PROVINCE OF BRITISH COLUMBIA

REPORT

OF THE

COMMISSIONER OF FISHERIES

FOR THE YEAR ENDING DECEMBER 31ST, 1921

WITH APPENDICES

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:
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1922.

To His Honour WALTER CAMERON NICHOL,

Lieutenant-Governor of the Province of British Columbia.

MAY IT PLEASE YOUR HONOUR:

I beg to submit herewith the Report of the Provincial Fisheries Department for the year ending December 31st, 1921, with Appendices.

WILLIAM SLOAN,

Commissioner of Fisheries.

Provincial Fisheries Department,

Commissioner of Fisheries' Office,

Victoria, British Columbia, January, 1922.

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FISHERIES COMMISSIONER'S REPORT FOR 1921.

VALUE OF CANADIAN FISHERIES AND THE STANDING OF PROVINCES.

The value of the fishery products for Canada for the year 1920 totalled $49,241,339, compared with $56,508,479 in 1919 and $60,250,544 in 1918.

During the year 1920 British Columbia produced fishery products of a total value of $22,329,161, or 39.4 per cent. of the total fishery products for the Dominion.

British Columbia again led all the Provinces of the Dominion of Canada in the value of her fishery products. Her output for 1920 exceeded that of Nova Scotia by $9,586,502, and it exceeded that of all the other Provinces combined by $8,160,742.

The following statement gives in the order of their rank the value of the fishery products of the Provinces of the Dominion for the years 1918, 1919, and 1920:—

Value of Fisheries by Provinces, 1818, 1919, and 1920.

Province.	1918.	1919.	1920.
British Columbia	$27,282,223 00	$25,301,607 00	$22,329,161 00
Nova Scotia	15,143,066 00	15,171,929 00	12,742,659 00
New Brunswick	6,298,990 00	4,979,074 00	4,423,745 00
Quebec	4,568,773 00	4,258,731 00	2,592,382 00
Ontario	3,175,111 00	3,410,750 00	3,306,412 00
Prince Edward Island	1,148,201 00	1,536,844 00	.....
Manitoba	1,830,435 00	1,008,717 00	.....
Saskatchewan	447,012 00	475,797 00	2,108,257 00
Alberta	318,913 00	333,330 00	.....
Yukon	37,820 00	8,800 00	.....

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, 1920, is given in the following statement:—

Salmon	$15,129,348
Halibut	4,104,869
Herring	1,228,131
Whales	435,746
Pilchards	540,265
Cod	322,737
Black cod	181,202
Flounders, brill, etc.	55,348
Soles	20,012
Crabs	57,963
Clams and quahaugs	33,363
Red cod	20,016
Oysters	36,834
Perch	16,437
Grayfish	4,550
Shrimps	13,536
Smelts	15,936
Octopus	4,082
Sturgeon	3,775
Skate	2,697
Oolachans	9,096
Fur-seals	24,712
Shad	205
Tomcod	60
Hake and cusk	1,255
Bass	798
Whiting	274
Eels	162
Fish-oil	31,155
Fish-offal	1,462
Fish-fertilizer	37,685
Total	$22,329,161

The catch of salmon in 1920 was valued at $2,407,818 less than in 1919 and $2,077,897 less than in 1918. The price received for the pack of 1920 was relatively considerably higher than in 1918 and 1919, but the pack was much less than that made in those years.

THE SALMON-PACK OF 1921.

The salmon pack in the Province in the year 1921 totalled 603,548 cases, compared with 1,187,616 cases in 1920, 1,393,156 cases in 1919, and 1,626,738 cases in 1917. The total pack for 1921 was less than 50 per cent. of the average pack of the Province for the preceding ten years. There was a marked decline in the catch of all species. The catch of sockeye, spring, and cohoe was due to a poor run to all waters. The pack of pinks and chums was small owing to the lack of demand for those grades. Very few canners packed any chums.

The total pack of sockeye for the year was 163,914 cases, as against 136,661 cases in 1920, 167,944 in 1919, 210,851 in 1918, and 402,538 cases in 1917. The catch in every district shows a decline.

THE 1921 SALMON-PACK BY DISTRICTS.

The Fraser River.—The total pack of all species of salmon in the Fraser River District in the Province in 1921 totalled 107,650 cases, as against 136,661 in 1920, 163,123 cases in 1919, 276,459 cases in 1918, and 330,209 cases in 1917.

The catch of sockeye in the Provincial waters of the Fraser River system produced a pack of 39,631 cases, as against the preceding fourth year of 148,164 cases, and compared with the pack of eight years ago of 719,796 cases.

The 1921 pack of sockeye in the State of Washington waters of the Fraser River system in 1921 totalled 102,967 cases, as against 411,538 cases in 1917 and 1,665,728 cases in 1913.

The total pack of sockeye in the entire Fraser River system in 1921 was 142,598 cases, compared to 559,702 cases in the preceding fourth year and to 2,385,524 cases in the preceding eighth year. The pack of sockeye in the system in 1921 was less than 6 per cent. of that of the big year 1913. The full effect of the blockade in the Fraser River Canyon at Hell's Gate in 1913 and the heavy drain made on the remnant of that run in 1917 is now fully manifest. The run of former big years has dwindled to less than the average of recent lean years. The Fraser is fished out of sockeye. The big run has been destroyed.

The Salmon-catch of Northern Waters.

The Skeena River.—The salmon-catch in the Skeena River in 1921 totalled 234,765 cases, as against 332,887 cases in 1920, 398,877 cases in 1919, and 374,306 cases in 1918. There was a marked decline in the catch of all species of salmon. The catch of sockeye was the smallest ever made on the Skeena and totalled but 41,118 cases. The catch of spring produced a pack of 21,765 cases; cohoes, 45,033; pinks, 124,457; and chums, 1,993 cases.

Rivers Inlet.—The salmon-pack of Rivers Inlet was again very disappointing. It totalled for all grades but 59,272 cases. The sockeye-catch was also the smallest ever made at Rivers Inlet and produced a pack of but 43,300 cases; cohoes, 4,718; and pinks, 5,305 cases.

The Nass River.—The salmon-pack of the Nass River totalled but 51,765 cases, consisting of 9,364 cases of sockeye, 8,236 cases of cohoes, 29,488 cases of pinks, and 2,176 cases of chums.

SALMON CONDITIONS IN NORTHERN WATERS.

It becomes more and more apparent, from a study of the records of the catch of sockeye and the reports from the spawning areas, that the runs of salmon to our northern waters are being rapidly depleted, and that unless greater protection is given them than has been afforded in the last few years they will go the way of the runs to the Fraser. They cannot stand the drain that has been and is now being made upon them. When it is shown that in District No. 2, our northern waters, (1) there has been since 1912 a material decrease in the catch, notwithstanding there has been an increase in the amount of gear used; (2) a great increase in the area of waters where fishing is conducted; and (3) a very great increase in the price paid for fish, it is evident that less fish are seeking entrance to the spawning area and that the escapement is less.

It has been previously pointed out that by resorting to averages of the pack which cover periods of years, the supply, with a considerable degree of certainty, can be determined. The following statements should be of value in this connection:—

Statement showing Average Sockeye-pack, Number of Boats licensed, and Prices paid for Sockeye on Skeena, 1903 to 1918, inclusive.

Period.	Average Sockeye-pack.	Average Number of Boats licensed.	Average Price paid Fishermen for Sockeye.
			Cents.
1903–06	78,868	600	10
1907–10	130,851	800	10
1911–14	103,164	908	12½
1915–18	91,427	876*	24†

* In 1919, 1,150 boats were fished, and in 1920, 1,109.
† In 1920 and 1921 fishermen were paid 30 cents each for sockeye.

Statement showing Average Sockeye-pack, Number of Boats licensed, and Price paid Fishermen for Sockeye on Rivers Inlet, 1903 to 1918, inclusive.

Period.	Average Sockeye-pack.	Average Number of Boats licensed.	Average Price paid Fishermen for Sockeye.
			Cents.
1903–06	91,846	550	10
1907–10	92,118	700	10
1911–14	88,320	750	12½
1915–18	65,720	815*	24†

* In 1920, 871 boats were fished, and in 1921, 1,000.
† In 1920 fishermen were paid 30 cents for sockeye and 55 cents for all over 600. In 1921 fishermen were paid 30 cents for sockeye.

The record of the sockeye-pack on the Skeena for the ten years 1902 to 1911 shows that it was 24 per cent. greater than it was in the following ten years, notwithstanding that in the latter period the amount of gear and the price paid for the fish and the area of the waters in which fishing was conducted were all far greater than in the first period. The average pack from 1902 to 1911, inclusive, was 108,762 cases, as against 95,682 cases from 1912 to 1920, inclusive, or 13½ per cent. greater. Up to 1912 the number of boats and nets engaged in the Skeena fishing did not average over 700 per year, as against an average of 900 from 1912 to 1920, an increase of over 28 per cent. In 1920 and 1921 there was an average of 1,129 boats and nets fished, an increase over the period of 1902 to 1911 of 60 per cent.

Up to and including 1908 no fish were taken in the Skeena District outside of Kennedy Island, at its mouth. In recent years the waters from 15 to 20 miles outside that island have been successfully fished by many boats.

The sockeye-catch at Rivers Inlet for the ten years 1902 to 1911 produced a 26-per-cent. greater pack than was made in the following ten years, notwithstanding that in the later period there was in increase of 27 per cent. in the number of nets employed. Up to 1912 the price paid for sockeye did not exceed 10 cents. From 1912 to 1915 the price was increased to 12½ cents, for 1916 to 1919 it was increased to an average of 24 cents, and in 1920 the fishermen were paid 30 cents each for all the sockeye caught up to 600 and 50 cents for all over that number.

In considering these statements it should not be overlooked that during the war period 1915–18 every effort was made to increase food production. Had the numbers of sockeye in the waters leading to the spawning area of District No. 2 during the war period, or since, been as numerous as they were in earlier years, the catch would most certainly have been increased and not diminished. It should be noted that in consequence of the increased price paid for sockeye the Indians engaged in fishing in recent years have been far more industrious than in the years when but 10 and 12 cents was paid them for fish, and that in consequence their average annual catch has compared much more favourably with that made by the whites and Japanese fishermen.

No other conclusion can be drawn from a study of the records in our northern waters than that there has been a serious reduction in the number of fish that now seek the spawning area, and that unless the fish are given much greater protection than is now afforded them by the fishery regulations the run will be destroyed.

In considering conditions at Rivers Inlet and on the Skeena, it is to be noted that no inspection was made by this Department of conditions on the spawning-bed of the Skeena in 1916, 1917, and 1918. The investigations of the spawning-beds of Rivers Inlet in 1916 and 1917 disclosed unsatisfactory conditions. Fishery Overseer A. W. Stone, who has made an annual inspection of that section since 1912, in his report for 1916, wrote: "I am of the opinion, after closely investigating conditions on the spawning-beds of Rivers Inlet, that the number of sockeye that reached the beds this year falls below that of the seasons of 1913, 1914, and 1915 by close to 75 per cent., and is due to a poor run to the inlet this year." Of conditions in 1917 he wrote: "I am of the opinion that there was a general falling-off in the number of sockeye that reached the beds this year; although better than last year, the run in no way approaches the vast numbers seen on the beds in 1914 and 1915."

The seriousness of the situation in our northern waters is further made manifest by the evidence submitted in Dr. Gilbert's analysis of the sockeye runs to Rivers Inlet, the Skeena and Nass Rivers in 1920 and 1921, which will be found in the Appendix of this report and which is reviewed in the following pages.

CONTRIBUTIONS TO THE LIFE-HISTORY OF THE SOCKEYE SALMON.

Dr. C. H. Gilbert's seventh 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 years 1920 and 1921.

It will be recalled that for physical reasons Dr. Gilbert was unable to furnish a report of the 1920 run in time to include it in the Department's report for that year.

With the present paper we now have a complete analysis of the runs of sockeye to all our principal rivers for the past nine years. They are of great economic and scientific value, as they disclose the facts in the life-history of the sockeye that are essential to an intelligent conduct of our most valuable fishery. The facts submitted demonstrated beyond all question that the runs of sockeye to all our waters have been seriously depleted, and that they will be destroyed unless they are given far greater protection than has heretofore been afforded.

The following is a brief summary of Dr. Gilbert's present contribution:—

Rivers Inlet Sockeye Runs of 1920 and 1921.

In his previous report—1919—Dr. Gilbert commented on the prospects for 1920, calling attention to the fact that the brood-years which would be responsible for the run of 1920 exhibited a wide disparity. The five-year fish in 1920 would be derived from eggs laid down in 1915, when the pack of Rivers Inlet sockeye exceeded 130,000 cases and was the largest ever put up in this district. The four-year fish, on the contrary, would be descendants of 1916, with a pack of less than 45,000 cases, the smallest of any recent year. He then wrote: "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 poorest and the very richest years of which we have a record. It will be most interesting to observe whether the five-year age-groups will appear in 1920 in overwhelming proportions." His study of the 1920 run disclosed such to be the case. The run was gratifyingly large after a series of four very poor years. It was practically all derived from 1915; the proportion of four-year fish was but 5 per cent. of the total run. Some 115,000 of the 121,000 cases of the 1920 run were the results of the 1915 brood, and approximately 26,000 cases of the 1919 pack were from the same brood. "If we assume," he states, "that the packs of these two years give reliable indications of the size of the runs, then the four-year fish that developed from the 1915 brood represented 18 per cent. and the five-year fish 82 per cent. of the total progeny of that brood. It is facts of this nature that lead us to call the Rivers Inlet cycle predominantly one of five years, in contrast to the Fraser River cycle, well-known to be one of four years."

The five-year males of the 1920 Rivers Inlet run averaged 26 inches and the females 25 inches in length, and were practically identical in size with the same year-groups in 1915 (26 and 25.1 inches), which was the brood-year for these fish.

Dr. Gilbert has previously called attention to the fact that with diminishing runs in Rivers Inlet the size of the fish was also decreasing; no cause, he states, is known for such a coincidence, but it is interesting to observe that the size of the individuals promptly recovered in a good-year run.

Rivers Inlet Sockeye Run for 1921.

After presenting nearly a maximum pack in 1920 (124,254 cases), the Rivers Inlet sockeye run declined in 1921 to the lowest level, with one exception, since the industry has been well established. The exception occurred in 1916, and it is worthy of consideration that a five-year period is thus seen to have intervened between the two lowest packs the river has produced, and, as has been stated, a five-year period also separates the generous run of 1920 from the record pack of the river which occurred in 1915, and was in excess of the 130,000 cases, and another period of five years between 1915 and 1910 with its 126,000 cases. The three largest packs at Rivers Inlet are thus shown to be separated by five-year intervals, as though one were the direct descendant of the other.

The Rivers Inlet sockeye run in 1921, as in previous years, consisted of two age-groups, those that matured in their fourth year and those that matured in their fifth year. In both of these groups the early history is the same. They spent the first year in fresh water and descended to the sea early in their second spring. In upwards of 1,000 individuals examined by Dr. Gilbert only one was found which had spent two growing seasons in the lake, and it matured in its fifth year. Though this type is abundant in many river-basins, its almost total absence in the Owikeno basin may conceivably be due to the same adverse feeding conditions which apparently dwarf the fingerling migrants during their first year.

As has been noted in previous reports, the most prosperous seasons at Rivers Inlet are distinguished by large percentages of the five-year group, and this was the case in 1921. Fifty-one per cent. of the run consisted of five-year fish and 49 per cent. of four-year fish, the total pack being but 46,300 cases; while in 1920, with a pack of 121,254 cases, 95 per cent. were five-year fish and but 5 per cent. four-year fish. The average lengths and weights of the 1921 run depart but little from the averages of the eight preceding years. The four-year fish were fully up to the average, but the five-year females were notably lacking in both length and weight, and the five-year males only less so.

The Sockeye Run to the Skeena in 1920 and 1921.

Dr. Gilbert shows that the Skeena River sockeye run of 1920 agreed with that of Rivers Inlet in being derived in part from a good brood-year and in part from a very poor brood-year. The five-year fish of 1920 belonged to the brood of 1915, which produced a pack of 116,553 cases; while the four-year component of the 1920 run was derived from the brood-year of only a 60,923-case run. The result was clearly reflected in the character of the run, which was well below the average in size, giving a pack of only 90,869 cases. The run consisted largely of five-year fish, showing that the run of 1916 contributed very little to its number. Like the Rivers Inlet and the Nass River colonies of sockeye, the Skeena is dependent more on its five- than its four-year members, and thus approximates a five-year cycle. The average percentage of the five-year group in the eight years from 1912 to 1919 is 60 per cent. and the highest attained in any year was 75 per cent. But in 1920 the five-year group comprised 82 per cent. of the one-year-in-lake type, and must be attributed to their favourable brood-year, in conjunction with the very favourable brood-year for the four-year fish. As already noted, an entirely similar condition in Rivers Inlet produced in 1920 a still larger representation of the five-year group, 95 per cent. of the run.

The salient features of the sockeye run in the Skeena in 1921, Dr. Gilbert states, are best brought out by a comparison with the run of 1920. The latter was produced by the good brood-year 1915 and the poor one of 1916. The result was a run of medium size, over four-fifths of which were progeny of 1915. The run of 1921 had as antecedent two extremely poor brood-years, the worst, with a single exception, that has hitherto occurred on the Skeena. The result of this portentous combination was, in 1921, a still lower level of production than the Skeena has previously attained. The pack of only 41,000 in 1921 registered a further decline of 35 per cent., compared with the extremely meagre yields of the two brood-years that produced it.

Discussing this feature, Dr. Gilbert states: "If the salmon runs were enemy forces that we were desirous of annihilating, no more certain method could be devised than destroying them

thus in detail. The detachments appearing each year operate wholly independently of those that immediately precede and follow. If we succeed in destroying only one or two annual detachments in a five-year cycle, the results become cumulative and the eventual destruction of the run is assured.

"It cannot too often be urged that a rational policy of conservation must prescribe a large annual safety factor. We must continue each year to provide for the escape of larger numbers of spawning fish than are necessary to ensure adequate production during seasons in which conditions are favourable. A rationally controlled stream will show its spawning-grounds each year seemingly overpopulated. This is nature's method of preventing serious depletion during the not infrequent years when conditions are unfavourable for successful propagation and growth, and there is no other safe method. Failure to observe this obvious precaution must be held responsible in no small measure for the certain depletion with which all our salmon-streams are threatened.

"The appearance of occasional good years in the course of a declining run is customary and to be expected. They should not serve in any degree to allay our apprehensions. Poor years also, it is true, have occurred during the most prosperous periods of productivity in our streams. But in a declining salmon run the poor years become more numerous, they infallibly in the long run produce their kind, and they fall to lower and lower levels. The average production for a series of years can always be depended on to tell the tale.

"With these facts in mind, no one can doubt the serious condition we are fast realizing on the Skeena and, it may be just to remark, on all the great salmon-rivers of the Province.

"The measures adopted in 1908 for the preservation of salmon-fisheries for the Province were of much promise. By preventing the incursion of new canneries in districts already fully developed, and by limiting the amount and character of the gear that should be used in each fishing district, a measure of control was assumed which would, if adequately administered, ensure the preservation of the salmon run. This method is incontestably the best that has been devised for the purpose. Opposed to it stands the alternative method of unrestricted competition, the results of which are now so alarmingly manifest in the waters of Alaska. But restrictions in numbers of canneries and in amount of fishing-gear obviously will not suffice to protect a stream unless the restrictions are adequate in amount.

"It is impossible to know in advance the utmost extent of the drafts that can safely be made on the run of any stream. Cannery restrictions and adequate boat-rating must always be considered tentative measures. The situation is one that calls for solicitous inspection and constant watchfulness. Regulations should be subject to annual revision on the part of responsible officials closely in touch with conditions as they develop."

The Fraser River Sockeye of 1920.

The total pack of the Fraser River sockeye in 1920 amounted to 111,053 cases, and showed little change from the packs of 1916 (116,783) and 1919 (103,200). The season of 1918 (71,572) still shows the river at its lowest ebb, while 1917 (559,702) exhibited the last remains of the former big years of the Fraser River cycle. The average pack for the three years 1916, 1919, and 1920 is 110,345 cases, so the condition of the runs seems neither to have improved nor deteriorated within that period, unless, perhaps, an improvement is shown in 1920 by the better conditions on the spawning-grounds shown in the Department's report for that year.

The small number of three-year grilse occurring in the run of 1920, and the bearing of this fact on the probable size of the run of 1921, has already been discussed by Dr. Gilbert in the Commissioner's report for 1920. The three-year males, to which the term "grilse" is applied, always belong to the prevailing Fraser River group, characterized by having spent one whole year in fresh water before migrating to the sea. The other members of the Fraser group mature either in their fourth or in their fifth years, the four-year contingent predominating always in the Fraser basin.

The four-year fish in the 1920 run, Dr. Gilbert shows, consisted of 77 per cent. and the five-year fish 23 per cent. of the one-year-in-the-lake group. These percentages have remained practically the same since the Fraser run definitely declined to its present low rate of production, in 1916. Prior to that date the proportions of four- and five-year sockeye in successive runs fluctuated widely. To illustrate this, Dr. Gilbert gives a list of all except the big years since 1912, from which it appears that the four-year percentage varied only between 76 to 77 in 1916,

1918, 1919, and 1920. While these figures represent averages for the entire season, in each year there was a wide range during the course of the run. In 1920 the four-year fish ranged from 57 per cent. at the beginning of the run to 97 per cent. in the middle of July, and during the height of the run, the last week in July and the first half of August, the percentage characteristic of the entire season was attained. Dr. Gilbert states that "these varying percentages are characteristic of special stream-colonies found in the river during definite portions of the run, or of groups of colonies that enter the river together."

The relative number of males and females in the different year-groups is a comparatively constant feature in each river-basin, but varies appreciatively in different races of sockeye. It rises to the dignity of a racial character. In the record of the Fraser for a series of years the males and females of the four-year fish, and also the five-year fish, are approximately equal in number. This condition contrasts strikingly with that found in Rivers Inlet, where each year shows that four-year males are much in excess of four-year females, while the five-year females are more numerous than the five-year males.

The lengths of both four- and five-year fish in the Fraser in 1920 were below the average for that river-basin. Dr. Gilbert called attention to this same condition in the run of 1919. The average lengths of four-year males during five years prior to 1919 was 25 inches, and of the four-year females during the same period 24.1 inches. In 1919 the males averaged 24.1 inches and the females 22.8 inches; and in 1920, 24.1 and 23.2 inches. In dealing with this feature, Dr. Gilbert states: "In the recent reduction of the Fraser River sockeye run the smaller sizes characteristic of one or more tributaries may have suffered less extensively than the larger sizes, which could not pass through the meshes of the gill-nets. The smaller races may be in larger proportions than formerly, and thus pull down the average for the run."

Of the two-year-in-the-lake type of the Fraser run, it is shown that evidence accumulates that the colonies bound for different tributaries enter the Fraser in regular order and on comparatively constant dates. Year by year, relatively to the other colonies, they seem to maintain their proper place in the procession. In both 1916 and 1920 the two-year-in-the-lake type was running in moderate fashion during the latter part of June and almost wholly disappeared in July, to again appear in August.

As throwing additional light on the definite schedule of events which characterizes the Fraser River run of sockeye, Dr. Gilbert again notes that the run of individuals which have proceeded to sea shortly after hatching, and as soon as they become free swimming, did not begin in 1920 until after the middle of July. So close a chronology as July 14th, 15th, 17th, and 19th for the first appearance of the fish of this type in the runs of four different years is striking evidence of the regularity with which the run is conducted year by year. Individuals of sea-type and those of the two-year-in-lake type are the only ones that can with certainty be recognized always in a composite assemblage, such as that which comprises the Fraser River run.

The Fraser River Sockeye Run of 1921.

In analysing the Fraser River sockeye run of 1921, Dr. Gilbert states: "As a lineal descendant of the series of quadrennial big years of the Fraser, 1921 possesses a special interest. Some traces of its origin are discernible. In size the run ranks somewhat above the very low estimate of the present small years, among which we must go back to 1915 to find as large a pack. It diverges from the recent small years which precede it in the limited number of the five-year group which were present. It will be recalled that in 1913, before the big years had suffered any reduction in numbers, it was essentially of four-year fish. Diligent search was necessary at that time for the detection of any five-year individuals. The run was then derived from eggs laid down the previous big year, four years before, and contained no contribution of consequence from any other year. Five-year individuals of course were present in numbers which would have made them conspicuous in a small year, but they were "concealed by the vast hordes of four-year-olds, the progeny of the last big run."

"'This condition characterized all the big years until 1917, when the run was cut to a fourth or a fifth of its previous dimensions. This reduction has not affected the five-year contingent of that run, for the five-year fish of 1917 had been spawned in 1912, before the catastrophe that closed Hell's Gate Canyon to the ascent of the 1913 run. They were present in their usual numbers and were associated with so reduced a body of four-year fish that their presence was easily discovered. In the earlier and in the latter part of the run, in fact, the five-year fish in

1917 attained considerable proportions in the run; in June 16th, 66 per cent; June 25th, 37 per cent.; June 28th, 20 per cent; and July 4th to 14th, 4 or 5 per cent." It is shown that the total numbers of four-year fish contained in the twenty-one samplings examined amounted to 94 per cent. and the five-year fish to 6 per cent. of both groups.

With 1917 Dr. Gilbert now compares the run of 1921, which also began the season with a high percentage of five-year fish, which then decreased rapidly in the early part of July and increased again toward the last of the run. The total number of individuals examined in both age-groups was 997, with 84 per cent. four-year fish and 16 per cent. in the five-year class.

It will be recalled that prior to 1921 a series of small years had exhibited a remarkable uniformity in the relative sizes of the age-groups. In 1916, 1918, 1919, and 1920 the percentage of four-year fish was either 76 or 77. In 1917, with a recognizable remnant of the big-year series still persisting, the percentage of four-year fish rose to 94 per cent. in approximation of 1913, when it was 99 per cent.; and in 1921, when a faint vestige of the big-year cycle still can be traced, the percentage drops to 84, but is still well above the small years with which it is associated.

The length of the four-year fish in the 1921 run exhibits a further decline. The tendency has been marked since 1919. Dr. Gilbert also states that a similar reduction in size is to be noted in recent years at Rivers Inlet. The further history of this tendency will be a matter of interest.

The Nass River Runs in 1920 and 1921.

Dr. Gilbert's digest of the sockeye runs to the Nass in 1920 and 1921 is as thorough and complete as that of our other salmon-rivers. In 1919 he called attention to certain disquieting features in the recent history of that river, and stated that extreme interest would attach to the history of the next few years, because the runs would demonstrate to what extent the Nass has been depleted. The runs of 1920 and 1921 go a long way to justify the foreboding entertained. The pack of 1920 was but 16,740 cases, nearly 25 per cent. less than the smallest pack of recent years. The sockeye-pack of the Nass in 1921 totalled but 9,364 cases, or 6,376 cases less than that of the preceding year, when the pack was the smallest made on that river.

The Nass has a five-year cycle. The average pack for the last cycle, 1916 to 1920, is 24,083 cases, and for the preceding cycle, 1911 to 1915, is 33,523 cases. Three years of the previous cycle had each a larger pack than was made in any single year of the last period, and three years of the last period had each a lower record than was made in any year during the preceding five-year cycle. Such evidence conclusively demonstrates that the runs of sockeye to the Nass have suffered such serious impairment that "all of those interested in the perpetuation of the industry should co-operate to lessen the intensity of fishing operations in the district before depletion has become a fact. The condition has become highly critical."

The above summary of Dr. Gilbert's report for the years 1920 and 1921 inadequately displays the nature and the value of his work. Those interested will find the complete report attached hereto.

THE ALASKA FUR-SEAL HERD AND THE SOCKEYE OF THE FRASER RIVER SYSTEM.

In 1911 a convention was signed by Great Britain, the United States, Japan, and Russia, prohibiting their people from pelagic killing of fur-seals. Under its terms the United States was permitted to kill a number of the batchelor males on the Pribyhoff Islands in Alaska and to pay to each Government a percentage of the sale of the skins taken.

Following the treaty, the United States imposed a closed season on the islands for five years, during which no seals were killed. It resulted in a satisfactory increase. Since then the killing of batchelor males only has been resumed under direction of United States officials. The killing of surplus males is of direct benefit to the herd, as on their reaching maturity the males fight so fiercely for possession of the rookeries that they kill many of the young pups. The skins of the males taken on the islands—none are killed in the sea—and sold since 1917 realized over $7,000,000, of which sum Great Britain has received 15 per cent.

In 1873 the number in the herds of fur-seals on the Pribilof Islands was estimated at 2,500,000 individuals. In 1911, when the convention was signed, the herds had been reduced to 125,000. The census recently taken shows that the herd now contains over 500,000 individuals, and it is confidently expected that under the protection now afforded the herds will attain their original numbers. It is estimated by experts that within a few years the skins of 100,000 surplus

males will be taken annually, and that Great Britain's share, that is paid to Canada, will amount to $1,000,000 per year. An authority writing on the subject states: "The value of conservation has never been more swiftly or more decisively illustrated."

A convention by Great Britain and the United States that would afford to the schools of sockeye salmon that yet remain in the Fraser River system and in the open sea the same measure of protection now afforded the fur-seal would in twenty or thirty years give a far greater return than has come or will come from the convention of 1911. The sockeye salmon of the Fraser River system can and should be handled in the same businesslike manner as Great Britain, the United States, Japan, and Russia have successfully handled the fur-seal question. It is the only way in which this vital situation can be handled. It is an international question and it can be handled only in an international way.

REPORTS FROM THE SALMON-SPAWNING AREAS OF THE PROVINCE IN 1921.

Following the practice inaugurated in 1902, the Department conducted investigations of the spawning areas of the Fraser, Skeena, and Nass Rivers and Smith and Rivers Inlets. The detailed reports from each section for 1921 will be found in the Appendix of this report.

The Fraser River.—John P. Babcock, Assistant to the Commissioner, again inspected the spawning area of the Fraser River basin. It was his eighteenth annual inspection. Major J. A. Motherwell, Chief Inspector of Fisheries for the Dominion in the Province, accompanied him over the greater portion of the area, and he is indebted to him and his assistants, and also many local residents, both white and Indians, scattered over the basin, for information of value as to conditions.

Mr. Babcock in his report states that sockeye made their appearance at Hell's Gate in the Fraser Canyon, above Yale, late in July, and were observed there during August and September. The run was greatest in August. "At no time this year were sockeye observed there in as large numbers as in 1920." No pink salmon were seen there during the year or in the waters above, and none have been since the disaster in 1913. On the other hand, the number of spring salmon seen at Hell's Gate was larger than usual.

Attention is called to a press statement that the sockeye that pass through the Fraser Canyon to the waters above enter the Fraser annually in July, and that the August run to the Fraser spawns annually in the tributaries of that stream below Hell's Gate. Such, Mr. Babcock states, is not the case. Every season since observations were begun in 1901 more sockeye have been seen at Hell's Gate in August and September, and in some years in October, than at any time in the month of July. In 1901 and again in 1905 there was a good run of sockeye through the canyon in November, and they have been seen there in considerable numbers in December.

The report deals with conditions in all sections and shows that very few sockeye reached any one of them this year. In concluding the report, Mr. Babcock states: "A summary of conditions of the spawning area of the Fraser basin this year shows that, notwithstanding the fact that 1921 was in the cycle of former big runs, the run of sockeye was no larger and the spawning-beds no better seeded than in recent lean years. The quadrennial big run of sockeye to the Fraser has been destroyed. There were not eggs enough deposited on the Fraser this year to produce an ordinary lean-year run."

Rivers Inlet.—The spawning-beds of Rivers Inlet were again inspected by Fishery Officer A. W. Stone in 1921. It was his ninth fall trip over the tributaries of Owikeno Lake, the spawning area of the Rivers Inlet run. His report gives in detail his observation on each of the tributaries. In summarizing the general conditions, he states that the rivers at the head of the lake were far from satisfactory. There was a light run to them all, as was the case in both 1916 and 1917. The other tributaries of the lake were as well seeded as in any season in recent years. The size of the sockeye observed in all tributaries coincided with the bi-weekly tests made at the canneries. They averaged but little over 5 lb. each, being smaller than in former seasons at Rivers Inlet.

Smith Inlet.—The spawning-bed of the Smith Inlet sockeye was inspected by Fishery Overseer A. W. Stone. The exceptionally poor run of sockeye to Smith Inlet this season demonstrates the merit of the warning given by Mr. Stone in his report of spawning conditions in 1916 and 1917, the two brood-years of the 1921 run. Conditions this year show how serious the situation at Smith Inlet has become. Notwithstanding that drag-seines are no longer used in the inlet, so many gill-nets were used this season, with the result that the spawning-beds were very poorly seeded.

The Nass River.—The spawning-beds of the Meziadin Lake section of the Nass River were again inspected by Inspector of Fisheries C. P. Hickman. He was accompanied by Overseer J. M. Collison, of the Dominion service, who has repeatedly visited the section. In comparing the run of sockeye to the Meziadin watershed for 1921 with former years, Inspector Hickman is of the opinion that there were more fish to be seen in the lake than usual, but far less at the falls en route to the lake than in the years 1919 and 1920. Conditions at the fishway at the falls in the Meziadin River were fairly satisfactory. The basins of the fishway, however, are fast filling with gravel and should be cleaned out. Observations in the Nass basin have largely been confined to the Meziadin section. The Bowser Lake section has not been visited since the year of its discovery—1912—because access to that lake is most difficult. It is unquestionably a very important spawning section of the Nass and more information as to conditions there is necessary to a comprehensive study of spawning conditions. The lack of information as to conditions in that section has always been the weakness of the reports on the spawning area of the Nass.

The Skeena River.—The spawning-beds of the Skeena River basin were again inspected this season by Fishery Officer Gibson. He reports that the Dominion fishery officials from the Stuart Lake Hatchery, Fraser basin, again collected sockeye-eggs at 15-Mile and Pierre Lake Creeks, at the head of Babine Lake. The run to that section compared favourably with former years. Stuart Lake Indians caught and smoked some 7,000 sockeye taken from the stream at that end of Babine Lake.

Conditions at the hatchery at the outlet of Morrison Lake were most promising. The hatchery was filled with sockeye-eggs and natural propagation is reported greater than usual. Sockeye in large numbers entered this section in June. The retaining-ponds at the hatchery were well filled with vigorous fry of last season's hatch.

The beds of the Skeena at the outlet of Babine Lake and the Indian smoke-houses located there displayed very few sockeye. The Indians stated that the number of sockeye that passed there this year was so small that they had been unable to obtain their usual supply. From their account the run was much below the average of recent years. Reports of the run of sockeye up the Bulkley River this year are more satisfactory than in recent years.

Major J. A. Motherwell, Dominion Chief Inspector of Fisheries in the Province, supplied the following statement showing the number of salmon-eggs placed in each of the hatcheries of the Province in 1921:—

COLLECTION OF SALMON-EGGS, BRITISH COLUMBIA, 1921.

Hatchery.	Salmon.					Totals.
	Sockeye.	Cohoe.	Humpback.	Spring.	White Spring.	
Anderson Lake	10,033,200	.....	.....	.....	.....	10,033,200
Babine Lake	6,090,000	.....	.....	.....	.....	6,090,000
Cowichan Lake	.....	1,227,800	.....	1,507,300	9,000	2,744,100
Cultus Lake	4,306,200	.....	.....	.....	.....	4,306,200
Harrison Lake	727,000	.....	4,515,000	937,000	.....	6,179,000
Kennedy Lake	1,854,000	82,950	.....	.....	.....	1,936,950
Pemberton	26,053,000	.....	.....	.....	.....	26,053,000
Pitt Lake	2,680,750	.....	.....	.....	.....	2,680,750
Rivers Inlet	18,374,400	.....	.....	.....	.....	18,374,400
Skeena River	4,286,000	4,000	396,000	.....	.....	4,686,000
Stuart Lake*	5,530,000	.....	.....	.....	.....	5,530,000
Totals	79,934,550	1,314,750	4,911,000	2,444,300	9,000	88,613,600

* Eggs collected from the Skeena River basin.

APPENDICES.

CONTRIBUTIONS TO THE LIFE-HISTORY OF THE SOCKEYE SALMON. (No. 7.)

AN ANALYSIS OF THE RUNS OF SOCKEYE TO THE PRINCIPAL RIVERS OF BRITISH COLUMBIA IN 1920 AND 1921.

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

THE FRASER RIVER SOCKEYE RUN OF 1920.

The total pack of Fraser River sockeye in 1920 amounted to 111,053 cases, and showed little change from the packs of 1916 (116,783) and 1919 (103,200). The season of 1918 (71,572) still shows the river at its lowest ebb, while 1917 (559,702) exhibited the last remains of the former big years of the Fraser River cycle. The average pack for the three years 1916, 1919, and 1920 is 110,345 cases, so the condition of the run seems neither to have improved nor deteriorated within that period, unless, perhaps, an improvement is shown in 1920 by the better condition of the spawning-grounds, as reported by Mr. Babcock in a previous bulletin.

(1.) THE ONE-YEAR-IN-LAKE TYPE.

The small number of three-year grilse occurring in the run of 1920, and the bearing of this fact on the probable size of the run in 1921, has already been discussed by us in the Commissioner's Report for 1920, page 27. The three-year males, to which we apply the term "grilse," always belong to the prevailing Fraser River group, characterized by having spent one whole year in fresh water before passing down to the sea. The other members of this group mature either in their fourth or in their fifth years, the four-year contingent predominating always in this river-basin. An analysis of the prevailing one-year-in-lake group for the year 1920 is given in the following table, based on over 1,700 individuals taken by random sampling on twenty-six different days, well-spaced throughout the run. They were captured in traps along the southern shore of Vancouver Island and were examined at the Esquimalt Cannery of J. H. Todd & Sons, to whom our thanks are due for many courtesies.

Table I.—Fraser River Sockeyes from Vancouver Island Traps, 1920, One Year in Lake, grouped by Age, Sex, and Length.

Length in Inches.	Number of Individuals.			
	Four Years old.		Five Years old.	
	Males.	Females.	Males.	Females.
19	3	1	..	..
19½	1	5	..	1
20	4	3	1	..
20½	..	10	..	..
21	2	6	..	..
21½	7	26	1	..
22	11	40	1	3
22½	34	104	2	2
23	56	142	2	9
23½	105	118	3	15
24	141	137	11	45
24½	144	50	17	42
25	73	17	26	44
25½	54	3	28	29
26	19	1	22	11
26½	2	..	34	11
27	..	..	23	2
27½	1	..	11	1
28	..	..	3	..
28½	1	..	2	..
29	..	..	1	..
Totals	658	663	188	215
Totals each group	1,321		403	
Average lengths	24.1	23.2	25.7	24.6

As is shown in the above table, the four-year fish in 1920 constituted 77 per cent. and the five-year fish 23 per cent. of the one-year-in-lake group. These percentages have remained practically the same since the Fraser run definitely declined to its present low rate of production, in 1916. Prior to that date the proportions of four- and five-year sockeyes in successive runs fluctuated widely. To illustrate this phase of the history of the river, we give below a list of all except the big years since 1912, with the number of cases of sockeyes packed each year and the percentage of four-year fish:—

	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
1920	111,053	77

From this it appears the four-year percentage has varied only between 76 and 77 in 1916, 1918, 1919, and 1920. But these figures represent averages for the entire season, while in each of the above years a wide range occurred during the course of the run. In the following table we specify the percentages of four- and five-year sockeyes found in each sample taken during the season of 1920. The four-year fish range from 57 per cent. at the beginning of the run to 97 per cent. in the middle of July, and then during the height of the run, including the last week of July and the first half of August, the percentage characteristic of the entire season is attained. Considering the entire series, we find it easily divisible into three or possibly four periods. From June 14th to July 2nd the four-year sockeyes average 65 per cent.; from July 5th to July 19th they average 90 per cent.; and for the remainder of the run they average 75 per cent. A minor division seems indicated at August 11th, with 74 per cent. characterizing the run from that date to July 22nd, and 79 per cent. from August 11th to the 30th. That these varying percentages are characteristic of special stream-colonies found in the river during definite portions of the run, or of groups of colonies that enter the river together, admits of no question. Divisions of the season similar to those indicated above have been proposed on the same basis during previous years.

Table II.—Percentages of Four- and Five-year Fraser River Sockeyes, 1920 Run, One Year in Lake, occurring on Different Dates.

Date.	Four-year Fish.	Five-year Fish	Specimens examined.
June 14	57	43	105
„ 15	79	21	94
„ 23	69	31	80
„ 28	57	43	91
July 2	63	37	90
„ 5	84	16	57
„ 9	90	10	96
„ 13	97	3	97
„ 16	92	8	101
„ 19	89	11	90
„ 22	77	23	74
„ 28	76	24	72
„ 30	65	35	60
Aug. 2	80	20	89
„ 4	67	33	55
„ 6	76	24	46
„ 9	67	33	66
„ 11	76	24	91
„ 13	80	20	49
„ 16	80	20	40
„ 18	78	22	51
„ 20	80	20	35
„ 23	82	18	51
„ 25 to 30	80	20	49

The relative numbers of males and females in the different year-groups is a comparatively constant feature in each river-basin, but varies appreciably in different races of sockeyes. It thus rises to the dignity of a racial character. In our record of the Fraser River runs for a series of years the males and females of the four-year fish, and also the five-year fish, are approximately equal in number. This condition contrasts strikingly with that found in Rivers Inlet, where each year it is seen that four-year males are much in excess of four-year females, while the five-year females are more numerous than the five-year males. The 1920 run to the Fraser River was no exception in this regard, the four-year males and females being practically in equal numbers, while the male five-year fish were 47 per cent. of the five-year group. Taking both four- and five-year groups together, the males constituted 49 per cent. of the run.

The lengths of both four- and five-year fish in 1920 were below the average for this river-basin. In 1919 we called attention to the same condition prevailing in that year. The average lengths of the four-year males during five years prior to 1919 was 25 inches, and of the four-year females during the same period 24.1 inches. But in 1919 the males averaged 24.1 and the females 22.8 inches; and in 1920, 24.1 and 23.2 inches. In the recent reduction of the Fraser River sockeye run the smaller sizes characteristic of one or more tributaries may have suffered less extensively than the larger sizes, which could not pass through the meshes of the gill-nets. The smaller races may be in larger proportion than formerly, and thus pull down the average for the run.

In our reports for the years 1917, 1918, and 1919 we have presented tables showing increase in average size during the progress of the season, in each year-group, the later fish being appreciably larger than are the first to run. As this increase in size during the season does not occur in Rivers Inlet, where the average size remains approximately the same or actually diminishes toward the close of the run, the matter merits attention.

(2.) THE TWO-YEARS-IN-LAKE TYPE.

In our previous reports we have called attention to the regular appearance of this type in certain portions of the Fraser River run and its virtual absence on other dates. Compared with the other groups present, it may vary widely in abundance in different years, but the parts of each run characterized by its presence agree closely in successive seasons. A regular schedule is maintained year after year. Samples of the run taken in June always contain representatives of this class. They diminish in numbers or entirely disappear in July and then reappear in greater abundance in August. This unequal distribution in the run suggests a like inequality among the various tributaries of the Fraser. And such, in fact, we have found. In certain colonies they are apparently wholly absent, or are very rare. In other colonies they are comparatively abundant. Their presence in any portion of the run can be accepted as evidence that some colony is then entering the river bound for a tributary which normally contains them. An intensive study of this type, including its growth characteristics and its distribution within the run and throughout the river-basin, would promise to throw much light on the inner constitution of the run itself. Evidence accumulates that the colonies bound for different tributaries enter the river in regular order and on comparatively constant dates. Year by year, relatively to the other colonies, they seem to maintain their proper place in the procession.

In the following table we bring together our determinations of the percentages of this type which we have made for different dates in the runs of 1916, 1919, and 1920. In both 1916 and 1920 the two-years-in-lake type was running in moderate fashion during the later part of June and almost wholly disappeared in July, to again appear in August. The June run of this type in 1920 began unusually late (none were seen among nearly 300 specimens examined June 14th, 15th, and 23rd), and the August run exceeded in intensity anything hitherto reported.

Six-year fish of this type are never abundant in the Fraser basin. In 1920 but three individuals were encountered in nearly 2,000 examined. Two of these appeared June 28th, the date on which the first five-year fish of this class were taken; the third was obtained July 2nd. All three were male fish, 24½, 26, and 26½ inches long.

A second table gives the distribution of lengths among males and females of this group. The average lengths are practically identical with those of the one-year-in-lake class one year younger. The additional year spent in the lake greatly increases the hazards of this class and gives them no advantage in final size in the Fraser basin.

Table III.—Percentages of Two-years-in-lake Type on Different Dates of the Run.

Date.	1916.	1919.	1920.
June 2	..	..	..
„ 8	1.5	..	..
„ 9	1.5	10	..
„ 15	10	..	..
„ 17	..	18	..
„ 22	11	..	..
„ 26	..	16	..
„ 28	15	..	8
July 2	..	11	8
„ 5	..	..	5
„ 9	..	..	4
„ 11	1.5	..	..
„ 13	..	..	1
„ 15	..	10	..
„ 16	..	..	..
„ 17	0.5	..	..
„ 19	..	..	1
„ 20	..	..	..
„ 22	..	..	..
„ 25	..	..	..
„ 27	1.7	..	..
„ 28	..	..	4
„ 30	2.5	..	3
Aug. 2	..	..	3
„ 4	..	..	2
„ 6	1.6	..	..
„ 8	..	..	..
„ 9	..	..	11
„ 10	8.5	..	2
„ 11	..	..	..
„ 13	..	..	4
„ 16	..	..	13
„ 18	..	..	14
„ 20	..	..	23
„ 23	..	..	24
„ 25	..	..	33
„ 27	10	..	45
„ 30	..	..	33

Table IV.—Fraser River Sockeyes from Vancouver Island Traps, 1920, Two-years-in-lake Type.

Length in Inches.	Number of Individuals.			
	Five Years old.		Six Years old.	
	Males.	Females.	Males.	Females.
20	..	1	..	..
20½	..	..	..	..
21	..	2	..	..
21½	..	1	..	..
22	1	2	..	..
22½	..	9	..	..
23	8	18	..	....
23½	8	11	..	..
24	10	12	..	...
24½	8	3	1	..
25	14	1	....	..
25½	5	1	..	..
26	2	1	1	...
26½	..	..	1	..
Totals	56	62	3	..
Average lengths	24.3	23.2	25.7	..

(3.) THE SEA-TYPE.

As throwing additional light on the definite schedule of events which characterizes the Fraser River run of sockeyes, we again note that the run of individuals which had proceeded to sea shortly after hatching, and as soon as they became free-swimming, did not begin in this year until after the middle of July. The first capture in 1920 was on July 19th. In 1916 the first was observed on July 17th, and in 1918 on July 14th. In 1919 one occurred very exceptionally on June 9th, but as none appeared between that date and July 15th, and they appeared daily after that date, July 15th is properly to be selected as the beginning of the run in 1919. So close a chronology as July 14th, 15th, 17th, and 19th for the first appearance of the fish of this type in the runs of four different years is striking evidence of the regularity with which the run is conducted year by year. Individuals of sea-type and those of the two-years-in-lake type are the only ones that can with certainty be recognized always in a composite assemblage, such as that which comprises the Fraser River run. Could we detect locality groups as unerringly and segregate them from the general mass, we cannot doubt that they too would appear in regular sequence and on fairly regular dates.

The sea-type in 1920 occurred daily after its first appearance, and most numerously from July 22nd to August 13th. Fifty-three specimens were included in our material, distributed among three- and four-year groups, as shown in the following table:—

Table V.—Fraser River Sockeyes, Sea-type, 1920.

Length in Inches.	Number of Individuals.			
	Three Years old.		Four Years old.	
	Males.	Females.	Males.	Females.
20	..	1	..	....
20½	..	..	..	..
21	2	4	..	..
21½	1	3	..	..
22	..	1	..	1
22½	3	1	..	..
23	4	1	..	1
23½	7	1	..	1
24	2	..	2	1
24½	1	1	..	1
25	3	..	..	1
25½	..	..	2	2
26	..	..	3	1
26½	..	..	..	..
27	..	..	1	..
Totals	23	13	8	9
Average lengths	23.3	21.8	25.5	24.3

THE FRASER RIVER SOCKEYE RUN OF 1921.

The total pack of sockeyes bound for the Fraser River in 1921 was 142,598 cases, 39,631 packed in British Columbia and 102,967 on Puget Sound. The Puget Sound figures include also sockeyes bound for the Skagit River, in the State of Washington. These run earlier in the season than the Fraser River sockeyes and are known to be somewhat inferior to the latter in quality. But no attempt has been made to determine the size of the Skagit River run and we have no data which would enable us to segregate the two. It is not believed, however, that the Skagit pack attains any considerable size.

As a lineal descendant of the series of quadrennial big years of the Fraser, 1921 possesses a special interest. Some traces of its origin are discernible. In size the run ranks somewhat above the very low estate of the recent small years, among which we must go back to 1915 to find as large a pack. It diverges also from the recent small years which precede it in the limited number of the five-year group which were present. It will be recalled that in 1913,

before the big year had suffered any reduction in numbers, it was made up essentially of four-year fish. Diligent search was necessary at that time for the detection of any five-year individuals. The run was derived from eggs laid down the previous big year, four years before, and contained no contributions of consequence from any other year. Five-year individuals were of course present in numbers which would have made them conspicuous in a small year, but they were "concealed by the vast hordes of four-year-olds, the progeny of the last big run."

This condition must have characterized all the big years until 1917, when the run was cut to a fourth or a fifth of its previous dimensions. This reduction had not affected the five-year contingent of that run, for the five-year fish of 1917 had been spawned in 1912, before the catastrophe that had closed the canyon to the ascent of salmon. They were present in their usual numbers and were associated with so reduced a body of four-year fish that their presence was easily discovered. In the earlier and in the latter part of the run, in fact, the five-year fish in 1917 attained considerable proportions in the run; on June 16th, 66 per cent.; June 25th, 37 per cent.; June 28th, 20 per cent.; and July 4th to 14th, 4 or 5 per cent. After this date, throughout July, the number was reduced to 1 per cent. or less, but rose again on August 6th, and from that time on to the conclusion of the run maintained an average of 8 per cent. The total number of four-year fish contained in our twenty-one samplings, well distributed throughout the run, amounted to 94 per cent. and the five-year fish to 6 per cent. of the total of both groups.

With 1917 we can now compare 1921, which also began the season with a high percentage of five-year fish, which then decreased rapidly to the early part of July and increased again toward the last of the run. From June 9th to the 20th the five-year fish in our samples comprised 56 per cent.; on June 27th, 41 per cent.; on June 30th, 17 per cent. From July 4th to August 9th the percentages of thirteen samples averaged 11 per cent. and from August 11th to the 31st 19 per cent. of the members of both groups. The total number of individuals examined in both age-groups was 997, with 84 per cent. four-year fish and 16 per cent. in the five-year class.

It will be recalled that prior to 1921 a series of the small years had exhibited a remarkable uniformity in the relative sizes of their age-groups. In 1916, 1918, 1919, and 1920 the percentage of four-year fish was either 76 or 77. In 1917, with a recognizable remnant of the big-year series still persisting, the percentage of four-year fish rose to 94 per cent. in approximation of 1913, when it was 99; and in 1921, when a faint vestige of the big-year cycle still can be traced, the percentage drops to 84, but is still well above the small years with which it is associated.

In the following table we present an analysis of the one-year-in-lake type, the only one which has any considerable economic importance in the Fraser run. In 1921, as in 1920, the females in both year-groups were somewhat in excess of the males, 52 per cent. of the four-year group and 58 per cent. of the five-year group.

The lengths of the four-year fish exhibit a still further decline in 1921. The tendency has been marked since 1919, as appears below:—

	Males.	Females.
Average lengths for five years prior to 1919	25.0	24.1
Lengths in 1919	24.1	22.8
Lengths in 1920	24.1	23.2
Lengths in 1921	23.7	23.0

A similar reduction in size has been observed during the declining years of the Rivers Inlet fishery. The further history of this tendency will be a matter of interest.

Table VI.—Fraser River Sockeyes from Vancouver Island Traps, 1921, One Year in Lake, Grouped by Age, Sex, and Length.

Length in Inches.	Number of Individuals.			
	Four Years old.		Five Years old.	
	Males.	Females.	Males.	Females.
18½	..	2	..	..
19	..	1	..	..
19½	..	1	..	..
20	1	2	..	..
20½	2	1	..	..
21	8	4	..	..
21½	5	16	..	1
22	16	55	1	3
22½	38	83	..	1
23	62	112	1	2
23½	72	79	5	6
24	72	53	1	15
24½	56	18	1	21
25	40	5	5	20
25½	14	2	4	10
26	11	2	23	11
26½	6	..	9	1
27	..	..	9	..
27½	..	1	4	..
28	..	..	2	..
28½	..	..	1	..
Totals	403	437	66	91
Total each group	840		157	
Average lengths	23.7	23.0	25.9	24.6

We have not included in the above table five representatives of the one-year-in-lake group, which matured at the age of three and were all males. These precocious males, to which we apply the term "grilse," are never relatively abundant. They represent always a very small percentage of the brood to which they belong. Five is an unusually large number to find among a thousand individuals, now that the big year has vanished. None appeared in the run prior to July 28th. One was 18½, the other four were 19 inches long, and they weighed 3 to 3½ lb.

TWO-YEARS-IN-LAKE GROUP.

This group was sparsely represented in the run of 1921, but exhibited clearly the peculiar distribution within the period of the run that we have commonly observed in the Fraser. The group was in evidence, although in small numbers, throughout the month of June, but became very rare in the early half of July. Our samples taken on July 8th, 11th, and 15th contained only 2 per cent. of this group, and samples taken on July 18th, 21st, 25th, and 28th are wholly without any individuals that had spent their first two years in their native lake before passing out to the sea. On August 1st representatives of the group reappeared, more abundantly than in June, and were then present in each of our samples taken throughout the month of August. On August 15th they constituted 11 per cent. of the run. It seems probable that the early-running members of this group belong with colonies which are bound well up-stream beyond the Yale Canyon, perhaps to the Chilcotin, while the members of the August run are bound for one or more of the tributaries below the canyon. Our samples in 1921 contained fifty-one examples of the two-years-in-lake type, forty-four of which were in their fifth year and seven in their sixth year.

THE SEA-TYPE.

The first ten of our samplings, covering the entire month of June and the first half of July, were without any members of this group. The first one was observed July 18th and one or more

specimens appeared in each of our numerous samples taken after that date. 1921 agrees closely with other years in which we have observed the first appearance of this group in the run. In 1916 we recorded the first individual on July 17th and in 1919 on July 19th. Of the twenty-eight specimens examined in 1921, six were in their third year and twenty-two in their fourth year.

THE RIVERS INLET SOCKEYE RUN OF 1920.

(1.) GENERAL CHARACTERISTICS.

In our previous report in this series (Report of the Commissioner of Fisheries, 1919, page 52) we commented on the prospects for 1920, calling attention to the fact that the two brood-years which would be responsible for the run of 1920 exhibited a wide disparity. The five-year fish of 1920 would be derived from eggs laid down in 1915, when the pack of Rivers Inlet sockeyes exceeded 130,000 cases and was the largest ever put up in this district. The four-year fish, on the contrary, would be descendants of 1916, with a pack of less than 45,000 cases, the smallest of any recent year. We remarked: "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." Such, in fact, as will appear, turned out to be the case. The run was gratifyingly large after a series of four very poor years, and it was practically all derived from 1915, the proportion of four-year fish (5 per cent. of the total) being so small as to be negligible. Some 115,000 of the 121,000 cases of the 1920 run were results of the 1915 brood, and approximately 26,000 cases of the 1919 pack were composed of four-year fish from the same great brood of 1915. If we assume that the packs of these two years give reliable indications of the size of the runs, then the four-year fish that developed from the 1915 brood represented 18 per cent. and the five-year fish 82 per cent. of the total progeny of that brood. It is facts of this nature that lead us to call the Rivers Inlet cycle predominantly one of five years, in contrast to the Fraser River cycle, well known to be one of four years.

(2.) AGE-GROUPS, LENGTHS AND WEIGHTS.

Among 596 individuals examined, distributed well throughout the run, only thirty-one were in the fourth year, a number too small to be available for statistical treatment. It is interesting to note, however, that the usual changes in the constitution of the run are indicated by this very limited material. Although no samples were secured later than July 23rd, it is seen that more four-year fish were appearing on the later dates. The numbers are as follows: June 29th, 1; July 2nd, 5; 5th, 3; 9th, 3; 13th, 3; 16th, 2; 20th, 9; 23rd, 5. The males, as usual, are in excess of the females, only eight females (26 per cent.) being present.

Because of the small numbers of four-year individuals examined, the average lengths and weights for this group would be wholly unreliable. The five-year males average 26 inches and the females 25 inches in length, and are practically identical in size with the same year-groups in 1915 (26 and 25.1 inches), which was the brood-year for these fish. We have called attention heretofore to the fact that with diminishing runs in Rivers Inlet the size of the fish was also decreasing. No cause is known for such a coincidence, but it is interesting to observe that the size of the individuals promptly recovered in a year of a good run.

Table VII.—Rivers Inlet Sockeyes, Run of 1920, grouped by Length, Age, and Sex.

Length in Inches.	Number of Individuals examined.			
	Four Years old.		Five Years old.	
	Males.	Females.	Males.	Females.
19½	..	..	..	..
20	1	..	..	..
20½	2	..	..	..
21	7	..	1	..
21½	4	1	..	..
22	3	1	2	3
22½	2	2	3	4
23	..	2	5	6
23½	..	2	5	18
24	3	..	15	36
24½	1	..	17	50
25	..	..	30	61
25½	..	..	29	43
26	..	..	43	43
26½	..	..	37	20
27	..	..	35	9
27½	..	..	23	2
28	..	..	17	..
28½	..	..	5	1
29	..	..	4	..
Totals	23	8	271	296

Table VIII.—Rivers Inlet Sockeyes, Run of 1920, grouped by Weight, Age, and Sex.

Weight in Pounds.	Number of Individuals examined.			
	Four Years old.		Five Years old.	
	Males.	Females.	Males.	Females.
3	..	..	..	..
3½	1	..	..	..
4	4	1	1	..
4½	7	1	4	1
5	2	1	7	17
5½	1	5	9	32
6	3	..	21	66
6½	..	..	32	50
7	..	..	35	55
7½	..	..	42	33
8	..	..	42	27
8½	..	..	28	10
9	..	..	21	5
9½	..	..	14	..
10	..	..	10	..
10½	..	..	3	..
11	..	..	..	..
11½	..	..	2	..
Totals	23	8	271	296

Table IX.—Five-year Rivers Inlet Sockeyes, 1920, showing Length Frequency Distribution through the Season.

Inches.	Males.									Females.								
	June 29.	July 2.	July 5.	July 9.	July 13.	July 16.	July 20.	July 23.	Total.	June 29.	July 2.	July 5.	July 9.	July 13.	July 16.	July 20.	July 23.	Total.
21	..	..	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..	..
21½	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
22	..	1	..	..	..	..	..	1	2	..	..	..	..	1	1	..	1	3
22½	..	2	..	..	..	..	..	1	3	..	..	1	1	..	1	..	1	4
23	..	1	2	..	..	1	..	1	5	..	..	2	1	1	..	2	..	6
23½	..	..	1	1	1	2	..	..	5	2	2	1	1	1	4	2	5	18
24	2	2	1	2	4	1	2	1	15	2	4	4	3	5	3	5	10	36
24½	2	4	2	1	3	1	..	4	17	4	2	3	6	10	7	12	6	50
25	6	4	2	5	3	5	4	1	30	5	5	3	5	8	7	11	17	61
25½	5	3	3	3	3	5	5	2	29	4	9	8	5	4	5	3	5	43
26	6	8	2	9	6	5	3	4	43	7	2	4	8	4	9	5	4	43
26½	8	2	8	5	4	4	3	3	37	..	1	5	7	1	3	1	2	20
27	8	5	7	2	6	1	5	1	35	..	1	2	2	1	1	2	..	9
27½	6	6	5	2	4	..	..	..	23	1	..	1	..	..	..	..	..	2
28	3	3	2	1	2	6	..	..	17	..	..	..	..	..	..	..	..	..
28½	1	1	1	1	..	..	1	..	5	..	..	1	..	..	..	..	..	1
29	1	1	1	1	..	..	..	..	4	..	..	..	..	..	..	..	..	..
Totals..	48	43	37	33	36	32	23	19	271	25	26	35	39	36	41	43	51	296

Table X.—Average Lengths in Inches of Rivers Inlet Sockeyes, 1920, in Fifth Year, on a Series of Dates.

	June 29.	July 2.	July 5.	July 9.	July 13.	July 16.	July 20.	July 23.
Males	26.4	25.9	26.3	26.0	25.9	25.8	25.9	25.0
Females	25.2	25.1	25.4	25.4	24.8	25.0	24.9	24.7

Not only is no increase in length shown with advancing season in the above table, but there is evident in the later dates a run of fish of distinctly inferior size. A discussion of this subject appears later in this paper under the run for 1921.

(3.) PROPORTIONS OF THE SEXES.

As we have already indicated, the four-year class was so sparsely represented in 1920 that no statistics of any value can be obtained from it. Males were more abundant than females in our few samples, as is always the case in this race of sockeyes, but the percentages (74 per cent. males, 26 per cent. females) has no significance for the reason stated.

In the case of the five-year group we find the rates of males to females varying widely through the season, the males, as usual, showing the highest percentages early in the run. Samples were procured on eight days, spaced three or four days apart, the earliest date being June 29th, the latest July 23rd. For these eight dates the percentages of male five-year fish ran: 66, 62, 51, 46, 50, 44, 35, 27. The average of these percentages is 48 per cent. males and 52 per cent. females, and these percentages hold also for the total number of males and females (271 males, 296 females) taken during the season.

THE RIVERS INLET SOCKEYE RUN OF 1921.

(1.) GENERAL CHARACTERISTICS.

After presenting nearly a maximum pack in 1920 (121,254 cases) the Rivers Inlet sockeye run declined in 1921 to the lowest level, with one exception, since the industry has become well established. The exception occurred in 1916, and it is worthy of consideration that a five-year period is thus seen to have intervened between the two lowest packs the river has produced. A five-year period also separated the generous run of 1920 from the record pack of the river, which occurred in 1915 and was in excess of 130,000 cases; and another period of five years between 1915 and the season of 1910, with its 126,000 cases. The three largest sockeye-packs on the river are thus seen to be separated by five-year intervals, as though one were the direct descendant of the other. Inasmuch as the Rivers Inlet cycle is prevailingly one of five years—a larger proportion of the fish maturing in their fifth than in their fourth year—the above-noted coincidences seem reasonable and lead us to arrange other recent years in similar five-year sequences and observe the results.

We give below, in even thousands of full cases, the packs since 1907, arranged in accordance with the five-year cycle:—

1907	87,000	1912	112,000	1917	61,000
1908	64,000	1913	61,000	1918	53,000
1909	89,000	1914	89,000	1919	56,000
1910	126,000	1915	130,000	1920	121,000
1911	88,000	1916	44,000	1921	46,000

That a certain consistency marks these series of related years is not to be questioned, and is only faintly obscured by the obvious impoverishment which the river has suffered during the last five-year period and which began in less marked degree even during the preceding period. The product of the first five-year period was 454,000 cases; of the second, 436,000 cases; of the third, 337,000 cases. From an inspection of these figures it seems reasonable to conjecture that fishing operations during the period 1912 to 1916 had become more concentrated and effective than in the previous cycle, and that there was captured for commercial purposes a larger proportion of the runs than had previously been the case. This would tend to obscure such reduction in the runs as had already occurred, and would prepare for the impressively serious decline during the following five-year period.

To what extent the future will approve a five-year cycle in Rivers Inlet only the future can disclose. If predictions during the fifteen years above listed had been based on the fifth year preceding, but one surprise would have been experienced, that of the exceptional year 1912, when the pack of 112,000 cases was seemingly without competent ancestors and left no worthy descendants. Such other changes as are evident in the cyclical series can be properly ascribed to the progressive decline in the runs.

During previous years we have sought to investigate the internal constitution of the annual sockeye run by means of samples collected at more or less equal intervals throughout the season. By this means we have endeavoured to ascertain the comparative sizes of the year-groups, the relative proportions of the sexes, and the size distribution of males and females among the various classes. An obvious source of possible error in our method lay in treating all the various samples as contributing data of equal importance for determining the total constitution of the run, whereas the earlier and later samples were taken when the number of individuals running was very small, while some of the intermediate takes sampled the run at its maximum. It becomes of importance, therefore, to ascertain the course of the run throughout the season. If it develops symmetrically, with its peak midway of the season and its advance and decline similar in degree, our method of sampling will produce reliable results with regard to all factors which are constant and those also which vary progressively in the same direction and with equal pace.

To throw light on the course of the run, we have obtained through the co-operation of Fisheries Overseer Stone the daily sockeye-catch at three of the Rivers Inlet canneries during the season of 1921. We have taken the total daily catch of the three canneries in even hundreds,

have smoothed the series once by threes, and present the results in the following graph. Considering the nature of the data, which are affected by weather conditions and the weekly closed season, the symmetrical development of the run clearly appears.

Magnitude of the sockeye-salmon run throughout the season of 1921, measured by the receipts at the canneries.

(2.) THE AGE-GROUPS.

The Rivers Inlet run in 1921, as in previous years, consisted almost entirely of two age-groups, those that matured in their fourth and those that matured in their fifth year. In both of these groups the early history is the same, the initial year of their lives being spent in fresh water, descent to the sea taking place early in the second spring. Among nearly a thousand individuals examined in 1921, only one was found which had spent two growing seasons in the lake, maturing then in its fifth year. This type is abundant in many river-basins. Its almost total absence in the Owikeno River may conceivably be due to the same adverse feeding conditions which apparently dwarf the fingerlings in this stream during their first season.

The relative proportions of the four- and the five-year groups is a constantly varying one throughout the season. In the majority of the years the older group predominates strongly during the early part of the run, but loses more or less of its advantage over the four-year group with the advancing season. In exceptional years we have witnessed a reversal of this procedure, the four-year fish relatively decreasing and the five-year fish increasing toward the close of the run. The following table gives our experience in this regard from 1915 to 1921. During four of the six years the five-year fish were relatively most abundant during the early part of the run. This was the case in 1921.

Table XI.—Percentages of Five-year Rivers Inlet Sockeyes appearing at Different Dates from 1915 to 1921.

Date.	1915.	1916.	1917.	1918.	1919.	1921.
June 27	..	93	..	7	..	..
„ 28	..	..	..	..	..	77
„ 29	..	92	..	19	..	..
„ 30	..	..	..	..	..	56
July 1	..	..	..	..	..	..
„ 2	..	..	..	25	..	66
„ 3	..	..	..	..	..	..
„ 4	..	90	94	32	..	..
„ 5	79	..	..	..	..	51
„ 6	..	..	..	..	..	..
„ 7	..	..	..	..	65	48
„ 8	..	..	..	..	..	..
„ 9	..	..	..	..	..	..
„ 10	..	..	88	37	47	..
„ 11	..	84	..	..	..	48
„ 12	..	..	..	64	..	..
„ 13	..	76	82	..	..	..
„ 14	..	..	..	..	..	..
„ 15	84	..	..	..	66	..
„ 16	..	..	70	59	..	47
„ 17	..	..	..	..	..	..
„ 18	..	72	..	..	67	57
„ 19	..	..	..	69	..	40
„ 20	..	..	..	..	..	..
„ 21	84	69	59	..	..	..
„ 22	..	..	..	..	52	..
„ 23	..	..	..	44	..	..
„ 24	..	..	73	..	..	..
„ 25	..	78	..	..	..	..
„ 26	..	..	..	59	55	..
„ 27	..	68	..	..	..	36
„ 28	88	..	41	..	..	..
„ 29	..	..	..	..	..	44
„ 30	..	..	..	54	..	..
„ 31	..	..	46	..	55	..
Aug. 1	..	..	..	..	..	53
„ 2	92	60	..	..	32	..
„ 3	..	..	44	..	..	..
„ 4	..	53	..	..	..	38

We have noted in our reports of previous years that the more prosperous seasons in Rivers Inlet tend to be distinguished by larger percentages of the older year-group. The year 1921 was no exception to this general rule. Taking the total number of all our samples, obtained on thirteen different dates, well spaced during the continuance of the run, we find the five- and four-year groups in approximately equal numbers, the former constituting 51 per cent. and the latter 49 per cent. of the run. The following table gives the relative size of the age-groups for each year since 1912, with the brood-year from which each age-group was derived:—

Table XII.—Percentages of Four- and Five-year Rivers Inlet Sockeyes in Runs from 1912 to 1921, with 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%	1909 (89,027 cases).
1914 (89,890 cases)	5 yrs. 65% 4 yrs. 35%	1910 (126,921 cases).
1915 (130,350 cases)	5 yrs. 87% 4 yrs. 13%	1911 (88,763 cases).
1916 (44,936 cases)	5 yrs. 76% 4 yrs. 24%	1912 (112,884 cases).
1917 (61,195 cases)	5 yrs. 67% 4 yrs. 33%	1913 (61,745 cases).
1918 (53,401 cases)	5 yrs. 43% 4 yrs. 57%	1914 (89,890 cases).
1919 (56,258 cases)	5 yrs. 54% 4 yrs. 46%	1915 (130,350 cases).
1920 (121,254 cases)	5 yrs. 95% 4 yrs. 5%	1916 (44,936 cases).
1921 (46,300 cases)	5 yrs. 51% 4 yrs. 49%	1917 (61,195 cases).

(3.) DISTRIBUTION OF THE SEXES.

It will be seen by the following table that the four-year male sockeyes were much less abundant than usual in 1921 in proportion to the females, and that the five-year males were also notably less abundant. Whereas in most years the total male sockeyes in our samples well exceed the total females of both groups, in 1921 the two sexes were present in almost equal numbers.

Table XIII.—Relative Numbers of Males and Females, Rivers Inlet Sockeyes, 1916 to 1921.

	1916.	1917.	1918.	1919.	1920.	1921.
Average percentages—						
Four-year males	74	75	74	79	74	65
Four-year females	26	25	26	21	26	35
Five-year males	40	42	49	45	48	38
Five-year females	60	58	51	55	52	62
Average total males	52	53	66	58	49	51
Average total females	48	47	34	42	51	49

The distribution of the sexes during the course of the run followed the customary series of changes. Both four- and five-year males show a decided tendency to precede the females, as is shown in the table given below, which presents the percentages of the two sexes separately for each year group on a series of thirteen dates. While the average of all the percentages of four-year males throughout the season is 65, the average for the first four dates is 82 per cent. and for the last four dates 43 per cent. Similarly, the average of all the percentages of five-year males is 38, but the first four dates of the table give an average of 52 per cent. and the last four dates 22 per cent.

Table XIV.—Percentage of Males and Females in Rivers Inlet Sockeyes occurring on Different Dates, Season of 1921.

	June 28.	June 30.	July 2.	July 5.	July 7.	July 12.	July 16.	July 18.	July 19.	July 27.	July 29.	Aug. 1.	Aug. 4.
Four-year males	88	82	80	78	67	67	75	66	76	43	50	40	37
Four-year females	12	18	20	22	33	33	25	34	24	57	50	60	63
Five-year males	57	59	53	38	42	36	51	30	33	15	30	22	21
Five-year females	43	41	47	62	58	64	49	70	67	85	70	78	79

(4.) LENGTHS AND WEIGHTS.

The length and weight frequency distributions are given in the following tables, separately for males and females of each year-group. Comparing with a similar table presented in a previous report for the year 1919, we find the parallelism very close. The four-year males ranged during both seasons from 19½ to 25 or 25½ inches and the four-year females from 20½ to 24½ or 25 inches. The five-year males show an unusual distribution, which is rather clearly bimodal, with a large number of individuals among the larger sizes, from 25½ to 27 inches. An entirely similar curve is formed by the male five-year weights, which are bimodally arranged, with excess of individuals of the heavier size.

Table XV.—Rivers Inlet Sockeyes, Run of 1921, grouped by Lengths, Age, and Sex.

Length in Inches.	NUMBER OF INDIVIDUALS EXAMINED.			
	Four Years old.		Five Years old.	
	Males.	Females.	Males.	Females.
19½	1	..	..	..
20	1	..	..	..
20½	4	1	..	..
21	5	4	1	..
21½	17	16	1	2
22	48	25	2	2
22½	56	48	8	23
23	67	51	12	28
23½	51	20	17	40
24	29	11	17	73
24½	14	1	13	41
25	5	..	15	44
25½	1	..	25	15
26	..	..	24	14
26½	..	..	28	11
27	..	..	21	3
27½	..	..	7	1
28	..	..	1	..
28½	..	..	..	..
29	..	..	2	..
Totals	299	177	194	297

Table XVI.—Percentages of Four- and Five-year Rivers Inlet Sockeyes, 1921, where Lengths overlap.

Length in Inches.	Proportion.	
	Four Years old.	Five Years old.
21	90	10
21½	92	8
22	96	4
22½	77	23
23	75	25
23½	55	45
24	31	69
24½	22	78
25	8	92
25½	2	98

Table XVII.—Rivers Inlet Sockeyes, Run of 1921, grouped by Weight, Age, and Sex.

Weight in Pounds.	Number of Individuals examined.			
	Four Years old.		Five Years old.	
	Males.	Females.	Males.	Females.
3	3	..	..	..
3½	2	1	..	2
4	15	12	..	1
4½	61	61	3	15
5	95	64	16	45
5½	68	28	24	68
6	34	10	26	67
6½	17	1	14	47
7	4	..	24	26
7½	..	..	33	18
8	..	..	22	5
8½	..	..	17	3
9	..	..	10	..
9½	..	..	4	..
10	..	..	1	..
Totals	299	177	194	297

The average lengths and weights are shown below in comparison with previous years. They depart but little from the averages of the eight preceding years, which are given in the last column. The four-year fish are fully up to average length and weight, but the five-year females are notably lacking in both length and weight, and the five-year males only less so.

Table XVIII.—Average Length in Inches of Rivers Inlet Sockeyes for Nine Years.

	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1921.	Average.
Four-year males	23.2	22.9	23.0	22.9	22.9	22.5	22.3	22.4	22.9	22.8
Four-year females	22.8	23.0	22.8	22.8	22.8	22.3	22.5	22.3	22.6	22.7
Five-year males	25.8	25.9	25.9	26.0	25.8	25.0	24.9	24.8	25.2	25.5
Five-year females	24.6	25.2	25.2	25.1	25.0	24.4	24.5	24.4	24.2	24.8

Average Weight in Pounds of Rivers Inlet Sockeyes for Seven Years.

	1914.	1915.	1916.	1917.	1918.	1919.	1921.	Average.
Four-year males	5.4	5.3	5.5	5.0	4.9	4.9	5.2	5.2
Four-year females	5.2	5.1	5.0	4.9	5.1	4.8	4.9	5.0
Five-year males	7.3	7.3	7.6	6.6	6.7	6.3	6.9	7.0
Five-year females	6.8	6.6	6.7	6.2	6.7	5.9	6.0	6.5

Table XIX.—Four-year Rivers Inlet Sockeyes, 1921, showing Length Frequency Distribution on a Number of Dates.

Inches.	MALES.													
	June 28.	June 30.	July 2.	July 5.	July 7.	July 12.	July 16.	July 18.	July 19.	July 27.	July 29.	Aug. 1.	Aug. 4.	Total.
19	..	..	..	...	..	..	..	..	..	..	..	...	..	..
19½	..	..	..	..	...	..	..	..	1	..	..	..	..	1
20	..	..	..	..	...	..	..	..	1	..	...	..	..	1
20½	1	1	1	..	..	..	..	..	1	..	..	..	..	4
21	2	...	..	..	2	..	1	..	..	..	...	..	..	5
21½	2	2	3	..	2	1	2	..	2	..	..	..	3	17
22	4	5	2	6	6	3	5	3	4	..	6	2	2	48
22½	1	6	5	8	4	8	4	4	4	2	3	5	2	56
23	5	3	3	10	5	1	6	5	7	3	8	4	7	67
23½	..	4	2	3	5	6	4	4	9	9	1	2	2	51
24	..	3	3	1	2	6	3	2	4	2	1	1	1	29
24½	..	2	1	..	..	..	4	1	1	3	2	..	..	14
25	...	1	..	..	..	1	1	2	..	..	..	...	..	5
25½	..	..	..	..	..	..	..	..	..	1	..	..	..	1
Totals	15	27	20	28	26	26	30	21	34	20	21	14	17	299

Inches.	FEMALES.													
	June 28.	June 30.	July 2.	July 5.	July 7.	July 12.	July 16.	July 18.	July 19.	July 27.	July 29.	Aug. 1.	Aug. 4.	Total.
19	..	..	...	..	..	..	..	..	..	..	..	..	..	..
19½	..	..	..	..	..	..	..	..	..	..	..	..	..	..
20	...	..	..	..	..	..	..	..	..	..	..	..	..	..
20½	..	..	..	..	..	..	..	..	...	..	1	..	..	1
21	...	..	..	..	..	1	..	..	..	..	2	..	1	4
21½	..	..	1	1	1	2	2	2	2	2	..	1	2	16
22	..	2	..	1	4	1	3	2	2	3	2	2	3	25
22½	...	1	1	2	5	5	4	4	4	3	9	4	6	48
23	1	1	2	2	2	2	1	2	2	11	6	7	12	51
23½	..	1	..	1	1	1	..	1	1	7	1	4	2	20
24	1	1	1	..	..	1	..	..	..	1	..	3	3	11
24½	..	..	..	1	..	..	..	...	..	..	..	..	..	1
25	..	..	..	..	..	..	..	..	..	..	..	..	..	..
25½	..	..	..	...	..	..	..	..	..	..	..	..	..	..
Totals	2	6	5	8	13	13	10	11	11	27	21	21	29	177

Table XX.—Five-year Rivers Inlet Sockeyes, 1921, showing Length Frequency Distribution on a Number of Dates.

Inches.	Males.													
	June 28.	June 30.	July 2.	July 5.	July 7.	July 12.	July 16.	July 18.	July 19.	July 27.	July 29.	Aug. 1.	Aug. 4.	Total.
21	..	1	..	..	..	..	..	..	..	...	..	..	..	1
21½	..	..	..	..	..	..	1	..	..	..	..	..	..	1
22	..	1	..	..	..	..	..	..	..	...	1	..	..	2
22½	..	..	..	2	2	..	1	1	2	..	..	..	..	8
23	...	1	..	3	1	1	1	..	..	..	3	2	..	12
23½	..	1	1	3	3	1	1	..	..	2	2	1	2	17
24	2	..	4	1	..	3	1	1	2	1	..	1	1	17
24½	3	..	1	..	1	..	2	2	1	1	1	..	1	13
25	..	7	3	..	..	2	2	..	..	..	1	...	..	15
25½	1	6	5	2	2	2	1	2	1	..	..	3	..	25
26	9	1	3	1	1	1	4	1	1	..	1	..	1	24
26½	10	2	3	2	3	3	..	3	1	..	..	1	..	28
27	3	5	4	..	1	..	3	3	1	..	..	...	1	21
27½	4	1	..	..	....	..	1	..	1	..	..	..	..	7
28	..	..	1	..	..	..	..	..	..	..	..	...	..	1
28½	..	..	...	..	..	..	..	..	..	..	..	...	..	..
29	..	..	..	..	1	..	..	..	..	..	..	1	..	2
Totals	32	25	26	14	15	13	18	13	10	4	9	9	6	194

Inches.	Females.													
	June 28.	June 30.	July 2.	July 5.	July 7.	July 12.	July 16.	July 18.	July 19.	July 27.	July 29.	Aug. 1.	Aug. 4.	Total.
21	..	..	..	..	..	..	..	...	..	..	..	..	..	..
21½	..	..	1	..	...	..	..	..	..	..	..	..	1	2
22	..	..	..	..	..	..	1	..	..	..	..	1	..	2
22½	..	2	3	2	1	..	..	3	..	3	2	3	4	23
23	..	1	..	2	2	1	3	4	2	3	5	2	3	28
23½	2	2	3	4	7	3	2	1	2	2	6	2	4	40
24	6	3	2	6	3	5	4	9	6	10	4	9	6	73
24½	2	4	3	4	5	4	4	3	3	3	3	2	1	41
25	5	2	3	3	1	7	1	5	4	1	3	8	1	44
25½	3	..	4	..	..	2	1	1	1	..	..	2	1	15
26	2	2	2	..	1	1	1	2	1	..	..	1	1	14
26½	4	1	1	2	..	..	..	2	..	..	..	1	..	11
27	..	..	1	..	1	..	..	..	..	..	1	...	..	3
27½	..	..	..	..	..	..	..	..	1	..	..	..	..	1
28	..	..	..	..	...	..	..	...	..	..	..	..	..	..
28½	..	..	..	..	..	..	..	...	..	..	..	..	..	..
29	..	..	..	..	..	..	..	...	..	..	..	..	..	..
Totals	24	17	23	23	21	23	17	30	20	22	24	31	22	297

Table XXI.—Four-year Rivers Inlet Sockeyes, 1921, Weight Frequency Distribution on a Number of Dates.

Pounds.	Males.													
	June 28.	June 30.	July 2.	July 5.	July 7.	July 12.	July 16.	July 18.	July 19.	July 27.	July 29.	Aug. 1.	Aug. 4.	Total.
3	..	..	..	..	..	..	..	..	3	...	..	..	..	3
3½	1	1	..	..	..	..	..	..	..	..	..	..	..	2
4	6	..	1	...	1	..	1	..	1	..	3	..	2	15
4½	3	7	5	1	6	5	6	5	4	1	9	3	6	61
5	2	6	9	11	7	9	10	7	9	7	4	9	5	95
5½	3	7	2	9	6	6	6	6	9	6	3	2	3	68
6	..	4	1	4	3	3	3	2	8	4	2	...	..	34
6½	..	2	2	3	3	1	3	1	..	1	..	..	1	17
7	..	..	..	..	..	2	1	..	..	1	..	..	..	4
Totals	15	27	20	28	26	26	30	21	34	20	21	14	17	299

Pounds.	Females.													
	June 28.	June 30.	July 2.	July 5.	July 7.	July 12.	July 16.	July 18.	July 19.	July 27.	July 29.	Aug. 1.	Aug. 4.	Total.
3	..	..	..	...	..	..	..	...	..	..	..	..	..	..
3½	..	..	..	..	..	..	..	..	..	..	1	..	..	1
4	..	..	..	..	..	..	1	1	1	1	4	...	4	12
4½	..	1	1	1	4	7	5	8	6	6	8	5	9	61
5	1	5	2	3	6	3	2	2	1	13	8	10	8	64
5½	..	..	2	1	2	3	2	..	3	5	..	3	7	28
6	..	..	..	3	1	..	..	..	..	2	..	3	1	10
6½	1	..	..	..	...	..	..	..	..	..	..	...	..	1
7	..	..	..	..	..	..	..	...	..	..	..	..	..	..
Totals	2	6	5	8	13	13	10	11	11	27	21	21	29	177

Table XXII.—Five-year Rivers Inlet Sockeyes, 1921, Weight Frequency Distribution on a Number of Dates.

Pounds.	Males.													
	June 28.	June 30.	July 2.	July 5.	July 7.	July 12.	July 16.	July 18.	July 19.	July 27.	July 29.	Aug. 1.	Aug. 4.	Total.
3	..	..	..	..	..	..	..	..	..	..	..	..	..	..
3½	..	..	..	...	..	..	..	..	..	..	...	..	..	..
4	..	..	..	..	..	..	..	..	..	..	...	..	..	..
4½	..	1	..	..	..	..	1	..	..	..	1	..	..	3
5	..	2	1	3	1	..	2	..	2	..	3	2	..	16
5½	2	1	3	..	3	2	2	2	1	2	3	2	1	24
6	2	1	3	5	3	3	3	2	1	2	..	..	1	26
6½	...	6	2	2	..	1	1	..	..	..	..	..	2	14
7	2	5	3	1	..	2	3	1	1	..	2	4	..	24
7½	10	3	8	..	2	4	..	5	..	..	..	..	1	33
8	6	3	2	2	1	1	3	1	2	..	...	..	1	22
8½	8	1	1	..	1	..	2	2	2	..	..	..	..	17
9	2	2	2	1	2	..	1	..	..	..	..	..	..	10
9½	..	..	1	..	1	..	..	...	1	..	..	1	..	4
10	..	..	..	..	1	..	..	..	..	..	..	..	..	1
Totals	32	25	26	14	15	13	18	13	10	4	9	9	6	194

Table XXII.—Five-year Rivers Inlet Sockeyes, 1921, Weight Frequency Distribution on a Number of Dates—Continued.

Pounds.	Females.													
	June 28.	June 30.	July 2.	July 5.	July 7.	July 12.	July 16.	July 18.	July 19.	July 27.	July 29.	Aug. 1.	Aug. 4.	Total.
3	..	..	..	..	..	..	..	..	..	..	...	..	..	..
3½	..	..	..	...	..	..	2	..	..	..	..	..	..	2
4	..	..	..	..	..	..	..	..	..	..	..	...	1	1
4½	..	..	1	..	..	..	..	3	..	2	1	3	5	15
5	1	3	3	2	2	1	2	4	2	7	11	5	2	45
5½	3	3	3	5	4	4	5	6	5	7	5	8	10	68
6	6	5	5	6	7	8	4	6	6	5	3	5	1	67
6½	5	2	2	5	4	8	2	6	2	1	2	6	2	47
7	3	2	3	3	2	2	2	1	3	..	1	3	1	26
7½	4	1	4	1	1	..	..	4	1	..	1	1	..	18
8	2	1	1	..	...	..	...	..	1	..	..	..	..	5
8½	..	..	1	1	1	..	..	..	..	..	..	..	..	3
9	..	..	..	..	..	..	..	...	..	..	..	..	..	..
9½	..	..	..	..	..	..	..	..	..	..	...	..	..	..
10	..	..	...	..	..	..	..	..	..	..	...	..	..	..
Totals	24	17	23	23	21	23	17	30	20	22	24	31	22	297

Table XXIII.—Average Lengths in Inches of Rivers Inlet Sockeyes, Run of 1921, on a Number of Dates.

	June 28.	June 30.	July 2.	July 5.	July 7.	July 12.	July 16.	July 18.	July 19.	July 27.	July 29.	Aug. 1.	Aug. 4.
Four-year males	22.1	22.9	22.7	22.7	22.6	23.1	23.0	23.2	22.8	23.6	22.9	22.8	22.7
Four-year females	23.5	22.8	22.8	22.8	22.4	22.5	22.2	22.6	22.4	22.9	22.8	23.0	22.8
Five-year males	26.1	25.5	25.5	24.2	24.8	25.0	25.0	25.6	25.0	23.9	23.7	24.8	24.5
Five-year females	25.0	24.3	24.5	24.1	24.1	24.7	23.1	24.3	24.5	23.7	23.9	24.3	23.2

From the above table it appears that, with the possible exception of the four-year males, none of the year-groups increased in average length during the season. For the first six dates given the four-year males averaged 22.7 inches and for the last six dates 23 inches. The four-year males differ from the other three year-groups in the diminutive size of the first fish to appear on June 28th. In all other groups the first fish to appear were of larger average size than on any subsequent date during the season, while the reverse was the case with the four-year males. The smallest males entered first. The four-year females maintained their average size unchanged throughout the season. The first six dates give us an average of 22.8 inches and the last six dates 22.75 inches. The point that here deserves our attention is the longer feeding and growing period of those which entered late. The females that averaged 22.8 inches on August 4th had been feeding and growing five weeks longer than those which also averaged 22.8 inches on June 30th. The conclusion is inevitable that the first fish to enter the river were the largest of the schools (with the exception of the four-year males), and the others successively abandoned their sea-feeding grounds and turned streamwards, when they had attained the same stature as those earliest to run.

This tendency for the Rivers Inlet sockeyes of the 1921 run to inaugurate the run with the largest individuals is even better shown in the five-year fish. In these, notwithstanding their continued growth, the later individuals were smaller than those of the early half of the run. They had not been able to overtake them, in spite of their additional weeks of growth. For the first six dates of the above table the five-year males averaged 25.2 inches and for the last six dates 24.6 inches, and the corresponding averages for the five-year females are 24.5 and 24.0

inches. Five-year sockeyes, as is well known, grow far less rapidly during their last season than do four-year fish. The smaller individuals among the five-year group would be less likely, therefore, to make good their deficiency by an additional period of feeding in the sea.

It is not known whether the tendency here observed is followed generally in all years by the Rivers Inlet race. Still less do we know of its existence in other races. Often the later portion of the run in certain rivers is characterized by somewhat larger fish. But they may have been smaller during the first days of the season, when the early run left them behind to continue their feeding. In such cases, also, the larger individuals of the school may successively have been drafted to maintain the spawning run.

The procedure here in the conduct of the spawning migration is very similar to what we have observed in the seaward migration of the yearlings in the early spring. In the third paper of this series (Report of the Commissioner of Fisheries for the year ending December 31st, 1915, page 45) we reported on the size of yearling migrants obtained in the Owikeno River. An extensive series of the year 1914 agreed perfectly with a second series collected the following year, in showing a constantly diminishing size as the season progressed. In this case, also, the larger individuals successively abandoned the school and those that remained behind in the lake continued to feed voraciously and to grow. While the causes that determine this procedure are unknown, the parallelism is striking between the seaward migration of the diminutive fingerlings and the streamward migration of the mature salmon.

THE SKEENA RIVER SOCKEYE RUN OF 1920.

(1.) THE YEAR-GROUPS.

The Skeena River run of 1920 agreed with that of Rivers Inlet in being derived in part from a good brood-year and in part from a very poor brood-year. The five-year fish of 1920 belonged to the brood of 1915, which produced a pack of 116,553 cases; while the four-year component of the 1920 run was derived from the brood of 1916, which produced a pack of only 60,923 cases. These conditions were clearly reflected in the character of the run, which was well below the average in size (90,869 cases) and was largely composed of five-year fish. The year 1916 contributed very little to its success.

As is shown by the following table, different years in the Skeena basin vary in the relative size of the four- and five-year classes, but almost always the older group predominates. Like the Rivers Inlet and Nass River colonies, the Skeena is dependent more on its five- than its four-year members, and thus approximates a five-year cycle. The average percentage of this group for the eight years from 1912 to 1919 is 60 per cent. and the highest attained in any year was 75 per cent. But in 1920 the five-year group comprised 82 per cent. of the one-year-in-lake type. The extremely large representation in 1920 was undoubtedly due to the favourable brood-year for the five-year fish, in conjunction with the very unfavourable brood-year for the four-year fish. As appears elsewhere in this report, an entirely similar condition produced in the 1920 run in Rivers Inlet a still larger representation of the five-year group, which comprised 95 per cent. of the run.

Table XXIV.—Percentages of Four- and Five-year Skeena 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% 4 yrs. 57%	1907 (108,413 cases). 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).
1920 (90,869 cases)	5 yrs. 82% 4 yrs. 18%	1916 (60,923 cases).

The relative size of the various age-groups that constitute the run varies not only from year to year, but in different portions of the same run. This is shown for the year 1920 by the following table, which gives the percentages in which the four year-classes occur in the run on a series of dates. A similar table in our report for the year 1919 (1920), page 60, shows a definite and progressive change in the relative dimensions of the two principal classes, which belong to the one-year-in-lake type. In 1919 the four-year class was poorly represented at first, but increased steadily in numbers throughout the season, while the opposite tendency was clearly shown in the five-year class. But in 1920 no tendency is as clearly defined and such changes as occur are rather in the opposite direction. The four-year class is relatively smaller in the latter half of the run.

Table XXV.—Percentages of Different Age-groups, Skeena River Sockeyes, on a Succession of Dates, Season of 1920.

Dates, 1920.	Number of Specimens.	One Year in Lake.		Two Years in Lake.	
		Four Years old.	Five Years old.	Five Years old.	Six Years old.
July 5	75	16	68	8	8
„ 7	49	20	74	4	2
„ 9	124	16	66	11	7
„ 12	117	18	73	6	3
„ 16	125	18	68	6	8
„ 19	124	15	73	6	6
„ 20	122	18	73	5	4
„ 26	124	9	74	3	14
„ 28	123	18	63	8	11
Aug. 2	118	19	72	3	6
„ 5	171	8	77	6	9
„ 10	71	7	75	8	10
„ 12	120	8	79	3	10
„ 18	104	16	55	11	18
Totals	1,567	15	71	6	8

Table XXVI.—Percentages of Different Age-groups, Skeena River Sockeyes, from 1916 to 1920.

Year.	One Year in Lake.		Two Years in Lake.	
	Four Years old.	Five Years old.	Five Years old.	Six Years old.
1916	34	38	13	15
1917	57	29	9	5
1918	51	34	9	6
1919	27	60	9	4
1920	15	71	6	8
Averages	37	46	9	8

The size attained by the different age-classes is determined principally by the number of years spent in the sea, and the age when they become mature is similarly determined. Two of the four age-classes in the Skeena have spent three seasons in the sea; the other two have spent four seasons. To the former group belong the four-year fish and the five-year class that spent two years in fresh water before entering the sea. The group that spent four seasons feeding in the sea is composed of the five-year class that remained one year in the lake and the six-year class that remained two years in the lake. If we consider the relative abundance of the two groups thus defined at different periods of the run in 1920 we have the results shown in the following table. The fish that had lived longest in the sea, and were maturing one year later than the other group, ran more heavily in the later part of the season.

Table XXVII.—Percentages, 1920.

Date.	Three Years' Sea-feeding.	Four Years' Sea-feeding.
July 5, 7, 9	28.7	71.3
„ 12, 16, 19	22.8	77.2
„ 20, 26, 28	20.0	80.0
Aug. 2, 5, 10	17.0	83.0
„ 12, 18	18.0	82.0

(2.) LENGTHS.

The material at hand for study of the 1920 run consists of random samples taken at close intervals in time throughout the run. Fourteen dates are represented, distributed through July and the first half of August, the total number of individuals examined being 1,567. The lengths were obtained, as usual for these studies, with a steel tape, and were measured over the curve of the sides of the fish from the median line of the snout to the outer tip of the middle rays of the caudal fin. The middle rays are the shortest and their tips lie at the beginning of the notch of the tail-fin.

We give below an analysis of the run, based on the samples submitted. The number of individuals of each age-class appear, grouped by sex and by length, and the average size is given of each category.

Table XXVIII.—Skeena River Sockeyes, 1920, grouped by Age, Sex, and Length.

Length in Inches.	Number of Individuals.							
	One-year-in-lake Type.				Two-years-in-lake Type.			
	Four-Years old.		Five Years old.		Five Years old.		Six Years old.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
19	..	..	..	..	..	..	..	..
19½	..	1	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..
20½	..	..	..	..	..	..	..	..
21	..	1	..	..	..	..	..	..
21½	..	3	..	..	..	..	..	..
22	3	14	..	2	..	2	..	1
22½	7	24	1	3	1	8	..	..
23	13	18	1	4	5	8	1	2
23½	23	31	3	26	4	18	..	6
24	17	22	7	47	13	12	1	10
24½	16	14	31	115	13	6	4	11
25	7	3	31	141	3	1	6	13
25½	5	..	72	143	3	..	10	16
26	2	..	66	125	..	..	6	9
26½	..	..	93	52	..	..	4	6
27	..	1	41	26	..	..	8	3
27½	..	..	41	11	..	..	9	3
28	..	..	16	2	..	..	6	..
28½	..	..	9	..	..	..	..	..
29	..	..	1	..	..	..	..	..
Totals	93	132	413	697	42	55	55	80
Average lengths	23.8	23.2	26.2	25.3	24.1	23.4	26.2	25.1

A comparison of the average lengths in 1920 of males and females of the different year-classes with those of former years is given in the two tables which follow. The figures for 1920 stand very close to the averages of several years. The younger age-class in each table is slightly smaller than the average for a number of years, and the older age-class in each table is larger than the general average, in both males and females.

From an inspection of the general averages given in the last columns of these tables it again becomes apparent that the two-years-in-lake type obtain no advantage in size from their extra year of life. The five-year class of this type has spent the same time feeding at sea as the four-year class of the one-year-in-lake type. As seen from the tables, there is no significant differences in their size. The same is true of the six-year fish of the lower table compared with the five-year group above. The extra year brings no advantage and exposes them to attack for an entire year in which they are especially vulnerable.

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

	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1920.	Average.
Four-year males	24.6	23.5	24.2	24.2	23.9	23.6	24.1	24.3	23.8	24.0
Four-year females	23.5	22.9	23.4	23.5	23.6	23.2	23.3	23.4	23.2	23.3
Five-year males	26.4	25.5	26.2	25.9	26.2	25.5	25.9	25.7	26.2	25.9
Five-year females	25.2	24.7	25.1	25.0	25.0	24.7	25.0	24.8	25.3	25.0

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

	1916.	1917.	1918.	1919.	1920.	Average.
Five-year males	24.1	23.9	23.9	24.3	24.0	24.1
Five-year females	23.8	23.8	23.4	23.4	23.4	23.6
Six-year males	26.2	25.4	25.2	25.8	26.2	25.8
Six-year females	24.8	25.0	24.7	24.7	25.1	24.9

The weight distribution among the four year-classes is given in the following table, the males and females in each class being given separately. On the lower two lines of the table are given the average lengths for each year-class, and for comparison the general averages for a term of years. The latter can be used as a basis for judging the standing of the year with respect to size. As we found in our discussion of lengths, so here it appears that the two younger classes in each of the types are slightly smaller than the general averages, while the two older classes of each type are well above the average.

Table XXXI.—Skeena River Sockeyes, 1920, grouped by Weight, Age, Sex, and by their Early History.

Weight in Pounds.	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.
3	..	..	..	..	..	..	..	..
3½	..	..	..	..	..	..	..	..
4	..	7	..	..	..	1	..	..
4½	10	44	1	5	2	15	..	1
5	24	34	8	26	4	17	1	4
5½	22	24	20	112	11	14	6	17
6	22	18	49	135	15	5	3	19
6½	12	4	61	204	5	3	8	13
7	2	..	83	104	4	..	6	8
7½	1	1	78	73	1	..	11	16
8	..	..	60	28	..	..	7	2
8½	..	..	34	9	..	..	10	..
9	..	..	12	1	..	..	3	..
9½	..	..	6	..	..	..	..	..
10	..	..	1	..	..	..	..	..
10½	..	..	..	..	..	..	..	..
No. of specimens	93	132	413	697	42	55	55	80
Average weights	5.6	5.1	7.2	6.4	6.3	5.1	7.3	6.3
Averages, 1915–20	5.7	5.2	6.9	6.3	5.9	5.3	6.8	6.1

In the two groups most numerously represented in the Skeena River—the four- and five-year classes, that spent their first year in lake residence—an increase in length as the season progresses is clearly evident. This appears below in the average lengths for a series of dates in 1920:—

Date.	Four Years old.		Five Years old.	
	Males.	Females.	Males.	Females.
July 5, 7, 9	23.3	22.9	25.4	24.9
,, 12, 16, 19	23.6	23.2	26.0	25.2
,, 20, 26, 28	24.3	23.1	26.4	25.4
Aug. 2, 5, 10	23.9	23.4	26.4	25.3
,, 12, 18	24.3	23.4	26.3	25.2

(3.) MALES AND FEMALES.

The season of 1920 was exceptional in presenting a higher percentage of females than of males in every age-class. During the eight previous years of which we have a record the males of the four-year class have been more numerous than the females, the females have outnumbered the males in the five-year class with one lake-year, the males have again been most abundant in the five-year class of the two lake-year type, and also in the six-year class, prior to 1919.

In all river-basins thus far examined, in which the five-year classes predominate, the four-year males are in excess of the five-year females. But in the Fraser River, in which the four-year class prevails, this group has the sexes equally represented.

The history of the Skeena River as regards the relative numbers of the sexes is shown in the following table:—

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

Year.	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
1920	41	59	37	63	43	57	41	59
Averages	59	41	44	56	55	45	51	49

THE SKEENA RIVER SOCKEYE RUN OF 1921.

(1.) GENERAL CHARACTERISTICS.

The salient features of the run of 1921 are best brought out by a comparison with the run of 1920. The latter was produced by one good brood-year (1915) and one poor one (1916). The result was a run of medium size, over four-fifths of which were progeny of the good brood-year. The run of 1921 had as antecedents two extremely poor brood-years, the worst, with a single exception, that had hitherto occurred in the Skeena River. The result of this portentous combination was, in 1921, a still lower level of production than the Skeena had previously attained. The pack of only 41,000 cases in 1921 registered a further decline of 35 per cent., compared with the extremely meagre yields of the two brood-years that produced it.

If the salmon runs were enemy forces that we were desirous of annihilating, no more certain method could be devised than destroying them thus in detail. The detachments appearing each year operate wholly independently of those that immediately precede and follow. If we succeed in destroying only one or two annual detachments in a five-year cycle, the results become cumulative and the eventual destruction of the run is assured.

It cannot too often be urged that a rational policy of conservation must prescribe a large annual safety factor. We must continue each year to provide for the escape of larger numbers of spawning fish than are necessary to ensure adequate production during seasons in which the conditions are favourable. A rationally controlled stream will show its spawning-grounds each year seemingly overpopulated. This is nature's method of preventing serious depletion during the not infrequent years when conditions are unfavourable for successful propagation and growth, and there is no other safe method. Failure to observe this obvious precaution must be held responsible in no small measure for the certain depletion with which all our salmon-streams are threatened.

The appearance of occasional good years in the course of a declining run is customary and to be expected. They should not serve in any degree to allay our apprehensions. Poor years also, it is true, have occurred during the most prosperous periods of productivity in our streams. But in a declining salmon run the poor years become ever more numerous, they infallibly in the long run produce their kind, and they fall to lower and lower levels. The average production for a series of years can always be depended on to tell the tale.

With these facts in mind, no one can doubt the serious condition we are fast realizing on the Skeena and, it may be just to remark, on all the great salmon-rivers of the Province.

The measures adopted in 1908 for the preservation of the salmon-fisheries of the Province were of much promise. By preventing the incursion of new canneries in districts already fully developed, and by limiting the amount and character of gear that should be used in each fishing district, a measure of control was assumed which would, if adequately administered, ensure the preservation of the salmon runs. This method is incontestably the best that has been devised for the purpose. Opposed to it stands the alternative method of unrestricted competition, the results of which are now so alarmingly manifest in the waters of Alaska.

But restriction in number of canneries and in amount of fishing-gear obviously will not suffice to protect a stream unless the restrictions are adequate in amount. It is impossible to know in advance the utmost extent of the drafts that can safely be made on the run of any stream. Cannery restriction and a definite boat-rating must always be considered tentative measures. The situation is one that calls for solicitous inspection and constant watchfulness. Regulations should be subject to annual revision on the part of responsible officials closely in touch with conditions as they develop.

(2.) THE AGE-CLASSES.

We have made our customary analysis of the run of 1921 and present the results in a series of tables given below.

As regards their early history, the Skeena sockeyes fall in two main groups, the one-year-in-lake and the two-years-in-lake groups; those of the former group descending to salt water after one year's residence as fingerlings in their native lake, the members of the second group spending an additional year in fresh water.

In the Skeena basin always the one-year-in-lake group is the most important, and contains two year-classes, which are maturing at the ages respectively of four and of five years. The less important group, with two lake-years in their early history, also contains two year-classes, which are respectively in their fifth and their sixth years. The relative numbers in these four year-classes, with their length and weight distributions, appear in the two tables which follow.

Table XXXIII.—Skeena River Sockeyes, 1921, grouped by Length, Age, Sex, and by their Early History.

Length in Inches.	Number of Individuals that spent							
	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.
19	..	..	..	..	..	1	..	..
19½	..	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..
20½	1	..	..	..	..	..	..	..
21	1	10	..	..	..	..	..	..
21½	9	20	..	1	..	3	..	..
22	16	59	..	4	..	..	..	..
22½	42	158	2	7	2	14	1	3
23	66	152	6	15	5	11	2	3
23½	125	189	11	56	16	10	1	4
24	113	91	19	49	10	10	2	4
24½	124	52	33	37	12	7	4	8
25	60	9	28	42	8	2	6	4
25½	27	3	38	15	4	..	3	3
26	6	1	20	7	..	1	..	..
26½	1	1	19	7	1	..	2	..
27	1	..	10	1	..	..	2	..
27½	..	..	6	..	1	..	..	1
28	..	..	..	..	..	..	..	..
28½	..	..	..	..	..	..	..	..
29	..	..	..	..	..	..	..	..
Totals	592	745	192	241	59	59	23	30
Average lengths	23.8	23.1	25.2	24.2	24.2	23.4	24.9	24.2

Table XXXIV.—Skeena River Sockeyes, 1921, grouped by Weight, Age, Sex, and by their Early History.

Weight in Pounds.	Number of Individuals that spent							
	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.
2	..	..	..	..	..	..	..	..
2½	..	..	..	..	..	1	..	..
3	1	..	..	..	..	..	..	..
3½	..	2	..	..	..	..	..	..
4	9	23	..	3	..	1	..	..
4½	59	179	4	15	5	16	1	6
5	90	246	10	48	12	17	4	5
5½	162	185	34	71	14	10	3	6
6	142	78	37	52	10	12	6	3
6½	83	28	44	31	10	2	5	8
7	29	3	24	11	4	..	1	1
7½	13	..	23	7	2	..	3	..
8	4	1	10	2	1	..	..	1
8½	..	..	5	1	..	..	..	..
9	..	..	..	..	1	..	..	..
9½	..	..	1	..	..	..	..	..
10	..	..	..	..	..	..	..	..
Totals	592	745	192	241	59	59	23	30
Average weights	5.7	5.1	6.4	5.7	5.8	5.1	6.0	5.7

As is seen by the preceding tables, the one-year-in-lake group far exceeds the other and constitutes so large a percentage of the run that our statistics of the Skeena run have often concerned themselves for practical reasons exclusively with this group. In 1921 it comprised 91 per cent. of all the salmon that entered the Skeena, a figure somewhat, though not greatly, in excess of the average for a term of years. We give below for comparison the relative proportions of the four year-classes in the Skeena runs from 1916 to 1921. If we exclude the year 1916, which was very unusual in extreme development of two-years-in-lake sockeyes, we find the other five years show a remarkable agreement in the relative size of the two main divisions. The average for the five years is 87 per cent. one-year-in-lake type and 13 per cent. two-years-in-lake type.

Table XXXV.—Percentages of Different Age-groups, Skeena River Sockeyes, from 1916 to 1921.

Year.	One Year in Lake.		Two Years in Lake.	
	Four Years old.	Five Years old.	Five Years old.	Six Years old.
1916	34	38	13	18
1917	57	29	9	5
1918	51	34	9	6
1919	27	60	9	4
1920	15	71	6	8
1921	69	22	6	3
Averages, 1916 to 1920	37	46	9	8

The two tables which follow treat the two general groups and the four age-classes as these were found to occur in different periods throughout the entire run. The material collected by the Department of Fisheries consisted of eighteen samples taken on different dates, usually three or four days apart, consisting in all of 1,941 sockeyes. No very obvious changes in the constitution of the run with respect to its year-classes are indicated by these tables.

Table XXXVI.—Percentages of Different Age-classes, Skeena River Sockeyes, found to constitute the Run on a Succession of Dates, Season of 1921.

Dates, 1921.	One Year in Lake.		Two Years in Lake.		Number of Specimens.
	Four Years old.	Five Years old.	Five Years old.	Six Years old.	
June 21	71	21	7	1	125
„ 24	68	20	7	5	121
„ 27	71	19	4	6	123
„ 30	61	30	7	2	122
July 5	61	26	8	5	122
„ 8	68	16	13	3	115
„ 12	70	20	8	2	124
„ 14	74	19	4	3	124
„ 18	68	22	9	1	120
„ 21	80	18	1	1	120
„ 25	72	19	8	1	118
„ 28	68	30	1	1	106
Aug. 2	66	20	6	8	105
„ 5	75	22	3	..	102
„ 9	83	12	4	1	78
„ 11	68	24	5	3	75
„ 15	53	37	6	4	71
„ 18	53	33	7	7	70
Averages	69	22	6	3	1,941

Table XXXVII.—Relative Numbers in One-year-in-lake and Two-years-in-lake Groups, Skeena River Sockeyes, 1921, on a Succession of Dates.

Dates, 1921.	One Year in Lake.	Two Years in Lake.
June 21	92	8
„ 24	88	12
„ 27	90	10
„ 30	91	9
July 5	87	13
„ 8	84	16
„ 12	90	10
„ 14	94	6
„ 18	90	10
„ 21	98	2
„ 25	92	8
„ 28	98	2
Aug. 2	87	13
„ 5	97	3
„ 9	95	5
„ 11	92	8
„ 15	90	10
„ 18	86	14
Averages	91	9

If the classes be grouped according to the number of years spent feeding in the sea, where practically all of their growth occurs, we find that the two younger classes of each group have had three years' feeding at sea and the two older classes of each group have had four years. On a series of dates extending throughout the run we find a uniform progression in the relative sizes of these two assemblages, as shown in the following table. The extent of the change is not great, but the uniform trend is obvious, and its significance is attested by a similar progression of much greater amount which appeared in the run of 1919, and is made evident in Table 40 of our report for that year. In 1919 the assemblage which had spent three years in the sea increased from 27 per cent. at the beginning of the season to 51 per cent. at its close. The change was therefore in the same direction as in 1921, the older group running most heavily in the early part of the season.

Table XXXVIII.—Percentages of Skeena River Sockeyes, 1921, with Three and Four Years' Feeding at Sea.

Date.	Three Years' Sea-feeding.	Four Years' Sea-feeding.
June 21, 24, 27, 30	74	26
July 5, 8, 12, 14	77	23
„ 18, 21, 25, 28	77	23
Aug. 2, 5, 9	79	21
„ 11, 15, 18	64	28

A most striking contrast is presented by the runs of 1920 and 1921 in the relative numbers which they contained of the two principal year-classes, the four- and the five-year classes of the one-year-in-lake group. In 1920, as has been pointed out in the report of the run of that year, the five-year class was far in excess and constituted 82 per cent. of the group. In 1921 the relations were almost completely reversed, with the four-year class comprising 76 per cent. of the group. In 1920 the disparity in numbers of the two age-classes seems to receive ready explanation in the relative sizes of their respective brood-years. 1915 could well be expected to produce a larger number of progeny than 1916. But the case is not so clear in the run of 1921. Both four- and five-year fish of 1921 had very poor brood-years, to all appearances about equally

poor. We can only assume that the run of 1916 encountered even harder conditions than its almost equally poor sister. The relations of brood-years to their progeny are shown below for a term of years.

Table XXXIX.—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-years from which derived.
1912 (92,498 cases)	5 yrs. 43% 4 yrs. 57%	1907 (108,413 cases). 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).
1920 (90,869 cases)	5 yrs. 82% 4 yrs. 18%	1916 (60,923 cases).
1921 (41,018 cases)	5 yrs. 24% 4 yrs. 76%	1917 (65,760 cases).

(3.) Lengths and Weights.

The size attained by the different categories of the 1921 run to the Skeena, as evidenced by the lengths and weights of our samples, is shown in a series of tables given below.

In the first of these the average lengths of the four year-classes in 1921 are brought in comparison with the average of similar figures obtained during analyses of the runs from 1912 to 1920. These general averages undoubtedly present a reliable normal size for the age-classes of this river. On comparison, it is seen in 1921 that the two younger year-classes of each group —the four-year class of the first and the five-year class of the second—are almost up to the standard, while the older two year-classes—the five-year class of the first group and the six-year class of the second—are in each case far below the normal. The apparent significance of this diversity in growth among the different year-classes is emphasized when we come to consider the nature of the grouping. The two younger classes, which reached normal size, while not of the same age, had spent the same length of time, and in fact the same three years, in the sea. Equally the two older classes, while one was five and the other six years old, had spent the same period in the ocean—a period which included the same three years with the two younger classes, together with a fourth year which was not shared by the other two. A more intensive study of the scales than we have been able to make would demonstrate whether the abnormally restricted growth was evenly distributed among the years of sea-feeding or could be considered the result of unfavourable conditions during a shorter period of time. It is worthy of note that five- and six-year classes in the 1921 run of the Nass and Rivers Inlet—the nearest important sockeye-streams—showed no deficiency in length compared with averages in those streams.

Table XL.—Average Lengths of Skeena River Sockeyes, 1921, compared with General Averages, 1912 to 1920.

	Average Lengths, 1921.	Averages, 1912 to 1920.
One year in lake—		
Four-year males	23.8	24.0
Four-year females	23.1	23.3
Five-year males	25.2	25.9
Five-year females	24.2	25.0
Two years in lake—		
Five-year males	24.2	24.1
Five-year females	23.4	23.6
Six-year males	24.9	25.8
Six-year females	24.2	24.9

Table XLI.—Skeena River Sockeyes, 1921, One Year in Lake, Average Lengths on a Series of Dates.

Date.	Four Years old.		Five Years old.	
	Males.	Females.	Males.	Females.
June 21, 24	23.9	23.0	25.2	24.1
„ 27, 30, July 5, 8	23.7	22.9	25.4	23.9
July 12, 14, 18	23.9	23.0	25.1	24.2
„ 21, 25, 28	23.8	23.1	24.8	24.4
Aug. 2, 5	24.1	23.3	25.1	24.5
„ 9, 11	24.4	23.4	25.6	24.0
„ 15, 18	23.8	23.3	25.4	24.6

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

	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1920.	1921.
Four-year males	24.6	23.5	24.2	24.2	23.9	23.6	24.1	24.3	23.8	23.8
Four-year females	23.5	22.9	23.4	23.5	23.6	23.2	23.3	23.4	23.2	23.1
Five-year males	26.4	25.5	26.2	25.9	26.2	25.5	25.9	25.7	26.2	25.2
Five-year females	25.2	24.7	25.1	25.0	25.0	24.7	25.0	24.8	25.3	24.2

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

	1916.	1917.	1918.	1919.	1920.	1921.
Five-year males	24.1	23.9	23.9	24.3	24.1	24.2
Five-year females	23.8	23.8	23.4	23.4	23.4	23.4
Six-year males	26.2	25.4	25.2	25.8	26.2	24.9
Six-year females	24.8	25.0	24.7	24.7	25.1	24.2

The average weights of the different year-classes are in accord with the data presented above for the lengths. The two classes with three years' residence in the sea are of average size or only slightly below the average. This holds equally for males and females of each class.

But the two classes that remained growing in the sea for four seasons are not only below normal, but so far below that no parallel can be found among the runs of the preceding seven years for which we have records of weights.

Table XLIV.—Average Weights of Skeena River Sockeyes, 1921, compared with General Averages, 1915 to 1921.

	Average Weights, 1921.	Averages, 1915 to 1920.
One year in lake—		
Four-year males	5.7	5.7
Four-year females	5.1	5.2
Five-year males	6.4	6.9
Five-year females	5.7	6.3
Two years in lake—		
Five-year males	5.8	5.9
Five-year females	5.1	5.3
Six-year males	6.0	6.8
Six-year females	5.6	6.1

Table XLV.—Average Weights of Skeena River Sockeyes for Eight Successive Years.

	1914.	1915.	1916.	1917.	1918.	1919.	1920.	1921.
One year in lake—								
Four-year males	5.9	5.7	5.4	5.3	5.8	6.1	5.6	5.7
Four-year females	5.3	5.2	5.1	5.0	5.3	5.5	5.1	5.1
Five-year males	7.2	6.8	7.1	6.4	6.9	7.0	7.2	6.4
Five-year females	6.3	6.2	6.3	6.0	6.4	6.2	6.4	5.7
Two years in lake—								
Five-year males	..	5.9	5.8	5.5	5.7	6.1	6.3	5.8
Five-year females	..	5.2	5.4	5.2	5.3	5.4	5.1	5.1
Six-year males	..	6.6	7.1	6.3	6.6	6.9	7.3	6.0
Six-year females	..	6.0	5.9	5.8	6.1	6.3	6.3	5.6

(4.) MALES AND FEMALES.

The last two years stand alone in the series which we have examined, in the excess of females in practically all groups. It is the general rule on the Skeena, as indeed in the majority of the sockeye-streams, for the four-year males to exceed in number the females. During the eight years prior to 1920 the records give an average of 59 per cent. males and only 41 per cent. females in this class, and in no year of the series did females outnumber the males. It seems remarkable, therefore, that this relation should be reversed during two years in succession.

The same condition exists to an approximately equal degree in the five-year class that spent two years in lake. The average of four years shows 55 per cent. males, but in 1920 there were but 43 per cent. males and in 1921 50 per cent.

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

Year.	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
1920	41	59	37	63	43	57	41	59
1921	44	56	44	56	50	50	43	57
Averages, 1912–20	59	41	44	56	55	45	51	49

THE SOCKEYE RUN TO THE NASS RIVER IN 1920.

(1.) General Considerations.

In our report on the Nass River run of sockeyes in 1919 (page 64) we called attention to certain disquieting features in the recent history of the river, and stated that extreme interest would attach to the history of the next few years, which would certainly demonstrate to what extent the river was being depleted of salmon. The first of this series goes far toward justifying any forebodings we may have entertained. The pack of 16,740 cases was nearly 25 per cent. less than the smallest previous pack of recent years. The Nass River has a five-year cycle. The average pack for the last cycle, 1916 to 1920, is 24,083 cases; and for the preceding cycle, 1911 to 1915, is 33,523 cases. Three years of the previous cycle had each a larger pack than was made by any single year of the last period, and three years of the last period had each a lower record than was made by any year during the preceding five-year cycle. The evidence now appears conclusive that the Nass River run has suffered impairment. How serious the damage has been cannot be fully ascertained until the progeny of the present cycle, now feeding in lake and sea, shall have matured and constituted the runs of the next few years. All of those interested in the perpetuation of the salmon industry on the Nass should co-operate to lessen the intensity of fishing operations in this district before hopeless depletion has become a fact. The condition has become highly critical.

(2.) THE AGE-GROUPS.

In the 1920 run there were represented seven different age-groups, four of which constituted 98 per cent. of the run. These are the four- and five-year groups, the young of which had spent one year in fresh water before passing out to sea; and the five- and six-year groups, the young of which had spent their first two years in fresh water. Of these, the two five-year groups, as usual in this river-basin, were of prime importance, together forming 84 per cent. of the whole run. Although containing such diverse elements and sockeyes of such a wide range in age—from three to seven years—the Nass may well be considered to have a five-year cycle.

The following table gives the percentages of the four principal year-groups in the Nass River run for the past nine years. Minor fluctuations occur in the relative abundance of the four groups in different years, but in general the order of precedence is clearly maintained. The most abundant group numerically is the five-year-old, two-years-in-lake class, which usually constitutes well over 50 per cent. of the run. The five-year-old, one-year-in-lake class occupies second place, producing nearly 20 per cent. of the run, usually exceeding the other two classes combined. The year 1920 closely approximated the average distribution of the year-classes, showing an excess in the predominating class and a corresponding deficiency in the one-year-in-lake groups.

Table XLVII.

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
1920	8	14	72	6
Averages	12	20	62	6

An analysis of the entire run is presented in the two tables which follow, based on 974 individuals, taken by random samplings at weekly intervals from July 18th to August 22nd. The lengths and weights are given for males and females separately of each of the seven year-groups represented in the run. The seven-year type, three years in lake, usually found in Nass River runs, furnished no representatives in 1920. The sea-type, the young of which proceed to sea directly on hatching, had but two representatives in our samples, one for each year-group. While this type is never abundant, it contained more representatives in 1919 than the three-years-in-lake type.

Table XLVIII.—Nass River Sockeyes which ran in 1920, grouped by Age, Sex, and Length, 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.		Three Years old.		Four Years old.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
21	1	..	..	..	..	..	..	..	..	..	..	..	..	..
21½	..	2	..	..	..	..	..	..	..	..	..	..	..	..
22	..	3	..	..	1	3	..	..	..	..	..	..	..	..
22½	3	5	..	..	..	6	..	..	..	..	..	..	..	..
23	2	3	..	2	3	6	..	..	..	..	..	1	..	..
23½	9	12	..	6	4	5	1	..	..	..	..	..	..	1
24	6	10	2	9	8	15	2	3	..	..	..	..	..	..
24½	5	1	4	13	7	21	1	2	..	..	..	..	..	..
25	2	2	6	24	11	45	5	3	..	..	..	..	..	..
25½	5	..	4	11	10	58	5	4	1	1	..	..	..	..
26	..	1	5	7	40	110	2	2	2	3	..	..	..	..
26½	..	..	13	5	35	59	1	..	2	..	..	..	..	..
27	..	..	7	4	67	48	1	2	4	4	..	..	..	..
27½	..	..	4	..	45	15	1	3	2	1	..	..	..	..
28	..	..	5	..	28	14	4	1	..	1	..	..	..	..
28½	..	..	1	..	12	1	4	1	..	..	..	..	..	..
29	..	..	..	..	5	1	7	..	..	..	..	..	..	..
29½	..	..	..	..	1	1	2	..	..	..	..	..	..	..
30	..	..	..	..	..	..	2	..	..	..	..	..	..	..
30½	..	..	..	..	..	..	2	..	..	..	..	..	..	..
31	..	..	..	..	..	..	1	..	..	..	..	..	..	..
Totals	33	39	51	81	277	408	41	21	11	10	..	1	..	1
Ave. lengths	24.0	23.4	26.3	25.0	26.7	25.9	27.4	25.9	26.6	26.7	..	..	..	..

Table XLIX.—Nass River Sockeyes which ran in 1920, grouped by Age, Sex, and Weight, and by their Early History.

Weight in Pounds.	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.		Three Years old.		Four Years old.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
4	1	3	..	..	..	3	..	..	..	..	..	..	..	..
4½	3	5	..	2	2	4	..	..	..	..	..	..	..	1
5	5	10	..	4	3	18	..	1	..	..	..	..	..	..
5½	10	12	2	11	12	37	1	2	..	..	..	1	..	..
6	8	7	4	25	11	80	4	..	..	1	..	..	..	..
6½	4	1	10	18	30	93	6	8	1	3	..	..	..	..
7	1	..	4	8	51	93	4	2	2	4	..	..	..	..
7½	1	1	11	9	72	51	6	4	5	2	..	..	..	..
8	..	..	9	3	59	22	2	1	1	..	..	..	..	..
8½	..	..	6	1	29	6	5	1	1	..	..	..	..	..
9	..	..	5	..	8	1	7	2	1	..	..	..	..	..
9½	..	..	..	..	..	..	3	..	..	..	..	..	..	..
10	..	..	..	..	..	..	1	..	..	..	..	..	..	..
10½	..	..	..	..	..	..	1	..	..	..	..	..	..	..
11	..	..	..	..	..	..	1	..	..	..	..	..	..	..
11½	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Totals	33	39	51	81	277	408	41	21	11	10	..	1	..	1
Ave. weights	5.6	5.2	7.4	6.3	7.4	6.7	7.9	7.0	7.6	6.9	..	..	..	..

The relative sizes of the different types and year-classes are in general similar in successive seasons if we consider the runs as a whole, but the variations in this respect are extreme from one end of a fishing season to the other. For this reason numerous samplings are necessary to give us satisfactory data concerning the construction of the run.

These changes in the relative abundance of the year-groups in different portions of the run occur in fairly uniform sequence in different years, as can be seen on comparing the following table with similar tables in our previous reports in this series. The sea-type and the one-year-in-lake type, with their four year-classes, appear most numerously in the earlier half of the run. Representatives of the sea-type are among the earliest to enter—a fact which may account for the small numbers to appear in our samples in 1920, our first sample dating past the middle of July. The two-years-in-lake and the three-years-in-lake types show a distinct tendency to run late in greatest numbers.

Table L.—Percentages in each Class of Nass River Sockeyes running at Different Dates in 1920.

Date.	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.	Three Years old.	Four Years old.	
July 18	15	33	35	18	..	1	1	121
„ 25	18	24	44	12	2	..	..	171
Aug. 1	11	23	58	7	1	..	..	124
„ 8	6	10	75	5	4	..	..	174
„ 15	..	1	96	1	2	..	..	298
„ 22	..	..	94	2	4	..	..	86

(3.) Proportions of the Sexes.

In the 1920 run the females outnumbered the males in all except one wholly unimportant year-group. The total number of males in our six samplings constituted 47 per cent. and the females 53 per cent. of the run.

Considerable diversity has occurred in this regard in different years. Considering the four principal year-classes only, we find that the four-year class, one-year-in-lake type has more males than females in every year of which records are available, except in 1920; the five-year class of the same type has always the reverse condition, with more females than males; the five-year class, two-years-in-lake type has a distinct excess of males in three years out of seven, an equal excess of females in two of the above years, including 1920, and an essential equality of the sexes the remaining two years; the six-year class of this type is always poorly represented, so averages are uncertain, but our material shows a distinct tendency toward excess of males.

(4.) Lengths and Weights.

The Nass River sockeyes of 1920 were of average size or above, the slight deficiency in both male and female four-year fish being more than compensated for by noticeable excess above the averages in the other year-groups.

The following tables of lengths and weights give a comparative view over a number of years. The reliability of our data for 1920 is attested by the agreement in every group shown in the two tables. Wherever the lengths are above or below the average as given, the weights are correspondingly above or below the average obtained from a series of years.

Table LI.—Nass River Sockeyes, Average Lengths of Different Classes from 1912 to 1920.

Year.	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
1920 "	24.0	23.4	26.3	25.0	26.7	25.9	27.4	25.9
Total averages...	24.3	23.5	26.0	25.0	26.2	25.4	27.0	25.8

Table LII.—Nass River Sockeyes, Average Weights of Different Classes from 1912 to 1920.

Year.	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
1920 " ...	5.6	5.2	7.4	6.3	7.4	6.7	7.9	7.0
Total averages...	5.8	5.3	7.1	6.3	7.0	6.3	7.8	6.7

In previous reports we have called attention to the fact that the August part of the run may often be distinguished sharply from the part of the run that precedes the first of August. The differences are often clearly marked in the two series in the centres of the scales, which record the early history of the fish in fresh water, and a further difference is found in the decidedly larger size of the August fish. The latter difference may be exemplified in the 1920 run by the average size of the females of the dominant type in different parts of the run. The dominant type consists of five-year individuals that had spent their first two years in fresh water.

	July 18.	July 25.	Aug. 1.	Aug. 8.	Aug. 15.	Aug. 22.
Average lengths	24.8	24.8	25.4	25.8	26.4	25.9
Average weights	6.1	6.1	6.4	6.5	6.9	6.3

We have not previously in these studies plotted weights against lengths in any group to ascertain the amount of variation that exists in the weights of fish having the same length and other facts of interest in connection with this distribution. In the following tables we have done this for the dominant Nass River group, which consists, as we have shown, of five-year individuals, which spent their first two years in their lake before descending to sea. In the tables the males and females are treated separately, and for purposes of comparison similar data are given also for the year 1919.

On each of the horizontal lines of the table is given the number of individuals which have the length stated at the left end of the line and the weights as given at the tops of the columns. The variation in weight of fish of equal length is astonishingly great. In Table LV. it is shown, for example, that male salmon of this group, captured in 1919, 26½ inches long, varied from 5 to 8 lb. in weight. The right-hand column gives the average weights for the different lengths. That these increase together is of course inevitable, as is also the fact of a regular progressive increase. The irregularities in our table are wholly due to the small number of individuals in certain of the categories, and largely disappear in the first table in the groups between 25 and 28 inches, where the numbers are large enough to give fairly reliable averages. When this series of numbers is smoothed it is seen that in 1919, in this group of male sockeyes, an increase of ½ inch in the length caused a corresponding increase of 0.3 lb.

This method of handling the data makes possible a direct comparison of the weights of males and females of equal length. The general impression prevails that female fish are plumper and therefore heavier than males if material of equal length is chosen. It is a matter of observation that the snouts of the males are sharper and appear longer, even in the earlier phases of the run. This characteristic would also tend to decrease weight relative to length. But the result of our tabulation was exactly the reverse of what we had anticipated. For every length which the males and females have in common the males average heavier than the females, a fact that holds equally in 1919 and in 1920.

To bring these facts together in small compass and in simplified form, we repeat below the average weights from the four tables, having first smoothed each set by threes.

Table LIII.

Inches.	1919.		1920.	
	Males.	Females.	Males.	Females.
	Lb.	Lb.	Lb.	Lb.
24	5.2	5.1	5.8	5.5
24½	5.5	5.3	6.0	5.8
25	5.7	5.6	6.2	6.0
25½	6.0	5.9	6.7	6.4
26	6.3	6.2	6.9	6.7
26½	6.6	6.5	7.3	7.0
27	6.9	6.7	7.6	7.3
27½	7.2	6.9	7.9	7.7
28	7.5	..	8.2	8.0

Table LIV.—Length and Weight, Distribution of Male Nass River Sockeyes, 1919, Five Years old, Two Years in Lake.

Length in Inches.	Weight in Pounds.									Average Weights.
	5.	5½.	6.	6½.	7.	7½.	8.	8½.	9.	
23	..	..	1	..	..	..	..	..	..	..
23½	..	..	..	..	1	..	..	..	..	..
24	4	..	1	..	..	..	..	..	..	5.2
24½	2	3	2	2	..	..	..	..	..	5.7
25	3	9	10	2	..	..	..	..	..	5.7
25½	1	9	22	17	4	..	..	..	..	6.1
26	..	13	30	35	17	2	..	..	..	6.3
26½	1	9	17	18	29	12	1	..	..	6.6
27	..	..	12	16	50	21	5	3	..	7.0
27½	..	..	4	7	16	19	3	3	1	7.2
28	..	..	..	6	8	5	15	1	..	7.5
28½	..	..	..	..	..	1	3	..	..	7.9
29	..	..	..	..	..	..	..	..	..	..
29½	..	..	..	..	..	..	..	1	..	..
Ave. lengths	24.8	25.7	26.0	26.3	26.8	27.1	27.8	27.6	..	..

Table LV.—Length and Weight Distribution of Female Nass River Sockeyes, 1919, Five Years old, Two Years in Lake.

Length in Inches.	Weight in Pounds.									Average Weights.
	4.	4½.	5.	5½.	6.	6½.	7.	7½.	8.	
23	..	1	3	..	..	..	..	..	..	4.9
23½	..	..	3	2	..	..	..	..	..	5.2
24	..	..	12	3	..	..	..	..	..	5.1
24½	..	1	16	15	3	..	..	..	..	5.3
25	1	1	15	54	23	6	..	..	..	5.6
25½	..	..	9	26	48	15	3	..	..	5.8
26	..	..	2	23	53	41	20	1	..	6.2
26½	..	..	1	9	25	30	26	3	..	6.4
27	..	..	..	1	8	14	19	22	1	6.9
27½	..	..	..	..	2	2	3	4	..	6.9
28	..	..	..	..	..	..	..	..	..	..
28½	..	..	..	..	..	..	1	..	..	..
Ave. lengths	..	..	24.6	25.3	25.8	26.2	26.5	27.0	..	..

Table LVI.—Length and Weight Distribution of Male Nass River Sockeyes, 1920, Five Years old, Two Years in Lake.

Length in Inches.	Weight in Pounds.										Average Weights.
	4½.	5.	5½.	6.	6½.	7.	7½.	8.	8½.	9.	
22	1	..	..	..	..	..	..	..	..	..	4.2
22½	..	..	..	..	..	..	..	..	..	..	..
23	..	2	..	..	..	..	..	..	..	..	5.0
23½	..	1	2	1	..	1	..	..	..	..	5.8
24	..	..	5	2	1	..	..	..	..	..	5.8
24½	1	..	2	3	..	..	..	..	..	..	5.6
25	..	..	..	2	7	2	..	..	..	..	6.5
25½	..	..	1	1	5	3	..	..	..	..	6.5
26	..	..	1	1	8	20	10	1	..	..	7.0
26½	..	..	..	..	5	12	15	2	..	..	7.2
27	..	..	..	..	5	8	29	21	3	..	7.6
27½	..	..	..	..	..	2	12	19	9	1	7.9
28	..	..	..	..	..	1	3	12	8	2	8.1
28½	..	..	..	..	..	..	..	..	6	5	8.7
29	..	..	..	..	..	..	..	..	1	2	8.8

Table LVII.—Length and Weight Distribution of Female Nass River Sockeyes, 1920, Five Years old, Two Years in Lake.

Length in Inches.	Weight in Pounds.											Average Weights.
	4.	4½.	5.	5½.	6.	6½.	7.	7½.	8.	8½.	9.	
22	2	1	..	..	..	..	..	..	..	..	..	4.1
22½	..	1	3	2	..	..	..	..	..	..	..	5.1
23	..	2	1	3	..	..	..	..	..	..	..	5.1
23½	..	..	3	1	1	..	..	..	..	..	..	5.3
24	..	..	3	7	6	..	..	..	..	..	..	5.6
24½	..	..	3	10	5	..	1	..	..	..	..	5.6
25	..	..	..	6	22	9	2	1	..	..	..	6.1
25½	..	..	..	2	22	19	10	1	..	..	..	6.4
26	..	..	..	1	11	54	38	8	..	..	..	6.7
26½	..	..	..	..	1	15	20	16	1	..	..	7.0
27	..	..	..	..	..	5	15	15	9	..	..	7.3
27½	..	..	..	..	..	..	1	8	3	2	..	7.7
28	..	..	..	..	..	..	..	2	8	3	..	8.0
28½	..	..	..	..	..	..	..	..	1	..	..	..
29	..	..	..	..	..	..	..	1	..	..	..	..
29½	..	..	..	..	..	..	..	..	..	..	1	..

THE SOCKEYE RUN TO THE NASS RIVER IN 1921.

(1.) GENERAL CHARACTERISTICS AND THE AGE-GROUPS.

No facts are known to us which can in any degree explain the phenomenally poor run of sockeyes to the Nass River in 1921. The principal brood-year for 1921 was 1916, when a pack of over 31,000 cases was put up, and the spawning-grounds were reported to be abundantly populated when inspected in the fall of that year.

Fears have been frequently expressed during the last few years lest the future of the river might be menaced by American traps located at projecting points along the northern side of Dixon Entrance. That certain of these traps do intercept the schools of Nass River sockeyes cannot be questioned. But they were in no way responsible for the shortage in 1921. Had they made serious inroads on the brood-year, 1916, the canneries at the mouth of the river could not have made a full pack, as they did in that year. As for 1921, the American traps were not driven and the Nass fish were undisturbed. An occasional floating trap was installed in the region in question, but the few sockeyes we were able to examine from their captures were certainly not bound for the Nass River. The poor packs on Rivers Inlet and the Skeena in 1921 could be anticipated from the history of these streams in 1916 and 1917. But the occurrence of a similar shortage in the Nass River remains totally unexplained.

The material that served for the following analysis of the run was gathered by random sampling on twenty different periods, selected at close intervals throughout the season. The total number of individuals examined was 1,797 and the dates extend from June 28th to August 19th.

Seven year-classes were present in the 1921 run, as shown in the two following tables, in which the individuals comprising these classes are shown grouped according to sex, length, and weight. The seven-year-old class, which spends three years in the lake as fingerlings, is always in very small numbers when present. No individuals of this class were found among our samples in either 1920 or 1921.

Table LVIII.—Nass River Sockeyes which ran in 1921, grouped by Age, Sex, and Length, 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.		Three Years old.		Four Years old.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
19	..	..	..	..	..	..	..	..	..	..	..	1	..	..
19½	..	..	..	..	..	..	..	..	..	..	..	..	..	..
20	..	..	..	..	..	..	..	..	..	..	..	..	..	..
20½	..	..	..	..	..	..	..	..	..	..	..	2	..	..
21	..	..	..	..	..	..	..	..	..	..	..	..	..	..
21½	..	3	..	..	..	1	..	..	..	..	..	..	..	..
22	2	10	..	2	2	3	..	..	..	..	..	2	..	..
22½	7	9	..	2	1	6	..	..	..	..	3	1	..	2
23	5	19	2	8	5	19	..	4	..	..	1	1	1	2
23½	8	21	5	11	14	16	1	1	..	..	2	1	1	2
24	12	18	5	12	15	45	1	3	..	..	..	1	..	1
24½	11	10	5	7	33	70	1	3	..	1	1	..	1	2
25	5	7	12	14	57	87	2	6	1	2	..	..	2	1
25½	13	3	8	12	85	119	..	4	2	1	..	..	..	..
26	2	1	7	2	98	115	6	7	..	2	..	..	..	..
26½	2	1	3	1	95	96	4	7	2	3	..	1	..	..
27	1	..	4	..	93	68	7	12	2	3	..	..	..	..
27½	..	..	5	1	47	30	7	8	4	1	..	..	..	..
28	..	..	2	..	33	14	9	3	1	..	..	..	..	..
28½	..	..	..	..	19	3	13	2	..	1	..	..	..	..
29	..	..	1	..	8	..	14	2	1	1	..	..	..	..
29½	..	..	..	..	2	..	4	..	..	..	..	..	..	..
30	..	..	..	..	1	..	3	1	..	..	..	..	..	..
30½	..	..	..	..	..	..	1	..	..	..	..	..	..	..
Totals	68	102	59	72	608	692	73	63	13	15	7	10	5	10
Average lengths	24.3	23.5	25.5	24.3	26.2	25.6	27.9	26.2	26.9	26.5	23.1	22.4	24.2	23.6

Table LIX.—Nass River Sockeyes which ran in 1921, grouped by Age, Sex, and Weight, and by their Early History.

Weight in Pounds.	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.		Three Years old.		Four Years old.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
3	..	..	..	..	..	..	..	..	..	..	1	1	..	..
3½	..	..	..	..	..	..	..	..	..	..	..	1	..	..
4	..	2	..	..	..	1	..	..	..	..	..	2	..	..
4½	2	10	1	1	1	5	..	..	..	..	..	1	..	1
5	14	35	1	7	16	49	2	2	..	..	3	3	1	4
5½	12	27	3	16	31	117	1	12	1	2	2	1	..	1
6	15	16	11	20	76	201	4	13	2	3	1	..	3	2
6½	13	10	12	15	135	129	5	11	3	4	..	..	1	1
7	5	1	8	7	132	110	11	8	1	5	..	1	..	1
7½	6	..	11	3	122	59	12	12	4	1	..	..	..	..
8	1	1	6	2	63	18	17	1	1	..	..	..	..	..
8½	..	..	4	..	22	3	7	2	..	..	..	..	..	..
9	..	..	1	1	9	..	9	1	1	..	..	..	..	..
9½	..	..	1	..	1	..	4	1	..	..	..	..	..	..
10	..	..	..	..	..	..	1	..	..	..	..	..	..	..
10½	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Totals	68	102	59	72	608	692	73	63	13	15	7	10	5	10
Average weights	6.0	5.4	6.9	6.1	6.9	6.3	7.7	6.6	7.0	6.5	5.0	4.6	5.9	5.5

The percentages of the four principal groups in the 1921 run diverged sharply from the average in one respect. The five-year class of the one-year-in-lake type was very scantily represented. Whereas it usually comprises a fifth or more of the run, in 1921 it contributed little more than a fifteenth. It was even less numerous than either the four- or the six-year classes, although it usually outnumbers both of these combined. It was proportionally far smaller than in the nine previous years of which we have record, while the other five-year class was correspondingly more numerous than ever before.

Table LX.

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
1920	8	14	72	6
1921	10	7	75	8

In the following table we give again the percentages, on a large number of dates throughout the season of 1921, of each class of sockeyes then comprised in the run. The table displays the entrances and the exits of groups and the period during the run when they attained their maximum numbers. It is to be noted that at the opening of the fishing season the two one-year-in-lake classes were present in small numbers only, that the two classes increased in parallel fashion until they reached their maximum numbers during the third week in July, and then rapidly decreased until they almost wholly disappeared in August. Their parallel history during the season is a striking phenomenon. The two six-year classes also progressed proportionally, being absent or nearly so on the early days of the run and increasing toward the close, the class belonging to the three-years-in-lake type entering later than the other. The two sea-type classes were present only during the first two weeks of the season. The principal class of five-year-olds does not vary significantly during the season.

Table LXI.—Percentages in each Class of Nass River Sockeyes running at Different Dates in 1921.

Date.	One Year in Lake.		Two Years in Lake.		Three Years in Lake.	Sea-type.		Number of Individuals examined.
	Four Years old.	Five Years old.	Five Years old.	Six Years old.	Six Years old.	Three Years old.	Four Years old.	
June 28	6	2	83	..	..	5	4	122
July 1	5	6	79	2	..	5	3	125
July 7, 8	8	8	79	..	..	2	3	123
July 9	11	6	80	..	..	3	..	99
July 11	19	7	66	6	1	..	1	122
July 13, 14	17	21	57	4	..	..	1	125
July 16	28	36	36	..	..	..	..	25
July 18	20	18	56	5	1	..	..	95
July 20	22	11	62	5	..	..	..	100
July 22	6	9	77	6	2	..	..	47
July 26	17	8	63	12	..	..	..	72
July 29	8	8	67	17	..	..	..	125
July 30	16	4	64	14	2	..	..	49
Aug. 1	7	1	83	8	1	..	..	74
Aug. 5	5	2	86	4	6	..	..	98
Aug. 6	1	..	80	16	3	..	..	69
Aug. 8	1	2	79	16	2	..	..	174
Aug. 13	..	3	79	14	4	..	..	67
Aug. 16	3	..	67	22	8	..	..	36
Aug. 19	..	2	74	12	12	..	..	50
No. individuals	170	131	1,300	136	28	17	15	1,797
Percent. each class	9	7	72	8	2	1	1	..

(2.) Lengths and Weights.

Table LXII.—Nass River Sockeyes, Average Lengths of Different Classes from 1912 to 1921.

Year.	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
1920 ,,	24.0	23.4	26.3	25.0	26.7	25.9	27.4	25.9
1921 ,,	24.3	23.5	25.5	24.3	26.2	25.6	27.9	26.2

Table LXIII.—Nass River Sockeyes, Average Weights of Different Classes from 1913 to 1921.

Year.	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
1920 "	5.6	5.2	7.4	6.3	7.4	6.7	7.9	7.0
1921 "	6.0	5.4	6.9	6.1	6.9	6.3	7.7	6.6

In the two tables which precede we have given the average lengths and the average weights of Nass River sockeyes for a term of years. These show in general a close correspondence in the averages of the different age-groups, especially in those groups that are most numerously represented in every run. The annual averages in these are more reliable than in groups with smaller numbers and are less subject to the chance variations of limited random sampling. The groups with smaller numbers are always those of the sea-type and those that remain three years in the lake after hatching. As each of these types contains two distinct year-groups and the males and females of each year-group are listed separately, each category has very few individuals. In 1921 the three year-groups of these two types combined contained only sixty individuals and the categories ranged from five to fifteen. Averages based on such very limited material are of little value for any one year. It is only by summing up the averages of a long series of years that we obtain a reliable index of the sizes characteristic of the members of these year-groups.

The dominant classes in the Nass are the four-year group and the five-year group of the one-year-in-lake type and the five-year and six-year groups of the two-years-in-lake type. Together these constituted in 1921 approximately 97 per cent. of the run. Their lengths and weights, which we compare in the following tables with the general averages derived from our records since 1912, indicate that they had had a normal existence in the sea and were as well nourished as average representatives of their respective groups in any year. There is no reason to believe that the phenomenally small run in 1921 was due in any measure to adverse conditions that affected injuriously the growth of the fish.

Table LXIV.—Average Weights of Nass River Sockeyes, 1921, compared with General Averages of 1914 to 1919.

	Average Weights, 1921.	General Averages, 1914 to 1919.
One year in lake—		
Four-year males	6.0	5.9
Four-year females	5.4	5.4
Five-year males	6.9	7.0
Five-year females	6.1	6.3
Two years in lake—		
Five-year males	6.9	6.9
Five-year females	6.3	6.3
Six-year males	7.7	7.8
Six-year females	6.6	6.6

Table LXV.—Average Lengths of Nass River Sockeyes, 1921, compared with General Averages of 1912 to 1919.

	Average Lengths, 1921.	General Averages, 1912 to 1919.
One year in lake—		
Four-year males	24.3	24.4
Four-year females	23.5	23.5
Five-year males	25.5	25.9
Five-year females	24.3	25.0
Two years in lake—		
Five-year males	26.2	26.2
Five-year females	25.6	25.4
Six-year males	27.9	27.0
Six-year females	26.2	25.8

It is a remarkable fact that the averages in size taken for the entire season compare so closely between one year and the next, while yet such very extensive fluctuations in size occur each year during the continuance of the run. The causes for these fluctuations are obscure. In some cases, undoubtedly, they have to do with racial differences and the disparity in size which may characterize colonies bound for distinct tributary streams. The more extensive fluctuations may well be ascribed to this cause, but there are minor changes in size from day to day or week to week, too numerous and often too slight, to make plausible such an explanation.

In the two tables below and in the graph which follows we illustrate the fluctuations in size by dividing the run into eleven periods, and giving for each of these the distribution of individuals taken during such period. Males and females are given separately. It might be considered that the apparent changes in average size were due to the vagaries of chance sampling, were it not that the frequency distributions display a fair symmetry, in whatever part of the scale they may occur; and for the additionally significant fact that the fluctuations of male and female lengths throughout the series of dates are parallel. As all the measurements were taken by the same observer, the average errors due to observation should be the same in different samples. It is possible the minor differences in size are in part due to the arrival of different schools of fish that have lived together in the sea and have fed better or worse than schools which precede or follow them in the run.

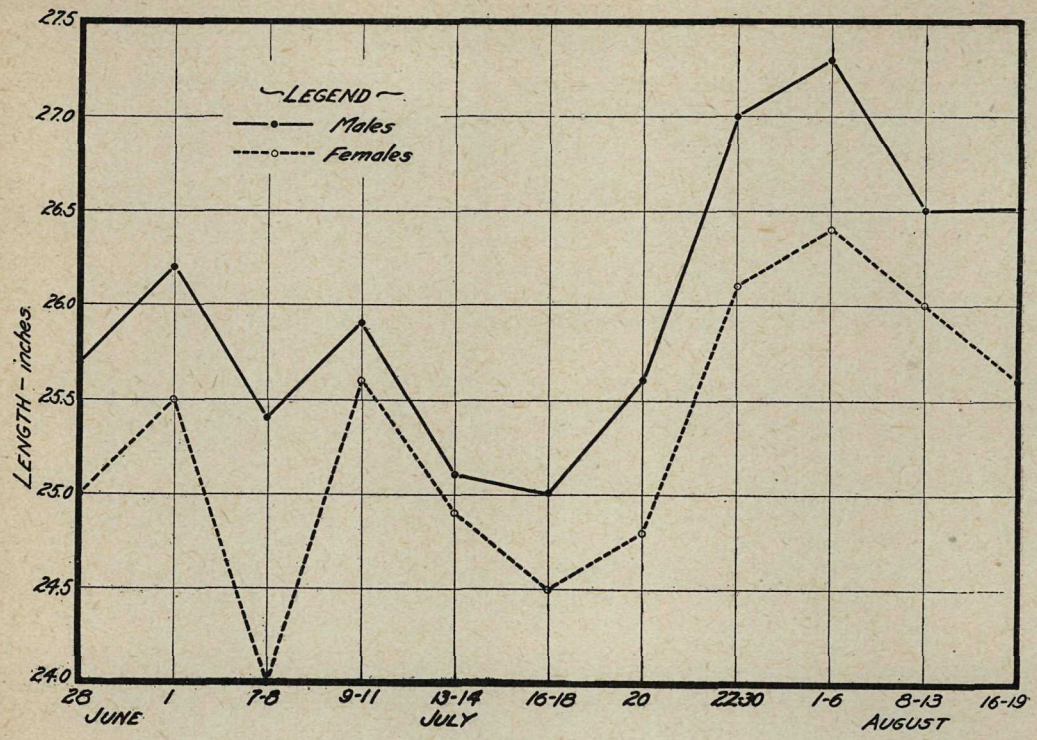
The group chosen for the following tables is the largest group present on the Nass River run, consisting of five-year fish that remained in the lake for two years after hatching. This group comprised numerically 72 per cent. of the run in 1921.

Table LXVI.—Nass River Male Sockeyes, 1921, in Fifth Year, Two-year-in-lake Type, arranged by Lengths on a series of Dates.

Inches.	June 28.	July 1.	July 7, 8.	July 9, 11.	July 13, 14.	July 16, 18.	July 20.	July 22, 26, 29, 30.	Aug. 1, 5, 6.	Aug. 8, 13.	Aug. 16, 19.
21	..	..	..	..	..	..	..	..	..	..	..
21½	..	..	..	..	..	..	..	..	..	..	..
22	..	..	..	..	2	..	..	..	..	..	..
22½	..	..	..	..	..	1	..	..	..	..	..
23	..	..	..	1	2	2	..	..	..	..	..
23½	..	..	5	3	2	3	1	..	..	..	..
24	..	1	5	1	3	1	3	..	1	..	..
24½	3	2	8	4	3	5	2	..	2	2	2
25	8	1	12	14	5	2	4	3	1	6	1
25½	20	7	8	15	6	4	6	5	5	7	2
26	11	11	6	16	6	9	6	7	6	14	6
26½	10	6	5	17	2	3	2	18	11	13	8
27	1	11	..	13	1	..	4	23	15	20	5
27½	..	2	1	3	1	..	..	13	18	8	1
28	..	..	..	..	1	..	1	13	10	4	4
28½	..	..	..	1	..	..	..	1	13	3	..
29	..	..	..	..	..	..	..	3	5	..	..
29½	..	..	..	..	..	..	..	..	2	..	..
30	..	..	..	..	..	..	..	..	1	..	..
Totals	53	41	51	88	34	30	29	86	90	77	29
Average lengths	25.7	26.2	25.4	25.9	25.1	25.0	25.6	27.0	27.3	26.5	26.5

Table LXVII.—Nass River Female Sockeyes, 1921, in Fifth Year, Two-years-in-lake Type, arranged by Lengths on a Series of Dates.

Inches.	June 28.	July 1.	July 7, 8.	July 9, 11.	July 13, 14.	July 16, 18.	July 20.	July 22, 26, 29, 30.	Aug. 1, 5, 6.	Aug. 8, 13.	Aug. 16, 19.
21	..	..	..	..	..	..	..	..	..	..	..
21½	..	..	..	..	..	..	1	..	..	..	..
22	..	..	1	1	1	..	..	..	..	..	..
22½	..	..	4	..	..	1	1	..	..	..	..
23	..	..	9	..	4	5	1	..	..	..	..
23½	2	..	7	1	1	2	2	..	..	..	1
24	7	2	3	5	4	5	3	5	4	4	3
24½	11	7	12	6	4	6	7	2	2	7	4
25	12	5	3	14	6	2	10	13	6	14	4
25½	10	26	5	14	9	5	1	17	10	18	4
26	4	10	1	15	3	6	4	21	19	25	7
26½	1	6	1	8	4	..	1	25	25	19	6
27	1	2	..	4	1	..	1	20	22	16	1
27½	..	..	..	4	..	..	..	5	13	7	1
28	..	..	..	..	..	..	1	2	8	2	1
28½	..	..	..	..	..	..	..	..	1	2	..
29	..	..	..	..	..	..	..	..	..	..	..
Totals	48	58	46	72	37	32	33	110	110	114	32
Average lengths	25.0	25.5	24.0	25.6	24.9	24.5	24.8	26.1	26.4	26.0	25.6



Variations in average size of Nass River sockeyes, five-year-old class, two years in lake, at different periods in the run of 1921.

Inspection of the graph makes evident the sudden and extensive increase in length which characterized the late-running fish. In a period of only two days, from July 20th to the 22nd, the average length of the males increased nearly 1½ inches, from 25.6 to 27 inches, and the females a similar amount, from 24.8 to 26.1 inches. They remained nearly constant at this new level, but in both sexes with distinct additional increase, for a period of over two weeks, when the size again diminished.

This is one of the major fluctuations referred to on a previous page as probably of racial origin. A similar phenomenon has been observed in the run of previous years and ascribed to the same cause. In our report for 1915 (1916, page 60) we state: "The outstanding feature of the run of 1915 was its sharp division into an early and a late period, the two exhibiting very distinct characteristics. The second period was marked by a new run of conspicuously larger fish appearing after the middle of the season, in the final days of July or during the first of August." We there called attention to a difference manifested by the larger late-running fish of 1915 in the character of the central area of the scales, which records growth in fresh water. A different habit of growth in fresh water, taken in connection with distinctive size and definite appearance in the run, warranted the assumption that we had to do with a distinct race, bound either for Meziadin or Bowser Lake, the only two spawning areas known in this watershed. The difficulties in the way of adequate exploration of the Nass River basin have thus far prevented a determination of this matter by examining the spawning populations of the two lakes.

THE SPAWNING-BEDS OF THE FRASER RIVER.

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

SIR,—I have the honour to submit the following report of my annual inspection of the salmon-spawning area of the Fraser River basin during the season of 1921:—

I made my eighteenth annual inspection of the principal spawning area of the Fraser River basin during July, August, September, and October. Major J. A. Motherwell, Chief Inspector of Fisheries for the Dominion in the Province, accompanied me over the greater portion of the area. I am indebted to him and his assistants, and also to many local residents, both white and Indian, scattered over the basin, for information of value.

For the past three years the Indian residents on the Fraser, above the commercial fishing limits at Mission Bridge, have been prohibited from catching salmon. Previous to three years ago the Indians above Mission Bridge were permitted to take fish for their own use. They maintained regular fishing-stations in the canyon above Yale, in the canyon above the mouth of Bridge River, at Soda Creek and Quesnel on the Fraser, at three stations on the Chilcotin River, and also at numerous points on the Thompson River. By observations made at these stations valuable data as to the time, duration, and abundance of the salmon run were easily obtained. But since then they no longer fish openly, and such data are therefore difficult to obtain, and when obtained are far less satisfactory.

By authority granted by the Minister in Ottawa, this Department was permitted to use a gill-net daily in the Fraser near New Westminster, and in the Harrison at the rapids above Harrison Mills, during the months of May and June, during which time commercial fishing for sockeye is prohibited. This work was undertaken in order to ascertain if any considerable number of sockeye entered the Fraser during those months. By this means it was demonstrated that no run of sockeye entered the Fraser in May and June this year. No sockeye were taken in the nets used in the Harrison and less than twenty in the nets employed in the Fraser.

Sockeye made their appearance at Hell's Gate in the Fraser Canyon above Yale late in July and were observed there during August and September. The run was greatest in August. I visited the canyon several times in August and September and was twice accompanied by Major Motherwell. At no time this season were sockeye observed there in as large numbers as in 1920. Dominion Fishery Officer Scott, who has been detailed to patrol that canyon for the past seven years, reported to Major Motherwell that the number of sockeye that passed through Hell's Gate this year was less than last year. The run during last season is believed to have been larger than in the preceding year. Water conditions at Hell's Gate throughout this season were most favourable for the passage of fish. The fish were not delayed there at any time. No pink salmon were seen at Hell's Gate during the season, nor have any been observed there, or in the waters above, since 1913. The number of spring salmon seen at Hell's Gate this year was larger than usual.

It has been stated in the press that the sockeye that pass through the Fraser Canyon to the waters above enter the Fraser annually in July, and that the August run to the Fraser spawns annually in the tributaries of that stream below Hell's Gate. Such is not the case. Every season since our observations began in 1901 more sockeye have been seen at Hell's Gate in August and September, and in some years in October, than at any time in the month of July. In 1901 and again in 1905 there was a good run of sockeye through the canyon in November, and they have been seen there in December.

The number of sockeye that entered Quesnel Lake this year was much more difficult to determine than in any year since my observations began in 1901. The great dam that was built at the outlet of the lake in 1898 was virtually removed in May of this year by the Public Works Department of the Provincial Government. Some 250 feet of the dam near the left bank bulk-head was removed because of its weakened condition. There was danger that the dam might give way during high water and cause serious damage to the bridges and the valley lands immediately below. It will be recalled that the Province constructed a large fishway in the race of the dam in 1903, and that all the salmon that have since entered the lake have passed through it. In doing so they were enumerated with some considerable degree of accuracy.

It was shown, for example, that over 4,000,000 sockeye passed through the fishway in 1909, that some 550,000 passed through it in 1913, and less than 28,000 in 1917. The removal of the section of the dam above referred to enabled the fish this year to enter the lake with ease and without passing through the fishway, though passage through the fishway was still available to them. It could not therefore be determined with any degree of accuracy how many entered the lake this year. A watchman was stationed there during the season as in the years since the fishway was constructed. His report states that sockeye first reached there on August 18th, and that small numbers were observed daily up to September 18th; that they were most numerous between September 1st and 10th, and that he believed the total number that entered the lake this year was greater than last year, but very much smaller than four years ago.

On visiting the Horsefly River, the main spawning tributary of Quesnel Lake, we were informed by men mining in the river-bed and by residents along the banks that more sockeye reached the Horsefly this year than last, but that the run was very small for a big year.

At the spawning-grounds at the head of Bowron Lake (called Bear Lake in my early reports), a tributary of the South Fork of the Fraser, very few sockeye were found. The run to this section in the big years up to 1913 was always large, and in the lean years up to 1909 considerable numbers were seen there. Observations by residents on the stream below Bowron Lake indicate that the sockeye were more numerous this year than last year and that the run of spring salmon was larger.

For the first time in several years it is reported that sockeye were seen in the tributaries of the Nechako River.

Sockeye reached the Chilcotin River on August 4th. The Indians, notwithstanding the existence of prohibitory regulations, are known to have taken a few at night for some two weeks after that date. Indians living at the head of the Chilko River near the outlet of Chilko Lake state that the run this year was greater than last season. From the statements made by Chilcotin Indians and resident whites, there is reason to believe that the run to that section this year was better than to any other section above Hell's Gate.

Not a single sockeye is known to have entered Seton Lake this year, though a close watch was maintained at the Seton Lake Hatchery and by residents on the Portage between Seton and Anderson Lakes.

The number of sockeye observed in the Shuswap Lake section was less than last season. None were seen in the Thompson and none made their appearance at the dam at the outlet of Adams Lake. Fishery Overseer Shotten, who has patrolled the Shuswap District and the Thompson River for the past eight years, reports that there were less sockeye this year than last, that no pinks were seen, and that the run of spring salmon was up to the average of recent years.

Superintendent T. W. Graham, of the Pemberton Hatchery at the head of Lillooet Lake, reported to Major Motherwell that the run of sockeye to that section this year was not as great as last year, but that it equalled those of 1908 and 1919, and was at least five times greater than in 1917, the year of the poorest run recorded there since the making of records was begun in 1902. Superintendent Graham collected 26,000,000 sockeye-eggs this year. The water in the river was high throughout the season, and owing to a break in the weir the egg collection was lessened by some millions of eggs.

Harrison Lake.—Alexander Robinson, Superintendent of the hatchery in the Harrison Lake District, reports that the run of sockeye this year was small to all waters in that section, the smallest since the hatchery was built in 1905. Sockeye-egg collections totalled but 700,000. There was a big run of pinks, but the run of springs was not as large as in recent years. Water conditions were most unfavourable for natural spawning.

Pitt Lake.—There was an average early run of sockeye to Pitt Lake and tributaries, but water conditions were most unfavourable for natural spawning and egg collections.

Cultus Lake.—Sockeye made their appearance at Cultus Lake in August, a month earlier than usual. Approximately 10,000 reached the spawning-station at the lake's entrance, the majority of which were spawned artificially. More than 4,000,000 sockeye-eggs were secured.

A summary of conditions of the spawning area of the Fraser basin this year shows that, notwithstanding the fact that 1921 was in the cycle of former big runs, the run of sockeye was no larger and the spawning-beds no better seeded than in recent lean years. The quadrennial big run of sockeye to the Fraser River has been destroyed.

There were not sufficient eggs deposited in the Fraser this year to produce an ordinary lean-year run.

The following statement forwarded to the Department by Major J. A. Motherwell, Chief Inspector of the Dominion Fisheries Department, gives the total egg collections of all the hatcheries:—

COLLECTION OF EGGS, BRITISH COLUMBIA, 1921.

Hatchery.	SALMON.					Totals.
	Sockeye.	Cohoe.	Humpback.	Spring.	White Spring.	
Anderson Lake	10,033,200	.....	.....	.....	.....	10,033,200
Babine Lake	6,090,000	.....	.....	.....	.....	6,090,000
Cowichan Lake	.....	1,227,800	.....	1,507,300	9,000	2,744,100
Cultus Lake	4,306,200	.....	.....	.....	.....	4,306,200
Harrison Lake	727,000	.....	4,515,000	937,000	.....	6,179,000
Kennedy Lake	1,854,000	82,950	.....	.....	.....	1,936,950
Pemberton	26,053,000	.....	.....	.....	.....	26,053,000
Pitt Lake	2,680,750	.....	.....	.....	.....	2,680,750
Rivers Inlet	18,374,400	.....	.....	.....	.....	18,374,400
Skeena River	4,286,000	4,000	396,000	.....	.....	4,686,000
Stuart Lake*	5,530,000	.....	.....	.....	.....	5,530,000
Totals	79,934,550	1,314,750	4,911,000	2,444,300	9,000	88,613,600

* Eggs collected from the Skeena River Basin.

Respectfully submitted.

JOHN PEASE BABCOCK,
Assistant to the Commissioner.

Victoria, B.C., December 1st, 1921.

THE SPAWNING-BEDS OF THE SKEENA RIVER.

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

SIR,—In obedience to your instructions, I beg to submit herewith the following report on the spawning-beds of the Skeena River for the season 1921:—

I arrived at Donald's Landing, on Babine Lake, on the evening of September 6th, and on the following day proceeded to 15-Mile Creek, which is some 10 miles from the head of the lake on the south shore. This creek has about half a mile of ideal spawning-grounds commencing at the mouth of the creek and ending at the first little waterfall. Beyond that the creek is of a rocky nature, with a series of waterfalls, which hinder the sockeye from going up and is not suitable for spawning purposes. At the time of my visit there were fourteen Stuart Lake Indian families fishing with thirty nets off the mouth of the creek and had caught something like 4,000 sockeye. I met Mr. Crawford, the Superintendent of Stuart Lake Hatchery, and his assistant, Mr. Karnock, who were busy spawning. The barricade, or fence, for spawning purposes is erected at the head of the spawning area, which in no way interferes with the natural propagation in the creek. Mr. Crawford informed me he commenced spawning on August 29th, which is eleven days earlier than last year, and that he had then almost a million sockeye-eggs. This creek was in excellent shape and there would be at least three times as many sockeye as last year. The creek will be well seeded and will compare favourably with any former average year. The sockeye could be plainly seen spawning from the mouth of the creek right up to the barricade, and although there were quite a number of undersized fish, or "runts," as they are called, the average size on the whole was much better than last year. The females were in excess of the males in proportion of about ten to eight. I visited this creek again on September 17th and found the Indians had caught about 7,000 sockeye. I am informed that there have been at least twenty-four Indian families, all from Stuart Lake, fishing off the mouth of this creek this season. As this is quite a drain on this particular creek, I think some restrictions should be imposed, limiting at least the number of nets used at one time. I understand that it is owing to the fishing restrictions on the Fraser River watershed that the Stuart Lake Indians are now coming to Babine. Mr. Crawford had then secured 2,110,000 sockeye-eggs and he was hopeful of obtaining another 500,000 from this creek. One Indian who had his net out the night before had caught twenty-four green sockeye, all females too, which was evidence the sockeye were still running at this date. Mr. Crawford informed me it was his intention to plant 250,000 eyed sockeye-eggs in this creek when he was through spawning, and another 250,000 in Pierre Creek, another creek on Babine Lake from which he obtains ova for Stuart Lake Hatchery.

On September 9th I arrived at Pierre Lake, which is almost midway between the Old Fort and the head of the lake, and was agreeably surprised to find no Indian fishing at the mouth. This creek was also in good condition, having even a bigger spawning area than 15-Mile Creek. Mr. Crawford had his fish barricades erected away up the creek too, as this was of a similar formation to 15-Mile. Sockeye were seen in this creek on August 1st and Mr. Crawford commenced spawning on August 18th, which is five days earlier than last year. The number of sockeye-eggs Mr. Crawford had spawned in this creek was approximately 2,000,000. This creek was also well stocked with sockeye, large numbers even being seen in the lake at the mouth of the creek, some of which were spawning. The fish here were of a good size and were of a better average than 15-Mile, the males, if anything, predominating. From the number of fish seen and also the number that had already spawned by the formation of the gravel, this creek will be well seeded and up to the average of former years.

Leaving Pierre Creek, I arrived at the Babine Hatchery on the night of September 10th and met Mr. Gibbs, the Superintendent. The following day an inspection was made of the Hatchery Creek from the mouth to the outlet of Morrison Lake, where the hatchery is located, a distance of about 2½ miles. This creek is cleared of all obstructions and is a series of pools and gravel patches. Although the big majority of the sockeye spawn in the upper part of the creek, a large number were seen in the deep pools at the lower end and some were spawning in the shallow gravel patches. This creek is undoubtedly the best sockeye-creek on the Skeena watershed, and its success is mainly due to the hatchery and its location. Although it is not considered an early

spawning-creek, I was informed by Mr. Gibbs and his men that a large number of sockeye came up the creek and into Morrison Lake as early as June 18th. As the barricades and fish-pens were not erected till July 15th, it was evident from the number of dead sockeye in the creek at the head of Morrison Lake that an early run had occurred. Hatchery Creek was alive with sockeye, the big fish-pens being one swarming mass. The creek will be well seeded and easily up to the average of former years. The fish in this creek are of an exceptional quality and attain a high average, the males and females being evenly balanced. Two of the female sockeye picked at random measured 25½ and 26½ inches respectively, while I should think the average weight of the sockeye to be in the vicinity of 9 lb. Up to September 12th Mr. Gibbs had spawned 2,500,000 eggs, and judging by the sockeye still available he should not have much difficulty in obtaining his 8,000,000 capacity for the hatchery. I may say that Mr. Gibbs is having great success with his retaining-ponds, where this year's sockeye-fry are being held. The pond, or rather the series of ponds, have an intake of running water from Morrison Lake and there were in the neighbourhood of 5,000,000 fry. To look at the ponds in the evening one would imagine it was pouring rain, so swift were the young fry in catching the small flies that would alight. Although a keen search was made, I could only see two or three dead fry in the bottom of the ponds.

I arrived at Babine on September 13th and the following morning went down the Babine River for about 10 miles. It is on this stretch of water that the Babine Indians, approximately 100 families, catch their winter's supply of fish. Although this stretch of water from the bridge at Babine for a distance of at least 3 miles has always been considered a good spawning-ground, there were very few sockeye to be seen. There were large numbers of humpbacks, however, and a few cohoes, which was a decided contrast to the well-stocked sockeye-creeks in the lake. The Indians have their smoke-houses all down this stretch of water on both side of the river and complained bitterly about the scarcity of sockeye. Unlike the down-river Indians and their choice of salmon, the Babine Indians prefer sockeye and sockeye only. An examination of their smoke-houses revealed that the average catch per family would be less than 200 sockeye, with probably from 400 to 500 humpbacks and a few cohoe and spring salmon. This stretch of water will be poorly seeded and away below the average of former years.

Leaving Babine on September 14th, I arrived at Tachek or Fulton Creek, where there were seven Indian families fishing off the mouth. The Indians had a fair amount of sockeye in their smoke-houses, but complained about not catching enough through their rotten nets. The Dominion Department furnishes each family with a new net each year, but it appears they keep using their old nets as well, with the result stated. This creek resembles a slough for about a mile from the lake and has about 3 miles of fair spawning-grounds. The sockeye go up as far as the falls, about 4 miles from the lake, but cannot get beyond. This creek was also in good condition, with a large number of sockeye in the pools and many spawning in the shallow gravel patches. The sockeye were of a good size, with the males slightly in excess of the females. This creek will be exceptionally well seeded and will rank next to Hatchery Creek, being well up to the average of former years. Last year this creek was almost devoid of sockeye.

I visited Beaver Creek on September 17th, which is a much longer creek than the others. This also has a slough for about 3 miles from the lake, with a series of rock and log obstructions and a few good spawning areas for about 9 miles up the creek. This creek is the farthest from the mouth of the Babine Lake and also the earliest spawning-creek. I am informed there was a big run of sockeye up this creek on July 30th, and that it has never been so good for years. I went up the creek for a considerable distance, but there were few live sockeye. It was well seeded, however, judging from the big number of dead salmon caught in the log-jams and in the big pools. The Indians speak well of this creek too and are very enthusiastic about it, as they say that lots of sockeye in creek means lots of bear.

Leaving Beaver Creek, I called in at 4-Mile Creek, but this is too small to be of any importance, as one can jump across it almost anywhere. There were, however, a few live and some dead sockeye which had spawned. As this was the last point of interest on Babine, I returned to Donald's Landing and arrived at Burns Lake on September 18th. In summing up the Babine District, I may say that, with the exception of Lower Babine River, which will be poorly seeded, all the creeks on the lake, the more important spawning-grounds, will be well seeded, very much better than last year and will compare favourably with any former average year. It was plainly evident that the run was much earlier than previous years; hence the

poor catch of sockeye from the hundred Indian families on Babine River. There were also, I may say, more fish with net-scars than former years.

While at Burns Lake I was informed by the Indians that there was a run of sockeye in Burns Lake from the Fraser River for the first time for eighteen years. Mr. Crawford also said the same occurred in Stuart Lake, of the Fraser River watershed.

I arrived at Hazelton on September 20th and visited Awillgate Canyon, in the Bulkley River, where the Hazelton Indians catch their fish. The Indians had removed a lot of the fish from the smoke-houses, but the Dominion Guardians informed me that the Indians must have put up at least 10,000 sockeye. According to the Guardians' report, there was a good run of sockeye up the Bulkley River and the Indians were apparently quite satisfied with the amount they had caught. The Kispiox River and creeks in the Hazelton vicinity were swarming with humpbacks and there has also been a good run of cohoes.

Leaving Hazelton, I arrived at Terrace on September 22nd and visited Lakelse Lake and hatchery the following morning, when I met Mr. Catt, the Superintendent of the hatchery. Mr. Catt informed me that the sockeye run to the lake was very poor this year and that he only had obtained to date a total of 3,800,000 sockeye-eggs for the hatchery. The first sockeye, he informed me, were seen in the creeks on June 12th, and the barricades, or spawning-fences, were not put in till July 24th, so a few sockeye would undoubtedly spawn naturally up the creeks. Mr. Catt commenced spawning on August 5th and he said there were more ripe fish then than the first day's spawn last year, which again bears out the theory of an earlier run this year. The first creek visited was Williams Creek, which is a long, swift-running creek opening out near the mouth. The sockeye do not go far up, preferring to spawn in the shallow gravel-beds near the lake. There were not many sockeye in the creek, but the fish-pens at the barricade were full and contained a good number of green or unripe sockeye. A number could be seen in the lake at the mouth of the creek, so apparently the sockeye were still running. This creek will be poorly seeded and will be below the average of former years.

Schallabuchan was the next creek visited, but as this is a much earlier spawning-creek there were few live sockeye to be seen. From the number of dead salmon in the creek it is apparent that a few had gone up and spawned, but the average was away below normal.

The remaining creeks were much smaller, but the same poor condition existed, which forecasts that the Lakelse area will be poorly seeded this year and will be away below the average of former years. All the creeks on Lakelse are of a mountainous nature, and Mr. Catt attributes the failure this year to the excessive high water in these mountain streams in the fall of the year 1917, when most of the natural spawned ova was washed away. As this was the last point of interest, I returned to Terrace and arrived in Port Essington on September 25th.

I wish to express my thanks and appreciation to the Dominion Hatchery Superintendents and the Dominion Fishery Guardians, to whom I am indebted for information supplied and hospitality shown.

I have, etc.,

ROBERT GIBSON,

Provincial Constable and Fishery Overseer.

Port Essington, B.C., October 5th, 1921.

THE SPAWNING-BEDS OF THE NASS RIVER.

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

SIR,—In obedience to the wishes of the Department, I have made a trip of inspection to the salmon-spawning area of the Meziadin watershed of the Nass River, and beg to submit the following report:—

Before leaving for the north I made arrangements with the Chief Inspector of Dominion Fisheries, J. A. Motherwell, to make the trip into the Nass in company with their Overseer, J. M. Collison. I left New Westminster on September 8th and arrived at Prince Rupert on the 10th, where I met Mr. Collison. We engaged three Indian packers for the trip. We arrived at Stewart on the 11th and after getting our outfit together left for the interior on the 13th.

On the trip in we encountered many difficulties on account of the bad condition of the trails, also in crossing the Bear River Glacier. The ice, which is receding in many places, makes travelling very dangerous. There being no bridge or other means of crossing the Surprise River, it is necessary to ford it. This is a mountain stream about 200 feet wide and the water is waist-high. A cable crossing at this place would be of great benefit to travellers, as the waters rise very rapidly during freshet and it is very dangerous to ford when you have a heavy pack on your back.

We reached the head of Meziadin Lake on Saturday, September 17th, in a pouring rain and everything wet through.

On Sunday, September 18th, we made an inspection of the spawning-beds at the south-west section of the lake, from the head of the lake and for a distance of 3 miles down. Sockeye were to be seen at different favourable places for spawning and at one place they were fairly plentiful. On the 19th we left the head of the lake and followed the north-westerly shore-line on our journey down. For a distance of between 3½ or 4 miles there are several favourable shallow gravel reaches suitable for spawning sockeye, and at these places sockeye were to be observed in considerable numbers and far more numerous than I have seen at this place before. Here we saw a grizzly bear wade into the lake and take two salmon.

On continuing our journey down the lake we went up Hanna Creek and McLeod Creek, two streams of considerable size, emptying into the lake on its northerly side. We only saw one sockeye there. The water, which is very clear, enables you to see the bottom, and my observations bear out my previous contention that sockeye do not go up these streams for spawning purposes.

There were very few salmon to be seen leaping in the lake, which is their habit when they enter the lake green, or, rather, when they are not nearly ripe for spawning.

At the spring-salmon spawning-ground below the McBride Rapids in the Meziadin River there were not so many springs to be seen as in former years. After inspecting the vicinity of the rapids we continued our way on down the river and arrived at the cabin at the fishway after dark. It was raining hard.

On Tuesday, September 20th, it poured with rain all day and we were unable to make any inspection worthy of note.

On the 21st, the rain having ceased, we made a thorough inspection of both the upper and lower falls from all angles. There were very few salmon at either place. Two small schools were to be seen immediately below the upper fall and a small number on the far side, not more than twenty-five in each lot. They were about half sockeye and half cohoe. No salmon were to be seen congregated below the lower fall, but a few salmon were passing up at intervals, mostly cohoe.

Very few salmon were passing through the fishway, only an odd one once in a while, and only a small number resting in the basins of the fishway. The reason for this is that there were no fish to come through. The salmon passing up were sockeye and cohoe, and the cohoe were in greater numbers.

The absence of sockeye at the fishway was very noticeable to one whose duty it has been to make an annual inspection, for in the past, up to and including the year 1917, as many sockeye could be observed passing through the fishway in one minute as we saw this season

pass through in one hour. It must be borne in mind that I have always timed my inspection at this point to take place between September 20th and 28th. The stage of water at the falls and fishway was favourable for the salmon to pass up.

In the evening of the 22nd and morning of the 23rd there were more cohoe salmon coming in, but no improvement in the sockeye run. On the 22nd we inspected the main Nass River from its junction with the Meziadin and for 1 mile above. A few salmon were to be seen passing up the Nass to watersheds above the Meziadin, but conditions for making observations at this point are not good owing to the discoloration of the water and its great volume.

The conditions at the fishway and approach to it are practically the same as reported upon during my visit of inspection last season. The braces that were put in to hold up the crib-work are all intact and look good for another year, unless some unforeseen trouble comes along, such as a flood or freshet like that which visited the Upper Nass District in the late fall of 1917. The basins of the fishway are gradually filling up, the debris being nearly up to the top of the facing-wall and for about half of the depth of each basin, leaving very little resting-place at the present time. All of these basins will have to be cleaned out in the near future. It can best be done by placing a dam across the intake. The work will have to be done at the lowest stage of water, which I think would be in the early spring before the snow and ice start to melt.

Summary.—In comparing the run of sockeye salmon to the Meziadin watershed for 1921 with former years, I am of the opinion that there were more sockeye to be observed on the spawning-beds in the lake and a slight decrease at the falls in comparison with the years 1919 and 1920. The run of spring salmon was not as good and the cohoe appeared to be more plentiful.

All my previous trips of inspection were timed so that I would be at the Meziadin Falls about the same date each year, and from the time of my first visit in 1908 up to and including the year 1917 there were always a large number of sockeye to be observed at this place. This happy state of affairs has ceased to exist, and at times it is now only possible for an experienced eye to detect salmon lying below the falls. It will be noted that no inspection was made in the year 1918, but the work was carried on in 1919, 1920, and 1921. From the reports of these three years it is shown that the runs of sockeye to the Meziadin watershed have materially diminished.

In making a report on the sockeye situation of the Lower Nass River, with the exception of a small unimportant stream close to Ayansh, all of our data have been taken from the Meziadin watershed. While I think that the Meziadin watershed is the most important as far as the run of sockeye to the Nass is concerned, we have it on record that the sockeye still continue on up the main Nass River above the Meziadin, and have been seen in Bowser Lake. Owing to the shortage of provisions and the inclemency of the weather at the time of my visit to Bowser Lake it was not possible to make more than a survey of the lake, and to substantiate the fact that sockeye did run to this watershed I have been informed that there is a river entering the main Nass from the east side, and above the Bowser Lake watershed, that sockeye run to. We have no data from this source and we do not know what bearing the streams above the Meziadin have on the sockeye situation of the Nass. The country around the Upper Nass is very difficult to travel, there being several large rivers to cross and no means of crossing otherwise than by raft, and then only in favourable places. Many parties travelling in this district have nearly met disaster.

Yours obediently,

C. P. HICKMAN,

Inspector of Fisheries.

New Westminster, B.C., November 21st, 1921.

THE SPAWNING-BEDS OF SMITH INLET.

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

Sir,—In pursuance of instructions from the Department to conduct an inspection of the spawning-beds at Smith and Rivers Inlet respectively, the watershed at Smith Inlet was visited first.

The exceptionally poor run of sockeye salmon manifest in the small pack obtained by the canneries during the fishing season, totalling, I am reliably informed, to but a little over 4,000 cases, clearly demonstrated the merit of the warning given in my reports for 1916–17, two years from which the present run resulted, that if the intensive fishing to which this inlet has been subjected yearly was repeated disastrous effects would result. The conditions were serious on the spawning-beds this year, as the following detailed report will show:—

Leaving Rivers Inlet Cannery on September 18th, I proceeded to Smith Inlet, and after making arrangements with Indians conducted an inspection at Long Lake, the breeding-grounds of the sockeye salmon.

The Docee river (the overflow of the lake) was negotiated with little difficulty and camp made at this point. The number of spring salmon noted in this river showed no falling-off from other years, large numbers being in evidence all the way up. The water was too high to estimate the number spawning on the gravel shore at the foot of the lake, but the continual breaking of water indicated a good run.

Proceeding to Quay Creek, a distance of about 7 miles, an examination was made of the spawning-beds both inside and outside the creek, but the small numbers disclosed conclusively demonstrated that little value can be attached to the supply of eggs deposited this year. The run to this stream was a failure.

On reaching the head of the lake, a distance of 16 miles, two or three schools of sockeye salmon were observed schooled in the still waters of the lake close to the entrance of Geluch River, or Smoke-house Creek, as it is termed by the Indians, and on the spawning-beds inside the entrance. Hope was entertained that the run here would be a considerable improvement on that reflected in the run of fish to Quay, but the spawning-beds disclosed few sockeye as we proceeded up to the falls 3½ miles distant. The small mountain streams emptying into this tributary contained a few sockeye, but in comparison with other years the poor showing of fish both here and in the main river was distinctly disappointing. The run, in my opinion, is the poorest since 1916. The fish generally were small in size. No log-jams or other obstructions interfered with the free movement of salmon up-stream.

An inspection of the Delabah River, situated about 2 miles from the head of the lake, was conducted under ideal conditions. From the entrance up for a distance of 500 yards the spawning-beds contained no evidence of sockeye salmon, in striking contrast to the scene represented last year, when in this part of the stream thousands of fish had collected; farther up, however, sockeye were seen in large numbers, the first real showing of fish found on the beds. In the bay outside, where in former years big schools of sockeye were observed, none were to be found. The run to the head of the lake did not approach even the small number seen here in 1916.

Usually salmon are seen breaking water in all directions on the lake when travelling up and down, but this season none were in evidence.

Reviewing the conditions of the spawning-beds at Smith Inlet this year, I am obliged once more to emphasize the danger of intensive fishing. The effects of the use of drag-seines operated in 1916–17 was manifested in no uncertain manner by the poor run of sockeye to the inlet this year. Now, although the seines have been eliminated, it is vital to the interests of those concerned to conserve the runs, especially during the next two years, in order to allow the spawning-beds to recover from the depletion which is all too apparent. The outlook is not encouraging in this respect, as it is to be noted that the cannery interests, instead of nursing the runs, are increasing their gear to such an extent that no less than 218 gill-nets were distributed over the inlet this season. Such a policy if continued cannot but have a devastating effect upon the runs in future years, as the runs will not stand the drain and will assuredly become extinct if present conditions are continued. In size the sockeye were much below the average.

I have, etc.,
A. W. Stone,
Fisheries Overseer.

Rivers Inlet, B.C., November 1st, 1921.

THE SPAWNING-BEDS OF RIVERS INLET.

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

SIR,—I have the honour to submit my report upon the inspection of the Rivers Inlet watershed for the year 1921.

Having completed the inspection of the spawning-beds at Smith Inlet, where conditions were found to be anything but satisfactory, it was with a feeling of misgiving that the spawning-beds at Lake Owikeno were approached, especially considering the small pack of sockeye salmon obtained by the canneries during the fishing season, amounting to about 45,000 cases.

Leaving for the lake on October 4th, I stayed overnight at the Dominion Hatchery and was able to view, by the courtesy of Weldon R. Reid, the officer in charge, the new ponds which have been built under the direction of Mr. McHugh, Engineer for the Department of Dominion Fisheries, for retaining the young fry until the yearling stage. The advantage which will be derived from this system is manifest, as it means that the young fish when liberated will be in a much stronger state to withstand the numberless enemies met with on their migration to the sea. It entails a great deal of extra work, as the young fry have to be fed; this is being performed by the use of cheap-grade salmon, and also by making use of the spawned-out sockeye, which are collected from the spawning-beds and dried in a special drying-kiln erected for the purpose. It is an entirely new departure upon which the Dominion authorities have to be commended, and is an earnest of their desire to keep the supply of sockeye salmon at Rivers Inlet up to its full productive power.

Taking advantage of the fine weather, I first made an inspection of the Sheemahant River, situated about 30 miles up the lake. It is an arduous trip at any time, but difficult and dangerous when the river is not just right for canoeing. On this occasion we were able to reach to within half a mile of the falls by canoe. It was very disappointing to note the utter lack of spawning sockeye on the beds as we made our way through the innumerable rapids to the falls 18 miles distant. At a small creek entering this tributary 12 miles from the mouth, and which in former years never failed to contain sockeye, no fish of any description were noted. Our first view of the sockeye salmon was obtained at the falls, where numbers were making futile efforts to surmount them, but were hurled back at each attempt. A careful examination was made of the rock-slide which for a distance of about 300 yards obstructs the flow of water from above. The first obstruction is composed of two huge rocks flung across the river, with about 10 feet dividing them. It is through this narrow passage the torrent of water hurls itself, forming an insurmountable barrier. Above this other large rocks have decreased the original width of the river to such an extent that the easy flow of the water above is now turned into a seething torrent. With comparatively little expense at the proper time the rocks could be blasted out and the salmon given access to about 20 miles of the fine spawning-grounds. It is encouraging to learn that the Dominion Department of Fisheries is directing its attention to this rock-slide and that in the near future it is to be removed. The same care was exercised in examining the river on our return, but there was no evidence of either sockeye or cohoe salmon. There were two obstructions in the river, one about 5 miles up and the other a little farther along from this; both should receive attention.

Arriving at the head of the lake, camp was made and an inspection conducted at the tributaries situated here. The Cheo, examined first, was very disappointing, no evidence of sockeye being noted, with the exception of about fifty seen in a small creek 3 miles up. The log-jam at the bend and situated just below the falls still obstructs the river, but proves no hindrance to the salmon reaching the spawning-beds between this and the falls. No salmon were noted here, which is in striking contrast to the well-stocked beds reported last year.

The Indian River failed to show any sign of fish, which may have been due to the freshet earlier in the spawning season, but the absence of the dead salmon usually seen here, in my opinion, points clearly to a very poor run.

The Washwash River, situated directly opposite the lake, was fairly well supplied with spawning sockeye, but in comparison with last year very much below the average. In that portion of the river situated between the log-jam and the entrance not one salmon was observed

on the spawning-beds, the run closely resembling the poor showing encountered in 1916. A great deal of work is necessary to clear out the mass of debris and log-jams which have accumulated once more in that part of the river which a few years ago received attention from the Department of Dominion Fisheries, and will again become a source of danger if not taken in hand shortly. The new channel formed two years ago, and to which reference has already been made, is still covered with fallen trees and log-jams.

Returning from the head of the lake, I examined Sunday Creek and was glad to see an improvement in the run of fish here. The spawning-beds lying along the shore-line at the mouth were thickly covered, closely resembling the number which returned to spawn in 1917.

The spawning-grounds situated near the Sheemahant flats were well covered with both cohoe and sockeye salmon, providing the Indians located here with all the fish necessary for their winter's use. At the landing close to the Indian shack thousands upon thousands of yearling salmon were seen in the clear water feeding upon the offal of dead salmon. They were undoubtedly the results of last year's spawning.

Jeneesee Creek, from which the Dominion Hatchery has annually taken eggs, unlike the conditions experienced in recent years, showed up remarkably well. The retaining-fence which had been carried out by a freshet earlier in the season permitted thousands of sockeye to reach the spawning-beds above. The hatchery officials had made little progress in collecting eggs owing to the large number that had escaped, but were not worrying on this account, as there still remained sufficient sockeye available for their requirements. From the entrance up to the fence the creek was alive with fish, decidedly the best showing here since 1913. The Indians had placed a net right across the mouth and determined action on the part of hatchery people was necessary in order to put a stop to their depredations. Mr. Reid wasted no time in argument, but had the net pulled up by his men, threatening to take other action if they employed similar methods in future. I understand it is the intention of the Department of Dominion Fisheries to build a retaining-pond in this creek in order to hold the young fry until the yearling stage, similar to the method employed at the hatchery.

A visit to the Machmell River was next undertaken, but owing to the high stage of the water it was impossible to form any estimate of the number of salmon on the spawning-beds here. In order to prevent this river overflowing into Jeneesee Creek as it did last year a new channel has been blown out on the extreme right. It is hoped by these measures that a great body of water will be turned away, relieving the strain on the dam which, under the direction of Mr. Reid, of the Dominion Hatchery, was hurriedly constructed at the time the Machmell broke through into Jeneesee Creek. Great ingenuity was displayed by Mr. Reid in meeting the emergency at the time of its occurrence.

The Nookins River, a tributary to the Machmell, was examined under the most favourable circumstances. For the first time in many years it was possible to go right through to the big rapids several miles up by canoe. I was disappointed at the run of sockeye here, the spawning-beds disclosing a great scarcity of fish, reminding me of the small number that reached there in 1916.

Asklum River, situated about 12 miles from the mouth of the Owikeno Lake, experienced an exceptional run of sockeye salmon this year. The run closely coincided with the remarkable numbers observed on the spawning-beds in 1913–14. The hatcherymen had erected two fences about a quarter of a mile from the entrance and, although meeting with constant difficulties, succeeded in obtaining a fair number of eggs. The river-bed up to the fences was literally covered with spawning fish, while in the deeper portion of the river thousands waited. Above the fences sockeye in equal numbers to those seen below were noted.

The Indians outside this stream were catching fish by means of a net. They had experienced no difficulty all the season in obtaining all they required for smoking purposes. Large numbers were in evidence in the lake near the mouth of the stream.

At the Dominion Hatchery, situated on Quap River, there was a scene of great activity. The men had their hands full in collecting eggs. The traps were full of fish and a seething mass lined the spawning-beds below the fence. From there down to the entrance thousands upon thousands of sockeye were making their way up-stream or waiting in the deep pools. Out in the bay the water was black with them, corresponding very closely to the remarkable numbers seen here last year, and even this number did not represent the total run to this river this year, as I was later informed that after my visit another big run had come in. Beyond the fence only

those fish that had artificially been spawned out were in evidence. With the opening of the fences after the requirements of the hatchery have been filled, the spawning-beds, now clear of all obstructions, should be exceptionally well seeded.

The Dalley River, situated directly opposite, bore unusual evidence of a fine run of fish; distributed over the river-bed numberless dead bodies could be seen in the clear water below the rapids, testifying to a big run earlier in the season. Large numbers were observed spawning on the beds all the way up to the falls about 4 miles distant, and in my opinion equalled the numbers seen there in 1917. No log-jams or other obstructions interfered with the free movement of the salmon up-stream.

Returning to the hatchery once more, the small creek, which on my former visit contained very few sockeye, now showed up to great advantage. The beds were thickly covered with spawning fish, and it was hoped that a fair number of eggs would be collected by means of the trap located at the entrance. It was the intention of Mr. Reid to fill the hatchery with 18,000,000 eggs if possible, a greater number than it had ever received before. To prevent the danger of such a large number becoming smothered at the time of hatching, it is proposed to thin them out immediately and place them in the retaining ponds recently built for the purpose.

Sockeye were much in evidence spawning on the gravel-beds situated along the shore-line close to the rancherie. Spring salmon also showed up in numbers here and should provide a fair run of this species on their return as adults. Both cohoe and chum salmon failed to appear in large numbers this year, the run of each species showing up very poorly.

In summarizing the general conditions of the spawning-beds at Rivers Inlet, I find that the rivers situated at the head of the lake, comprising the Indian, Cheo, and Washwash, were anything but satisfactory. The recent freshet may have accounted partly for the poor showing made here, but all the evidence points to a very poor run of sockeye, as was the case in 1916–17. The Sheemahant and Nookins Rivers were both poorly seeded in those years. The other tributaries of the lake, comprising the Asklum, Jeneesee, Quap, Dalley, and the spawning-beds of the lake-shore, were, on the other hand, as well seeded as in recent years. The size of the sockeye observed in all the tributaries closely coincided with the bi-weekly tests made by me at the canneries during the fishing season. They averaged but little over 5 lb. each. That may be the reason why more fish were not caught in the great amount of gear employed.

In conclusion, I wish to extend my thanks to C. C. Johnston, Manager of Rivers Inlet Cannery; Weldon R. Reid, officer in charge at the Dominion Hatchery, and to his assistants for the courtesy received at their hands.

I have, etc.,

A. W. STONE,

Fisheries Overseer.

Rivers Inlet, B.C., November 1st, 1921.

PACK OF BRITISH COLUMBIA SALMON, SEASON 1921.

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 TOTAL (Cases).
FRASER RIVER DISTRICT—								
B.C. Fishing & Packing Co., Ltd...	16,922	4,663	5,235	845	12,018	2,739	2,355	44,777
J. H. Todd & Sons, Ltd.	2,196	3	.....	66	4,792	439	1,043	8,539
A.B.C. Packing Co., Ltd.....	2,255	546	471	.....	100	1,640	.....	5,012
Gosse-Millerd, Ltd.....	2,631	529	36	.....	108	559	....	3,863
Great West Packing Co., Ltd.. ...	1,903	1,178	.....	.....	4,200	.....	62	7,343
Glenrose Canning Co., Ltd.....	3,969	2,127	199	.....	5,149	.....	.....	11 444
Canadian Fishing Co., Ltd..... ...	2,125	.....	.....	.....	2,653	2,219	7,763	14,760
Great Northern Packing Co., Ltd...	1,483	1,694	.....	.....	422	549	.....	4,148
M. DesBrisay & Co.....	827	150	4	.....	277	33	.....	1,291
A. H. Sherman, Ltd..	1,589	470	4	420	259	.....	.....	2,742
J. H. Todd & Sons (Esquimalt).....	2,754	.....	.....	.....	.....	.....	.....	2,754
Sooke Harbour Fg. & Pk. Co., Ltd..	977	.....	.....	.....	.....	.....	.....	977
Totals.....	39,631	11,360	5,949	1,331	29,978	8,178	11,223	107,650
SKEENA RIVER DISTRICT—								
B.C. Fishing & Packing Co., Ltd...	4,680	7,699	201	229	13,003	29,449	466	55,727
J. H. Todd & Sons, Ltd.....	6,233	620	.....	.....	11,462	7,729	.....	26,044
A.B.C. Packing Co., Ltd.....	4,177	2,895	821	18	12,626	13,719	237	34,492
Gosse-Millerd, Ltd.....	3,706	380	29	155	1,182	9,890	31	15,373
B.C. Canning Co., Ltd.....	3,635	304	.....	.....	605	12,393	.....	16,937
Kildala Packing Co., Ltd.....	2,241	1,001	210	96	519	12,276	84	16,427
Northern B.C. Fisheries.....	2,698	1,443	477	.....	973	6,401	.....	11,992
Cassiar Packing Co., Ltd.....	2,043	872	.....	.....	694	6,866	....	10,475
Wallace Fisheries, Ltd.....	5,829	1,324	.....	.....	836	10,515	.....	18,504
Can. Fish & Cold Storage Co., Ltd.	4,223	1,657	1,060	.....	2,902	11,164	1,175	22,181
Maritime Fisheries, Ltd.....	1,553	404	369	.....	231	4,055	.....	6,612
Totals.....	41,018	18,599	3,167	498	45,033	124,457	1,993	234,765
RIVERS INLET DISTRICT—								
B.C. Fishing & Packing Co., Ltd....	11,880	110	.....	.....	2,997	233	155	15,375
J. H. Todd & Sons, Ltd.....	4,697	.....	.....	.....	172	247	.....	5,116
Provincial Canning Co., Ltd.....	5,603	.....	.....	.....	1,429	4,809	18	11,859
Anglo B.C. Packing Co., Ltd.....	3,547	25	.....	.....	43	12	.....	3,627
Gosse-Millerd, Ltd.....	4,352	45	.....	.....	.....	.....	.....	4,397
B.C. Canning Co., Ltd.....	5,419	48	.....	.....	6	.....	.....	5,473
Kildala Packing Co., Ltd.....	5,593	85	.....	97	12	.....	.....	5,787
Wallace Fisheries, Ltd.....	5,135	51	.....	.....	59	4	.....	5,249
Northern Fisheries (Namu)..... ...	2,389	.. ...	.....	.....	.....	.....	.....	2,389
Totals..... ..	48,615	364	.....	97	4,718	5,305	173	59,272
NASS RIVER DISTRICT—								
B.C. Fishing & Packing Co., Ltd...	1,975	725	252	238	3,257	5,329	567	12,343
Anglo B.C. Packing Co., Ltd.....	2,370	79	64	46	502	4,857	....	7,918
M. DesBrisay & Co.....	1,789	58	.....	.....	1,676	10,062	1,005	14,590
Northern B.C. Fisheries, Ltd..... ..	1,974	327	53	129	2,236	3,559	27	8,305
Western Salmon Packing Co., Ltd..	1,256	242	288	.....	505	5,681	577	8,609
Totals..... ..	9,364	1,431	657	413	8,236	29,488	2,176	51,765
VANCOUVER ISLAND DISTRICT—								
B.C. Fishing & Packing Co., Ltd....	3,501	.....	.....	7	3,285	1,593	4,350	12,736
J. H. Todd & Sons, Ltd.	.....	155	164	.....	5,903	4,633	1,172	12,027
Nootka Packing Co., Ltd.....	136	2,350	376	.....	592	.....	8,820	12,274
Clayoquot Sound Canning Co., Ltd.	1,174	102	.....	.....	781	.....	1,702	3,759
Quathiaski Canning Co., Ltd.....	2,100	83	.....	3,144	388	4,434	241	10,390
Wallace Fisheries, Ltd.....	25	.....	.....	.....	61	.....	4,171	4,257
Gosse-Millerd, Ltd.....	.....	.....	.....	.....	50	.....	3,402	3,452
Lummi Bay Packing Co., Ltd.....	.....	.....	.....	.....	60	.....	10,573	10,633
Totals.....	6,936	2,690	540	3,151	11,120	10,660	34,431	69,528
OUTLYING DISTRICTS—								
B.C. Fishing & Packing Co., Ltd....	4,654	318	2,452	3	9,584	3,030	5,295	25,336
Gosse-Millerd, Ltd.....	2,776	219	.....	45	2,908	7,217	15,854	29,019
Northern B.C. Fisheries, Ltd.....	3,871	1,215	183	156	1,955	4,464	263	12,197
Western Packers, Ltd.....	3,429	42	44	.....	66	31	.....	3,612
Sea Fish Co., Ltd.....	69	.....	.....	2,586	426	76	.....	3,157
Wm. Hickey & Sons, Ltd.....	2,215	487	35	.....	3,264	.....	.....	6,001
Wallace Fisheries, Smith Inlet.....	1,336	.....	.....	.....	.....	.....	.....	1,336
Totals.	18,350	2,281	2,714	2,790	18,203	14,818	21,412	80,568
Grand totals.....	163,914	33,725	13,027	8,280	117,288	192,906	71,408	603,548

STATEMENTS SHOWING THE SALMON-PACK OF THE PROVINCE, BY DISTRICTS AND SPECIES, FROM 1906 TO 1921, INCLUSIVE.

FRASER RIVER.

	1921.	1920.	1919.	1918.	1917.	1916.	1915.	1914.	1913.	1912.	1911.	1910.	1909.	1908.	1907.	1906.
Sockeyes	39,631	48,399	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
Springs, Red	11,360	10,691	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
Springs, White	5,949	4,432	4,296	24,853	18,916	11,430	5,392	15,300	49	9,826	6,751	8,925	.....	2,263	557	.....
Chums	11,233	23,884	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
Pinks	8,178	12,839	39,363	18,388	134,442	840	138,305	6,272	20,773	574	142,101	128				
Cohoes	29,978	22,934	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
Steelhead Trout	8	34	328	4,395	4,951	3,129	31	.....	.....	.....	.....	.....	.....	.....	.....	.....
Bluebacks	1,323	4,488	15,613	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals	107,650	136,661	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

SKEENA RIVER.

	1921.	1920.	1919.	1918.	1917.	1916.	1915.	1914.	1913.	1912.	1911.	1910.	1909.	1908.	1907.	1906.
Sockeyes	41,018	89,364	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
Springs	21,766	37,403	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
Chums	1,993	3,834	31,457	22,573	21,516	17,121	5,769	8,329	.....	504	70	.....	} 28,120	45,404	25,217	38,991
Pinks	124,457	177,679	117,303	161,727	148,319	73,029	107,578	71,021	66,045	97,588	81,956	13,473				
Cohoes	45,033	18,068	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
Steelhead Trout	498	1,218	2,672	4,994	1,883	3,743	1,798	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals	234,765	332,887	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

RIVERS INLET.

	1921.	1920.	1919.	1918.	1917.	1916.	1915.	1914.	1913.	1912.	1911.	1910.	1909.	1908.	1907.	1906.
Sockeyes	48,615	125,742	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
Springs	364	1,793	1,442	1,409	817	1,422	1,022	566	594	1,149	317	383	587	454	450	181
Chums	173	1,226	7,089	6,729	16,101	20,144	5,387	5,023	.....	3,845	288	.....	.....	.....	.....	.....
Pinks	5,303	25,647	6,538	29,542	8,065	3,567	2,964	5,784	2,097	8,809	5,411	19	.....	479	700	.....
Cohoes	4,718	2,908	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
Steelhead Trout	97	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals	59,272	133,248	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

NASS RIVER.

	1921.	1920.	1919.	1918.	1917.	1916.	1915.	1914.	1913.	1912.	1911.	1910.	1909.	1908.	1907.	1906.
Sockeyes	9,364	16,740	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
Springs	2,088	4,857	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
Chums	2,176	12,145	24,041	40,368	24,938	11,200	11,076	25,569	2,987	3,245	5,189	351	3,589	.....	.....	.....
Pinks	29,488	43,151	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
Cohoes	8,236	3,700	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
Steelhead Trout	413	560	789	1,305	1,125	1,498	113	.....	....	.....	.....	140	.....	1,101	681	.....
Totals	51,765	81,153	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

Vancouver Island Districts.*

	1921.	1920.	1919.	1918.
Sockeyes	6,936	6,987	6,452	6,143
Springs	3,230	29,211	36,013	29,324
Chums	34,431	12,591	128,013	251,266
Pinks	10,660	14,391	43,186	57,035
Cohoes	11,120	20,555	53,629	40,752
Bluebacks	3,151	.....	.....	.....
Totals	69,528	74,170	267,293	389,815

Outlying Districts.

	1921.	1920.	1919.	1918.	1917.	1916.	1915.	1914.	1913.	1912.	1911.	1910.	1909.	1908.	1907.	1906.
Sockeyes	18,350	64,473	54,677	51,980	32,902	45,373	98,600	87,130	149,336	79,464	67,866	70,506	49,832	48,367	40,159	45,481
Springs	4,995	15,633	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
Chums	21,412	30,946	165,717	90,464	112,364	160,812	40,849	70,727	52,758	37,734	39,167	5,551	.....	.....	.....	.....
Pinks	14,818	247,149	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
Cohoes	18,203	33,807	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
Steelhead Trout	204	3,721	702	1,009	865	712	985	.....	.....	.....	.....	.....	.....	36	2	.....
Bluebacks	2,586	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals	80,568	395,728	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

Total packed by Districts in 1906 to 1921, inclusive.

	1921.	1920.	1919.	1918.	1917.	1916.	1915.	1914.	1913.	1912.	1911.	1910.	1909.	1908.	1907.	1906.
Fraser	107,650	136,661	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
Skeena	234,765	332,787	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
Rivers Inlet	59,272	157,522	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
Nass River	51,765	81,153	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
*Vancouver Island	69,528	84,170	267,293	389,815	325,723	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Outlying Districts	80,568	395,223	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
Grand totals	603,548	1,187,616	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

STATEMENTS SHOWING SALMON-PACK OF PUGET SOUND, BY SPECIES, FROM 1906 TO 1921.

	1921.	1920.	1919.	1918.	1917.	1916.	1915.	1914.	1913.	1912.	1911.	1910.	1909.	1908.	1907.	1906.
Sockeyes	102,967	62,654	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
Cohoes	89,412	24,502	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
Puget Sound Pinks	404,713	4,669	421,215	6,605	1,121,884	1,887	589,780	909	788,789	708	1,038,136	.....	365,156	.....	448,730	.....
Chums	30,831	48,849	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
Totals	527,923	140,520	1,221,985	560,726	1,863,983	670,234	1,268,731	780,488	2,553,843	415,389	1,534,016	537,324	1,561,824	309,277	709,155	435,668

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