,773	574	142,101	128						
Cohoes	39,253	40,111	25,895	31,330	43,514	43,504	16,018	36,190	39,740	35,031	27,919	33,270	35,766	34,413	30,836	45,667
Steelhead Trout	328	4,395	4,951	3,129	31	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Blue Backs	15,613	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals	167,944	208,857	402,538	127,472	320,519	349,294	782,429	199,322	301,344	247,994	623,469	112,425	163,116	240,486	877,136	128,903

SKEENA RIVER.

	1919.	1918.	1917.	1916.	1915.	1914.	1913.	1912.	1911.	1910.	1909.	1908.	1907.	1906.	1905.	1904.
Sockeyes	184,945	123,322	65,760	60,293	116,533	130,166	52,927	92,498	131,066	187,246	87,901	139,846	108,413	86,384	84,717	93,404
Springs	25,941	22,931	16,285	20,933	15,273	11,740	26,436	23,833	17,942	9,785	12,469	13,842	10,378	20,138	14,598	20,621
Chums	31,457	22,573	21,516	17,121	5,769	8,329	.....	504	70	.....	28,120	45,404	25,217	38,991	7,523	30,529
Pinks	117,303	161,727	148,319	73,029	107,578	71,021	66,045	97,588	81,956	13,473						
Cohoes	36,559	38,759	38,456	47,409	32,190	16,378	18,647	39,835	23,376	11,531	12,249	10,085	15,247	16,897	7,247	10,315
Steelhead Trout	2,672	4,994	1,883	3,743	1,798	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals	398,877	374,306	292,219	223,158	279,161	237,634	164,055	254,258	254,410	222,035	140,739	209,177	159,255	162,420	114,085	154,869

RIVERS INLET.

	1919.	1918.	1917.	1916.	1915.	1914.	1913.	1912.	1911.	1910.	1909.	1908.	1907.	1906.	1905.	1904.
Sockeyes	56,258	53,401	61,195	44,936	130,355	89,890	61,745	112,884	88,763	126,921	89,027	64,652	87,874	122,631	82,771	93,862
Springs	1,442	1,409	817	1,422	1,022	566	594	1,149	317	383	587	454	450	181	351	11
Chums	7,089	6,729	16,101	20,144	5,387	5,023	.....	3,845	288	.....	.....	.....	.....	.....	.....	.....
Pinks	6,538	29,542	8,065	3,567	2,964	5,784	2,097	8,809	5,411	19	.....	479	700	.....	.....	61
Cohoes	9,038	12,074	9,124	15,314	7,115	7,789	3,660	11,010	6,287	2,075	1,400	9,505	5,040	66	.....	358
Totals	80,367	103,155	95,302	85,383	146,838	109,052	68,096	137,697	101,066	129,398	91,014	75,090	94,064	122,878	83,122	94,292

NASS RIVER.

	1919.	1918.	1917.	1916.	1915.	1914.	1913.	1912.	1911.	1910.	1909.	1908.	1907.	1906.	1905.	1904.
Sockeyes	28,259	21,816	22,188	31,411	39,349	31,327	23,574	36,037	37,327	30,810	28,246	27,584	17,813	22,166	24,462	15,000
Springs	3,574	4,152	4,496	3,845	3,701	3,385	3,151	6,936	3,759	1,239	2,337	3,263	1,288	921	3,340	2,357
Chums	24,041	40,368	24,938	11,200	11,076	25,569	2,987	3,245	5,189	351	3,589	.....	.....	.....	.....	.....
Pinks	29,949	59,206	44,568	59,593	34,879	25,333	20,539	12,476	11,467	895	.....	6,612	5,957	3,450	1,840	31
Cohoes	10,900	17,061	22,180	19,139	15,171	9,276	3,172	12,468	7,942	6,285	6,818	8,348	6,093	5,997	3,083	1,697
Steelhead Trout	789	1,305	1,125	1,498	113	.....	.....	.....	.....	140	.....	1,101	681	.....	.....	.....
Totals	97,512	143,908	119,495	126,686	104,289	94,890	53,423	71,162	65,684	39,720	40,990	46,908	31,832	32,534	32,725	19,085

VANCOUVER ISLAND DISTRICTS.*

	1919.	1918.	1917.
Sockeyes	6,452	6,143	9,639
Springs	36,013	29,324	19,509
Chums	128,013	251,266	240,381
Pinks	43,186	57,035	49,156
Cohoes	53,629	40,752	31,733
Totals	267,293	389,815	325,723

OUTLYING DISTRICTS.

	1919.	1918.	1917.	1916.	1915.	1914.	1913.	1912.	1911.	1910.	1909.	1908.	1907.	1906.	1905.	1904.
Sockeyes	54,677	51,980	32,902	45,373	98,660	87,130	149,336	79,464	67,866	70,506	49,832	48,367	40,159	45,481	51,234	48,272
Springs	14,766	8,582	6,056	11,423	9,488	7,108	7,246	22,837	12,659	7,439	2,196	6,439	9,977	3,581	4,563	2,950
Chums	165,717	90,464	112,364	160,812	40,849	70,727	52,758	37,734	39,167	5,551	.....	.....	.....	.....	.....	.....
Pinks	110,300	201,847	112,209	143,615	83,626	111,930	83,430	128,296	64,312	20,098	6,148	23,538	23,300	7,964	1,303	4,409
Cohoes	35,011	42,331	30,201	70,431	48,966	43,254	28,328	65,806	42,457	19,460	13,532	20,709	25,754	11,759	3,292	13,114
Steelhead Trout	702	1,009	865	712	985	.....	.....	.....	.....	.....	.....	36	2	.....	.....	.....
Totals	381,163	404,793	294,597	432,366	313,894	320,168	285,898	334,187	226,461	123,054	71,708	99,089	99,192	68,785	60,392	68,745

TOTAL PACKED BY DISTRICTS IN 1904 TO 1919, INCLUSIVE.

	1919.	1918.	1917.	1916.	1915.	1914.	1913.	1912.	1911.	1910.	1909.	1908.	1907.	1906.	1905.	1904.
Fraser	167,944	210,851	402,538	127,472	320,519	349,294	782,429	199,322	301,344	247,994	623,469	112,425	163,116	240,486	877,136	128,903
Skeena	398,877	374,216	292,219	223,158	279,161	237,634	164,055	254,258	254,410	222,035	140,739	209,177	159,255	162,420	114,085	154,869
Rivers Inlet	80,367	103,155	95,302	85,383	146,838	109,052	68,096	137,697	101,066	129,398	91,014	75,090	94,064	122,878	83,122	94,292
Nass River	97,512	143,908	119,495	126,686	104,289	94,890	53,423	71,162	65,684	39,720	40,990	46,908	31,832	32,534	32,725	19,085
*Vancouver Island	267,293	389,815	325,723	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Outlying Districts	381,163	404,793	294,597	432,366	313,894	320,169	285,898	334,187	226,461	123,054	71,708	99,089	99,192	68,785	60,392	68,745
Grand totals	1,393,156	1,626,738	1,557,485	995,065	1,164,701	1,111,039	1,353,901	996,626	948,965	762,201	967,920	542,689	547,459	627,103	1,167,460	465,894

STATEMENTS SHOWING SALMON-PACK OF PUGET SOUND, BY SPECIES, FROM 1914 TO 1919.

	1919.	1918.	1917.	1916.	1915.	1914.	1913.	1912.	1911.	1910.	1909.	1908.	1907.	1906.	1905.	1904.
Sockeyes	64,346	50,723	411,538	84,637	87,465	357,374	1,665,728	201,572	140,529	234,437	1,005,120	162,228	96,974	182,241	837,122	123,419
Cohoes	210,883	235,860	114,276	155,832	180,799	151,135	49,150	149,977	244,208	154,077	139,297	95,863	111,611	98,206	89,636	106,856
Puget Sound Pinks	421,215	6,605	1,121,884	1,887	589,780	909	788,789	708	1,038,136	.....	365,156	.....	448,730	.....	71,490	.....
Chums	525,541	267,538	216,285	427,878	410,687	280,070	50,176	63,132	111,143	148,810	52,251	51,186	51,840	155,221	49,047	56,355
Totals	1,221,985	560,726	1,863,983	670,234	1,268,731	789,488	2,553,843	415,389	1,534,016	537,324	1,561,824	309,277	709,155	435,668	1,047,295	286,630

* Previously the Vancouver Island pack was shown in Outlying Districts pack.