PROVINCE OF BRITISH COLUMBIA

REPORT

OF THE

COMMISSIONER OF FISHERIES

FOR THE YEAR ENDED DECEMBER 31ST, 1928

WITH APPENDICES

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:
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1929.

THE HONOURABLE WILLIAM SLOAN.
Commissioner of Fisheries for British Columbia from 1918 to 1928, died on March 2nd, 1928.

Mr. Sloan first entered public life on his election to the Federal House of Commons for Comox-Atlin in 1904. He was re-elected in 1908. In 1916 he was elected to represent the Nanaimo District in the Provincial Legislature and entered the Cabinet as Minister of Mines. In 1918 he was appointed Commissioner of Fisheries for the Province and served until his death. As a member of the Federal House of Commons Mr. Sloan took an active part in all fishery discussions, notably in connection with the fur-seal question and the salmon and herring fisheries of British Columbia. On his insistence the use of herring in fish-reduction in British Columbia was prohibited.

As Commissioner of Fisheries of the Province he pressed steadily for conservation measures, and advocated the exchange of treaties between Canada and the United States dealing with the halibut-fisheries of the Pacific and the salmon-fisheries of the Fraser River system.

To His Honour ROBERT RANDOLPH BRUCE,
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 ended December 31st, 1928, with Appendices.

SAMUEL LYNESS HOWE,
Commissioner of Fisheries.

Provincial Fisheries Department,
Commissioner of Fisheries' Office,
Victoria, British Columbia, December 31st, 1928.

TABLE OF CONTENTS.

FISHERIES COMMISSIONER'S REPORT FOR 1928.

APPENDICES.

FISHERIES COMMISSIONER'S REPORT FOR 1928.

VALUE OF CANADIAN FISHERIES AND THE STANDING OF PROVINCES, 1927.

The value of the fishery products of Canada for the year 1927 totalled $49,497,038.

During the year 1927 British Columbia produced fishery products of a value of $23,264,342, or 47 per cent. of Canada's total.

In 1927 British Columbia again led all the Provinces in the Dominion, as has been the case for many years, in the value of her fishery products. Her output in 1927 exceeded in value that of Nova Scotia, the second in rank, by $12,480,711, and also exceeded that of all the other Provinces combined by $7,815,277.

The market value of the fishery products of British Columbia in 1927 was $4,102,757 less than in the previous year, 1926, due largely to a decrease in the salmon-pack.

The capital invested in the fisheries of British Columbia in 1927 was $31,117,986, or 55 per cent. of the total capital employed in Canada. Of the $31,117,986 invested in the fisheries of British Columbia in 1927, $12,263,636 was employed in catching and handling the catches and $18,854,350 invested in canneries, fish-packing establishments, and fish-reduction plants.

The number of persons engaged in British Columbia fisheries in 1927 was 21,322, or 26½ per cent. of Canada's total of 80,112. Of the 21,322 engaged in British Columbia, 13,076 were employed in catching and handling the catches and 8,246 in packing, curing, and fish-reduction.* The total number engaged in the fisheries in 1927 was 724 greater than in the preceding year.

The following statement gives in the order of their rank the value of the fishery products of the Provinces of Canada for the years 1923 to 1927, inclusive:—

Province.	1923.	1924.	1925.	1926.	1927.
British Columbia	$20,795,914	$21,257,567	$22,414,618	$27,367,109	$23,264,342
Nova Scotia	8,448,385	8,777,251	10,213,779	12,505,922	10,783,631
New Brunswick	4,548,535	5,383,509	4,798,589	5,325,478	4,406,673
Ontario	3,159,427	3,557,587	3,436,412	3,152,193	3,670,229
Quebec	2,100,412	2,283,314	3,044,919	3,110,964	2,736,450
Manitoba	1,020,595	1,232,563	1,466,939	2,328,803	2,039,738
Prince Edward Island	1,754,980	1,201,772	1,598,119	1,358,934	1,367,807
Alberta	438,737	339,107	458,504	749,076	712,469
Saskatchewan	286,643	482,492	494,882	444,288	503,609
Yukon Territory	11,917	18,773	15,370	17,866	12,090
Totals	$42,565,545	$44,534,235	$47,942,131	$56,360,633	$49,497,038

THE SPECIES AND VALUE OF FISH CAUGHT IN BRITISH COLUMBIA.

The total value of each of the principal species of fish taken in British Columbia for the year ended December 31st, 1927, is given in the following statement:—

Salmon	$14,253,803
Halibut	3,841,333
Herring, oil, meal, etc.	1,867,429
Cod, hake	402,438
Pilchards, oil, meal, etc.	1,838,867
Clams, abalones	102,244
Black cod	123,421
Crabs	68,477
Carried forward	$22,498,012

* As this report goes to press the Commissioner is in receipt of a preliminary report on the fishery products of the Province for the year 1928, issued by the Dominion Bureau of Statistics—R. H. Coats, Statistician—from which the following data are taken: The value of the fishery products of British Columbia in 1928 totalled $26,562,691, an increase of $3,298,349, compared with the production in 1927.

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

Brought forward	$22,498,012
Soles	82,180
Shrimps	16,592
Oysters	32,258
Flounders, brill	17,631
Red cod	22,479
Perch	12,402
Smelt	16,459
Sturgeon	7,971
Octopus	2,241
Skate	5,490
Oolachans	2,800
Whiting	487
Trout	1,118
Whales	241,488
Fish-oils, grayfish, etc.	138,180
Fish-meals	145,449
Fish-fertilizer	5,300
Fur-seals	15,805
Total	$23,264,342

The above statement shows that the salmon-fisheries of the Province in 1927 produced $14,253,803, or 61 per cent. of the total. It was $4,522,959 less than in the previous year.

The total halibut landings were marketed for $3,841,333. It was $702,387 less than in the preceding year. The herring-catch produced $1,867,429. It was $338,695 larger than in 1926.

The foregoing data are derived from the "Fisheries Statistics of Canada" for 1927.

THE SALMON-PACK OF THE PROVINCE IN 1928.

The salmon-pack of the Province in 1928 totalled 2,035,629 cases, the second largest recorded. It was but 29,561 cases less than the highest record pack of 1926. It consisted of 203,542 cases of sockeye, 18,891 cases of springs, 150,657 cases of cohoes, 792,372 cases of pinks, and 862,230 cases of chums. The sockeye-pack of 203,542 cases was the second smallest recorded. There was a decrease in every district. It constituted but 10 per cent. of the total pack. Since 1915 there has been a decline in the percentage of sockeye in the pack, due to the decrease in the sockeye run to most districts and to the great increase in the pack of pinks and chums. The combined pack of pink and chum salmon in 1928 constituted 79 per cent. of the total pack made in the Province.

The market value of the pack in 1928 has been estimated at $16,518,286, as compared with $14,253,803 in 1927 and $18,776,762 in 1926.

THE 1928 PACK BY DISTRICTS.

The Fraser River System.—The catch of all species of salmon made in the Fraser River system in the Province in 1928 produced a total pack of 258,244 cases, as against 284,378 in 1927, 274,951 in 1926, 276,855 in 1925, and 212,059 in 1924.

The pack consisted of 29,299 cases of sockeye, 5,082 cases of springs, 27,061 cases of cohoes, 2,881 cases of pinks, and 193,106 cases of chums.

The pack of sockeye was the second smallest recorded in the Provincial waters of the Fraser system. It was 32,094 cases less than in 1927, 56,390 cases less than in 1926, and 10,444 cases less than in its brood-year, 1924. The pack of 193,106 cases of chums was the largest made. It was 83,611 cases greater than in the former high-record pack of 109,495 cases made in 1924. The pack of pinks—it was not a "pink" year—was but 2,881 cases. It was 29,375 cases less than the pack in its brood-year, 1926. The cohoe-pack of 27,061 cases was 9,656 cases less than in its brood-year, 1925.

The catch of sockeye in the State of Washington waters of the Fraser River system in 1928 produced a pack of 61,044 cases. It was 8,325 cases less than the pack in the preceding fourth year—its brood-year.

The combined pack of sockeye in the entire Fraser River system totalled 90,343 cases. It was 18,769 cases less than in its brood-year, 1924. It was 32,028 cases less than the average of the preceding eight years. There was no late run to correspond with the late runs in both 1926 and 1927.

The following statement gives the weekly pack of sockeye from fish caught in the Fraser River in Provincial waters:—

Week ending.	Cases.	Week ending.	Cases.
July 14	414	Sept. 8	1,346
July 21	2,164	Sept. 15	973
July 28	2,613	Sept. 22	1,676
Aug. 4	4,908	Sept. 29	1,507
Aug. 8	4,006	Oct. 6	115
Aug. 18	2,794	Oct. 13	57
Aug. 25	1,129		
Sept. 1	2,538	Total	26,240*

The Skeena River.—The salmon-pack in the Skeena District in 1928 totalled 298,709 cases, consisting of 34,559 cases of sockeye, 6,420 cases of springs, 30,194 cases of cohoes, 209,579 cases of pinks, and 298,709 cases of chums. The total pack was 68,360 cases less than the average pack of the preceding ten years.

The pack of sockeye was the smallest recorded on the Skeena since the fishery was developed. It was 59,270 cases less than the average in the last eight preceding years. The sockeye run to the Skeena in 1928, like that to all the northern waters of the Province, was most disappointing. The run of sockeye to the Skeena, as the records of the Department abundantly show, consist of four-year-old and five-year-old fish in more or less even proportion; hence the run of 1928 consisted of sockeye derived from the spawnings in 1923 and 1924, two years in which the packs were large—131,731 cases in 1923 and 144,747 cases in 1924. The catches in both of those years were larger than the averages of the last ten years. The packs in the brood-years of the 1928 run were not only large, but the reports from the spawning-beds in each of those years show a large seeding. The only disconcerting factor in forecasting the sockeye run to the Skeena in 1928 was that brought out by Drs. Clemens in their report for 1927; to wit, that the catch in 1923 of five-year-old fish formed but 34 per cent. of that run and in 1924 the four-year-old fish formed but 25 per cent. of that run. On that basis they estimated that the 1928 run would not produce a pack much in excess of 80,000 cases. It did not come near that figure; it totalled but 34,559 cases.

The small catch of 1928, together with the records of 1923 and 1924, are so unsatisfactory that measures to afford a far greater escapement four and five years hence are imperative.

The poor runs of sockeye to the Skeena in 1927 and 1928 and the reports from the spawning-beds in those years demonstrate how little dependence can be placed on forecasts based on pack and spawning-bed records of brood-years. Years in which the catches and seedings were large may be followed by a poor return. The records do not, however, show a large return from a year when the catches and the seedings were small.

The catch of pinks on the Skeena in 1928 was large—the third largest made there. It totalled 209,579 cases and has only been exceeded by the packs of 210,081 in 1926 and 301,655 in 1922, both of which years are in the 1928 cycle. The fish were unusually large and in prime condition.

The catch of chum salmon on the Skeena this year was again small. It produced a pack of but 17,716 cases, as against 19,006 in 1927, 63,527 in 1926, 74,308 in 1925, and 25,588 in 1924.

The pack of springs on the Skeena in 1928 was the smallest recorded there. It totalled but 6,420 cases, as against 19,038 cases in 1927, 30,594 in 1926, 23,445 in 1925, 12,028 in 1924, and 12,247 cases in 1923. The tierced pack of springs was also much less than usual.

The foregoing statements of the catches of sockeye, springs, and chums show that conditions in the Skeena are far from satisfactory and call for greater protective regulations if the industry in the cycles in question is to be productive.

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* Does not include the 3,059 cases consisting of sockeye caught in traps in Juan de Fuca Strait, Vancouver Island.

Rivers Inlet.—The salmon-pack in the Rivers Inlet District in 1928 totalled 81,527 cases. It consisted of 60,044 cases of sockeye, 468 cases of springs, 868 cases of cohoes, 16,546 cases of pinks, and 3,594 cases of chums.

The run of sockeye to Rivers Inlet, like that to the Skeena, consists of four- and five-year-old fish; hence it was derived from the spawnings of 1923 and 1924, years in which the catches produced packs of 116,850 and 94,891 cases. Drs. Clemens, in their digest of the data collected in 1927, stated that there was little hope for a large sockeye run to Rivers Inlet in 1928. They called attention to the reports that the escapement to the beds in 1918 was very poor, and that this was confirmed by the analysis of the run in 1923, when the five-year-old fish formed but 24 per cent. of the run, and that in consequence a large run of five-year-old fish could not be anticipated in 1928.

As to the other brood-year—1924—of the 1928 run, it had been shown that there was an exceptionally good escapement and that in that year the run consisted of 44 per cent. of four-year-old fish. On these showings they anticipated a fair run in 1928 of five-year-old fish. Drs. Clemens's analysis of the 1928 run shows that it consisted of 58 per cent. of four-year and 42 per cent. of five-year-olds.

Conditions at Rivers Inlet, like those on the Skeena, call for drastic action if the runs are to be restored.

Smith Inlet.—The catch of salmon at Smith Inlet in 1928 was most satisfactory. There was an exceptionally large return. The catch of sockeye produced a pack of 33,442 cases. It was 10,760 cases larger than the good run of the previous year. It is interesting, in view of the rather limited spawning area of the Smith Inlet run of sockeye, to note that it produced almost as large a return as that made from the vastly more extensive spawning area of the Skeena.

The Nass River.—The catch of salmon in the Nass River District produced a total pack of 104,877 cases, consisting of 5,540 cases of sockeye, 1,846 cases of springs, 10,734 cases of cohoes, 83,183 cases of pinks, and 3,538 cases of chums.

There was a large increase in the catch of pinks, larger than in the two preceding brood-years of that cycle. The catch of sockeye, on the other hand, produced much the smallest pack recorded in that district. The run of sockeye to the Nass is periously near extinction. The reports from the spawning areas this year are no more promising than the catch.

Queen Charlotte Islands.—The salmon-catch in Queen Charlotte waters produced a pack of 247,757 cases, consisting of 167,217 cases of pinks, 72,477 cases of chums, 7,619 cases of cohoes, and a few cases of sockeye and springs. This district is strictly a producer of pink and chum salmon, its fresh waters being unsuited to the propagation of other species. The catch of pinks—it was a "pink" year—was 33,295 cases less than in the brood-year 1926. The catch of chums was below the average of the last four years.

Vancouver Island.—The catch of salmon from the waters of Vancouver Island produced a total pack of 390,470 cases, consisting of 14,248 cases of sockeye, 2,269 cases of springs, 23,345 cases of cohoes, 41,885 cases of pinks, and 303,474 cases of chums. The pack of chums was the largest made from its waters.

Outlying Districts.—The catch of salmon in the outlying districts produced a pack of 619,915 cases, consisting of 26,372 cases of sockeye, 2,084 cases of springs, 50,606 cases of cohoe, 270,914 cases of pinks, and 269,336 cases of chums.

REPORTS FROM SALMON-SPAWNING BEDS.

In 1928, as in former years, the Department investigated conditions on the spawning-beds of the Fraser, Skeena, and Nass Rivers, and Rivers and Smith Inlets.

The following is a brief summary of the reports, which will be found in full in the Appendix of this report:—

The Fraser River.—The inspection of the salmon-spawning areas of the Fraser River basin was again made by Mr. Babcock, his twenty-sixth annual inspection.

Sockeye in numbers made their appearance in Hell's Gate Canyon, above Yale, in July. The July and August runs were the largest. The number seen there in September and October was less than in recent years. Sockeye in numbers entered the Chilcotin in July and August. The Chilcotin Indians caught upwards of 1,900 sockeye during the season. Their catch this year was three or four times greater than that made in any one of the last twelve years. Dominion Fishery Officer Harvey, assigned to the Chilcotin section, observed upwards of 20,000 sockeye in the reaches of the Chilko River, below the outlet of Chilko Lake, the first time in

twelve years that sockeye in numbers have been observed there. The size of the run of sockeye to the Chilko this year is as difficult to account for as the runs to Adams and Little Rivers, Shuswap area, late in 1926 and 1927. In no other tributary of the Fraser, above the mouth of Bridge River, which includes Quesnel and Stuart Lakes, were sockeye in numbers reported this year.

Dominion Fishery Officer Shotton reported that approximately 10,000 sockeye spawned in Little River in October, the majority of the fish being small in size. Sockeye in numbers were not found in any of the tributaries of Shuswap Lake.

The number of sockeye that reached the Birkenhead River, at the head of the Harrison-Lillooet Lakes section, while up to the average, was considerably less than the run in their brood-year, 1924. Sockeye-egg collection totalled 35,000,000.

The run of sockeye to Cultus Lake was intercepted at the entrance to the lake, in accordance with the experiments being conducted there by the Biological Board of Canada. The number of fish taken totalled 14,899—11,205 females and 3,694 males, a most exceptional ratio of three females to each male.

As a result of Mr. Babcock's investigation he concludes that "a small return is all that can be anticipated from this year's seeding of the spawning-beds of the Fraser River basin."

The Skeena River.—An inspection of the sockeye-salmon spawning-beds in the Skeena River basin this year was again made by Fishery Officer Gibson. In his report he states that because of the small pack this year he did not anticipate finding well-seeded beds and, in consequence, was surprised to find them so well seeded. In 15-Mile Creek, at the head of Babine Lake, the main lake tributary of the Skeena, he found more sockeye than he had seen there since 1920. He reports similar conditions in Pierre Creek and Fulton River. In his summary of the Babine Lake area he says it was exceptionally well seeded. The report is filled with details. With the exception of the Lakelse Lake area, all the beds are reported as well seeded.

Rivers Inlet.—The spawning areas of the Rivers Inlet sockeye run were again inspected by Fishery Officer Stone. In his summary of the conditions he expresses the opinion that "a moderate run only may be expected from the result of the sockeye spawning this year." With the exception of three tributaries, all showed a marked falling-off, which he estimates to be 40 per cent. lower than in the brood-years 1923 and 1924. This he attributes in great measure to the severe floods in the late fall of 1924.

Smith Inlet.—Fishery Officer Stone again inspected the spawning areas of the sockeye run to Smith Inlet. He reports an excellent seeding of the entire area and expresses the opinion that "we can look forward to a big run of sockeye from this year's seeding four and five years hence."

Nass River.—Inspector of Fisheries C. P. Hickman again inspected the Meziadin Lake area of the Nass River—the main spawning area in the Nass basin—this year being his twentieth annual inspection. His summary of conditions shows that few sockeye were found in any section—"far less than have been found there in any one of the last four years. Neither in Meziadin Lake nor at the fishway at the falls below the lake were sockeye in number to be seen." There were so few sockeye at the fishway that he was unable to obtain sufficient specimens from which to collect the scales desired by Drs. Clemens. The set-nets which he placed in the Nass River, above the mouth of the Meziadin River, failed to catch a single sockeye. The fishway was found in excellent condition.

MILD-CURED SALMON PRODUCTS.

The mild-cured salmon products totalled 2,676 tierces—approximately 1,800,000 lb.; substantially that of 1927.

FISH OIL AND MEAL PRODUCTION IN 1928.

The production of fish oil and meal in the Province in 1928 shows a large increase. The twenty-three fish-reduction plants on the west coast of Vancouver Island produced 4,035,879 gallons of oil and 15,280 tons of meal, as against 2,827,796 gallons of oil and 13,571 tons of meal in 1927. Four new plants were in operation. Of the total production in 1928, 3,997,656 gallons of oil and 14,502 tons of meal were extracted from pilchards and 38,223 gallons of oil and 320 tons of meal from herring.

The twenty-three plants in operation on the west coast in 1928 handled 81,740 tons of fresh-caught pilchards, from which they extracted an average per ton of 48.6 gallons of oil and 0.016

ton of meal. The seven plants which engaged in herring production used 1,846 tons of fresh herrings, from which was extracted an average of 19.9 gallons of oil and 0.017 ton of meal from each ton of fresh fish handled.

While the bulk of the pilchards landed were taken in estuary waters, the catches made in the open sea off the coast were much larger than in previous years.

The fish meal and oil products of the Province are exported, England, Germany, and the United States being the largest importers.

The stockmen of the Province should not overlook the animal food value of the fish-meals being produced on our west coast. Professor G. W. Cavanagh, of Cornell University, states that calves fed a ration of fish-meal per day " at the end of a year had an average height of 2½ inches in excess of the standard height and an average weight of 300 lb. in excess of the standard weight. Herds fed on a ration of fish-meal are free from goitre, and no cases of abortion in cows of the herd recorded." Other authorities claim that herds fed a ration per day of fish-meal have no tubercular cows.

HALIBUT LANDINGS IN 1928.

The landings of halibut in British Columbia ports in 1928 totalled 30,007,179 lb., as against 26,892,328 lb. in 1927. a gain in Provincial landings of 3,114,851 lb. Of the total Provincial landings, 9,758,560 lb. were docked by the Canadian fleet and 20,248,619 lb. by the United States fleet, the catches of the latter being shipped in bond to the United States. Of the total landings in British Columbia, 28,412,356 lb. were made at Prince Rupert, 1,214,771 lb. at Vancouver, and the balance on the west coast of Vancouver Island and at Butedale. The landings in Prince Rupert were 3,101,767 lb. greater than those made in 1927. An interesting feature of the landings made at Prince Rupert in 1928 is the statement that the " Prosperity A " led the fleets in her total landings of 293,000 lb. and that her crew's share for that season was close to $2,500 per man; also that the " Onome " ranked second in the season's record of landings, the crew's share per man being $2,170.

The landings of halibut at all Pacific ports in 1928, with a few scattered returns missing, totalled 54,255,918 lb., against 54,712,796 lb. in 1927, a decline of 456,878 lb. The total landings at Provincial ports were 55.3 per cent. of the total Pacific port landings.

CONTRIBUTION TO THE LIFE-HISTORY OF THE SOCKEYE SALMON.

The fourteenth contribution to the series of papers on the life-history of the sockeye salmon, issued by the Department, which is contained in the Appendix of this report, is contributed by Drs. W. A. and Lucy S. Clemens. The present paper, together with those which have preceded it, constitute one of the most detailed continuous records of any fishery. They give the constituents of the age-classes, sex, weights, and lengths of the salmon in each of the runs to the principal waters of the Province for the last fifteen years. The following is a brief summary of the present paper:—

In 1928 the packs of sockeye in the four areas considered by Drs. Clemens in the present report were small and in three of them were below expectancy, the exception being in the run to Rivers Inlet, and, what is equally significant, the reports from the spawning-beds indicate small escapements to the spawning-beds, with the exception of Skeena River.

The situation disclosed by Drs. Clemens's present paper merits earnest consideration. When such close study of representative sampling of runs, examination of packs, and reports from spawning-beds indicates so clearly a steady decline in any cycle, coupled with small escapements, it is obvious that the amount of the catch should be reduced in order that a greater escapement to the spawning-beds may be secured. In this connection Drs. Clemens instance the pack on the Nass River. The catch this year produced a pack of but 5,540 cases. The bulk of the sockeye in that river system mature at five years of age. The year 1928 therefore falls in the cycle-years 1908–13–18–23–28. The packs in those years were as follows: 1908, 27,584 cases; 1913, 23,574 cases; 1918, 21,816 cases; 1923, 17,821 cases; 1928, 5,540 cases. The reports from the spawning-beds of the Nass in those years show good escapement in 1908; a fair one in 1913; no report for 1918; a poor escapement in 1923; and a very poor one in 1928—indicating clearly that escapements have not been adequate to maintain the runs in this cycle.

Drs. Clemens call attention to the efforts being made in British Columbia and in Alaska to obtain exact data concerning the relation between catch and escapement. It is not known at

present what this relation should be in order to maintain a run at a reasonable high level of production. Until such time as this information is available, resort must be made to experiment. In those cycle-years of any stream where continuous decreases in the catches have occurred and where escapements have been obviously inadequate, the line of action should be to restrict the catch to such an extent as to ensure an adequate escapement; and, as already stated, the restriction must at present be determined by experiment. However, in the case of the 1908–13–18–23–28 cycle of the Nass River, depletion has become so serious that only complete prohibition of sockeye-fishing in 1933 can apparently save the cycle.

With the accumulation of our knowledge in the last fifteen years concerning the cycles of the runs to our principal streams, it would seem that the time has arrived when a definite limit of the catches for each river system might be made. Drs. Clemens call attention to the fact that in conjunction with such a procedure it is imperative that provision be made for obtaining more exact information concerning escapements, preferably by the installation of counting-weirs.

General Characteristics of Fraser Sockeye Run in 1928.

In dealing with the total sockeye-pack for the Fraser River system in 1928, Drs. Clemens show that the catch produced a total pack of 90,343 cases, of which 29,299 cases were packed in British Columbia and 61,044 cases in the State of Washington. The year 1928 was the continuation of the 1912–16–20–24 cycle and its pack shows a continuation of the steady decline in the packs of that series. It cannot be assumed that the blockade in Hell's Gate Canyon in 1913 affected that cycle; hence there can be but one conclusion drawn—namely, that the catches have greatly exceeded the reproductive capacity of the escapement of the years in that cycle. It is now more clearly evident that the catches in 1904 and 1908, with packs of 458,000 and 429,000 respectively, were too great, and, in face of the continued decline in the cycle as indicated by the pack and the spawning-bed reports, it is manifest that the toll of the fishery is still too great to maintain even the present low average of the Fraser.

The sockeye run to the Fraser system in 1929, Drs. Clemens state, will be derived from the spawnings of 1925. The year 1929 is in the cycle of the one-time "big years," and there is a reasonable expectation of the run in that year being at least equivalent to that of 1925. This conclusion appears justified from the report on the spawning-beds in 1925, which states: "A summary of observations and reports on spawning conditions in the Fraser River basin this season warrants the conclusion that the escapement of sockeye was somewhat greater than in any year since 1913. However, the number of sockeye that reached and spawned in all sections was not sufficiently great to produce much, if any, increase in the run four years hence."

The material used by Drs. Clemens for this year's study of the Fraser sockeye run consisted of data and scales from 1,004 sockeye selected at random from April 20th to September 15th, in twenty-nine samplings.

The 4_2 age-group predominated as usual, being represented by 717 individuals, or 71 per cent. of the total. The 5_2 age-group, the next most abundant numerically, was represented by 188 individuals, or 19 per cent. Other age-groups—namely, 5_3, 6_3, 3_1, 4_1, 3_2, and 4_3—were present in small numbers. Drs. Clemens present this year a table giving the percentages of the various age-groups in each year since 1919.

The average lengths and weights of the 1928 fish were normal.

General Characteristics of the Rivers Inlet Sockeye Run of 1928.

The run of sockeye to Rivers Inlet in 1928 was the only one that came up to expectancy. It amounted to 60,044 cases and, while comparatively small, was without doubt all that could have been expected from the spawnings of 1923 and 1924. A disquieting feature, however, is that the reports from the spawning-beds in 1928 indicate a poor escapement.

Drs. Clemens furnish a table giving a general summary of the packs and the composition of the Rivers Inlet runs for a period of seventeen years, which shows some considerable uncertainty as to the real nature of the sockeye runs. The annual pack varies over a wide range and the relative proportions of the four- and the five-year-old fish show a marked variability from year to year, a seemingly uncorrelated mass of data. "If, however, we accept," Drs. Clemens state, "the theory that this river has pre-eminently a five-year cycle, we are able to interpret this data with considerable satisfaction, both for packs and also for relative percentages

of the age-groups. Turning attention first to the commercial yield, we find a striking correlation if we tabulate the successive packs in series of five-year intervals. In the following table each series, or five-year cycle, is arranged horizontally across the page:—

1. 1907, 87,874 cases; 1912, 112,884; 1917, 61,195; 1922, 53,584; 1927, 64,461.
2. 1908, 64,652 cases; 1913, 61,745; 1918, 53,401; 1923, 107,174; 1928, 60,044.
3. 1909, 89,027 cases; 1914, 89,890; 1919, 56,258; 1924, 94,891.
4. 1910, 126,921 cases; 1915, 130,350; 1920, 125,338; 1925, 159,554.
5. 1911, 88,763 cases; 1916, 44,936; 1921, 48,615; 1926, 65,581.

The major fluctuations in size of pack are remarkably constant in series 2, 3, and 4. Series 2, with the exception of the year 1923, has produced packs ranging between 50,000 and 65,000 cases. Series 3, except for one year, 1919, is composed of greater packs, varying within the limits of 89,000 to 95,000 cases. The pack in 1923 is much larger than would be anticipated from the brood-year pack of 1918. Similarly, in series 3 the pack of 1919 is noticeably small and less than expected. These two exceptions in the series find a ready explanation in Overseer Stone's report of the conditions on the spawning-beds in 1919. He wrote: "Taking into consideration the comparatively poor pack obtained by the canners at Rivers Inlet this season, it is surprising that the spawning-beds did not show a correspondingly poor seeding. The exceptionally large number of sockeye observed spawning on the beds, and noted in tens of thousands schooled up in the deeper portions of the various tributaries, precludes the opinion generally expressed by the canning fraternity that the run this year was a small one. My inspection showed that the spawning-beds were as abundantly seeded as in 1914 and more so than in 1915. As the sockeye, generally speaking, did not reach an average standard in size, the poor catch may be attributed to their having passed through the nets. Fishermen whom I interviewed during the fishing season time and again deplored their luck in seeing hundreds of salmon pass through their nets. The extension of the weekly closed season had its effect, because I found the spawning-beds of the tributaries of Owikeno Lake so abundantly seeded this year that I look for a favourable return in the runs four and five years hence." "Hence," state Drs. Clemens, "the small commercial pack of 1919 is accounted for by the fact that the fish were smaller than usual and immense numbers of them passed through the nets. While the pack statistics for the year 1919 indicate a poor run, it was in reality a very large one. This simply shows that the size of the pack in itself may not be a reliable index to a run."

As for the pack of 1923, which was considerably greater than expectancy, 76 per cent. of the fish were four years old and were the progeny of the enormous escapement of 1919.

Series 4 of the five-year pack statement has a uniformly high pack of 120,000 cases or better. Undoubtedly the success of this cycle is at least partly accounted for by the fact that in the 5_2 group, which predominates the cycle, the females outnumber the males.

Series 1 and 5 of the statement under consideration show less uniformity in size of pack than do the other series. It is possible that we would find some explanation for these fluctuations, which are particularly marked in the earlier years, if reports of the escapements were available.

A most interesting correspondence is brought out in the runs in the years in question, if we arrange a similar series, substituting the percentage of the four- and the five-year-old fish in place of the pack:—

1. 1912.....79%	1917.....67%	1922.....18%	1927.....17%
21%	33%	82%	83%
2. 1913.....20%	1918.....43%	1923.....24%	1928.....42%
80%	57%	76%	58%
3. 1914.....65%	1919.....54%	1924.....56%	
35%	46%	44%	
4. 1915.....87%	1920.....95%	1925.....77%	
13%	5%	23%	
5. 1916.....76%	1921.....51%	1926.....40%	
24%	49%	60%	

As would be expected, the second, third, and fourth series are those in which the greatest constancy is found. In the second series in all cases the percentage of four-year-old fish is greater than that of the five-year-olds. In series 3 the five-year-old fish slightly outnumber the four-year fish. In series 4 the five-year-olds form the great bulk of the packs.

In comparing these two sets of tabulations, Drs. Clemens saw at once that there is a correlation between the size of the pack and the relative proportions of the four- and five-year-old fish. A majority of four-year-old fish means a small pack, roughly between 50,000 and 60,000 cases. When the five-year-old slightly exceed the fours the pack amounts to 85,000 to 95,000 cases. A preponderance of five-year-old fish produces a pack of at least 120,000 cases.

At the present time Drs. Clemens can give no explanation for the reversal of the proportions of the age-groups either between any two successive years, such as 79 per cent. five-year-olds and 21 per cent. four-year-olds in 1912, against 20 per cent. five-year-olds and 80 per cent. four-year-olds in 1913; or between any two five-year periods within the same series—as illustrated by 67 per cent. fives and 33 per cent. fours in 1917 and 18 per cent. fives and 82 per cent. fours in 1922.

Neither are they able to determine why the four-year age-groups have a greater correlation when plotted on a basis of five than they have when tabulated on a basis of four. All they suggest is that these tabulations show that certain rather definite proportions of the four- and five-year age-groups seem to have been established in three five-year cycles in Rivers Inlet and that these proportions are in turn linked with packs of certain size.

Drs. Clemens state that the year 1928 belongs to the cycle in which the packs have the small average of about 60,000 cases. The average packs of the cycles 1909–14–19–24 and 1910–15–20–25 show that Rivers Inlet is capable of a much greater annual yield than 60,000 cases. If, therefore, the cycle of 1908–13–18–23–28, which is known to be "weak," is to be made more productive, it can only be done by making provision for a greater escapement to the spawning-beds.

Referring to the run of 1929, Drs. Clemens say it will be the product of the spawnings of 1924 and 1925. In 1924, according to the report from the spawning-beds, there was an exceptionally large escapement and the samplings in that year showed that five-year-old fish made up 56 per cent. of the run. The pack consisted of 94,891 cases. The report from the spawning-beds in 1925 indicated an excellent escapement, but in that year 77 per cent. of the run consisted of five-year-old fish and it is not expected that the progeny of these fish will appear until 1930. The four-year-old fish formed but 23 per cent. of the run which produced the large pack of 159,554 cases. There may therefore be a return of a fair number of four-year-old fish in 1929. Taking these things into consideration and also the fact that the year 1929 belongs to the 1909–14–19–24 cycle, there would seem to be a reasonable expectancy of a run which may produce a pack of between 85,000 and 95,000 cases.

General Characteristics of the Skeena River Sockeye Run of 1928.

In dealing with the Skeena River sockeye run of 1928, Drs. Clemens state that "from the commercial standpoint the pack was the darkest spot in the sockeye-fishing of that season." The pack consisted of only 34,559 cases, which is the lowest on record and 6,459 cases less than the previous low record of 1921. In their report for the year 1927 they pointed out that a large pack could not be expected in 1928 because of the low percentages of four- and five-year-old fish in the runs of 1924 and 1923 respectively, and stated that a pack much in excess of 80,000 cases could not be expected. It is of interest, therefore, to seek possible causes for the discrepancy between the prediction and the actual pack.

Predictions at the present time, Drs. Clemens state, are based upon pack statistics according to cycle-years, analyses of random samplings of the runs from year to year and annual reports from the spawning-beds, also *upon the assumption that conditions remain reasonably constant from year to year.* Nothing is known concerning the success of the hatch, conditions during either the fresh-water or the marine periods of growth, and but little concerning the fishing conditions in any year. It is evident, therefore, that the pack of any year may not coincide with predictions. However, in 1928, although the pack was relatively small, the reports from the spawning-beds indicate a large escapement. Mr. Gibson, who has inspected the beds for a number of years, says of 15-Mile Creek, a tributary of Babine Lake, in Skeena basin: "Although I have been inspecting the spawning-grounds of Babine Lake since 1920, I have never before seen so many sockeye in this creek." Again: "In summing up the Babine area, I can say with confidence that this area will be exceptionally well seeded this year." He suggests that the additional weekly twelve hours of "close season" may have been responsible for the large escapement. Undoubtedly the extra closed period did allow more fish to pass up to the spawning-beds than otherwise would have done so. Whether this circumstance is sufficient to account for the difference between the expected and the actual pack cannot be determined at the present

time, and the returns four and five years hence will be watched with great interest. It would seem, however, that with the large escapement the situation as regards the future of this cycle on the Skeena River is satisfactory and that there should be a good return four or five years hence.

The run of 1929, Drs. Clemens state, will be derived from the seedings of 1924 and 1925. In 1924 the pack consisted of 144,747 cases and the sampling of the fish in that year showed that the five-year-old fish made up 75 per cent. of the run. The report from the spawning-beds at both Lakelse and Babine Lakes stated that large numbers of sockeye reached the stream and in general the runs were exceptionally good. The prospects of a large return of five-year-old fish in 1929 should therefore be good. In 1925 the pack totalled 77,784 cases and the run was made up of 53 per cent. of four-year-old fish. The spawning-beds were reported as having been very well seeded. In view of these facts it would seem that a large run, possibly producing a pack in the neighbourhood of 140,000 cases, may be expected.

General Characteristics of Nass River Sockeye Run in 1928.

The year 1928 Drs. Clemens find the erratic Nass a normal river, fulfilling a logical expectation of a very small sockeye-pack. The pack is the smallest on record and consists of the astonishingly small figures of 5,540 cases. Although the certainty of an unmistakable decline in the run of sockeye to the Nass has been impressing itself during the past few years, up to the present time it has not been necessary to face the possibility of complete failure in the near future. We cannot look ahead without looking back. As is well known, the great majority of the Nass sockeye mature at the end of five years. Hence the principal brood-year of this 1928 run was 1923, which yielded the mediocre pack of 17,821 cases. In that year, after his annual inspection of the spawning-grounds in the Meziadin watershed of the Nass River basin, Inspector of Fisheries Hickman reported a very poor seeding. In view of the small size of this year's pack it is not surprising to find the following in the summary of Inspector Hickman's report for 1928: "A summary of spawning conditions shows that very few sockeye were to be found in any section; far less than have been found in any one of the last four years."

In 1923 the pack on the Nass was 17,821 cases; in 1928 it was 5,540—a drop of 12,000 cases. What will the pack be in 1933? While predictions and expectancy in the Nass run are in general unreliable, one cannot conceive of any condition which could produce in 1933 anything but an exceedingly small run and a pack of very small commercial value. On the other hand, the run itself, by reason of its greatly reduced numbers, will be very valuable for seeding purposes and every effort should be made to allow all the sockeye to reach the spawning-beds.

Drs. Clemens quote what Dr. Gilbert wrote in 1919, to wit: "When the experience of a series of years indicates unmistakably that the productivity of a stream is declining to a lower level, the common-sense treatment of the situation is to modify favourably the only factor over which we exercise control. We should increase the spawning reserve and thus seek to augment the egg production. Egg production must, after all, be fundamentally most important. As a constant factor, in the long run it will dominate the situation." Unless the taking of sockeye in the Nass River is prohibited, in the year 1933 we can look for nothing but complete annihilation of the run which occurs in the five-year cycle, 1923–28–33–38.

As to the run of 1929, Drs. Clemens make no prediction. They simply state that in the past the packs of this five-year-cycle stream have been consistently large, as the following figures show: 1909, 28,246 cases; 1914, 31,327 cases; 1919, 28,259 cases; and 1924, 33,590 cases. Consequently we may await 1929's returns with interest.

In former years the late Dr. Gilbert pointed out, in several of his contributions to this series of papers, that large runs to the Skeena and Rivers Inlet seem to be intimately associated with large percentages of five-year-old fish. It is interesting to note that in this cycle of the Nass the four-year-old component of the runs is very small. We have no figure for 1909, but in 1914 the four-year-olds constituted only 4 per cent. of the run; in 1919, 7 per cent.; and in 1924, 4 per cent.; while over a period of seventeen years the general average of the group is 11–12 per cent. Not only is the brood-year pack of 1919 larger, but, in addition, in that year Inspector Hickman reported the spawning-beds more extensively seeded than usual. In any other river system except the Nass these facts would indicate a very good return in 1929.

The full text of Drs. Clemens's paper, together with its thirty-one tabulations, will be found in the Appendices of the report. It is, as the foregoing digest shows, one of the most interesting and valuable of the series published in the annual reports of the Department since 1912.

SALMON-TAGGING IN BRITISH COLUMBIA WATERS.

The Biological Board of Canada, following an agreement with the International Pacific Salmon Investigation Federation, consisting of the executive and scientific staffs of the Fisheries Departments of Canada, the United States, British Columbia, Washington, Oregon, California, and Alaska, has been tagging and liberating salmon in British Columbia waters since 1925. The purpose of the Federation is to produce through joint and uniform effort the knowledge essential for the proper and scientific administration of the salmon-fisheries of the Pacific Coast in order to effectively conserve the great salmon resources of the North Pacific.

The tagging of salmon experiments conducted by the Biological Board of Canada in British Columbia waters were begun in 1925 and have been continued since then. The following is a brief summary of the Board's efforts:—

SUMMARY OF SPRING SALMON (O. TSCHAWYTSCHA) TAGGED IN BRITISH COLUMBIA WATERS, 1925–28.

Date tagged.	Location.	Total tagged.	Recaptured.	Per Cent. of Recapture.
1925	Ucluelet, west coast of Vancouver Island	1,125	122	10.8
1925	Hippa Island, Queen Charlottes	274	34	12.0
1926	Ucluelet, west coast of Vancouver Island	1,353	179	13.2
1927	Quatsino, west coast of Vancouver Island	54	18	33.0
1927	Kyuquot, west coast of Vancouver Island	518	64	12.4
1927	Deep Bay, Vancouver Island	168	15	9.0
1928	Nanaimo	267	15	5.6
1928	Queen Charlotte	133	6	4.5
	Totals	3,892	453	.....

Of the 1,125 spring salmon tagged at Ucluelet in 1925, sixty-eight were recaptured the same year, two of which were taken in the Sacramento River in California, forty-one in the Columbia, two on the coast of Oregon, eleven in Puget Sound, and four in the Fraser River.

In 1926 the number of recaptures of spring salmon tagged in 1925 off Ucluelet totalled forty-five, of which twenty-six were retaken in the Columbia River, two in Oregon, one on the west coast of Washington, and the balance inside the entrance to Juan de Fuca Strait, only one of which was taken in the Fraser.

Of the 1,353 spring salmon tagged off Ucluelet in 1926, 128 were recaptured that year—sixty-nine were taken in the Columbia, one off the Washington coast, fifty-six taken inside Cape Flattery, only nine of which were taken in the Fraser. Forty-seven of the spring salmon tagged off Ucluelet in 1926 were retaken in 1927, thirty-seven of which were retaken in the Columbia. All the other ten were retaken east of Cape Flattery.

Seven of the fish tagged off Ucluelet in 1925 were retaken in the Columbia River in 1927; also one tagged there in 1926 was retaken in the Columbia River in 1928.

Of the fifty-four spring salmon tagged off Quatsino in 1927, eighteen were retaken that year—twelve of which were caught in the Columbia River and only three inside Cape Flattery. None have since been taken.

Of the 518 spring samon tagged off Kyuquot in 1927, fifty-eight were retaken that year—forty of which were caught in the Columbia, seven off the coast of Washington, and three off the coast of Oregon.

Five of the fish tagged off Kyuquot in 1927 were retaken in 1928—one off Goose Island, north of the Queen Charlotte Islands, two at Cape Flattery, one in Barkley Sound, and one in the Fraser River.

Of the 274 spring salmon tagged off Hippa Island, west coast of Queen Charlottes, in 1925, thirty-one were retaken that year—seven in the Columbia, twelve off the Oregon coast, one off the Washington coast, two in the Skeena River, and two in Barkley Sound. But three of the fish tagged off Hippa in 1925 were retaken in 1926—one in Alaska, one in the Nass River, British Columbia, and one off the Washington coast.

Of the 133 spring salmon tagged in Queen Charlotte Sound in 1928, but six were retaken that year—four of which were taken in the Fraser River, one near Nanaimo, and one at West Beach, Washington.

Of the 168 spring salmon tagged at Deep Bay, north-east coast of Vancouver Island, in 1927, only nine were recovered that year—four of which were taken in the Fraser and one in the Skagit River in Washington. But six of the fish tagged at Deep Bay in 1927 were retaken in 1928—three in the Fraser, one at Knight Inlet, one at Cape Mudge, and one at Deep Bay.

Of the 267 spring salmon tagged near Nanaimo, east coast of Vancouver Island, in 1928, fifteen were recaptured that year—of which eight were taken from the Fraser, one in the Columbia River, one at Smith Inlet, north of Queen Charlottes, one at Point Roberts, and one in the Cowichan.

The foregoing shows that of the 2,478 spring salmon tagged off Ucluelet in 1925 and 1926, 181 were recaptured in the Columbia River; and that of the 572 spring salmon tagged off Quatsino and Kyuquot in 1927, fifty-two were retaken in the Columbia.

The foregoing data demonstrate that a considerable number of Columbia River breed spring salmon feed off the west coast of Vancouver Island, and that one of them was caught and tagged on the east coast of Vancouver Island.

SUMMARY OF COHOE SALMON (O. KISUTCH) TAGGED, 1925–28.

Date tagged.	Location.	Total tagged.	Return.	Per Cent. of Return.
1925	Ucluelet	51	5	9.8
1926	Ucluelet	180	11	6.1
1927	Kyuquot	135	8	6.0
1927	Deep Bay	357	47	13.5
1928	Sooke, Vancouver Island	99	23	23.0
1928	Nanaimo	1,609	158	9.8
1928	Queen Charlotte Sound	833	77	9.2
	Totals	3,264	329	.....

Of the fifty-one cohoe salmon tagged off Ucluelet in 1925, only five were retaken that year; all were retaken east of the point of liberation. Of the 180 tagged in 1926, eleven were retaken—one as far south as Grays Harbour, Washington, one at Dungeness, and one in Bute Inlet. Of the 135 tagged off Kyuquot in 1927, eight were retaken that year, two of which were captured in the Columbia.

Of the ninety-nine cohoe tagged at the traps at Sooke, twenty-four were retaken that year, all inside Juan de Fuca Strait.

Of the 833 cohoe tagged in Queen Charlotte Sound in 1928, seventy-seven were retaken that year—eleven in the Fraser, thirteen in Bute Inlet, and the others in waters south of the point of liberation.

Of the 1,609 cohoe tagged near Nanaimo in 1928, 158 were recaptured that year—thirty-five, or 22 per cent., in the Fraser.

SUMMARY OF SOCKEYE SALMON (O. NERKA) TAGGED, 1925 AND 1928.

Date tagged.	Location.	Total tagged.	Recaptures.	Per Cent. of Return.
1925	Haystack Island (Vancouver Island)	659	135	20.5
1925	Deep Water Bay	515	107	20.0
1928	Johnstone Strait	10	3	30.0
1928	Fraser River	402	61	15.0
	Totals	1,586	306	.....

Of the 515 sockeye salmon tagged at Deep Water Bay in 1925, sixty-five were retaken that year. As was anticipated, fifty-six, or 86 per cent., were retaken in the Fraser, three in English Bay, and only one in the State of Washington waters. Limited as is the above return, it sustains the belief that a portion of the run of sockeye which seek the Fraser come down from the north through Johnstone Strait.

Of the 659 sockeye that were tagged off Haystack Island, north-west end of Vancouver Island, in 1925, 135 were retaken that year. The return shows that eighty, or 60 per cent., were taken in the Nass, thirteen in the Skeena, twenty-seven in South-eastern Alaska, and the balance in various waters north of the point of liberation.

HALIBUT INVESTIGATION.

The International Fisheries Commission, created by the Halibut Treaty between Canada and the United States to make a thorough investigation into the life-history of the Pacific halibut and the condition of that fishery, made its first report to the two Governments in the spring of 1928. The report is reproduced in the Appendix of this report. The following excerpt from the report shows the extent and condition of the fishery:—

"Fisheries for halibut are prosecuted in the North Pacific and the North Atlantic Oceans, and yield about ninety millions of pounds annually. The Pacific halibut-fishery, which is covered by the terms of this convention, is the greatest in the world. The annual catch exceeds fifty millions of pounds, which represents about 60 per cent. of the world's catch. Of the remainder, about thirty millions are credited to European countries and six millions to the Atlantic Coast of this continent. The value of the Pacific halibut-catch to the fishermen is about seven million dollars annually, and it is consequently one of the most important fisheries in North American waters. The Pacific halibut is, therefore, one of the most important species of food-fishes indigenous to the waters of the North American Continent. The halibut-fishery banks of the Eastern Pacific are shown in Plates Nos. 1–3. The division into areas shown thereon is for statistical purposes and should not be confused with those referred to in the Commission's recommendations, which will be submitted later on.

"The Pacific halibut-fishery originated soon after the first railway communication was established between the two coasts of the United States. It is, therefore, comparatively young. It had its inception in 1888 near Cape Flattery, at the entrance to Juan de Fuca Strait. The fishery expanded rapidly and by 1910 it had extended to grounds off Cape Ommaney, Baranof Island, 600 miles to the north. Subsequent expansion has extended the fishery until it now covers about 1,800 miles of coast. Formerly as many fish were taken from the 600-mile stretch as are now procured from the entire area of 1,800 miles. The banks on the eastern side of the Gulf of Alaska, which yield spawning fish, were first exploited in 1913. In 1926 the larger boats made by far the greater part of their catches in the vicinity of Kodiak Island, on the western side of the Gulf of Alaska, about 1,200 miles beyond the original fishery. The catch on the older grounds south of Cape Ommaney has decreased from a total in excess of fifty million pounds in 1910 to about twenty-one millions in 1926, and much greater effort was exerted in making the catch in the latter year. It is evident that the present level of production has been maintained by extending fishing operations to new areas, as the catch on the older grounds decreased, and by increasing the intensity of the fishing effort.

"The amount of gear now used on the older banks is about two and one-half times the quantity formerly used, yet the present catch is only about 40 per cent. of the former yield from these grounds. Under the stress of this great intensification of fishing effort the abundance of fish on the older banks has fallen enormously, to 16 per cent. of the abundance in 1906. Where in 1906 the catch per set of a unit of fishing-gear was nearly 300 lb., in 1926 it was below 50 lb. Expressed in another way, it required six units of gear to catch as many fish as one unit caught in 1906. The decline has gone on at an even rate and shows no tendency to slacken. Accompanying this fall in abundance there has been a decrease in the average size of the fish landed and a great increase in the percentage of undersized fish. For example, between 1919 and 1926 the percentage of undersized fish from the older banks increased from 20 to 30 per cent.

"The more recently exploited banks to the westward show the same trend, the catch having fallen from 160 lb. per unit of gear in 1923 to 100 lb. in 1926, and was still lower in 1927, while at the same time there was an increase in the number of fish under 11¾ lb.

"The rapidity of decline is regarded as especially serious because of the very slow rate of growth of the halibut, an adult being from twelve to twenty-five years, or over, in age. Hence the present decline has taken place within the life-span of one halibut of ordinarily large size. As nearly all the fish which are being caught now were spawned eight or ten years ago, the abundance of the younger fish, which will annually be available for capture in the next ten years, has already been established. If these are greatly reduced in numbers, and the intensity of the fishery is maintained, the outlook for a future stock of spawning fish sufficient to maintain the supply presents a hopeless picture. In fact, the Commission's investigations indicate that relatively few mature halibut are now found on the older banks.

"These illustrations demonstrate beyond a doubt that the fishery is in a very serious condition, and that the banks cannot stand the intensity of fishing to which they are subjected. The Commission is fully convinced that the conditions are so serious that no delay should be permitted in the adoption of additional conservation measures. In the light of the investigations made, such action is essential to the maintenance of the fishery."

RECOMMENDATIONS.

The Commission recommends that power be given proper governmental authorities:—

"1. (*a.*) To establish areas, within each of which, if deemed necessary for the preservation of the fishery there, the total catch of halibut may be reduced by a predetermined percentage annually, commencing not less than one year after the putting into force of this recommendation, until the fishery therein shall reach a state of stability of yield.

"(*b.*) To determine upon the amount of this percentage reduction, and to revise the same from time to time as may be found necessary, the intent being to restrain any increase in the amount of fishing within such area.

"2. To close permanently to all fishing the two areas herewith defined, and known to be populated by small immature halibut, and to close such other grounds as may be found by the Commission to be populated by a similar class of fish.

"3. To prevent the use of any fishing-gear deemed unduly destructive.

"4. To extend the present closed season by two weeks at its beginning, making the closure for all fishing in all areas from November 1st to February 15th, both dates inclusive, and to facilitate future alterations in the length of close season.

"5. To license all vessels fishing for halibut in treaty waters, under such terms as are necessary for the purpose of the treaty, including statistical returns, and for clearance to regulated waters."

APPENDICES.

CONTRIBUTIONS TO THE LIFE-HISTORY OF THE SOCKEYE SALMON. (No. 14.)

By Wilbert A. Clemens, Ph.D., Director, Pacific Biological Station, Nanaimo, and Lucy S. Clemens, Ph.D.

INTRODUCTION.

In the year 1928 the packs of sockeye in the four areas considered in this series of reports have been low, and in three of these below expectancy, the exception being in the case of Rivers Inlet. Coupled with this, the reports from the spawning-beds indicate small escapements to the streams, except in the case of the Skeena River. The situation therefore merits earnest consideration.

When study of representative samplings of runs, examination of pack statistics, and perusal of reports from spawning-beds have been made, and clear indication of steady decline in any cycle coupled with poor escapements has been found, it is obvious that the amount of the catch should be reduced so that greater escapements to the spawning-beds may be permitted. For example, the pack on the Nass River this year was 5,540 cases. The bulk of the sockeye in this river system mature at five years of age and the year 1928 therefore falls in the cycle-years 1908–13–18–23–28. The packs in these years were as follows: 1908, 27,584 cases; 1913, 23,574; 1918, 21,816; 1923, 17,821; 1928, 5,540. The reports from the spawning-beds were as follows: 1908, good; 1913, fair; 1918, no report; 1923, poor; 1928, very poor. It is thus clearly evident that escapements have not been adequate to maintain the runs of this cycle.

While efforts are being made both in British Columbia and in Alaska to obtain exact data concerning the relation between catch and escapement, we do not know at the present time what this relation should be in order to maintain a run at a reasonably high level of production, and therefore until such time as this information is available, resort must be made to experiment. In those cycle-years of any stream where continuous decreases in packs have occurred, and where escapements have been obviously inadequate, the line of action should be to restrict the catch to such a point that there is definite assurance of adequate escapement. As stated previously, the extent of restriction must for the present be determined by experiment. In the case of the 1908–13–18–23–28 cycle of the Nass River, depletion has become so serious that it would seem that only complete prohibition of sockeye-fishing in 1933 would save the cycle.

With the accumulation of our knowledge concerning the cycles of runs, it would seem that the time had arrived when a definite limit to the amount of catch for each river system might be made. In conjunction with such a procedure, it would be imperative that provision be made for obtaining more exact information concerning escapements, preferably by the installation of counting-weirs.

1. THE FRASER RIVER SOCKEYE RUN OF 1928.

(1.) General Characteristics.

The total pack for the Fraser River system in 1928 amounted to 90,343 cases, of which 29,299 cases were packed in the Province of British Columbia and 61,044 cases in the State of Washington. The year 1928 is the continuation of the 1912–16–20–24 cycle and its pack shows a continuation of the steady decline in the packs of this series (Table I.). It cannot be conceived that the blockade at Hell's Gate in 1913 affected this cycle, and there can be but one conclusion—namely, that the catch has greatly exceeded the reproductive capacity of the cycle. It is abundantly evident now that the catches in 1904 and 1908, with packs of 458,000 and 429,000 respectively, were too great, and in the face of the continued decline in the cycle, as indicated by the packs and the spawning-bed reports, it is evident that the toll of the fishery is still too great.

The run of 1929 will be derived from the spawning of 1925. This is in the cycle of the one-time "big years," and there is a reasonable expectation of the run of 1929 being at least equivalent to that of 1925. This conclusion appears justified from the report on the spawning-beds in 1925, which states: "A summary of observations and reports on spawning conditions in the Fraser River basin this season warrants the conclusion that the escapement of sockeye was somewhat greater than in any year since 1913. However, the number of sockeye that reached and spawned in all sections was not sufficiently great to produce much, if any, increase in the run of four years hence."

The material for this year's study consisted of data and scales from 1,004 sockeye salmon selected at random from April 20th to September 15th in twenty-nine samplings.

(2.) Age-groups.

The 4_2 age-group predominated as usual, being represented by 717 individuals, or 71 per cent. of the total. The 5_2 age-group,* the next most abundant numerically, was represented by 188 individuals, or 19 per cent. Other age-groups—namely, 5_3, 6_3, 3_1, 4_1, 3_2, and 4_3—were present in small numbers (Tables II. and III.).* We present this year Table IV., showing the percentages of the various age-groups in each year since 1919.

The average lengths of the males and females of the dominant age-group, 4_2, were practically the same as those of their progenitors in 1924. The average was 23.4 inches in the case of the males and 23 in the case of the females.

Similarly, the average lengths of the 5_2 and 5_3 age-groups are quite normal. The outstanding feature in the lengths is the large average size of the 6_3 group and the small average sizes of the 3_1 and 4_1 groups. It must be kept in mind, though, that the number of individuals in these groups is relatively small. (*See* Table V.)

The average weights of the 4_2, 5_2, and 5_3 age-groups are quite similar to those of their progenitors. It is interesting to note the much greater weight of the 5_3 group in 1928 as compared with that of 1927. Corresponding with the great length of the 6_3 group, we find large weight. Curiously enough, in the 3_1 and 4_1 groups, while the lengths are the smallest on record, the weights are normal (Table VI.).

The total number of males was 559, while that of the females was 445, and the males exceeded the females in numbers in all the important year-classes.

Table I.—Fraser River Packs, 1910–28, arranged in accordance with the Four-year Cycle.

B.C.....1910—	150,432	1914—198,183	1918— 19,697	1922— 51,832	1926— 85,689
Wash.....	248,014	335,230	50,723	48,566	44,673
Total.....	398,446	533,413	70,420	100,398	130,362
B.C.....1911—	58,487	1915— 91,130	1919— 38,854	1923— 31,655	1927— 61,393
Wash.....	127,761	64,584	64,346	47,402	97,594
Total.....	186,248	155,714	103,200	79,057	158,987
B.C.....1912—	123,879	1916— 32,146	1920— 48,399	1924— 39,743	1928— 29,299
Wash.....	184,680	84,637	62,654	69,369	61,044
Total.....	308,559	116,783	111,053	109,112	90,343
B.C.....1913—	719,796	1917—148,164	1921— 39,631	1925— 35,385	
Wash.....	1,673,099	411,538	102,967	112,023	
Total.....	2,392,895	559,702	142,598	147,408	

* In this paper, as in the preceding one, a modification in the terminology for describing the age-classes comprising the sockeye runs to the various rivers has been adopted. In the earlier papers the age-groups were distinguished at maturity and the years spent in fresh water as "four-years-old, one-year-in-the-lake," or "five-years-old, two-years-in-the-lake." In the present terminology these terms are used symbolically as follows: 4_2 and 5_3, in which 4 and 5 represent the age of the fish and the 2 and 3 the year of its life in which the fish left the fresh water. Fish which spend one year in fresh water migrate to sea in their second year; hence the terms "four-years-old, one-year-in-the-lake" and 4_2 are synonymous. Likewise "five-years-old, two-years-in-the-lake" and 5_3 are synonymous, and so on. The age-group known as the sea-type, in which the fish go to sea as fry in their first year, are designated as 3_1 and 4_1, according as they mature at the age of three or four years.

Table II.—Fraser River Sockeyes, 1928, Vancouver Island Traps, grouped by Age, Sex, and Length, and by their Early History.

Length in Inches.	Number of Individuals.																Total.
	4_2		5_2		5_3		6_3		3_1		4_1		3_2		4_3		
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
16½	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1
17½	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1	.....	4
18	4	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5
18½	11	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1	.....	.....	18
19	9	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	13
19½	13	11	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	1	1	.....	.....	27
20	10	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	1	.....	.....	16
20½	7	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9
21	8	9	3	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	23
21½	8	10	2	.....	1	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	22
22	1	27	1	4	.....	1	.....	.....	.....	3	.....	1	.....	.....	.....	.....	38
22½	17	42	6	.....	.....	3	.....	.....	.....	3	.....	.....	.....	.....	.....	.....	71
23	32	68	4	1	1	4	.....	.....	4	.....	.....	.....	.....	.....	.....	.....	114
23½	40	66	2	8	3	3	.....	.....	6	2	.....	.....	.....	.....	.....	.....	130
24	52	54	1	8	9	6	.....	.....	1	.....	.....	2	.....	.....	.....	.....	133
24½	61	29	3	7	4	.....	1	.....	.....	.....	1	.....	.....	.....	.....	.....	106
25	53	8	18	16	8	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	104
25½	34	2	14	9	4	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	65
26	14	.....	17	10	2	.....	.....	1	.....	.....	1	.....	.....	.....	.....	.....	45
26½	3	.....	19	2	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	25
27	1	.....	18	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	19
27½	.....	.....	8	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9
28	.....	.....	1	1	.....	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	5
28½	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
Totals	379	338	120	68	35	18	4	1	11	9	2	5	5	6	3	.....	1,004
Ave. lengths	23.4	23.0	25.5	24.7	24.2	23.4	27.1	26.0	23.4	22.4	25.2	24.2	19.1	18.7	19.8	.....	.....

Table III.—Fraser River Sockeyes, 1928, Vancouver Island Traps, grouped by Age, Sex, and Weight, and by their Early History.

Weight in Pounds.	Number of Individuals.																
	4_2		5_2		5_3		6_3		3_1		4_1		3_2		4_3		Total.
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1
2½	12	6	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	20
3	23	7	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	2	4	.....	.....	37
3½	15	12	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	30
4	14	11	5	1	1	1	.....	.....	.....	.....	.....	.....	1	.....	1	.....	35
4½	17	22	5	4	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1	.....	50
5	20	65	6	4	.....	5	.....	.....	.....	4	.....	1	.....	.....	.....	.....	105
5½	33	70	2	7	5	3	.....	.....	1	3	.....	.....	.....	.....	.....	.....	124
6	56	65	10	7	7	4	1	.....	3	2	.....	1	.....	.....	.....	.....	156
6½	58	48	11	6	7	3	.....	.....	5	.....	.....	1	.....	.....	.....	.....	139
7	62	22	12	13	4	1	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	116
7½	26	8	13	5	2	1	.....	.....	.....	.....	1	1	.....	.....	.....	.....	57
8	26	2	15	10	3	.....	.....	1	.....	.....	.....	1	.....	.....	.....	.....	58
8½	10	.....	13	5	1	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	30
9	4	.....	14	4	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	25
9½	2	.....	3	.....	.....	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	8
10	1	.....	4	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6
10½	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
11	.....	.....	3	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4
11½	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
12	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Totals	379	338	120	68	35	18	4	1	11	9	2	5	5	6	3	.....	1,004
Ave. weights	6.0	5.5	7.4	6.9	6.5	5.7	8.6	8.0	6.4	5.4	8.0	6.6	3.4	3.2	3.5	.....	.....

Table IV.—Fraser River Sockeyes, Percentages of the Year-classes from 1919 to 1928.

Year.	4_2	5_2	5_3	6_3	3_1	4_1	3_2	4_3
1919	70.5	20.3	3.4	0.9	3.1	1.8	.....	.....
1920	69.6	21.2	6.2	0.2	1.9	0.9	.....	.....
1921	78.1	14.6	4.1	0.7	0.5	2.0	.....	.....
1922	70.5	9.3	4.5	2.0	6.3	5.6	0.9	0.9
1923	67.1	10.8	3.9	1.2	6.7	9.9	0.4	0.0
1924	68.2	18.7	9.2	0.5	0.5	2.0	0.8	0.1
1925	67.9	24.9	3.4	0.2	2.2	0.0	0.6	0.8
1926	66.1	20.3	5.2	1.6	2.0	2.5	2.1	0.2
1927	84.6	7.5	3.0	0.8	1.9	2.2	.....	.....
1928	71.4	18.8	5.3	0.5	2.0	0.7	1.0	0.3

Table V.—Fraser River Sockeyes, Average Lengths of Principal Classes from 1919 to 1928.

Year.	4_2		5_2		5_3		6_3		3_1		4_1	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1919	24.1	22.8	26.1	25.1	24.2	22.7	25.8	23.5	22.6	22.2	25.0	24.3
1920	24.1	23.2	25.7	24.6	24.3	23.2	25.7	.....	23.3	21.8	25.5	24.3
1921	23.7	23.0	25.9	24.6	.....	.....	.....	.....	.....	.....	.....	.....
1922	24.0	23.0	25.8	24.1	23.5	22.7	25.4	24.3	23.0	22.6	25.5	24.2
1923	24.3	23.3	25.8	24.8	24.2	22.9	26.3	24.9	23.3	22.7	25.2	24.1
1924	23.8	22.8	24.9	23.9	23.7	22.7	24.3	.....	21.9	20.4	25.2	24.4
1925	23.5	22.9	25.8	24.6	24.0	22.0	.....	.....	22.5	21.7	.....	.....
1926	22.6	22.3	24.6	24.0	23.2	22.4	25.5	23.7	23.4	22.5	25.4	24.6
1927	24.1	23.1	26.1	24.6	21.7	22.0	25.3	24.6	23.4	22.2	25.1	24.5
1928	23.4	23.0	25.5	24.7	24.2	23.4	27.1	26.0	19.1	18.7	19.8	.....

Table VI.—Fraser River Sockeyes, Average Weights of Principal Classes from 1919 to 1928.

Year.	4_2		5_2		5_3		6_3		3_1		4_1	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1919	6.1	5.1	7.2	6.5	5.7	4.5	6.5	5.3	5.3	4.8	6.8	6.1
1920	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1921	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1922	6.4	5.7	7.0	6.1	6.1	5.4	7.2	5.5	5.9	5.2	7.9	6.9
1923	6.6	5.8	7.8	6.9	6.0	5.2	7.3	6.5	6.2	5.3	7.3	6.5
1924	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1925	5.8	5.2	7.6	6.6	6.1	5.3	.....	.....	5.3	4.6	.....	.....
1926	5.2	4.9	6.2	5.7	5.4	4.8	7.4	5.7	6.1	5.4	7.3	6.6
1927	6.1	5.5	7.3	6.8	4.5	4.8	6.5	5.5	5.9	5.2	7.2	6.8
1928	6.0	5.5	7.4	6.9	6.5	5.7	8.6	8.0	6.4	5.4	8.0	6.6

2. THE RIVERS INLET SOCKEYE RUN OF 1928.

(1.) General Characteristics.

The pack of the Rivers Inlet area was the only one of the four under consideration which came up to expectancy in 1928. It amounted to 60,044 cases and, while comparatively small, was without doubt all that could be expected from the spawnings of 1923 and 1924. However, a disquieting feature is the report from the spawning-beds indicating a very poor escapement.

Table VII. gives a general summary of the packs and the composition of the runs over a period of seventeen years. A perusal of this table leaves one in considerable uncertainty as to

the real nature of the Rivers Inlet sockeye run. The annual pack varies over a wide range and the relative proportions of the four- and five-year-old fish show marked variability from year to year. We have before us a seemingly uncorrelated mass of data. If, however, we accept the theory that this river has pre-eminently a five-year cycle, we are able to interpret this data with considerable satisfaction, both for packs and also for the relative percentages of the age-groups. Turning our attention first to the commercial yield, we find a striking correlation if we tabulate the successive packs in series with five-year intervals. In the following table each series, or five-year cycle, is arranged horizontally across the page:—

1. 1907, 87,874 cases; 1912, 112,884; 1917, 61,195; 1922, 53,584; 1927, 64,461.
2. 1908, 64,652 cases; 1913, 61,745; 1918, 53,401; 1923, 107,174; 1928, 60,044.
3. 1909, 89,027 cases; 1914, 89,890; 1919, 56,258; 1924, 94,891.
4. 1910, 126,921 cases; 1915, 130,350; 1920, 125,338; 1925, 159,554.
5. 1911, 88,763 cases; 1916, 44,936; 1921, 48,615; 1926, 65,581.

The major fluctuations in size of pack are remarkably constant in series 2, 3, and 4. Series 2, with the exception of the year 1923, has produced packs ranging between 50,000 and 65,000 cases. Series 3, except for one year, 1919, is composed of greater packs, varying within the limits of 89,000 and 95,000 cases. The pack of 1923 is much larger than would be anticipated from the brood-year pack of 1918. Similarly, in series 3 the pack of 1919 is noticeably small and less than expected. These two exceptions in our series find a ready explanation in Inspector Stone's report of the conditions on the spawning-beds in 1919. He writes: "Taking into consideration the comparatively poor pack obtained by the canneries at Rivers Inlet this season, it is surprising that the spawning-beds did not show a correspondingly poor seeding. The exceptionally large number of sockeye salmon observed spawning on the beds, and noted in tens of thousands schooled up in the deeper portions of the various tributaries, precludes the opinion generally expressed by the canning fraternity that the run this year was a small one. My inspection showed that the spawning-beds were as abundantly seeded as in 1914 and more so than in 1915. As the sockeye, generally speaking, did not reach an average standard in size, the poor catch may be attributed to their having passed through the nets. Fishermen whom I interviewed during the fishing season time and again deplored their luck in seeing hundreds of salmon pass completely through their nets. The extension of weekly closed time had its effect, because I found the spawning-beds on the tributaries of Owikeno Lake so abundantly seeded this year that I look for a favourable return in the runs four and five years hence."

Hence, the small commercial pack of 1919 is accounted for by the fact that the fish were smaller than usual and immense numbers of them passed through the nets. While the pack statistics for the year 1919 indicate a poor run, it was in reality a very large one. This simply shows that size of pack in itself may not be a reliable index to a run.

As for the pack of 1923, which was considerably greater than expectancy, 76 per cent. of the fish were four years old and were the progeny of the enormous escapement of 1919.

Series 4 has a uniformly high pack of 120,000 cases or better. Undoubtedly the success of this cycle is at least partially accounted for by the fact that in the 5_2 group, which predominates the cycle, the females outnumber the males.

Series 1 and 5 show less uniformity in size of pack than do the other series. It is very possible that we would find some explanation for these fluctuations, which are particularly marked in the earlier years, if reports of the escapements were available.

Secondly, a most interesting correspondence is brought out if we arrange similar series, substituting the percentages of the four- and five-year-old fish in place of the packs:—

1.	1912.....79%	1917.....67%	1922.....18%	1927.....17%
	21%	33%	82%	83%
2.	1913.....20%	1918.....43%	1923.....24%	1928.....42%
	80%	57%	76%	58%
3.	1914.....65%	1919.....54%	1924.....56%	
	35%	46%	44%	
4.	1915.....87%	1920.....95%	1925.....77%	
	13%	5%	23%	
5.	1916.....76%	1921.....51%	1926.....40%	
	24%	49%	60%	

As we should expect the second, third, and fourth series are those in which the greatest constancy is found. In the second series in all cases the percentage of the four-year-old fish is greater than that of the five-year-olds. In series 3 the five-year-old fish slightly outnumber the four-year fish. In series 4 the five-year-olds form the great bulk of the packs.

In comparing these two sets of tabulations, we see at once that there is a correlation between the size of the pack and the relative proportion of the four- and five-year-old fish. A majority of four-year-old fish means a small pack, roughly between 50,000 and 65,000 cases. When the five-year-olds slightly exceed the fours the packs amount to 85,000 to 95,000 cases. A preponderance of five-year-old fish produces packs of at least 120,000 cases. At the present time we can give no explanation for the reversal of the proportions of the age-groups either between any two successive years, such as 79 per cent. 5's and 21 per cent. 4's in 1912, against 20 per cent. 5's and 80 per cent. 4's in 1913; or between any two five-year periods within the same series—as illustrated by 67 per cent. 5's and 33 per cent. 4's in 1917 and 18 per cent. 5's and 82 per cent. 4's in 1922.

Neither can we explain why the four-year age-groups have a greater correlation when plotted on a basis of five than they have when tabulated on a basis of four. All we can say is that these tabulations show that certain rather definite proportions of the four- and five-year age-groups seem to have been established in three five-year cycles in Rivers Inlet and that these proportions are in turn linked with packs of certain sizes.

The year 1928 belongs to the cycle in which the packs have the small average of about 60,000 cases. The average packs of the cycles 1909–14–19–24 and 1910–15–20–25 show that Rivers Inlet is capable of a much greater annual yield than 60,000 cases. If, therefore, the cycle of 1908–13–18–23–28, which is known to be "weak," is to be made more productive, it can only be done by making provision for a greater escapement to the spawning-beds.

The run of 1929 will be the product of the spawnings of 1924 and 1925. In 1924, according to the report from the spawning-beds, there was an exceptionally large escapement and the samplings in that year showed that five-year-old fish made up 56 per cent. of the run. The pack consisted of 94,891 cases. The report from the spawning-beds in 1925 indicated an excellent escapement, but in that year 77 per cent. of the run consisted of five-year-old fish and it is not expected that the progeny of these fish will appear until 1930. The four-year-old fish formed 23 per cent. of the run which produced the large pack of 159,554 cases. There may therefore be a return of a fair number of four-year-old fish in 1929. Taking these things into consideration, and also the fact that the year 1929 belongs to the 1909–14–19–24 cycle, there would seem to be reasonable expectancy of a run which may produce a pack between 85,000 and 95,000 cases.

(2.) Age-groups.

The material which formed the basis for the study of the 1928 run was composed of 1,179 samples gathered at random on nine different days between the dates of June 25th and July 30th. The vast majority of the Rivers Inlet sockeyes spend one year in the fresh water and two or three years in the ocean, thus maturing in their fourth and fifth years respectively, and are known as the 4_2 and 5_2 classes. A small number of fish wait two years before migrating oceanward. These also mature after two or three years of sea-feeding and constitute the 5_3 and 6_3 groups. One other class, known as sea-type, in which the fry pass immediately to the salt water, is very occasionally found. Three such individuals were present this year and are the first noted since 1919.

The 1,179 fish were distributed as follows: 643 4_2's, 470 5_2's, 51 5_3's, 12 6_3's, and 3 3_1's. The two dominant groups form 94 per cent. of the entire run. Table VII. shows that the proportions of these two principal classes vary considerably from year to year. As we have stated above, the history of this river shows that, with but one exception, years such as 1928, in which the 4_2's outnumber the 5_2's, the packs are small. In this connection it may be worth while pointing out that, given equal numbers of 4_2's and 5_2's, the commercial yield from the former lot would be less than from the latter, because of the considerable difference in the size of the individual fish in the two groups. This factor combined with a small run will always produce a poor pack.

(3.) Lengths and Weights.

Tables VIII. and IX. give the length and weight distribution of all classes except the sea-type. The three individuals belonging to this class are all males and are of nearly identical

size. Their lengths and weights are as follows: 4 lb., 21½ inches; 4¼ lb., 21½ inches; and 4¼ lb., 21¼ inches.

The 4_2 group of Rivers Inlet is unique among all the age-groups of the four river systems, because the average size of the males and females is so nearly the same. In most years the two sexes have differed in length by only 0.1 or 0.2 inch. This year the difference is 0.5 inch, which, although small in comparison with the differences in the other rivers, is the greatest recorded. The weights exhibit the same feature. In this group there is another interesting size relationship, which is a natural consequence of similarity in size—namely, that the females are sometimes larger than the males. Such has been the case for the past three years in respect to average lengths and for the last two years in regard to average weights. Scattered cases also occur during the earlier years. In all the other river systems there is only a single instance to be found, that in the 5_3 group of the Fraser River in 1927.

The average length of the males (22.3 inches) in the 4_2 class of 1928 compares favourably with the averages of recent years, but is less than those of earlier years. The average length for the females (22.8 inches) has been exceeded once only, in the year 1926. The males of the 5_2 class set a new high record in their length of 26.1 inches and the female average of 25.2 inches has never been exceeded (Table X.). As for the average weights of males, that of the four-year-olds (4.8 lb.) is decidedly low, while that of the five-year-olds (7.5 lb.) is but one-tenth of a pound less than the greatest average recorded. The average weights of the females in both age-groups do not depart from the general averages for the classes (Table XI.).

(4.) Distribution of the Sexes.

The year 1928 is no exception to the rule in Rivers Inlet that the four-year males outnumber the females, while in the five-year group the conditions are reversed (Table XII.). In both classes the percentages of the females are high, particularly when compared with those of earlier years. Conversely, in 1928 the male percentages are low. The total numbers of the two sexes are nearly equivalent; the males slightly outnumber the females, with a percentage of 51 per cent. against 49 per cent. While this basis of approximately equal numbers is probably the normal distribution of the sexes, our data show that the resultant packs are small or mediocre. On the other hand, as stated previously in this report and in the report for 1925, the cycle of 1915–20–25, in which the total females exceed the males, the packs are large.

Table VII.—Percentages of 4_2 and 5_2 Age-groups, Rivers Inlet Sockeyes, in Runs of Successive Years.

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).
1922 (60,700 cases)	5 yrs. 18% 4 yrs. 82%	1918 (53,401 cases).
1923 (107,174 cases)	5 yrs. 24% 4 yrs. 76%	1919 (56,258 cases).
1924 (94,891 cases)	5 yrs. 56% 4 yrs. 44%	1920 (121,254 cases).
1925 (159,554 cases)	5 yrs. 77% 4 yrs. 23%	1921 (46,300 cases).
1926 (65,581 cases)	5 yrs. 40% 4 yrs. 60%	1922 (60,700 cases).
1927 (64,461 cases)	5 yrs. 17% 4 yrs. 83%	1923 (107,174 cases).
1928 (60,044 cases)	5 yrs. 42% 4 yrs. 58%	1924 (94,891 cases).

Table VIII.—Rivers Inlet Sockeyes, Run of 1928, Grouped by Age, Sex, and Length, and by their Early History.

Length in Inches.	Number of Individuals.								Total.
	4_2		5_2		5_3		6_3		
	M.	F.	M.	F.	M.	F.	M.	F.	
19½	3	....	....	....	....	....	....	....	3
20	19	....	....	....	2	....	....	....	21
20½	40	2	....	....	3	....	....	....	45
21	56	11	....	....	5	....	....	....	72
21½	52	19	....	....	5	1	....	....	77
22	54	35	1	1	3	2	....	....	96
22½	33	42	2	5	1	2	....	....	85
23	26	48	2	5	2	4	....	....	87
23½	33	42	4	18	3	3	....	....	103
24	37	26	7	29	4	1	....	1	105
24½	28	10	7	47	2	....	....	....	94
25	15	2	11	55	3	1	....	3	90
25½	7	....	16	61	1	....	....	3	88
26	2	....	23	63	2	....	....	....	90
26½	1	....	18	30	1	....	1	2	53
27	....	....	28	13	....	....	....	1	42
27½	....	....	14	2	....	....	....	....	16
28	....	....	2	....	....	....	1	....	3
28½	....	....	4	....	....	....	....	....	4
29	....	....	2	....	....	....	....	....	2
Totals	406	237	141	329	37	14	2	10	1,176
Ave. lengths	22.3	22.8	26.1	25.2	22.8	23.0	27.2	25.5	.....

Table IX.—Rivers Inlet Sockeyes, Run of 1928, Grouped by Age, Sex, and Weight, and by their Early History.

Weight in Pounds.	Number of Individuals.								Total.
	4_2		5_2		5_3		6_3		
	M.	F.	M.	F.	M.	F.	M.	F.	
3	2	....	....	....	....	....	....	....	2
3½	52	3	....	....	5	....	....	....	60
4	91	31	....	1	9	1	....	....	133
4½	90	60	2	4	5	4	....	....	165
5	46	53	7	18	2	3	....	1	130
5½	44	52	8	31	1	3	....	....	139
6	42	31	9	52	6	2	....	1	143
6½	27	7	16	66	4	....	....	3	123
7	5	....	13	56	2	1	....	1	78
7½	6	....	18	57	3	....	....	3	87
8	1	....	33	30	....	....	1	1	66
8½	....	....	16	10	....	....	....	....	26
9	....	....	11	2	....	....	....	....	13
9½	....	....	4	1	....	....	1	....	6
10	....	....	1	....	....	....	....	....	1
10½	....	....	3	....	....	....	....	....	3
11	....	....	....	1	....	....	....	....	1
Totals	406	237	141	329	37	14	2	10	1,176
Ave. weights	4.8	5.0	7.5	6.7	5.1	5.2	8.7	6.8	.....

Table X.—Average Lengths in Inches of Rivers Inlet Sockeyes for Seventeen Years.

Year.	Four-year Males.	Four-year Females.	Five-year Males.	Five-year Females.
1912	23.2	22.8	25.8	24.6
1913	22.9	23.0	25.9	25.2
1914	23.0	22.8	25.9	25.2
1915	22.9	22.8	26.0	25.1
1916	22.9	22.8	25.8	25.0
1917	22.5	22.3	25.0	24.4
1918	22.3	22.5	24.9	24.5
1919	22.4	22.3	24.8	24.4
1920	.....	.....	26.0	25.0
1921	22.9	22.6	25.2	24.2
1922	22.5	22.4	24.6	24.2
1923	22.4	22.3	24.6	24.1
1924	22.3	22.3	24.9	24.3
1925	22.2	22.2	25.5	24.8
1926	22.8	22.9	25.1	24.6
1927	22.1	22.4	24.6	24.2
1928	22.3	22.8	26.1	25.2

Table XI.—Average Weight in Pounds of Rivers Inlet Sockeyes for Fourteen Years.

Year.	Four-year Males.	Four-year Females.	Five-year Males.	Five-year Females.
1914	5.4	5.2	7.3	6.8
1915	5.3	5.1	7.3	6.6
1916	5.5	5.0	7.6	6.7
1917	5.0	4.9	6.6	6.2
1918	4.9	5.1	6.7	6.7
1919	4.9	4.8	6.3	5.9
1921	5.2	4.9	6.9	6.0
1922	6.0	5.9	7.4	7.0
1923	5.0	4.8	6.5	5.9
1924	4.9	4.8	6.6	6.1
1925	4.6	4.4	6.9	6.2
1926	5.2	5.2	6.9	6.3
1927	5.3	5.8	7.3	7.6
1928	4.8	5.0	7.5	6.7

Table XII.—Relative Numbers of Males and Females, Rivers Inlet Sockeyes, of the 4_2 and 5_2 Groups, 1915 to 1928.

Year.	Average Percentages.				Per Cent. Total Males.	Per Cent. Total Females.
	Four-year Males.	Four-year Females.	Five-year Males.	Five-year Females.		
1915	....	....	....	....	45	55
1916	74	26	40	60	52	48
1917	75	25	42	58	53	47
1918	74	26	49	51	66	34
1919	79	21	45	55	58	42
1920	74	26	48	52	49	51
1921	65	35	38	62	51	49
1922	66	34	38	62	61	39
1923	71	29	33	67	62	38
1924	74	26	31	69	50	50
1925	66	34	34	66	41	59
1926	63	37	32	68	51	49
1927	68	32	36	64	62	38
1928	63	37	30	70	51	49

3. THE SKEENA RIVER SOCKEYE RUN OF 1928.

(1.) General Characteristics.

From the commercial standpoint the pack of the Skeena River was the darkest spot in the sockeye-fishing of the season. The pack consisted of only 34,559 cases, which is the lowest on record and 6,459 cases less than the previous low record of 1921 (Table XIII.). In our report for the year 1927 we pointed out that a large pack could not be expected in 1928 because of the low percentages of four- and five-year-old fish in the runs of 1924 and 1923 respectively, and stated that a pack much in excess of 80,000 cases could not be expected. It is of interest, therefore, to seek possible causes for the discrepancy between prediction and actual pack.

Our predictions at the present time are based upon pack statistics according to cycle-years, analyses of random samplings of the runs from year to year, and annual reports from the spawning-beds, and upon the assumption that conditions remain reasonably constant from year to year. We know nothing concerning the success of hatch, conditions during either the fresh-water or the marine periods of growth, and but little concerning the fishing conditions in any year. It is evident, therefore, that the pack of any year may not coincide with prediction. However, in 1928, although the pack was relatively small, the reports from the spawning-beds indicate a large escapement. Mr. Gibson says of 15-Mile Creek, a tributary of Babine Lake, in Skeena basin: "Although I have been inspecting the spawning-grounds of Babine Lake since 1920, I have never before seen so many sockeye in this creek." Again: "In summing up the Babine area, I can say with confidence that this area will be exceptionally well seeded this year." He suggests that the additional weekly twelve hours of "close season" may have been responsible for the large escapement. Undoubtedly the extra "close" period did allow more fish to pass up to the spawning-beds than otherwise would have done so. Whether this circumstance is sufficient to account for the difference between the expected and the actual pack cannot be determined at the present time, and the returns four and five years hence will be watched with great interest. It would seem, however, that with the large escapement the situation as regards the future of this cycle on the Skeena River is satisfactory and that there should be good returns four and five years hence.

The run of 1929 will be derived from the seedings of 1924 and 1925. In 1924 the pack consisted of 144,747 cases and the samplings of fish in that year showed that the five-year-old fish made up 75 per cent. of the run. The report from the spawning-beds at both Lakelse and Babine Lakes states that large numbers of sockeye reached the streams and in general the runs were exceptionally good. The prospect of a large return of five-year-old fish in 1929 should therefore be good. In 1925 the pack amounted to 77,784 cases and the run was made up of 53 per cent. of four-year-old fish. The spawning-beds were reported as having been very well seeded. In view of these facts, it would seem that a large run, possibly producing a pack in the neighbourhood of 140,000 cases, may be expected.

(2.) Age-groups.

Our material for study this year consisted of scales and data of 2,562 fish collected from June 30th to August 14th, in twelve samplings. The four-year-old fish (4_2) were predominant, amounting to 1,318 individuals, or 51 per cent. The five-year-old fish (5_2) consisted of 996 individuals, or 39 per cent. The 5_3 and 6_3 age-groups were present in percentages of 7 and 3 respectively (Tables XIV., XV., and XVI.).

(3.) Lengths and Weights.

The average lengths and weights in all the age-groups are low and in general slightly lower than those of their progenitors. New low records in lengths are set by the 4_2 males, the 5_3 males, and the 5_3 females, with 23.3, 23.5, and 22.8 inches respectively, and in weights by the 4_2 males and females and the 5_3 males and females, with 5, 4.6, 5, and 4.6 respectively (Tables XVII. to XX.).

(4.) Proportions of the Sexes.

The females slightly outnumbered the males in all the year-classes except in the 6_3 group. The total number of females was 1,372 and of males 1,190, percentages of 54 and 46 respectively (Table XXI.).

Table XIII.—Percentages of 4_2 and 5_2 Age-groups, Skeena River Sockeyes, 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 (59,927 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).
1922 (96,277 cases)	5 yrs. 19% 4 yrs. 81%	1918 (123,322 cases).
1923 (131,731 cases)	5 yrs. 34% 4 yrs. 66%	1919 (184,945 cases).
1924 (144,747 cases)	5 yrs. 75% 4 yrs. 25%	1920 (90,869 cases).
1925 (77,784 cases)	5 yrs. 47% 4 yrs. 53%	1921 (41,018 cases).
1926 (82,360 cases)	5 yrs. 30% 4 yrs. 70%	1922 (96,277 cases).
1927 (83,996 cases)	5 yrs. 31% 4 yrs. 69%	1923 (131,731 cases).
1928 (34,559 cases)	5 yrs. 43% 4 yrs. 57%	1924 (144,747 cases).

Table XIV.—Percentages of the Principal Year-classes, Skeena River Sockeyes, from 1916 to 1928.

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
1922	70	16	12	2
1923	56	29	8	7
1924	23	69	7	1
1925	51	45	3	1
1926	62	26	9	3
1927	62	28	9	1
1928	51	39	7	3

Table XV.—Skeena River Sockeyes, 1928, grouped by Age, Sex, and Length, and by their Early History.

Length in Inches.	Number of Individuals.								Total.
	4_2		5_2		5_3		6_3		
	M.	F.	M.	F.	M.	F.	M.	F.	
20	1	1	....	....	....	....	....	....	2
20½	3	2	....	....	1	....	....	....	6
21	18	17	1	....	1	2	....	....	39
21½	23	35	....	3	1	3	....	....	65
22	59	141	7	6	5	24	....	....	242
22½	61	104	4	2	7	19	....	....	197
23	152	220	10	32	16	32	1	2	465
23½	88	74	19	40	16	9	....	5	251
24	109	59	50	112	16	12	4	8	370
24½	61	22	40	80	8	2	3	5	221
25	41	6	88	136	4	1	5	6	287
25½	13	3	54	61	....	....	1	2	135
26	1	....	91	57	2	....	10	1	161
26½	2	2	32	10	1	....	4	1	52
27	....	....	39	10	....	....	4	1	54
27½	....	....	6	....	....	....	....	....	6
28	....	....	2	....	....	....	1	1	4
28½	....	....	4	....	....	....	....	1	5
Totals	632	686	447	549	78	104	33	33	2,562
Ave. lengths	23.3	22.8	25.3	24.7	23.5	22.8	25.6	24.7	.....

Table XVI.—Skeena River Sockeyes, 1928, grouped by Age, Sex, and Weight, and by their Early History.

Weight in Pounds.	Number of Individuals.								Total.
	4_2		5_2		5_3		6_3		
	M.	F.	M.	F.	M.	F.	M.	F.	
3½	15	12	1	....	3	1	....	....	32
4	80	168	3	4	6	26	....	....	287
4½	175	284	14	28	20	42	....	1	564
5	169	157	32	85	24	21	1	9	498
5½	95	50	62	158	17	6	7	9	404
6	73	14	101	146	3	6	4	7	354
6½	17	1	96	87	....	2	7	5	215
7	7	....	68	32	4	....	10	....	121
7½	....	....	29	7	1	....	3	....	40
8	....	....	24	1	....	....	1	....	26
8½	1	....	8	....	....	....	....	....	9
9	....	....	7	1	....	....	....	1	9
9½	....	....	1	....	....	....	....	1	2
10	....	....	1	....	....	....	....	....	1
Totals	632	686	447	549	78	104	33	33	2,562
Ave. weights	5.0	4.6	6.4	5.8	5.0	4.6	6.5	5.8	.....

Table XVII.—Average Lengths of Skeena River Sockeyes, 4_2 and 5_2 Age-groups, for Seventeen Successive Years.

Year.	Four-year Males.	Four-year Females.	Five-year Males.	Five-year Females.
1912	24.6	23.5	26.4	25.2
1913	23.5	22.9	25.5	24.7
1914	24.2	23.4	26.2	25.1
1915	24.2	23.5	25.9	25.0
1916	23.9	23.6	26.2	25.0
1917	23.6	23.2	25.5	24.7
1918	24.1	23.3	25.9	25.0
1919	24.3	23.4	25.7	24.8
1920	23.8	23.2	26.2	25.3
1921	23.8	23.1	25.2	24.2
1922	23.6	23.2	25.3	24.4
1923	23.7	23.1	25.5	24.5
1924	24.1	23.3	26.2	25.2
1925	23.6	22.8	25.6	24.7
1926	23.8	23.4	25.6	24.8
1927	23.9	23.3	25.7	24.8
1928	23.3	22.8	25.3	24.7

Table XVIII.—Average Lengths of Skeena Sockeyes, 5_3 and 6_3 Age-groups, for Thirteen Successive Years.

Year.	Five-year Males.	Five-year Females.	Six-year Males.	Six-year Females.
1916	24.1	23.8	26.2	24.8
1917	23.9	23.8	25.4	25.0
1918	23.9	23.4	25.2	24.7
1919	24.3	23.4	25.8	24.7
1920	24.1	23.4	26.2	25.1
1921	24.2	23.4	24.9	24.2
1922	23.8	23.3	24.6	24.1
1923	23.9	23.2	25.6	24.4
1924	24.7	23.6	25.8	24.8
1925	24.1	23.3	25.8	24.8
1926	24.6	23.8	26.0	25.0
1927	24.1	23.5	25.2	24.9
1928	23.5	22.8	25.6	24.7

Table XIX.—Average Weights of Skeena River Sockeyes, 4_2 and 5_2 Age-groups, for Fifteen Successive Years.

Year.	Four-year Males.	Four-year Females.	Five-year Males.	Five-year Females.
1914	5.9	5.3	7.2	6.3
1915	5.7	5.2	6.8	6.2
1916	5.4	5.1	7.1	6.3
1917	5.3	5.0	6.4	6.0
1918	5.8	5.3	6.9	6.4
1919	6.1	5.5	7.0	6.2
1920	5.6	5.1	7.2	6.4
1921	5.7	5.1	6.4	5.7
1922	5.4	5.1	6.5	5.7
1923	5.3	4.9	6.3	5.7
1924	5.6	5.0	7.0	6.3
1925	5.1	4.7	6.5	5.8
1926	5.3	5.1	6.5	5.8
1927	5.4	5.1	6.5	5.9
1928	5.0	4.6	6.4	5.8

Table XX.—Average Weights of Skeena River Sockeyes, 5_3 and 6_3 Age-groups, for Fourteen Successive Years.

Year.	Five-year Males.	Five-year Females.	Six-year Males.	Six-year Females.
1915	5.9	5.2	6.6	6.0
1916	5.8	5.4	7.1	5.9
1917	5.5	5.2	6.3	5.8
1918	5.7	5.3	6.6	6.1
1919	6.1	5.4	6.9	6.3
1920	6.3	5.1	7.3	6.3
1921	5.8	5.1	6.0	5.6
1922	5.5	5.1	6.2	5.7
1923	5.3	4.8	6.3	5.4
1924	5.9	5.1	6.6	5.8
1925	5.5	4.9	6.9	5.4
1926	5.9	5.2	6.9	6.2
1927	5.4	5.0	6.0	5.8
1928	5.0	4.6	6.5	5.8

Table XXI.—Percentages of Males and Females in each of the Different Year-groups, Skeena River Sockeyes, in a Series of Years.

Year.	4_2		5_2		5_3		6_3	
	M.	F.	M.	F.	M.	F.	M.	F.
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
1922	52	48	41	59	52	48	53	47
1923	60	40	37	63	56	44	40	60
1924	50	50	43	57	46	54	46	54
1925	57	43	42	58	45	55	47	53
1926	40	60	43	57	48	52	49	51
1927	45	55	41	59	47	53	56	44
1928	48	52	45	55	43	57	50	50

4. THE NASS RIVER SOCKEYE RUN OF 1928.

(1.) General Characteristics.

The year 1928 finds the erratic Nass a normal river, fulfilling a logical expectation of a very small pack. This pack is the smallest on record and consists of the astonishingly small figure of 5,540 cases. Although the certainty of an unmistakable decline of the run of sockeyes to the Nass has been impressing itself upon us during the past few years, up to the present time it has not been necessary to face the possibility of complete failure in the near future. We cannot look ahead without glancing back. As is well known, the great majority of Nass sockeyes mature at the end of five years. Hence, the principal brood-year of this 1928 run was 1923, which yielded the mediocre pack of 17,821 cases. In that year, after his annual inspection of the spawning-grounds in the Meziadin watershed of the Nass River basin, Inspector Hickman reported a very poor seeding. In view of the small size of this year's pack it is not surprising to find the following in the summary of Inspector Hickman's report for 1928: "This year shows that very few sockeye were to be found in any section; far less than have been found in any one of the last four years."

In 1923 the pack was 17,821 cases. In 1928 it was 5,540, a drop of 12,000 cases. In 1933 what will the pack be? While predictions and expectations in the Nass run are in general unreliable, one cannot conceive of any condition which could produce in 1933 anything but an exceedingly small run and a pack of very small commercial value. On the other hand, the run itself, by reason of its greatly reduced numbers, will be very valuable for seeding purposes and every effort should be made to allow all the fish to reach the spawning-beds.

As the late Dr. Gilbert wrote in 1919, "When the experience of a series of years indicates unmistakably that the productivity of a stream is declining to a lower level, the common-sense treatment of the situation is to modify favourably the only factor over which we exercise control. We should increase the spawning reserve and thus seek to augment the egg production. Egg production must, after all, be fundamentally most important. As a constant factor, in the long run it will dominate the situation." *Unless the taking of sockeye in the Nass River is prohibited in the year 1933 we can look for nothing but complete annihilation of the run which occurs in the five-year cycle, 1923–28–33–38.*

As for the run of 1929, we make no prediction. We will simply state that in the past the packs of this five-year cycle have been consistently large, as the following figures show: 1909, 28,246 cases; 1914, 31,327 cases; 1919, 28,259 cases; 1924, 33,590 cases. Consequently we await next year's return with unusual interest.

In former years the late Dr. Gilbert pointed out on several occasions that large runs in the Skeena and Rivers Inlet seemed to be intimately associated with large percentages of five-year-old fish. It is interesting to note that in this cycle of the Nass the four-year-old component of the runs is very small. We have no figure for 1909, but in 1914 the four-year-olds constituted only 4 per cent. of the run; in 1919, 7 per cent.; and in 1924, 4 per cent.; while over a period of seventeen years the general average of this group is 11–12 per cent. Not only is the brood-year pack of 1919 larger, but, in addition, in that year Inspector Hickman reported the spawning-beds more extensively seeded than usual. In any other river system, except the Nass, these facts would indicate a very good return in 1929.

(2.) Age-groups.

The analysis of the run of 1928 is based upon 1,760 samples gathered every three or four days beginning on June 23rd and continuing through August 16th. Only seven of the usual eight age-groups are present. These are enumerated in Tables XXIV. and XXVI. The 7_4 class has not been regarded as an important component of the run because it has never been represented except by a very small number of individuals. Consequently it is no surprise to find a year without a single representative. Of the principal age-groups, 30 per cent. are 4_2's; 6 per cent. belong to the 5_2's; 61 per cent. to the 5_3's; and 3 per cent. to the 6_3's (Table XXII.).

A comparison of these percentages and those of other years shows an unusual abundance of 4_2's. This is readily explained when one remembers that these fish are descendants of the run of 1924, which was one of the most extensive runs known to the Nass. It is to be hoped that the remainder of the progeny which will mature in 1929 will return in equal strength. Just as the 4_2's have returned in greater numbers than usual, so the dominant class, the 5_3's, has fallen below its usual average. The percentages of 5_2's and 6_3's are not unlike those of 1927 and the five-year period 1922–26 (Table XXIII.).

(3.) Lengths and Weights.

A study of Tables XXV. and XXVII. shows that a slight lowering of the general average lengths and weights has taken place in each year-class and, in general, in both sexes. It is particularly noticeable in the 5_3's and 6_4's. In the past, maintenance of size from year to year has been regarded as a racial characteristic. At the present time we regard the size reduction of 1928 more as a peculiarity of the year than as an indication of a tendency likely to be exhibited in the runs of the future. In the past the late Dr. Gilbert frequently made the suggestion that there seemed to be a definite correlation between general size reduction and a small run. The facts of this year's run to the Nass certainly substantiate his suggestion.

Tables XXVIII. to XXX. are included to give additional data on another racial characteristic—namely, that age and size are closely associated. The relation is this: that the smallest fish are the youngest and, conversely, the largest fish are of the greatest age. In the other river systems the factor determining the size does not seem to be age, but the number of years spent on the sea-feeding grounds. For example, the Fraser, Skeena, and Rivers Inlet fish which have lived three years in the ocean are all practically the same size irregardless of the age at which they left the fresh water. Table XXVIII. illustrates this point. The Fraser figures for 1928 do not conform with those of past years. Their sequence suggests a correlation between age and size as in the Nass. This, however, is probably not the case. A scrutiny of the table shows both that the lengths of the sea-types (3_1's and 4_1's) are considerably below the averages of former years, and also that the lengths of the 6_4's are appreciably greater than usual. The explanation of these differences presumably lies in the fact that these age-classes are not well represented numerically. In small groups of individuals there is always a danger that all variations will be in one direction, either toward largeness or smallness. In such cases the average falls above or below the normal mean of a much larger number of the same individuals.

(4.) Seasonal Changes during the Run.

One feature of the Nass run, the seasonal succession of the age-groups, shows no variation from year to year. As stated previously, the 5_3's are the dominant group and appear with varying degrees of strength throughout the entire run. On the one hand, the sea-types, those fish which go to sea without spending one or more years in fresh water, are present early in the run. On the other hand, the oldest fish, the 6's, run late. The 4_2's and 5_2's are found during

the whole run, but reach their maximum numbers in the second and third weeks of July (Table XXXI.).

(5.) The Meziadin and Bowser Lake Sockeye Colonies.

The discussion of these colonies is of necessity omitted this year. It has been the custom of Inspector Hickman to collect scales and take measurements of sockeyes during his annual visit to the spawning-grounds of the Nass River watershed. This year, however, the fish were so scarce that he could not procure sufficient specimens from which to obtain material.

Table XXII.—Percentages of Principal Age-groups present in the Nass River Sockeye Run from 1912 to 1928.

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 (36,037 cases)	8	27	63	2
1913 (23,574 cases)	15	12	71	2
1914 (31,327 cases)	4	41	45	10
1915 (39,349 cases)	19	14	59	8
1916 (31,411 cases)	9	17	66	8
1917 (22,188 cases)	10	15	71	4
1918 (21,816 cases)	30	16	45	9
1919 (28,259 cases)	7	22	65	6
1920 (16,740 cases)	8	14	72	6
1921 (9,364 cases)	10	7	75	8
1922 (31,277 cases)	6	2	91	1
1923 (17,821 cases)	11	6	77	6
1924 (33,590 cases)	4	3	91	2
1925 (18,945 cases)	23	8	67	2
1926 (15,929 cases)	12	12	63	13
1927 (12,026 cases)	8	7	81	4
1928 (5,540 cases)	30	6	61	3

Table XXIII.—Percentage of Principal Age-groups in Nass River Sockeye Run from 1912 to 1926 combined into Five-year Periods.

	One Year in Lake.		Two Years in Lake.	
	Four Years old.	Five Years old.	Five Years old.	Six Years old.
1912–16	11	22	62	5
1917–21	13	15	65	7
1922–26	11	7	77	5

Table XXIV.—Nass River Sockeyes, 1928, grouped by Age, Sex, and Length, and by their Early History.

Length in Inches.	Number of Individuals.																Total.
	4_2		5_2		5_3		6_3		6_4		7_4		3_1		4_1		
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
21	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	....	2
21½	....	2	....	....	....	....	....	....	....	....	....	....	....	....	....	1	3
22	1	12	....	....	....	5	....	....	....	....	....	....	2	1	....	....	21
22½	6	21	....	....	....	2	....	....	....	....	....	....	3	2	....	1	35
23	31	71	....	1	5	29	....	....	....	....	....	....	6	3	....	10	156
23½	30	50	....	....	10	32	....	....	....	....	....	....	4	1	....	4	131
24	68	66	1	7	20	139	....	2	....	2	....	....	7	....	2	10	324
24½	36	23	3	5	38	120	....	2	....	....	....	....	1	....	3	2	233
25	58	10	10	13	113	162	....	1	1	1	....	....	....	....	2	2	373
25½	15	3	5	9	64	53	....	2	1	1	....	....	....	....	1	....	154
26	16	2	7	12	105	34	2	1	1	....	....	....	....	....	1	....	181
26½	3	....	6	1	37	6	....	4	....	....	....	....	....	....	2	....	59
27	....	....	9	....	31	1	7	3	....	....	....	....	....	....	....	....	51
27½	....	....	3	....	5	....	1	1	....	....	....	....	....	....	....	....	10
28	....	....	....	....	2	....	8	3	....	....	....	....	....	....	....	....	13
28½	....	....	1	....	....	....	2	....	....	....	....	....	....	....	....	....	3
29	....	....	....	....	....	....	7	....	....	....	....	....	....	....	....	....	7
29½	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	2
30	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	2
Totals	264	260	45	48	430	583	31	19	3	4	....	....	23	9	11	30	1,760
Ave. lengths	24.3	23.5	26.0	25.1	25.5	24.6	28.1	26.2	25.5	24.6	....	....	23.7	22.4	25.1	23.6	.....

Table XXV.—Nass River Sockeyes, Average Lengths of Principal Classes from 1912 to 1928.

Year.	4_2		5_2		5_3		6_3	
	M.	F.	M.	F.	M.	F.	M.	F.
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
1922 „	24.2	23.4	25.6	24.6	25.7	25.0	28.0	25.9
1923 „	24.3	23.7	25.9	25.3	26.2	25.5	27.2	26.5
1924 „	24.7	23.8	26.2	24.9	26.3	25.4	28.0	25.4
1925 „	24.4	23.8	25.9	24.7	25.9	25.0	26.9	25.4
1926 „	24.9	24.1	26.1	25.3	26.1	25.3	27.9	27.0
1927 „	24.9	24.2	25.3	25.2	26.3	25.9	27.6	26.5
1928 „	24.3	23.5	26.0	25.1	25.5	24.6	28.1	26.2

Table XXVI.—Nass River Sockeyes, 1928, grouped by Age, Sex, and Weight, and by their Early History.

Weight in Pounds.	Number of Individuals.																Total.
	4_2		5_2		5_3		6_3		6_4		7_4		3_1		4_1		
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
4	1	7	....	....	....	2	....	....	....	....	....	....	....	1	....	....	11
4½	15	58	1	....	1	36	....	....	....	....	....	....	2	4	....	3	120
5	61	118	....	2	21	157	....	1	....	2	....	....	6	4	....	8	380
5½	76	59	2	10	77	204	....	4	....	1	....	....	10	....	....	8	451
6	63	15	7	12	134	135	....	1	1	1	....	....	4	....	2	7	382
6½	36	2	6	16	107	41	2	4	2	....	....	....	1	....	4	4	225
7	12	1	8	5	55	7	5	5	....	....	....	....	....	....	2	....	100
7½	....	....	13	3	25	1	4	2	....	....	....	....	....	....	....	....	48
8	....	....	6	....	9	....	7	2	....	....	....	....	....	....	3	....	27
8½	....	....	1	....	1	....	5	....	....	....	....	....	....	....	....	....	7
9	....	....	....	....	....	....	5	....	....	....	....	....	....	....	....	....	5
9½	....	....	1	....	....	....	2	....	....	....	....	....	....	....	....	....	3
10½	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	1
Totals	264	260	45	48	430	583	31	19	3	4	....	....	23	9	11	30	1,760
Ave. weights	5.6	5.0	7.0	6.2	6.2	5.5	8.1	6.6	6.3	5.4	....	....	5.4	4.7	6.9	5.5	.....

Table XXVII.—Nass River Sockeyes, Average Weights of Principal Classes from 1914 to 1928.

Year.	4_2		5_2		5_3		6_3	
	M.	F.	M.	F.	M.	F.	M.	F.
1914 (pounds)	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
1922 ,,	5.9	5.4	6.8	6.2	6.8	6.3	8.1	6.6
1923 ,,	5.8	5.2	6.7	6.1	6.6	6.0	7.2	6.8
1924 ,,	5.9	5.4	7.2	6.1	6.8	6.1	8.0	6.5
1925 ,,	5.9	5.4	6.8	6.1	6.7	6.0	7.4	6.3
1926 ,,	6.0	5.4	6.9	6.2	6.7	6.0	7.8	7.1
1927 ,,	6.2	5.8	7.1	6.3	6.9	6.2	7.8	7.0
1928 ,,	5.6	5.0	7.0	6.2	6.2	5.5	8.1	6.6

Table XXVIII.—Nass, Fraser, and Skeena Rivers and Rivers Inlet Sockeyes, 1923, 1926, 1927, and 1928, grouped by Number of Years spent on the Sea-feeding Grounds.

Age.		Nass.		Fraser.*		Skeena.		Rivers Inlet.	
		M.	F.	M.	F.	M.	F.	M.	F.
	Year 1923.								
	Three years at sea—	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
3	Sea-type	23.1	22.4	23.3	22.7	.....	.....	.....	.....
4	One-year-in-lake type	24.3	23.7	24.3	23.3	23.7	23.1	22.4	22.3
5	Two-years-in-lake type	26.2	25.5	24.2	22.9	23.9	23.2	23.0	23.0
	Four years at sea—								
4	Sea-type	25.5	24.3	25.2	24.1	.....	.....	.....	.....
5	One-year-in-lake type	25.9	25.3	25.8	24.8	25.5	24.5	24.6	24.1
6	Two-years-in-lake type	27.2	26.5	26.3	24.9	25.6	24.4	.....	.....
	Year 1926.								
	Three years at sea—								
3	Sea-type	23.7	22.3	23.4	22.5	.....	.....	.....	.....
4	One-year-in-lake type	24.9	24.1	22.6	22.3	23.8	23.4	22.8	22.9
5	Two-years-in-lake type	26.1	25.3	23.2	22.4	24.6	23.8	22.9	23.1
	Four years at sea—								
4	Sea-type	24.5	24.0	25.4	24.6	.....	.....	.....	.....
5	One-year-in-lake type	26.1	25.3	24.6	24.0	25.6	24.8	25.1	24.6
6	Two-years-in-lake type	27.9	27.0	25.5	23.7	26.0	25.0	25.6	26.8
	Year 1927.								
	Three years at sea—								
3	Sea-type	23.4	23.5	23.4	22.2	.....	.....	.....	.....
4	One-year-in-lake type	24.9	24.2	24.1	23.1	23.9	23.3	22.1	22.4
5	Two-years-in-lake type	26.3	25.9	21.7	22.0	24.1	23.5	22.5	23.2
	Four years at sea—								
4	Sea-type	25.6	24.1	25.1	24.5	.....	.....	.....	.....
5	One-year-in-lake type	26.3	25.2	26.1	24.6	25.7	24.8	24.6	24.2
6	Two-years-in-lake type	27.6	26.5	25.3	24.6	25.2	24.9	.....	24.3
	Year 1928.								
	Three years at sea—								
3	Sea-type	23.7	22.4	19.1	18.7	.....	.....	.....	.....
4	One-year-in-lake type	24.3	23.5	23.4	23.0	23.3	22.8	22.3	22.8
5	Two-years-in-lake type	25.5	24.6	24.2	23.4	23.5	22.8	22.8	23.0
	Four years at sea—								
4	Sea-type	25.1	23.6	19.8	.....	.....	.....	.....	.....
5	One-year-in-lake type	26.0	25.1	25.5	24.7	25.3	24.7	26.1	25.2
6	Two-years-in-lake type	28.1	26.2	27.1	26.0	25.6	24.7	27.2	25.5

* The figures formerly recorded in this table as those of 1923 were in reality those of 1922. The mistake has been corrected in this report.

Table XXIX.—Nass River Sockeyes, 1919–28, grouped by Age, Sex, and Average Lengths of Principal Age-groups.

Year.	Average Lengths in Inches of Groups.															
	Three Years old.		Four Years old.				Five Years old.				Six Years old.				Seven Years old.	
	3_1		4_2		4_1		5_2		5_3		6_4		6_3		7_4	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1919	.....	.....	24.9	24.1	26.1	25.1	26.2	25.2	26.5	25.8	28.2	26.5	27.9	26.7	27.2	28.0
1920	.....	.....	24.0	23.4	.....	.....	26.3	25.0	26.7	25.9	26.6	26.7	27.4	25.9	.....	.....
1921	23.1	22.4	24.3	23.5	24.2	23.6	25.5	24.3	26.2	25.6	26.9	26.5	27.9	26.2	.....	.....
1922	.....	.....	24.2	23.4	24.5	23.5	25.6	24.6	25.7	25.0	26.2	25.4	28.0	25.9	.....	.....
1923	.....	.....	24.3	23.7	25.5	24.3	25.9	25.3	26.2	25.5	26.1	25.5	27.2	26.5	.....	.....
1924	.....	.....	24.7	23.8	.....	.....	26.2	24.9	26.3	25.4	27.1	26.4	28.0	25.4	.....	.....
1925	.....	.....	24.4	23.8	.....	.....	25.9	24.7	25.9	25.0	26.3	25.3	26.9	25.4	.....	.....
1926	23.7	22.3	24.9	24.1	24.5	24.0	26.1	25.3	26.1	25.3	26.7	25.8	27.9	27.0	28.2	27.0
1927	23.4	23.5	24.9	24.2	25.6	24.1	26.3	25.2	26.3	25.9	26.8	27.0	27.6	26.5	29.0	.....
Ave. lengths	.....	.....	24.5	23.8	25.1	24.1	26.0	24.9	26.2	25.5	26.8	26.1	27.6	26.2	.....	.....
1928	23.7	22.4	24.3	23.5	25.1	23.6	26.0	25.1	25.5	24.6	25.5	24.6	28.1	26.2	.....	.....

Table XXX.—Nass River Sockeyes, 1919–28, grouped by Age, Sex, and Average Weights of Principal Age-groups.

Year.	Average Weights in Pounds of Groups.															
	Three Years old.		Four Years old.				Five Years old.				Six Years old.				Seven Years old.	
	3_1		4_2		4_1		5_2		5_3		6_4		6_3		7_4	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1919	....	....	6.0	5.5	6.4	5.7	6.6	5.9	6.7	6.1	7.7	7.0	7.8	6.7	7.1	7.5
1920	....	....	5.6	5.2	....	....	7.4	6.3	7.4	6.7	7.6	6.9	7.9	7.0	....	....
1921	5.0	4.6	6.0	5.4	5.9	5.5	6.9	6.1	6.9	6.3	7.0	6.5	7.7	6.6	....	....
1922	....	....	5.9	5.4	6.1	5.5	6.8	6.2	6.8	6.3	7.5	6.3	8.1	6.6	....	....
1923	....	....	5.8	5.2	7.0	5.5	6.7	6.1	6.6	6.0	6.7	6.3	7.2	6.8	....	....
1924	....	....	5.9	5.4	....	....	7.2	6.1	6.8	6.1	7.3	6.5	8.0	6.5	....	....
1925	....	....	5.9	5.4	....	....	6.8	6.1	6.7	6.0	6.8	6.0	7.4	6.3	....	....
1926	5.5	4.5	6.0	5.4	5.9	5.7	6.9	6.2	6.7	6.0	6.8	6.2	7.8	7.1	7.7	7.3
1927	5.3	....	6.2	5.8	6.8	5.6	7.1	6.3	6.9	6.2	7.0	7.2	7.8	7.0	9.0	....
Ave. weights	....	....	5.9	5.4	6.3	5.6	6.9	6.1	6.8	6.2	7.2	6.6	7.7	6.7	....	....
1928	5.4	4.7	5.6	5.0	6.9	5.5	7.0	6.2	6.2	5.5	6.3	5.4	8.1	6.6	....	....

Table XXXI.—Number of Individuals of each Class of Nass River Sockeyes running at Different Dates in 1928.

Date.	4_2	5_2	5_3	6_3	6_4	7_4	3_1	4_1	Number of Individuals examined.
June 23	25	6	44	.....	.....	.....	15	20	110
June 26	28	10	46	2	.....	.....	14	12	112
June 29	34	12	63	1	.....	.....	2	7	119
July 3	41	4	72	2	.....	.....	1	.....	120
July 6	31	6	85	1	.....	.....	.....	1	124
July 9	33	12	74	1	1	.....	.....	.....	121
July 13	52	10	51	7	.....	.....	.....	1	121
July 16	50	8	62	1	.....	.....	.....	.....	121
July 20	49	5	64	2	1	.....	.....	.....	121
July 24	59	6	53	3	.....	.....	.....	.....	121
July 28	37	3	69	9	1	.....	.....	.....	119
July 31	36	1	78	5	2	.....	.....	.....	122
Aug. 4	22	5	87	7	.....	.....	.....	.....	121
Aug. 8	18	3	50	3	1	.....	.....	.....	75
Aug. 13	3	.....	30	2	.....	.....	.....	.....	35
Aug. 16	6	2	85	4	1	.....	.....	.....	98
Individuals	524	93	1,013	50	7	.....	32	41	1,760

THE SPAWNING-BEDS OF THE FRASER RIVER.

Hon. S. L. Howe,

Commissioner of Fisheries, Victoria, B.C.

SIR,—I have the honour to submit the following report of my twenty-sixth yearly inspection of the salmon fishing and spawning areas of the Fraser River, made during the year 1928:—

The Catch in the Fraser River System.—The catch of all species of salmon in Provincial waters of the Fraser River system this year produced a pack of 258,224 cases, as against 284,378 cases in 1927, 274,951 cases in 1926, 276,855 cases in 1925, and 212,059 cases in 1924.

The pack consisted of 29,299 cases of sockeye, 5,082 cases of springs, 27,061 cases cohoes, 2,881 cases pinks, and 193,106 cases of chums.

The pack of 29,299 cases of sockeye was the second smallest recorded in Provincial waters of the system. It was 32,094 cases less than in 1927, 56,390 cases less than in 1926, and 10,444 cases less than in its brood-year, 1924. The pack of chums, 193,106 cases, was the largest made in Provincial waters of the Fraser. It was 83,611 cases greater than the former record high pack of 109,495 cases made in 1924. The pack of pinks—it was not a "pink" year—was but 2,881 cases. It was 29,375 cases less than the pack in its brood-year, 1926. The cohoe-pack of 27,061 cases was 9,656 cases less than in its brood-year, 1925.

The catch of sockeye in the State of Washington waters of the Fraser River system in 1928 produced a pack of 61,044 cases. It was 8,325 cases less than the pack in the preceding fourth year.

The combined pack of sockeye in the Fraser River system totalled 90,343 cases. It was 18,769 cases less than in its brood-year, 1924. It was 32,029 cases less than the average of the preceding eight years. There was no late run this year to correspond with the late runs in 1926 and 1927.

The Spawning Areas of the Fraser River Basin.—As in the preceding twenty-five years, the inspection of the sockeye-salmon spawning areas of the Fraser basin was made in August, September, and October. In addition to the information gained from personal inspection, I am greatly under obligation to Major J. A. Motherwell, Dominion Chief Inspector of Fisheries in the Province, for furnishing me copies of spawning-bed reports made him by his many assistants stationed at important points, and am also indebted to members of the Provincial Police and to many white and Indian residents on the Fraser and its tributaries. The information so gained enabled me to form a more comprehensive view of conditions than was possible from my own personal observation.

Sockeye in numbers made their appearance in Hell's Gate Canyon, in the Fraser above Yale, in July. A few fish were seen there in May. The July and August runs were the largest this year, but the number seen there in September and October was smaller than in recent years. Throughout the season water conditions appeared to be more favourable than usual. The July and August fish were exceptionally large, as was the case with those caught in the traps in Juan de Fuca Strait and in the Lower Fraser in July and early August. They were typical up-river fish. Later reports indicate that they spawned in the Chilcotin and North Thompson Rivers. Very few of them were reported from any other section.

Reports made to Major Motherwell show that sockeye salmon made their first appearance at the canyon in the Fraser above the mouth of Bridge River on July 21st, and remained in evidence until August 10th; they increased in number between the 10th and 21st. A small number passed daily in September and a few were noted October 7th and 8th. The fish were large, averaging 25 inches in length. Water conditions were unusually favourable up to September 13th. The Indians fishing at the canyon caught 2,724 sockeye and 1,092 springs.

Sockeye in numbers entered the Chilcotin River on July 25th and ran until August 8th. Another school entered the river August 19th and ran until August 21st. Both consisted of large fish. During the runs the Chilcotin Indians, at their fishing-stations at Fish Canyon and at Indian Bridge, caught upwards of 1,900 large-sized sockeye. Their catch this year was three or four times greater than that made in any one of the past twelve years. Their fishing was closely watched by Dominion Fishery Guardian Harvey, who later on visited Chilko Lake, where he states he observed upwards of 20,000 sockeye in the reaches of the rivers, a few miles below the lake itself. This is the first time in twelve years that sockeye in numbers have been seen there. So few sockeye have reached Chilko Lake in recent years that some observers have been led to conclude that Chilko Lake had never been frequented by any considerable number of sockeye and that the spawning-beds of that lake had never been an important factor in contributing to

a big year's run of fish to the Fraser. The contrary is true, as the records abundantly show. No other tributary of the Fraser basin, not even excepting the Quesnel and Shuswap sections, was formerly more abundantly seeded than Chilko. It was one of the greatest tributaries to the runs of the big year in the entire Fraser basin.

From the known facts in the life-history of the sockeye it must be assumed that the runs of from 20,000 to 30,000 sockeye to the Chilcotin-Chilko Rivers this year were the product of fish which spawned in that area four years ago. But the records do not show that any considerable number of sockeye were noted in that section that year. The run this year is as difficult to account for as the October runs of sockeye to Adams and Little Rivers in 1926 and 1927. It only goes to show how little reliance can be placed on the inspection of spawning areas. The areas are so vast, the points where accurate estimates can be made so few, and the runs of sockeye that have entered the mouth of the Fraser in recent years so small that it has been and is most difficult to form an opinion as to the approximate number which reached many sections.

In no other tributary of the Fraser, above the mouth of Bridge River, which includes Quesnel and Stuart Lakes, were sockeye in numbers reported this season.

The run of sockeye to the Thompson River, Shuswap section, this year, while larger than in average years, was not up to that of the two previous years. There was a run in August. Instead of proceeding to Shuswap Lake they passed up the North Thompson River. The majority appear to have spawned in Raft River and Finn Creek; Fishery Officer Shotton saw them there. It is the first time in many years, he stated, when any considerable number of sockeye have been seen in that section. The Indians who flocked to the section appear to have taken a large number.

Officer Shotton further reported that approximately 10,000 sockeye spawned in Little River in October. The majority of the fish observed were of the small variety of sockeye. The Indians caught a considerable number. The run was very much smaller than the runs in October of 1926 and 1927. They appear to have spawned largely in Little River; very few entered Adams River.

Very few sockeye entered Seton-Anderson Lakes this year.

The run of sockeye that reached the Birkenhead River, at the head of the Harrison-Lillooet Lakes section, this year, while up to the average, was considerably less than the run in their brood-year 1924. The fish were rather late in arriving. The sockeye-egg collection from the Birkenhead totalled 35,010,000.

The run of sockeye to Cultus Lake was intercepted at the entrance to the lake, in accordance with the experiments conducted there by the Biological Board of Canada. The number of fish taken in the traps totalled 14,899, of which 11,205 were females and 3,694 males, a most exceptional ratio of three females to each male. The fish taken were stripped and eggs placed in the hatcheries. The number taken totalled 28,114,000.

From the foregoing it will be appreciated that a small return is all that can be anticipated from this year's seeding of the spawning-beds of the Fraser River.

I am indebted to Major Motherwell for the following statement giving the egg collection at the hatcheries on the Fraser River and other streams this year:—

SALMON-EGG COLLECTIONS, BRITISH COLUMBIA HATCHERIES, 1928.

Hatchery.	Sockeye Salmon.	Spring Salmon.
Anderson Lake, V.I.	8,799,000	.....
Babine Lake, Skeena	9,144,000	.....
Cowichan Lake, V.I.	.....	1,670,000
Cultus Lake, Fraser	28,114,000	.....
Kennedy Lake, V.I.	2,819,600	.....
Pemberton, Fraser	35,010,000	.....
Pitt Lake, Fraser	5,550,000	.....
Rivers Inlet	14,060,500	.....
Skeena River	5,525,000	.....
Totals	109,022,100	1,670,000

Respectfully submitted.

JOHN PEASE BABCOCK,
Assistant to the Commissioner.

Victoria, December 1st, 1928.

THE SPAWNING-BEDS OF RIVERS INLET.

Hon. S. L. Howe,
Commissioner of Fisheries, Victoria, B.C.

SIR,—In pursuance of instructions from the Department, I have the honour to submit my report upon the inspection of the spawning-grounds at Rivers Inlet for the year 1928.

It was anticipated that the exceptionally fine run of sockeye experienced at the commencement of the fishing season would, if continued, result in a big pack being put up by the canneries, but as the season progressed it fell off to such an extent that little more than half a big-year pack was obtained. This failure was generally attributed to the cold, wet season combined with the large number of power-boats operating on the inlet, causing the fish to swim deep, thus avoiding the nets and passing through to the spawning-grounds; but, as it turned out, such was not the case, because conditions on the spawning-grounds were anything but satisfactory. The failure was due to a poor run of fish.

In the brood-years 1923–24 the reports show that the spawning-beds with one or two exceptions contained a big run, and had conditions during the spawning been favourable the return of mature sockeye this year would have shown up much more favourably. In the late fall of 1924 an abnormal downfall of rain, lasting for several days, caused such extreme "freshets" that the rivers and creeks, one and all, were literally scoured out, undoubtedly causing untold damage to the eggs, and to this I have every reason to believe the failure to be attributable.

It was not until October 4th that I was available to make the inspection; consequently it was not possible to see the condition of the head-rivers when the fish were at the height of spawning. I am, however, indebted to Mr. Frank Tingley, Superintendent of the Hatchery, and Mr. James Boyd, Dominion Fishery Overseer, for valuable information. They had visited the spawning-beds at the Indian, Cheo, and Washwash Rivers three weeks prior to my visit and were in a position to give me first-hand information. All the rivers contained a big run of sockeye and compared very favourably with the fine showing experienced last year. The exceptional size of the sockeye was especially noted, indicating a big return of five-year fish. Mr. Boyd informed me that in the Washwash River the run of sockeye was composed of 60 per cent. of five-year and 40 per cent. of four-year fish, which indicates a big run of four-year sockeye entered this stream. He also noted a big run of spring salmon. It is apparent from their report that the "freshet" had not affected these early-running streams like those which receive the later runs.

Leaving the cannery at Rivers Inlet on October 4th, we proceeded through the rapids to the Owikeno Lake. On the way up cohoe and spring salmon were breaking water in all directions. At the Old Town Rancheries, situated near the mouth of the lake, the Indians informed me that few sockeye were spawning here, but anticipated that a big run of fish would drop back from the lake later. On reaching Quap River I made camp and, as very few sockeye had shown up, crossed over and inspected the Dalley River, situated directly opposite. Proceeding up through the rapids to the headwaters, a very fair run of sockeye could be seen spawning in the clear water above each riffle. It did not reach the proportions of the brood-years 1923–24 by 20 per cent., but in size they represented a high average, the males outnumbering the females two to one. No log-jams or other obstructions interfered with the movement of the fish up-stream.

An examination of the Asklum River, situated about 16 miles from the mouth of the lake and generally considered one of the most prolific spawning-streams on the lake, was very disappointing. There was no evidence of sockeye in the lower portion near the entrance, or out in the lake, but a very fair run had taken possession of the spawning-beds farther up and were much in evidence right up to the rough water. Large and small sockeye were about equally represented, the males predominating in the proportion of two to one over the females. The river was clear of obstructions, but showed signs of the havoc caused by the "freshets." In comparing the run of sockeye to this tributary with the vast numbers which returned in the brood-years 1923–24, it falls short by at least 50 per cent.

Making camp at Jeneesee Creek, the inspection of the tributaries at this section was made. Jeneesee Creek contained a fair run of sockeye and at the time of my visit they were coming in from the lake in large numbers. Small three-year sockeye were much in evidence above the hatchery fence. The hatcherymen had made a fair collection of eggs, but the fish were too green for spawning purposes and many had to be thrown back. The run did not compare in any way with the dense masses seen during the brood-years. In size the fish were above the

average and no doubt derived from the 1923 brood. On my return from the head of the lake I again visited this creek, but no improvement was shown.

The low stage of the Machmell River permitted an uninterrupted view of the spawning-beds right up to the canyon, but the thick, muddy condition of the water prevented an accurate estimate of the run. A few sockeye cast up on the bars were noted, and in the shallow water above each riffle a few could be seen spawning. In size they were above the average, males outnumbering the females two to one.

The Nookins (or Nechants, as it is sometimes termed), tributary to the Machmell, ranks with the best of the spawning-streams on the lake, but this year fell far below expectations. Passing up through the rapids a few sockeye were observed close inshore, and in the side-streams adjacent others spawned, but taking the entire run on the whole it was very poor and one of the smallest seen in years. In size the fish represented a high average, the males outnumbering the females two to one.

The inspection of Sheemahant River was next undertaken. It is one of the most difficult rivers to negotiate, extending up to the falls 18 miles distant. Above the falls spawning-beds of the finest description extend again 20 miles in to the mountains. Proceeding up through the various rapids, sockeye in fair numbers were seen spawning on the gravel-beds above each riffle, while many others were observed making their way up-stream close inshore. The water was very milky, so that it was difficult to estimate the run, but sufficient numbers were spawning on the beds to ensure a fair run of fish from the seed deposited. There was a fair run of sockeye in the small creek 10 miles up, large and small fish being about equally represented. The run is similar in numbers to that which returned in 1924. Two or three log-jams obstructed portions of the river, but did not interfere with the movement of the sockeye up-stream. Males and females were about equally divided.

There were a few sockeye and cohoe salmon spawning on the beds at the "Narrows," close to the Indian smoke-house, and also at Sunday Creek, but in each case the run fell far short of the return in the brood-years.

Making camp at the head of the lake, the three tributaries, Indian, Cheo, and Washwash, were next inspected. It was of course too late to observe the extent of the run, but indications showed that a big run of sockeye entered these streams a month prior to my visit, and which Mr. Tingley and Mr. Boyd commented so favourably upon. In the Indian River, lying over on the extreme left of the lake, carcasses in hundreds littered the bars, creating a most offensive odour. Small patches of half-eaten fish along the banks showed that the bears were not slow in taking advantage of the opportunity to have a big feast. A few spent sockeye were noted even at this late stage in the lower portion near the entrance. The run was composed of sockeye above the average size, females outnumbering the males two to one.

Passing up through to the headwaters of the Cheo River, hundreds of dead fish covered the bars, and especially was this so between the log-jam and the falls; sockeye in the last stages of spawning could be seen in the clear water swimming around near the entrance. The run here was composed of large sockeye similar to the Indian River, males and females being about equally divided. With the exception of the big log-jam 3½ miles up the river, no other obstructions impeded the movement of the sockeye up-stream.

The Washwash River, lying over on the extreme right of the lake, was again a great scene of chaos; log-jams scattered all over the bars near the entrance had split up the main river into several small ones. Each of these small streams contained hundreds of carcasses of sockeye, indicating a very big run earlier in the spawning season. Some in the last stages of exhaustion were swimming around at the entrance. There appeared to be a greater proportion of small sockeye in the Washwash than had been noted in any of the other rivers previously examined, although the large sockeye were in the majority. Males outnumbered the females two to one.

Returning from the head of the lake, a visit was again paid to Quap River, where the hatcherymen were busy collecting eggs for the hatchery. About half the hatchery had been filled at this time, and it was anticipated that a big run of sockeye would enter later with the rise of the lake. Indications, however, did not look very promising, since the dense masses of fish which in the last few years had invaded Quap River appeared to be entirely absent this year. Usually, when a big run of fish is on, the water outside in the bay is continually disturbed by fish breaking water, but this was noticeably absent. The run is composed of sockeye ranging from 6 to 10 lb. in weight, reminding me of the very high average of the big-year runs. Males were in greater proportion to the females by at least two to one.

The small creek adjoining the hatchery was full of sockeye and showed up in great contrast to the poor showing in some of the other streams. The run is composed of sockeye of exceptional size.

On my return to the Indian rancheries at the head of the Owikeno River, the Indians were not able to give me a very favourable account of the spawning. Many had been out spending all day in trying to get sufficient sockeye for their winter's need—where in other years no difficulty was found in filling the nets in one haul. The sockeye also were small fish, and no doubt the result of the 1924 brood. Passing down through the rapids chum salmon in large numbers were observed.

In summing up the results of the inspection of the Rivers Inlet watershed, I am of the opinion that a moderate run only may be expected from the result of the spawning this season. With the exception of the Indian, Cheo, and Washwash Rivers, all showed a marked falling-off, which I estimate to be 40 per cent. lower than the total runs which returned in the brood-years 1923–24. There is no doubt that great damage was done to the eggs in the late fall of 1924 by the extreme freshet, which probably accounts for the lack of small fish. The run of big sockeye was apparently not so affected, since they predominated the run not only on the fishing-grounds, but on the spawning-beds. Humpback salmon were very scarce in this district, but cohoe and chum salmon were in great abundance.

In conclusion, I wish to express my appreciation for courtesies extended by Mr. Frank Tingley, Superintendent of the Dominion Hatchery, and the men at the various spawning camps.

Respectfully submitted.

A. W. Stone,
Provincial Fisheries Overseer.

Rivers Inlet, B.C., November 19th, 1928.

THE SPAWNING-BEDS OF SMITH INLET.

Hon. S. L. Howe,
Commissioner of Fisheries, Victoria, B.C.

SIR,—I have the honour to submit my report upon the inspection of the spawning-grounds of Smith Inlet for the year 1928.

The run of sockeye which returned to Smith Inlet this year was derived from the eggs spawned in 1923–24. In 1923 the spawning-beds were exceptionally well seeded, but in 1924 were not so satisfactory; this, however, may have been due to the early inspection, and that the main run of fish were late in leaving the lake-waters for the spawning-beds, due note of which was recorded in my report for that year. Looking back over the records of the packs put up during the "lean" years prior to 1920, it will be seen that the Dominion Department of Fisheries made no mistake when they curtailed the activities of the seine-nets in Qualla Creek. Not only did the packers put up a record for a "lean" year, of 33,000 cases of sockeye, but sufficient numbers escaped to the spawning-beds to ensure a big return four and five years hence, subject of course to climatic conditions not having affected the spawn. From the remarkable size of the sockeye it is evident that the run was composed mainly of five-year fish.

On account of the delay in the inspection of the spawning-beds at Rivers Inlet, it was later than usual that the inspection was made at Smith Inlet. Reaching the vicinity of the spawning-beds on October 28th, I made camp at the mouth of the lake, and examined the Docee River (the overflow to the lake) first. Spring salmon, all in an advanced stage of spawning, filled the entire river and provided one of the biggest runs of this species of salmon known in years. Cohoe salmon intermingled with the springs in very large numbers, and were busy spawning not only in the river, but along the shore-line at the mouth of the lake.

Proceeding up the lake to Quay Creek, 7 miles distant, a few spent sockeye were swimming around on spawning-beds outside, but, as this is an early-running stream, it was not possible to estimate the extent of the run, which had arrived three weeks prior to my visit.

Arriving at the Geluch (or Smoke-house Creek, as it is generally termed), camp was made and an inspection of the spawning-beds undertaken. Passing up through the various rapids, thousands of sockeye lined the beds, all in the last stages of spawning, while dead fish covered the bars in all directions; hundreds had been left high and dry on the banks during high water, not having spawned. All the mountain streams adjacent to the river were full of spawned-out sockeye, representing large and small fish in about equal numbers. Males and females were evenly distributed. The scene in this river is a repetition of the remarkable run which returned in 1923. No log-jams or other obstructions interfered with the movement of the salmon upstream.

The Delabah River, lying about 2 miles from the head of the lake, was again a scene of unparalleled activity. No sockeye were to be seen outside in the lake, but from the entrance right up to the falls thousands upon thousands of fish, all in the last stages of exhaustion, covered the beds, while carcasses littered the bars in every direction, the stench being overpowering. Big fish formed the majority of the run, indicating that it was from eggs spawned in 1923, or composed mainly of five-year sockeye.

Returning down the lake, cohoe salmon were to be seen breaking water in all directions, while in the Docee River they were coming in to spawn in ever-increasing numbers.

A very poor run of humpback salmon this year was the report received from all quarters, but chum salmon, on the other hand, were exceptionally prolific, representing one of the biggest runs known in years, while cohoe salmon were plentiful.

In summing up the results of the spawning for this year, I am of the opinion that we can look forward to a big run of sockeye from this year's seeding, four and five years hence.

Respectfully submitted.

A. W. STONE,
Fishery Overseer.

Rivers Inlet, B.C., November 19th, 1928.

THE SPAWNING-BEDS OF THE SKEENA RIVER.

Hon. S. L. Howe,
Commissioner of Fisheries, Victoria, B.C.

SIR,—In obedience to your instructions, I beg to submit the following report on the spawning-beds of the Skeena River for the year 1928:—

I left Prince Rupert on September 7th and arrived at Burns Lake early the following morning. After outfitting I set out again and reached Donald's Landing, on Babine Lake, on the evening of the 9th.

Babine Lake is due north from Burns Lake, about 25 miles distant, and is reached by a fair wagon-road. Babine Lake was at about its average low level for late summer and was therefore favourable for natural propagation purposes. At the outset, I may say, I was not very optimistic of finding well stocked and seeded sockeye-creeks, as the sockeye-pack on the Skeena River this year was much below the average. I was agreeably surprised, however, as the following report will show.

The first creek visited was 15-Mile Creek, near the head of the lake, which is one of the best all-round spawning-creeks on the Babine watershed. At the mouth of the creek six Stuart Lake Indian families were encamped in smoke-houses and were catching sockeye with nets in the lake near the mouth of the creek. The total catch each night up to the time of my visit would average about sixty sockeye. The nets are not used during the day owing to the water being very clear, and of course not used during the weekly closed season. A Dominion Fishery Guardian is stationed at this creek during the sockeye run to prevent the Indians fishing during the close season and also to stop any interference with the spawning-beds. 15-Mile Creek is a fairly long creek, but it has only about half a mile of good spawning-grounds. The spawning-grounds stretch from the mouth of the creek and are ideal for the purpose, having not a rock or boulder in the half-mile stretch. This area was one teeming mass of sockeye. Although I have been inspecting the spawning-grounds of Babine Lake since 1920, I have never before seen so many sockeye in this creek. I made a trip beyond the usual spawning-grounds farther up the creek and noticed many sockeye utilizing to the best advantage the few gravelly patches here and there between the boulders. The Fishery Guardian informed me that the first sockeye were seen in this creek on August 8th and the first run two days later. The males and females appeared to be evenly distributed and of a good average size. There were again many "runts" or grilse to be seen, but their numbers did not appear to be in excess of previous years.

On September 12th I visited Pierre Creek, another good sockeye-creek on Babine Lake. Babine Lake, I may say, is about 113 miles long and Pierre Creek enters it about midway. This creek has about 2 miles of good spawning-ground, beginning, like 15-Mile Creek, right at the mouth of the creek. Mr. Crawford, Superintendent of Stuart Lake Hatchery, was busily engaged at the time in spawning operations and had obtained approximately 5,000,000 sockeye-eggs for Stuart Lake Hatchery. There was also a fine showing of sockeye in this creek, being far ahead of any former year that I have seen. The females were slightly in excess of the males in number and both sexes were of a good average size. It was pleasing to note that few runts were to be seen here. Although Pierre is considered to be an early-spawning creek, many sockeye were still to be seen in the lake at the mouth of the creek, indicating that the sockeye were still running.

On September 13th I visited Fulton River, the largest creek flowing into Babine Lake. This creek flows from Fulton Lake, about 5 miles distant, and is a real angler's paradise, as far as big rainbow trout are concerned. The sockeye do not spawn in the lower stretches of Fulton River as the first half-mile resembles a slough, in that it has a muddy bottom. Two falls close to Fulton Lake, the largest having a sheer drop of 40 feet, prevent the sockeye entering Fulton Lake. Many fine specimens were seen in the large pools at the foot of the first falls. The sockeye were plentiful in this creek and could be plainly seen in large numbers on all the gravelly patches. The males and females appeared to be evenly balanced, but the runts were more numerous than in former years. Fulton River is one of the later-spawning creeks of Babine and many sockeye could be seen breaking water at the mouth of the creek. Five Babine Indian families were fishing near the mouth of the creek and, judging by the sockeye in their smoke-houses, had done very well. Fulton River will be well seeded and will compare favourably with any previous good year.

Leaving Fulton River I arrived at Babine village the same night. The following morning I made the usual trip down the 12-mile stretch of the Babine River. This is the only outlet of Babine Lake. This stretch is fairly wide, with very little current, and it is the scene of much activity during the months of August and September. Thirty smoke-houses of a permanent nature are located on this stretch and they are occupied by some sixty-five Babine Indian families. Every evening except Saturday, during the sockeye run, these sixty-five families set their nets, about 195 in number, for the night. The nets are taken in again in the morning and hung up to dry; meanwhile all hands attend to the catch of fish, cleaning and smoking, etc. Each family is supplied with a gill-net every second year by the Dominion authorities. These nets are 200 feet long, 25-mesh deep, with 5½-inch extension measure. The smoke-houses visited were found well stocked with sockeye and few complaints were heard as to lack of fish. A few good-sized spring salmon were seen in the smoke-houses and many pinks on the racks at the lower end of this stretch. In the narrow part beyond this stretch the river was swarming with pinks. A Fishery Guardian patrols this 12-mile stretch, and to him I am indebted for the following information: Sockeye were first seen and caught entering Babine Lake on July 9th. Fair run on July 24th and running strong on July 29th. Ten families were fishing on August 10th and the whole sixty-five families fishing by August 28th. On the following dates big runs of sockeye were reported entering the lake: August 10th, 13th, 20th, 21st, 23rd, 27th, 28th, 29th, and 31st; September 4th, 5th, 6th, 12th, and 13th. On August 30th there was a big run of pinks below the fishing-grounds on Babine River. With the sockeye the males appeared to be in excess of the females by about three to one. The runts were also very much in evidence here and are undoubtedly on the increase. In regard to the pinks, it is interesting to note that, although the pack of this variety was a big one on the Skeena this year, the run to Babine was not as good as last year.

Leaving Babine village I arrived at the Dominion Government Hatchery on September 15th. The hatchery is located at the head of Hatchery Creek and is about 3 miles from Babine Lake. Hatchery Creek in turn flows out of Morrison Lake, which is about 12 miles long. The trail from Babine Lake to the hatchery is close to the creek, and all the way up continuous splashing was heard, indicating the presence of many sockeye. I met Mr. Eaton, the Hatchery Superintendent, who had just started to collect his quota of 8,000,000 sockeye-eggs for the hatchery. The "pens" erected at the head of the creek, close to the hatchery, were full of sockeye, which ensured a full hatchery. Hatchery Creek has long been noted for its steady run of sockeye and also the large size of the fish. This year was no exception, but unfortunately there was an extraordinary number of runts among them. This is the first year that I have noticed so many runts in this creek. The first sockeye were seen in Hatchery Creek on July 27th, which is a little later than usual. The males and females were about even in number. While I was at the hatchery word was received that 6,000,000 sockeye-eggs collected by Mr. Crawford from Pierre Creek and 3,000,000 from 15-Mile Creek, originally intended for Stuart Lake Hatchery, were to be brought to Babine Hatchery. On receipt of this information all pens and fences in the creek were immediately removed, allowing the sockeye to go where they desired and spawn naturally. In this regard it was interesting to note that, although the majority that were near the lake passed on through, and many would certainly spawn in the creek at the head of Morrison Lake, a good number returned to Hatchery Creek. Mr. Eaton informed me that the biggest cohoe run known on Hatchery Creek and Morrison Lake took place last year. While spawning, Mr. Eaton had obtained an adult female sockeye having the adipose fin cut. This fish was so marked at the hatchery four or five years ago, and I was fortunate in obtaining the data, which were forwarded to Dr. Clemens at Nanaimo.

I returned to Donald's Landing, but was unable to visit Grizzly Creek, at the head of the lake, owing to stormy weather. I did, however, visit 15-Mile Creek again, which I found in even better condition. The fences had all been removed and the Indians had returned to Stuart Lake, from all accounts well satisfied with their catch.

A delay in transportation facilities necessitated a stop of two days at Donald's Landing and I reached Burns Lake on September 25th.

In summing up the Babine area, I can say with confidence that this area will be exceptionally well seeded this year. From a canneryman's point of view this may be difficult to understand, owing to the poor sockeye-fishing this year. Undoubtedly there will be good reasons advanced as to why this is so, but I think that the most important reason, and the most logical one, was

the enforced additional twelve hours of a "close season" throughout sockeye-fishing. A distressing feature, however, was the big increase seen in the number of runts. These runts are undersized but fully matured three-year-old sockeye, properly called grilse, and are practically all males. Some measure should be taken to eliminate them, at least to some extent.

On September 26th I visited Moricetown Falls, on the Bulkley River. In accounting for ten fish going over the falls, five were cohoes, three were sockeye, and two were large steelheads. An old Indian, with a safety-rope around his waist in Alpine fashion, was catching one of these three varieties every five minutes with the aid of a long pole with gaff-hook attached.

I visited Agwillgate Canyon the same day, but found little to be seen there. I was assured, however, that there had been a good run of sockeye up the Bulkley River.

Kispiox River was again up to expectations in regard to the pinks, the river being literally swarming with this variety.

On September 28th I visited Lakelse Lake and met Mr. Hearne, the Superintendent at the Dominion Hatchery. Lakelse Lake is the first important sockeye-spawning area and the earliest of the Skeena watershed. It is 12 miles from Terrace and is reached by a good automobile-road. The lake is about 5 miles long and is becoming famous for its cut-throat and rainbow trout. Excellent fly-fishing can be had, and this, coupled with the added attraction of a well-equipped hot springs and hotel, is yearly drawing an increasing number of anglers and tourists.

There are four sockeye-creeks on Lakelse Lake—namely, Williams, Schullabuchan, Granite, and Hot Springs. Owing to the late date I did not visit the last three named creeks, but did visit Williams Creek as the sockeye were still running there. Heavy rains had discoloured the water and swollen the creek considerably, so that other than an occasional sockeye breaking water it was impossible to determine the extent of the run. Fences and pens for spawning purposes were erected at Williams Creek on July 22nd. Spawning commenced on August 4th, but the pens and fences were washed out on August 9th, allowing between 3,000 and 4,000 sockeye to pass through. Mr. Hearne informed me that when spawning first began the males predominated to the extent of fifteen to one, but gradually lessened off and later on the sexes were about equal in number. In contrast to Babine there were very few runts at Lakelse, the sockeye being big in average. Mr. Hearne had obtained 5,400,000 sockeye-eggs and, but for the difficulty experienced with the high water and loss of fences, could have obtained at least 10,000,000. He was, however, hopeful of securing a few more thousands.

The run to Granite and Hot Springs Creeks this year was only fair, but the run to Schullabuchan was good. Sockeye were first noticed in the lake on June 14th, which is about the usual time. Very few net-scarred fish were seen this year. An unusual incident was noticed by Mr. Hearne—a female pink spawning with a male sockeye. This female chased the males of its own species away in order to spawn with the sockeye. At the time there was no scarcity of male pinks or female sockeye.

While at the hatchery I saw the retaining-ponds, where excellent results of artificial propagation were seen. The young fry were large in size and thriving well, being in good shape for their long journey seaward.

In summing up the Lakelse spawning area as regards the sockeye, I may say that the run this year was disappointing, not being as good as previous years. The run of pinks, however, was well up to former good years, Lakelse River in particular being one teeming mass of this variety.

This being the last point of interest, I returned to Terrace and arrived at Prince Rupert on October 1st.

I wish to express my appreciation to the Hatchery Superintendents and Fishery Guardians for hospitality shown and information supplied.

I have, etc.,

ROBERT GIBSON,

Fishery Overseer.

Prince Rupert, B.C., October 30th, 1928.

THE SPAWNING-BEDS OF THE NASS RIVER.

Hon. S. L. Howe,
Commissioner of Fisheries, Victoria, B.C.

SIR,—In response to instructions to inspect the salmon-spawning areas of the Meziadin Lake watershed of the Nass River, I have the honour to submit the following report:—

Leaving Victoria on August 29th, I arrived at the town of Stewart on September 1st, there meeting Mr. A. E. Young, Dominion Fishery Officer. As in the past, we joined forces on this trip of inspection. Upon my arrival Mr. Young informed me that the new canvas canoe being supplied by the Dominion Fisheries Department had not arrived, and a few days later received a telegram from Mr. A. Mackie, Inspector of Dominion Fisheries, Prince Rupert, to the effect that the canoe would arrive on Monday, September 10th. In the meantime we engaged two assistant packers and had our outfit in readiness to start. The delay was unfortunate as we missed some fine weather. The canoe arrived on the night of the 10th and we left Stewart on the 11th, raining hard. We made American Creek and stayed there for the night. The weather was very wet on the journey into Meziadin Lake, arriving there on September 14th after having trouble in fording Beaver and Surprise Rivers. On September 15th we assembled the new "King" canoe and made an inspection of the sockeye-spawning grounds at the head of the lake, down the southerly shore to 5-Mile Point, thence across the lake to the northerly shore to its head. In making this examination we did not see twenty spawning sockeye on the beds where they are usually to be observed. Conditions at this particular part of the district were poorer than I have found for many years, the last very poor showing being in 1923.

On Sunday, September 16th, we made the trip down the lake in the canoe. No salmon were to be seen disporting themselves in the lake or at the mouths of McLeod Creek and Hanna River. On leaving the lake we entered the Meziadin River and waded the canoe through the McBride Rapids, which were running high. We arrived at the Falls Cabin at 6.30 p.m.

September 17th was a very wet day. We inspected the fishway, also upper and lower falls. There were very few sockeye to be seen passing through the fishway, and only a small number were observed in the resting-places below both falls. The salmon assembled were about equally divided between sockeye and cohoe, this species just commencing to arrive. During our stay at the falls until September 27th sockeye conditions did not improve, but the run gradually declined, and at the time of our departure all had passed up-stream. In past years the large white-nosed variety of sockeye have been noticeable. There were none to be seen this year.

Upon opening six sockeye caught below the falls, two of them were infested with thin thread-like worms in the abdominal cavity. The blood in the dorsal aorta, which extends along the lower surface of the backbone, was of a pale-slate colour. The specimen in general had not the appearance of being in a healthy condition.

The cohoe run improved for a few days, reaching its peak about the 25th, when they commenced to diminish. It is possible that there may be a later run to this district, but from observations the cohoe situation was not as good as in former years.

On September 18th we hung the net and fished it in the main Nass River above the Meziadin, fishing the net continually until the evening of the 26th. The water in the Nass was high and discoloured during that time. Our operations with the net were most discouraging as we did not take a single sockeye. In past years we have always taken about an equal number of sockeye and cohoe. It is evident that no sockeye were passing up the main river as we had a splendid set with the net. The total results of the net-fishing was twenty-one cohoe and four steelhead. While this was the first time that we have failed to obtain specimens of sockeye, it was also the first time that we have taken steelhead.

On September 21st we inspected the spring-salmon spawning-beds at the lower end of McBride Rapids in the Meziadin River. There was very little sign of dead spent fish, only a few undersized females were seen; also the remaining springs on the spawning-beds were scarce.

The fishway is in good condition. There was a considerable growth of vegetation and brush around the crib-work and sides, which we removed. There is no sign of crumbling or decay in the cement-work. One piece of slate rock had sloughed off into the uppermost basin, which we could not displace. This rock will be of no hindrance to the passage of fish providing no further dislodgment occurs.

After completing our work at the falls we started on our return journey on September 27th. On the way up the lake some cohoe were observed at the mouth of the Hanna River. We arrived back in Stewart in the evening of October 1st after experiencing wet and broken weather for the entire time that we were in the field.

Summary.—A summary of spawning conditions in the Meziadin watershed of the Nass River basin this year shows that very few sockeye were to be found in any section—far less than have been found there in any one of the last four years in which I have inspected this district. Neither in Meziadin Lake or at the fishway at the falls below were sockeye in numbers to be seen. Sockeye were so few in numbers that we were unable to obtain sufficient specimens from which to collect scales, and in consequence no scales were collected. The net we set in the Nass River above its junction with the Meziadin failed to catch any sockeye, though the water was greatly discoloured and the net most favourably located. The fishway at the falls is in excellent condition.

Respectfully submitted.

C. P. Hickman.
Inspector of Fisheries.

A CANADIAN-AMERICAN SALMON RECLAMATION PROJECT.*

By John Pease Babcock.

The sockeye-salmon fishery of the Fraser River System was once the most productive salmon-fishery in which Canadian and American fishermen engaged. No other salmon-fishery was so speedily developed. No other reached such a wealth of production. No other was so speedily destroyed. No other affords so promising a field for exploitation. The restoration of that fishery is the greatest reclamation project in which Canada and the United States can jointly engage.

The history of the development and the destruction of the sockeye-salmon fishery of the Fraser River System is one of the most calamitous fish stories ever told. Notwithstanding that the story is hackneyed, no version of it has appeared in the Proceedings of the American Fisheries Society. It is the purpose of this paper to fill that void.

The sockeye-fishery of the Fraser River System was and is an international fishery. The term "Fraser River System" includes all the waters in British Columbia and the State of Washington which are frequented by sockeye salmon. The term "Fraser River System" includes all the waters of Juan de Fuca, Rosario, and Haro Straits, the Gulf of Georgia, and the channels of the Fraser River frequented by sockeye salmon in their migrations.

The history of the sockeye-fishery of the Fraser River System has been faithfully recorded. The records of no other fishery are as complete.

The Annual Reports of the British Columbia Fisheries Department since 1901, and those of three International Commissions which investigated conditions in 1905, 1908, and 1918, demonstrate that the sockeye salmon that formerly frequented the waters of the Fraser River System in vast numbers were hatched in the Fraser River watershed in British Columbia, lived for their first year or more in its lake-waters, then migrated to sea, where they remained until the summer of their fourth year and then sought to return through Canadian and United States waters to that river to spawn, and after spawning died.

Because all the sockeye caught in the Fraser River System have been canned, the pack records afford an accurate measure of abundance. The outstanding fact in the pack records, other than that of depletion, is the former four-year periodicity in abundance. From the beginning up to and including 1913, the pack records show an astonishingly large pack every fourth year—known as the "big year"; and relatively small packs in each of the three following years—known as the "small years"—a condition that had no counterpart in any other waters. The periodicity in abundance is made plain by reference to the packs in the "big years" and in the "small years." In the big years 1897, 1901, 1905, 1909, and 1913 the pack averaged 1,777,585 cases. The packs in small years in the period 1894–1900—a period before depletion was manifest in the small years—produced an average pack of 542,597 cases.

Commercial fishing for sockeye began in a small way in Canadian waters in 1876, with a pack of less than 10,000 cases. Fishing was confined to the channels of the Fraser River up to 1890 and gill-nets alone were employed. Gill-net fishing was extended to the discoloured salt waters off the mouths of the river in 1890. Up to that year only the Canadian fleet was engaged, the market was limited, and the catch in any one season did not produce a pack in excess of 183,000 cases.

Commercial fishing for sockeye began in the State of Washington waters of the system in 1891, with the installation of traps in the vicinity of Point Roberts. Proving most effective, the number of traps employed increased rapidly and became the leading factor in 1897. Purse-seines came into use in American waters in 1901 and have since that year been extensively used. Since 1901, with one or two minor exceptions, the yearly catch in American waters of the system has been in excess of 60 per cent. of the total catch.

Production in the system in the big years of each four-year cycle reached its height in 1913 with a total pack of 2,392,895 cases, containing the edible portion of over 25,000,000 individual sockeye. In 1917, the big year following the record high pack of 1913, the pack fell to 559,702 cases, a drop of close to 77 per cent. Since 1917 the packs in the big years of each four-year cycle have not exceeded 148,000 cases and can no longer be distinguished by their size from the packs of the three small years. There has been no periodicity in abundance since 1917. The glory of the Fraser has been destroyed.

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* Read at meeting of the American Fisheries Society, Seattle, Washington, August 30th, 1928.

The catches in the small years of each cycle up to the period 1898, 1899, and 1900 display no evidence of depletion. In each of those small years the pack averaged 648,912 cases. From then on the packs in the small years rapidly declined. In each of the last eight years the total pack in any one year has not exceeded 159,000 cases, and in one year—1923—it fell to 79,057 cases. The pack in the last eight years has averaged but 123,372 cases. Furthermore, the bulk of the pack in recent years has consisted of late-running fish—runs that were not drawn upon prior to 1914.

The factors that so speedily destroyed the sockeye run to the Fraser River System are easily determined. In 1901 the Fisheries Department of the British Columbia Government inaugurated a system of inspecting the entire spawning areas of the Fraser River. An annual inspection has been made and reports published. Year after year, since 1901, these reports have called attention to the significant fact that the greater proportion of the vast spawning-beds of the Fraser basin were but lightly seeded in each of the small years and in all the big years since 1909. The late Dr. Gilbert, the cleverest of all fishery investigators, in one of his classic "Contributions to the Life-history of the Sockeye Salmon," published in the reports of the British Columbia Fisheries Department, states that: "The history of the Fraser River sockeye shows unmistakably that the three small years of each cycle were overfished early in the industry. During the early years, when fishing was confined to the region about the mouths of the river and drift-nets alone were employed, no evidence exists of overfishing. The last cycle in which these conditions obtained was 1894–96. During each of the small years of that cycle there were packed approximately 350,000 cases on the Fraser River and about 60,000 cases in Puget Sound. During each of those years, therefore, about 5,000,000 sockeye were taken from the spawning run. . . . Apparently, however, a third of a million cases a year could be safely taken, for the following cycle shows no decrease. . . . During the following period of four years (1897–1900) the traps in Puget Sound became an important matter. While the British Columbia pack showed little or no reduction, it was now met by a pack on Puget Sound which nearly equalled it. The total catches during the three off-years of that cycle nearly doubled those of the preceding cycle and exacted an average toll of about 10,000,000 fish from the spawning runs of 1897–1900. The total pack of the three small years of that cycle was over 2,000,000 cases.

"The result was quickly apparent. . . . The small years of the following cycle showed such a marked decline as to indicate that we had far overstepped the line of safety. It was then during the cycle of 1897–1900 that the first serious damage was done to the sockeye run of the Fraser. By doubling the pack of the three small years, not only was the surplus fully taken, but the necessary spawning reserve was seriously encroached on, with the result that in the small years of the following cycle (1902, 1903, and 1904), in spite of the increased amount of gear employed, the pack was cut in half, while the spawning-beds at the same time were but sparsely seeded.

"The inevitable and disastrous trend of events should have been evident to the dullest. But the parties in interest refused to hold their hands and proceeded with the slaughter of the spawning remnant."

Turning now to the decline in the runs in the big years: The records are equally clear. As already stated, the sockeye runs in the big years 1897, 1901, 1905, 1909, and 1913 produced an average pack of 1,777,585 cases, and it should be noted that the catches on both sides of the line in 1901 and 1905 exceeded the canning capacity and several millions of fish were wasted.

Up to and including 1913 the packs in the big year show no evidence of an overdrain on the spawning-runs. The British Columbia Fisheries Report for 1913 shows that the escapement that year was as great, if not greater than in the preceding big year, 1909—the brood-year of the 1913 run. But that report shows that the escapment in 1913 met with disaster and that comparatively few sockeye reached the spawning-beds that year, with the result that four years later—1917—the pack fell to 559,732 cases, or close to 77 per cent. less than in 1913, and in 1921 it dropped to 142,598 cases, a drop in eight years of 2,250,297 cases.

The escapement in 1913 did not reach the spawning-beds for the reason that the river's channel above Yale—known as Hell's Gate Canyon—was virtually closed to the passage of fish by a great rock-slide. Millions of fish that had escaped capture and reached the obstruction in Hell's Gate Canyon were unable to pass over it, notwithstanding that strenuous efforts were made to enable them to do so. After frantic and continuous efforts to overcome the obstruction the fish became exhausted and were swept down-stream, where they died without spawning. The Report of the British Columbia Fisheries Department for 1913 deals exhaustively, in both text and illustration, with the disaster to the escapement in 1913. That report shows that the

number of sockeye that reached the spawning-beds above Hell's Gate Canyon in 1913 was less than an eighth of the number that reached the beds in 1909. This is made manifest by brief reference to the spawning-bed reports for 1909 and 1913. In 1909 4,000,000 adult sockeye were counted as they entered Quesnel Lake, one of the great lakes in the Fraser basin above Hell's Gate. In 1913 a similar count records that only 550,000 entered that lake. The spawning report of the British Columbia Fisheries Department for 1913 concludes with the following words: "The foregoing statements warrant the conclusion that the number of sockeye that spawned in the Fraser watershed this year was not sufficient to make the run four years hence even approximate the runs of 1905, 1909, or 1913." The accuracy of that forecast and the disastrous effects of the 1913 blockade were made manifest on the fishing-grounds in 1917. Notwithstanding that far more fishermen and more fishing-gear were employed and a much higher price paid for the fish on both sides of the line in 1917, the total catch produced a pack of but 559,732 cases, as against 2,392,895 cases in 1913.

From then on conditions became even worse. Had the 6,000,000 of individual sockeye that went to make up the pack of 1917 been permitted to reach and seed the spawning-beds in that year, some of the loss occasioned by the 1913 blockade could have been recovered. But such was not the case. The authorities, the fishermen, and the canners on both sides of the line did not heed the warning in the reports of 1913. No additional protective measures were enacted and the fishermen and the canners spared no efforts to capture every last sockeye in the run of 1917, with the inevitable result that the escapement of that year was no greater than it had been in recent small years and in consequence the spawning-beds produced no greater returns. The catch four years later—1921—produced a pack of but 142,598 cases.

The sockeye-salmon fisheries of the Fraser River System were not destroyed by the parties in interest without vigorous protest from fishery authorities on both sides of the line. As early as 1905 a joint commission, representing Canada and the State of Washington, after a full investigation of conditions, unanimously recommended the cessation of all sockeye-fishing in the system in the small years 1906 and 1908. The commission expressed the opinion that by so doing the runs in the following cycle-years would be materially inceased. The closing was to be an experiment; the runs at that period had not been reduced to a low level. The Government of Canada accepted the suggestion and passed the necessary enabling Act. A similar Act was denied passage by the Legislature of the State of Washington and Canada repealed her Act; and every one concerned went after the fish harder than ever.

In 1908 an international commission was created to study conditions. Following its unanimous report and recommendation, Canada and the United States drafted a treaty providing for the preservation and propagation of sockeye in the Fraser River System. The Government of Canada ratified the treaty. The President transmitted the treaty to the United States Senate. After two years' delay the Senate refused to concur and the treaty was withdrawn.

Then came the disaster of 1913 and renewed efforts to secure international intervention. In 1918 Canada and the United States again appointed a second international commission, headed by the Chief Justice of New Brunswick and the Secretary of Commerce of the United States. In accordance with the unanimous recommendations of that commission a second treaty was drawn, which provided for "the times, seasons, and methods of sockeye-fishing in the Fraser River System" and "for the conduct of investigations into the life-history of the salmon, hatchery methods, spawning-ground conditions, and other relative matter."

That treaty was promptly approved by the Government of Canada. The United States Senate again refused to concur and the President withdrew it.

Nothing has since been accomplished. The pitiful remnants of the former abundant runs to the Fraser are still being preyed upon by Canadian and United States fishermen, and the vast spawning areas of the Fraser basin remain unseeded and unproductive.

The Fraser River basin contains 1,514,000 acres of spawning area. That area has not been lessened or contaminated. It is as extensive and as suitable for the propagation of sockeye as formerly. The vast lake-waters of the Fraser are as rich in the natural foods of young sockeye as ever. The channels of the river are open and free to the passage of such fish as are permitted to enter them. All that is required to produce the abundant runs of former years is a sufficient number of fish to seed them as abundantly as they were seeded in those years. No other waters afford so alluring a field for exploitation.

The restoration of the sockeye-salmon fisheries of the Fraser River System is the greatest reclamation project in which Canada and the United States can jointly engage.

REPORT OF THE INTERNATIONAL FISHERIES COMMISSION APPOINTED UNDER THE NORTHERN PACIFIC HALIBUT TREATY.

The treaty between Canada and the United States for the preservation of the halibut-fishery of the northern Pacific Ocean, including Behring Sea, was ratified on October 21st, 1924. It is remarkable from the double standpoint that it is the first treaty entered into by Canada as a nation and that it is the first effective one anywhere having for its object the conservation of a threatened high-seas fishery. It, therefore, serves as a precedent for international co-operative control of sea-fisheries, where such is necessary. This forms an important additional reason why success should be achieved under it.

The treaty provides an entire cessation of halibut-fishing for three months each year. This was regarded, at the time it was entered into, as an essential minimum of protection. It also provided for the appointment of an International Fisheries Commission, the duties of which are to make recommendations regarding the need for modification of the close season, to make a thorough investigation into the life-history of the Pacific halibut, and to make recommendations as to the regulation of the fishery that may be deemed desirable for its preservation and development. The specific provisions of the convention dealing with these phases follow:—

"The nationals and inhabitants and the fishing vessels and boats of the Dominion of Canada and of the United States, respectively, are hereby prohibited from fishing for halibut (*Hippoglossus*) both in the territorial waters and in the high seas off the western coast of the Dominion of Canada and of the United States, including Behring Sea, from the 16th day of November next after the date of the exchange of ratifications of this convention, to the 15th day of the following February, both days inclusive, and within the same period yearly thereafter, provided that upon the recommendation of the International Fisheries Commission hereinafter described this close season may be modified or suspended at any time after the expiration of three such seasons, by a special agreement concluded and duly ratified by the High Contracting Parties.

"The High Contracting Parties agree to appoint within two months after the exchange of ratifications of this convention, a commission to be known as the International Fisheries Commission, consisting of four members, two to be appointed by each party. This commission shall continue to exist so long as this convention shall remain in force. Each party shall pay the salaries and expenses of its own members and joint expenses incurred by the commission shall be paid by the two High Contracting Parties in equal moieties.

"The commission shall make a thorough investigation into the life-history of the Pacific halibut, and such investigation shall be undertaken as soon as practicable. The commission shall report the results of its investigation to the two Governments and shall make recommendations as to the regulation of the halibut-fishery of the North Pacific Ocean, including the Behring Sea, which may seem desirable for its preservation and development."

The undersigned, having been appointed commissioners under the treaty by their respective Governments, undertook their duties without delay. At the outset they decided to employ a competent man as director of investigations, in which capacity the services of W. F. Thompson were secured. He not only brought to the work the needed training and ability, but the experience and knowledge that resulted from three seasons' investigations in the Pacific halibut-fishery, which he had undertaken some years previously on behalf of the Provincial Government of British Columbia. A competent staff of young energetic scientists to assist him was also employed. The commision further arranged for the appointment of an honorary scientific council, with which not only the commission but the director of investigations could consult, and to which has been submitted the plans of investigations to be undertaken from time to time. This council consists of two representatives from each country:—

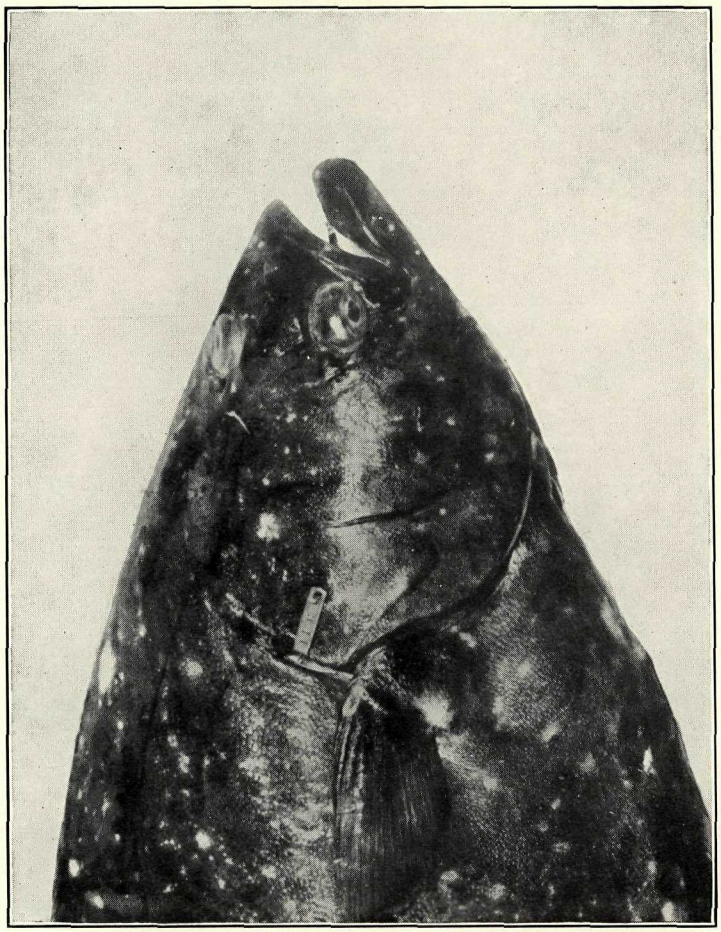
Professor John N. Cobb, Dean of the College of Fisheries of the University of Washington, Seattle.

Mr. N. B. Scofield, Head of the Department of Commercial Fisheries of the Fish and Game Commission of California.

Dr. C. McLean Fraser, Professor of Zoology in the University of British Columbia, and formerly Director of the Marine Biological Station at Nanaimo, B.C.

Dr. W. A. Clemens, present Director of the aforesaid station.

PLATE IV.



Live halibut ready for liberation with numbered tag on cheek-bone.

The director and staff have from time to time presented reports on the progress of the investigation and on their findings to the commission, and to the scientific council. These findings are used in the formulation of the present recommendations. The scientific results are, however, not inserted in this report, but will be published later in more detailed form than is practicable here.

The task with which the commission found itself to be charged is one of great magnitude and difficulty. The fishery covers a coast-line of about 1,800 miles in length. The halibut can only be studied at sea and under difficult conditions. Hence it has not been possible in the three years during which the commission has been at work to cover the whole field exhaustively. What has been accomplished has, however, been done with care and the information obtained is sufficient to satisfy the commission as to the necessity of certain main lines of action, if the fishery is to be preserved.

Though the investigation has been highly scientific in character, the commission determined at the outset that it would be carried out along practical lines, with close adherence to facts and avoidance of unsupported theory. Its aim has been to establish beyond doubt the actual condition of the fishery at present and the history of its trend to that condition. It has sought to define the remedial measures which should be adopted to save the fishery and to build it up, as well as the conditions that would have to be met in applying such measures.

Statistics have formed an indispensable part of the facts gathered. They have included not only complete records of landings, but of operations at sea. Through the splendid co-operation of the fishing-vessel captains, the commission has secured extensive records of the individual catches, from which the yield per unit of fishing effort, the "skate," has been ascertained for each section of the coast. These cover every season and are for years as far back as 1906.

Even more important have been the biological studies. These have included the rates of growth according to localityy, the migrations, the "races" existent, and the spawning habits. Material has been collected by the staff, not merely from voyages on fishing-vessels, but through the operations of vessels chartered for the purpose. Thousands of halibut have been caught and released with numbered tags attached, and have been recovered from fishermen through rewards offered. From the records thus furnished it has been possible to determine the migrations of the halibut. Extensive studies of the physical characteristics and the growth of the different "races" have confirmed such findings. The drift of the eggs and larvæ in the open ocean have been studied by means of fine-meshed silk nets and by observation of the currents. The results of these biological studies, in conjunction with those from the statistics, form the basis for the conclusions reached in this report.

IMPORTANCE OF FISHERY.

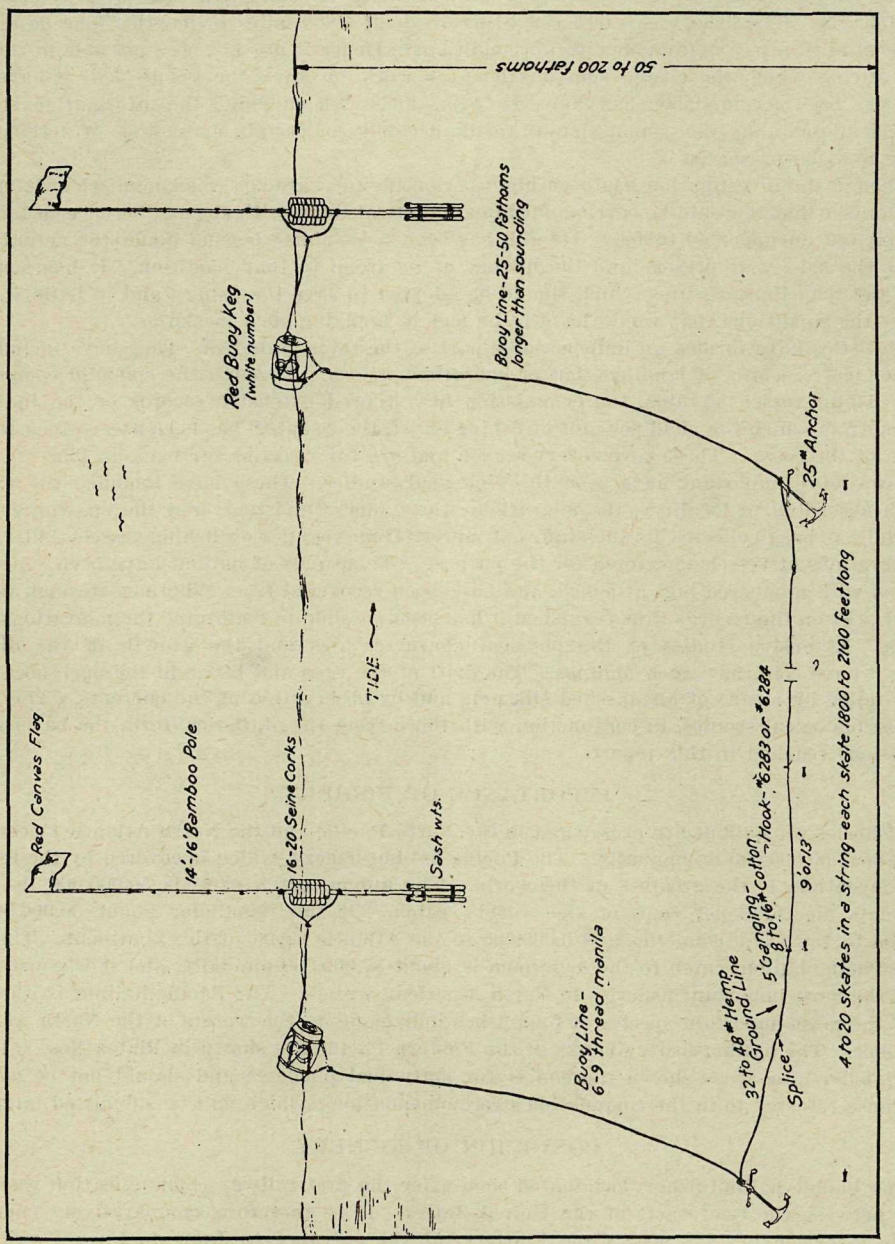
Fisheries for halibut are prosecuted in the North Pacific and the North Atlantic Oceans, and yield about 90,000,000 lb. annually. The Pacific halibut-fishery, which is covered by the terms of this convention, is the greatest in the world. The annual catch exceeds 50,000,000 lb., which represents about 60 per cent. of the world's catch. Of the remainder about 30,000,000 are credited to European countries and 6,000,000 to the Atlantic Coast of this continent. The value of the Pacific halibut-catch to the fishermen is about $7,000,000 annually, and it is consequently one of the most important fisheries in North American waters. The Pacific halibut is, therefore, one of the most important species of food-fishes indigenous to the waters of the North American Continent. The halibut-fishery banks of the Eastern Pacific are shown in Plates Nos. I. to III.* The division into areas shown thereon is for statistical purposes and should not be confused with those referred to in the commission's recommendations, which will be submitted later on.

CONDITION OF FISHERY.

The Pacific halibut-fishery originated soon after the first railway communication was established between the two coasts of the United States. It is, therefore, comparatively young. It had its inception in 1888 near Cape Flattery, at the entrance to Juan de Fuca Strait. The fishery expanded rapidly and by 1910 it had extended to grounds off Cape Ommaney, Baranof Island, 600 miles to the north. Subsequent expansion has extended the fishery until it now covers about 1,800 miles of coast. Formerly as many fish were taken from the 600-mile stretch as are now procured from the entire area of 1,800 miles. The banks on the eastern side of the

*Not reproduced in this reprint of report.

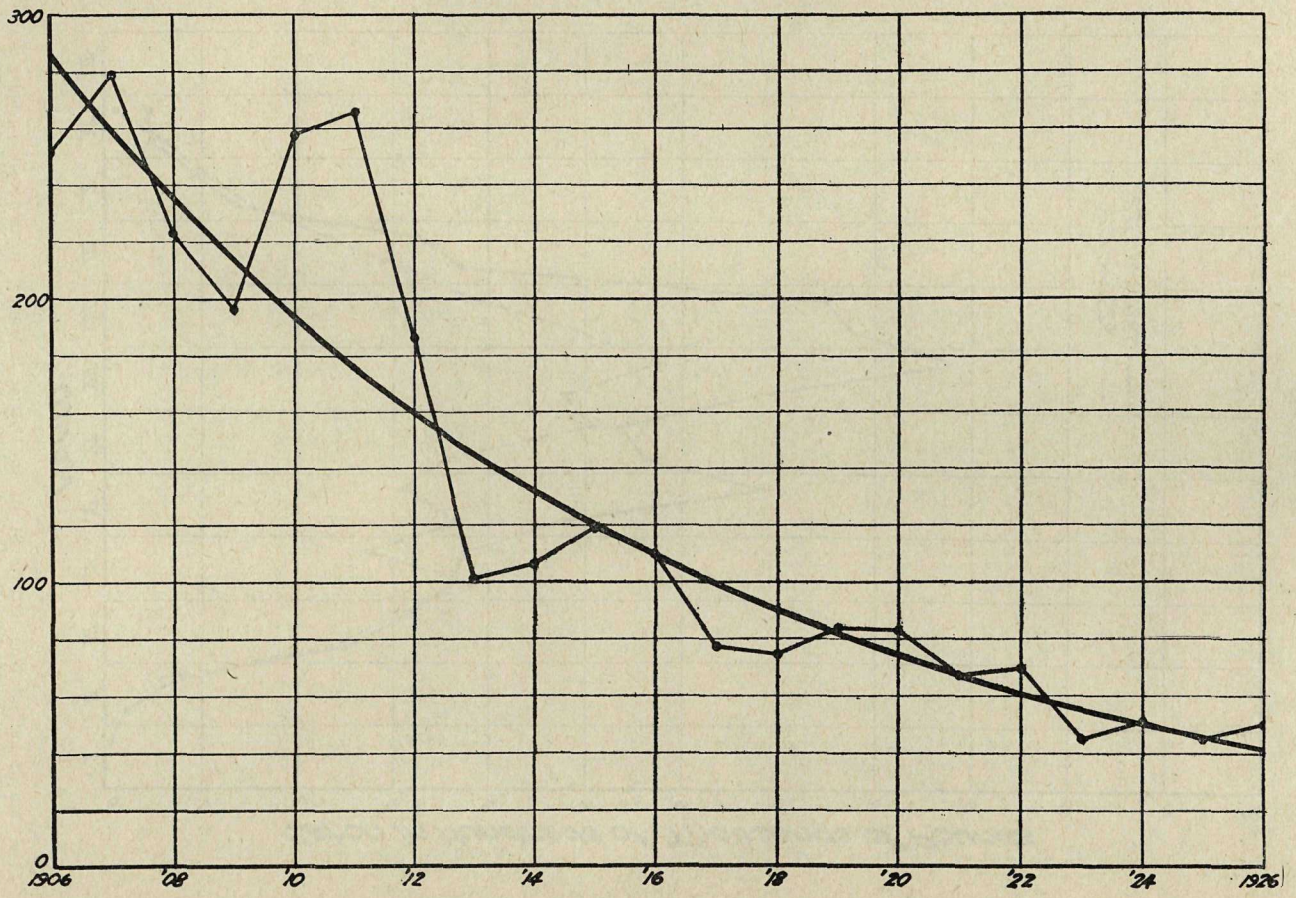
PLATE V.



Halibut-gear. Ground-line made up of units called "skates," set on the bottom and usually baited with herring.

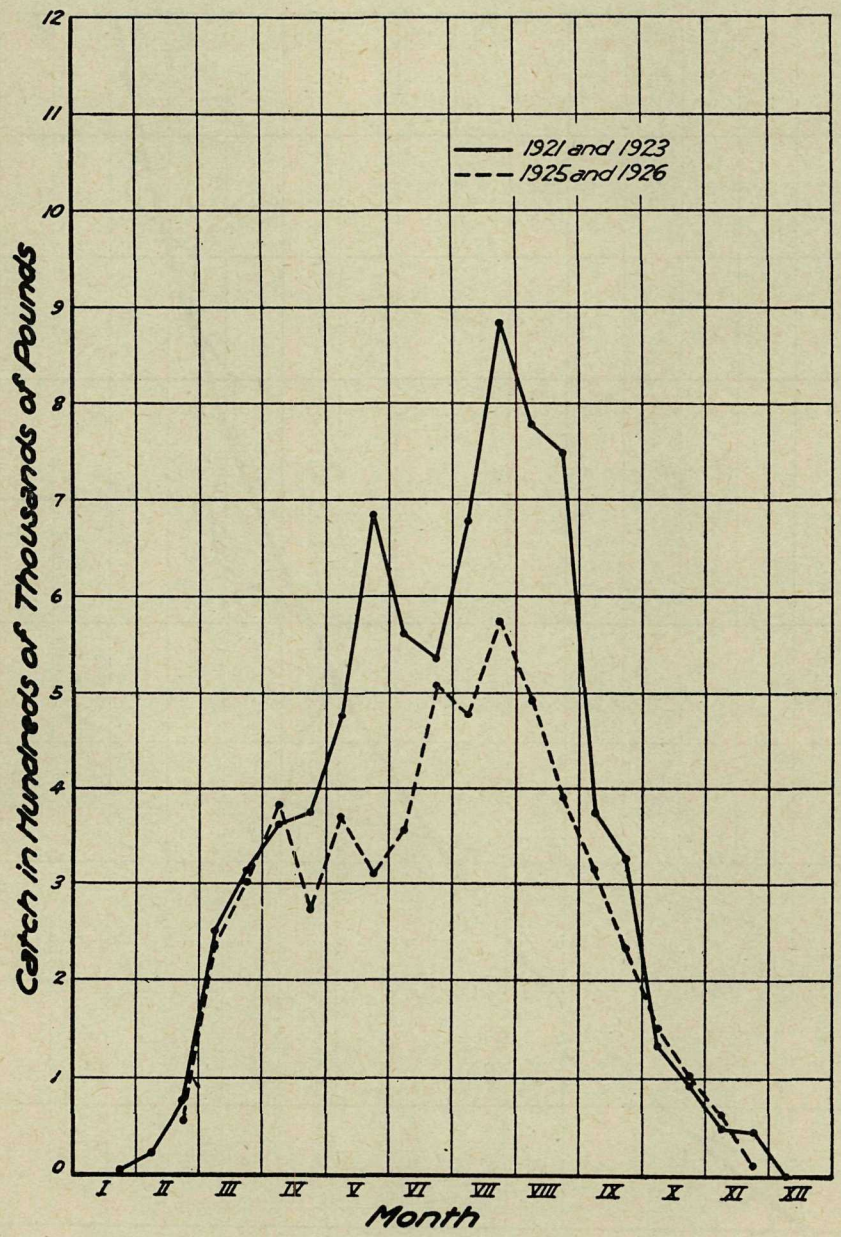
PLATE VI.

Catch per Skate in Pounds.



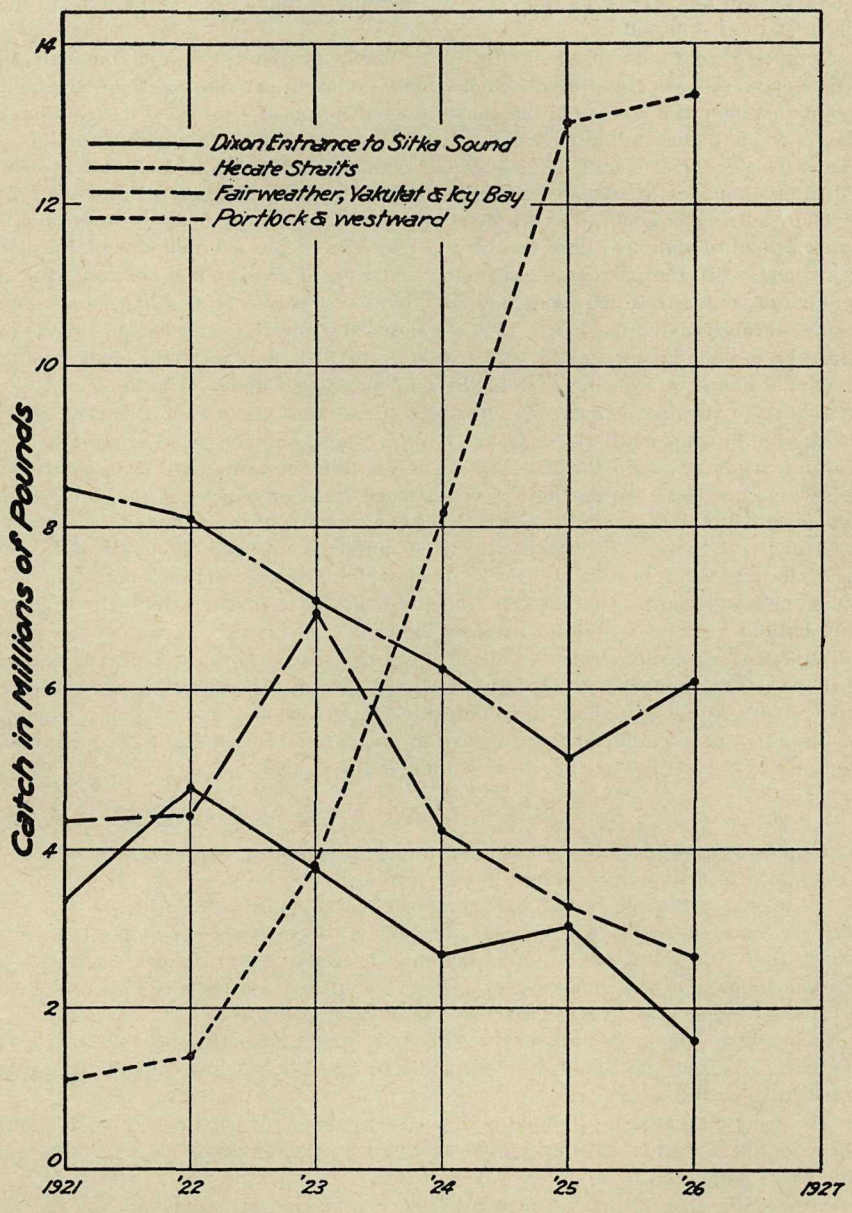
Decline of abundance of fish, as shown by the catch in pounds per set of a standard unit of gear, the skate. From 1906 to 1926, on the grounds south of Cape Ommaney.

PLATE VIII.



Catch of halibut from Hecate Strait and Dixon Entrance, by two-week periods, as hailed in Prince Rupert. Unbroken line before, and broken line after, the closure of the winter season, November 16th to February 15th.

PLATE IX.



The rise in landings from the westward banks, including Portlock, contrasted with the decline in those from other regions. Prince Rupert, 1921 to 1926.

Gulf of Alaska, which yield spawning fish, were first exploited in 1913. In 1926 the larger boats made by far the greater part of their catches in the vicinity of Kodiak Island, on the western side of the Gulf of Alaska, about 1,200 miles beyond the original fishery. The catch on the older grounds south of Cape Ommaney has decreased from a total in excess of 50,000,000 lb. in 1910 to about 21,000,000 in 1926, and much greater effort was exerted in making the catch in the latter year. It is evident that the present level of production has been maintained by extending fishing operations to new areas, as the catch on the older grounds decreased, and by increasing the intensity of the fishing effort.

The amount of gear now used on the older banks is about two and one-half times the quantity formerly used, yet the present catch is only about 40 per cent. of the former yield from these grounds. Under the stress of this great intensification of fishing effort the abundance of fish on the older banks has fallen enormously, to 16 per cent. of the abundance in 1906. Where in 1906 the catch per set of a unit of fishing-gear was nearly 300 lb., in 1926 it was below 50 lb. Expressed in another way, it required six units of gear to catch as many fish as one unit caught in 1906. The decline has gone on at an even rate and shows no tendency to slacken. Accompanying this fall in abundance there has been a decrease in the average size of the fish landed and a great increase in the percentage of undersized fish. For example, between 1919 and 1926 the percentage of undersized fish from the older banks increased from 20 to 30 per cent.

The more recently exploited banks to the westward show the same trend, the catch having fallen from 160 lb. per unit of gear in 1923 to 100 lb. in 1926, and was still lower in 1927, while at the same time there was an increase in the number of fish under 11¾ lb.

The rapidity of decline is regarded as especially serious because of the very slow rate of growth of the halibut, an adult being from 12 to 25 years, or over, in age. Hence the present decline has taken place within the life-span of one halibut of ordinarily large size. As nearly all the fish which are being caught now were spawned eight or ten years ago, the abundance of the younger fish, which will annually be available for capture in the next ten years, has already been established. If these are greatly reduced in numbers and the intensity of the fishery is maintained, the outlook for a future stock of spawning fish sufficient to maintain the supply presents a hopeless picture. In fact, the commission's investigations indicate that relatively few mature halibut are now found on the older banks.

These illustrations demonstrate beyond a doubt that the fishery is in a very serious condition, and that the banks cannot stand the intensity of fishing to which they are subjected. The commission is fully convinced that the conditions are so serious that no delay should be permitted in the adoption of additional conservation measures. In the light of the investigations made, such action is essential to the maintenance of the fishery.

RECOMMENDATIONS.

The commission recommends certain additional measures of conservation, which are here summarized and are dealt with in detail in pages following.

It is recommended that power be given proper governmental authorities:—

1. (*a.*) To establish areas, within each of which, if deemed necessary for the preservation of the fishery there, the total catch of halibut may be reduced by a predetermined percentage annually, commencing not less than one year after the putting into force of this recommendation, until the fishery therein shall reach a state of stability of yield.

(*b.*) To determine upon the amount of this percentage reduction, and to revise the same from time to time as may be found necessary, the intent being to restrain any increase in the amount of fishing within such area.

2. To close permanently to all fishing the two areas herewith defined, and known to be populated by small immature halibut, and to close such other grounds as may be found by the commission to be populated by a similar class of fish.

3. To prevent the use of any fishing-gear deemed unduly destructive.

4. To extend the present closed season by two weeks at its beginning, making the closure for all fishing in all areas from November 1st to February 15th, both dates inclusive, and to facilitate future alterations in the length of close season.

5. To license all vessels fishing for halibut in treaty waters, under such terms as are necessary for the purpose of the treaty, including statistical returns, and for clearance to regulated waters.

First Recommendation.

Establishment of Areas and Limitation of Catch therein.

The commission is unable, after careful scrutiny, to recognize in the close season as now constituted any contribution to the preservation of the halibut-fishery. From its study of the effects of the closure and of the fishery in general, it has reached the conclusion that to render any regulations beneficial from this aspect, they must be framed so as to distribute their effects according to the needs of the different banks or areas, and that on each of the badly depleted areas the amount of fish taken must be reduced. The present measure is not thus framed.

Its investigations have shown that the banks along the Pacific Coast are inhabited by stocks of halibut which are largely independent. Extensive tagging experiments have been carried on, with careful examination of physical characteristics and rates of growth. The fish below spawning size have thus been shown to be well differentiated according to bank, and to move but little in comparison with the great extent of the grounds. The fish of mature size are perhaps less limited in range, but are still sufficiently localized to render generally ineffective regulations of local application. In accord with these findings, and in checking them, the various banks have been found to be very unevenly depleted. A relative abundance exists on the more distant banks, with a marked degree of depletion on the nearer, the degree of depletion being dependent upon the distance of the banks from the markets. The proportion of spawners is high on the more distant, but almost non-existent on the near-by banks. There appears to be no such active interchange as would render regulations applied to one bank effective on all.

It has, therefore, become of paramount importance to discover how far the effects of regulation are localized, for each area must bear the burden of its own regeneration. The commission has, therefore, carefully and laboriously collected statistics regarding the effect of the close season on the several main areas of the fishery. The closure being from November 16th to the following February 15th, it has affected directly the fisheries at that time taking place. These were along the eastern side of the Gulf of Alaska, between Cape St. Elias and Cape Spencer. Here there has been prevented a very considerable fall, winter, and spring catch of mature fish. In contrast to this, the fishery on the older, more depleted banks south of Dixon Entrance has for years been a summer fishery, and, accordingly, the amount of the catch eliminated has been very small. At the time of adoption of the present treaty, the newer, less depleted banks to the farther west of the Gulf of Alaska did not have a fishery of any magnitude, but since then a very considerable summer, or open season, fishery has been developed. The close season has mainly affected, therefore, one area—that on the eastern side of the Gulf of Alaska.

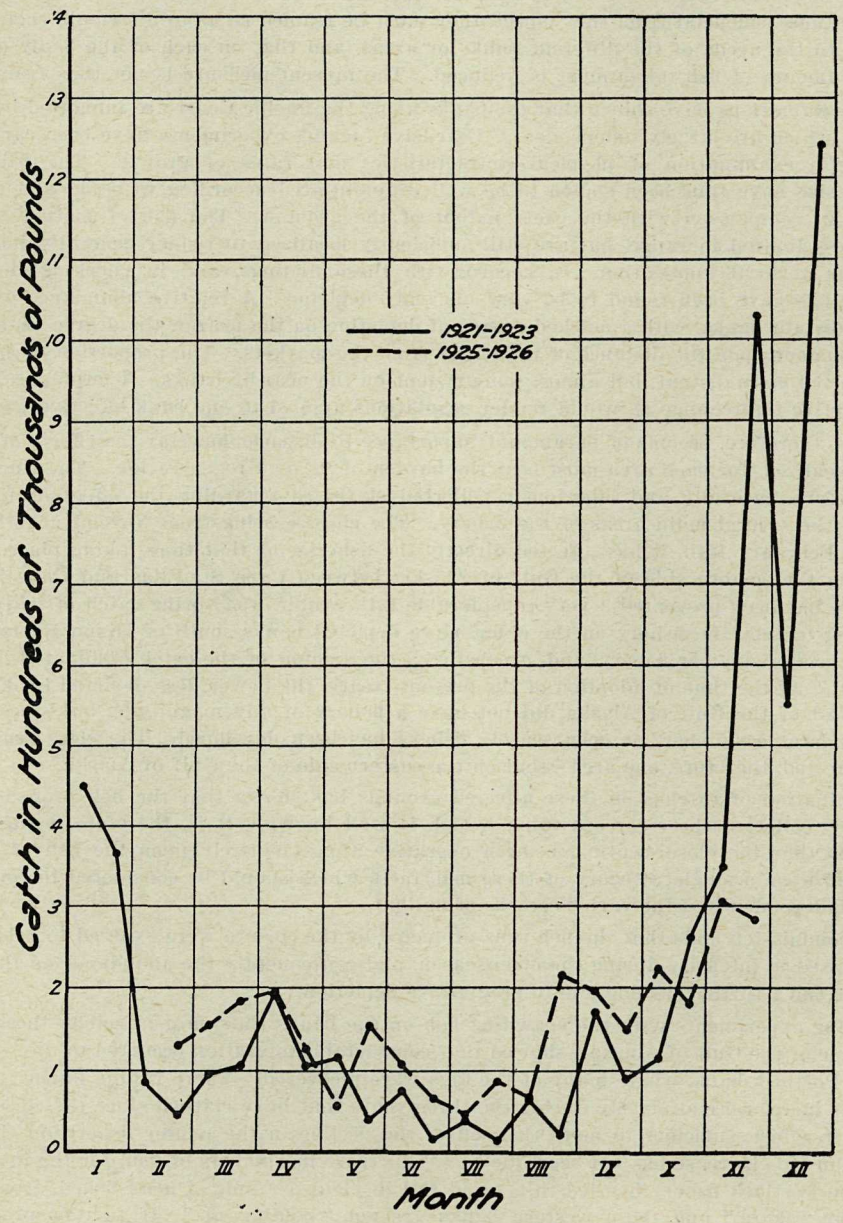
Examination of catches on these affected grounds has shown that the fish protected were largely fish collected there for spawning, which is well known. It is, therefore, evident from these facts that the close season has been operative almost entirely upon the fish of a given region, and upon a single category of these fish, facts which should be considered in connection with the independence of the various stocks of halibut.

The commission finds that the fish thus protected by the closure were exposed to fishing that was increased in intensity during the open season, and consequently the abundance on the banks has undergone a further decline due to progressive depletion.

Tagging experiments with the spawning fish on the banks thus most affected—those on the eastern side of the Gulf of Alaska—showed that considerable migration occurred to the westward as far as Portlock bank, where many of the tags were recovered. There fishing during the open season has increased enormously during the three years that have elapsed since the close season has been in effect, sufficient to more than offset the decline in the winter fishery on the other banks. But this increase has not been due to any increase in numbers of fish, for the intensification of the Portlock fishery has led to a rapid fall in yield per unit of gear fished, from 160 to 100 lb. per "skate," and these western banks are not "holding up." If further proof were required that this enormous increase of the fishery on Portlock is not due to the presence of more fish there, it will be remembered that halibut are on the average considerably more than 5 years of age when they first come into the commercial size, and that the great increase in catch was, therefore, from the pre-existing stock.

The same increase in the open season total catch is obvious on the banks referred to as most affected. This increase, too, was due to the more intensive fishing and not to an increase in the

PLATE VII.



Catch of halibut from the eastern side of the Gulf of Alaska, between Cape Spencer and Cape St. Elias, by two-week periods, as hailed in Prince Rupert. Unbroken line before, and broken line after, the closure of the winter season, November 16th to February 15th.

abundance of fish. Had there been an increase in abundance, there would have inevitably been an instant increase in fishing, sufficient to destroy the increase in abundance before it progressed far—it could not escape the notice of the fleet.

On the older banks, as has been said, the effect of the closure was very small, and during each month of the open season there was a decrease in the total taken, due to the progressing depletion of the banks. Yet this decline did not suffice to balance the increase on the other banks.

In accord with this, the absence of marked effects beneficial to the perpetuation of the fishery is shown by the fact that there has been no reduction in the total annual catch. On the contrary, there has been an increase, as is shown by the following statistics of landings for the five-year average preceding the close season and for the four years the close season has been operative:—

	Lb.
Five-year average, 1919 to 1923	51,595,000
1924	57,691,000
1925	53,170,000
1926	56,278,000
1927	56,899,000

The close season, therefore, has merely shortened the period within which the catch has been taken.

The reasons for this increased intensity of fishing, which has more than balanced the effects of the close season, are not far to seek. The economic advantages of the closure are sufficiently great to explain the lack of decline in total catch. The season of the year during which fishing is prevented, was the most expensive because of the bad weather, the consequent loss of gear and of time, and the severe effect on the morale of the men. With the elimination of the three winter months the work during the remainder of the year has become more efficient, and the losses and delays inherent in fishing operations have been greatly reduced. Moreover, the vessel-owners at present spend part of the close season in overhauling their gear and boats. A certain part of it is used en route to and from the fishing areas. The market for frozen fish is steadier, giving better prices for frozen fish according to general opinion. Furthermore, the grade of fish taken during the summer months is said to be superior to that formerly taken during the winter. The closure thus being of benefit from an economic standpoint, it follows that as long as the fishery continues to pay well, as it has in the past, there is no limit to the expansion it will undergo, beyond the satisfaction of the demand. The close season could not be expected to restrict, without adverse economic effects.

It is, moreover, true that in the past there has been a general and rapid increase in intensity of fishing sufficient to counterbalance the effect of the closure. Thus on the older banks the amount of gear fished is about two and one-half times that employed in 1910. This great and rapid increase in intensity has gone on unchecked during the nine most important months of the year. So great has it been that it has sufficed to maintain the total catch despite a fall in returns per unit of gear fished, and despite the fact that the new grounds exploited have yielded at their maximum but a third the abundance of fish found originally on the older southern grounds. Some measure of the effect of the closure in relation to this increased intensity can be gained by comparing the amount of catch formerly taken on the grounds along the eastern side of the Gulf of Alaska with the effect of the fall in abundance from year to year. It is estimated that not more than 6,000,000 or 7,000,000 lb. came from these grounds before the closure, or about 10 or 12 per cent. of the total for the coast. The loss of this could not exceed that annually lost through a failing supply, since on the older grounds the fall in abundance was approximately 10 per cent. yearly, and on the newer grounds even greater.

It is evident that the close season has met a complexity of conditions which destroys its uniformity of operation, and that in its application to one subordinate portion of the fishery it has left abundant opportunity for all supposed benefits to be eliminated. A stream cannot be controlled by throwing a dam half across its course. The result is nothing more than an increased rate of flow in the other half.

The commission has been unable to devise any general measure for the whole fishery which would properly meet the needs of the various areas.

Artificial propagation of the halibut is, for technical and scientific reasons, impracticable. The numbers of young that could be thus produced would be a minute part of those hatched under natural conditions. Their culture would be expensive and the young fish could not be kept long after hatching. Hence it is evident that the natural supply is overwhelmingly the most important, and that it must be cared for. The only adequate manner of meeting the present situation is to preserve in each area a sufficient number of young to produce spawning adults, and to leave enough of the latter to produce an adequate amount of spawn under natural conditions.

It becomes evident, upon the first study of the halibut-fishery, that regulations designed to produce and protect such a spawning reserve must be adapted to very different conditions in the various areas. The state of depletion varies from area to area, and the need for regulation varies accordingly. Certain of the banks have been resorted to for many years, while others are undergoing their first exploitation. In accord therewith the yield and abundance of fish varies. Moreover, the initial returns from any bank reflect the abundance thereon under natural conditions, and the newer, more westerly banks are much less productive naturally than the older southern banks—about a third in fact. In agreement with the state of depletion, the percentage of mature fish varies from a very small one on the southern banks to a high one on the western, and there is, therefore, a fishery for spawning-age fish on some banks and a fishery for immature fish on others. The fish on the banks vary not merely in their natural abundance, but in their rates of growth and physical characteristics. Thus the trade terms applied to fish according to size have a very different meaning and do not indicate their age or their need of protection. The seasons of the fishery vary also, in accord with the biology of the fish and the geographical location of each bank. In agreement with all this, the same complexity is found reflected in the fleet, the fishery on various banks being carried on by different types of fishing-vessels, with different sea-going ability, different methods of fishing to some extent, and different landing-ports. No uniform protection of a single class of fish, such as the spawners, no close season, no size limit or limit on gear, will be found to apply equally and efficiently.

The commission, therefore, finds itself forced by the aforesaid conditions to a consideration of the treatment of each individual area according to its needs. In thus acting it sees two alternatives.

One of these is to follow the method used in adopting the present close season, and on the basis of an exact and intimate knowledge of the fishery in each area, to close such seasons, protect such classes of fish, or prohibit such gear, as will reduce the amount of fish caught to the amount which the species is able to replace. This alternative has the same faults as has the present close season. It is necessary to look forward to a compensating intensity of the fishery on those classes not protected or upon all classes during the open season. The degree of this reaction of the fishery is an economic matter, for as long as the fishery pays there is no doubt but that it will increase gear and vessels to supply the demand. The restriction cannot be effective unless it so raises the expense of the fishery, the costs of operation, as to prevent this increase. In that sense the restrictions become, if successful, economic handicaps adjusted to limit to the required extent the fleet and the amount of fish removed. The results of the present closure, the complicated conditions to be met, the extensive and arbitrary powers which would be necessary to meet unforeseen changes in the economic world, and the wide knowledge necessary, discourage the adoption of this alternative.

The commission feels that the effect of regulations so varied would be difficult to forecast, and that in many cases the results would be harmful rather than good. The manner in which the fishery compensates itself for the protection of a single category of fish, such as spawners or young, has already been referred to in the discussion of the close season, and will be further discussed when dealing with the closure of small-fish grounds. The biological conditions underlying the principle of protecting spawning, mature, or young halibut are still unknown, and it is impossible to be certain that the shifting of the strain to any one of these classes rather than another is actually beneficial. Great fisheries exist which make exclusive use of one or the other. Many regulations, particularly those regarding gear, may be handicaps in the development of efficiency, or become causes of high cost of operation, which limit the output per man and prevent the sale of the catch at reasonable prices. Failure to dispose of the catch causes a surplus. The existence of the surplus creates a demand for further restriction of the catch per

man or per vessel, with still higher costs of operation, so that the evil may be intensified instead of relieved.

The commission is fully aware of the care which must be used in undertaking a task of this character. It has given careful consideration to the determination of the minimum reduction consistent with the perpetuation of the fishery, having in mind the last possible harm to the industry.

There has been, without restrictions, a decrease in the total catch from the older areas. The banks south of Cape Ommaney yielded, in 1910, more than 50,000,000 lb.; whereas at present there are not more than 21,000,000 taken. Since the amount of fishing which produced these totals is and has been too great for the banks in their present state, this decrease must be taken into account, and the restriction imposed must be sufficient to more than cover this decline, or it would be meaningless.

This declining total yield is secured by means of an increasing amount of gear. In other words, the intensity of the fishery has become greater, and a constantly higher proportion of the stock is taken. Six units of gear are set now for the same result that one formerly yielded.

This increase in the amount of gear and vessels is not in the best interests of either the fishermen or the halibut, and it is the greatest danger to which the fishery is subjected. The increased proportion of the stock taken lowers the abundance of fish on the banks progressively until a very minimum is produced, not merely for the effort involved, but in total. Therefore, if stability of return from the fishery is sought, the intensity of the fishery should not be continually increased.

Without positive restriction, the investment in gear and vessels already existent will face a decline in returns of fish, in accord with the decline in yield per set of a standard unit of gear, the "skate." This yield reflects the abundance of halibut on the banks, and its changes; and a certain number of sets of such skates should on the average take a definite proportion of the total stock on the banks. So that to maintain the present rate of removal, or proportion of the existing supply taken annually, the total catch allowed from a given area must be diminished at a rate at least equal to the rate of this decline in returns of the gear in present use.

But knowing that the present proportion of the supply captured is too great a strain upon the species, what hope can be held forth that the retention of that rate of removal would bring stability or permanence to the yield? The proportion taken is already in excess of the rate of replacement. We know that with the total yield as it is, this abundance—as measured by the yield per unit of gear—is still declining. Is there any ground for believing that this decline would stop?

Hopefulness lies in the fact that the rate of replacement varies with the condition of the fishery. It is a well-recognized biological law that under a state of nature a maximum population brings about a decline in the rate of reproduction until replacement just balances mortality. This is self-evident, since species cannot go on increasing indefinitely without overpopulating the world, which none of them do. But where, from one cause or another, the maximum population is not present, the rate of reproduction is much higher than the mortality, and up to a certain point becomes increasingly so. This has been observed in many organisms, ranging from man, and the various species of birds introduced into America, to transplanted species of fish such as the shad, and various insect pests. Among indigenous species this phenomenon must hold true, in order that they may recover from disastrous years. Whether this is caused by a greater abundance of food for the fewer individuals, or by some other factor, it would seem to be a general rule that the rate of replacement is higher when the species is below its maximum in numbers. Hence, if the decline has not gone too far, it is to be expected that in response to steadiness of the mortality rate the numbers of the species will decline only until the thereby increased rate of replacement is sufficient to balance the mortality.

With the data at hand, evidence of this increased productivity in the halibut is available. The abundance has fallen on the grounds south of Cape Ommaney in sixteen years to about 25 per cent. of its original amount, but the total catch seems to have fallen to about 40 per cent., therefore not as fast. Such a calculation cannot in the nature of things be exact, yet it errs on the conservative side, as, for reasons that cannot be detailed here, the fall in abundance may have been greater than this, possibly to such a degree that the present abundance is but 15 per cent. of its original amount. In this case the contrast with the decrease in total catch is still

more marked. The lower level of abundance seems to have produced in recent years a higher catch in proportion, although not in total figures.

There is, therefore, ground for believing that if the proportion taken does not increase, the halibut-fishery on the older banks will ultimately come to a position of stability. This would imply the reduction of the total catch at a rate equal to the fall in abundance of the stock of fish. The latter can best be measured by the returns per set of a standard unit of gear. This indicates that from 1906 to 1926 the fall has been at the rate of 10 per cent. a year. Such a reduction in total catch is the minimum which could be considered for the purpose, and is equivalent to the use of a fleet and gear the equal of that now employed.

It will be noted that the essential principle of the reduction in total catch is that it shall proceed at a rate at least equal to that of the declining return from a definite amount of fishing. Were this to be accomplished with precision, the reduction in catch would cease immediately with the cessation of the decline in abundance; and with a definite amount of fishing the returns would then be constant. It is the same principle upon which regulation of the salmon-fisheries in Alaska and British Columbia is conducted—that a definite proportion of the fish shall be allowed to pass the commercial fishermen.

The adoption of such a procedure must be made with full knowledge that it may not suffice. The thinning-out of the population may have already gone so far as to have increased the rate of replacement to its maximum. No further increase may be possible, so that the present degree of intensity of fishing may suffice to continue the decline, or the present drain on the species may exceed anything that even an increased rate of replacement may be able to care for. In such case the only alternative would be to reduce the catch annually at a faster rate. That is for the future to indicate.

On the other hand, it is well recognized by the fishermen that the banks are now but very sparsely populated, and it is more than possible that the maximum rate of replacement was reached long before the thinning-out had proceeded as far as it has. In that case a larger population of halibut than now exists on the banks would give a proportionately larger total replacement and a greater amount would be available for the fishery without harm to the species. Therefore, once the halibut-fishery is brought to a stable condition, the question will undoubtedly arise as to whether a further step to increase the "breeding stock" may not be advisable. This distinct possibility of increase in total yield would necessitate a temporarily greater restriction than that which is here proposed.

The determination of the amount of the reduction in the total catch from any area must, then, be guided by a study of the amount of fishing in relation to the returns. In making this determination, the discretion of the regulatory powers must be relied upon in drawing conclusions from the statistics obtainable. The latter should, however, be as accurate and comprehensive as is possible. The information now in the hands of the commission is very extensive for recent, but less so for the earlier years. It must serve as a basis for the initial reduction. For the period 1906 to 1926 the rate of fall in abundance has been 10 per cent. a year, with minor fluctuations of one to five years in duration, when there may or may not have been a continuous fall. Further reductions should be based on accurate, comprehensive data as to men, boats, and gear used, and the returns therefrom, so that the condition of the fishery may be measured in as many ways and as correctly as possible. Upon this information the rate of reduction in total catch should be revised at as frequent intervals as possible.

The frequent revision of this rate of reduction is necessary for several reasons. In case the reduction reflects the changes in the abundance of fish, as shown by the catch of a given amount of gear, unnecessary increases and decreases in fishing operations would be avoided. Furthermore, in case the rate of decline in abundance slackens, the reduction in the catch should be less, so that when the fishery becomes stable in yield, reduction will cease at once.

From present statistics, the initial total catch, from which the reduction should be made, can only be estimated for the several regions. The information at hand is designed to be representative only, and not comprehensive. It was obtained through voluntary returns, and may not give results comparable with those from a more complete, legally enforceable system. The commission regards it as necessary that the installation of a complete system of records be made at once, so that the initial amount from which reduction is made shall have been obtained by the same system and under the same conditions as those subsequently determined as limits. For that reason no reduction should be made until complete returns are at hand for a full year.

As has already been said, the reduction made in the total catch should vary with the needs of the various areas. This implies the formation of such areas for administrative purposes. In view of the fact that such control, if adopted, would be applied for the first time in the history of deep-sea fisheries, it is the commission's opinion that they should be large enough to render enforcement easily effective, and that they should correspond to a natural division of the fleet. For this purpose the first division should be into two main areas—the banks south of Cape Spencer and those north and west thereof. Later, when there has been more experience with the matter, smaller areas may be chosen, if deemed necessary.

Second and Third Recommendations.

Permanent Closure of Small-fish Grounds; Prevention of Gear deemed Unduly Destructive.

In the halibut-fishery the sizes vary from 2 or 3 lb. to over 200 lb. The value of the very small fish, if they are accepted at all, is very low. It is not until a size of 11¾ lb. is reached that full price is obtained.

The small fish are everywhere the young, still rapidly growing, and are not a different race of fish from the medium-sized, first-grade fish. The smallest fish, the so-called "baby chickens," are from 5 to 8 years of age, and during that period treble their weights. The next class of fish, the "chickens," are from 8 to 11 years of age, on the average, and within the three years they double their weight. These statements are, of course, approximate only, and pertain to halibut from Hecate Strait. On the western banks the ages are greater because of the slower growth. The mortality of these young fish is probably light, since even at their ages they are larger than most of those fishes which are presumably their enemies.

It therefore appears economically desirable to protect these small fish until they are of larger size. The gain in weight of the individual would be supplemented by the increased value, pound for pound, so that the economic gain would very probably be considerable. The hearings held by the commission indicate almost universal acceptance of this view, one which the commission endorses.

The commission believes it very evident, however, that if the small fish become more valuable at a later stage of life, and that if the fishery thereby gains from an economic standpoint, the intensity of the fishery will correspondingly increase. It is natural that the profit in a fishery should govern its intensity, and the greater the profit in fishing the larger classes of fish, the more they will be sought after. What would be saved in one part of the fishery would simply be added to another part, and there is no economic reason why that part should not be fished just as closely and to as low a level as before. This being so, it is unlikely that any considerable part of the fish protected by regulation would survive the four or five years necessary to reach spawning size after leaving the "baby chicken" stage. To retain for the fishery the benefits that accrue from the protection of these small fish would involve restraint of the fishery within the area concerned for other grades of fish as well.

Nor can the gain by such protection be in any way a substitute for general restriction of the fishery. Even were there thus permanently withheld from the fishery some small fraction of the total population, there would be serious doubt as to whether it could compare in magnitude with the loss in abundance that is year by year incurred by the general increase in gear used. It would, as was remarked in connection with the closure of the winter season, simply cause a temporary set-back that would be offset by an increase in intensity of the fishery.

Furthermore, it is to be considered that protection has to some extent been afforded these smaller sizes in the past, by trade usage and agreements with the dealers. The price obtainable for them has always been low. The sentiment against "baby chickens" being landed was, and still is, strong. They have constituted a third grade of fish, which were supposed to be destroyed and not sold. Yet the decline in the halibut-fishery has gone on.

The percentage of the smallest size of fish landed is not known, but that of "chickens" is recorded. This should show the trend. There has been, for instance, a more or less steady increase from 20 per cent. to 30 per cent. of the total landed at Prince Rupert from Hecate Strait in the last seven years. There is little doubt that undersized fish are forming a continually larger share of the catches from the southern banks in general. Legal protection to these small fish may prevent their use in the future to an increasing extent, but it can be preventive only and not constructive. It cannot apply to the factors which have caused the

damage in the past unless there are sizes included which have in the past formed acceptable parts of the market landings.

In considering the protection of these small fish, whatever sizes are included as such, their distribution is important. They are found to a greater or less extent in all areas and form a factor in all catches. But the smallest sizes are found in much greater proportion on certain banks commonly called "nurseries." Whether the extent of these banks, or the number of small fish thereon, has increased is difficult to say, as accurate observations have not yet been completed. Those "nurseries" which have been recognized for many years are on the old, more southern banks; but when the western grounds are better known, "nurseries" will doubtlessly be distinguished by fishermen there. At present little can be discovered statistically as to distribution or relative abundance in various areas. Vessels fishing on "nurseries" are reluctant to admit the fact. Catches everywhere are mixed and are rarely made from one area. The fishermen shake off the smaller sizes, frequently in great numbers, so that their catches do not give a fair picture of the proportion of small fish. They reflect, more than anything else, the market demand. But they also reflect the distance of the bank fished, since a catch of low-priced fish is not likely to be brought from a great distance as long as there is any chance for first-grade fish. Hence, although it is possible to say that certain "nurseries" actually exist, it is not possible as yet to give an accurate picture of the distribution of young, nor of what the effect of various restrictive measures on the various areas might be.

There have been three methods of protection for small fish suggested—namely, the imposition of a size limit, the prohibition of the use of small hooks, and the closure of "nurseries" to all fishing.

The use of a minimum size limit would involve a great destruction of undersize fish, much more extensive than is now the case. The investigations of the commission during tagging operations showed that more than 50 per cent. of the small fish are seriously injured by hooking even when carefully handled. It is deemed highly probable that when such fish are handled as roughly as is done in commercial fishing, when they are jerked off the hook, only a very small part of the 50 per cent. are in good condition for survival. Yet, as previously explained, in all commercial fishing, wherever the lines may be set, it is impossible to avoid the capture of a certain percentage of these small fish, and occasionally a high percentage. If such catches were to be discarded, great waste would be entailed.

To a certain extent fishing on "nurseries" or small-fish grounds would be penalized. Yet when prices for fish are good it is probable that vessels would nevertheless use these grounds, culling extensively, as is now frequently the case. It is therefore preferable to act directly in the protection of these "nurseries," as is proposed below.

Another proposed method of protecting small fish is to prohibit the use of smaller-sized hooks (other than the standard No. 6283), which are used with lighter lines. This matter was carefully investigated by the commission in a series of experiments. It was found that the small-hook gear, supposed to catch an undue proportion of small fish, actually did not do so, but took no larger nor smaller proportion of small fish than did the standard gear. On the other hand, the small-hook gear was more efficient, catching as much as 60 per cent. more fish per unit of gear set, whether large or small fish were considered. But the lighter lines are adapted to fishing in shoaler water, where fishing conditions are easier and where there are now greater quantities of small fish than formerly in proportion to large. In deep water, and for large fish, the amount of breakage was found to be high. The prohibition of this gear therefore becomes a possible means of penalizing the present fishery on the older grounds, where the fish are mostly small.

At present the commission has not ascertained the efficient element in the combination, which would have to be covered by a "blanket" prohibition. Heavier, less flexible lines would have to be required on all grounds. Yet it is entirely possible that the efficient element could be adapted for use in deep-water fishing for large fish, and the commission is loath to block the development of efficiency for its own sake. If the shoaler grounds are to be fished at all, and indeed if the halibut-fishery in general is to be carried on, it would seem the part of reason that it should be done with efficiency, and that the amount taken should be limited in a direct fashion, as has already been proposed.

The use of the small-hook gear is, moreover, a relatively recent matter. As with the "nurseries," prohibition of its use is a preventive of future additional ills, and not for those

which have already injured the fishery. Its prohibition cannot suffice in itself to meet all of the existing conditions, the extent of its effect cannot easily be foretold, and the great increase of the fishery could proceed unchecked along previous lines. It partakes of the disadvantages of indirect economic restrictions, which must in the end be justified by the amount of restriction in total catch they impose, a method regarded undesirable by the commission.

In all the circumstances the commission desires to defer its recommendation as to the use of this gear, but provision should be made to prevent the use of any such gear deemed unduly destructive in the light of future investigation.

The third alternative, the closure of the young-fish grounds, or "nurseries," remains to be considered. On these areas the commission, by means of its own fishing operations, has found that the fish are actually the younger classes only. They are populated by very few fish over 11 lb. in weight, the majority being well under 8, and some being as small as 3 lb. Their age, on the average, is from 5 to 8 years. No mature fish are found among them except as strays.

Closure of these areas would therefore be a clear-cut protection of young fish. Unlike a size limit, it would not involve great waste of culled fish, but it would prevent the worst of what now occurs. No hindrance would thereby be placed upon the use of what small fish are taken on the banks in general in the course of ordinary fishing. There would be no penalty upon efficiency of method. The economic benefits to be derived from the increase in weight and value per pound would not be conditioned in any way by economic losses. If the protection of young fish is desirable, then the closure of the nurseries must be.

But the area thus protected is very small, in comparison with the extent of the banks as a whole. The some 500 or 600 square miles includes but a very small fraction of the general halibut population, or indeed of the small fish in general. To that extent their closure could, even if it completely removed these fish from the catch, be but of small effect compared to the general increase in intensity of the fishery. Moreover, what effect is observable must be confined to the general region in which these nurseries are located because of the slow migratory movements. For these reasons, the closure of nurseries being advisable, the principle should be extended to all similar banks, in all parts of the grounds, as soon as definite information is at hand.

In view of the present condition of our knowledge of marine fisheries, a word of caution in regard to such closures may be added. The maximum productivity of a bank may not be served by permitting overpopulation. Although it would seem unlikely that such would occur, nevertheless the condition of the "nurseries" should be under observation, and too implicit faith in their efficiency should be withheld.

The commission, therefore, while it agrees with the universal sentiment for closure of these grounds, regards the principal justification for closure as economic. The value of such action for the perpetuation of the species must be conditioned upon the control of the remaining fishery, and must at best be insufficient to stem the course of overfishing in general.

The areas that the commission recommends should now be closed are the so-called "nurseries" about Timbered Islands, Alaska, and Masset, British Columbia. Their description is as follows:—

Timbered Islands Nursery.—The waters off the coast of Alaska within the following boundaries: From the north-west extremity of Cape Lynch, Hecate Island, south-west (magnetic) 18 miles to a point approximately latitude 55° 42′ 21″ north, longitude 134° 12′ 20″ west; thence south-east (magnetic) 19 miles to a point approximately latitude 55° 24′ north, longitude 134° 3′ 42″ west; thence approximately north-east (magnetic) 8.5 miles to the southern extremity of Cape Addington, Noyes Island.

From the north-west extremity of Cape Lynch, Hecate Island, south-east three-fourths south (magnetic) approximately 14.5 miles to a point on Noyes Island in range with the peak shown on chart numbered 850 published by the Coast and Geodetic Survey, said point being approximately in west longitude 132° 39′ 30″.

Masset Nursery.—The waters off the north coast of Graham Island within the following boundaries: From the north-west (magnetic) extremity of Wiah Point, Graham Island, true north 5½ miles to a point approximately latitude 54° 12′ 20″ north and longitude 132° 19′ 18″ west; thence true east 25 miles to a point approximately latitude 54° 12′ 40″ north and longitude 131° 37′ west; thence magnetic south to a point on Graham Island.

PLATE X.

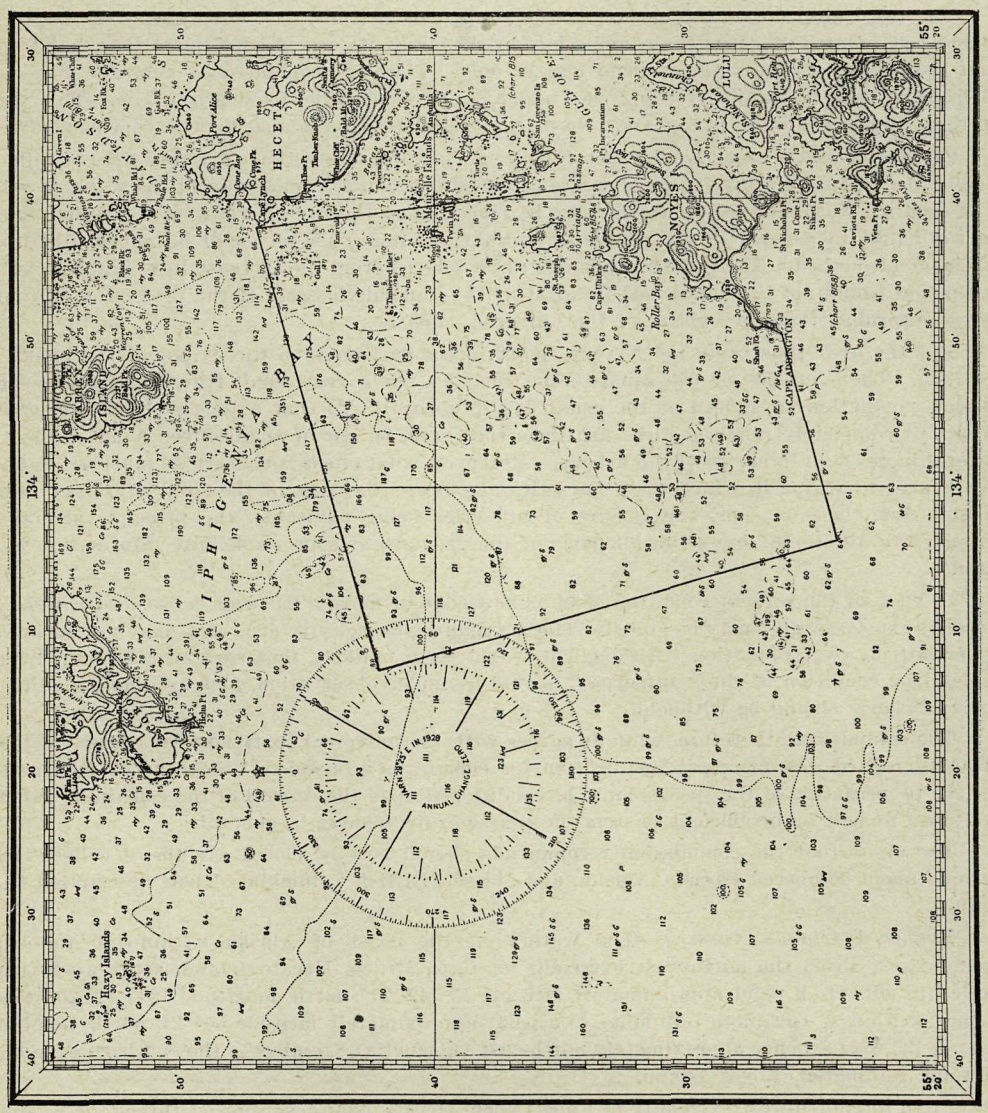
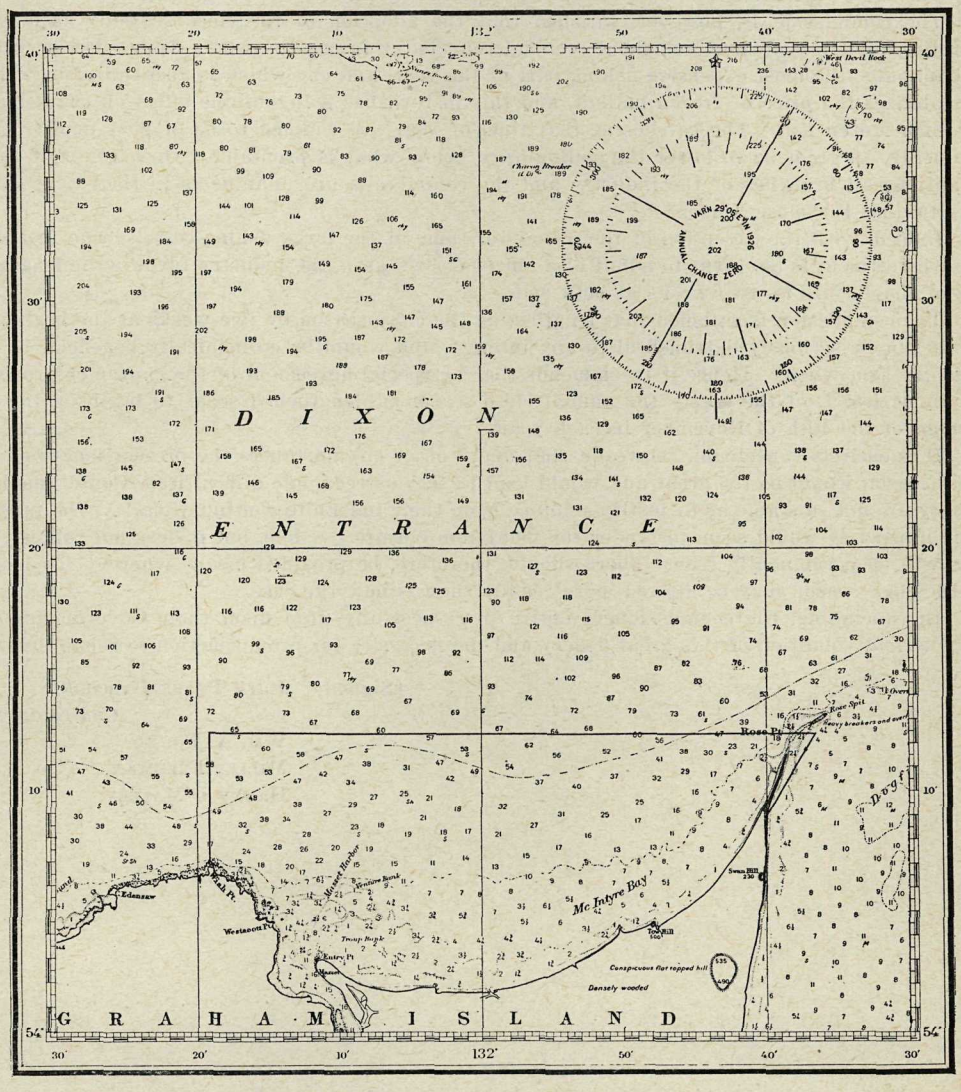

HECETA
STRAIT
GULF OF CARPENTARIA
NOTES
Proposed Timbered Islet Closed "Nursery."

PLATE XI.



Proposed Masset Closed "Nursery."

FOURTH RECOMMENDATION.

The Extension of the Present Close Season by Two Weeks, and the Facilitation of Future Alterations.

Article I. of the present treaty provides a yearly closed season for all halibut-fishing in the waters covered by the treaty from the 16th day of November to the 15th day of February following, both days inclusive. The economic advantages of this closure and the absence of effects beneficial to the perpetuation of the fishery have been already commented upon. It is evident that the close season has merely shortened the period within which the catch has been taken.

The commission is, however, satisfied that the adoption of the close season was a wise measure, as it has obvious beneficial economic effects, as far as the whole fishery is concerned. It eliminates the most expensive fishing part of the year, and one which is also full of hardship. It stabilizes the price of frozen halibut, and this in turn has a favourable effect on the demand for such frozen fish. The catches at that time of year are claimed to be of poor quality, and frequently so great as to lower the selling-price below what is profitable. On account of these conditions all branches of the industry and the commission are unanimous in their support of maintaining the close season.

Indeed, with the exception of the owners of some of the large fishing-vessels, who feel that their investment is too great to admit of a longer close season, the industry favours the lengthening of the closure by two weeks at both ends.

The commission is satisfied that lengthening the close season by two weeks at the beginning would not be seriously detrimental to any interest, and would be economically beneficial to the industry as a whole. Hence it recommends that by special agreement of the character provided for in Article I. of the treaty the annual close season be lengthened so as to begin on the 1st instead of the 16th of November in each year.

It is entirely conceivable, however, that under other circumstances the present length of the close season would be too great and would lead to serious economic difficulties. Conditions in a fishery are not so stable as to justify reliance upon their indefinite continuation. At the present time prosperity would seem to render the maximum closure possible, but it does not follow that this will be permanently true. There should, therefore, be provided means whereby the length of the close season may be altered more readily than is now the case.

In concluding, the commissioners desire to respectfully urge upon their Governments the very serious condition of this great fishery and the necessity for prompt action to rehabilitate it.

(Signed) JOHN PEASE BABCOCK,
Chairman.
WM. A. FOUND.
MILLER FREEMAN.
HENRY O'MALLEY.

PACK OF BRITISH COLUMBIA SALMON, SEASON 1928.

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

Fraser River District.

Names.	Sockeyes.	Fancy Red Springs.	Standard Springs.	White Springs.	Bluebacks.	Steel-heads.	Cohoes.	Pinks.	Chums.	Grand Total (Cases).
B.C. Packers, Ltd.	17,155	397	37	1,533	518	.....	11,057	424	72,730	103,851
Canadian Fishing Co., Ltd.	6,463	.....	696	2,167	.....	.....	10,291	2,407	70,547	92,571
Great West Packing Co., Ltd.	2,912	.....	43	209	277	.....	2,115	.....	12,407	17,963
Francis Millerd	.....	.....	.....	.....	.....	.....	3,598	50	37,422	41,070
J. H. Todd & Sons, Ltd.	2,769	.....	.....	.....	.....	.....	.....	.....	.....	2,769
Totals	29,299	397	776	3,909	795	.....	27,061	2,881	193,106	258,224

Skeena River District.

B.C. Packers, Ltd.	17,031	618	1,195	309	.....	11	8,266	94,929	7,684	130,042
J. H. Todd & Sons, Ltd.	3,238	215	295	218	.....	.....	16,829	21,809	5,839	48,443
Anglo-B.C. Packing Co., Ltd.	5,681	2,884	300	100	.....	.....	3,071	31,654	2,269	45,959
Canadian Fishing Co., Ltd.	3,110	.....	181	97	.....	191	643	16,883	671	21,776
Cassiar Packing Co., Ltd.	2,286	.....	8	.....	.....	39	636	13,036	383	16,388
Skeena River Packing Co., Ltd.	3,213	.....	.....	.....	.....	.....	749	31,268	870	36,100
Totals	34,559	3,717	1,979	724	.....	241	30,194	209,579	17,716	298,709

Rivers Inlet District.

B.C. Packers, Ltd.	31,059	.....	67	210	.....	7	360	6,865	214	38,782
J. H. Todd & Sons, Ltd.	6,374	.....	.....	.....	.....	.....	192	2,101	2,992	11,659
Provincial Canning Co., Ltd.	5,207	.....	.....	.....	.....	.....	146	1,686	65	7,104
Anglo-B.C. Packing Co., Ltd.	6,141	51	.....	10	.....	.....	43	359	25	6,629
Canadian Fishing Co., Ltd.	11,263	.....	57	73	.....	.....	127	5,535	298	17,353
Totals	60,044	51	124	293	.....	7	868	16,546	3,594	81,527

PACK OF BRITISH COLUMBIA SALMON, SEASON 1928—*Continued.*

Smith Inlet District.

Names.	Sockeyes.	Fancy Red Springs.	Standard Springs.	White Springs.	Bluebacks.	Steel-heads.	Cohoes.	Pinks.	Chums.	Grand Total (Cases).
B.C. Packers, Ltd.	13,874	30	.....	70	.....	6	69	69	7	14,125
Anglo-B.C. Packing Co., Ltd.	5,897	.....	76	5	.....	.....	73	48	12	6,111
Canadian Fishing Co., Ltd.	9,060	.....	2	103	.....	.....	88	50	.....	9,303
Kingcome Packers, Ltd.	4,611	.....	.....	.....	.....	.....	.....	.....	.....	4,611
Totals	33,442	30	78	178	.....	6	230	167	19	34,150

Nass River District.

B.C. Packers, Ltd.	2,109	548	509	303	.....	.....	445	24,245	670	28,829
Anglo-B.C. Packing Co., Ltd.	1,972	389	68	.....	.....	36	9,906	26,513	677	39,561
Canadian Fishing Co., Ltd.	1,459	.....	25	4	.....	.....	383	32,425	2,191	36,487
Totals	5,540	937	602	307	.....	36	10,734	83,183	3,538	104,877

Queen Charlotte Islands District.

B.C. Packers, Ltd.	7	1	.....	22	.....	.....	927	83,802	27,973	112,732
Canadian Fishing Co., Ltd.	16	.....	.....	.....	.....	.....	1,272	31,664	24,598	57,550
Langara Packing Co., Ltd.	15	.....	344	8	.....	.....	4,335	32,311	8,637	45,650
Massett Canners, Ltd.	.....	61	.....	.....	.....	.....	1,085	19,440	11,239	31,825
Totals	38	62	344	30	.....	.....	7,619	167,217	72,447	247,757

Vancouver Island District.

B.C. Packers, Ltd.	7,514	547	.....	228	.....	22	8,589	17,756	159,010	193,666
J. H. Todd & Sons, Ltd.*	.....	198	.....	.....	.....	.....	5,505	60	881	6,644
Canadian Fishing Co., Ltd.	1,217	.....	326	65	1	.....	5,075	13,723	62,274	82,681
Nootka Packing Co., Ltd.	.....	5	.....	.....	.....	.....	2,824	252	51,322	54,403
Clayoquot Sound Canning Co., Ltd.	3,873	176	.....	.....	.....	.....	874	966	12,187	18,076
Quathiaski Canning Co., Ltd.	1,097	.....	7	3	1,993	.....	223	5,110	2	8,435
Deep Bay Packing Co., Ltd.	547	161	308	245	3,233	.....	255	4,018	17,798	26,565
Totals	14,248	1,087	641	541	5,227	22	23,345	41,885	303,474	390,470

* 2,769 cases sockeye taken from J. H. Todd Vancouver Island pack and added to Fraser River District.

Outlying Districts.

B.C. Packers, Ltd.	13,804	494	25	306	.....	376	29,190	125,161	173,235	342,591
Anglo-B.C. Packing Co., Ltd.	1,614	.....	257	353	28	.....	5,696	25,919	16,739	50,606
Canadian Fishing Co., Ltd.	8,886	.....	181	148	.....	199	6,520	100,483	61,233	177,650
Kingcome Packers, Ltd.†	1,368	145	.....	59	.....	.....	5,878	11,169	5,553	24,172
Klemtu Canning Co., Ltd.	700	.....	116	.....	.....	.....	3,322	8,182	12,576	24,896
Totals	26,372	639	579	866	28	575	50,606	270,914	269,336	619,915

Districts.

Fraser River District	29,299	397	776	3,909	795	.....	27,061	2,881	193,106	258,224
Skeena River District	34,559	3,717	1,979	724	.....	241	30,194	209,579	17,716	298,709
Rivers Inlet District	60,044	51	124	293	.....	7	868	16,546	3,594	81,527
Smith Inlet District	33,442	30	78	178	.....	6	230	167	19	34,150
Nass River District	5,540	937	602	307	.....	36	10,734	83,183	3,538	104,877
Queen Charlotte Islands District	38	62	344	30	.....	.....	7,619	167,217	72,447	247,757
Vancouver Island District	14,248	1,087	641	541	5,227	22	23,345	41,885	303,474	390,470
Outlying Districts	26,372	639	579	866	28	575	50,606	270,914	269,336	619,915
Grand totals	203,542	6,920	5,123	6,848	6,050	887	150,657	792,372	862,230	2,035,629

† 4,611 cases sockeye taken from Kingcome Packers, Ltd., Outlying District pack and added to Smith Inlet District.

STATEMENT SHOWING THE SALMON-PACK OF THE PROVINCE, BY DISTRICTS AND SPECIES, FROM 1913 TO 1928, INCLUSIVE.

Fraser River.

	1928.	1927.	1926.	1925.	1924.	1923.	1922.	1921.
Sockeyes	29,299	61,393	85,689	35,385	39,743	31,655	51,832	39,631
Springs, Red	1,173	7,925	12,783	7,989	2,982	3,854	10,561	11,360
Springs, White	3,909	10,528	20,169	25,701	4,648	4,279	6,300	5,949
Chums	193,106	67,259	88,495	66,111	109,495	103,248	17,895	11,233
Pinks	2,881	102,536	32,256	99,800	31,968	63,645	29,578	8,178
Cohoes	27,061	24,079	21,783	36,717	21,401	20,173	23,587	29,978
Bluebacks and Steelheads	795	10,658	13,776	5,152	1,822	15	817	1,331
Totals	258,224	284,378	274,951	276,855	212,059	226,869	140,570	107,650

	1920.	1919.	1918.	1917.	1916.	1915.	1914.	1913.
Sockeyes	48,399	38,854	19,697	148,164	32,146	91,130	198,183	719,796
Springs, Red	10,691	14,519	15,192	10,197	17,673	23,228	11,209	3,573
Springs, White	4,432	4,296	24,853	18,916	11,430	5,392	15,300	49
Chums	23,884	15,718	86,215	59,973	30,934	18,919	74,826	22,220
Pinks	12,839	39,363	18,388	134,442	840	138,305	6,272	20,773
Cohoes	22,934	39,253	40,111	25,895	31,330	43,514	43,504	16,018
Bluebacks and Steelheads	4,522	15,941	4,395	4,951	3,129	31	.....	.....
Totals	136,661	167,944	208,857	402,538	127,472	320,519	349,294	782,429

Skeena River.

	1928.	1927.	1926.	1925.	1924.	1923.	1922.	1921.
Sockeyes	34,559	83,996	82,360	81,146	144,747	131,731	96,277	41,018
Springs	6,420	19,038	30,594	23,445	12,028	12,247	14,176	21,766
Chums	17,716	19,006	63,527	74,308	25,588	16,527	39,758	1,993
Pinks	209,579	38,768	210,081	130,079	181,313	145,973	301,655	124,457
Cohoes	30,194	26,326	30,208	39,168	26,968	31,967	24,699	45,033
Steelhead Trout	241	582	754	713	214	418	1,050	498
Totals	298,709	187,716	407,524	348,859	390,858	338,863	477,915	234,765

	1920.	1919.	1918.	1917.	1916.	1915.	1914.	1913.
Sockeyes	89,364	184,945	123,322	65,760	60,293	116,533	130,166	52,927
Springs	37,403	25,941	22,931	16,285	20,933	15,273	11,740	26,436
Chums	3,834	31,457	22,573	21,516	17,121	5,769	8,329	.....
Pinks	177,679	117,303	161,727	148,319	73,029	107,578	71,021	66,045
Cohoes	18,068	36,559	38,759	38,456	47,409	32,190	16,378	18,647
Steelhead Trout	1,218	2,672	4,994	1,883	3,743	1,798	.....	.....
Totals	332,887	398,877	374,306	292,219	223,158	279,161	237,634	164,055

STATEMENT SHOWING THE SALMON-PACK OF THE PROVINCE, BY DISTRICTS AND SPECIES, FROM 1913 TO 1928, INCLUSIVE—*Continued.*

Rivers Inlet.

	1928.	1927.	1926.	1925.	1924.	1923.	1922.	1921.
Sockeyes	60,044	65,269	65,581	*192,323	94,891	116,850	53,584	48,615
Springs	468	608	685	496	545	599	323	364
Chums	3,594	1,122	11,727	11,510	4,924	3,242	311	173
Pinks	16,546	671	12,815	8,625	15,105	10,057	24,292	5,303
Cohoes	868	2,094	7,286	4,946	1,980	1,526	1,120	4,718
Steelhead Trout	7	9	11	.....	.....	.....	82	97
Totals	81,527	69,773	98,105	217,900	117,445	132,274	79,712	59,272

	1920.	1919.	1918.	1917.	1916.	1915.	1914.	1913.
Sockeyes	125,742	56,258	53,401	61,195	44,936	130,355	89,890	61,745
Springs	1,793	1,442	1,409	817	1,422	1,022	566	594
Chums	1,226	7,089	6,729	16,101	20,144	5,387	5,023	.....
Pinks	25,647	6,538	29,542	8,065	3,567	2,964	5,784	2,097
Cohoes	2,908	9,038	12,074	9,124	15,314	7,115	7,789	3,660
Steelhead Trout	.....	.....	.....	.....	.....	.....	.....	.....
Totals	133,248	80,367	103,155	95,302	85,383	146,838	109,052	68,096

Nass River.

	1928.	1927.	1926.	1925.	1924.	1923.	1922.	1921.
Sockeyes	5,540	12,026	15,929	18,945	33,590	17,821	31,277	9,364
Springs	1,846	3,824	5,964	3,757	2,725	3,314	2,062	2,088
Chums	3,538	3,307	15,392	22,504	26,612	25,791	11,277	2,176
Pinks	83,183	16,609	50,815	35,530	72,496	44,165	75,687	29,488
Cohoes	10,734	3,966	4,274	8,027	6,481	7,894	3,533	8,236
Steelhead Trout	36	96	375	245	1,035	595	235	413
Totals	104,877	39,828	92,749	89,008	142,939	99,580	124,071	51,765

	1920.	1919.	1918.	1917.	1916.	1915.	1914.	1913.
Sockeyes	16,740	28,259	21,816	22,188	31,411	39,349	31,327	23,574
Springs	4,857	3,574	4,152	4,496	3,845	3,701	3,385	3,151
Chums	12,145	24,041	40,368	24,938	11,200	11,076	25,569	2,987
Pinks	43,151	29,949	59,206	44,568	59,593	34,879	25,333	20,539
Cohoes	3,700	10,900	17,061	22,180	19,139	15,171	9,276	3,172
Steelhead Trout	560	789	1,305	1,125	1,498	113	.....	.....
Totals	81,153	97,512	143,908	119,495	126,686	104,289	94,890	53,423

* Including 40,000 cases caught in Smith Inlet and 20,813 cases packed at Namu.

STATEMENT SHOWING THE SALMON-PACK OF THE PROVINCE, BY DISTRICTS AND SPECIES, FROM 1913 TO 1928, INCLUSIVE—*Continued.*

Vancouver Island District.

	1928.	1927.	1926.	1925.	1924.	1923.	1922.	1921.
Sockeyes	14,248	24,835	25,070	10,895	15,618	12,006	15,147	6,936
Springs	2,269	6,769	5,222	5,664	283	138	886	3,230
Chums	303,474	220,270	174,383	127,520	165,161	120,520	108,478	34,431
Pinks	41,885	52,561	86,113	51,384	63,102	30,149	36,943	10,660
Cohoes	23,345	58,834	51,551	59,747	30,593	21,342	18,575	11,120
Bluebacks	5,249	10,194	5,383	4,832	2,510	7,097	5,495	3,151
Totals	390,470	373,463	347,722	260,042	277,267	191,252	185,524	69,528

Queen Charlotte and other Districts.

	1928.	1927.	1926.	1925.	1924.	1923.	1922.	1921.
Sockeyes	59,852	60,533	62,383*	49,962	40,926	24,584	47,107	18,350
Springs	2,806	7,826	3,650	5,002	4,245	2,711	4,988	4,995
Chums	341,802	252,230	348,682	305,256	195,357	148,727	80,485	21,412
Pinks	438,298	36,481	380,243	120,747	141,878	146,943	113,824	14,818
Cohoes	58,455	47,433	47,183	40,269	26,031	29,142	31,331	18,203
Steelheads and Bluebacks	609	973	973	1,520	497	732	409	2,790
Totals	901,822	405,476	844,114	522,756	408,934	352,839	278,144	80,568

	1920.	1919.	1918.	1917.	1916.	1915.	1914.	1913.
Sockeyes	64,473	54,677	51,980	32,902	45,373	98,600	87,130	149,336
Springs	15,633	14,766	8,582	6,056	11,423	9,488	7,108	7,246
Chums	30,946	165,717	90,464	112,364	160,812	40,849	70,727	52,758
Pinks	247,149	110,300	201,847	112,209	143,615	83,626	111,930	83,430
Cohoes	33,807	35,011	42,331	30,201	70,431	48,966	43,254	28,328
Steelheads and Bluebacks	3,721	702	1,009	865	712	985	.....	.....
Totals	395,728	381,163	404,793	294,597	432,366	313,894	320,168	285,898

Total packed by Districts in 1913 to 1928, inclusive.

	1928.	1927.	1926.	1925.	1924.	1923.	1922.	1921.
Fraser	258,224	284,378	274,951	276,855	212,059	226,869	140,570	107,650
Skeena	298,709	187,716	407,524	348,859	390,858	338,863	477,915	234,765
Rivers Inlet	81,527	69,773	98,105	217,900	117,445	132,274	79,712	59,272
Nass River	104,877	39,828	92,749	89,008	142,939	99,580	124,071	51,765
Vancouver Island	390,470	373,463	347,722	263,904	277,267	191,252	185,524	69,528
Other Districts	901,822	405,476	844,139*	522,756	604,745	352,839	278,144	80,568
Grand totals	2,035,629	1,360,634	2,065,190	1,719,282	1,745,313	1,341,677	1,285,946	603,548

	1920.	1919.	1918.	1917.	1916.	1915.	1914.	1913.
Fraser	136,661	167,944	210,851	402,538	127,472	320,519	349,294	782,429
Skeena	332,787	398,877	374,216	292,219	223,158	279,161	237,634	164,055
Rivers Inlet*	157,522	80,367	103,155	95,302	85,383	146,838	109,052	68,096
Nass River	81,153	97,512	143,908	119,495	126,686	104,289	94,890	53,423
Vancouver Island	84,170	267,293	389,815	325,723	.....	.....	.....	.....
Other Districts	395,223	381,163	404,793	294,597	432,366	313,894	320,169	285,898
Grand totals	1,187,616	1,393,156	1,626,738	1,557,485	995,065	1,164,701	1,111,039	1,353,901

* Including 17,921 cases of sockeye packed at Smith Inlet.

STATEMENT SHOWING THE SOCKEYE-PACK OF THE ENTIRE FRASER RIVER SYSTEM FROM 1913 TO 1928, INCLUSIVE.

	1928.	1927.	1926.	1925.	1924.	1923.	1922.	1921.
Fraser River, B.C.	29,299	61,393	85,689	35,385	39,743	31,655	51,832	39,631
State of Washington	61,044	97,594	44,673	112,023	69,369	47,402	48,566	102,967
Totals	90,343	158,987	130,362	147,408	109,112	79,057	100,398	142,598

	1920.	1919.	1918.	1917.	1916.	1915.	1914.	1913.
Fraser River, B.C.	48,399	38,854	19,697	148,164	32,146	91,130	198,183	719,796
State of Washington	62,654	64,346	50,723	411,538	84,637	64,584	335,230	1,673,099
Totals	111,053	103,200	70,420	559,702	116,783	155,714	533,413	2,392,895

STATEMENT SHOWING THE SOCKEYE-PACK OF THE PROVINCE, BY DISTRICTS, 1913 TO 1928, INCLUSIVE.

	1928.	1927.	1926.	1925.	1924.	1923.	1922.	1921.
Fraser River	29,299	61,393	85,689	35,385	39,743	31,655	51,832	39,631
Skeena River	34,559	83,996	82,360	81,146	144,747	131,731	96,277	41,018
Rivers Inlet	60,044	65,269	65,581	192,323	94,891	116,850	53,584	48,615
Nass River	5,540	12,026	15,929	18,945	33,590	17,821	31,277	9,364
Vancouver Island	14,248	24,835	25,070	14,757	15,618	12,006	15,147	6,936
Other Districts	59,852	60,533	62,383	49,962	41,014	24,584	47,107	18,350
Totals	203,542	308,052	337,012	392,518	369,603	334,647	295,224	163,914

	1920.	1919.	1918.	1917.	1916.	1915.	1914.	1913.
Fraser River	48,399	38,854	19,697	148,164	32,146	91,130	198,183	719,796
Skeena River	89,064	184,945	123,322	65,760	60,923	116,553	130,166	52,927
Rivers Inlet	125,742	56,258	53,401	61,195	44,936	130,350	89,890	61,745
Nass River	16,740	28,259	21,816	22,188	31,411	39,349	31,327	23,574
Vancouver Island	6,987	6,452	6,243	9,639	9,223*	.....	.....	.....
Other Districts	64,473	54,677	51,980	32,902	36,150	98,660	87,130	149,336
Totals	351,405	369,445	276,459	339,848	214,789	476,042	536,696	972,178

* Vancouver Island's pack not previously segregated.

PRODUCTION OF FISH OIL AND MEAL, B.C., 1920–28.

Year.	From Pilchards.		From Herring.		From Whales.			From other Sources.	
	Meal and Fertilizer.	Oil.	Meal.	Oil.	Whalebone and Meal.	Fertilizer.	Oil.	Meal.	Oil.
	Tons.	Gals.	Tons.	Gals.	Tons.	Tons.	Gals.	Tons.	Gals.
1920	.....	.....	.....	.....	503	1,035	604,070	466	55,669
1921	.....	.....	.....	.....	.....	.....	.....	489	44,700
1922	.....	.....	.....	.....	326	230	283,314	911	75,461
1923	.....	.....	.....	.....	485	910	706,514	823	180,318
1924	.....	.....	.....	.....	292	926	645,657	1,709	241,376
1925	2,083	495,653	.....	.....	347	835	556,939	2,468	354,853
1926	8,481	1,898,721	310	13,700	340	666	468,206	1,752	217,150
1927	12,145	2,610,120	2,218	173,343	345	651	437,967	1,948	250,811
1928	14,502	3,997,656	788	61,245	376	754	571,914	3,205	387,276

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