PROVINCE OF BRITISH COLUMBIA

REPORT

OF THE

PROVINCIAL FISHERIES DEPARTMENT

FOR THE YEAR ENDED DECEMBER 31ST, 1937

WITH APPENDICES

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:
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1938.

To His Honour E. W. HAMBER,

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, 1937, with Appendices.

GEORGE SHERRATT PEARSON,

Commissioner of Fisheries.

Provincial Fisheries Department,

Commissioner of Fisheries' Office,

Victoria, British Columbia.

Honourable George S. Pearson,
Commissioner of Fisheries, Victoria, B.C.

SIR,—I have the honour to submit herewith the Annual Report of the Provincial Fisheries Department for the year ended December 31st, 1937, together with Appendices.

I have the honour to be,
Sir,
Your obedient servant,
GEO. J. ALEXANDER,
Assistant Commissioner.

LUCY S. CLEMENS, PH.D.

It is with regret that we have to record the passing on May 23rd, 1937, of Dr. Lucy S. Clemens, wife of Dr. W. A. Clemens, Director of the Pacific Biological Station at Nanaimo, B.C. Mrs. Clemens was born in Sheffield, Massachusetts. She received her early education at the public and high schools in Malden, Massachusetts, and graduated in 1909 from Mount Holyoke College, receiving the Ph.D. degree from Cornell University in 1914.

During her residence at the Pacific Biological Station, Mrs. Clemens continued a keen interest in zoological work and was associated with her husband in studies on the life-history of the sockeye salmon. All those who were privileged to know Mrs. Clemens regretfully realize that in her passing they have lost a valued friend.

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VALUE OF CANADIAN FISHERIES AND THE STANDING OF THE PROVINCES, 1936.

The value of the fisheries products of Canada for the year 1936 totalled $39,165,055. During that year British Columbia produced fisheries products to the value of $17,231,534, or 44 per cent. of Canada's total.

British Columbia in 1936 led all the Provinces in the Dominion in respect to the production of fisheries wealth. Her output exceeded that of Nova Scotia, the second in rank, by $8,326,266.

The market value of the fisheries products of British Columbia in 1936 was $2,062,005 more than in the previous year. There was an increase in the value of salmon amounting to $1,288,069.

The capital invested in the fisheries of British Columbia in 1936 was $22,360,630, or nearly 49 per cent. of the total capital employed in fisheries in all of Canada. Of the total invested in the fisheries of British Columbia in 1936, $9,829,117 was employed in catching and handling the catches and $12,531,513 invested in canneries, fish-packing establishments, and fish-reduction plants.

The number of persons engaged in British Columbia fisheries in 1936 was 17,989, or 25 per cent. of Canada's total fishery-workers. Of those engaged in British Columbia, 11,393 were employed in catching and handling the catches and 6,596 in packing, curing, and in fish-reduction plants. The total number engaged in the fisheries in British Columbia in 1936 was 959 more 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 1932 to 1936, inclusive:—

Province.	1932.	1933.	1934.	1935.	1936.
British Columbia	$9,909,116	$12,001,471	$15,234,335	$15,169,529	$17,231,534
Nova Scotia	6,557,943	6,010,601	7,673,865	7,852,899	8,905,268
New Brunswick	2,972,682	3,061,152	3,679,970	3,949,615	4,399,735
Quebec	1,815,544	2,128,471	2,306,517	1,947,259	2,108,404
Ontario	2,147,990	2,089,842	2,218,550	2,852,007	3,209,422
Manitoba	1,204,892	1,076,136	1,465,358	1,258,335	1,667,371
Prince Edward Island	988,919	842,345	963,926	899,685	953,029
Saskatchewan	186,174	186,417	219,772	252,059	367,025
Alberta	153,789	144,518	245,405	225,741	309,882
Yukon Territory	20,060	17,100	14,625	20,725	13,385
Totals	$25,957,109	$27,558,053	$34,022,323	$34,427,854	$39,165,055

SPECIES AND VALUE OF FISH CAUGHT IN BRITISH COLUMBIA.

The total marketed value of each of the principal species of fish taken in British Columbia for the years 1932 to 1936, inclusive, is given in the following table:—

Species.	1932.	1933.	1934.	1935.	1936.
Salmon	$7,586,479	$9,184,090	$12,402,042	$12,099,275	$13,387,344
Halibut	960,166	1,391,941	797,390	860,349	943,568
Halibut-livers	.....	.....	36,439	80,513	96,311
Herring	536,491	738,522	628,982	580,031	1,142,397
Pilchard	383,920	77,464	549,910	670,328	667,313
Cod, ling	172,029	215,796	324,669	382,490	418,142
Clams	89,848	52,699	33,402	61,886	88,422
Black cod	38,754	41,443	44,057	65,862	53,497
Carried forward	$9,767,687	$11,701,955	$14,816,891	$14,800,734	$16,796,994

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

Species.	1932.	1933.	1934.	1935.	1936.
Brought forward	$9,767,687	$11,701,955	$14,816,891	$14,800,734	$16,796,994
Crabs	16,832	34,296	32,325	44,525	38,855
Soles	25,936	27,737	34,921	30,808	37,019
Shrimps	19,988	19,609	17,758	25,492	9,827
Oysters	28,800	25,670	38,922	41,609	59,687
Abalones	.....	.....	2,400	.....	34
Flounders	3,923	5,208	5,216	3,773	3,332
Red cod	9,333	5,629	6,607	10,409	13,875
Perch	4,707	3,428	3,334	5,054	7,633
Smelt	7,084	4,916	8,423	9,578	7,621
Sturgeon	3,161	5,006	3,391	6,936	2,053
Octopus	1,336	1,048	1,406	1,094	982
Skate	2,748	2,483	2,872	3,363	3,233
Oolachans	470	771	1,134	1,110	803
Whiting	135	1,180	207	170	69
Trout	544	1,062	.....	.....	.....
Grayfish, etc.—					
Fresh	.....	.....	.....	.....	68
Oil	4,629	13,783	26,272	23,744	34,745
Meal	7,018	26,299	45,597	22,924	34,906
Whales	.....	110,030	183,738	105,360	172,201
Fur-seals	4,885	7,060	547	1,671	5,664
Miscellaneous	.....	4,301	2,374	31,175	1,933
Totals	$9,909,116	$12,001,471	$15,234,335	$15,169,529	$17,231,534

Previous to 1934 the totals for halibut included landings at British Columbia ports by United States vessels, whereas for 1935 and onwards the landings by United States vessels are excluded from the statistics.

VALUE OF BRITISH COLUMBIA'S FISHERIES IN 1937 SHOWS A DECREASE OF OVER $1,000,000 OVER THE PREVIOUS YEAR.*

The value of production of the fisheries of British Columbia for 1937 was $16,155,439, compared with $17,231,534 in 1936. This is a decrease of $1,076,095. The totals represent the value of the product as marketed, whether for consumption fresh, or canned, dried, smoked, salted, etc. British Columbia is still the leading Province of the Dominion with respect to fisheries production, its wealth lying in the abundant product of its salmon-fishery. The drop in the total value of the output of the fisheries of the Province is due to the decrease in the value of the product of the salmon-fisheries. The market value of the catch of British Columbia salmon in 1937 was $11,907,905, a decrease of $1,479,439 from that of the previous year. The main item in the output of the salmon-fishery is canned salmon. The value of this product in 1937 amounted to $9,261,988, compared with $11,128,636 in 1936. A very large part of the canned salmon produced is exported. In 1937 approximately 1,232,902 cases found a market outside of Canada. These were shipped to sixty-eight countries, the largest quantities going to the United Kingdom and Australia, with France third, the United States fourth, and New Zealand fifth. The exports of canned salmon in 1937 exceeded those of 1936 and the value of export canned salmon for 1937 shows an increase of $1,166,325 over the previous year.

Among the other important fisheries of British Columbia are the halibut and herring fisheries, the former with a product in 1937 valued at $1,190,056 and the latter with $1,181,466. Both of these show increases over 1936 in quantity and in marketed value. A considerable portion of the herring-catch is used in the manufacture of meal and oil, which also applies in the case of pilchards.

The number of whales taken by British Columbia fishermen in 1937 was 317, with a marketed value of $220,251, compared with a catch of 376 and a marketed value of $172,201 in the preceding year. The chief product of the whale-fishery is oil, and although the quantity produced in 1937 was less than in 1936 the total value increased owing to the higher average price per gallon received for the oil.

The total quantity of fish taken of all kinds (exclusive of fur-seals and whales) by British Columbia fishermen during 1937 was 4,954,195 cwt., with a value at point of landing of $7,837,930, compared with a catch of 4,896,753 cwt. and a landed value of $7,503,697 in 1936.

CAPITAL, EQUIPMENT, AND EMPLOYEES.

In Primary Operations.

Capital.—An amount of $9,207,478 is recorded as the value of the vessels, boats, and gear used in the primary operations of catching and landing the fish, compared with a total of $9,870,417 in 1936. The principal items, in order of value, are gasoline and Diesel boats valued at $4,119,124, sailing, gasoline, and Diesel vessels valued at $2,802,790.

Employees.—The number of fishermen employed during the year was 11,184, compared with 11,393 in 1936.

In Fish Canning and Curing.

Capital.—The amount of capital invested in the fish canning and curing industry in British Columbia in 1937 is placed at $11,771,130, of which the investment of the salmon-canneries accounts for $8,377,110 or 70 per cent. of the total. Compared with the previous year the total capital employed shows a decrease of $760,383. The number of establishments in operation was eighty-four, compared with ninety-one in 1936.

Employees.—There were 5,574 persons employed by the establishments during the year, this total comprising 3,250 male and 2,324 female employees. Comparative figures for 1936 are: Male, 3,859; female, 2,737; total, 6,596.

The period of greatest employment in the canning and curing branch of the fishing industry is from May to November.

* Note.—The above figures are taken from the advance report on British Columbia Fisheries, Dominion Department of Statistics, Department of Trade and Commerce.

THE CANNED-SALMON PACK FOR BRITISH COLUMBIA IN 1937.

The total pack of all species of salmon canned in British Columbia in 1937 amounted to 1,509,677 full cases. This was less than the previous year's pack by 354,826 cases, but in comparing the packs of these two years it must be remembered that the pack of 1936 was the largest since 1930 and very much above the ten-year average. The 1937 pack was 7,770 cases less than the average for the past ten years—1928–37, inclusive—and 40,746 cases less than the average for the five-year period 1933–37, inclusive.

The pack in 1937 consisted of 325,836 cases of sockeye, 16,174 cases of springs, 844 cases of steelhead (trout), 133,489 case of cohoe, 585,574 cases of pinks, and 447,760 cases of chums. In the above figures 19,226 cases of bluebacks are included in the figures for the cohoe-pack.

Examination of the pack figures by species shows that the sockeye-pack of 1937, amounting to 325,836 cases, was 88,973 cases less than in 1936, but here again due allowance must be made for the exceptionally large pack of this species in 1936. The comparison between the 1937 pack and the average for the five-year period 1933–37, inclusive, shows the 1937 pack to be 19,572 cases below the five-year average and 699 cases less than the average annual pack for the previous ten-year period 1928–37, inclusive.

The spring-salmon pack in 1937, amounting to 16,174 cases, was 13,679 cases less than 1936, and was also less than the average for the previous five-year period by 7,424 cases. In considering the spring-salmon pack it should be pointed out that the pack figures for this species are not necessarily indicative of the quantity available in any given year, as the quantity canned in any year is conditioned by the requirements of the fresh, frozen, and mild-cured trade.

While steelheads are trout and not salmon, a few are caught and canned each year incidental to salmon-fishing, and on this account the amounts are included in the figures of the canned-salmon pack. There were 844 cases of steelhead canned in 1937.

The pack of canned cohoe for the year in question amounted to 133,489 cases. This was the smallest pack of this species since 1931, when the total pack amounted to 102,175 cases, and is 96,261 cases less than in 1936. This year's pack was also 62,354 cases below the average of the five-year period 1933–37, inclusive.

The pink-salmon pack of 585,574 cases for 1937 was 5,961 cases less than in 1936 and 53,381 cases greater than the average for the five-year period 1933–37, inclusive.

The total pack of chums amounted to 447,760 cases in 1937, which was 149,728 cases less than in 1936 and 4,572 cases below the average for the previous five-year period.

BRITISH COLUMBIA CANNED-SALMON PACK BY DISTRICTS.

Fraser River System.

Sockeye.—The Canadian pack of Fraser River sockeye in 1937 amounted to 100,272 cases compared with 52,465 cases in 1933, the cycle-year for this run. The combined Canadian and American packs of sockeye running to this river in 1937, however, was slightly less than in 1933, amounting to 160,531 cases in 1937 compared with 179,069 cases in 1933. In their "Contributions to the Life-history of the Sockeye Salmon," published in this Department's report for 1936, Drs. Clemens pointed out that "The run of 1937 will be derived largely from the brood-year of 1933. In that year the pack was 179,069 cases and the escapement was reported as disappointing, except in the Chilco area, where at least 100,000 fish were estimated to have spawned. There are no known factors which would indicate an increased run in 1937."

The sockeye-run to the Fraser in 1937 belonged to the cycle-year which formerly produced the large run known as the "big year," but since 1913 this "big year" has largely disappeared. It will be recalled that a rock-slide at Hell's Gate in 1913 effectively blocked the progress to the spawning-grounds of a large number of the sockeye which habitually spawn in the upper regions of the Fraser River. The effect of this rock-slide was noticeably felt in the decrease in numbers of sockeye composing the 1917 run. Notwithstanding the decrease in the run, however, there were packed a total of 559,702 cases. It is obvious that this large pack, together with overfishing since, has had a cumulative effect in reducing the fourth "big year" to the level of the average of the three intervening years. In view of the circumstances, the 1937 pack must be considered as being satisfactory.

Another feature of the 1937 run of sockeye which should also be noted, is the fact that the fish again proceeded up-river shortly after reaching the fishing-grounds off the mouth. This has the effect of producing a pack of averagely high quality.

The escapement to the principal spawning-grounds, generally speaking, must be considered as fair. The reader is referred to Major Motherwell's report on the "Inspection of Salmon-spawning Grounds for 1937," which is published in full in the Appendix to this report. The principal spawning area in the upper reaches of the Fraser River watershed is at Chilco Lake and the run to this area in 1936 was exceedingly good. It is reported that at least 110,000 sockeye were observed on the spawning-grounds. Spawning conditions are reported as being favourable. Another feature of the spawning season of 1937 was a remarkably fine return of sockeye to the Seton-Anderson Lake area. It is estimated that approximately 60,000 adult sockeye returned to this area. It is pointed out in Major Motherwell's report that in connection with this area the Federal Department of Fisheries has been endeavouring for a number of years to build up a run of sockeye similar to that occurring previous to 1913 by means of plantings of eyed-eggs and fry. The return of adults in 1936 amounted to some 10,000, while, as stated above, approximately 60,000 were observed in 1937. This is indeed most encouraging.

Canadian gear again in 1937 obtained the largest share of the total catch of sockeye proceeding to the Fraser River, the catch on the Canadian side amounting to, as stated above, 100,272 cases while Washington gear accounted for 60,259 cases. Expressed in percentages, Canadians obtained approximately 62½ per cent. of the total catch while American gear accounted for approximately 37½ per cent. The percentages, in round figures, taken by American and Canadian gear during the past ten years are tabulated for comparison:—

Year.	American. Per Cent.	Canadian. Per Cent.
1928	68	32
1929	64	36
1930	78	22
1931	68	32
1932	55	45
1933	71	29

Year.	American. Per Cent.	Canadian. Per Cent.
1934	72	28
1935	47	53
1936	25	75
1937	38	62

The figures quoted above for the 1937 sockeye-salmon pack include 72 cases of sockeye caught in the State of Washington and canned by Canadian canners.

Spring Salmon.—The canned pack of this species caught on the Fraser River in 1937 amounted to 5,444 cases, compared with 15,126 cases in 1936, 9,401 cases in 1935, 16,218 cases in 1934, and 5,579 cases in 1933. From the above figures it will be observed that the 1937 pack was very much below the average for the past five years. In the case of springs, however, the canned pack of this variety is not altogether indicative of the size of the run, as spring salmon finds an outlet in other markets. Reports from the spawning-grounds indicate that the numbers of spring salmon passing through the commercial fishing area were about normal.

Cohoe Salmon.—The cohoe-pack on the Fraser River, like most other districts in British Columbia, was smaller than anticipated. The pack amounted to 11,244 cases. This figure is compared with 28,716 cases in 1936 and 24,950 cases in 1935, the cycle-year. A special closed period in District No. 1 during the cohoe-run had the effect of permitting a larger percentage of the run to pass to the spawning-grounds, which, according to reports, indicate that the seeding, though not heavy, was considered fair.

Pink Salmon.—The year 1937 was the cycle-year for the pink-salmon run to the Fraser River. This run occurs every alternate year, coinciding with the odd-numbered years. The pack of this variety in 1937 amounted to 94,010 cases, compared with 111,328 cases in 1935 and 92,746 cases in 1933. The pack of pinks in 1937, though less than the pack for 1935, must be considered as satisfactory when it is recalled that the pack in 1935 was, with the exception of that of 1929, the largest pack of pinks put up in this district since 1917. Reports from the spawning-grounds indicate that seeding was adequate.

Chum Salmon.—The Fraser River in 1937 produced a pack of canned chums amounting to 20,878 cases, compared with a pack of 31,565 cases in 1936, 8,227 cases in 1935, and 104,092 cases in 1934. The pack figures for this species are not necessarily indicative of the size of the run, however, as large numbers of chum salmon find a market in a frozen and salted condition. It should be mentioned, however, that the run of chums in the southern portion of British Columbia in 1937 was considerably short of the requirements of the salt- and frozen-fish trade. This created a brisk demand with considerably higher prices prevailing. This is, no doubt, reflected in the size of the canned pack.

Comparing the canned-salmon pack figures for the Fraser River for the years 1936 and 1937 with previous years, the reader's attention is drawn to a change made in allocating the pack figures since 1936. Previous to that year all Johnstone Strait caught sockeye were credited to the Vancouver Island District. In order that each principal watershed might be credited with the proper amount regardless of where the fish were caught, and due to the continued growing practice of transporting fish from the district where caught to be canned in another, the Provincial Department of Fisheries in 1936 required the canners to submit a return showing the location where the fish were taken, together with the quantities of the various species canned. All canners make this return, and as a result the Department has been able to present figures more truly indicative of the production of the various salmon-producing rivers.

In the figures quoted above for the Fraser River sockeye-pack 33,689 cases caught in Johnstone Strait are included. Prior to 1936 all Johnstone Strait caught sockeye were shown in the pack figures for Vancouver Island District.

The Skeena River.

The total pack of all species of salmon canned on the Skeena River in 1937 amounted to 132,638 cases. This was the smallest total pack recorded for this river since 1905, practically all varieties showing a decline in the amount packed compared with the packs of recent past years. The 1937 total pack on the Skeena was 65,612 cases less than the average for the past five years and 103,089 cases less than the ten-year average. The Skeena pack consisted

of 42,491 cases of sockeye, 4,401 cases of springs, 21 cases of steelhead, 15,514 cases of cohoe, 59,400 cases of pinks, and 10,811 cases of chums.

Sockeye Salmon.—The sockeye-pack for 1937, amounting to 42,491 cases, was the smallest since 1933, when 30,506 cases were packed. In 1937 the sockeye-pack was slightly more than half the size of the sockeye-pack for the previous year. The comparatively small pack of sockeye in 1937 was not unexpected. Dr. Clemens, in his paper "Contributions to the Life-history of the Sockeye Salmon" (No. 22), published in this Department's report for 1936, pointed out that "The run of 1937 will be the product of the spawnings of 1932 and 1933. In the former year the pack was 59,916 cases with a fair escapement in the Babine area and a good one at Lakelse, but with the possibility of freshets doing considerable damage. In the latter year the pack was 30,506 cases and the escapement was reported as fair. The above data would seem to indicate a relatively small return and that the catch should be on a conservative basis."

In discussing the Skeena River pack for 1937 it should also be pointed out that in order to restore the Skeena River to its original state of productivity, particularly in connection with the sockeye-salmon fisheries, the Federal Department of Fisheries has in the past few years put into effect the following regulations:—

1. The upper fishing boundary in 1936 was lowered to a point approximately 10 miles below the original fishing boundary, thus cutting off some of the most productive drifts.

2. Since 1935 the date of opening the sockeye-fishing season has been altered from June 20th to July 1st.

These measures, no doubt, have had the effect of reducing the pack somewhat, but the action was justified as the success of these regulations is reflected in the increase in the numbers of sockeye reaching the spawning-beds. It is reported that an excellent escapement occurred to the principal spawning areas tributary to the Skeena River. (*See* Major Motherwell's report on the inspection of spawning-grounds, 1937, published in the Appendix to this report.)

Another factor which should be considered in addition to the above is the voluntary reduction made by the industry in the number of fishing-boats operating in 1937. This reduction was made in order to avoid further increase in the weekly closed time.

Spring Salmon.—The spring-salmon pack on the Skeena in 1937, amounting to 4,401 cases, was 150 cases less than in the year previous, but should be considered as normal. As pointed out elsewhere in this report, the canned pack of spring salmon is not indicative of the amount available due to the requirements of other market outlets for this variety. The escapement of this species to the spawning-grounds is reported as good.

Cohoe Salmon.—There were 15,514 cases of cohoe canned on the Skeena in 1937. This was the smallest pack of this species since 1931, and was 9,876 cases less than in the previous year and 7,984 cases less than in 1935, the cycle-year. It is worthy of note that the cohoe-salmon pack in all districts in 1937 was considerably short of expectation.

Pink Salmon.—The pack of pink salmon on the Skeena, amounting to 59,400 cases, was considerably lower than in recent past years, the packs for the previous five years being as follows: 1932, 58,261; 1933, 95,783; 1934, 126,163; 1935, 81,868; and 1936, 91,389. It is pleasing to note, however, that the numbers of pink salmon reaching the spawning-beds in 1937 are reported to have been heavy; in fact, it is stated that this was the largest escapement observed since 1929.

Chum Salmon.—The chum-pack on the Skeena in 1937 amounted to 10,811 cases. This was 4,486 cases less than was packed in 1936 and 2,698 cases greater than the pack in 1935. It may be well to mention that the Skeena River is not a heavy producing area for this species but the escapement is reported as being normal.

The Nass River.

The total pack of all varieties of salmon canned on the Nass River in 1937 amounted to 49,042 cases, compared with a total of 139,575 cases in 1936. In making this comparison, however, it should be remembered that the total pack in 1936 was the largest in any year since 1924. The 1937 pack consisted of 17,567 cases of sockeye, 1,251 cases of springs, 46 cases of steelhead, 12,067 cases of cohoe, 8,031 cases of pinks, and 10,080 cases of chums; all varieties showing a decrease from the 1936 pack, except that for cohoe, which was slightly greater.

Sockeye Salmon.—The sockeye-pack on the Nass in 1937, amounting to 17,567 cases, was the product of the spawning of 1932. In that year the pack amounted to 14,154 cases; therefore a large run in 1937 was not anticipated, although the complicated age-groups representing the sockeye-runs to the Nass make it most difficult to attempt any prediction on the future runs. The 1937 sockeye-pack was 3,401 cases less than the average previous five years —1933–1937, inclusive. Reference to the sockeye-packs for previous years will indicate the variable nature of the runs to this watershed.

The escapement of sockeye to the spawning-grounds, particularly in the Meziaden Lake District, is reported to have been quite good.

Spring Salmon.—The pack of spring salmon is never very large on the Nass River, and although the pack in 1937, amounting to 1,251 cases, was slightly smaller than the pack of this variety for the year previous, it must be considered as average.

Cohoe Salmon.—The pack of cohoe amounted to 12,067 cases, which was 225 cases greater than the pack of this variety for the previous year, while 21,810 cases were packed in 1935, 9,935 cases in 1934, and 3,251 cases in 1933. It is reported that a fairly heavy escapement of cohoes was observed in all the streams frequented by this variety.

Pink Salmon.—The pink-salmon pack, amounting to 8,031 cases, was somewhat disappointing. The run in 1937 was derived from the spawning of 1935, in which year the pack amounted to 25,508 cases, while in 1933, the same cycle, the pack was 44,306 cases. Reports from the spawning-grounds also indicate that the seeding of the areas frequented by pink salmon was poor. It is interesting to note also that a heavy toll of this species was taken by the numerous seines and traps operating in Alaska, just north of the International Boundary, and it is possible that this heavy fishing may be a factor in the fluctuating runs of pink salmon to the Nass River.

Chum Salmon.—The pack of chums on the Nass River is never a large one, and the pack of 10,080 cases in 1937 must, therefore, be considered as a normal one, although amounting to approximately only one-half of the amount of this variety canned in the previous year. It was pointed out in this Department's report for 1936 that the pack for that year was the largest pack of chums on the Nass since 1925.

Rivers Inlet.

The total pack of all varieties of salmon canned at Rivers Inlet in 1937 amounted to 108,782 cases. The pack consisted of 84,832 cases of sockeye, 917 cases of springs, 70 cases of steelhead, 6,012 cases of cohoe, 7,536 cases of pinks, and 9,415 cases of chums.

Sockeye Salmon.—The sockeye-pack of 84,832 cases must be considered as a fair pack for this cycle. The 1937 run was the result of the spawning of 1932 and 1933. The packs in these years amounted to 69,732 cases and 83,507 cases respectively. In 1932 the escapement to the spawning-beds was not entirely satisfactory, while in 1933 the spawning-beds were reported to have been heavily seeded. In view of these conditions, a pack of medium size was all that could be reasonably expected.

The pack of sockeye in 1937 was 498 cases below the average for the previous five-year period, but was 2,604 cases above the average for the preceding ten-year period. Reports from the spawning-grounds indicate that the escapement in 1937 was satisfactory, the conditions equalling those of 1933 and an improvement over 1932. It will be recalled that in 1933 the spawning-beds were reported to have been heavily seeded. For a full account of the conditions at the various spawning-beds in British Columbia the reader is referred to the "Report on the Salmon-spawning Grounds, 1937," by Major J. A. Motherwell, Chief Supervisor of Fisheries, Federal Government, which is printed in the Appendix to this report.

Spring Salmon.—Spring salmon are never a large factor in the packs of Rivers Inlet, although the pack of 4,401 cases is quite large, compared with the packs of recent past years—i.e., 1936, 582 cases; 1935, 429 cases; 1934, 436 cases; 1933, 449 cases; and 1932, 459 cases.

Cohoe Salmon.—The cohoe-pack at Rivers Inlet, amounting to 6,012 cases, must be considered as fair. This variety is never packed in large quantities in this area and the pack is compared with 7,123 cases in 1936, 8,375 cases in 1935, 4,852 cases in 1934, 3,446 cases in 1933, and 7,062 cases in 1932. Reports from the spawning-beds indicate that the escapement was light.

Pink Salmon.—Rivers Inlet is considered chiefly as a sockeye area and most other varieties canned here are principally caught incidental to the sockeye-fishery. The pink-pack in 1937, amounting to 7,536 cases, was 1,104 cases above the pack for the year previous, while in 1935 there were packed of this variety 4,554 cases, and 2,815 cases in 1934.

Chum Salmon.—Chum salmon are also caught at Rivers Inlet incidental to the sockeye-fishery. There were packed in 1937, 9,415 cases of this variety, compared with 11,505 cases in 1936, 7,136 cases in 1935, and 895 cases in 1934.

Smith Inlet.

The total pack of all varieties canned in Smith Inlet in 1937 amounted to 35,502 cases, consisting of 25,258 cases of sockeye, 21 cases of springs, 5 cases of steelhead, 241 cases of cohoe, 483 cases of pinks, and 9,494 cases of chums. Smith Inlet, like Rivers Inlet, is considered chiefly a sockeye area. Other varieties canned, with the exception of the chum salmon, are caught incidental to the sockeye-salmon fishing.

Sockeye Salmon.—The sockeye-pack, amounting to 25,258 cases in 1937, was the product of the spawning of 1932 and 1933. In these years the packs amounted to 25,488 and 37,369 cases respectively. In 1936 the pack amounted to 12,788 cases, while in 1935 the pack was 31,648 cases. The 1937 pack was 924 cases above the average for the previous five years. Reports from the spawning-grounds indicate that while the escapement was found to be good in the Geluck River it was poor in the Delabah River. In summing up, the conditions are not considered as satisfactory as were hoped for, although the run to the principal spawning-stream, the Delabah River, was considered satisfactory.

Spring Salmon.—Springs are never a factor in the pack at Smith Inlet, there being 121 cases packed in 1937.

Cohoe Salmon.—Cohoe are not fished in Smith Inlet, but a few are taken incidental to sockeye-fishing. There were 241 cases packed in 1937.

Pink Salmon.—Remarks contained in the above paragraph also apply to this species. There were 483 cases of pink salmon packed in this inlet in 1937.

Chum Salmon.—The pack of chum salmon, amounting to 9,494 cases, is compared with packs for the previous five years in the following figures: 1936, 1,653 cases; 1935, 12,427 cases; 1934, 15,548 cases; 1933, 8,841 cases. A pack of this variety is not altogether indicative of the supply, as occasionally much more fishing effort is expended in the fall of the year, largely depending on the demand. In 1937 this species was in demand, both by the canners and the dry-salteries. The escapement to the spawning-grounds of this variety is reported as normal.

Queen Charlotte Islands.

Salmon-canning in the Queen Charlotte Islands is confined almost exclusively to pinks and chums, other varieties reported from these islands are caught incidental to these. There were packed 4,631 cases of cohoe and 72,689 cases of chums.

Pink Salmon.—This variety appears in the waters adjacent to the Queen Charlotte Islands in every alternate year, the runs coinciding with the even-numbered years. There was no run of pink salmon in the Queen Charlotte Islands District in 1937.

Chum Salmon.—The chum-salmon pack of 72,689 cases in these islands is somewhat larger than the pack of 1936, in which year it amounted to 69,304 cases, while the pack in 1935 was 86,298 cases and in 1934, 38,062 cases. Reports from the spawning-grounds indicate that the escapement was normal.

Other varieties canned in these islands were: Sockeye, 2 cases; springs, 140 cases; and pinks, 13 cases.

Central Area.

The Central area includes all the waters from Cape Calvert to the Skeena River and the adjacent waters, exclusive of Rivers Inlet. The total pack of all varieties in this area for 1937 amounted to 265,065 cases, consisting of 29,987 cases of sockeye, 1,641 cases of springs, 614 cases of steelhead, 25,009 cases of cohoe, 97,321 cases of pinks, and 110,493 cases of chums. In the year previous the total pack in this area amounted to 420,496 cases. The principal difference in the totals of the two years is accounted for by the large pack of pinks in 1936, which amounted to 246,378 cases.

Sockeye Salmon.—The sockeye salmon produced in the Central area are caught principally in Fitzhugh Sound and Burke and Dean Channels. The 1937 pack of 29,987 cases must be considered as of reasonable size for this area when compared with the packs in recent past years, there having been packed 27,499 cases in 1936, 32,417 cases in 1935, 20,438 cases in 1934, and 26,106 cases in 1933. The 1937 pack of sockeye was the largest in this area since 1930, in which year 39,198 cases were packed. Reports from the principal spawning-areas indicate that the escapement was satisfactory.

Cohoe Salmon.—The cohoe-pack, amounting to 25,009 cases in the Central area, was considerably below the packs for this area in recent past years. The pack in 1936 amounted to 45,824 cases; in 1935, 41,831 cases; and 1934, 53,850 cases; while in 1933 the pack was 33,471 cases. This small pack of cohoe is not peculiar to the Central area however, as this species was noticeably short in all districts in 1937.

Pink Salmon.—The pack of pink salmon, amounting to 97,321 cases, compares favourably with the pack of 1935, the cycle-year, although the 1937 pack was considerably lower than the pack in 1936, when 246,378 cases were packed. The pack in 1935 amounted to 94,190 cases. The year 1937 was a bad one for pinks in certain parts of the Central area, but reports from the various spawning-grounds indicate that the escapement was fair to heavy.

Chum Salmon.—The chum-salmon pack, amounting to 110,493 cases, compares favourably with the pack in 1934, the cycle-year, when 117,309 cases were packed in this area. The pack of this variety in 1936 amounted to 99,592 cases, while in 1935 it was 125,953 cases. Escapement to the various spawning-grounds is reported to have been good, while in certain districts in this area the inspecting officers report a heavy escapement.

Other Varieties.—In addition to the above, there were packed 1,641 cases of springs and 614 cases of steelhead.

Vancouver Island.

The total canned-salmon pack credited to Vancouver Island District amounted to 608,798 cases. This exceeds the previous year's large pack by 49,052 cases. The principal increase is reflected in the figures for the pink-pack. The total pack consisted of 25,427 cases of sockeye, 2,359 cases of springs, 88 cases of steelhead, 58,244 cases of cohoe, 318,780 cases of pinks, and 203,900 cases of chums.

Sockeye Salmon.—The total sockeye-pack credited to Vancouver Island in 1937 was 25,427 cases, compared with 32,696 cases in the previous year, 22,928 cases in 1935, 27,282 cases in 1934, and 18,397 cases in 1933. Reports from the different spawning-areas of the Vancouver Island District indicate that the needs of conservation are being taken care of adequately.

Spring Salmon.—The pack of springs in this district, amounting to 2,359 cases, was considerably below the packs for 1936 and 1935, although somewhat better than in 1934. It should be mentioned in relation to canned springs, however, that the pack figures are not indicative of the quantities available, as this species finds its largest outlet in the fresh- and frozen-fish trade; therefore, any comparison of pack figures should be made keeping this factor in mind.

Cohoe Salmon.—The cohoe-pack, amounting to 58,244 cases, including bluebacks, was disappointing. It might here be mentioned that the run of cohoe in all districts in British Columbia shows a considerable drop compared with recent past years. There would seem to be no particular reason for this for it is noted that such seasonal fluctuations occasionally happen. The pack of this variety for recent past years was as follows: 1936, 90,625 cases; 1935, 104,366 cases; 1934, 78,670 cases; and 1933, 60,019 cases. The reader is referred to Major Motherwell's "Report on the Spawning-grounds, 1937," for detailed information on escapements.

Pink Salmon.—The pack of pinks credited to Vancouver Island District for 1937 amounted to 318,780 cases. This was considerably larger than the packs of this species in recent past years, the pack in 1936 amounting to 82,028 cases, while in 1935, the cycle-year, the pack was 191,627 cases.

Chum Salmon.—The chum-salmon pack credited to Vancouver Island for 1937 amounted to 203,900 cases, compared with a pack of 347,951 cases in 1936, 143,960 cases in 1935, 210,239 cases in 1934, and 96,642 cases in 1933. In the case of chum salmon, large quantities also find a market in the salt- and frozen-fish trades, which somewhat affects the size

of the canned pack. In making comparisons this factor should be remembered, as the amount disposed of in the salt- and frozen-fish trades materially affects the quantity canned.

In considering the detailed figures for the various species of salmon canned in several districts of the Province, due consideration must be given to the numbers reaching the many spawning-grounds. Inspection of the spawning-beds is made each year by Fishery Officers of the Federal Department of Fisheries. The reader is referred to the detailed "Report on the Salmon-spawning Grounds, 1937," by Major J. A. Motherwell, and published in the Appendix to this report by his kind permission.

REVIEW OF BRITISH COLUMBIA'S SALMON-CANNING INDUSTRY, 1937.

There were thirty-seven salmon-canneries operated in British Columbia in 1937, compared with forty-six which operated in the previous year.

The canneries operated in the various districts were as follows:—

Queen Charlotte Islands	1
Nass River	2
Skeena River	7
Central Area	4
Rivers Inlet	5
Smith Inlet	1
Johnstone Strait	3
Fraser River and Lower Mainland	10
West Coast of Vancouver Island	4

A comparison of districts with the previous year shows that there were in 1937 three less canneries operating in the Queen Charlotte Islands, one less on the Nass River, one less on the Skeena River, one less on Rivers Inlet, one less on Smith Inlet, one less in Johnstone Strait, and one less on the Fraser River and Lower Mainland.

The year 1937 was an off-year for pinks in the Queen Charlotte Islands which, no doubt, accounts for the lessened activity in this district. On the Nass River one cannery owned by one of the larger operators was closed as a cannery but operated as a fish-camp, the fish being transported to the Skeena River for processing. A similar curtailment programme on the Skeena River accounted for one less operating cannery in that district. In the Central area the same number of canneries—i.e., four—operated as in the year previous; while at Rivers Inlet one of the older canneries was closed as an operating plant and the production canned at another of this company's canneries operating on the inlet. In Smith Inlet one of the two canneries which operated in the previous year was closed as a cannery but operated as a net-camp, the production being canned at Rivers Inlet. In Johnstone Strait the cannery of the Deep Bay Packing Company, at Bowser, British Columbia, was destroyed by fire just previous to the commencement of the operating season. This cannery was not rebuilt, which accounts for one less in this area. On the Fraser River the Ladner cannery which operated the previous year was closed, while on the west coast of Vancouver Island the same number was operated in 1937 as in 1936.

In this Department's report for 1936, attention was drawn to the growing practice of closing down operating canneries and consolidating the canning operations in fewer plants, while retaining a net-crew at the non-operating cannery and fishing that cannery's full complement of gear but canning the product of several canneries' gear in one operating cannery. This tendency is again reflected in the reduction in the number of canneries operated. As was pointed out in these pages in 1936, this tendency is, no doubt, an attempt on the part of the operator to lower production costs, but would seem that unless the amount of gear operated is also curtailed the financial gain to be derived by the operator is less than what otherwise might be expected. In "A Brief Statistical Review of the Sockeye-fishing Industry in Rivers Inlet," published in this Department's report for 1934, attention was drawn to the fact that the number of boats operating was far in excess of the number required to produce the pack normally canned, and that by a reduction in gear lessened production costs would be the natural result. It is again pointed out that the consolidation of canneries while maintaining the full complement of gear is not the complete answer to the question of lessening production costs.

The 1937 season opened on July 1st in the northern areas, and early reports indicated that the season got off to a fair start, particularly on the Nass, while on the Skeena River and Smith Inlet the season commenced rather slow. At Bella Coola, due to a misunderstanding between the canners and some of the Indian fishermen, the boats did not commence fishing the first day. This misunderstanding was rectified over the week-end and no further labour troubles occurred during the season, although in Rivers Inlet negotiations and adjustments on prices were continued after the season commenced. These negotiations were occasioned by the fact that an attempt was made to change the price of buying sockeye by the piece to that of a per pound basis.

From the view-point of the quantity canned, the 1937 season must be considered as generally satisfactory, although the cohoe-pack was very much smaller than anticipated or desirable.

Another outstanding feature in relation to the sockeye-runs to various districts in 1937 was the noticeably smaller size of the individual fish. This was particularly noticeable on Rivers Inlet, while reports reaching this office from other areas indicate that a similar reduction in size from that of previous years was quite in evidence.

OTHER CANNERIES (PILCHARD, HERRING, AND SHELL-FISH).

Pilchard.—The canning of pilchards on the west coast of Vancouver Island continues to show a slight increase from year to year, no doubt reflecting the increase in consumer demand for this product. Production of canned pilchards in 1937 amounted to 40,901 cases, compared with 35,007 cases in 1936 and 27,184 cases in 1935. There is no doubt that the 1937 production of canned pilchards would have been very much greater if a greater amount of fish suitable for canning had been available. The pilchard-runs to the west coast in 1937 did not materialize, and as a consequence the boats caught most of the pilchards canned in British Columbia off the coast of Washington, which necessitated long hauls, thus seriously reducing the amount of pilchards of a quality suitable for canning purposes. The industry continued to can pilchards in a variety of can sizes, and it would appear that by offering the public such an excellent food in a variety of different sized containers at a low cost the effect will be to encourage a wider distribution of this valuable fish-food. There were three pilchard-canneries operated in British Columbia in 1937.

Herring.—The canned-herring production in 1937 amounted to 27,365 cases as compared with 20,914 cases in 1936 and 26,143 cases in 1935. Two herring-canneries operated in British Columbia in 1937.

Shell-fish.—Shell-fish are canned in British Columbia to some extent, but the production is never large. In 1937 there were canned 12,596 cases of clams compared with 12,173 cases the previous year; 1,419 cases of crabs in 1937 as against 1,869 cases in 1936; and 800 cases of shrimps. There were no shrimps canned in 1936. In 1937 there were canned 370 cases of oysters while 3,601 cases of oysters were canned in 1936. In addition to the above, one small cannery canned 53 cases of abalone.

There were six plants licensed to operate as shell-fish canneries in the 1937 season.

MILD-CURED SALMON.

The production of mild-cured salmon in British Columbia in 1937 shows an encouraging increase over the pack figures for 1936. There were packed in 1937, 3,798 tierces, compared with 1,642 tierces in 1936. The pack for 1935 amounted to 2,775 tierces, while in 1934 the production figures reached 4,447 tierces. There were six tierced-salmon plants operated in 1937 as against five in the previous year.

DRY-SALT SALMON.

In 1935 and 1936 the production of dry-salt salmon was controlled by the British Columbia Salt-fish Marketing Board, which was a scheme set up under the Federal Government's "Marketing Act." Court judgments ruled that this "Marketing Act" was *ultra vires* Federal jurisdiction, and previous to the commencement of the salt-salmon operating season the operators petitioned the Provincial Government for a scheme under the "Natural Products Marketing (British Columbia) Act," similar to the scheme under which they had been operating previously. The members of the British Columbia Salt-fish Board are appointed

by the industry, with a chairman designated by the Commissioner of Fisheries. In 1937 the Board functioned in a similar manner to the Federal Board in previous years. The reader is referred to "Detailed Report of the British Columbia Salt-fish Board," published in the Appendix to this report.

In 1937 there were twenty-six salmon dry-salteries operated, whereas in 1936 thirty-one plants were licensed. The production in 1937 amounted to 5,523 tons, as compared with 8,190 tons in 1936. The chum-salmon season in British Columbia in 1937 was not good from the standpoint of the salters. In the Queen Charlotte Islands the season closed early and before the salters operating in that district had produced their quotas allowed by the Marketing Board. Similar conditions prevailed on the west coast of Vancouver Island, and there was also a shortage of chum salmon in the southern districts of the Province, the result being that very few of the salters were able to complete the quota allowed by the "Marketing Act."

DRY-SALT HERRING.

The production of dry-salt herring in British Columbia in 1936 was regulated by the British Columbia Salt-fish Board under the "Natural Products Marketing (British Columbia) Act." The total production of dry-salt herring is exported to the Orient. In previous years practically the total production went to China, but in recent past years Japan has been taking a fairly large quantity for re-export to Manchukuo. Unsettled conditions in the Orient during the producing season rendered marketing a most difficult problem, with the result that production was drastically curtailed. Here again the reader is referred to the "Report of the British Columbia Salt-fish Marketing Board," published in the Appendix to this report. As a result of curtailed production, the total herring salted in British Columbia in 1937 amounted to 10,230 tons. The production in 1936 amounted to 16,457 tons. Five herring-salteries were licensed to operate in 1937, while the number operating in 1936 was eighteen.

HALIBUT PRODUCTION.

The total halibut landings on the Pacific Coast of North America are regulated and fixed by the International Halibut Commission. The Coast, for administrative and regulative purposes, is divided into four areas, the principal areas from a production standpoint being Areas Nos. 2 and 3, the waters off the coast of Washington and British Columbia corresponding with Area No. 2 and the waters off the coast of Alaska corresponding with Area No. 3. The total allowed to be landed in 1937 from these two areas was fixed at 46,000,000 lb., which has been the amount fixed by the Commission since its commencement of regulation. On this account there is little opportunity for a wide variation in the total catch figures from year to year. In 1937 the total landings from Areas Nos. 2 and 3 amounted to 48,768,127 lb., compared with 48,175,466 lb. from these two areas the year previous. The total landings from all areas in 1937 amounted to 49,517,489 lb., compared with 48,874,672 lb. in 1936. Previous to 1935 very little, if any, halibut was caught in what is known as Area No. 1. In 1935, however, this area produced 1,290,000 lb., while in 1936 Area No. 1 is credited with 699,206 lb. The production for this area in 1937 amounted to 749,362 lb., which figure is included in the figures quoted above for all areas.

The halibut-fishery is shared in by both Canadian and American fishing-vessels, and some American caught halibut is landed in Canadian ports while some Canadian caught halibut is landed in American ports. The total landings in Canadian ports by all vessels, Canadian and American, in 1937 amounted to 18,761,711 lb., while in 1936 the total Canadian landings by all vessels amounted to 16,790,345 lb. The comparison of these figures indicate that the total halibut landed in Canadian ports increased from the year previous 1,971,426 lb.

Canadian vessels' share of this fishery in 1937 amounted to 11,733,914 lb., of which 9,827,533 lb. were caught in Area No. 2 and 1,916,381 lb. were caught in Area No. 3. The total Canadian catch for 1937 shows an increase for the Canadian fleet of 1,144,701 lb. over the Canadian catch for the previous year.

Based on the unweighted average prices paid for all Canadian landings at the port of Prince Rupert, the prices paid to Canadian fishermen again show a continued upward trend. The average price calculated on the above basis in 1934 was 5 cents per pound; in 1935 the average price was 5.6 cents per pound, and in 1936 it was 6.2 cents per pound, while the unweighted average price for Canadian halibut in 1937 was 6.5 cents per pound. Attention is

called to the fact that these prices are the unweighted average prices for all Canadian landings and should be used only as indicating the trend.

Halibut-liver is in continued demand by the pharmaceutical houses as a valuable source of concentrated vitamins. Halibut-livers have now become a source of considerable revenue to the fishermen, whereas previously they were thrown away. The value of the halibut-liver production in 1937 amounted to $475,350, while this source of revenue accounted for $424,350 in 1936 and $363,082 in 1935.

The above figures are compiled from information supplied by the International Fisheries Commission.

FISH OIL AND MEAL.

Fish oil and meal is produced in British Columbia from several sources. The principal source ordinarily is the pilchard-fishery. These fish are caught almost exclusively for reduction to oil and meal. In recent years considerable quantities of herring were also reduced to fish meal and oil, while fish-offal, salmon-cannery waste, and dogfish reduction account for the remainder of the oil and meal produced, except the production from whales. This branch of the industry has now attained the proportions of a major fishery. Contrary to general belief, the fish-meal manufactured in British Columbia plants is not used as fertilizer, but is used altogether as a supplementary food for the feeding of domestic animals—cattle, hogs, poultry, etc. The oil finds a market in various manufacturing industries, largely in the making of soaps, paint, linoleum products, etc. There is also a continually expanding outlet for certain grades of fish-oil for the feeding of poultry and other live stock, due to its high vitamin content. Plants are now established in British Columbia to refine the raw oil and to supply those requiring an oil of a guaranteed vitamin content.

Pilchard Reduction.—The pilchard-fishery is conducted principally on the west coast of Vancouver Island. A few years ago fishing activity was confined almost entirely to the inlets and sounds on the west coast, but the vessels now proceed far to sea for their catches and this fishery may rightfully be termed a " deep-sea " fishery. Fishing usually commences about the first week in July and continues until the first fall storms, usually about the middle of September.

In 1937 fishing commenced around July 10th with limited catches. Ordinarily pilchard are taken off the west coast as far west as Quatsino, but in 1937 the fish did not show in their usual haunts and, as a result, the fishing-vessels finally located them off the coast of Washington. The schools of pilchard did not come to the west coast at all during the fishing season, and as a result Canadian vessels had to proceed a long way to the fishing-grounds, necessitating a considerable loss of time running to and fro with their catches. As a result, the reduction plants operating in Barkley Sound did very well, while those plants operating farther to the west were at a disadvantage due to the extra long haul. Notwithstanding these difficulties, the production of pilchard-meal in 1937 amounted to 8,483 tons, compared with 8,561 tons produced in 1936 and 8,666 tons in 1935. The production of pilchard-oil in 1937 amounted to 1,709,981 imperial gallons, as against 1,271,144 imperial gallons in 1936. There were eight pilchard-reduction plants licensed to operate in 1937, the same number as operated in 1936.

Whale Reduction.—Two whaling-stations operated in 1937, the same number as were operating in 1936. A total of 317 whales were captured as against 376 in the previous year, 202 in 1935, and 350 in 1934. The 1937 catch of 317 whales produced 268 tons of meal, 527 tons of fertilizer, and 662,355 imperial gallons of oil, compared with 332 tons of meal, 687 tons of fertilizer, and 763,740 imperial gallons of oil in 1936. Of the 317 whales captured in 1937, 265 were sperms.

Herring Reduction.—Herring were again permitted to be reduced to meal and oil in 1937 in definite limited quantities. In 1936 the catch-limits for the various districts were set by a small committee consisting of the Chief Supervisor of Fisheries for the Federal Government, the Director of the Pacific Biological Station at Nanaimo, and the Assistant Commissioner of Fisheries for British Columbia. In 1937 the limits so set the previous year for the various districts were incorporated in the Special Fisheries Regulations for British Columbia. The catch-limits for 1937 are as follows: East Coast of Vancouver Island, 25,000 tons; West Coast area, 40,000 tons.

Provided that in the following described sub-districts of the West Coast area not more than the quantity of herring shown opposite each shall be so fished for, caught, or killed in any season, even though by the time it is taken the total quantity authorized for the West Coast area has not been caught.

	Tons.
Barkley Sub-district	15,000
Clayoquot Sub-district	5,000
Nootka Sub-district	10,000
Kyuquot Sub-district	10,000
Quatsino Sub-district	5,000

The above quotas are extracted from the Special Fisheries Regulations for the Province of British Columbia.

In 1937, due to the very limited demand for dry-salt herring, only a portion of the East Coast quota was required by the salters. The balance of the quota, however, was caught and reduced to meal and oil, some being taken to the West Coast, while the balance was processed in East Coast plants.

Commencing in 1936, considerable activity in winter herring-fishing was manifest in District No. 2 in the vicinity of Namu, Bella Bella, and Ocean Falls, as well as in the Prince Rupert areas. This activity was continued in 1937. Due to the fact that herring-fishing has not been conducted extensively in this area prior to 1936, no catch-limits have as yet been set, but the Biological Officers in charge of the pilchard-herring investigation are maintaining a close observation as to the effect of fishing on these parent stocks, with a view to obtaining factual information which will indicate what conservation measures may be deemed advisable in the light of the information obtained.

Thirteen plants were licensed to reduce herring in 1937. These thirteen plants produced 14,643 tons of meal as against 10,340 tons in 1936, and 1,333,245 imperial gallons of oil compared with 786,742 imperial gallons in 1936. Of the thirteen plants operated in 1937, eight were located on the west coast of Vancouver Island, two in the Prince Rupert area, two in the Central area, and one on the Fraser River.

Miscellaneous Reduction.—Fish oil and meal is also produced in lesser quantities in plants operated on other than whales, pilchard, and (or) herring—principally on dogfish and cannery-waste. Eight plants were licensed in this category in 1937, producing 2,445 tons of meal and 266,009 imperial gallons of oil.

CLAMS.

During the past two or three years digging activities for clams in British Columbia have increased most rapidly, particularly in those areas adjacent to the south end of Vancouver Island on the east coast. This activity has been occasioned largely by the demand for clams by American canners while in the past year the demand by Canadian canners has also increased, adding a further drain on those beds which are of easiest access. In addition to the digging centered largely on the east coast of Vancouver Island, the buyers have gone farther afield and considerable quantities in 1937 were taken in the Alert Bay and Bella Bella areas.

Until recently digging for clams commercially was done on such a small scale that it was felt the regulations were adequate to prevent depletion. In view of the increased digging activity, however, the Provincial Department of Fisheries and representatives of the Dominion Department of Fisheries, including the Chief Supervisor of Fisheries for British Columbia, held a conference at which it was decided to make representations for a change in the regulations which would have the effect of giving the necessary added protection. At the same time it was also recommended that the Fisheries Research Board undertake a preliminary survey with a view to ascertaining whether a more comprehensive investigation was necessary. This preliminary survey was made in December, 1937. Due to the short time available the survey was confined to that area from Dodd Narrows to Sidney, B.C., the area which had been most heavily exploited. The results of this preliminary survey indicate that a more comprehensive investigation is not only desirable but necessary if regulations are to be devised which will effectively prevent serious depletion of this resource. The preliminary survey indicates that in certain areas digging has already taken place to such an extent as to cause some depletion of the beds, and it is expected that the Fisheries

Research Board will, in the near future, institute a thorough investigation in respect to the clams of the Province. In the meantime it is felt that the recent change in the regulations recommended by the above-mentioned conference, and already in effect, will adequately take care of the situation until such time as investigation shows a further change in regulations to be desirable.

CONDITIONS OF BRITISH COLUMBIA SALMON-SPAWNING GROUNDS.

Owing to this Department having discontinued making personal inspections of the various salmon-spawning areas in the Province, we are indebted to Major Motherwell, Chief Supervisor of Fisheries, and the officers of his Department who conducted the investigations, for furnishing us with a copy of his report. His courtesy in supplying us with this report is gratefully acknowledged.

Major Motherwell's report on the condition of British Columbia's salmon-spawning grounds will be found in full in the Appendix to this report.

CONTRIBUTIONS TO THE LIFE-HISTORY OF THE SOCKEYE SALMON (DIGEST). (No. 23.)

The twenty-third paper of the above-named series appears in the Appendix to this report, and is contributed by Dr. W. A. Clemens, Director of the Pacific Biological Station, Nanaimo. In this contribution Dr. Clemens points out that the run of the sockeye salmon in 1937 to the four principal river systems in British Columbia—namely, the Fraser, Nass, Skeena, and Rivers Inlet—were very close to expectation, the total pack for the four areas amounting to 305,421 cases, which was nearly 100,000 cases less than in 1936. It is pointed out, however, that reports of conditions on the spawning-grounds indicate good escapements for the particular cycle-years in relation to the commercial catches.

The Fraser River Sockeye Run of 1937.—The sockeye-run to the Fraser River in 1937 belongs to the cycle-years which once produced packs exceeding 2,000,000 cases. Since 1917 the cycle has maintained itself at a fairly steady level, producing 160,000 cases a year. The author points out that the pack in 1937 was 160,531 cases and that the escapement was reported as good. Of the total pack, 100,272 cases were packed in the Province of British Columbia and 60,259 cases in the State of Washington, the percentages of these two packs being 62 per cent. and 38 per cent. respectively. It is pointed out that included in the number of cases attributed to the Fraser River are 33,689 cases of fish which were caught in Johnstone Strait. This amounts to 21 per cent. of the total pack for that river and again indicates a run of considerable size coming in by the northern route. The author also points out that the fish were well distributed throughout the river system in 1937. Approximately 6,000 were reported from the Stuart Lake area; small numbers in the Francois Lake and Quesnel systems; at least 110,000 to Chilco Lake; light runs to the Shuswap and North Thompson areas; and at least 60,000 to the Seton-Anderson Lake area; while in the lower areas the escapements to Harrison and Pitt Lakes were good, but only 3,055 fish, by actual count, reached Cultus Lake.

The author points out that, while these spawning escapements would seem to be encouraging, the fact that the total escapement was very small in relation to the catch must not be overlooked. The two large escapements to Chilco and Seton Lakes together accounted for only 170,000 fish, and it is doubtful if the combined escapements to all other areas would greatly exceed half the above number. As against this, the pack represents approximately 3,250,000 fish. This is a consideration which should not be overlooked.

In commenting on the sockeye-runs for 1938 to this river, the author points out that this is the cycle-year of the large late runs. In 1926 a large number of sockeye appeared in Adams River late in the season. Again, in 1930 there was a large return with a total pack of 455,886 cases and an escapement to Adams River estimated at 400,000 fish. In 1934 there was again a large pack of 491,817 cases and an estimated escapement to Adams River of 500,000 fish, so that there is every reason to expect a large return in 1938. Further, it is pointed out that large runs to the upper Fraser River have usually been preceded by the appearance of relatively large numbers of three-year-old fish or what are commonly known as grilse. These were particularly abundant in the run of 1937, and this fact may be taken as further indication of the large return of four-year-old sockeye in 1938.

Sampling was made from fish obtained as usual from the traps at Sooke, random samplings from the catch being taken from May 10th to September 14th, thirty-four samplings in all; the 4_2 age-group being represented by 77.9 per cent. of the total sampled, the 5_2 account for 12 per cent., the 5_3 by 5.3 per cent., while of the 6_3 only three fish appeared in the samplings. The 3_2, or grilse, accounted for 4.1 per cent. of the total sampled. There were also four fish of the 4_1, three of the 3_1, and one of the 4_3 age-groups.

Rivers Inlet Sockeye Run of 1937.—In his remarks on Rivers Inlet, Dr. Clemens points out that this inlet produced a medium-sized pack in 1937 and the escapement was reported as satisfactory. The pack is termed medium-sized because it falls in the range of 60,000 to 100,000 cases. Less than 60,000 cases is considered small and greater than 100,000 cases large. Over the period from 1907 to 1935, inclusive, the packs on this basis have been distributed as follows: Small, 4; medium, 17; large, 8. Attention is drawn to the following proportions of the four- and five-year-old fish in the runs to Rivers Inlet, and on this account it is difficult to discern cycles, but one five-year cycle stands out, that of 1910–15–20–25–30–35, which has consistently produced packs of over 100,000 cases. The 1937 run was one which could not be identified as a five-year in preference to a four-cycle year.

In commenting on the 1938 run, Dr. Clemens says this will be the result of the spawnings of 1933 and 1934. In the former year the pack was 83,507 cases and the escapement was reported as very good. In the latter year the pack was 76,923 cases with an average escapement. The factors which determine the age of maturity are not definitely known, therefore it is impossible to determine what proportion of the progeny of a given year's spawning will return as four-year-olds and what as five-year-olds. Taking all available data into consideration, it would appear that the return of 1938 should be one producing a medium-sized pack.

The usual data were obtained in 1934 from 1,824 individuals taken in twenty-two random samplings from July 1st to August 5th. Of the individuals represented, 60 per cent. were of the 4_2 age-group, 37 per cent. 5_2 age-group, 2 per cent. of the 5_3, and of the 6_3 age-group approximately 0.5 per cent. Only one of the 4_1 age-group appeared in the sampling. It is pointed out that, while the proportions of the 4_2 and 5_2 age-groups over the period of the past twenty-four years have varied greatly, the average has been approximately 50:50. The extremes have been from 5:95 to 81:16. The percentages in 1937 are somewhat in favour of the 4_2's but are not exceptional.

It is also pointed out that in respect to the average lengths and weights of both sexes in the 4_2 and 5_2 age-groups for 1937, the averages are somewhat below that for the past twenty-two and twenty-five years. It is suggested that the size of the mesh used in taking the commercial catch may have some bearing.

Skeena River Sockeye Run of 1937.—The pack on the Skeena River, amounting to 42,491 cases, is relatively small. The author points out that it would appear to have fulfilled expectations. A very good escapement was reported from both the Lakelse and Babine Lake areas.

The author points out that the sockeye in the Skeena River mature for the most part at four and five years of age. The return of 1938 will be derived from the spawnings of 1933 and 1934. In 1933 the pack amounted to 30,506 cases, the smallest on record, with a relatively small escapement. In 1934 the pack was 70,655 cases and the escapement was reported as being "doubtful." In view of these facts, the inevitable conclusion is that the return of 1938 will be small. Only some at present unknown condition could produce an exceptionally large return.

The usual data were obtained again in 1937 from 1,597 fish taken in twelve random samplings from July 6th to August 4th; the 4_2 age-group accounting for 45 per cent. of the total, while the 5_2's represented 40 per cent., the 5_3's 11 per cent., and 6_3's 4 per cent. In addition to this the 3_2 age-group is represented by seven individuals which, however, are not taken into the calculations.

Nass River Sockeye Run of 1937.—The pack on the Nass River was 17,567 cases, and the escapement was reported as "quite good on the whole." While the escapement was apparently satisfactory in relation to the catch, the author points out that it is apparent that the run of 1937 was relatively small. Dr. Clemens points out that for the past twenty-five years 67 per cent. of the Nass River sockeye have been five-year-old fish with two years' residence in fresh waters (5_3's). In 1933 the pack consisted of 9,757 cases and the escape-

ment was reported as "not particularly satisfactory." It would seem, therefore, that little may be expected in 1938 from the 1933 spawning. In 1934 the pack was 36,242 cases, which was exceptionally large. The escapement was also stated to have been heavy, but since four-year-old fish usually form a relatively small proportion of the population (the average for the past twenty-five years being 15 per cent.) the 1934 spawning is not likely to produce a very large group of mature fish in 1938. The prospects for a large return in 1938 are not, therefore, particularly bright. The author points out, however, that returns to the Nass River have been very erratic and it has been almost impossible to predict production for any year for this river system. There is apparently some as yet unknown factor operating which causes considerable irregularity in the cycle returns.

The analysis of the 1937 run is based on data collected from 1,491 fish in thirteen random samplings between July 6th and August 17th. The 5_3 age-group predominates and amounts to 68 per cent. This is practically identical with the average for the past twenty-five years. The 4_2's are represented by 22 per cent., the 6_3's by 6 per cent., and the 5_2's by 4 per cent. It is interesting to note that the average lengths and weights for nearly all age-groups is considerably below the averages for the last twenty-five years. It is also worthy of note that for the first time since 1918 the males have outnumbered the females, the percentages being 51 per cent. and 49 per cent. respectively.

A BRIEF ACCOUNT OF THE LIFE-HISTORY OF THE PILCHARD.

Included in the Appendix to this report will be found a timely paper by Dr. John Lawson Hart, outlining briefly what is known in regard to the life-history of the British Columbia pilchard. It is not Dr. Hart's purpose in this paper to describe the original research, but rather an attempt has been made to summarize, in condensed form, the more recent findings relating to the life-history of this fish and to make this information available to the Canadian fishing industry.

The facts as outlined in Dr. Hart's paper have been obtained from many sources, not the least important of which may be credited to the original research-work of Dr. Hart and his associates at the Pacific Biological Station at Nanaimo. It is felt that this brief report will fill a much-felt want in that for the first time it briefly summarizes those facts which are known relating to the life-history of the British Columbia pilchard (*Sardinops cærulea*).

PILCHARD AND HERRING INVESTIGATIONS.

The investigations on pilchards and herrings have continued under the joint auspices of the Fisheries Research Board of Canada and the Provincial Fisheries Department. Emphasis has been continued on the tagging programme for both species, but the routine sampling of the catches has been continued. The work has been organized by Dr. J. L. Hart and Dr. A. L. Tester and has been carried out by them and their assistants.

PILCHARDS.

The 1937 pilchard season was in marked contrast with that of the previous year. Whereas in 1936 there was evidence for believing that the fish occurred to the north-west of the Vancouver Island fishing-grounds, in 1937 only a very few pilchards were taken as far to the north as Vancouver Island. A very large proportion of the Canadian catch was made off the Washington coast between Cape Flattery and the Columbia River. In consequence of this southern distribution, the fish-reduction plants situated in Nootka Sound and Esperanza Inlet operated at a disadvantage as compared with those in Barkley Sound.

Sampling showed that in length the fish were larger than average but were not so large on the average as in some years. The sizes were grouped around the average so that comparatively few lengths were recorded which differed from the average by more than 1 inch.

The results of the work on tagging pilchards and recovering the tags are reported in some detail in the Appendix. The report records the recovery of Canadian tags by California, Oregon, and Washington operators, and the recovery of California tags in Canadian reduction plants. The evidence indicates that during 1937 a considerable proportion of the Canadian pilchard-catch consisted of fish which had been off the California coast during the previous winter.

Included in the Appendix is a general account of the life-history of the pilchard as it is known at present.

Herring.

The most noteworthy feature of the herring-fishery has been its continued development in the areas north of Vancouver Island. The rapid growth would appear to call for an intensive study of the herring in the area to provide information to facilitate the most advantageous method of exploiting the resource. Herring were relatively abundant on the east coast of Vancouver Island and in Quatsino Sound on the west coast, but less abundant in other west coast areas.

Herring sampling for length, age, weight, sex, and vertebral number has been continued and expanded to include the newly-opened areas. These studies are designed to determine the effect of inequality of successive year broods on the availability of herring to the fishermen and to provide information concerning the extent of intermingling of herring from different areas.

The collection of herring-spawning reports has continued through the co-operation of the Dominion Department of Fisheries. A detailed study of the Barkley Sound spawning-grounds was made during the spring of 1938. It was found that spawning was very light and took place mostly along exposed shores (Macoah Passage). The extension of the spawning-grounds below the intertidal zone presented a formidable obstacle to the original programme—the quantitative sampling of the egg deposition to determine the absolute abundance of the spawning population.

Catch records for herring purse-seines have been collected in recent years to supply information concerning availability of fish in different years and different areas. In 1937–38 a new system was put into effect. Pilot-house record-books were distributed to seine-boat captains with instructions to record carefully the date, time, place, tonnage, and incidental information for each set and to return copies to the Pacific Biological Station. The new system has met with considerable success. The data show differences among the various fishing areas in the time of day at which most of the herring are caught. For the fishery on the south-east coast of Vancouver Island a relationship between the availability of herring, the tide, and the moon has been established; more fish for unit effort being taken in the first and third quarters than in the new and full phases of the moon. This appears to be related to the tidal series present during these lunar weeks and is possibly caused by the effect of tide on the movements of herring to the fishing-grounds. Undoubtedly as more data are accumulated under the improved system other relationships will be disclosed and much will be learned of the causes of short-term, annual, and long-term fluctuations in the herring-fishery.

An account of the herring-tagging work is included in the Appendix. The paper describes the installation of a new induction detector at Ucluelet and the improvements on the old one at Galiano Island. The magnets installed for the recovery of pilchard-tags were also used for the recovery of herring-tags, but the data obtained from them are not so satisfactory. The results give partial support to the conclusions based on racial studies that there is a tendency for separate populations to be formed on the west coast, but indicate that there is a considerable proportion of wandering, estimated at 15 to 20 per cent. There is, however, no evidence of intermingling of fish from the east coast and west coast. Evidence from fish tagged at Sooke shows that a large body of fish moves up the east coast of Vancouver Island and are subsequently taken on the Swanson Channel fishing-grounds. In view of this, it is worthy of note that one Sooke tag was recovered in Barkley Sound. It is proposed to continue and extend work under the tagging programme.

CONTRIBUTIONS TO THE LIMNOLOGY OF SHUSWAP LAKE.

In the Appendix to this report will be found a paper contributed by Drs. W. A. Clemens, R. E. Foerster, N. M. Carter, and D. S. Rawson, which contains a considerable amount of information concerning the limnology of a portion of Shuswap Lake.

The material for this paper was obtained, as the writers point out, during two weeks in July of the years 1931 and 1932. As very little work of this nature has been previously done in the many lakes of British Columbia, the observations made, it is felt, may be of real value, particularly in view of the importance of this body of water in relation to the Fraser River sockeye-salmon runs. The paper describes the lake, the geology, gives certain soundings, also

physicochemical observations, deals with the higher aquatic vegetation, the plankton, lists a number of shore invertebrates and bottom organisms, as well as lists a number of the fish indigenous to this lake.

INTERNATIONAL FISHERIES COMMISSION, 1937.

The International Fisheries Commission continued the investigation of the life-history of the Pacific halibut and the observation and regulation of the halibut-fishery, as provided in the treaties of May, 1930, and the new, supplanting treaty of January, 1937. Under its regulations the condition of the stocks on the banks continued to improve.

Canadian representation on the Commission was changed during the year. Mr. George J. Alexander, Chairman and Assistant Commissioner of Fisheries for British Columbia, resigned, and Mr. Louis W. Patmore was appointed to fill the vacancy. Mr. Edward W. Allen was elected Chairman to succeed Mr. Alexander.

The Commission maintained its usual close contact with the halibut industry. Informal meetings were held with various committees and individuals and the annual meeting with the Conference Board, composed of representatives of the different sections of the fishing fleet, was held in Seattle on December 3rd. The meetings afforded opportunities of explaining the progress of the Commission's investigations to the fishermen and of discussing the problems and difficulties encountered by the fishermen.

The 1937 halibut treaty gave the Commission additional regulatory powers at the request of the fishing fleets. The additions authorized the Commission to permit, regulate, or prohibit the retention and landing of halibut caught incidental to fishing for other species of fish in any area, when halibut-fishing is prohibited there, and the possession of halibut of any origin during such fishing. They also empowered the Commission to limit the departure of vessels for halibut-fishing in an area when the vessels which have departed for that area are sufficient to catch the limit set by the Commission. The new treaty did not become effective until August, 1937.

The 1937 halibut season opened on March 16th, as in the preceding year. Regulations governing fishing were essentially the same as in 1936 until August, after the closure of Areas 1 and 2, when new regulations were issued under the 1937 treaty.

The catch-limits in Areas 2 and 3 were attained and the areas were closed earlier than in 1936, in spite of the system of voluntary curtailment by the American fleet and the regulations under the " Marketing Act " in British Columbia, which proved generally effective in distributing the permitted catch over a longer season than would otherwise have been the case. Areas 1 and 2 were closed to halibut-fishing at midnight of July 28th, with catches of approximately 747,000 and 22,832,000 lb. respectively. September 29th was set as the date of last clearance for halibut-fishing in Area 3 and the area was closed to fishing at midnight of October 19th with a catch of approximately 25,556,000 lb. No halibut were landed from Area 4, which was closed at the same time as Area 3.

The regulations, issued August 11th, were modified from the previous ones in several respects. They provided for the closure of Area 3 by prohibition of clearance for that area, when the boats already cleared for or fishing there were sufficient to catch the limit allowed, and by the setting of a subsequent date of last fishing. This permitted a full trip by all vessels which were allowed to clear, and eliminated any desire to fish illegally after closure. No law-breaking of this kind was observed or suspected in 1937. The new regulations continued midnight of November 30th as the date of commencement of the closed season, in the event that closure was not already in effect as a result of catching the limits allowed, but provided that the Commission might substitute any earlier date subsequent to November 1st as the beginning of the closed season. They also changed the date of termination of the closed season from midnight of March 15th to midnight of March 31st of each year. Other provisions were essentially unchanged.

The provision, in the regulations issued under the 1937 treaty, for the retention and sale of a limited proportion of halibut caught incidental to fishing for other species in areas closed to halibut-fishing, proved very effective in reducing the amount of illegal fishing in Area 2 after closure, but it was a boon to law-observing fishermen. Halibut could no longer be held in possession after closure without a permit, which was not good for fishing in an open area and which limited the amount which could be held. But one pound of halibut could be sold

for every seven of other species, exclusive of salmon. The halibut landings by individual vessels under this provision were in general considerably less than the proportion legally allowed. Total landings from this source were only 278,000 lb., but they provided additional revenue, and, moreover, stimulated the cod-fishery.

The investigations of the scientific staff were continued where necessary for the fulfillment of the purposes of the treaty. They included the collection and analysis of current statistical and biological data by which the success of regulation can be determined and on which continued intelligent control must be based. The collection of biological data made necessary the operation of a vessel.

Further improvement in the stocks of halibut due to regulation was revealed by the investigations. The abundance of fish, as indicated by the catch per unit of fishing effort, increased in 1937 according to expectations. This increased abundance and the consequent ease of securing trips has had a very salutary effect upon the quality and size of fish landed.

Observation of the effects of regulations upon the stock of halibut by means of market measurements was continued. A total of more than 96,000 halibut from 102 representative trips were measured at Seattle. Data were simultaneously taken for the study of the age and sex composition of the stocks. The reduction in the rate of capture of the fish resulting from regulation was reflected in a further small increase in the size of the fish landed, which in conjunction with the general increase in abundance proved a further small increase in the spawning stock on the grounds. It is noteworthy that the increase in spawning stock, particularly in Area 2, is being achieved with no reduction in the total catch permitted the fleet.

Particular attention was devoted to the measurement of the production of spawn, the most direct way of determining the changes in spawning conditions at the time they occur. Vessel operations by charter of the schooner " Eagle " were carried on from December 4th, 1936, to February 6th, 1937, in the neighbourhood of Cape St. James, British Columbia. The materials from the net-hauls taken at eighty-seven stations during this period were sorted in the laboratory and analyzed. They showed a further increase in the abundance of spawn over the record of the previous winter. The collection of new materials in the same region was begun in December, 1937, and continued in January and February of 1938.

Numerous factors, such as the accidental occurrence of favourable hydrographic conditions for spawning and survival of the young, or the presence of unusual conditions of the ocean currents tending to concentrate the eggs in the vicinity of the spawning-banks rather than scatter them along the coast, cause sudden changes in the amount of spawn found in any areas. Only an increase in the number of eggs taken in the nets over a series of years may be interpreted as positive proof of an increase in spawning within a region. The numbers taken in Area 2 during the past four years have more or less steadily increased, and are reasonable proof of an actual increase in the number of spawners there.

As indicated in the report of last year, the increase in production of spawn that has occurred is due to the longer life allowed the fish on the banks and is not yet due to an increase in the number of fish entering the fishery. Since the female halibut does not mature until the age of twelve years on the average, it will be some years before the increase in spawning and the resultant increase in number of young have any effect upon the number of spawning fish.

One *report*, No. 12, and three additional *circulars*, Nos. 5, 6, and 7, were published during the year. The report dealt with *Theory of the effect of fishing on the stock of halibut*, by W. F. Thompson. This report gave the theory which explains the effect of the present regulations, and was written after the author's careful study of the changes in fisheries of other regions, particularly those of the North Sea. There is every reason to believe that the theory found practical here applies in other fisheries.

The subjects of the three circulars were, respectively: *Why are there separate areas?* by H. A. Dunlop; *Halibut-tagging experiments*, by John Laurence Kas; and *The early life-history of the halibut*, by Richard Van Cleve. They were written with a view to explaining the work of the Commission in simple, understandable form.

The investigations of the Commission continued to explain the changes taking place in the stocks of halibut on the banks. They demonstrated that the condition of the stock was improving as a result of regulation, and offered fresh assurance of the ultimate success of the Commission in rebuilding the fishery to a higher level of productiveness.

INTERNATIONAL PACIFIC SALMON-FISHERIES COMMISSION.

Probably the most outstanding happening in the recent history of British Columbia's fisheries was the conclusion of what had become known as the "Sockeye Treaty" between Canada and the United States.

To appreciate more fully the significance of this happening, it would probably not be amiss to briefly summarize the negotiations leading up to the final ratification of this treaty. The Provincial Department of Fisheries has, for many years, advocated the necessity for international action if the sockeye-fishery of the Fraser River was to be preserved. The Department also has continuously and diligently worked hard to bring about international action, as it has been realized for many years that only through international action could the Fraser River fisheries be preserved. The problem was most complex and complicated because of the various interests involved. It should be pointed out that the sockeye salmon returning to the Fraser River to spawn pass through American waters. This fact has, for forty years, prevented what might be considered any sensible action being taken relative to the preservation of the Fraser River sockeye. The reason for this is that when the sockeye pass through United States waters they are caught by American fishermen who are subject to rules and regulations which differ from those in force on the Canadian side. This condition of affairs has threatened to extinguish the Fraser River sockeye-run. American fishermen were opposed to the introduction of greater limitations upon the methods of fishing effective in their waters, while the Canadians were unwilling to further limit their own catches, unless their neighbours across the line were willing to act with them in a similar manner.

The sockeye-fisheries in the waters contiguous to British Columbia and the State of Washington first became a subject of international action as the result of negotiations between the American Secretary of State and the Canadian Fisheries Delegation, which took place at Washington, D.C., on February 15th, 1892, forty-five years ago. As a result of this conference a proposal was made by Senator Foster of the United States, on October 4th, 1892, to the Canadian Government, the proposal being that two experts, one representing each country, should be appointed to inquire into the following questions:—

(*a.*) The limitation or prevention of exhaustive or destructive methods of taking fish in the territorial waters and contiguous waters of the United States and Canada respectively, and also in the waters of the open ocean outside of the territorial limits of either country, to which the habitants of the respective countries habitually resort for the purpose of fishing.

(*b.*) The close seasons expedient to be enforced or observed by the inhabitants of both countries.

(*c.*) The adoption of practical methods of restocking and replenishing such waters with fish and by means of which such fish life may be preserved and increased.

These proposals were immediately agreed to by the Canadian Government and the agreement was brought into effect and completed on December 6th, 1892. Dr. Wakeham was appointed Canadian representative and Mr. Rathbun represented the United States. On December 31st, 1896, their report was finally submitted. The international agreement under which the Commission was appointed contained a clause which provided that as soon as the reports of the Commissioners were placed before the respective Governments an exchange of views thereon would take place and, if it was found expedient, the two Governments would undertake a treaty of concurrent legislation or such action as was found to be most desirable. The findings of the Commissioners, however, indicated that there was no acute fisheries problem in the Fraser River District at that time; consequently no action of the sort provided for was taken.

Events of the next few years, however, brought the international aspect of the fishery into a strong relief. By the late '90s fishing by Americans in the waters of Puget Sound had increased greatly. This competition of American fishermen with their more efficient trap-nets and purse-seines had become so vigorous by 1901 that on January 24th, 1902, the Canadian Government appointed a Commission to investigate the proper production and future development of the various branches of the salmon-fishing industry in British Columbia. Professor Prince was chairman of this Commission. The evidence submitted to the Commission was of such a nature that it was obvious the question was far wider and called for a more thorough investigation than that body had been authorized to make. That Commission's report con-

cerned itself merely with indicating the complexity of the problem and refrained from making any comprehensive recommendations.

Until the fishing season of 1902, no great anxiety had been felt in respect to the salmon-run. The run of 1901 had been satisfactory and up to this time the real issue had been the distribution of the catch between the Canadian and American interests. Limitation of the total catch was not, as yet, regarded as a matter of paramount importance. The season of 1902, however, was such a failure that the late J. P. Babcock, Deputy Commissioner of Fisheries for British Columbia, in the Department's report pointed out that: " Our fishermen should be permitted to take only that portion of the run which is in excess of the number necessary to the perpetuation of the species. The present regulations for the Fraser River do not accomplish the object for their enactment. Those in force in 1901 were shown to be effective and no further restrictions should be placed upon fishing in that stream in the known years of abundance. It was demonstrated in 1902 that these regulations did not produce the desired result, so it is evident that more stringent restrictions should be enforced during the years of poor runs." Babcock fully realized the difficulties inherent in the situation, particularly the very important one that further reduction of fishing in Canadian waters would only mean that Canadian fishermen and canners were being penalized for the benefit of American fishing interests. Mr. T. R. Kershaw, Fisheries Commissioner for the State of Washington, also saw the injustice of the situation and discussed the matter with Babcock at Victoria with a view to rectifying the situation. Kershaw's proposal was that of establishing an American hatchery on the Fraser River. Babcock felt that remedial measures were by treaty arrangement. The conference was not encouraging, and the proposal was later made to Professor Prince at Ottawa and Senator Foster at Washington. International correspondence on the subject followed. The Canadian Government was not favourably inclined towards the suggestion. Bowers, then U.S. Commissioner of Fisheries, suggested a conference between the representatives of his Bureau and those of Washington State Fisheries Commission, the Canadian Department of Marine and Fisheries, and the Fisheries Department of British Columbia.

In the meantime, the situation in the Fraser River fisheries was becoming strained. The catch of 1903 was a very poor one and both sides were ready to put the blame on the other. No effective action was taken, however, and it remained for Canada to take the initiative, and on July 22nd, 1905, another Commission was appointed by Order in Council to examine the entire fisheries situation on the British Columbia coast. Stress was laid, however, on the fact that the Fraser River question urgently demanded solution. Professor Prince was again Chairman of this Commission, which later became known as the " Prince Commission." The work of the Commission commenced on September 19th, 1905. After a year of sittings, hearings, and a conference with the Washington State Fish Commission, which had recently been appointed by the State of Washington, the Prince Commission was ready to make certain interim recommendations to the Federal Government. It was not prepared to make these recommendations, however, unless the Washington State Commission was prepared in its turn to make similar recommendations to its Government. This was agreed to by the Washington Commission in 1906. Action on these recommendations was first taken by the State of Washington on March 19th, 1907. It was not until June 8th, 1908, that Canadian action was taken. While these negotiations between Canada and the State of Washington were helpful, they promised little, however, as the recommendations required concurrent regulations on either side of the International Boundary. The degree of co-operation was bound to vary with the changes in the complexion of political affairs on each side of the line. The Provincial Department of Fisheries realized at this time that the paramount need was for a joint Commission with control over the international waters. However, such a Commission could not be established through negotiations of the Canadian Government with the Washington State Government, the latter not having treaty-making powers necessary; hence negotiations between the two Federal Governments commenced, and on April 11th, 1908, the Bryce-Root Treaty was signed. Ratifications were exchanged on June 4th and the treaty was proclaimed on July 1st, 1908. The treaty provided for an International Commission, assisted by one expert named by each Government; the Commission to be empowered to draw up regulations which were to be international in scope. The Commission was also to study the problem of fish-culture and make recommendations in regard to this matter. It was to exercise its

control throughout the duration of the convention, and its regulations, as drawn up, were to remain in force for a period of four years, and thereafter until one year from the date upon which either Government notified the other of its desire for a change in the regulations.

The Commission appointed consisted of Dr. David Starr Jordan, of Stanford University, for the United States, and Professor E. E. Prince, Canadian Commissioner of Fisheries, for Canada. A code of regulations was agreed upon by these Commissioners on May 29th, 1909, and specific recommendations applicable to the Fraser River fishing district were made. These eminently desirable regulations met with a sad fate. The Canadian Government amended the " Fisheries Act " during the following parliamentary session so as to permit the proclamation of the regulations whenever the United States should see fit to adopt similar legislation, but political activity in the State of Washington was too strong. By 1914 the Canadian Government had become extremely impatient at the delay in action on the part of the United States, and notified that Government that it would abrogate the treaty unless the latter took legislative steps necessary to make the convention effective. An appeal by President Wilson that Congress expedite the dispatch of the required Bill was ignored, and on October 19th, 1914, the Canadian Government notified the United States that it was its intention to assume its liberty of action in the matters with which the treaty was concerned. Thus, these negotiations which had promised so much came to an ignominious end. The State of Washington, having been satisfied that its sovereign rights were not impaired, again assumed its 1906 policy of negotiating with the Canadian Federal Government. However, the somewhat strained feeling between the people of Canada and the United States, which obtained until the latter country entered the war in 1917, constituted a temporary but effective barrier to international fisheries negotiations. It was not until 1917 that several important developments happened which changed the situation, principally the entry of the United States into the World War as an ally, the shortage of food, and the failure of the expected big run of Fraser River sockeye to materialize. These all combined to renew the willingness of the two countries to assume negotiations for an international treaty. The situation was considered sufficiently serious by both countries to justify the appointment of an investigatory Commission, and a Canadian-American Fisheries Conference was appointed in December, 1917. This Commission or Conference was composed of J. D. Hazen, G. J. Desbarats, and W. A. Found, representing Canada, while William C. Redfield, E. F. Sweet, and H. M. Smith represented the United States. An extensive survey revealed to the Commission that the conditions in the Fraser River fisheries had now become extremely serious, a $30,000,000 industry having fallen off to a $3,000,000 one and being threatened with complete extinction by overfishing. Both sides were apparently eager for international action. However, the situation was complicated by the unwillingness of the United States Federal Government to invade the sovereign rights of the State of Washington. On the basis of the Hazen-Redfield report, negotiations for the conclusion of a new international treaty commenced. This convention, the terms of which substantially were the same as the treaty of 1908, was approved by the Canadian House of Commons on October 21st, 1919, but on the American side of the border Washington State requested that the Senate refuse to ratify the convention, which again effectively killed the treaty.

The Canadian Government, therefore, dispatched a delegation to the Pacific Coast for the purpose of taking up the matter with the Fisheries Board of the State of Washington, which had recently been appointed with administrative powers sufficiently wide to enable it to take whatever steps were necessary for effectually dealing with the matter. The conference was held by the negotiants in December, 1921, and it was agreed by both sides that it was desirable to stop all fishing in the Fraser River district for a period of five years. A satisfactory conclusion, however, was not reached because the Canadian representatives demanded that at the end of the proposed five-year period of closed fishing, effective regulations should be made to properly regulate the fishery thereafter, otherwise the benefits of the five-year close period would soon disappear. Washington State representatives were not willing to accede to this proposal and the conference broke up abruptly.

Still another Fisheries Commission was appointed by Canada by Order in Council on July 10th, 1922. Its main task was to pick up the threads of negotiations where they had been abruptly dropped by the previous delegation. Recommendations of this Commission received scant consideration by the representative Governments and the condition of the

salmon-runs to the Fraser River continued to diminish. The combined Canadian and American sockeye-pack for the year 1928 was one of the three poorest years on record. As a consequence, negotiations for the conclusion of an international fisheries treaty again began. Except in one important respect, the new treaty differed very little from its precursors of 1908 and 1919. The important difference lay in a clause which provided that the International Commission, the establishment of which the treaty contemplated, was to devise regulations which would insure an approximately equal division of the season's sockeye-catch between Canadian and American fishermen. While this treaty was in its proper aspects satisfactory, a new development on the Pacific Coast promised to make the treaty, as it stood, ineffective. In 1928 large numbers of the American purse-seine fishermen decided to try their luck in the extraterritorial waters west of the entrance to the Strait of Juan de Fuca. Here, subject to no restrictions, they found a salmon-fisherman's paradise, for they were able to intercept the fish before the latter entered the Straits. Partly caused by this new development and partly caused by other minor flaws, legislative consideration of the treaty was temporarily halted, and the document was revised so as to lessen the powers of the contemplated International Commission and also to introduce provisions for the control of all nationals of either country who fished in the international waters beyond the Strait of Juan de Fuca. In this amended form the treaty was approved by the Canadian House of Commons on May 26th, 1930. Formal ratification, however, did not take place until July, 1937. The main opposition to the treaty arose from the purse-seiners of the State of Washington, who did not wish to be deprived of their fishing in extraterritorial waters, free of any regulation. During the interim, 1928 to 1934, Canadians had more or less given up hope of a successful conclusion of the pending treaty. Early in 1934 an exchange of correspondence between Governor Clarence D. Martin, of the State of Washington, and Premier T. D. Pattullo, of the Province of British Columbia, resulted in an informal conference being held in Seattle between interested parties on both sides of the line. Present at the conference were Governor Martin, of the State of Washington; B. M. Brennan, Director of the Washington State Department of Fisheries; Frank T. Bell, United States Commissioner of Fisheries; Miller Freeman, publisher; Dr. W. F. Thompson, Director of Investigations for the International Pacific Halibut Commission; Hon. Geo. S. Pearson, Commissioner of Fisheries for British Columbia; W. A. Found, Deputy Minister of Fisheries, Federal Fisheries Department; George J. Alexander, Assistant Commissioner of Fisheries for the Province of British Columbia; and J. P. Babcock, former Assistant Commissioner of Fisheries for British Columbia. At this conference the whole matter was reviewed and brought up to date, and largely as a result thereof the opposition of the American purse-seiners was gradually overcome. Another factor which, no doubt, had its effect on the final result was the passage by the people of Washington State of Initiative No. 77. This measure prohibited the use of traps in waters over which the State had jurisdiction. Previous to the passage of this measure, the American percentage of the total catch of sockeye proceeding to the Fraser River amounted to from 60 per cent. to 75 per cent. Immediately after the passage of Initiative No. 77, the position was reversed and Canadian gear caught the larger percentage of Fraser River fish. One of the provisions in the treaty under review required that the Commission should regulate the fishery in such a way that, as near as practicable, the catch should be equally divided between the nationals of both countries. Thus the clause which had previously been largely instrumental in effectively blocking the ratification of the treaty was now largely responsible for the final passage.

In order to satisfy the position of the American fishermen, the original treaty of 1930, as finally ratified, contains three added conditions under which the treaty was approved by Canada and the United States. A copy of the treaty, together with the conditions attached, will be found printed in the Appendix to this report.

The treaty of 1930 was signed early in 1937; formal ratification, however, did not take place until July 28th, 1937. The Canadian members of the Commission were appointed April 15th, 1937. These men are A. L. Hager, President and General Manager of the Canadian Fishing Company, Limited; Tom Reid, Member of Parliament for New Westminster District; and W. A. Found, Deputy Minister of Fisheries, Federal Fisheries Department, Ottawa. It was hoped that a similar action by the United States in naming its representatives on the Commission would be taken early in 1937, so that the Commission would commence to function without undue loss of time. However, the American representatives were not appointed until

August 24th, which, of course, was too late for any effective action by the Commission in that year. The American representatives are Charles E. Jackson, Assistant Commissioner of Fisheries for the United States; B. M. Brennan, Director of Fisheries for the State of Washington; and E. W. Allen, Secretary of the International Pacific Halibut Commission. Shortly after the appointment of the American representatives, the Commission held its first meeting in Vancouver for the purpose of organizing. A. L. Hager was elected Chairman, while B. M. Brennan was named Secretary. The Commission later named Dr. W. F. Thompson as Director of Investigations. Dr. Thompson still retains his position as Director of Investigations for the International Pacific Halibut Commission.

According to the conditions attached to the treaty a period of eight years was to lapse before this Commission may make regulations. This time will be utilized, no doubt, to thoroughly investigate the problem relating to the restoration of the Fraser River sockeye-runs, and it is hoped that the Commission will be in possession of sufficient factual data by that time to enable it to effectively regulate this fishery with a view to rehabilitating the runs in as short a time as possible to something like this river's former activity.

APPENDICES.

CONTRIBUTIONS TO THE LIFE-HISTORY OF THE SOCKEYE SALMON. (No. 23.)

By Wilbert A. Clemens, Ph.D., Director, Pacific Biological Station, Nanaimo, B.C.

INTRODUCTION.

The runs of sockeye salmon to the four main river systems of British Columbia were very close to expectation. The total pack for the four areas was 305,421 cases, which was nearly 100,000 less than in 1936. On the other hand, the reports of spawning conditions as supplied by the Dominion Department of Fisheries indicate good escapements for the particular cycle-years and in relation to the commercial catches.

The Fraser River run belongs to the cycle-years which once produced packs exceeding 2,000,000 cases. Since 1917 the cycle has maintained itself at a fairly steady level, producing approximately 160,000 cases per year. The pack of 1937 was 160,531 cases and the escapement was reported as good.

Rivers Inlet had a fairly large return with a medium-sized pack of 84,832 cases and a satisfactory escapement.

The run to the Skeena River was relatively small, but all that could be expected from the brood-years. Although the pack amounted to only 42,491 cases, the escapements to the Lakelse and Babine areas were reported as excellent.

The Nass River return as represented by the pack of 17,567 cases was small and the escapement, particularly to the Meziadin Lake district, was stated to be good.

DESIGNATION OF AGE-GROUPS.

Two outstanding features in the life-history of the fish have been selected in designating the age-groups—namely, the age at maturity and the year of its life in which the fish migrated from fresh water. These are expressed symbolically by two numbers, one in large type, which indicates the age of maturity, and the other in small type, placed to the right and below, which signifies the year of life in which the fish left the fresh water. The age-groups which are met most commonly in these river systems are:—

3_1, 4_1—the "sea-types" or fish which migrate in their first year and mature at the ages of three and four years respectively.

3_2—"the grilse," usually males, which migrate in their second year and mature at the age of three.

4_2, 5_2—fish which migrate in their second year and mature at the ages of four and five respectively.

5_3, 6_3—fish which migrate in their third year and mature at the ages of five and six respectively.

6_4, 7_4—fish which migrate in their fourth year and mature at the ages of six and seven respectively.

1. THE FRASER RIVER SOCKEYE RUN OF 1937.

(1.) General Characteristics.

The total pack of Fraser River sockeye in the season of 1937 amounted to 160,531 cases, of which 100,272 cases were packed in the Province of British Columbia and 60,259 cases in the State of Washington. The percentages of these two packs are 62 and 38, respectively (Table I.).

Included in the number of cases attributed to the Fraser River are 33,689 cases of fish caught in Johnstone Strait. This is 21 per cent. of the total pack, and again indicates a run of considerable size coming in by the northern route.

The fish were well distributed throughout the river system in 1937. In the upper areas approximately 6,000 were reported in the Stuart Lake areas, small numbers in the Francois Lake and Quesnel systems, at least 110,000 to Chilco Lake, light runs to the Shuswap and North Thompson areas, and at least 60,000 to the Seton-Anderson Lakes. In the lower areas, the escapements to Harrison and Pitt Lakes were reported as good, but only 3,055 by actual count reached Cultus Lake.

While this review of the spawning escapements would seem to be encouraging, the fact that the total escapement was very small in relation to the catch must not be overlooked. The two large escapements were those to Chilco and Seton Lakes, and together they accounted for only 170,000 fish. It is doubtful if the combined escapements to all other areas would much exceed half the above number. As against this, the pack represents approximately 3,250,000 fish.

The year 1938 brings around the cycle of the large late runs to the Fraser River. It will be recalled that in 1926 a large number of sockeye appeared in Adams River late in the season. In 1930 there was a very large return with a total pack of 455,886 cases and an escapement to Adams River estimated at 400,000 fish. In 1934 there was again a large pack of 491,817 cases and an estimated escapement to Adams River of 500,000 fish. There is thus every reason to expect a large return in 1938.

Large runs to the upper Fraser River have usually been preceded by the appearance of relatively large numbers of three-year-old fish (grilse). Grilse have been particularly abundant in the run of 1937, and this fact may be taken as a further indication of a large return of four-year-old sockeye in 1938.

(2.) Age-groups.

The material for this year's study consists of data and scales from 1,693 sockeye salmon taken at random from the catch in the traps at Sooke from May 10th to September 14th in thirty-four samplings. The 4_2 age-group is represented by 1,318 individuals or 77.9 per cent., the 5_2's by 204 or 12 per cent., the 5_3's by 90 or 5.3 per cent., the 6_3's by 3 fish, and the 3_2's (grilse) by 70 or 4.1 per cent. In addition there were four fish of the 4_1, three of the 3_1, and one of the 4_3 age-groups.

These distributions and percentages are not unusual, as shown by Table II., except in the case of the 3_2 age-group which has the highest representation since the year 1920.

The information concerning age-groups, lengths, weights, etc., are given in Tables III. and IV.

(3.) Lengths and Weights.

The outstanding feature of the fish in the 1937 run is the small size. The average lengths of the fish of the dominant 4_2 age-group are greatly below the average of the past seventeen years, while their average weights are the lowest on record. The average weight of the males is a pound less than that of the past fourteen years and that of the females almost three-quarters of a pound (Tables V. and VI.).

(4.) Distribution of the Sexes.

The total number of males in the samplings is 825 and of females 868, percentages of 49 and 51, respectively. In the dominant 4_2 age-group the sexes are approximately equal, with percentages of 48 for the males and 52 for the females. Among the 5_2 and 5_3 age-groups the males are decidedly in the minority (Table VII.). On the other hand, the 3_2 age-group (grilse) is represented by sixty-nine males and only one female.

Table I.—Fraser River Packs, 1895–1937, arranged in accordance with the Four-year Cycle.

B.C.	1895—	395,984	1896—	356,984	1897—	860,459	1898—	256,101
Wash.		65,143		72,979		312,048		252,000
Total		461,127		429,963		1,172,507		508,101
B.C.	1899—	480,485	1900—	229,800	1901—	928,669	1902—	293,477
Wash.		499,646		228,704		1,105,096		339,556
Total		980,131		458,504		2,033,765		633,033
B.C.	1903—	204,809	1904—	72,688	1905—	837,489	1906—	183,007
Wash.		167,211		123,419		837,122		182,241
Total		372,020		196,107		1,674,611		365,248
B.C.	1907—	59,815	1908—	74,574	1909—	585,435	1910—	150,432
Wash.		96,974		170,951		1,097,904		248,014
Total		156,789		245,525		1,683,339		398,446
B.C.	1911—	58,487	1912—	123,879	1913—	719,796	1914—	198,183
Wash.		127,761		184,680		1,673,099		335,230
Total		186,248		308,559		2,392,895		533,413
B.C.	1915—	91,130	1916—	32,146	1917—	148,164	1918—	19,697
Wash.		64,584		84,637		411,538		50,723
Total		155,714		116,783		559,702		70,420
B.C.	1919—	38,854	1920—	48,399	1921—	39,631	1922—	51,832
Wash.		64,346		62,654		102,967		48,566
Total		103,200		111,053		142,598		100,398
B.C.	1923—	31,655	1924—	39,743	1925—	35,385	1926—	85,689
Wash.		47,402		69,369		112,023		44,673
Total		79,057		109,112		147,408		130,362
B.C.	1927—	61,393	1928—	29,299	1929—	61,569	1930—	103,692
Wash.		97,594		61,044		111,898		352,194
Total		158,987		90,343		173,467		455,886
B.C.	1931—	40,947	1932—	65,769	1933—	52,465	1934—	139,238
Wash.		87,211		81,188		126,604		352,579
Total		128,158		146,957		179,069		491,817
B.C.	1935—	62,822	1936—	184,854	1937—	100,272		
Wash.		54,677		59,505*		60,259		
Total		117,499		244,359		160,531		

* This figure includes 16,611 cases of fish caught in British Columbia waters but packed in the State of Washington.

Table II.—Fraser River Sockeyes, Vancouver Island Traps, Percentages of the Year-classes from 1920 to 1937.

Year.	4_2	5_2	5_3	6_3	3_1	4_1	3_2
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
1923	67.1	10.8	3.9	1.2	6.7	9.9	0.4
1924	68.2	18.7	9.2	0.5	0.5	2.0	0.8
1925	67.9	24.9	3.4	0.2	2.2	.....	0.6
1926	66.1	20.3	5.2	1.6	2.0	2.5	2.1
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
1929	77.3	11.9	7.8	0.4	0.1	0.1	2.5
1930	75.7	19.6	2.8	0.5	0.2	0.7	0.5
1931	79.0	13.1	1.3	.....	2.0	2.0	2.6
1932	80.7	13.5	2.8	.....	0.8	0.8	1.4
1933	83.6	9.2	1.9	.....	1.4	0.5	3.4
1934	84.2	10.7	2.3	.....	0.1	1.2	1.5
1935	71.3	22.9	2.3	0.3	0.4	1.3	1.5
1936	83.0	11.7	4.1	0.5	.....	.....	0.7
1937	77.9	12.0	5.3	.....	.....	.....	4.1

Table III.—Fraser River Sockeyes, 1937, 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_2		
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
15	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	2
15½	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	2
16½	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
17	.....	.....	.....	.....	.....	.....	.....	.....	5	.....	5
17½	2	2	.....	.....	.....	.....	.....	.....	4	.....	8
18	3	5	.....	.....	.....	.....	.....	.....	19	1	28
18½	1	4	.....	.....	.....	.....	.....	.....	22	.....	27
19	1	4	.....	.....	.....	.....	.....	.....	9	.....	14
19½	4	4	.....	.....	.....	.....	.....	.....	2	.....	10
20	4	6	.....	.....	2	.....	.....	.....	.....	.....	12
20½	5	8	.....	1	.....	.....	.....	.....	.....	.....	14
21	19	21	2	2	1	.....	.....	.....	3	.....	48
21½	34	77	2	1	.....	1	.....	.....	.....	.....	115
22	104	160	.....	2	2	4	.....	.....	1	.....	273
22½	107	143	2	7	5	16	.....	.....	.....	.....	280
23	113	142	1	4	8	10	.....	.....	.....	.....	278
23½	79	74	4	13	5	8	.....	.....	.....	.....	183
24	89	27	5	16	3	9	.....	.....	.....	.....	149
24½	35	6	6	19	2	1	.....	.....	.....	.....	69
25	19	6	7	31	6	5	1	2	.....	.....	77
25½	6	.....	15	11	1	.....	.....	.....	.....	.....	33
26	3	.....	12	9	1	.....	.....	.....	.....	.....	25
26½	.....	.....	13	3	.....	.....	.....	.....	.....	.....	16
27	1	.....	8	.....	.....	.....	.....	.....	.....	.....	9
27½	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	2
28	.....	.....	4	.....	.....	.....	.....	.....	.....	.....	4
28½	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	2
29	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals	629	689	85	119	36	54	1	2	69	1	1,685
Average lengths	22.9	22.4	25.5	24.4	23.4	23.2	25.0	25.0	18.3	18.0	.....

Table IV.—Fraser River Sockeyes, 1937, Vancouver Island Traps, 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		3_2		
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
2	-----	3	-----	-----	-----	-----	-----	-----	5	-----	8
2½	5	9	-----	-----	-----	-----	-----	-----	14	-----	28
3	11	10	-----	-----	1	-----	-----	-----	37	1	60
3½	16	40	1	3	1	1	-----	-----	8	-----	70
4	76	135	3	1	4	7	-----	-----	3	-----	229
4½	169	218	2	10	5	11	-----	-----	1	-----	416
5	130	148	2	14	7	13	-----	-----	1	-----	315
5½	100	85	7	13	8	9	-----	-----	-----	-----	222
6	73	29	10	26	2	7	1	1	-----	-----	149
6½	25	9	15	20	2	4	-----	1	-----	-----	76
7	18	1	8	17	6	2	-----	-----	-----	-----	52
7½	4	1	10	6	-----	-----	-----	-----	-----	-----	21
8	2	1	14	8	-----	-----	-----	-----	-----	-----	25
8½	-----	-----	4	1	-----	-----	-----	-----	-----	-----	5
9	-----	-----	5	-----	-----	-----	-----	-----	-----	-----	5
9½	-----	-----	2	-----	-----	-----	-----	-----	-----	-----	2
10	-----	-----	2	-----	-----	-----	-----	-----	-----	-----	2
Totals	629	689	85	119	36	54	1	2	69	1	1,685
Average weights	5.0	4.7	6.9	6.1	5.3	5.1	6.0	6.3	3.0	3.0	-----

Table V.—Fraser River Sockeyes, Vancouver Island Traps, Average Lengths in Inches of Principal Age-groups, 1920 to 1937.

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.
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	-----
1929	23.7	22.9	25.5	24.3	24.8	23.7	26.2	24.8	-----	23.0	25.0	24.0
1930	24.4	23.6	26.2	24.6	24.4	23.5	26.7	26.0	22.5	20.7	24.7	23.2
1931	23.4	22.8	25.6	24.6	24.3	24.1	-----	-----	21.5	21.6	25.3	22.5
1932	23.6	22.8	25.3	24.2	24.6	23.2	-----	-----	21.9	21.5	23.0	23.4
1933	23.1	22.7	24.9	24.0	24.0	22.9	27.0	-----	22.5	22.3	24.3	23.8
1934	23.9	23.2	24.2	24.1	23.0	23.0	-----	-----	-----	-----	23.5	22.1
1935	23.8	22.8	26.4	24.9	23.6	22.5	25.5	24.0	22.2	22.2	23.0	23.5
1936	23.9	23.2	25.8	24.3	23.2	23.2	-----	25.3	-----	-----	-----	-----
Average lengths	23.7	22.9	25.5	24.4	23.8	23.0	25.9	24.8	22.3	21.7	24.3	23.7
1937	22.9	22.4	25.5	24.4	23.1	23.2	25.0	25.0	22.5	-----	24.7	22.7

Table VI.—Fraser River Sockeyes, Vancouver Island Traps, Average Weights in Pounds of Principal Age-groups, 1922 to 1937.

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.
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
1929	6.0	5.3	7.2	6.3	6.7	5.9	7.5	6.5	.....	5.0	6.5	6.0
1930	6.9	6.1	7.7	6.7	6.6	6.0	7.7	6.0	5.5	4.2	6.3	5.8
1931	5.8	5.2	7.3	6.5	6.1	6.3	.....	.....	4.5	4.6	7.3	6.0
1932	6.1	5.4	7.3	6.7	6.6	5.4	.....	.....	4.9	4.4	5.7	5.9
1933	5.4	5.0	7.0	6.3	6.0	5.2	8.8	.....	5.1	4.9	6.5	6.1
1934	6.3	5.6	6.5	6.4	5.2	5.1	.....	.....	.....	.....	6.6	5.1
1935	6.0	5.2	8.6	7.1	6.2	5.0	6.0	6.0	5.2	5.5	5.0	5.6
1936	6.3	5.7	7.7	6.5	5.5	5.2	.....	7.2	.....	.....	.....	.....
Average weights	6.1	5.4	7.3	6.5	6.0	5.4	7.6	6.3	5.5	4.9	7.0	6.2
1937	5.0	4.7	6.9	6.1	5.3	5.1	6.0	6.3	5.0	.....	6.7	5.0

Table VII.—Fraser River Sockeyes, Percentages of Males and Females of the 4_2, 5_2, and 5_3 Age-groups, 1915 to 1937.

Year.	4_2		5_2		5_3		Per Cent. Total Males.	Per Cent. Total Females.
	M.	F.	M.	F.	M.	F.		
1915	55	45	57	43	53	47	54	46
1916	49	51	50	50	38	62	51	49
1917	50	50	50	50	49	51	50	50
1918	51	49	56	44	57	43	52	48
1919	53	47	53	47	48	52	52	48
1920	50	50	47	53	47	53	49	51
1921	48	52	42	58	43	57	47	53
1922	49	51	52	48	46	54	53	47
1923	51	49	55	45	46	54	50	50
1924	51	49	50	50	47	53	51	49
1925	46	54	53	47	43	57	49	51
1926	52	48	48	52	50	50	51	49
1927	48	52	58	42	41	59	48	52
1928	53	47	64	36	66	34	56	44
1929	46	54	55	45	50	50	49	51
1930	42	58	55	45	44	56	45	55
1931	47	53	56	44	42	58	48	52
1932	44	56	58	42	30	70	46	54
1933	49	51	50	50	47	53	51	49
1934	54	46	56	44	46	54	55	45
1935	48	52	52	48	35	65	48	52
1936	42	58	47	53	44	56	43	57
1937	48	52	42	58	40	60	49	51
Average	49	51	53	47	46	54	50	50

2. THE RIVERS INLET SOCKEYE RUN OF 1937.

(1.) General Characteristics.

The sockeye-salmon run to Rivers Inlet in 1937 produced 84,832 cases, which may be termed a medium-sized pack, and an escapement which has been reported as satisfactory. The pack is termed medium-size because it falls within the range of 60,000 to 100,000 cases. Less than 60,000 cases is considered small and greater than 100,000, large. Over the period from 1907 to 1935, inclusive, the packs on this basis have been distributed as follows: Small four, medium seventeen, large eight. Because of the varying proportions of four- and five-year-old fish, it is difficult to discern cycles, but one five-year cycle stands out—namely, 1910–15–20–25–30–35—which has consistently produced packs of over 100,000 cases. The year 1937 is an example of one which cannot be identified with a five in preference to a four-year cycle.

The return to Rivers Inlet in 1938 will be the result of the spawnings of 1933 and 1934. In the former year the pack was 83,507 cases and the escapement was reported as very good. In the latter year the pack was 76,923 cases with only an average escapement. The factors which determine the age of maturity are not definitely known. It is impossible, therefore, to determine what proportion of the progeny of a given year's spawning will return as four-year-olds and what as five-year-olds. Taking all the available data into consideration, it would appear that the return of 1938 should be one producing a medium-sized pack.

(2.) Age-groups.

The usual data were obtained from 1,824 individuals taken in twenty-two random samplings from July 1st to August 5th. The 4_2 age-group is represented by 1,089 individuals or 60 per cent.; the 5_2 by 682 or 37 per cent.; the 5_3 by forty-four or 2 per cent.; and the 6_3 by 9 or approximately 0.5 per cent. A single male of the 4_1 age-class occurred. It has not been included in the tabulations or calculations.

While the proportions of the 4_2 and 5_2 age-groups over the period of the past twenty-four years has varied greatly the average has been approximately 50:50. The extremes have been from 5:95 to 81:16 (Table IX.). The percentages in 1937 are somewhat in favour of the 4_2's, but not exceptional.

(3.) Lengths and Weights.

The average lengths and weights of both sexes in the 4_2 and 5_2 age-groups are somewhat below the averages for the past twenty-two and twenty-five years (Tables X., XI., XII., and XIII.). For both lengths and weights the averages of the females in the 4_2 age-group are almost equal to those of the males. It is interesting to note that in some years the values have exceeded those of the males. It is possible that the size of mesh used is such that the smaller females escape capture.

(4.) Distribution of the Sexes.

The total number of males in the samplings is 883 and of females 941, percentages of 48 and 52 respectively. The distribution is not much removed from the average percentages of the past twenty-two years—namely, 51 and 49. The males in the 4_2 age-group are in the majority and in the minority in the 5_2 age-group (Table XIV.).

Table IX.—Rivers Inlet Sockeyes, Percentages of Age-groups in Runs of Successive Years and Packs.

Year.	Percentage of Individuals.			
	4_2	5_2	5_3	6_3
1907 (87,874 cases)	---	---	---	---
1908 (64,652 cases)	---	---	---	---
1909 (89,027 cases)	---	---	---	---
1910 (126,921 cases)	---	---	---	---
1911 (88,763 cases)	---	---	---	---
1912 (112,884 cases)	21	79	---	---
1913 (61,745 cases)	80	20	---	---
1914 (89,890 cases)	35	65	---	---
1915 (130,350 cases)	13	87	---	---
1916 (44,936 cases)	26	74	---	---
1917 (61,195 cases)	39	61	---	---
1918 (53,401 cases)	57	43	---	---
1919 (56,258 cases)	46	54	---	---
1920 (121,254 cases)	5	95	---	---
1921 (46,300 cases)	49	51	---	---
1922 (60,700 cases)	81	18	1	---
1923 (107,174 cases)	74	24	2	---
1924 (94,891 cases)	43	54	2	1
1925 (159,554 cases)	23	77	---	---
1926 (65,581 cases)	59	38	2	1
1927 (64,461 cases)	81	16	3	---
1928 (60,044 cases)	55	40	4	1
1929 (70,260 cases)	77	18	3	2
1930 (119,170 cases)	49	48	2	1
1931 (76,428 cases)	53	44	2	1
1932 (69,732 cases)	67	27	5	1
1933 (83,507 cases)	44	55	1	---
1934 (76,923 cases)	77	20	2	1
1935 (135,038 cases)	57	41	1	1
1936 (46,351 cases)	53	46	1	---
1937 (84,832 cases)	60	37	2	---

Table X.—Rivers Inlet Sockeyes, 1937, 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.	
19	2	-----	-----	-----	-----	-----	-----	-----	2
19½	5	4	-----	-----	-----	-----	-----	-----	9
20	27	12	-----	-----	-----	-----	-----	-----	39
20½	84	44	-----	2	2	3	-----	-----	135
21	136	77	1	2	2	3	-----	-----	221
21½	78	58	3	3	4	-----	-----	-----	146
22	71	62	5	18	-----	2	-----	-----	158
22½	41	62	9	33	3	1	-----	-----	149
23	63	57	26	68	4	2	1	1	222
23½	49	31	17	87	3	4	1	-----	192
24	59	13	27	80	5	3	-----	2	189
24½	32	5	22	69	1	-----	-----	1	130
25	9	2	24	60	-----	-----	-----	1	96
25½	4	-----	18	38	1	1	-----	-----	62
26	2	-----	18	24	-----	-----	-----	-----	44
26½	-----	-----	13	2	-----	-----	1	-----	16
27	-----	-----	9	1	-----	-----	-----	1	11
27½	-----	-----	1	2	-----	-----	-----	-----	3
Totals	662	427	193	489	25	19	3	6	1,824
Ave. lengths	22.0	21.9	24.5	24.0	22.8	22.6	24.3	24.6	------

Table XI.—Rivers Inlet Sockeyes, 1937, 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	-----	-----	-----	-----	-----	-----	4
3½	45	29	-----	-----	-----	2	-----	-----	76
4	189	126	1	9	7	5	-----	-----	337
4½	185	163	13	59	6	1	-----	-----	427
5	105	80	32	75	6	5	1	1	305
5½	87	19	37	103	2	3	-----	2	253
6	38	6	35	99	2	2	1	-----	183
6½	9	2	26	77	1	1	-----	1	117
7	2	-----	21	45	1	-----	-----	1	70
7½	-----	-----	16	18	-----	-----	-----	-----	34
8	-----	-----	10	3	-----	-----	-----	1	14
8½	-----	-----	2	1	-----	-----	1	-----	4
Totals	662	427	193	489	25	19	3	6	1,824
Ave. weights	4.6	4.4	6.1	5.8	4.9	4.8	6.5	6.3	-----

Table XII.—Rivers Inlet Sockeyes, Average Lengths in Inches of the 4_2 and 5_2 Groups, 1912 to 1937.

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
1929	22.6	22.2	25.2	25.3
1930	22.7	22.6	26.0	25.2
1931	21.9	22.0	25.2	24.8
1932	22.4	22.4	25.2	24.6
1933	22.1	22.0	25.5	24.7
1934	22.4	22.2	25.6	25.0
1935	22.4	22.4	25.8	25.1
1936	21.0	20.9	24.6	23.4
Average lengths	22.5	22.4	25.4	24.7
1937	22.0	21.9	24.5	24.0

Table XIII.—Rivers Inlet Sockeyes, Average Weight in Pounds of the 4_2 and 5_2 Groups, 1914 to 1937.

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
1929	5.0	4.8	6.6	6.7
1930	4.9	4.8	7.5	6.9
1931	4.5	4.6	6.7	6.4
1932	4.7	4.7	6.5	6.5
1933	4.8	4.6	7.3	6.6
1934	4.9	4.6	7.3	6.7
1935	4.5	4.3	6.9	6.1
1936	4.9	4.1	7.9	6.7
Average weights	5.0	4.9	7.0	6.5
1937	4.6	4.4	6.1	5.8

Table XIV.—Rivers Inlet Sockeyes, Percentages of Males and Females of the 4_2 and 5_2 Age-groups, 1915 to 1937.

Year.	4_2		5_2		Per Cent. Total Males.	Per Cent. Total Females.
	M.	F.	M.	F.		
1915	---	---	---	---	45	55
1916	65	35	43	57	49	51
1917	63	37	39	61	48	52
1918	79	21	49	51	66	34
1919	77	23	41	59	58	42
1920	74	26	48	52	49	51
1921	63	37	40	60	51	49
1922	66	34	38	62	61	39
1923	71	29	31	69	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	35	64	62	38
1928	63	37	30	70	50	50
1929	57	43	36	64	53	47
1930	56	44	37	63	47	53
1931	59	41	33	67	47	53
1932	54	46	28	72	47	53
1933	56	44	32	68	42	58
1934	55	45	27	73	49	51
1935	63	37	39	61	53	47
1936	43	57	20	80	32	68
1937	61	39	28	72	48	52
Average	63	37	35	65	51	49

3. THE SKEENA RIVER SOCKEYE RUN OF 1937.

(1.) General Characteristics.

The return to the Skeena would appear to have fulfilled expectations. It produced a relatively small pack of 42,491 cases, but a very good escapement was reported from both the Lakelse and Babine areas.

It may be recalled that production reached a low point in the years of 1933, 1934, and 1935. Limitation of catch in the succeeding cycle-years has been necessary to provide increased escapements for the restoration of the runs of these cycle years.

The sockeye of the Skeena River mature for the most part at four and five years of age. The return of 1938 will therefore be derived from the spawnings of 1933 and 1934. In the former year the pack was 30,506 cases, the smallest on record, and the escapement relatively small. In the latter year, the pack was 70,655 cases and the escapement was reported as not being "adequate." In view of these facts the inevitable conclusion is that the return of 1938 will be small. Only some at present unknown condition could produce an exceptionally large return.

Table XV.—Skeena River Sockeyes, Percentages of Age-groups in Runs of Successive Years and Packs.

Year.	Percentage of Individuals.			
	4_2	5_2	5_3	6_3
1907 (108,413 cases)	----	----	----	----
1908 (139,846 cases)	----	----	----	----
1909 (87,901 cases)	----	----	----	----
1910 (187,246 cases)	----	----	----	----
1911 (131,066 cases)	----	----	----	----
1912 (92,498 cases)	57	43	----	----
1913 (52,927 cases)	50	50	----	----
1914 (130,166 cases)	25	75	----	----
1915 (116,553 cases)	36	64	----	----
1916 (60,923 cases)	34	38	13	18
1917 (65,760 cases)	57	29	9	5
1918 (123,322 cases)	51	34	9	6
1919 (184,945 cases)	27	60	9	4
1920 (90,869 cases)	15	71	6	8
1921 (41,018 cases)	69	22	6	3
1922 (96,277 cases)	70	16	12	2
1923 (131,731 cases)	56	29	8	7
1924 (144,747 cases)	23	69	7	1
1925 (77,784 cases)	51	45	3	1
1926 (82,360 cases)	62	26	9	3
1927 (83,996 cases)	62	28	9	1
1928 (34,559 cases)	51	39	7	3
1929 (78,017 cases)	62	30	6	2
1930 (132,372 cases)	39	52	8	1
1931 (93,023 cases)	40	30	28	2
1932 (59,916 cases)	44	37	7	12
1933 (30,506 cases)	57	36	5	2
1934 (54,558 cases)	58	34	7	1
1935 (52,879 cases)	49	31	18	2
1936 (81,973 cases)	67	20	11	2
1937 (42,491 cases)	45	40	11	4

(2.) Age-groups.

Scales and length, weight and sex data were obtained from 1,597 fish from July 6th to August 4th in twelve random samplings. The 4_2 age-group is represented by 720 individuals or 45 per cent., the 5_2's by 631 or 40 per cent., the 5_3's by 183 or 11 per cent., and the 6_3's by 63 or 4 per cent. The percentage of 4_2's is only slightly below the average of the past twenty-five years and that of the 5_2's, while somewhat higher than in recent years, is equal to the

twenty-five-year average. The representations of the 5_3 and 6_3 age-groups is comparatively high (Table XV.).

In addition to the above, there were seven individuals of the 3_2 age-group (grilse). These have not been included in the tables or the calculations.

(3.) Lengths and Weights.

The length and weight data are presented in Tables XVI., XVII., XVIII., and XIX. The average lengths of the 4_2 age-group are slightly less than the averages of the past twenty-five years, while those of the other age-groups are much above the gross averages, approaching the past high records in the 5_2 and 5_3 groups and setting new high records in the case of the 6_3's.

The average weights of the 4_2 age-group are very low, equalling the lowest of the past years of record. Those of the 5_2's are considerably below while those of the 5_3's are exactly equal to the gross averages of the past years. On the other hand the average weights of the 6_3's are above the average.

(4.) Proportions of the Sexes.

The total number of males in the samplings is 670 and of females 927, percentages of 42 and 58 respectively. The females outnumbered the males in all the year-classes. In recent years this has been the usual condition and may possibly be associated with change in size of gill-net mesh (Table XX.).

Table XVI.—Skeena River Sockeyes, 1937, 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
20½	1	2	-----	-----	-----	-----	-----	-----	3
21	9	7	-----	-----	1	-----	-----	-----	17
21½	15	34	-----	-----	-----	1	-----	-----	50
22	34	62	-----	1	2	5	-----	-----	104
22½	26	63	1	6	3	10	-----	-----	109
23	45	91	2	12	3	12	-----	2	167
23½	50	54	5	21	11	13	-----	-----	154
24	50	50	16	47	7	16	-----	2	188
24½	35	19	14	61	12	11	-----	7	159
25	27	11	25	75	13	16	-----	12	179
25½	14	4	27	60	9	3	2	5	124
26	11	1	46	52	8	7	6	6	137
26½	1	-----	22	25	5	3	3	3	62
27	3	-----	35	16	2	2	2	2	62
27½	-----	-----	20	6	5	1	1	2	35
28	-----	-----	11	2	1	-----	3	1	18
28½	-----	-----	14	2	1	-----	2	-----	19
29	-----	-----	6	-----	-----	-----	-----	1	7
29½	-----	-----	1	-----	-----	-----	1	-----	2
Totals	322	398	245	386	83	100	20	43	1,597
Ave. lengths	23.5	22.9	26.2	25.1	24.9	24.1	26.9	25.5	-----

Table XVII.—Skeena River Sockeyes, 1937, 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	6	6	1	-----	-----	2	-----	-----	15
4	52	109	1	3	3	4	-----	-----	172
4½	80	150	9	22	9	24	-----	1	295
5	81	102	18	64	22	28	-----	7	322
5½	67	23	42	106	7	28	-----	10	283
6	30	8	43	95	17	13	3	10	219
6½	5	-----	38	58	16	-----	5	6	128
7	1	-----	38	27	8	1	7	3	85
7½	-----	-----	25	7	1	-----	1	4	38
8	-----	-----	13	4	-----	-----	1	2	20
8½	-----	-----	11	-----	-----	-----	3	-----	14
9	-----	-----	4	-----	-----	-----	-----	-----	4
9½	-----	-----	2	-----	-----	-----	-----	-----	2
Totals	322	398	245	386	83	100	20	43	1,597
Ave. weights	4.9	4.6	6.4	5.8	5.7	5.1	7.0	6.1	-----

Table XVIII.—Skeena River Sockeyes, Average Lengths in Inches of Principal Age-groups, 1912 to 1937.

Year.	4_2		5_2		5_3		6_3	
	M.	F.	M.	F.	M.	F.	M.	F.
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	24.5	23.4	25.6	24.4
1916	23.9	23.6	26.2	25.0	24.1	23.8	26.2	24.8
1917	23.6	23.2	25.5	24.7	23.9	23.8	25.4	25.0
1918	24.1	23.3	25.9	25.0	23.9	23.4	25.2	24.7
1919	24.3	23.4	25.7	24.8	24.3	23.4	25.8	24.7
1920	23.8	23.2	26.2	25.3	24.1	23.4	26.2	25.1
1921	23.8	23.1	25.2	24.2	24.2	23.4	24.9	24.2
1922	23.6	23.2	25.3	24.4	23.8	23.3	24.6	24.1
1923	23.7	23.1	25.5	24.5	23.9	23.2	25.6	24.4
1924	24.1	23.3	26.2	25.2	24.7	23.6	25.8	24.8
1925	23.6	22.8	25.6	24.7	24.1	23.3	25.8	24.8
1926	23.8	23.4	25.6	24.8	24.6	23.8	26.0	25.0
1927	23.9	23.3	25.7	24.8	24.1	23.5	25.2	24.9
1928	23.3	22.8	25.3	24.7	23.5	22.8	25.6	24.7
1929	22.9	22.7	25.5	24.7	23.8	22.8	25.5	24.3
1930	23.1	22.7	24.7	23.9	23.5	22.4	24.6	23.2
1931	23.5	23.1	25.7	24.8	23.8	23.1	25.8	24.7
1932	23.4	22.7	25.2	24.4	24.1	22.8	25.4	24.4
1933	23.2	22.8	26.1	25.2	24.3	23.4	26.4	25.3
1934	23.8	23.2	26.3	25.2	25.2	24.1	26.0	24.9
1935	23.1	22.9	26.3	25.2	23.6	22.8	26.2	25.1
1936	23.8	23.2	26.0	25.2	24.4	23.5	26.3	25.0
Average lengths	23.7	23.1	25.7	24.8	24.1	23.3	25.6	24.6
1937	23.5	22.9	26.2	25.1	24.9	24.1	26.9	25.5

Table XIX.—Skeena River Sockeyes, Average Weights in Pounds of Principal Age-groups, 1914 to 1937.

Year.	4_2		5_2		5_3		6_3	
	M.	F.	M.	F.	M.	F.	M.	F.
1914	5.9	5.3	7.2	6.3	.....	.....	.....	.....
1915	5.7	5.2	6.8	6.2	5.9	5.2	6.6	6.0
1916	5.4	5.1	7.1	6.3	5.8	5.4	7.1	5.9
1917	5.3	5.0	6.4	6.0	5.5	5.2	6.3	5.8
1918	5.8	5.3	6.9	6.4	5.7	5.3	6.6	6.1
1919	6.1	5.5	7.0	6.2	6.1	5.4	6.9	6.3
1920	5.6	5.1	7.2	6.4	6.3	5.1	7.3	6.3
1921	5.7	5.1	6.4	5.7	5.8	5.1	6.0	5.6
1922	5.4	5.1	6.5	5.7	5.5	5.1	6.2	5.7
1923	5.3	4.9	6.3	5.7	5.3	4.8	6.3	5.4
1924	5.6	5.0	7.0	6.3	5.9	5.1	6.6	5.8
1925	5.1	4.7	6.5	5.8	5.5	4.9	6.9	5.4
1926	5.3	5.1	6.5	5.8	5.9	5.2	6.9	6.2
1927	5.4	5.1	6.5	5.9	5.4	5.0	6.0	5.8
1928	5.0	4.6	6.4	5.8	5.0	4.6	6.5	5.8
1929	4.9	4.7	6.8	6.2	5.6	4.9	6.8	5.7
1930	5.4	5.1	6.7	6.0	5.6	5.0	6.8	5.8
1931	5.4	5.1	6.8	6.3	5.5	5.0	6.9	6.0
1932	5.4	4.9	6.9	6.1	6.0	5.0	6.8	5.9
1933	4.9	4.7	7.1	6.3	5.7	5.0	7.1	6.3
1934	5.7	5.2	7.7	6.6	6.7	5.8	7.7	6.2
1935	5.1	4.9	7.4	6.5	5.5	4.7	7.2	6.4
1936	5.6	5.2	7.3	6.6	6.1	5.5	7.4	6.2
Average weights	5.4	5.0	6.8	6.1	5.7	5.1	6.8	5.9
1937	4.9	4.6	6.4	5.8	5.7	5.1	7.0	6.1

Table XX.—Skeena River Sockeyes, Percentages of Males and Females of the 4_2 and 5_2 Age-groups, 1915 to 1937.

Year.	4_2		5_2		Per Cent. Total Males.	Per Cent. Total Females.
	M.	F.	M.	F.		
1915	56	44	45	55	49	51
1916	70	30	43	57	55	45
1917	66	34	48	52	60	40
1918	63	37	46	54	57	43
1919	53	47	46	54	49	51
1920	41	59	37	63	38	62
1921	44	56	44	56	45	55
1922	52	48	41	59	50	50
1923	60	40	37	63	52	48
1924	50	50	43	57	45	55
1925	57	43	42	58	50	50
1926	40	60	43	57	42	58
1927	45	55	41	59	44	56
1928	48	52	45	55	46	54
1929	50	50	46	54	50	50
1930	47	53	56	44	53	47
1931	43	57	39	61	44	56
1932	47	53	63	37	54	46
1933	48	52	40	60	45	55
1934	42	58	33	67	39	61
1935	41	59	32	68	40	60
1936	38	62	36	64	39	61
1937	45	55	39	61	42	58
Average	50	50	43	57	47	53

4. THE NASS RIVER SOCKEYE RUN OF 1937.

(1.) General Characteristics.

The pack on the Nass River amounted to 17,567 cases and the escapement was reported as "quite good on the whole" (Table XXI.). While the escapement was apparently satisfactory in relation to the catch, it is apparent that the run of 1937 was a relatively small one.

Over the past twenty-five years, 67 per cent. of the Nass River sockeye have been five-year-old fish with two years residence in fresh water (5_3's). In 1933, the pack consisted of 9,757 cases and the escapement was reported as "not particularly satisfactory." It would seem, therefore, that little may be expected in 1938 from the 1933 spawning. In 1934 the pack was 36,242 cases, an exceptionally large pack, and the escapement was stated to have been "heavy." Since four-year-old fish usually form a relatively small proportion of the population (the highest percentage so far recorded has been 35 per cent., and the average during the past twenty-five years 15 per cent.), the 1934 spawning is not likely to produce a very large group of mature fish in 1938. The prospects for a large return in 1938 are not therefore particularly bright. However, returns to the Nass River have been very erratic, and it has been almost impossible to predict production for any year for the river system. There is apparently some as yet unknown factor operating to cause considerable irregularities in the cycle returns.

Table XXI.—Nass River Sockeyes, Percentages of Principal Age-groups from 1912 to 1937 and Packs.

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
1929 (16,077 cases)	25	9	60	6
1930 (26,405 cases)	28	15	54	3
1931 (16,929 cases)	10	17	67	6
1932 (14,154 cases)	28	4	61	7
1933 (9,757 cases)	35	7	55	3
1934 (36,242 cases)	13	9	74	4
1935 (12,712 cases)	11	10	73	6
1936 (28,562 cases)	16	7	67	10
1937 (17,567 cases)	22	4	68	6

(2.) Age-groups.

The analysis of the run of 1937 is based on data for 1,491 fish collected in thirteen random samplings between July 6th and August 17th. The 5_3 age-group predominates with 1,015 fish or 68 per cent., which is practically identical with the average for the past twenty-five years—namely, 67 per cent. The 4_2's are represented by 320 fish or 22 per cent.; the 6_3's by 96 or 6 per cent.; and the 5_2's by 60 or 4 per cent. The representation of these age-groups does not present any unusual features (Table XXI.).

In addition and not included in the above calculations there were two individuals of the 6_4 age-group, females, average length 25 inches and average weight 6 pounds; also one individual of the 7_4 age-group, male, 27 inches in length and 8 pounds in weight.

(3.) Lengths and Weights.

The average lengths of both males and females of all the age-groups is considerably below those of the past twenty-five years, with the exception of the 6_3 females. The latter, while attaining the gross average, are much shorter than those of the past six years. The 5_3's are particularly small with lengths of 25 and 24.2 inches for males and females respectively. These values are slightly over an inch shorter than the gross average and the shortest on record.

The situation is almost identical with respect to average weights, except that in the 5_3 age-group the weights do not reach such extremely low values (Tables XXII., XXIII., XXIV., and XXV.).

(4.) Proportions of the Sexes.

The total number of males in the samplings is 766 and of females 725, percentages of 51 and 49 respectively. For the first time since 1918 the males have outnumbered the females. This is largely due to the large numbers of males in the 4_2 age-group. Not since 1925 have the 4_2 males exceeded the females in numbers. In the dominant 5_3 age-group the sexes were almost equally represented with 508 males and 507 females. Usually the females are slightly in excess in this age-class.

Table XXII.—Nass River Sockeyes, 1937, 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.	
21	2	2	-----	-----	-----	1	-----	-----	5
21½	-----	3	-----	-----	1	-----	-----	-----	4
22	8	19	-----	-----	4	7	-----	-----	38
22½	6	5	-----	1	2	8	-----	-----	22
23	41	50	-----	3	26	78	4	1	203
23½	18	17	-----	4	16	41	-----	-----	96
24	63	29	4	11	87	173	-----	2	369
24½	6	5	1	2	30	38	-----	-----	82
25	27	10	5	2	146	106	3	5	304
25½	4	1	1	4	53	24	1	3	91
26	3	1	6	6	103	23	4	12	158
26½	-----	-----	1	-----	15	2	2	1	21
27	-----	-----	4	1	21	6	13	7	52
27½	-----	-----	1	-----	2	-----	1	2	6
28	-----	-----	2	-----	1	-----	12	9	24
28½	-----	-----	-----	-----	-----	-----	6	-----	6
29	-----	-----	-----	-----	-----	-----	7	-----	7
29½	-----	-----	-----	-----	-----	-----	1	-----	1
30	-----	-----	1	-----	-----	-----	-----	-----	1
30½	-----	-----	-----	-----	-----	-----	-----	-----	-----
31	-----	-----	-----	-----	-----	-----	-----	-----	-----
31½	-----	-----	-----	-----	-----	-----	-----	-----	-----
32	-----	-----	-----	-----	1	-----	-----	-----	1
Totals	178	142	26	34	508	507	54	42	1,491
Average lengths	23.8	23.3	26.0	24.5	25.0	24.2	27.2	26.3	-----

Table XXIII.—Nass River Sockeyes, 1937, 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	-----	-----	-----	-----	-----	-----	-----	-----	-----
4	2	4	-----	-----	2	1	-----	-----	9
4½	12	15	-----	2	9	22	-----	-----	60
5	38	59	-----	2	36	109	-----	-----	244
5½	62	47	4	10	81	172	-----	1	377
6	47	13	2	6	118	136	3	6	331
6½	14	4	5	6	137	49	3	7	225
7	3	-----	7	7	92	14	6	12	141
7½	-----	-----	5	-----	25	3	15	10	58
8	-----	-----	2	-----	7	1	9	4	23
8½	-----	-----	1	1	1	-----	8	2	13
9	-----	-----	-----	-----	-----	-----	9	-----	9
9½	-----	-----	-----	-----	-----	-----	1	-----	1
Totals	178	142	26	34	508	507	54	42	1,491
Average weights	5.5	5.2	6.8	6.1	6.2	5.5	7.8	7.0	-----

Table XXIV.—Nass River Sockeyes, Average Lengths in Inches of Principal Age-groups, 1912 to 1937.

Year.	4_2		5_2		5_3		6_3	
	M.	F.	M.	F.	M.	F.	M.	F.
1912	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
1929	24.1	23.5	26.1	25.2	25.9	24.9	27.2	26.2
1930	24.5	23.7	26.5	25.4	26.4	25.3	27.9	26.8
1931	24.5	23.8	26.5	25.7	26.1	25.3	28.2	27.1
1932	24.9	23.9	26.4	25.2	26.6	25.6	28.3	27.1
1933	24.6	23.7	27.1	25.8	25.9	25.2	28.4	27.9
1934	24.9	24.1	26.9	25.9	26.3	25.4	28.6	27.1
1935	24.9	24.0	27.3	25.9	26.5	25.2	28.9	27.6
1936	24.9	24.1	26.8	25.8	26.6	25.6	28.3	27.1
Average lengths	24.5	23.7	26.2	25.2	26.2	25.3	27.6	26.3
1937	23.8	23.3	26.0	24.5	25.0	24.2	27.2	26.3

Table XXV.—Nass River Sockeyes, Average Weights in Pounds of Principal Age-groups, 1914 to 1937.

Year.	4_2		5_2		5_3		6_3	
	M.	F.	M.	F.	M.	F.	M.	F.
1914	6.2	5.0	7.4	6.5	7.2	6.5	7.9	6.8
1915	5.6	5.2	6.9	6.4	7.0	6.6	7.2	6.5
1916	6.0	5.3	7.2	6.3	7.2	6.2	8.1	6.4
1917	5.3	5.3	6.8	6.2	6.3	5.8	7.3	6.4
1918	6.3	5.8	7.2	6.3	7.2	6.4	8.3	6.7
1919	6.0	5.5	6.6	5.9	6.7	6.1	7.8	6.7
1920	5.6	5.2	7.4	6.3	7.4	6.7	7.9	7.0
1921	6.0	5.4	6.9	6.1	6.9	6.3	7.7	6.6
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
1929	5.7	5.2	7.1	6.6	6.7	5.9	7.6	6.8
1930	5.9	5.2	7.3	6.5	7.1	6.1	8.2	7.2
1931	6.0	5.5	7.4	6.8	6.8	6.2	8.3	7.4
1932	6.3	5.6	7.5	6.6	7.3	6.3	8.7	7.5
1933	6.2	5.4	8.1	7.0	7.0	6.2	8.4	7.9
1934	6.7	5.9	8.4	7.3	7.6	6.7	9.4	8.1
1935	6.1	5.2	7.8	6.5	7.0	6.1	8.4	7.4
1936	6.5	5.7	7.8	7.1	7.6	6.7	8.7	7.5
Average weights	6.0	5.4	7.2	6.4	6.9	6.2	8.0	6.9
1937	5.5	5.2	6.8	6.1	6.2	5.5	7.8	7.0

Table XXVI.—Nass River Sockeyes, Percentages of Males and Females of the 4_2, 5_2, 5_3, and 6_3 Age-groups, 1915 to 1937.

Year.	4_2		5_2		5_3		6_3		Per Cent. Total Males.	Per Cent. Total Females.
	M.	F.	M.	F.	M.	F.	M.	F.		
1915	55	45	49	51	52	48	53	47	52	48
1916	61	39	61	39	50	50	68	32	55	45
1917	55	45	47	53	46	54	58	42	47	53
1918	52	48	40	60	50	50	70	30	51	49
1919	53	47	48	52	46	54	54	46	48	52
1920	46	54	39	61	40	60	66	34	42	58
1921	40	60	45	55	47	53	54	46	46	54
1922	36	64	32	68	46	54	64	36	44	56
1923	43	57	43	57	47	53	60	40	46	54
1924	55	45	44	56	47	53	67	33	48	52
1925	58	42	52	48	45	55	68	32	49	51
1926	43	57	44	56	44	56	57	43	46	54
1927	39	61	54	46	45	55	61	39	46	54
1928	50	50	48	52	42	58	62	38	46	54
1929	48	52	51	49	44	56	58	42	46	54
1930	49	51	43	57	40	60	63	37	43	57
1931	49	51	53	47	43	57	70	30	47	53
1932	49	51	46	54	45	55	72	28	48	52
1933	49	51	56	44	47	53	76	24	49	51
1934	48	52	51	49	50	50	58	42	50	50
1935	39	61	40	60	39	61	71	29	42	58
1936	42	58	35	65	43	57	50	50	43	57
1937	56	44	43	57	50	50	56	44	51	49
Average	48	52	46	54	46	54	62	38	47	53

A BRIEF ACCOUNT OF THE LIFE-HISTORY OF THE PILCHARD.

By John Lawson Hart, Ph.D., Pacific Biological Station.

The fish which is known to the Canadian as a pilchard, to the Californian as a sardine, and to the unfortunate fisheries investigator as *Sardinops cærulea* is one of the greatest importance. In each of the last four years it has supplied the Pacific Coast fishing industry with more than half a million tons of raw fish. The Canadian share of this huge catch has been relatively small (5 to 10 per cent. of the total), but in spite of that the pilchard has provided what is one of British Columbia's major fisheries, judged from the standpoint of tonnage caught.

In spite of the prevalence of the pilchards along the Pacific Coast the facts of its life-history proved to be very difficult to unfold. During the present decade, however, many of the important features of its private life have been uncovered. This report is intended to summarize the more recent findings in a publication which is available to the Canadian fishing industry. It is not the purpose to describe original research. The facts are drawn from the published accounts of investigations carried out in British Columbia, and papers of the California State Fisheries Laboratory* have been freely called upon.

DEVELOPMENT OF THE FISHERY.

The first organized fishery for sardines was in 1904, when the Booth cannery at Monterey used approximately 100 tons of fish. These were taken with gill-nets or purse-seines. Nets and boats were, for the most part, company gear. In 1907 the lampara-net was introduced. By 1913 the success of this type of gear, operated by small launches which loaded their catches into "lighters," was so great that the fishermen using other kinds tried to have a law passed preventing its use. This attempt failed and the lampara gradually became constituted as the standard gear in the sardine-fishery until 1929 when purse-seines were introduced in numbers on modern boats having power winches and sufficient hold capacity to carry the catch. This type of net and its modification—the so-called ring-net—have become more and more important in the California fishery in recent years. The change back to the purse-seine met with considerable opposition from the conservative elements in the fishery. However, as investigation showed that purse-seines were not wastefully destructive of fish life, no restrictions were placed upon them. It is worthy of note that in contrast with the condition during the early years of the industry practically all of the boats and gear are now independently owned by the fishermen.

In the 1930–31 fishing season in California the first offshore floating reduction plant began operation. "Floaters" since then have operated each year and have added considerably to the production of sardine products. The total catch off the California coast delivered to shore plants and floaters is now more than half a million tons annually.

In comparison with the California sardine-fishery, the British Columbia pilchard-fishery is comparatively new. The beginnings of the fishery were in 1917 when a few pilchards were canned. In 1925 the first reduction plants began operation and the amount of pilchards used was increased by more than 1,000 per cent. From then on the production increased rapidly until the peak was reached in 1929 with a total catch of more than 86,000 tons. For the first ten years the fishing was carried on in the inlets with small herring purse-seines. The catch was handled on deck-scows. Small boats and light nets were found adequate, although considerable improvements were made to meet the increased demands of the growing reduction industry. In 1928 the fishery started to change slowly from one in the inlets to one in the open sea. This accelerated the improvement in gear which had begun as early as 1926. As a result the seiners and tenders used in the present fishery are fine, capable, modern boats, with sufficient hold capacity to pack the catch, and the large nets are made of heavy web to withstand the strain placed upon them when the seas raise the boats.

* No attempt is made to refer to specific publications. A great many investigators, many of whom have since been prominent in other fields of investigation, have applied their attention to problems relating to the California sardine under the auspices of the California State Fisheries Laboratory. During the preparation of the present account conscious reference has been made to one or more papers by the following: C. B. Andrews, P. Bonnot, F. N. Clark, G. H. Clark, D. H. Fry (Jr.), H. C. Godsil, E. Higgins, C. L. Hubbs, J. F. Janssen (Jr.), M. J. Lindner, J. B. Phillips, O. E. Sette, E. C. Scofield, N. B. Scofield, W. L. Scofield, W. F. Thompson, R. B. Tibby; as well as J. L. Hart, R. C. Lewis, G. H. Wailes, and M. Watanabe of other institutions.

The average Canadian seine-boat crew consists of seven or eight men. The boats fish in pairs consisting of a seine-boat and a tender. The latter is a boat usually similar in size and design which is used to tow the seine-boat off the net after it is set and to help pack the catch. With one or two notable exceptions the Canadian fishing fleet and gear are company owned.

During the last two years reduction plants have been opened on the coasts of Washington and Oregon. These plants have depended for the most part for their fish upon the more modern privately-owned fishing units which come up from California. As when they are in home waters, these boats fish singly and carry ten to thirteen men on a boat.

Pilchards and sardines are used mainly for three purposes. By far the greatest part of the total catch is reduced to make oil and meal. Large quantities, too, are used in canning. Canadian operators have depended mainly upon packs of cross-cuts of pilchards in ½-lb. flat and 1-lb. tall tins, although in the last couple of years more or less successful marketing experiments have been tried with packs put up in 5-oz. or oval cans, and packs of fillets. California canners, on the other hand, have consistently made use of more complicated packing methods, involving such refinements as the use of tomato sauce and precooking. The third use is as bait. Very large quantities of young sardines are used as live bait in southern California. In British Columbia herring is generally preferred as bait by the line-fishermen, but fresh pilchards are quite frequently used during the summer months.

SPAWNING.

For a long time nothing was known about the spawning of pilchards or sardines. Recently, however, spawn has been found off the coast of southern California. As a result the surrounding area has been made the subject of a thorough survey. The survey, lasting for four years, involved taking samples at 358 places between Eureka, California, and Cape San Lucas, Mexico. It showed that the area of maximum spawning was determined with reasonable accuracy and that it was fairly constant from year to year. This area is comparatively small, "200 miles in length and 100 miles in width. It is situated off the coast of southern California between San Diego and Point Conception and offshore to a distance of 100 miles. . . . The location of the maximum spawning area has remained constant from 1929 to 1932. The egg and larva productivity has been more than double that of all other spawning areas combined." Less intense spawning occurred over a larger area from near Cape San Lucas to off San Francisco and for more than 250 miles offshore. It is noteworthy that the bulk of sardines from all of its huge range appears to concentrate in such a limited area for spawning. On the other hand, attention should be drawn to the observation that 9 per cent. of the larvæ recorded in 1931 were taken off Point Arena (north of San Francisco). Evidently, in some years at least, spawning of considerable importance takes place well to the north of the area of maximum spawning.

There is no adequate reason for believing that pilchard spawning takes place off the British Columbia coast. This is in spite of the fact that in several years the early fish taken in July have had rather large eggs in them. But, although thousands of individuals have been examined, a fish with many free eggs in its body-cavity has never been observed. As the season advances the proportion of pilchards having the large eggs drops, and it is believed that the eggs are either reabsorbed or the early egg-containing fish are caught off. The opinion that no spawning takes place off the coast is confirmed by a rough survey made off southern Vancouver Island during the spring of 1932. Repeated hauls made with suitable nets failed to demonstrate the presence of anything even resembling a pilchard-egg.

The evidence obtained by the spawning-ground survey and from the examination of mature fish indicates a long-drawn-out spawning lasting from January to June, with the greatest intensity in April and May.

A well-defined relationship has been found to occur between the extent and abundance of spawning and the surface temperature of the water. No evidence of spawning was found in places where the water temperatures were below 55° F., and the optimum range appeared to be between 59° and 65° F. It was concluded from the study of the relationship with water temperature that "Spawning may not be expected inshore in the San Francisco region or farther north, with the exception of an occasional fortuitous spawning of very minor importance in years of unusually high surface temperature."

The smallest fish to spawn are less than 7 inches in body-length, but such very small mature fish are rare. However, of the fish examined it was found that about half of those which were 8½ inches long were mature and of fish 9½ inches long practically all were mature.

Reproduction in pilchards is unlike that of other familiar British Columbia fish in that individual fish spawn more than once during each spawning season. It is not known with certainty how many batches of eggs are ripened and spawned each year, but it is known that the larger fish not only produce more eggs in each batch but that they ripen more batches of eggs during each spawning season. The investigations indicate that the larger fish spawn three times during a season, but there are suggestions that this estimate is on the low side and that more spawnings may take place. The number of eggs produced at a spawning varies considerably with the size of the fish. Small pilchards (of a size smaller than those commonly encountered in Canadian waters) were found to be ripening approximately 30,000 eggs, average-sized pilchards were on the point of spawning nearly 50,000 eggs, and a rather large specimen was found to be maturing some 65,000 eggs. It is apparent that three such spawnings as the one anticipated for the large pilchard would produce close to 200,000 eggs during the single season.

EGGS AND YOUNG FISH.

The unfertilized pilchard-egg averages about one-twentieth of an inch in diameter. On fertilization and exposure to sea-water the diameter increases to approximately one-sixteenth of an inch. This increase is largely the result of the absorption of water, so that the resulting egg shows a comparatively small yolk (about one twenty-seventh of an inch in diameter) floating freely inside the spherical membrane which constitutes the shell. While in the water the eggs are relatively transparent and difficult to see, but when placed under magnification details of the yolk can be made out showing that it contains a single oil-globule (about one-sixtieth of an inch in diameter) and that it is divided into a large number of irregularly-shaped segments. As development proceeds it is around the yolk that the growing embryo lies. Until hatching the eggs float freely in the water at various depths. Some have been found as deep as 50 fathoms, but the greatest concentration is in the upper 25 fathoms, with the average level at 15 fathoms.

The length of time necessary for the eggs to hatch is not definitely known, but in the warm water in which they are found it is believed that the hatching period is less than a week.

When the young pilchards hatch they are little more than one-eighth of an inch long, they carry the yolk-sac complete with oil-globule, and are so incompletely organized that they could scarcely be recognized as fish at all. In about two weeks the yolk-sac has been absorbed and a long, slender youngster has been produced which, although it has achieved a general fish-like look, still bears no resemblance to the adult. Even at this stage, however, the identity of the young fish is recognized by certain characteristic pigment spots on the body and tail. By summer most of the young pilchards are more than 1 inch in length and have taken on the adult characters sufficiently to be recognized by their resemblance to the adults.

As the young fish can swim about after hatching it is not surprising to find that they are not always to be found in the same place. At night they are always found in the upper 5 fathoms, but in the daytime they occur at considerably greater depths, down to those in the neighbourhood of 25 fathoms.

During the early part of their first summer the young fish are carried or make their way toward the shores of southern and lower California where they are found when 1 to 3 inches long concentrated in a narrow strip and along the mainland shore. They remain relatively close to shore for a year or more, during which they are taken in large quantities for use as bait.

FOOD OF PILCHARDS.

The smallest fish examined apparently eat the small, shrimp-like copepods which are usually plentiful in the sea. Among the next largest sizes (1 to 3 inches) copepods are evidently still the favoured food. With fish of 4 inches and more, however, a new type of food is taken more plentifully. This is the diatom, a very small plant which is characterized by growing two glass-like half-shells, fitting together like square brackets ([]), within which it carries on its vital functions. Extensive food-studies on the British Columbia pilchards show that the adults depend chiefly on these diatoms as food during the summer, although the copepods remain an important secondary food.

STUDYING PILCHARDS BY SAMPLING THE CATCH.

When the sardine and pilchard investigations began nothing was known about the early life-history of the species and there was, consequently, no assurance that a profitable investigation of the early stages was possible. Accordingly, attention was concentrated on the larger young and mature fish which supply the commercial fishery. The study was planned to provide a basis for comparative estimates of the total mortality affecting the fish of commercial size each year. Consequently, attention is focused on the problem of defining the condition which is of principal interest economically.

In the case of a fish like the pilchard, which remains in the fishery and spawns annually for a number of years after reaching maturity, it is evident that the fishery will depend simultaneously upon a number of year-broods or crops of fish. Each one of these year-broods may be a success or a failure, just as a grain-crop may be a success or a failure. With the fish, however, the harvest for each crop is spread over a number of years, so that the abundance of fish for any year's fishery depends upon the degrees of success of a series of spawning for some years back. It was the comparative success of the different year-broods of fish which was chosen for study. This was done by taking a *representative sample* of each season's catch and recording the lengths of the fish in the sample. It would have been preferable to record the ages, but repeated trials have shown that it is not practical to determine the ages of pilchards by any of the methods usually applied to other fishes. Accordingly, it was found necessary to make use of the lengths, assuming that, as is the case for other fishes, pilchards continue to grow as long as they live and that length may be used as a rough index of age.

It was not anticipated that the work along these lines would solve the major problems within a few years. There are, however, a few immediate results which increase our knowledge of the pilchard and sardine populations. The sizes of fish taken by the various fisheries and at various times are, for example, accurately known. In California the average length of sardines taken is small during the autumn months, increases to a maximum in the winter and then falls off slightly. The increase in size takes place around the early part of December at Monterey and about a month later at San Pedro. This seasonal fluctuation in size can be satisfactorily explained by the movement of different-sized fish into and off the fishing-grounds. In British Columbia the situation is quite different, as there is no well-marked trend in the size of the pilchards taken during the fishing season. In average size they are always similar to or larger than the large fish taken by the California winter fishery.

Female pilchards appear to be more numerous than males throughout most of the range of the species. This is especially true off the British Columbia coast where a very extensive sampling shows the females to comprise nearly 56 per cent. of the total population. The females are not only more numerous but on the average they are longer. In Canadian waters female pilchards are found to be rather heavier than males of the same length, but this does not appear to be the case in California.

Certain treatment of the length measurements is necessary in order to learn anything further about the supply of fish. The following is a general outline of what is done, although some complicating refinements are not mentioned. The original measurements are made accurate to 1 mm. (about $\frac{1}{25}$ in.). All the fish from one season and locality are taken together and all the fish of each length are counted and tabulated. That is, a record is made of the number of fish 240 mm. in length, the number of fish 241 mm. in length, etc. The lengths of the fish are then indicated by a scale along the bottom of a diagram and the numbers of occurrences along the side. Then marks are made on the paper to indicate the number of fish occurring at each length. When the marks are joined they give a diagram something like one of those in Fig. 1. The line so formed illustrates diagrammatically the distribution of sizes of fish. It will be observed that the line is not regular, but consists of a number of humps and hollows. Some of these may be followed through from year to year as is indicated by the arrows on the diagram. In this way we can get a fairly accurate idea of how much the fish comprising the hump are growing from year to year. Careful estimates made in this way show that the rate of growth is remarkably slow among the larger fish, amounting to only about one-quarter of an inch annually. It cannot be said with certainty that the humps in the diagram represent single-year broods, but it is evident that they do represent size-groups of fish which are present in predominating abundance. Examination of many diagrams, such

as the one shown here, indicates that in California a group of sardines used to enter the fishery every two to four years and from that time on it could be followed for a number of years by its influence upon the length-distribution. These dominating groups during the last few years have been less frequent and they have not succeeded in maintaining their domi-

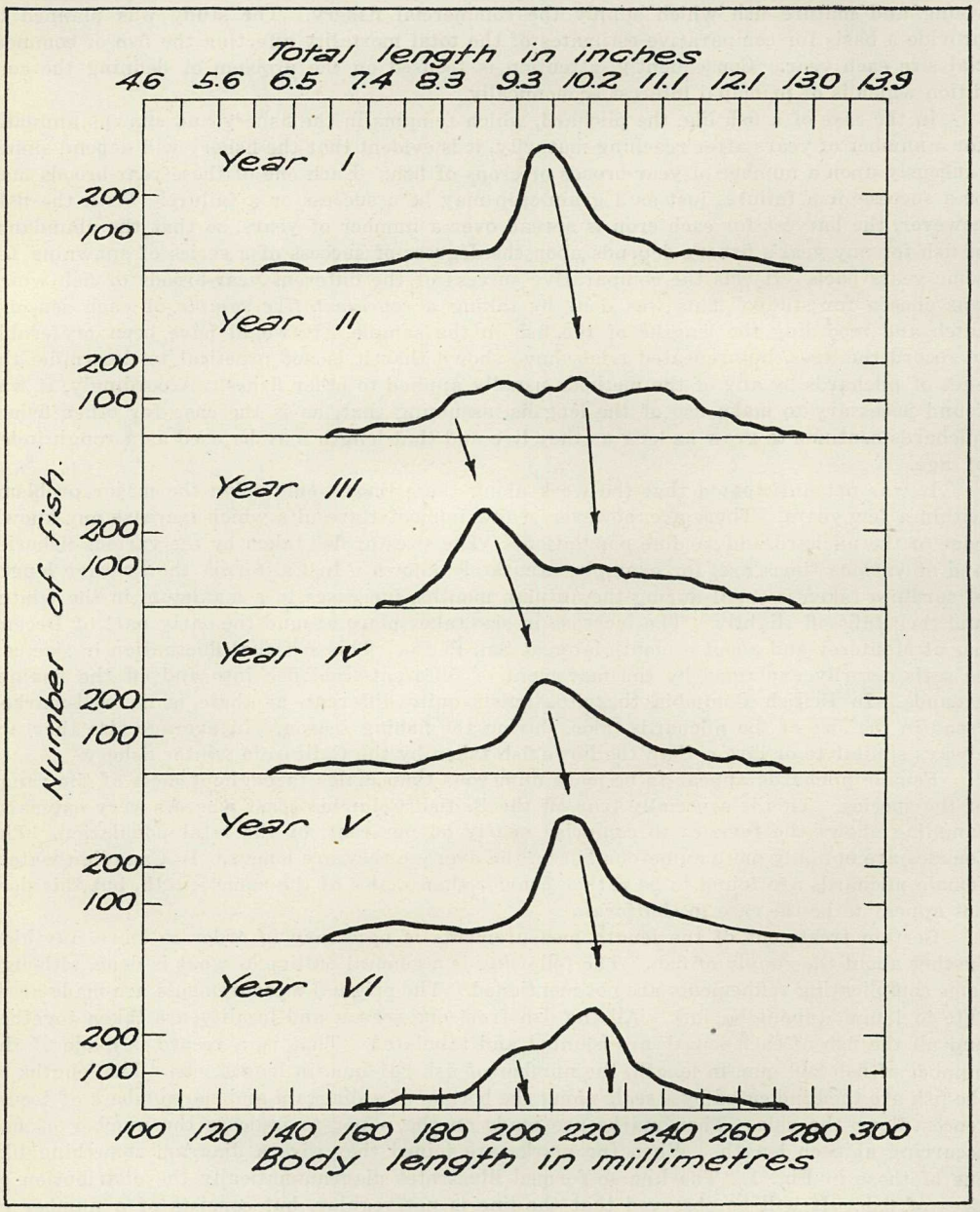

Fig. 1. Showing the distribution of lengths of California sardines and the way in which it is affected by dominant size-groups.

nance for such a long time. It is uncertain whether this has been the result of a series of relatively unsuccessful years of reproduction or whether the fall fishery in California which is directed against the small fish has been so intense as to materially reduce the incoming groups as they appear. If the suggestion is true that there have been few and relatively weak dominant size-groups entering the sardine-fishery and that serious inroads are being

made on them before they are large enough to enter the winter fishery, it may be expected that the supply of old sardines will become reduced. If that occurs, the Canadian fishery will have a real scarcity of fish to contend with as well as the more accustomed trials of weather, wildness, and fish not showing or not appearing on the usual fishing-grounds. It is worthy of note that any fishery which is thus dependent upon dominating groups of fish may be expected to show fluctuations in abundance which are not associated with the activities of the fishery.

The sort of diagram which is obtained for British Columbia pilchards when the length measurements are subjected to the treatment described above is shown in Fig. 2. It is evident that there is a single hump. This has always been the case, except for the one year—1936. The passage of a dominant year-class through the British Columbia fishery is shown by a gradual change in the position and shape of the hump as shown in the figure.

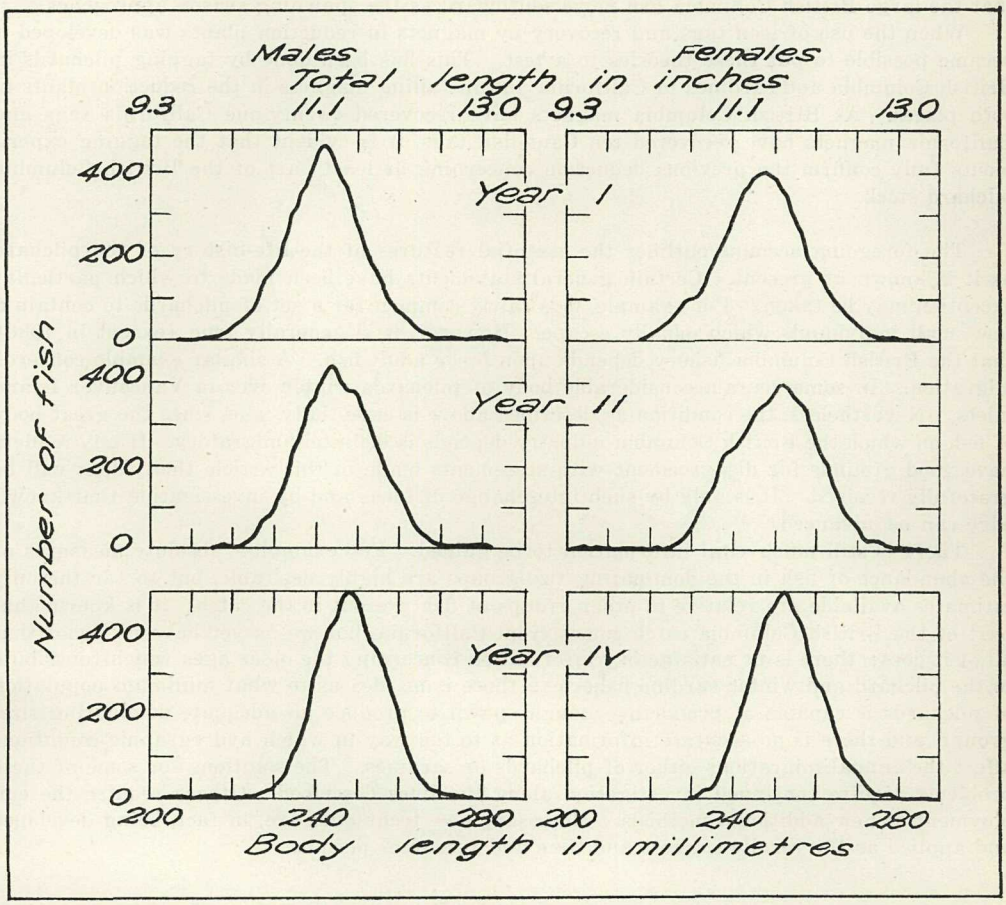

Fig. 2. Showing the distribution of lengths of British Columbia pilchards and the way in which the position and shape of the hump are affected by dominant size-groups.

MOVEMENTS OF PILCHARDS AND SARDINES.

Since the early days of pilchard reduction in Canada there has been considerable discussion as to whether the pilchard of British Columbia and the sardine of California were identical. The fishing industry proved to be pretty well divided on the question, but gradually the scientific workers became convinced that the pilchards were merely the largest sardines which made a northward migration each summer. This view is supported by the times of occurrence of sardines of different sizes at various points along the California coast. The younger sardines are more abundant in southern and lower California than in central California. Each succeeding summer as they grow older the sardines move a little farther north

along the California coast, returning southward again in the autumn. Since the larger fish go farther, they take a longer time getting back. This is especially true of the largest sizes (believed to be returning from Canada) which appear off San Francisco early in the winter, at Monterey somewhat later, and in middle or late winter off San Pedro and San Diego. Further support is to be obtained by studies in variation in body characters in sardines and pilchards. Such studies usually demonstrate differences in characters such as average length of head or average vertebral number between populations which do not mix to any great extent. Although Canadian investigators have made vertebral counts on many thousands of pilchards, and California workers have made corresponding counts on sardines, no such consistent differences were found between the fish from the two localities. Accordingly, the tentative conclusion is that rather free intermingling takes place. The location of the main spawning-grounds south of Point Conception has already been mentioned and again supports the view that the large British Columbia fish move southward as the spawning season approaches.

When the use of iron tags and recovery by magnets in reduction plants was developed it became possible to put these theories to a test. This has been done by tagging pilchards in British Columbia and sardines in California and installing magnets in the reduction plants in both places. As British Columbia magnets have recovered twenty-one California tags and California magnets have recovered ten Canadian tags, it is evident that the tagging experiments fully confirm the previous deduction concerning at least part of the British Columbia pilchard stock.

The foregoing account outlines the essential features of the life-history of the pilchard as it is known at present. Certain general statements have been made to which particular exception may be taken. For example, it is fairly common for a set of pilchards to contain a few small individuals which usually escape. However, it is generally true (except in 1936) that the British Columbia fishery depends upon *large* adult fish. A similar example concerns migration. In some years a considerable body of pilchards winter over in Vancouver Island inlets. Nevertheless, the condition as described above is essentially true, since the great body of fish on which the British Columbia industry depends is definitely migratory. If any readers have good grounds for disagreement with statements made in this article their ideas will be gratefully received. It is only by such interchange of ideas and by investigation that knowledge can be advanced.

There is still much vital information to be gained. For example: absolute measures of the abundance of fish in the dominating size-groups are highly desirable, but so far the only estimates available are relative to other groups of fish present in the catch; it is known that part of the British Columbia catch comes from California, but we as yet have no proof that all of it does; there is no satisfactory information concerning the older ages which contribute to the pilchard and winter sardine fisheries; there is no idea as to what minimum population of pilchards is capable of producing enough spawn to produce an adequate dominating size-group; and there is no accurate information as to the way in which hydrographic conditions affect the annual migrations either of pilchards or sardines. The solutions for some of these problems require continued investigation along the lines described. Others require the employment of new additional methods. Necessary new techniques are, in fact, being developed and applied as the results suggest and time and resources permit.

TAGGING BRITISH COLUMBIA PILCHARDS (*SARDINOPS CÆRULEA* (GIRARD)): INSERTIONS AND RECOVERIES FOR 1937–38.

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The programme of pilchard tagging and recovery begun in 1935 in an exploratory way and actively pursued in 1936 was continued during the 1937 season. The primary purpose of this programme is to investigate the movements and migrations of the commercial schools of pilchards. It is hoped, in addition, that by its continuation results will be obtained which may prove useful in enlarging our knowledge of other factors influencing the availability of pilchards to the fishermen. Several accounts of the tagging-work on Pacific Coast pilchards have already appeared. The returns for 1936 (Hart, 1937) indicate a rather random movement soon after tagging off the west coast of Vancouver Island, demonstrate the movement of fish into the west-coast inlets, and include the recovery of five Canadian tags by California plants. The recovery of twenty-one California tags by British Columbia plants during the summer of 1937 was covered by Janssen (1938) and was mentioned in a general preliminary account of the progress made in the Canadian tagging-work in 1937 (Hart, 1938). The present report is intended to describe in some detail improvements in methods and technique, to record recoveries, and to discuss the conclusions based on the results.

METHODS.

The method used for obtaining fish for tagging was essentially the same as that employed in 1936 (Hart, 1937). It involved tagging from the skiff of a commercial seine-boat. Trial showed that tagging could be somewhat speeded up by confining a few fish in a pocket of the net early in the set. This materially increased the time during which fish in good condition were readily available.

Another means of speeding up tagging was provided by the use of a so-called "tagging-gun," which greatly facilitated tagging under the trying conditions involved in this type of work. This instrument as modified for use on herring is fully described and figured in Hart and Tester (1938). The gun used on pilchards differs in having a magazine of only half the length. This is sufficient to accommodate 100 of the thinner pilchard-tags.

The same kind of numbered nickel-plated iron tags as used last year were employed again.

Recoveries were again made by the use of electromagnets fixed in the meal-lines of the reduction plants. Two new magnets have been installed, so that now magnets are operating in all plants. Owing to the design of certain plants it has not yet been possible to arrange to have all the meal pass over the recovery-magnets.

As before, the California State Fisheries Laboratory has co-operated by returning Canadian tags recovered by their magnets. New magnets have been installed in reduction plants in Washington and Oregon, and tags from these have been returned through the co-operation of fisheries officials.

TAGS APPLIED.

During the 1937 season 6,936 tags were used on pilchards taken on the grounds fished by the Canadian fleet. A summarized record of the tagging is given in Table I.

RECOVERIES.

The present report deals with eighty-seven recovered tags. They may be classified as follows:—

Canadian tags recovered in Canadian plants	43
Canadian tags recovered in Washington plants	9
Canadian tags recovered in Oregon plants	9
Canadian tags recovered in Californian plants	5
Californian tags recovered in Canadian plants	21
Total	87

Along with other information, Table II. shows the distribution of British Columbia recoveries according to the plant returning the tag. Table III. summarizes the information concerning the recovery of Canadian tags.

TABLE I.—SUMMARY OF TAGGING, GIVING REFERENCE NUMBERS, DATES, NUMBER OF TAGS INSERTED, LOCALITY OF RELEASE OF FISH AND SERIAL NUMBERS OF TAGS USED.

Tagging Reference No.	Date.	No. Tags.	Place Fish released.	Serial Nos. (P).
	1937.			
I.	July 6	200	10 mi. S. Effingham Is.	8101–8300.
II.	July 17	200	10 mi. S. Quillayute R.	8601–8700, 8801–8900.
III.	July 18	200	15 mi. S.W. Destruction Is.	8301–8500.
IV.	July 19	100	10 mi. S.W. Quillayute R.	7401–7500.
V.	July 20	300	15 mi. S. Quillayute R.	8701–8800, 8901–9100.
VI.	July 20	400	10 mi. S.W. Destruction Is.	8501–8600, 9101–9400.
VII.	July 20	100	5 mi. off Destruction Is.	9401–9500.
VIII.	July 21	500	10 mi. S.W. Destruction Is.	A001–A300, A401–A500, A901–A1000.
IX.	July 23	400	10 mi. S.W. Destruction Is.	A501–A900.
X.	July 28	500	20 mi. S.W. Grays Hr.	7501–7700, 9801–10000, A301–A400.
XI.	July 29	400	15 mi. S.W. Grays Hr.	4101–4200, 7701–7800, 9501–9700.
XII.	July 29	300	30 mi. S.W. Destruction Is.	4001–4100, 4701–4800, 9701–9800.
XIII.	July 31	300	15 mi. N.W. Cape Flattery	6801–7100.
XIV.	July 31	436	10 mi. S.W. Portage Head	1301–1498 (part), 2506–2600 (part), 3202–3298 (part), 6601–6800, 7201–7300.
XV.	Aug. 1	300	5 mi. S.W. Quillayute R.	3801–3900, 4501–4600, 6501–6600.
XVI.	Aug. 2	600	35 mi. S. Destruction Is.	4301–4500, 6101–6500.
XVII.	Aug. 2	200	10 mi. S. Aberdeen Light	5801–6000.
XVIII.	Aug. 2	300	20 mi. S.W. Aberdeen Light	5601–5800, 6001–6100.
XIX.	Aug. 5	200	15 mi. S.W. Aberdeen Light	5301–5400, 5501–5600.
XX.	Aug. 5	600	20 mi. S.W. Aberdeen Light	4801–5300, 5401–5500.
XXI.	Aug. 7	300	20 mi. S.W. by S. Columbia R.	3901–4000, 4201–4300, 4601–4700.
XXII.	Aug. 7	100	15 mi. S.W. Columbia R.	7101–7200.
C.	1937	6,936	Barkley Sound to Columbia R.	
A.	1935	978	Off Vancouver Is. near Nootka	101–1080.
B.	1936	2,535	Off Vancouver Is. between Bajo Rf. and Clayoquot Sd. and in Bedwell Sd.	1101–3700 (part).
	Total	10,449		

TABLE II.—THE NUMBER OF TONS OF PILCHARDS PROCESSED BY BRITISH COLUMBIA PLANTS, THE NUMBER OF CANADIAN AND CALIFORNIAN TAGS RECOVERED BY EACH, AND THE NUMBER OF TAGS OF EACH KIND RECOVERED PER 1,000 TONS OF FISH PROCESSED.

	Tons processed.	Total Tags.	Canadian Tags.		Californian Tags.	
			No.	No. per 1,000 Tons	No.	No. per 1,000 Tons
Ucluelet	12,660	33	24	1.90	9	0.71
Kildonan	9,647	7	5	0.52	2	0.21
Ecoole	8,949	12	6	0.67	6	0.67
Ceepeecee	7,617	8	6	0.79	2	0.26
Toquart	5,193	1	0	------	1	0.19
Nootka	2,106	3	2	0.95	1	0.47
Espinosa	1,784	0	----	------	----	------
Hecate	124	0	----	------	----	------
Totals	48,080	64	43	0.89	21	0.44

DISCUSSION.

Before drawing attention to the various points in the foregoing tables, sources of uncertainty in the data should be mentioned. Returns are open to two types of error. In the first place tags may be held up on the drier or conveyers of the reduction plant. This results in the tag being finally reported as coming from a catch made much later than that from which it really originated. Errors of this kind are inherent in the method. Defects of another type are of a clerical nature. These are the result of company employees failing to turn in tags promptly to the office, or of errors or negligence in recording the pertinent data. Where such errors have been detected the data concerned have not been used. Consistent negligence has been detected in one case only, but occasional mistakes have possibly been included. Some of the more interesting results are fortunately not affected greatly by this type of error.

One pilchard-tag was returned from a run of herring which were caught in Swanson Channel for a Porlier Pass saltery and subsequently sold to a west-coast reduction plant. Two explanations may be offered for this return. Pilchards occur in small numbers each year among east-coast herring and in 1937 they were especially numerous. It is possible, accordingly, that the tagged pilchard made its way to the Swanson Channel herring fishing-grounds (*see* Hart and Tester, 1938) where it was recaptured along with a school of herring. In that case, the record constitutes a valid return. On the other hand, it is quite probable that the tag entered the plant with a load of pilchards captured some weeks previous to the date given and became stuck in the plant. In such an event the recovery is only a further example of the disadvantage of the magnetic method of tag recovery (cf. Hart, 1937).

The returns in Table III. show a tendency for a very high proportion of the tags from all tagging areas to be returned from localities similar to "off Destruction Island." This may indicate some kind of milling movement of pilchards on a large scale so that a very high proportion were caught in the area where the fishery was most intense. On the other hand, it may merely represent the tendency on the part of operators making the returns to indicate all tags as having been recovered from the place where most of the fishing was done.

There is only one return from the 700 tags used in the first four taggings. As no selection of whole taggings can be made to yield such a poor return from 700 tags it seems likely that the number is significantly low. Whether this is a matter of different techniques early in the season or whether the significance is connected with the movement of the fish cannot be said at present.

Fish tagged in the vicinity of Cape Flattery were recovered around Destruction Island and Grays Harbour. Some tags used at Destruction Island were recovered at the same place two months later; one was taken off the mouth of the Columbia one week after tagging, indicating a speed of travel of 9 or 10 miles per day; others continued to be returned from the area between Tillamook Head and the mouth of the Columbia; and still another was returned from off Heceta Head after nine weeks. Tags used at Grays Harbour were recovered at both Destruction Island and off the Columbia River, one of the fish making the latter trip in three days. To summarize, more tags are returned from areas south of that of tagging than from those to the north. This may represent a general movement among the fish, or it may be attributed to the rather vague way in which localities of return are specified in many cases. There is evidence of fairly general mixing on the fishing-grounds. This is believed to be more extensive than indicated by the actual returns.

It has already been mentioned that five Canadian tags were recovered in California during the past season. One was a tag used in 1936 off Nootka light and recovered in Monterey. The other four were inserted in 1937. One of them was recovered in Monterey and three in San Pedro. Disregarding any digression from the straight line and assuming that the fish were captured as soon as arriving at their destinations,* the minimum rate of travel can be calculated as 3.2 and 3.6 miles per day. This corresponds closely with the rate of travel for the Heceta Head recovery (3.5 miles per day), but is considerably slower than the speed made on the northward migration as indicated by the recovery of California tags in British Columbia. The average speed of migration for all fish as calculated in a comparable

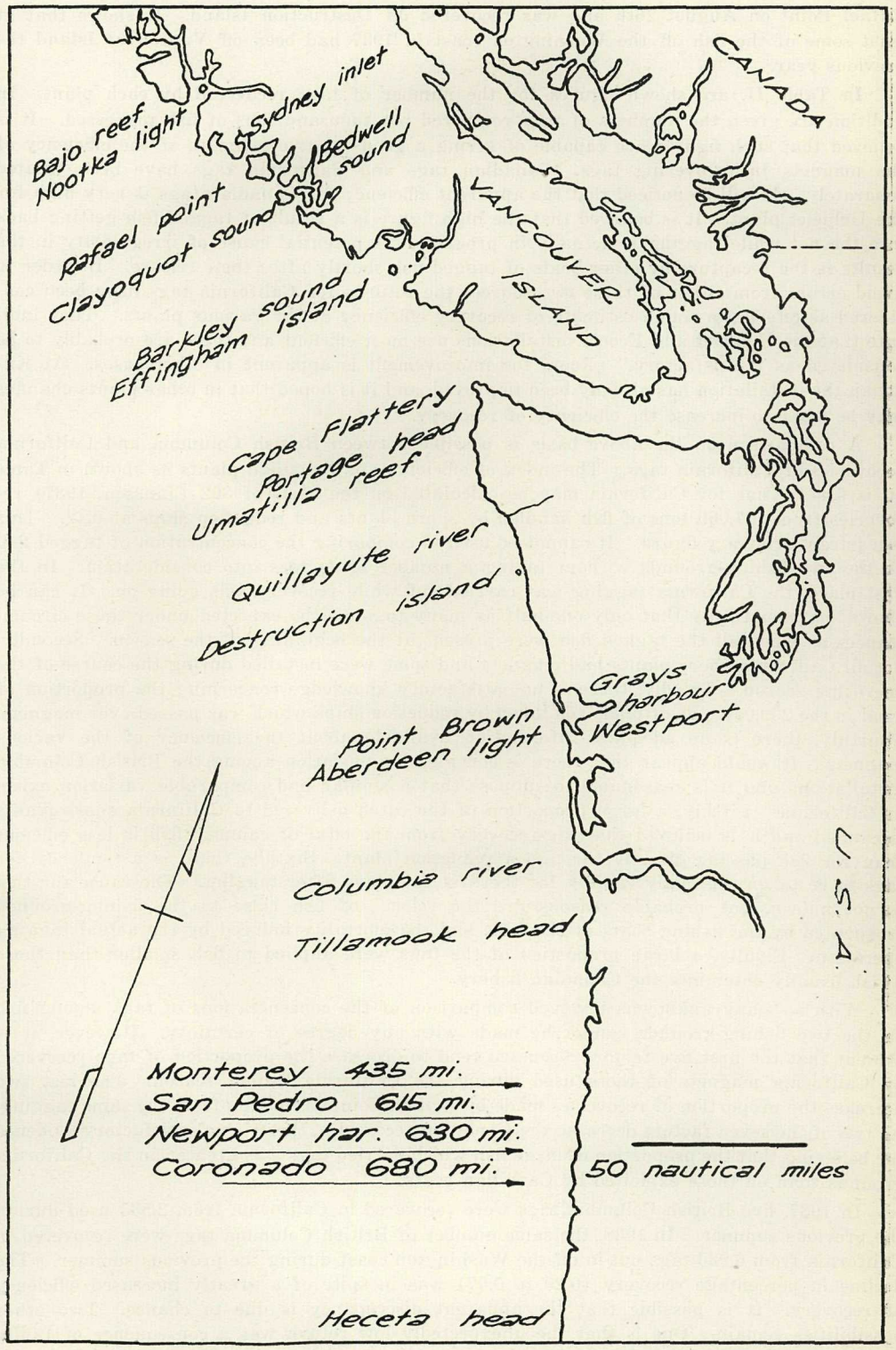
* It is quite reasonable to assume that the fish were caught soon after their returns to the fishing-grounds on which they were taken. The California sardine-fishery is actively pursued during the fall and winter, but fish of the size commonly taken by the Canadian fishery are not abundant until about a month before the time that the tags were recovered at the respective localities. The time at which the southward movement began is less certain.

way from the California data presented by Janssen (1938) was 5 miles per day, and one pilchard travelled at an average rate of 9.2 miles per day. It is worthy of note that in both 1937 (Hart, 1937) and 1938 the first recoveries of Canadian tags in California were in the more northerly fishing centres of San Francisco and Monterey. The recovery of Canadian tags in California and of California tags in Canada demonstrates definite movements between the respective fishing-grounds. The evidence to date indicates a rapid northward migration in the spring and early summer followed by a slower return trip in autumn and winter.

TABLE III.—NUMBER OF RECOVERIES AND PERCENTAGES RECOVERED OF TAGS INSERTED FOR EACH TAGGING BY ALL PLANTS, AND ALL PLANTS EXCEPT UCLUELET, WITH A SUMMARY OF REPORTED LOCALITIES OF RECOVERY.

Tagging Reference No.	All Recoveries.		Recoveries excluding Ucluelet.		Summary of Recoveries. (Dates 1937 except where noted.)
	No.	Per Cent.	No.	Per Cent.	
I.	0	0	0	0	
II.	0	0	0	0	
III.	1	0.5	0	0	Destruction Is., Sept. 25.
IV.	0	0	0	0	
V.	4	1.3	3	1	Tillamook Hd., Aug. 13; Westport, Sept. 4; Destruction Is., Sept. 14; Heceta Hd., Sept. 22.
VI.	2	0.5	1	0.2	2 Destruction Is., Sept. 14 and 26.
VII.	0	0	0	0	
VIII.	6	1.2	6	1.2	All U.S.; Columbia R., Aug. 19; 2 Grays Hr., Sept. 15 and 23; Monterey, Jan. 11, 1938; 2 San Pedro, Mar. 4 and 10, 1938.
IX.	4	1.0	3	0.8	Tillamook Hd., Aug. 6; Westport, Sept. 6; 2 Destruction Is., Sept. 16 and 23.
X.	5	1.0	5	1.0	Tillamook Hd., Aug. 7; 2 Destruction Is., Sept. 9; 2 Grays Hr., Sept. 17 and ?.
XI.	2	0.5	0	0	Destruction Is. (1?), July 29 and Sept. 10?.
XII.	5	1.7	3	1.0	2 Destruction Is., July 29 and Sept. 21; 2 Tillamook Hd., Aug. 7 and 19; (1, ?, ?).
XIII.	4	1.3	3	1.0	2 Destruction Is. or Umatilla Lt., Aug. 1; Destruction Is., ? Aug. 23?; Westport, Sept. 7.
XIV.	5	1.1	1	0.2	4 Destruction Is. (3?), July 13? and 22, 2 Aug. 23?; Grays Hr., Date ?.
XV.	3	1.0	1	0.3	3 Destruction Is., Sept. 17, 26, and ?.
XVI.	2	0.3	2	0.3	Grays Hr., Sept. 18; Porlier Pass, Herring, Oct. ?.
XVII.	4	2.0	3	1.5	Columbia R., Aug. 19; 2 Destruction Is., Aug. 28 and ?; Grays Hr., Date ?.
XVIII.	3	1.0	1	0.3	2 Destruction Is. (1?), Sept. 16 and ?; Westport, Sept. 4.
XIX.	2	1.0	2	1.0	Columbia R., Aug. 8; San Pedro, Mar. 9, 1938.
XX.	8	1.3	3	0.5	6 Destruction Is. (5?), Aug. 3?, 23?, 27?, 27, Sept. 1? and ?; 2 Grays Hr., Sept. 12 and 17.
XXI.	1	0.3	1	0.3	Pt. Brown, Sept. 17.
XXII.	1	1.0	1	1.0	Destruction Is. to Grays Hr., Sept. 11.
?	1	----	----	----	Defaced.
A (in 1936)	2	0.02	----	----	
A (in 1937)	0	0	----	----	
B (in 1936)	23	0.92	----	----	
B (in 1937)	3	0.06	2	0.04	Destruction Is., July 16?; Sydney In., July 30; Monterey, Jan. 11, 1938.

Although the recovery of California tags from fish caught off Barkley Sound and off the Washington coast indicates that the main run of pilchards, or at least part of it, came up from California, there is evidence for believing that the fish which comprised a few small catches made in Sydney Inlet had a different source. These fish yielded one Canadian tag which had been used in a fish released in Bedwell Sound the previous year. Two other tags used at the same time were recovered in the inside waters of Clayoquot Sound and Sydney Inlet during the autumn and winter of 1936–37. These returns, together with the known fact that pilchards do remain at the heads of some of the inlets during the winter, suggest, although they do not prove, that the small run of pilchards encountered in Sydney Inlet were moving out from the inside waters.


CANADA
Bajo reef
Nootka light
Sydney inlet
Bedwell sound
Rafael point
Clayoquot sound
VANCOUVER ISLAND
Barkley sound
Effingham island
Cape Flattery
Portage head
Umatilla reef
Quillayute river
Destruction island
Grays harbour
Westport
Point Brown
Aberdeen light
Columbia river
Tillamook head
U.S.A.
Monterey 435 mi.
San Pedro 615 mi.
Newport har. 630 mi.
Coronado 680 mi.
50 nautical miles
Heceta head

The third 1936 Canadian tag to be returned in 1937–38 was applied 20 miles south of Rafael Point on August 26th and was recovered off Destruction Island. It shows that at least some of the fish off the Washington coast in 1937 had been off Vancouver Island the previous year.

In Table II. are shown figures for the number of tags recovered by each plant. In addition are given the numbers of tags recovered per thousand tons of fish processed. It is believed that such figures are capable of giving a good relative estimate of the efficiency of the magnets in recovering tags. Canadian tags and California tags have been treated separately. It will be noticed that the apparent efficiency for Canadian tags is very high for the Ucluelet plant. It is believed that the high figure is a result of tagged fish getting back into the net while tagging is actually in progress. A potential cause of irregularity in the results is the recapture by other boats of tagged fish shortly after their release. In order to avoid errors from either of these two sources the returns for California tags have been considered as offering a rough estimate of recovery efficiency at the various plants. They indicate that the Ucluelet and Ecoole installations are most efficient and these are probably to be considered as "satisfactory." Room for improvement is apparent in other cases. At Kildonan the installation has already been improved, and it is hoped that in other plants changes may be made to increase the efficiency of recovery.

A comparison on the above basis is possible between British Columbia and California recoveries of California tags. The index of efficiency for Canadian plants as shown in Table II. is 0.44. That for California may be calculated on the basis of 302 (Janssen, 1937) recoveries from 727,000 tons of fish handled by shore plants and reduction ships at 0.42. This is a purely arbitrary figure. It cannot be used in comparing the concentration of tagged fish on the two fishing-grounds without taking a number of factors into consideration. In the first place, the California tagging was carried out while recovery was going on. It can be shown mathematically that only one-half as many tags can be expected under those circumstances as when all the tagged fish were present at the beginning of the season. Secondly, not all California shore plants had magnets and some were installed during the course of the operating season. Thirdly, there is no satisfactory knowledge concerning the proportion of meal in the 239,000 tons of pilchards taken by reduction ships which was passed over magnets. Fourthly, there is no adequate information available about the efficiency of the various magnets. It would appear that there is considerable variation among the British Columbia installations and it is reasonable to suppose that a similar and comparable variation exists in California. Fifthly, a large proportion of the catch delivered to California shore plants is canned and it is believed that tag-recovery from the offal of cannery fish is less efficient than for fish passing directly through a reduction plant. Sixthly, there is a tendency for tags to be taken especially rapidly for the first few days after tagging. The cause for this is not known, but probable reasons are the release of fish close to the fishing-grounds frequented by the fishing-boats at the time and the mortality induced by the actual tagging operation. Finally, a large proportion of the tags were applied to fish smaller than those which usually enter into the Canadian fishery.

With so many unknowns involved comparison of the concentrations of tags among fish on the two fishing-grounds cannot be made with any degree of certainty. However, it is evident that the first five factors discussed tend to decrease the proportion of tags recovered by California magnets of those used during the California fishing season. The last two decrease the proportion of recoveries made by British Columbia plants from the same tagging. As two of the seven factors decrease the Canadian recoveries, there is no satisfactory evidence for believing that the proportion of large fish which carried tags was greater on the California grounds than on those exploited by Canadian boats.

In 1937, five British Columbia tags were recovered in California from 2,535 used during the previous summer. In 1938, the same number of British Columbia tags were recovered in California from 6,936 tags put in off the Washington coast during the previous summer. The decline in percentage recovery (0.20 to 0.07) was in spite of a greatly increased efficiency of recovery. It is possible that the apparent discrepancy is due to chance. Two other possibilities remain. One is that the unexpectedly low return was a consequence of faulty tagging technique. The other is that the reason lies in biological factors which are not yet

understood. In the continuation of the work it is proposed to compare the percentage recovery of tags applied with a knife with those applied with a tagging-gun as a check on the newer technique.

ACKNOWLEDGMENTS.

The pilchard-tagging programme has depended upon the co-operation of a great many individuals and organizations. The co-operation has been so sincere that it is a pleasure to acknowledge it.

The work of Mr. Lennard Quickenden in continuing the tagging under rather arduous conditions has been invaluable. He worked from the boats of the Nootka Packing Company with Captain John Dale and Captain Gordon Wilks. Their help in the work is much appreciated.

We are indebted to the companies who have installed magnets and to the employees who have examined the magnets for tags. They have contributed a very essential part of the programme.

We have enjoyed the fullest co-operation of State officials of the Pacific Coast States. Mr. L. Royal, of the Washington State Fisheries Department, and Mr. M. T. Hoy, Master Fish Warden of the Fish Commission of Oregon, have been diligent in looking after tags recovered on the magnets in their respective States and returning them to us with the data. The programme has been carried out in full co-operation with the California State Fisheries Laboratory. To its director, Mr. W. L. Scofield, and to Dr. Frances N. Clark and Mr. John Janssen (Jr.), I am specially grateful for the return of tags, suggestions concerning programme, and other courtesies.

The work has been carried out under the auspices of the Pacific Biological Station of the Fisheries Research Board of Canada and the Department of Fisheries of the Province of British Columbia. Their help and the support of the respective executive officers, Dr. W. A. Clemens and Mr. George J. Alexander, are gratefully acknowledged.

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THE TAGGING OF HERRING (*CLUPEA PALLASII*) IN BRITISH COLUMBIA: APPARATUS, INSERTIONS, AND RECOVERIES DURING 1937–38.

By John Lawson Hart, Ph.D., and Albert L. Tester, Ph.D.,
Pacific Biological Station, Nanaimo.

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INTRODUCTION.

In the autumn of 1936 a herring-tagging recovery programme was started in British Columbia for the purpose of obtaining direct information on the extent of intermingling of the various runs and the nature and extent of herring movements. Indirect information obtained from an analysis and comparison of racial characters had already indicated the presence of "local runs" or "local populations," and it was hoped that the results from tagging would provide a check on these conclusions and would also yield information, which was not readily obtainable by the indirect method of study, on the extent of intermingling of closely-situated runs.

A previous publication appearing in the Report of the Provincial Fisheries Department for 1936 contains an illustrated and detailed account of the internal metal tags, the methods of tagging, and the induction detector used for recovering tagged fish from the conveyer system of a saltery. It also includes a list of the tags inserted and the recoveries made during the 1936–37 season. The results which were obtained demonstrated the feasibility of applying these tagging and recovery methods to study the movements of British Columbia herring and were sufficiently encouraging to warrant an expansion of the programme and the purchase of additional recovery equipment.

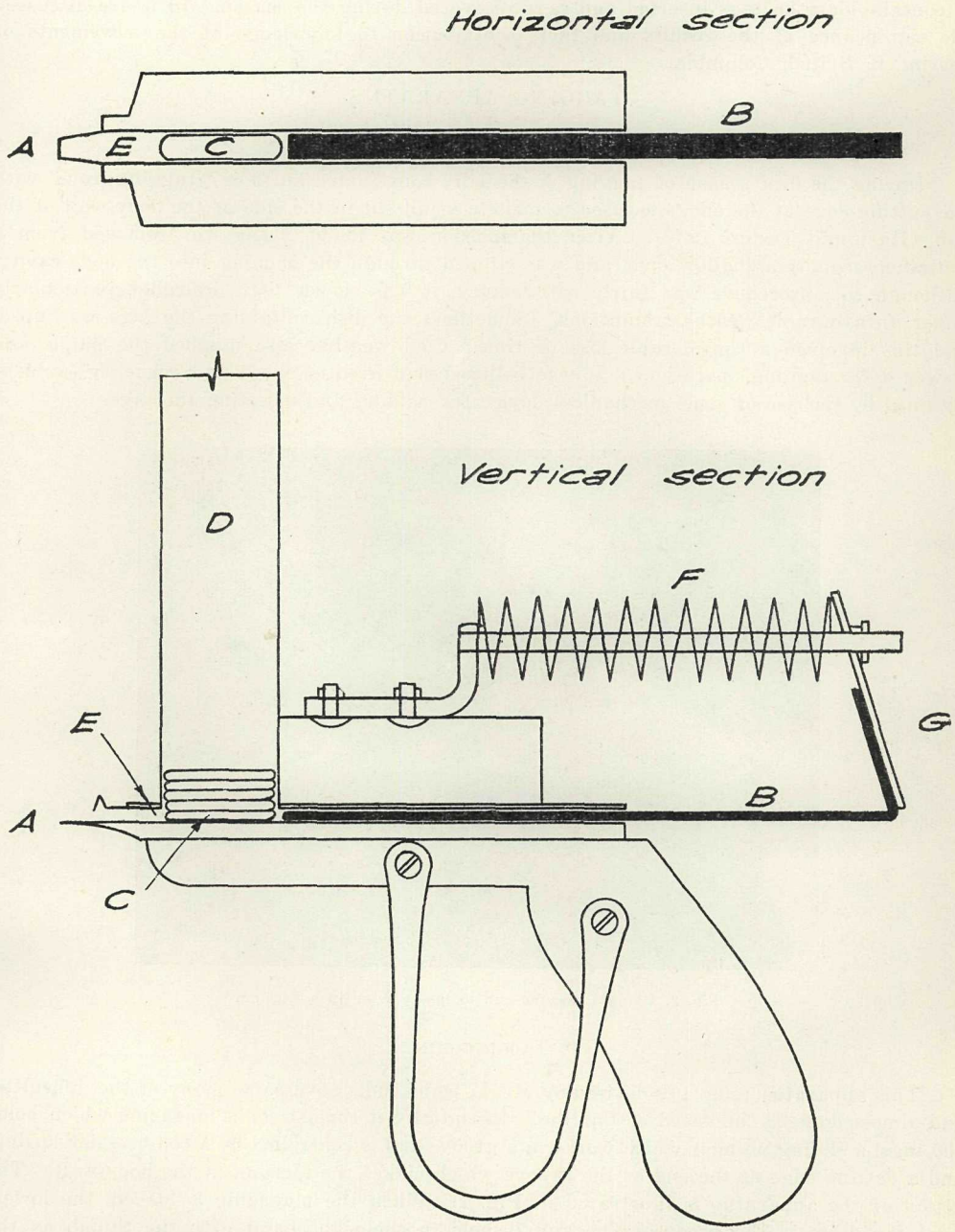


Fig. 1. Diagrammatic sections illustrating the mechanism of the tagging-gun. After an incision has been made in the side of the fish with the cutting-edge (A), the plunger (B) is depressed. This pushes the lowermost tag (C) from the stack of tags in the barrel (D) along a groove (E) and over the knife edge (A) into the incision in the fish. The plunger is forced back by the compression-spring (F) when the thumb is removed from the plate (G) and another tag drops into place.

The present paper describes the progress of the investigation during the season 1937–38. It includes a description of improved tagging apparatus and additional recovery apparatus. It contains data on tags inserted and tags recovered during the season. In it are discussed the significance of the results and their contribution to knowledge of the movements of herring in British Columbia.

TAGGING APPARATUS.

TAGGING-KNIFE.

During the first season of tagging, a specially constructed knife or "tagging-iron," with the cutting-edge at the end, was used to make a small slit in the side of the body-wall of the fish (Hart and Tester, 1937). After the incision was made, a tag was removed from a container, usually a shallow dish, and was slipped through the opening into the body-cavity. Although this procedure was fairly satisfactory, it was slower than desirable, particularly under unfavourable weather conditions. Sometimes the dish containing the tags was upset and this involved a considerable loss of time. Cold weather also numbed the hands and slowed down tagging operations. It was believed that greater speed and efficiency could be obtained by the use of some mechanical device for holding and inserting the tags.

Fig. 2. Using a tagging-gun to insert a tag in a herring.

TAGGING-GUN.

This apparatus (Fig. 1), devised by Mr. L. Quickenden, overcame many of the difficulties and almost doubled the speed of tagging. Essentially it consists of a magazine which holds 100 tags, a sliding plunger which works in a groove and is controlled by a compression-spring, and a cutting-edge at the end of the groove which makes the incision in the body-wall. The action of the apparatus is illustrated in Fig. 2. When the magazine is loaded, the lowermost tag rests in the groove. The gun is held in the right hand with the thumb on the plunger. The fish is removed from a dip-net and held firmly against the body with the left hand. A few scales are scraped away from the side of the fish with the cutting-edge and the latter is pushed into the flesh, making a small incision between the ribs. The plunger is then depressed and it slides along the groove pushing the lowermost tag down the groove to the knife edge and thence through the opening into the body-cavity of the fish. When the thumb is removed the compression-spring forces the plunger back beyond the base of the magazine and another tag drops into place in the groove.

The gun is loaded by means of clips made of shim copper or other thin metal. The clips, each holding 100 tags, are loaded at leisure. When the gun is empty it is held upside down and the loaded clip is fitted into the mouth of the magazine. By means of a stick of wood shaped to fit inside the clip, the tags are forced down the magazine until the first tag rests in the groove. The gun is then turned to its operating position and a cap is fitted over the end of the magazine. The use of loading-clips is necessary to prevent tags from resting edgewise in the magazine and thus causing the gun to jam.

Under average conditions two men, one dipping the fish from a net or pound and the other tagging with the gun (Fig. 3), are able to insert up to 300 tags per hour.

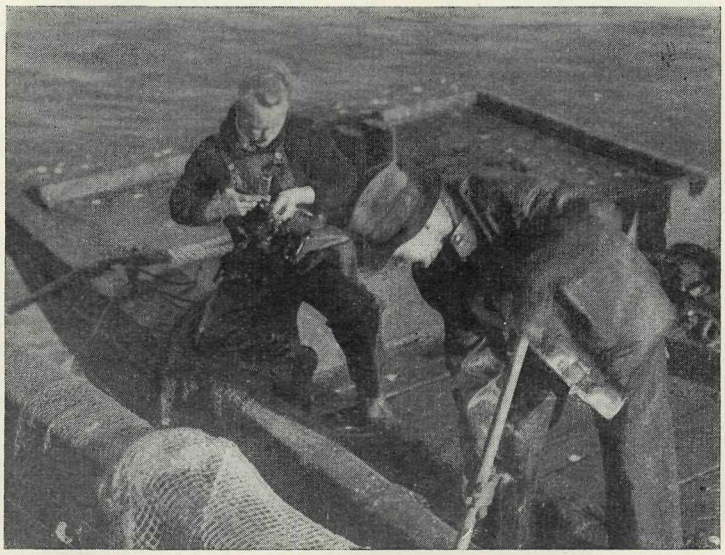


Fig. 3. Tagging herring at Sooke from a light seine suspended between a boat and a small scow.

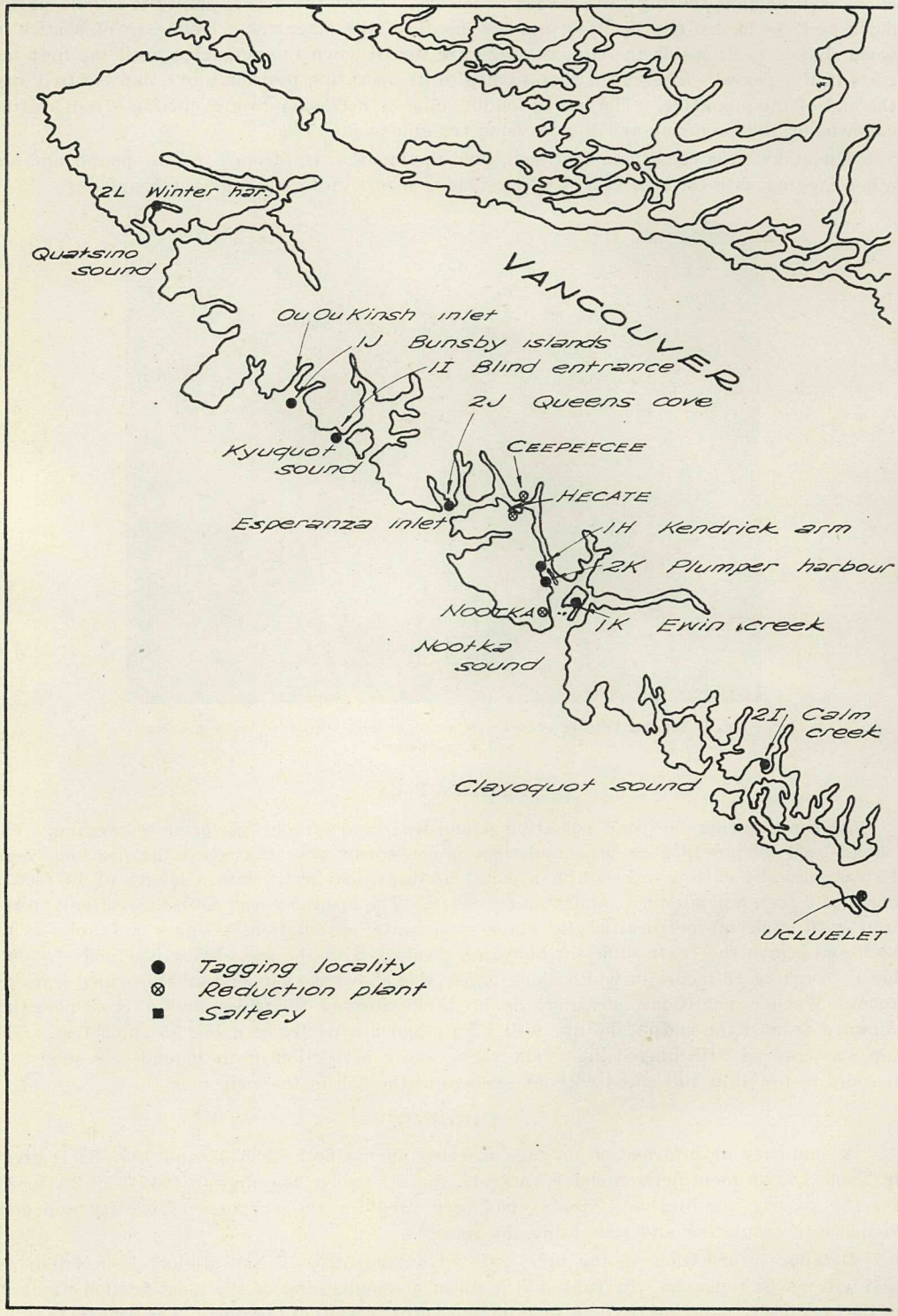
Floating Pound.

At times during the year a floating pound was used to hold fish prior to tagging. The pound used during 1937–38 was a distinct improvement over that used the previous year. It was made by cutting one end off a metal life-boat, leaving it with a length of 14 feet, a beam of 6 feet, a pointed bow and a square stern. The open end was covered with galvanized iron with sufficient perforations to allow some water circulation. Copper air-tanks along both sides gave the craft sufficient buoyancy to float with the gunwhales just above water-level. Decking 18 inches in width along either side above the copper tanks provided working room. Wooden partitions encasing the air-tanks formed the sides and a cross-partition forward formed the end of the live well. This had a capacity of about 75 cubic feet. The top was covered with hinged lids. The shape and construction of the pound was such that it could be towed at full speed without damage to the fish in the well.

TAGGING.

A summary of information on tags inserted during both 1936–37 and 1937–38 is given in Table I. An identification code (1A to 1L for the twelve taggings in 1936–37; 2A to 2T for the twenty taggings in 1937–38) has been used for the purposes of brevity and convenience in tabulating and presenting the results.

Detailed information on the tags inserted during 1936–37 has already been published and will not be repeated. In Table IV. is given a complete list of the identification numbers of the tags inserted during 1937–38, together with other details of tagging. The general tagging locality is given by code and may be obtained by reference to the summary given in Table I.


2L Winter har.
Quatsino sound
VANCOUVER
Ou Ou Kinsh inlet
1J Bunsby islands
1I Blind entrance
2J Queens cove
Kyuquot sound
CEEPEECEE
HECATE
Esperanza inlet
1H Kendrick arm
2K Plumper harbour
NOOTKA
1K Ewin creek
Nootka sound
2I Calm creek
Clayoquot sound
UCLUELET
Tagging locality
Reduction plant
Saltery

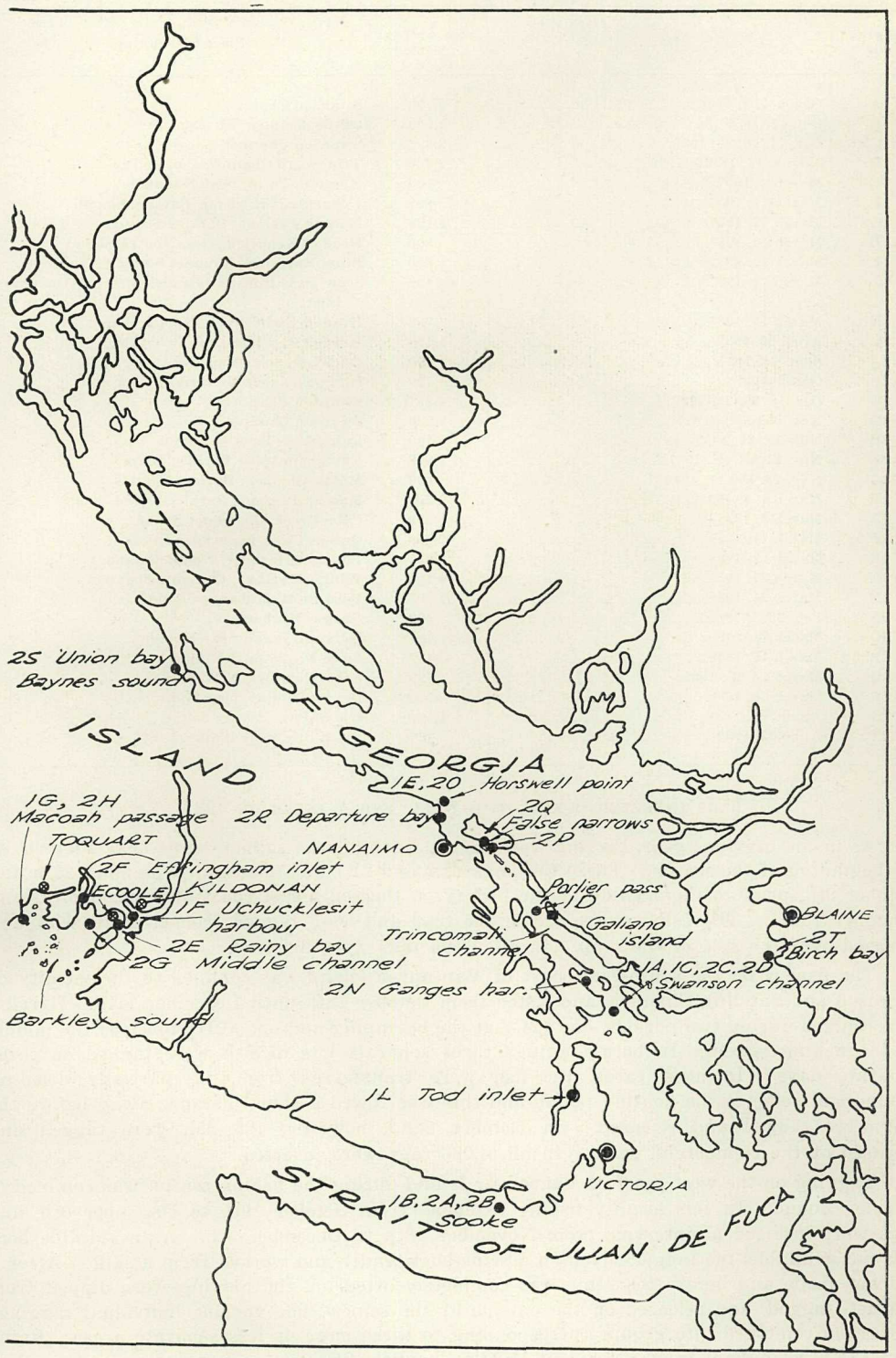

STRAIT OF GEORGIA
ISLAND
2S Union bay
Baynes sound
1E, 2O Horswell point
2Q
False narrows
2P
2R Departure bay
NANAIMO
1G, 2H
Macoah passage
TOQUART
2F Effingham inlet
ECOOLE
KILDONAN
1F Uchucklesit
harbour
2E Rainy bay
2G Middle channel
Barkley sound
Parlier pass
1D
Galiano
island
Trincomalt
channel
BLAINE
2T
Birch bay
1A, 1C, 2C, 2D
Swanson channel
2N Ganges har.
1L Tod inlet
VICTORIA
1B, 2A, 2B
Sooke
STRAIT OF JUAN DE FUCA

TABLE I.—A SUMMARY OF TAGS INSERTED DURING THE SEASONS 1936–37 AND 1937–38.

Tagging Code.	Date.	No. of Tags inserted.	Place of Tagging.
1A	Oct. 6, 7, 8, 1936	2,392	Swanson Channel.
1B	Oct. 15, 1936	1,500	Off Sooke, near Victoria.
1C	Oct. 17, 19, 20, 1936	2,398	Swanson Channel.
1D	Nov. 8, 12, 18, 19, 1936	2,300	Trincomali Channel, Porlier Pass.
1E	March 4, 1937	700	Horswell Point, near Nanaimo.
1F	March 11, 1937	898	Uchucklesit Harbour, Barkley Sound.
1G	March 12, 1937	1,199	Macoah Passage, Barkley Sound.
1H	March 14, 1937	899	Head of Kendrick Arm, Nootka Sound.
1I	March 17, 1937	1,000	Blind Entrance, Kyuquot Sound.
1J	March 17, 1937	898	Scow Bay, Bunsby Islands, entrance Ououkinsh Inlet.
1K	March 19, 1937	798	Head of Ewin Creek, Nootka Sound.
1L	April 25, 1937	1,198	Head of Tod Inlet, Saanich Inlet.
2A	Sept. 25, 1937	499	Off Sooke, near Victoria.
2B	Oct. 9, 1937	700	Off Sooke, near Victoria.
2C	Oct. 18, 22, 23, 1937	1,257	Swanson Channel.
2D	Nov. 9, 10, 12, 1937	2,829	Swanson Channel.
2E	Nov. 18, 25, 1937	700	Rainy Bay, Barkley Sound.
2F	Nov. 21, 23, 28, 1937	1,298	Effingham Inlet, Barkley Sound.
2G	Nov. 23, Dec. 1, 4, 1937	800	Middle Channel, Barkley Sound.
2H	March 7, 8, 1938	2,299	Macoah Passage, Barkley Sound.
2I	March 9, 1938	899	Calm Creek, Clayoquot Sound.
2J	March 11, 1938	1,293	Queens Cove, Esperanza Inlet.
2K	March 12, 1938	995	Plumper Harbour, Nootka Sound.
2L	March 21, 1938	1,198	Winter Harbour, Quatsino Sound.
2M	March 25, 1938	1,395	Bella Bella, Milbanke Sound.
2N	Feb. 25, 1938	699	Ganges Harbour.
2O	March 7, 8, 1938	791	Horswell Point, near Nanaimo.
2P	March 15, 1938	497	False Narrows, S.E. side.
2Q	March 16, 17, 1938	799	False Narrows, N.W. side.
2R	March 23, 1938	500	Departure Bay, near Nanaimo.
2S	April 2, 3, 1938	1,196	Union Bay, Baynes Sound.
2T	April 22, 1938	797	Birch Bay, near Blaine, U.S.A.

TAGS INSERTED DURING THE FALL AND WINTER OF 1937.

As in the previous year, herring were tagged at the Sooke salmon-traps near Victoria at the beginning of the season. These taggings (2A and 2B) took place on September 25th and October 9th, prior to the opening of the fishery on the south-east coast of Vancouver Island (October 18th). The fish were seined in the trap and were tagged from a small scow and released over the side of the trap. In all, 1,199 tags were inserted.

The fishery on the south-east coast of Vancouver Island was confined to the vicinity of Swanson and Satellite Channels and lasted from October 18th until December 11th. Herring were tagged during two periods, one (2C) at the beginning and one (2D) towards the middle of the fishing season. In both taggings three separate lots of fish were tagged on three separate days. In most cases, the fish were transferred from the partially dried-up commercial seine to the floating pound and this was towed a short distance away before the fish were tagged and released. On October 22nd, however, 195 fish were tagged and released at the commercial seine. In all, 4,086 tags were inserted.

Tagging on the west coast of Vancouver Island during the fishing season was confined to Barkley Sound. In this locality fishing extended from October 19th to December 6th, and tags were inserted at intervals from November 18th to December 4th. As a suitable boat was not available, the taggers lived on a seine-boat tender and worked from a skiff. After a set was made and before the seine was completely dried up, the herring were dipped from the net, tagged, and released on the outside of the seine. The various individual taggings have been combined into groups corresponding to three more or less separate areas: Rainy Bay (2E), Effingham Inlet (2F), and Middle Channel (2G), the last including Vernon Bay. In all, 2,798 tags were inserted in Barkley Sound.

TAGS INSERTED DURING THE SPRING OF 1938.

Practically all of the fish tagged during the spring were caught on the spawning-grounds and were either full of spawn, partially spent, or completely spent. Usually all three types were present in one catch, but the proportions of each varied among the various catches. Completely spent fish were tagged most satisfactorily as there was less danger of rupturing the body-wall and the gonads when the incision was made.

In the Strait of Georgia fish were tagged in seven different localities during the spawning season: At Ganges Harbour at the south end of Saltspring Island (2N); at Horswell Point, off Departure Bay (2O); at False Narrows on the south-east side (2P), and on the north-west side (2Q); at Departure Bay (2R); at Union Bay in Baynes Sound (2S); and at Birch Bay, near Blaine, U.S.A. (2T). The fish for the 2N tagging were caught by means of a small purse-seine and those for the 2T tagging were taken from a herring-weir (Fig. 4). In both instances the fish were tagged from a boat or scow and were released into deep water. All others were caught by means of a small beach-seine and were tagged at the shore-line and released in shallow water. In several instances some of the tagged fish were eaten by gulls before they were able to escape to deep water. In all, 5,279 fish were tagged in the Strait of Georgia.

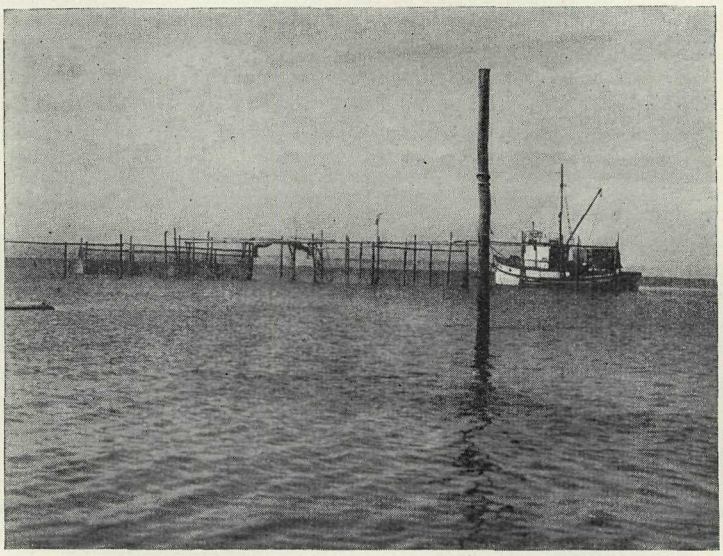


Fig. 4. A herring-weir at Birch Bay used for taking herring for bait. This method of capturing herring has not been developed on the Canadian side.

On the west coast of Vancouver Island herring were tagged during the spawning season at Macoah Passage, Barkley Sound (2H); at Calm Creek, Clayoquot Sound (2I); at Queens Cove, Esperanza Inlet (2J); at Plumper Harbour, Nootka Sound (2K); and at Winter Harbour, Quatsino Sound (2L). The fish for the last tagging (2L) were taken from a herring-pound. All others were caught by means of a small purse-seine operated from a pair of skiffs. The fish were tagged from one of the skiffs after the net had been partially dried up and were released into deep water. In all, 6,684 tags were inserted on the west coast of Vancouver Island.

The small purse-seine was again used to catch fish for tagging at Bella Bella in Milbanke Sound (2M). This is the first time that herring have been tagged north of Vancouver Island in British Columbia waters. In this locality, 1,395 tags were used.

Recapitulation.

The tags inserted during 1936–37 (previously published) and 1937–38 (listed above) may be summarized according to locality and number as follows:—

Locality.	1936–37.	1937–38.
	Fall.	
Strait of Juan de Fuca	1,500	1,199
South-east coast Vancouver Island	7,090	4,086
Barkley Sound	.....	2,798
	Spring.	
Strait of Georgia	1,898	5,279
West coast Vancouver Island	5,692	6,684
North of Vancouver Island	.....	1,395
Total	16,180	21,441

RECOVERY APPARATUS.

Galiano Island Detector.

The "electronic" or "induction" tag detector used at a saltery on Galiano Island in the fall of 1936 was again used at the same plant (the Moresby Island Fisheries Co., Ltd.), in the fall of 1937. This apparatus has already been described in detail (Hart and Tester, 1937) and it is only necessary to review the principle on which it works. After passing up an elevator, the fish slide down a chute to a horizontal conveyer which carries them to the salting-tanks. In their progress down the chute they pass through a rectangular compound coil and over a trap-door. The compound coil is held in delicate electrical balance with a second identical coil a short distance away. Almost immediately after a tagged fish passes through the coil the trap-door opens and closes resulting in the capture of about 100 fish, one of which is the tagged individual. This tagged fish is subsequently isolated by passing the trapped fish through the coil a few at a time. The action of the trap-door is due directly to the operation of a reversible compressed-air piston and this in turn is the culmination of a series of electrical and mechanical changes arising from the electrical disturbance caused by the temporary presence of the metal tag in the coil. In this series of changes thermionic amplifiers, relays, a solenoid pneumatic valve, and a mercoid switch all play important parts.

The addition of an A.C. voltage stabilizer and a plate-voltage control for the detector tube simplified the operation and increased the efficiency of the apparatus as compared with the previous season. Increased familiarity with the intricacies of the machine also contributed to more satisfactory service.

The efficiency of the induction detector in recovering tagged fish was determined by placing these in the scows at intervals throughout the season. Of the thirty-five tagged fish planted in this way, thirty-two, or 91.5 per cent., were recovered. This figure, roughly 90 per cent., may be considered as the average operating efficiency of the apparatus. Its actual efficiency, calculated on the basis of total tonnage of fish passing through the coils, would be lower as the machine was sometimes temporarily out of commission (but not during the above tests). The 10-per-cent. loss in operating efficiency may be attributed to variation in the speed of flow of the fish down the chute. It is possible to compensate partly for this variation in speed of flow by adjusting the sensitivity of the coil. It may be possible to further reduce the effects of this factor by decreasing the distance between the coil and trap-door. This can be accomplished if it proves possible to decrease the lag between the time of reception of the impulse and the operation of the trap by the use of larger air-hoses in the compressed-air system operating the trap-door.

Among the many factors which temporarily interfere with the action of the detector might be mentioned failure of the plant D.C. supply; interference from the ignition system of gas-engines; loose connections caused by vibration; and sticking of the solenoid valve. Some of these difficulties are readily overcome; others may be reduced in the future by further adjustment of the equipment.

Ucluelet Detector.

At the beginning of November, 1937, a second induction detector was installed at the Ucluelet reduction plant of the Banfield Packing Co., Ltd. In fundamental principle this

unit resembles that installed at Galiano Island. It differs from it, however, in several important respects.

Details of installation are different because of differences in the method of unloading. The unloading apparatus at the Galiano Island saltery consists of a single long-slat conveyer with a hopper at the bottom into which the fish are shovelled. The unloading apparatus at the reduction plant (Fig. 5) at Ucluelet is a marine leg having deep metal buckets which for the most part fill themselves during the unloading process. At the top of the marine leg the fish are spilled into a long, more or less horizontal, conveyer which has shallow iron buckets and which is pivoted at the end near the reduction plant (Fig. 6). By the movement of this conveyer the marine leg is lowered into and raised from the holds of the packers. The pivoted conveyer in turn empties into a fixed slat conveyer which raises the fish at a slight angle to the plant. It is between the pivoted and the slat conveyers that the chute containing the coil and trap-door used in recovering tagged fish is placed.

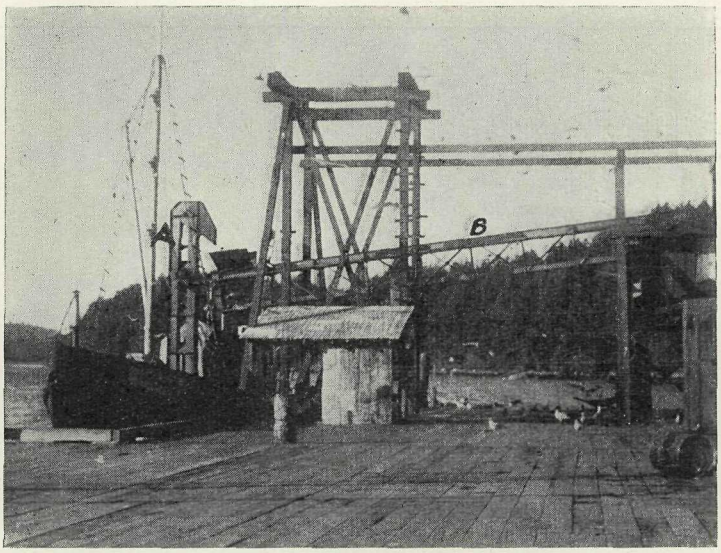


Fig. 5. Unloading herring from the hold of a boat at the Banfield Packing Company's plant at Ucluelet. (A) Marine leg; (B) pivoted conveyer.

The chute is considerably wider than that at the Galiano Island saltery and this necessitates the use of a coil which has inside measurements of 7 by 21 inches in place of 7 by 16 inches. The size of the trap-door is similarly enlarged. As the working-space is small, the fish-bin is placed immediately below the trap-door rather than below and off to one side as in the Galiano unit. When handling sticky fish a stream of water through a specially constructed distributing nozzle is necessary to enable them to slide freely down the chute. Certain details of the Ucluelet installation are shown in Figs. 7, 8, 9, and 10.

Several parts of the air system in the new unit are of larger size and this results in more rapid action of the trap-door. These include the compressed-air tank, the air-hoses, and the air channels of the solenoid valve.

Instead of the gasoline-driven motor-generator unit used at Galiano Island, a rotary converter provides a source of alternating current from the D.C. supply of the plant. In order to give some control over the voltage input to the set, an autotransformer is placed in the circuit. The latter proved to be very necessary as the plant's supply of current was found to be very erratic.

After the installation of the apparatus on November 3rd, tests indicated a very low efficiency in recovering tagged fish and it was necessary to decrease the slope of the chute. Mechanical difficulties with the trap-door and electrical difficulties with the balancing system prevented satisfactory operation until November 16th. Following that date, comparison of the number of detector and magnet (*see* next section) recoveries indicated an efficiency of

about 50 per cent. in recovering tagged fish. This low value indicates the need for further adjustments in the future to give more satisfactory service. Several methods of improvement are possible.

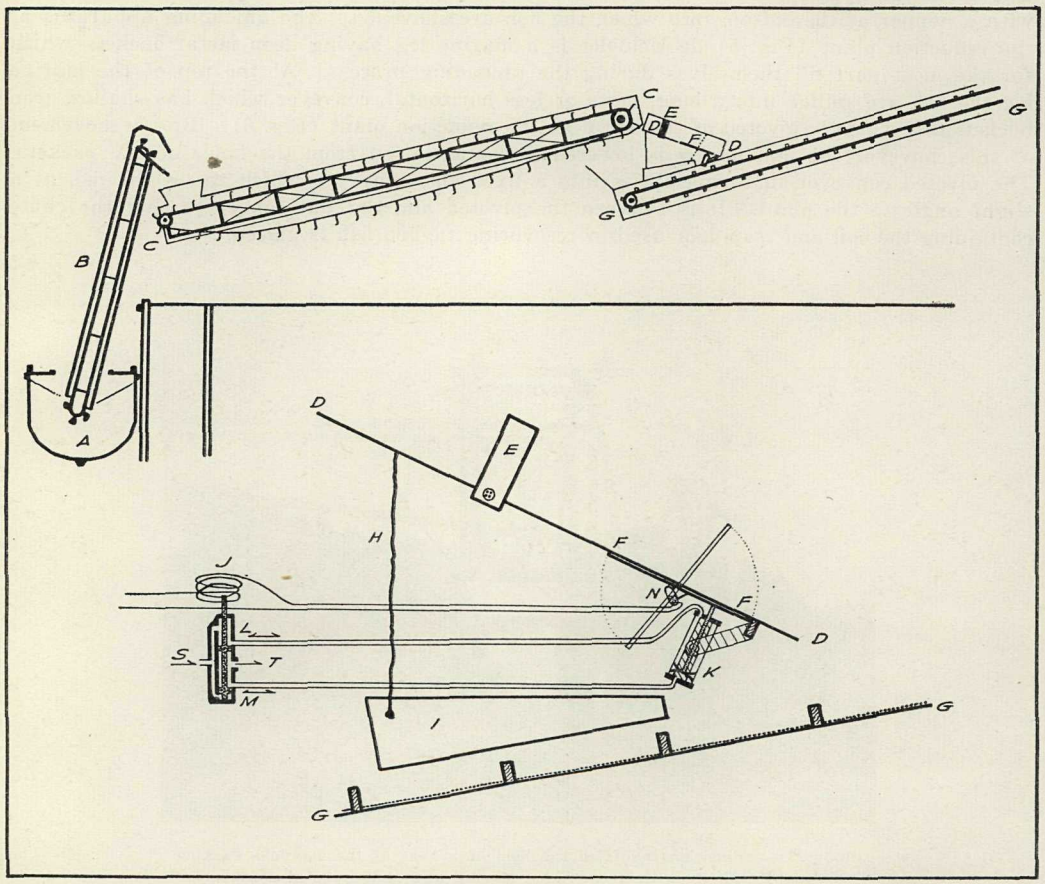


Fig. 6. Diagrammatic representation of the installation of the principal mechanical parts of the induction detector at Ucluelet. (A) represents a section of the boat being unloaded by the marine leg (B) with its deep buckets. These are emptied into a pivoted section (CC), which operates at only a slight angle and consequently requires only shallow buckets. From this conveyer the fish slide down a short chute (DD) through the detector coil (E) and over the trap-door (F) into a slat conveyer (GG). In the lower diagram the essential features of the trap-door and the air system are shown in some detail. (H) is a curtain which prevents the fish from being thrown clear of the fish-bin (I) when the trap-door is closing. When there is no current going through the solenoid (J) the air pressure is applied from (S) to the top of the piston (K) through the upper opening in the valve (L), and air is exhausted through (T) via the lower vent (M) so that the trap-door is held tightly closed. When the solenoid is energized the part of the valve shown stippled is raised, applying the air pressure through (M) to the lower side of the piston and exhausting the upper part of the cylinder through (L). This opens the trap-door allowing the fish to drop into the bin (I). When the door reaches the open position the mercury in the mercoid switch (N) runs away from the points, breaking the circuit. The solenoid is de-energized, the valve is restored to its normal position, and the trap-door is forcibly closed until another impulse produced by a tagged fish passing through the detector coil re-energizes the solenoid.

At present, insufficient space is available for the satisfactory installation of the coil-trap system. With further co-operation of the company it may prove possible to alter the conveyer system to permit the installation of a longer chute. The pick-up coil could then be moved to a greater distance from the pivoted metal conveyer and this would reduce the electrical interference caused by the moving buckets and enable a greater sensitivity to be maintained. It would also be possible to increase the distance between the coil and the trap-door and so recover those tagged fish which at present pass partially or completely over the door before it opens.

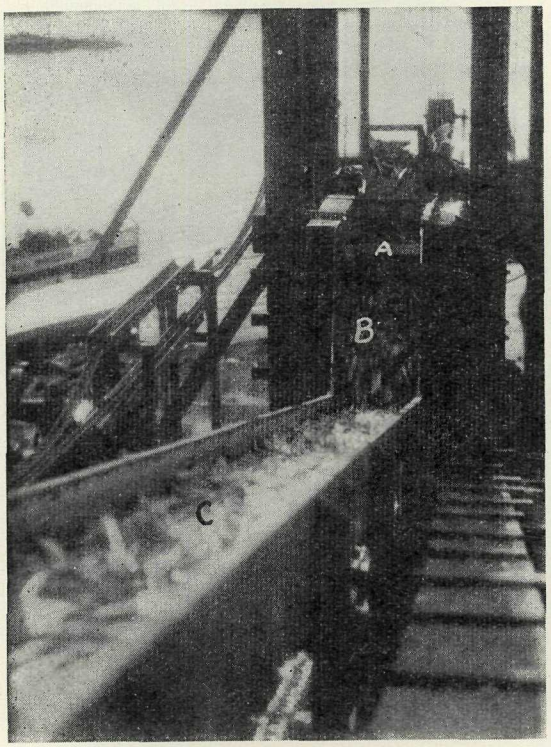


Fig. 7. Herring passing down the chute and over the trap-door before being carried up the slat conveyer. (A) Coil; (B) chute; (C) slat conveyer.

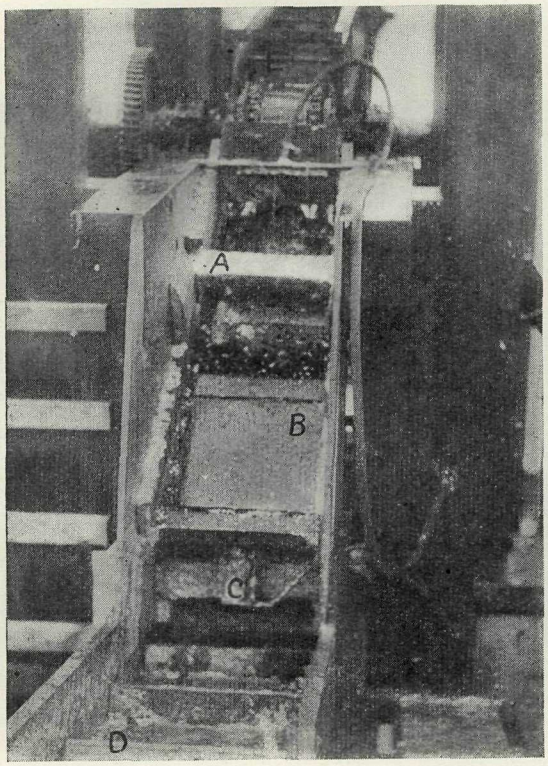


Fig. 8. The trap-door closed in the same position as in Fig. 7. (A) Coil; (B) trap-door; (C) cylinder containing piston; (D) slat conveyer; (E) pivoted conveyer.

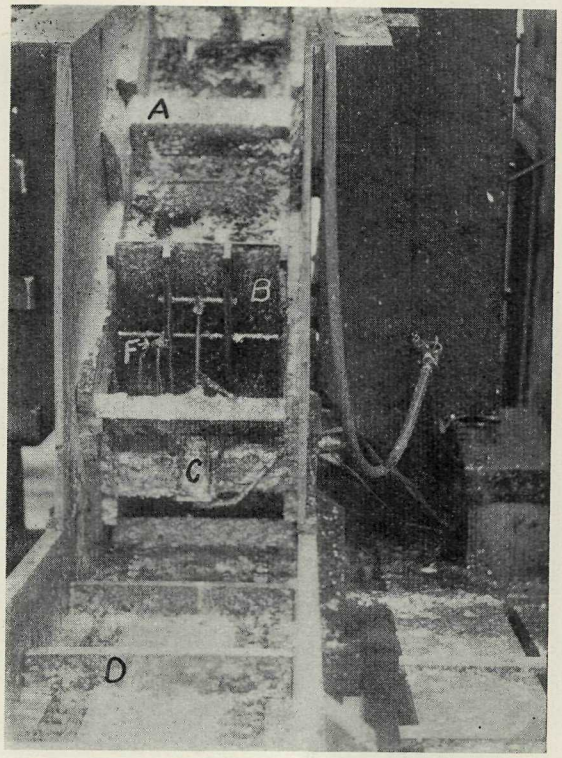


Fig. 9. A corresponding view of the trap-door open. Several of the essential parts can be made out on the lower side of the trap-door. (A) Coil; (B) under-side of trap-door; (C) cylinder containing piston; (D) slat conveyer; (F) mercoid switch.

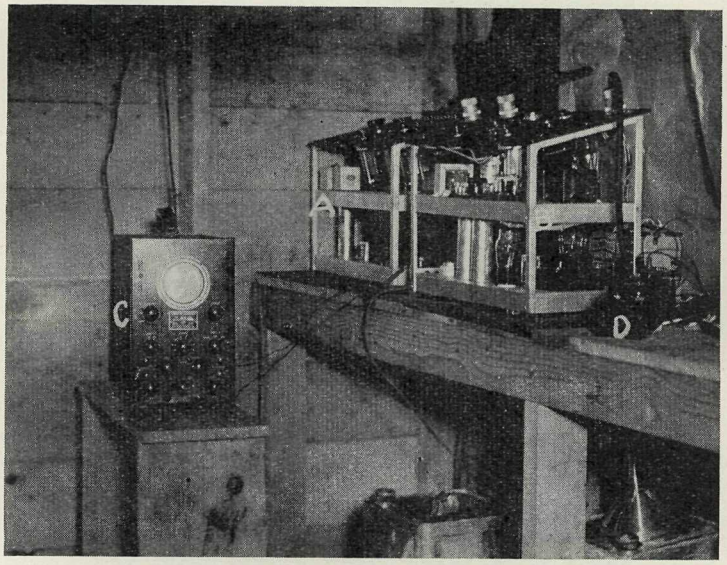


Fig. 10. Installation of the electrical equipment for the Ucluelet unit. The use of an oscilloscope and a micro-ohmmetre was necessary to procure a satisfactory electrical balance between the two coils. (A) Balancing-oscillator—detector unit; (B) relay power-amplifier unit; (C) oscilloscope; (D) micro-ohmmetre.

The addition of a delayed-action relay to the trap-door circuit would hold the door open for a fraction of a second and so ensure the capture of those fish which at present reach the opening too late, and those which at present reach the centre of the door and remain there by their own inertia during the complete cycle.

The addition of certain amplification units to the control-cabinets (already present in the Galiano detector) may enable a greater sensitivity to be maintained. It may also be possible to obtain greater sensitivity to tags and less interference from outside sources by reducing the size of the coils.

It should prove possible to make several of these proposed changes before the next fishing season and thus to increase the efficiency of the Ucluelet detector.

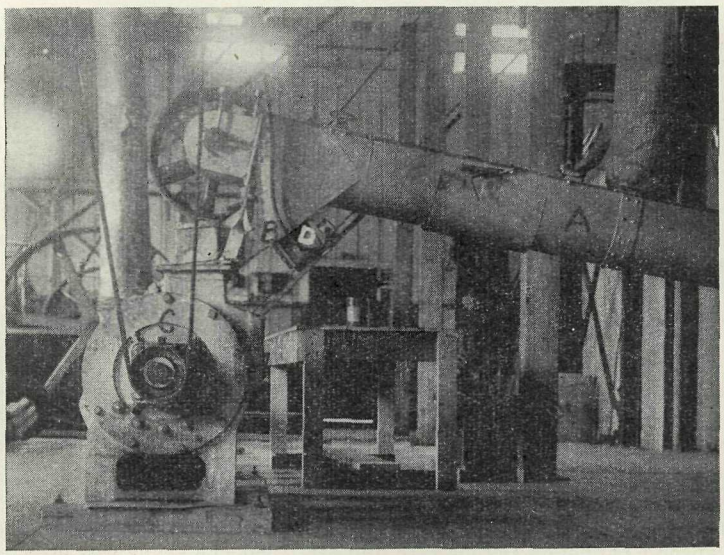


Fig. 11. Installation of a magnet for the recovery of tags at the Ucluelet plant. This magnet recovered 197 herring-tags during the past season. (A) Casing for worm-conveyer; (B) chute for meal; (C) grinder; (D) magnet installed in bottom of chute.

Magnets.

Powerful electromagnets, located in a chute between the drier and grinder in the meal-lines of reduction plants, have already been used successfully for the recovery of herring-tags in Alaska (Rounsefell and Dahlgren, 1933; Dahlgren, 1936) and pilchard-tags in both British Columbia (Hart, 1937) and California (Janssen, 1937). Those already installed in the reduction plants on the west coast of Vancouver Island in connection with the pilchard-work were used for the recovery of herring-tags during the past season (Fig. 11). Details of their installation may be obtained by referring to Hart (1937). A list of the plants making recoveries follows:—

B.C. Packers, Ltd.	Kildonan, Barkley Sound.
B.C. Packers, Ltd.	Ecoole, Barkley Sound.
Armac Packers, Ltd.	Toquart, Barkley Sound.
Banfield Packing Co., Ltd.	Ucluelet, Barkley Sound.
Nootka Packing Co., Ltd.	Nootka, Nootka Sound.
Nelson Bros. Fisheries, Ltd.	Ceepeecee, Esperanza Inlet.
B.C. Packers, Ltd.	Hecate, Esperanza Inlet.

While the reduction plants were operating, the magnets were inspected at irregular intervals by various company employees and tags adhering to the magnets were removed and turned in to plant officials, together with information on the date of recovery and the locality of capture of the fish which were being processed at the time. A reward of 50 cents was paid for each tag.

The information from tags recovered by magnets is less satisfactory than that from tags recovered by the induction detector in tracing the movements of herring. With magnet recoveries there is often considerable doubt as to the time and locality of capture of the fish which originally bore the tag. Often fish from two different areas are processed on the same day and because of the variable lag between the time a tagged fish enters the plant and the time the tag is recovered from the meal by the magnet, it is impossible to state with certainty from which of the two areas the tagged fish originated. Even when loads of fish from different areas are processed on different days, and even if the fish-bins, cookers, and presses are cleaned between runs, there is always the possibility of tags being held over for varying lengths of time in crevices behind the flanges of the drier or in the bottom of the screw-conveyer leading from the drier to the grinder. In fact, three tags were found in driers when they were being overhauled during holidays or after the close of the season. During the course of the season while the plants were in operation employees often recovered tags from the bottom of the worm-conveyer where they tended to accumulate at joints and other obstructions.

While the possibility of a tag being retained in the drier or worm-conveyer for one or several days is present in all plants, evidence from the sequence of the returns indicates that this probably happens to a lesser extent in some plants than in others. However, this and also the efficiency of the various magnets in recovering tags will be checked more closely in the future by planting tagged fish in the unloading conveyers and determining both the time-lag and the percentage recovery.

RECOVERY OF TAGGED FISH BY THE GALIANO DETECTOR.

Stability of Populations and Movements.

The Galiano detector was in operation from the opening of the fishing season on October 18th until the plant ceased operations on December 4th. During this interval 4,920 tons (estimated) of fish passed along the conveyer system of the plant. Of these, 4,512 tons (estimated) passed through the coils while the detector was in operation and yielded 104 tagged fish. A list of the daily recoveries is included in Table II.

Of special interest are the five returns from the 1936–37 taggings. Two of these were inserted at Swanson Channel on October 7th and 8th, 1936 (1A), one was inserted at Sooke on October 15th, 1936 (1B), one was inserted at Trincomali Channel on November 12th, 1936 (1D), and one was inserted at Tod Inlet, Saanich Arm, on April 25th, 1937 (1L). There were no recoveries from the Swanson Channel catches of tags inserted on the west coast of Vancouver Island during the spring (1F to 1K, inclusive). These results show that at least some of the herring come to the south-east coast of Vancouver Island in two successive seasons.* They offer no evidence for believing that fish from the west coast join the south-east-coast run. They are, therefore, in accord with the conclusions drawn from population studies (Tester 1936, 1937) in regard to the local nature of the south-east-coast run.

Of interest also is the recovery from Swanson Channel of tags inserted at Sooke during the current season. Eleven from the 2A and ten from the 2B taggings were recaptured. These results, combined with the two similar recoveries made last year (Hart and Tester, 1937) and supported by this year's 1B recovery, indicate that a large proportion of the fish supplying the south-east-coast grounds move in through the Strait of Juan de Fuca during September and October.

Certain fishermen have expressed the belief that there is no direct movement of herring between the Swanson Channel fishing-grounds and those in Trincomali Channel near Porlier Pass. Some of the evidence from the tagging-work seems to support this view. The evidence, chiefly contained in last season's results, is the lack of recovery of Swanson Channel tags and the recovery of both Trincomali Channel and Sooke tags from the Trincomali grounds in 1936–37. It is fairly certain that the fish supplying the two grounds belong to the same run, as a Trincomali tag (1D) was recovered along with two Swanson tags (1A) from Swanson Channel catches during 1937–38. Although the evidence suggests that direct

* Here, and throughout this discussion, it is assumed that the principal body of fish, after spawning, leaves the waters of the south-east coast of Vancouver Island, probably by way of the Strait of Juan de Fuca. Although there is no definite proof of this, the assumption seems justified as no large schools are seen during the summer on the south-east coast of the island prior to their appearance at Sooke in the early autumn.

movements from the Swanson Channel to the Trincomali Channel grounds do not take place there is no evidence concerning the migration route actually followed. The fish on the Trincomali grounds may come in through Porlier Pass as believed by fishermen or they may reach there by some devious course through the islands.

TABLE II.—DAILY RECOVERIES MADE BY THE DETECTOR AT GALIANO ISLAND FROM CATCHES TAKEN IN THE VICINITY OF SWANSON CHANNEL.

(The number of tons of fish examined each day is given in the last column.)

Date of Recovery.	Tagging.								Tonnage tested.
	1A (2,392).	1B (1,500).	1D (2,300).	1L (1,198).	2A (499).	2B (700).	2C (1,257).	2D (2,844).	
Oct. 19	0	0	0	0	0	0	0	----	35
„ 20	0	0	0	0	0	1	0	----	36
„ 21	0	0	0	0	0	0	2	----	97
„ 22	0	0	0	0	3	1	3	----	185
„ 23	----	----	----	----	----	----	----	----	-------
„ 24	0	0	0	0	0	1	1	----	155
„ 25	0	0	0	0	1	1	0	----	128
„ 26	0	0	0	0	1	0	1	----	30
„ 27	0	0	0	0	0	0	1	----	145
„ 28	0	0	0	0	1	0	3	----	190
„ 29	0	0	0	0	1	1	1	----	203
„ 30	----	----	----	----	----	----	----	----	-------
„ 31	0	0	0	0	0	0	0	----	30
Nov. 1	0	0	0	0	0	0	2	----	266
„ 2	0	0	0	0	0	1	2	----	80
„ 3	0	0	0	0	0	0	1	----	285
„ 4	0	0	0	0	0	0	2	----	210
„ 5	0	0	0	0	0	0	0	----	75
„ 6	----	----	----	----	----	----	----	----	-------
„ 7	----	----	----	----	----	----	----	----	-------
„ 8	0	0	0	0	0	0	3	----	140
„ 9	0	0	0	0	0	0	0	----	38
„ 10	1	0	0	1	1	1	0	4	235
„ 11	----	----	----	----	----	----	----	----	-------
„ 12	0	0	0	0	0	0	0	5	55
„ 13	----	----	----	----	----	----	----	----	-------
„ 14	0	0	0	0	0	0	0	3	55
„ 15	0	0	0	0	0	0	1	0	75
„ 16	0	0	0	0	0	0	0	1	100
„ 17	0	0	0	0	0	1	6	5	195
„ 18	0	0	0	0	0	0	2	0	45
„ 19	0	0	0	0	0	0	0	0	30
„ 20	----	----	----	----	----	----	----	----	-------
„ 21	0	0	1	0	0	0	0	3	158
„ 22	0	0	0	0	2	0	0	0	60
„ 23	1	0	0	0	0	2	3	7	380
„ 24	----	----	----	----	----	----	----	----	-------
„ 25	0	0	0	0	0	0	0	0	83
„ 26	0	0	0	0	0	0	0	0	30
„ 27	----	----	----	----	----	----	----	----	-------
„ 28	0	0	0	0	0	0	1	1	45
„ 29	0	0	0	0	0	0	5	2	195
„ 30	0	1	0	0	0	0	1	2	138
Dec. 1	0	0	0	0	1	0	0	1	115
„ 2	0	0	0	0	0	0	1	1	180
„ 3	0	0	0	0	0	0	1	0	10
Totals	2	1	1	1	11	10	43	35	4,512

From the 2C and 2D taggings on the Swanson Channel grounds there were forty-three and thirty-five recoveries respectively. These are of little interest from the migration standpoint as they were recovered from approximately the same locality and during the same season in which they were liberated.

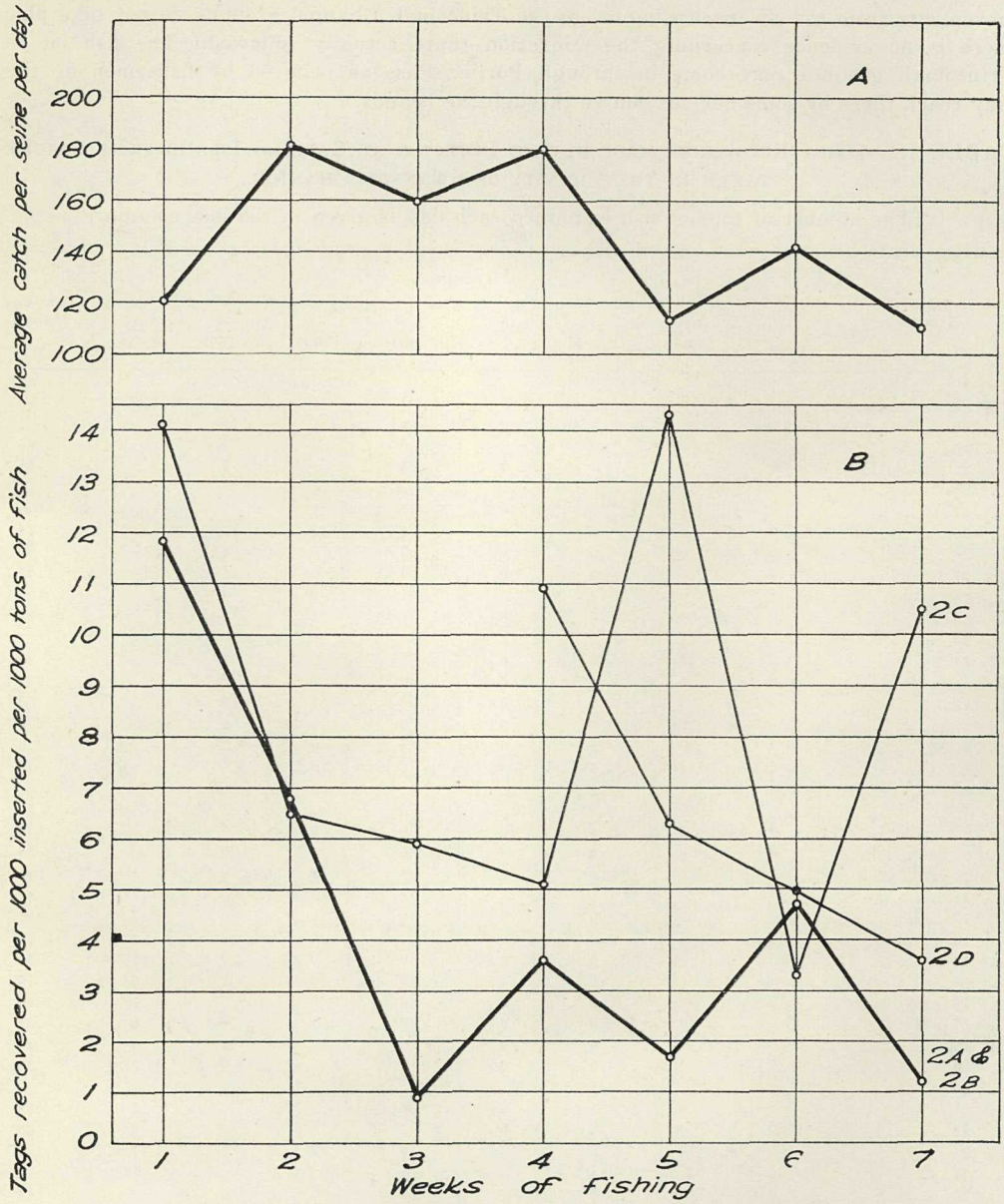


Fig. 12. (A) Weekly variation in the availability of herring as shown by the average catch per unit of effort. (B) Weekly variation in the number of tags recovered per 1,000 inserted per 1,000 tons of fish for the taggings at Sooke (2A and 2B), the first Swanson Channel tagging (2C) and the second Swanson Channel tagging (2D). Please consult the text for further explanation.

Weekly variation in the recoveries from the current taggings is shown in Fig. 12. The points on these graphs represent the number of tags recovered for each thousand inserted per 1,000 tons of fish taken by the fishery. For example, in the first week of fishing (ending October 22nd and consisting of four instead of the usual six fishing days) there were five recoveries from the 2A and 2B (combined) taggings, out of 353 tons of fish. This is equivalent to the recovery of 1,000 × 5/353 or 14.2 per 1,000 tons of fish. As there were 499 plus 700 or 1,199 tags inserted, this recovery is equivalent to 1,000 × 14.2/1,199 or 11.8 tags per thousand used. The recovery graphs, based on similar calculations, are directly comparable as allowance has been made for both variation in the weekly catch and variation in the

number of tags used at each tagging. In the figure is also included a graph showing the weekly variation in average catch per boat per day's fishing (compiled from daily catch records submitted by seine-boat captains). This graph traces the weekly availability of fish.

The actual number of recoveries for each tagging in each week is so small that the positions of the points on the graphs must be regarded as only approximate. Accordingly, definite conclusions cannot be based on the graphs, but it is perhaps appropriate to call attention to certain indications which they offer. There is a suggestion that at the beginning of the season there was an accumulation of fish on the Swanson Channel grounds which had moved in from the Strait of Juan de Fuca (2A and 2B). As these fish had been tagged for twenty-three and nine days, respectively, before the opening of the season, it seems probable that the subsequent decline in recovery rate resulted more from the inroads in the population by the fishery than from the initial mortality of tagged fish. Comparison of the Sooke recovery graph with the catch-record graph suggests that during the fourth and sixth weeks of fishing there were substantial influxes of fish from the Strait of Juan de Fuca to the Swanson Channel grounds.

The graph for the first Swanson Channel tagging (2C), contained in Fig. 12, appears to vary somewhat erratically. The steeper slope of the initial decline compared with that for the Sooke recoveries may be caused by the high initial mortality of tagged fish, which is probably at its maximum during the first day or two after tagging. It does not appear probable that the excessively high recoveries of the fifth and seventh weeks are the result of chance. They can be tentatively explained as the result of erratic addition of the 2C tagged fish to the schools. Of the tags recovered during these two weeks 78 and 86 per cent. were inserted on one day (October 22nd). It is possible that a large number of the fish tagged on this day did not enter the fishery until these two periods because of delay in mixing with other fish as a result of temporary segregation following tagging or because of joining temporarily isolated schools which were not fished immediately.

The graph for the 2D recoveries shows an initial decline of somewhat smaller slope than that of the 2C graph. On the whole, however, it is very similar to that of 2C for the first four weeks after tagging.

Intensity of the Fishery.

As the 2C tags were inserted at the beginning of and were recovered throughout the fishing season, although quite erratically in the latter part, they may be used to give a rough idea of the *minimum* fishing mortality. The forty-three recoveries may be considered equivalent to 47.8 recoveries on the basis of the 90-per-cent. efficiency of the apparatus. These were taken from 4,512 tons of fish. As the total catch was 25,059 tons (from statistics of the Department of Fisheries), there was a probable recovery of 25,059 × 47.8/4,512 or 265 tags. As there were 1,257 inserted, this is a probable recovery of 100 × 265/1,257 or 21.1 per cent. From this it would seem that the fishermen caught *at least* 21 per cent. of the fish on the grounds during the fishing season. This percentage is probably too low, as allowance has not been made for several important factors tending to reduce the number of recoveries. (*See* Hart and Tester, 1937, p. R 67.)

Conclusions concerning Technique.

There is some evidence from the current taggings that overcrowding in the pound prior to and during tagging causes a high mortality among the tagged fish. The data on which this opinion is based are shown in the following tabulation, which gives the date of tagging, the probable percentage recoveries of tags inserted for the twenty-one days following the date of insertion, and the numbers of fish tagged.

Date.	Percentage recovered.	Number tagged.
November 9	4.5	1,350
November 10	6.1	1,094
November 12	7.5	400

It is evident that the percentage recovery increases as the number of fish tagged and held in the pound at one time decreases. In the individual 2C taggings less than 500 fish were tagged from the pound and there was no similar relationship between the percentage recovery and the number tagged. The average probable percentage recovery for the three 2C taggings for twenty-one days following the date of insertion was 7.9, which is comparable

with that of November 12th above. Although trials have shown that the differences are not statistically significant, the results suggest that for the optimum survival of tagged fish not more than about 500 should be confined in and tagged from the pound at one time under present tagging conditions.

During the course of the season, observations were made at the time of recovery of the condition of the wound caused by tagging. In the five fish tagged in 1936–37, the wound had healed without sign of a scar and had become completely covered with scales. In the recoveries from the current taggings, some showed definite signs of healing from three to four weeks after insertion. The wounds in several fish were completely healed with only the scars showing two months after tagging. Two fish were recovered with the tags protruding from large, gaping wounds surrounded by irritated and probably infected tissue. In a few cases the wounds were rather large, ragged, and occasionally double; these were mostly due to inexperience in manipulating the tagging-gun at the beginning of the season. The majority of the wounds, however, were small, neat incisions which showed no signs of infection and which should have healed within a short time.

RECOVERY OF TAGGED FISH BY THE UCLUELET DETECTOR.

From November 12th to December 5th, inclusive, the Ucluelet detector recovered fifty-five tagged fish from 2,788 tons (plant records) which passed through the plant. Details of these recoveries follow:—

Tagging.	Number recovered.
2C; Swanson Channel	1
2D; Swanson Channel	1
2E; Rainy Bay, Barkley Sound	5
2F; Effingham Inlet, Barkley Sound	37
2G; Middle Channel, Barkley Sound	11

The two Swanson Channel tags were recovered from 406 tons of fish caught in Swanson Channel and transported to the Ucluelet plant. The fifty-three Barkley Sound tags were recovered from 2,382 tons of fish caught in Barkley Sound.

Although most of the tagged fish were recovered close to the area in which they were liberated, the results give some provisional indication of the nature and extent of the movements of herring within Barkley Sound. The pertinent data are included in the following table:—

Tagging.		Recovery.		No.
2E; Rainy Bay,	Nov. 18.	Middle Channel,	Dec. 3–4	1
2G; Middle Channel,	Nov. 23.	Rainy Bay,	Nov. 25	5
2E; Rainy Bay,	Nov. 25.	Middle Channel,	Dec. 3–4	2
2F; Effingham Inlet,	Nov. 28.	Middle Channel,	Dec. 2	1

The 2G recoveries indicate an early movement of fish from Middle Channel to Rainy Bay where they joined those already there. The 2E recoveries indicate a movement of fish from Rainy Bay back to Middle Channel in the early part of December. The recovery of the one Effingham Inlet tag (2F) about the same time indicates a more general movement into Middle Channel towards the close of the fishing season.

It is interesting to note that from one catch of 200 tons made in Effingham Inlet (November 28th) twenty-six tags were recovered by the detector even though it was operating at a relatively low efficiency. This concentration of tagged fish in the Effingham Inlet catches will be discussed later in connection with the magnet recoveries.

RECOVERY OF TAGS BY MAGNETS.

Sources and Limitations of Recoveries.

The seven magnets which were in operation on the west coast of Vancouver Island recovered 770 tags, which were distributed among the various plants as follows: Kildonan, 75; Ecoole, 288; Toquart, 117; Ucluelet, 197; Nootka, 38; Ceepeecee, 54; Hecate, 1. Among these were represented one or more recoveries from eleven of the twelve taggings of 1936–37 (1A to 1L, except 1K) and from all seven taggings of the fall of 1937 (2A to 2G). The catches yielding these tags came from a great diversity of fishing areas. All of the west-coast plants except Kildonan processed fish from the south-east coast of Vancouver Island at one time or another during the season. Although the Barkley Sound plants operated only

on Barkley Sound fish in addition to the east-coast fish, those to the westward received herring from most of the west-coast inlets extending from Barkley to Quatsino Sounds, and also from Rivers and Cousins Inlets to the north of Vancouver Island.

As has already been pointed out in a preceding section, when fish from different areas are passed through a reduction plant at close intervals or even during the same season, there is usually a measure of uncertainty as to the origin of tags picked up by the magnet because of the possibility of delay in their transit through the reduction machinery. This uncertainty not only detracts from the value of magnet recoveries in tracing the movements of herring but also renders difficult the task of presenting and assaying the results. The tags recovered by all magnets have been arranged according to locality of insertion and probable locality of capture in Table III., and foot-notes have been added to facilitate their interpretation.

TABLE III.—TAGS RECOVERED BY MAGNETS DURING 1937–38.

Code.	Place and Date of Tagging.	Reported Probable Place of Capture.									Total.
		Swanson Ch.	Swanson Ch. or Barkley Sd.	Barkley Sd.	Nootka Sd.	Nootka Sd. or Kyuquot Sd.	Kyuquot Sd.	Kyuquot Sd. or Ououkinsh In.	Kyuquot Sd. or Cousins In.	????	
1A	Swanson Channel, Oct., 1936	----	1	------	----	----	----	----	----	----	1
1B	Sooke, Oct., 1936	----	----	1*	----	----	----	----	----	1*	2
1C	Swanson Channel, Oct., 1936	1	----	------	----	----	----	----	----	----	1
1D	Trincomali Channel, Nov., 1936	1	----	------	----	----	----	----	----	----	1
1E	Horswell Point, March, 1937	1	2	1*	----	----	----	----	----	----	4
1F	Barkley Sound, March, 1937	----	----	1	----	----	----	----	----	----	1
1G	Barkley Sound, March, 1937	----	----	1¶	----	----	----	----	1‡	----	2
1H	Nootka Sound, March, 1937	----	----	1	----	1	----	----	----	----	2
1I	Kyuquot Sound, March, 1937	----	----	3‖	3§	2	4	4	3	1§	20
1J	Ououkinsh Inlet, March, 1937	----	----	------	1§	----	----	----	1	----	2
1K	Nootka Sound, March, 1937	----	----	------	----	----	----	----	----	----	------
1L	Saanich Inlet, April, 1937	1	----	------	----	----	----	----	----	----	1
2A	Sooke, Sept., 1937	4	----	4†	----	----	1*	----	----	----	9
2B	Sooke, Oct., 1937	5	5	6*	----	----	----	----	1*	----	17
2C	Swanson Channel, Oct., 1937	10	9	8*	----	----	----	----	----	----	27
2D	Swanson Channel, Nov., 1937	6	1	4*	----	----	----	----	----	----	11
2E	Barkley Sound, Nov., 1937	----	----	122	----	----	----	----	----	----	122
2F	Barkley Sound, Nov., 1937	2‡	----	422	5‡	----	----	----	----	----	429
2G	Barkley Sound, Nov., 1937	1‡	----	116	1‡	----	----	----	----	----	118
	Total	----	----	------	----	----	----	----	----	----	770

* Plants making recoveries processed fish from the east coast of Vancouver Island during the season.

† Plants making three recoveries processed fish from the east coast of Vancouver Island during the season. One recovery from plant processing only Barkley Sound fish.

‡ Plant making recovery processed fish from Barkley Sound during the season.

§ Plant making recovery processed fish from Kyuquot Sound during the season.

‖ Plant making one recovery processed fish from Kyuquot Sound during the season. Other two recoveries from plants which did not process Kyuquot Sound fish.

¶ Tag mutilated; probably H15119, inserted at Barkley Sound on March 12th, 1937; but possibly H16119, inserted at Ououkinsh Inlet on March 17th, 1937.

TAGS OF THE PREVIOUS SEASON (1936–37).

Considering first the recovery of tags inserted on the east coast of Vancouver Island and at Sooke in the fall of 1936 (1A to 1D) and in the spring of 1937 (1E and 1L), it will be observed that four recoveries are reported as coming from Swanson Channel, three from either Swanson Channel or Barkley Sound, two from Barkley Sound, and one is of unknown origin. The last three deserve further consideration. The 1B tag (H7300) was recovered by Ecoole on November 27th, 1937. Two days previously this plant had been operating on east-coast fish and there is a strong possibility that this tag came from those. The 1E tag (H10446) was recovered by the Toquart plant on December 5th–6th, 1937, and may actually have originated from Barkley Sound fish as the last delivery of east-coast herring took place

on November 1st, 1937. However, it must be remembered that there is always the possibility of a tag being delayed in its passage through the plant for a month or even longer. The second 1B tag (H6913) is of unknown origin as it was picked up in the drier of the Ceepeecee plant about December 25th, 1937. This plant had also processed fish from the east coast, the last delivery taking place on November 23rd, 1937. It seems certain that most, if not all, of the ten east-coast tags originated from east-coast fish, but it is possible that one or more were recovered from the Barkley Sound run.

From the two Barkley Sound taggings of the spring of 1937 (1F and 1G) there were only three recoveries. That of the 1F tagging (H12354) was recovered by the Kildonan plant and came from catches made in Barkley Sound, the only locality fished. There is some doubt concerning the 1G recoveries. One of these is included as a 1G tag (H15119), but it was so badly damaged in passing through the plant that the serial number was almost illegible. An alternative reading (H16119) would identify it as a 1J tag, inserted at Ououkinsh Inlet. However, unbiased opinion favours the former. It was reported recovered from Barkley Sound catches by the Ecoole plant. The second 1G recovery (H14116) is reported as originating from Kyuquot Sound or Cousins Inlet. However, it may have actually originated from one of several localities, including Barkley Sound, as fish from a number of areas were processed a short time previous to the recovery.

The recoveries from the 1H, 1I, and 1J taggings yield no reliable information on the extent of intermingling of fish of the Nootka and Kyuquot areas. However, the results from the Kyuquot tagging (1I) yielding the most returns suggest that intermingling is limited, for only three recoveries are reported from Nootka Sound as compared with eight from Kyuquot Sound and Ououkinsh Inlet. If, as seems highly probable, the tags reported from Kyuquot Sound or Cousins Inlet also originated in Kyuquot Sound, the ratio is even higher (3:11). However, because of the great uncertainty of the true origin of the tags, the results for the two areas (including Ououkinsh Inlet) will be considered together.

Of the twenty-four recoveries from the Nootka-Kyuquot taggings (1H, 1I, and 1J), four are reported as originating in Barkley Sound catches. There is no doubt that the 1H tag (H14407) came from Barkley Sound fish as it was recovered by the Kildonan plant which operated on fish from this area only. Likewise, one of the 1I tags (H13688), recovered by the same plant, came from Barkley Sound fish, but was picked from the drier after the close of the season. The second 1I tag (H14717) was recovered by the Toquart plant and very probably came from Barkley Sound fish, although it may have come from a small quantity of east-coast fish which were reduced at the beginning of the season. The fourth 1I tag (H14814), recovered by the Ceepeecee plant, may well have originated from Kyuquot Sound fish which were processed just prior to those from Barkley Sound. Therefore, of the twenty-four recoveries from the Nootka-Kyuquot taggings, three (including the Toquart recovery) definitely show a migration of Nootka-Kyuquot spawning fish to Barkley Sound. Some degree of intermingling between these two runs therefore takes place and, although its exact extent is unknown, it would appear to involve about 15 to 20 per cent. of the Nootka-Kyuquot fish. This figure, however, is a very rough approximation and should be accepted with reservation. A satisfactory estimate of the amount of intermingling requires some knowledge concerning the sizes of the populations involved and fuller recovery data than are now available. Accordingly, further discussion is reserved for future reports.

Tags of the Current Season (1937–38).

From the Sooke taggings of the fall of 1937 (2A and 2B), twenty-six recoveries were made by west-coast magnets. Of these nine are reported as coming from Swanson Channel, five from either Swanson Channel or Barkley Sound, ten from Barkley Sound, one from Kyuquot Sound, and one from either Kyuquot Sound or Cousins Inlet. It is probable that most or these tags originated from east-coast fish. On the other hand, at least one of the ten recoveries reported from Barkley Sound actually came from catches made in that area. This recovery (H19334) from the 2A tagging was made by the Kildonan plant from fish taken at the close of the Barkley Sound fishing season. The 2A tag reported as being recovered from Kyuquot Sound fish by Ceepeecee and the 2B tag from either Kyuquot or Cousins Inlet fish by Nootka may have originated from east-coast fish which passed through the plants one and three days previously.

The one definite recovery of a Sooke tag from Barkley Sound catches demonstrates that at least a small percentage of the fish tagged at Sooke moved along the west coast of Vancouver Island to Barkley Sound, rather than along the south shore to the east coast of the island. It suggests, also, that some of the other Sooke tags reported as coming from Barkley Sound catches may be considered to be authentic records. This applies particularly to three recoveries made by the Toquart plant about November 24th, 1937, and to three recoveries made by the Ucluelet plant from November 30th to December 4th, 1937. The last delivery of east-coast fish to the former was on November 1st and to the latter on November 18th. However, evidence that only a very small percentage of the fish tagged at Sooke moved to Barkley Sound is available in a comparison of the number of Sooke tags recovered per 1,000 tons of east-coast fish by the magnets and by the Galiano detector. West-coast plants which recovered the twenty-six Sooke tags processed 5,984 tons of east-coast fish. This represents 4.3 tags per 1,000 tons. The Galiano detector recovered twenty-one Sooke tags from 4,512 tons or 4.7 per 1,000 tons. If any considerable number of fish bearing Sooke tags were present in west-coast catches the former figure (4.3) would have been larger than the latter (4.7), assuming random distribution of tagged fish in east-coast catches and a similar efficiency in the two methods of recovering tags.

Concerning the thirty-eight Swanson Channel tags recovered by west-coast magnets, little need be said. It seems probable that all originated from east-coast fish, even although twelve are reported as having been recovered from Barkley Sound catches. All of the plants which recovered the latter processed east-coast fish a short time previous to each recovery. No Swanson Channel tags were recovered from Barkley Sound fish by the Kildonan plant.

By far the largest number of magnet recoveries consist of Barkley Sound tags (2E, 2F, and 2G) which were recovered from Barkley Sound fish soon after they were inserted. Of the 669 recoveries only nine were reported from catches made in other areas. Three of these were reported from Swanson Channel fish, but the plant making the recoveries (Ecoole) was operating on Barkley Sound fish at the same time. It seems certain that the tags came from the latter as they were recovered within a few days after the time they were used. More doubt surrounds the six tags recovered by the Nootka plant and reported as coming from Nootka Sound catches. These were recovered some time after the last Barkley Sound delivery (December 6th, 1937) as follows: December 16th, two; December 18th, three; January 9th, one. Between December 10th and December 15th, both the dust-chamber at the end of the drier and the conveyer leading from the drier to the grinder were cleaned out, thus reducing the possibility of tags from previous runs remaining there. Members of the plant crew noted that the tags collected on the magnet during or immediately following the processing of fish from one particular place—Ewin Creek. It would seem, therefore, that these results show a migration of fish from Barkley Sound to Nootka Sound after the close of the fishing season in the former area. However, this cannot be concluded with certainty as there is always the possibility of tags being temporarily caught in some hidden recess of the plant system, even though the latter was cleaned out following the processing of Barkley Sound fish.

The magnet recoveries of the Barkley Sound tags, although subject to considerable uncertainty in regard to their exact origin within the sound, nevertheless tend to confirm the local movements of fish shown by the induction detector recoveries and indicate that the movements involved considerable quantities of fish. In the following table are included only those recoveries which were reported as coming from Rainy Bay, Effingham Inlet, and Middle Channel, the three tagging localities. Other recoveries reported from intermediate points, and those in which the locality of capture is vague or is questioned by the operators, are omitted.

Tagging Locality.	No. reported as recovered from		
	Rainy Bay.	Middle Channel.	Effingham Inlet.
Rainy Bay (2E)	21	19	13
Effingham Inlet (2F)	12	54	181
Middle Channel (2G)	15	51	7

It may be seen that in each case the largest number of recoveries were reported from the tagging locality. However, the next largest numbers from the Rainy Bay and Effingham Inlet taggings were reported from Middle Channel, and the next largest number from the Middle Channel tagging was reported from Rainy Bay. Results such as this would be expected if, as shown by the Ucluelet detector returns, there was a movement of herring from Middle Channel to Rainy Bay, which was followed by a movement from both Rainy Bay and Effingham Inlet to Middle Channel.

Intensity of the Fishery in Barkley Sound.

The percentage recovery of tags inserted in Barkley Sound is included in the following schedule:—

Tagging.	No. inserted.	No. recovered.			Per Cent. recovered.
		Magnets.	Detector.	Total.	
2E	700	122	5	127	18.2
2F	1,298	429	37	466	35.9
2G	800	118	11	129	16.1
All	2,798	669	53	722	25.8

As magnets were installed in all plants operating on Barkley Sound fish, these percentages represent the minimum percentage of fish taken by the fishery during the interval between the date of tagging and the close of the fishing season (assuming for the present that all recoveries came from fish caught in Barkley Sound). The high value for Effingham Inlet (2F) may have been due partly to the capture of isolated lots of tagged fish immediately after their liberation; but, even so, it is taken as an indication of particularly intensive fishing on the schools which were present in that inlet. The average percentage recovery from all Barkley Sound taggings (25.8), over an average period of about two weeks, is somewhat greater than the probable percentage recovery of Swanson Channel tags (21.1) by the Galiano detector over a period of seven weeks. This is taken as an indication of a more intensive fishery in Barkley Sound than in Swanson Channel, relative to the quantities of fish present at the time. However, what proportion the latter form of the total population in each locality is not known.

MOVEMENTS AND INTERMINGLING OF HERRING AS INDICATED BY THE RECOVERY OF TAGS.

The results of the first two seasons of tagging and recovery have yielded considerable positive information on the movements of herring and certain indications of the extent of intermingling between fish of different localities. In the following summary of the information which has been gathered to date, the terms " certain " recovery and " probable " recovery are used in connection with magnet returns concerning which there is no doubt and some doubt, respectively, as to their origin.

The recoveries by the Galiano detector during the fall of 1936 and 1937 have shown that most if not all of the fish supplying the Swanson Channel and Trincomali Channel fishing-grounds on the south-east coast of Vancouver Island move in from the Strait of Juan de Fuca prior to and during the fishing season. There are indications that in 1936 the herring did not move directly from Swanson to Trincomali Channels, but arrived at the latter by some devious migration route, probably through Porlier Pass.

That some of the fish occurring in the Strait of Juan de Fuca during late September move along the west coast of Vancouver Island to Barkley Sound rather than to the east coast in shown by the certain recovery of one Sooke tag in Barkley Sound catches. However, the results indicate that the proportion of fish moving in this direction is quite small.

The probable recovery of Horswell Point tags from east-coast catches by magnets indicates that the run to the south-east coast of the island embraces waters at least as far to the north-west as Departure Bay.

The results of tagging to date have shown that at least some of the east-coast fish have come to the same general locality for two consecutive seasons. The Galiano detector returns and most of the magnet returns give no indication of intermingling between the runs of herring of the east and west coasts of the island. However, the probable recovery of one Horswell Point tag in Barkley Sound catches suggests that intermingling on a small scale may take place, although it has not been definitely proven as yet.

The majority of tags inserted in the spring and recovered by magnets in the fall on the west coast of Vancouver Island were reported from catches made in the same general areas in which they were liberated. For the present the Nootka-Kyuquot runs are considered as one, although there is some evidence that intermingling between them is limited. At least three of these magnet recoveries definitely show the movement of some fish from Nootka and Kyuquot Sounds in the spring to Barkley Sound in the fall. The exact extent of this intermingling is unknown, but it would appear to involve about 15 to 20 per cent. of the Nootka-Kyuquot fish. It should be borne in mind that this estimate applies only to the one year (spring to winter, 1937).

During December, 1937, some of the fish tagged in Barkley Sound during the previous month may have moved to the westward along the coast to Ewin Creek, Nootka Sound. This is strongly indicated, but not proven, by the probable recovery of Barkley Sound tags in catches from the latter locality.

Local movements of herring as shown by Ucluelet detector and magnet recoveries took place within the waters of Barkley Sound during the 1937 fall fishing season. These, however, are of minor importance.

A general discussion of the extent of intermingling of the herring-runs to the various inlets as revealed by the recovery of tags, and a comparison of these findings with those derived from racial studies (Tester, 1936 and 1937) will be reserved for the future, pending the collection of more complete data. For the present it may be stated that so far the general conclusions from the two methods of study are in accord, but that intermingling on the west coast of Vancouver Island appears to be somewhat more extensive than was expected from former work.

The present indications are that with the direct method of attack afforded by the application and recovery of internal tags it should be possible to solve the problems connected with the movements of herring within a relatively short time, and thus enable positive statements of practical importance to be made regarding the extent of intermingling of the various runs.

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The whole-hearted support and assistance of members of the herring fishery, including managers, plant crews, and fishermen, has been one of the major factors contributing to the advancement of this investigation. To all who have helped, we wish to express our sincere thanks.

We are particularly indebted to Mr. J. Lysnes and Mr. D. Wilson, in charge at the Ucluelet plant of the Banfield Packing Co., Ltd., for building the conveyer system to accommodate the Ucluelet detector and for assistance during its operation. We are also greatly indebted to the Moresby Island Fisheries Co., Ltd., Galiano Island, and to Mr. Condo, the plant manager, for permitting the Galiano detector to be installed and operated for the second season, even though this entailed some inconvenience to their own operations.

Again the assistance of the industry was invoked in carrying out the spring tagging programme. The British Columbia Packers, Ltd., placed the seine-boat "Chamiss" at our disposal during the month of March. To Mr. Frank Ellis and the company at large we express our appreciation, and to the crew—Captain J. H. Auchterlonie; Mr. Wm. Burgess, engineer; and Mr. J. Sherlock, cook—our sincere thanks for their assistance during the cruise.

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many fishermen who have allowed us to remove fish from their seines, sometimes to their own inconvenience. Once more our thanks are due to Mr. H. Goodrich, who has again given every assistance in helping us to tag herring taken in the salmon-traps at Sooke.

Mr. L. Quickenden, of this Station, has been of the greatest assistance in all phases of the work. He has done much of the actual tagging during both the fall and spring, and he both devised and manufactured the tagging-guns described in this report. We are very grateful to him for his many services.

The investigation has been undertaken under the combined auspices of the Provincial Fisheries Department and the Fisheries Research Board of Canada. Sincere thanks are again offered to Dr. W. A. Clemens, Pacific Biological Station, for direction and advice, and to Mr. G. J. Alexander, Assistant Commissioner of Fisheries, for interest and stimulation in the work.

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TABLE IV.

Detailed List of the Tags inserted during 1937–38.

Series H.	Date released.	Tagging Code.	Where released.	No. of Tags used.
8407– 8605	Oct. 22, 1937	2C	Off Moresby Island	100
8606– 9018	Nov. 9, 1937	2D	Swanson Channel	100
9019– 9128	Oct. 22, 1937	2C	Off Moresby Island	99
9130– 9289	Oct. 22, 1937	2C	Off Moresby Island	100
9201– 9298	Nov. 9, 1937	2D	Swanson Channel	35
9301– 9400	Sept. 25, 1937	2A	Off Sooke	100
9401– 9500	Oct. 23, 1937	2C	Off Shingle Bay	83
9501– 9600	Nov. 9, 1937	2D	Swanson Channel	100
9601– 9700	Sept. 25, 1937	2A	Off Sooke	99
9701– 9800	Nov. 9, 1937	2D	Swanson Channel	100
9801– 9900	Sept. 25, 1937	2A	Off Sooke	100
9901–10000	Nov. 9, 1937	2D	Swanson Channel	100
16601–16700	Nov. 9, 1937	2D	Swanson Channel	100
16901–17000	Nov. 9, 1937	2D	Swanson Channel	100
17101–17200	Oct. 18, 1937	2C	Off Beaver Point	100
17201–17300	Oct. 9, 1937	2B	Off Sooke	100
17701–17800	Oct. 9, 1937	2B	Off Sooke	100
17901–18000	Oct. 18, 1937	2C	Off Beaver Point	99
18101–18200	Oct. 18, 1937	2C	Off Beaver Point	100
18201–18500	Oct. 9, 1937	2B	Off Sooke	300
18501–18600	Oct. 22, 1937	2C	Off Moresby Island	96
18701–18800	Oct. 9, 1937	2B	Off Sooke	100
18801–18900	Oct. 18, 1937	2C	Off Beaver Point	100
18901–19000	Oct. 9, 1937	2B	Off Sooke	100
19201–19300	Nov. 9, 1937	2D	Swanson Channel	100
19301–19400	Sept. 25, 1937	2A	Off Sooke	100
19401–19500	Nov. 9, 1937	2D	Off Beaver Point	100
19501–19600	Sept. 25, 1937	2A	Off Sooke	100
19801–19900	Oct. 22, 1937	2C	Off Moresby Island	100
19901–20000	Nov. 9, 1937	2D	Swanson Channel	100
20001–20100	Nov. 25, 1937	2E	Off Knob Point	100
20101–20300	Nov. 28, 1937	2F	Effingham Inlet	199
20301–20400	Feb. 26, 1938	2N	Ganges Harbour	100
20401–20600	Nov. 25, 1937	2E	Rainy Bay	200
20601–20700	Nov. 28, 1937	2F	Effingham Inlet	100
20701–20800	Nov. 23, 1937	2F	Effingham Inlet	100
20801–20900	Nov. 23, 1937	2G	Off Pill Point	100
20901–21000	Nov. 28, 1937	2F	Effingham Inlet	100
21001–21100	Nov. 25, 1937	2E	Off Knob Point	100
21101–21200	Nov. 28, 1937	2F	Effingham Inlet	100
21201–21300	Dec. 1, 1937	2G	Useless Inlet	100
21301–21600	Nov. 23, 1937	2G	Off Pill Point	300
21601–21800	Nov. 23, 1937	2F	Effingham Inlet	200
21801–21900	Nov. 28, 1937	2F	Effingham Inlet	100
21901–22000	Nov. 21, 1937	2F	Effingham Inlet	100
22001–22100	Nov. 25, 1937	2E	Off Knob Point	100
22101–22200	Nov. 28, 1937	2F	Effingham Inlet	100
22201–22300	Nov. 23, 1937	2G	Off Pill Point	100
22301–22400	Nov. 21, 1937	2F	Effingham Inlet	100
22401–22500	Nov. 18, 1937	2E	Rainy Bay	100
22501–23200	Mar. 7, 1938	2H	Macoah Passage	700
23201–23300	Dec. 4, 1937	2G	Off Bird Rocks	100
23301–23400	Mar. 15, 1938	2P	False Narrows: S.E. side	100
23401–23700	Mar. 7, 1938	2H	Macoah Passage	300
23701–24100	Mar. 8, 1938	2H	Macoah Passage	400
24101–24200	Mar. 7, 1938	2H	Macoah Passage	99
24201–24300	Mar. 7, 1938	2O	Horswell Point	100
24301–24800	Mar. 8, 1938	2H	Macoah Passage	500
24801–25000	Mar. 9, 1938	2I	Calm Creek	199
25001–25100	Mar. 15, 1938	2P	False Narrows: S.E. side	100
25101–25200	Mar. 7, 1938	2O	Off Horswell Point	100
25201–25500	Mar. 8, 1938	2O	Off Horswell Point	300

DETAILED LIST OF THE TAGS INSERTED DURING 1937–38—*Continued.*

Series H.	Date released.	Tagging Code.	Where released.	No. of Tags used.
25501–25600	Mar. 7, 1938	2O	Off Horswell Point	100
25601–25700	Dec. 1, 1937	2G	Useless Inlet	100
25701–25800	Feb. 26, 1938	2N	Ganges Harbour	100
25801–26100	Mar. 15, 1938	2P	False Narrows: S.E. side	297
26201–26300	Mar. 7, 1938	2H	Macoah Passage	100
26301–26400	Feb. 26, 1938	2N	Ganges Harbour	99
26401–26500	Mar. 7, 1938	2O	Off Horswell Point	100
26501–26600	Mar. 7, 1938	2H	Macoah Passage	100
26601–26700	Feb. 26, 1938	2N	Ganges Harbour	100
26701–26800	Mar. 7, 1938	2O	Off Horswell Point	91
26801–26900	Feb. 26, 1938	2N	Ganges Harbour	100
26901–27000	Oct. 22, 1937	2C	Off Moresby Island	100
27001–27200	Nov. 9, 1937	2D	Swanson Channel	200
27201–27300	Oct. 22, 1937	2C	Beaver Point Bay	83
27301–27400	Oct. 18, 1937	2C	Off Beaver Point	97
27401–27500	Mar. 7, 1938	2H	Macoah Passage	100
27501–27700	Feb. 26, 1938	2N	Ganges Harbour	200
27701–27800	Nov. 18, 1937	2E	Rainy Bay	100
27801–28100	Nov. 12, 1937	2D	Moresby Passage	300
28101–28500	Nov. 10, 1937	2D	Moresby Passage	398
28501–28600	Nov. 12, 1937	2D	Moresby Passage	100
28601–28800	Nov. 10, 1937	2D	Moresby Passage	196
28801–28900	Nov. 9, 1937	2D	Off Beaver Point	100
28901–29200	Nov. 10, 1937	2D	Swanson Channel	300
29201–29300	Nov. 9, 1937	2D	Off Beaver Point	100
29301–29400	Nov. 21, 1937	2F	Effingham Inlet	99
29401–29600	Nov. 10, 1937	2D	Swanson Channel	200
29601–30200	Mar. 11, 1938	2J	Queens Cove	594
30201–30800	Mar. 9, 1938	2I	Calm Creek	600
30801–31500	Mar. 11, 1938	2J	Queens Cove	699
31501–32500	Mar. 12, 1938	2K	Plumper Harbour	995
32501–33400	Mar. 21, 1938	2L	Winter Harbour	898
33401–33500	Mar. 25, 1938	2M	Off Bella Bella	100
33501–33700	Mar. 21, 1938	2L	Winter Harbour	200
33701–33800	Mar. 25, 1938	2M	Off Bella Bella	99
33801–33900	Mar. 21, 1938	2L	Winter Harbour	100
33901–35100	Mar. 25, 1938	2M	Off Bella Bella	1,196
35101–35200	Apr. 2, 1938	2S	Union Bay	100
35201–35300	Apr. 3, 1938	2S	Union Bay	99
35301–35400	Apr. 22, 1938	2T	Birch Bay	99
35401–35500	Apr. 2, 1938	2S	Union Bay	100
35501–35600	Apr. 22, 1938	2T	Birch Bay	100
35601–35900	Apr. 3, 1938	2S	Union Bay	299
35901–36000	Apr. 2, 1938	2S	Union Bay	99
36001–36300	Apr. 22, 1938	2T	Birch Bay	298
41901–42000	Mar. 9, 1938	2I	Calm Creek	100
43001–43300	Mar. 23, 1938	2R	Departure Bay	300
43301–43800	Apr. 2, 1938	2S	Union Bay	499
44001–44300	Apr. 22, 1938	2T	Birch Bay	300
45001–45300	Mar. 16, 1938	2Q	False Narrows: N.W. side	300
45301–45800	Mar. 17 1938	2Q	False Narrows: N.W. side	499
45801–46000	Mar. 23, 1938	2R	Departure Bay	200

NOTE.—The general locality in which each tagging took place may be obtained from the tagging code by reference to Table I.

A CONTRIBUTION TO THE LIMNOLOGY OF SHUSWAP LAKE, BRITISH COLUMBIA.

By W. A. Clemens, R. E. Foerster, N. M. Carter, and D. S. Rawson,
Pacific Biological Station, Nanaimo, B.C.

During two weeks in July in each of the years 1931 and 1932 the writers conducted courses of instruction at Shuswap Lake for the Dominion Hatchery Officers in British Columbia. The headquarters in both years were at Sorrento, the field-work being carried out on the main arm of Shuswap Lake near its outlet. During the four weeks a considerable amount of information was obtained concerning the limnology of that section of the lake and it has seemed of value to record the data.

DESCRIPTION.

The lake lies at an elevation of 1,150 feet above sea-level and has roughly a shape of a distorted letter "H." The area is somewhat over 100 square miles, but the length and narrowness of the arms are such that the shore-line has a length of approximately 600 miles. The lake is drained by the South Thompson River into the Thompson River and thence into the Fraser. There are several large tributaries, notably, Adams River, Scotch Creek, Seymour River, Eagle River, Shuswap River, and Salmon River. The arm of Shuswap Lake investigated is shown in Fig. 1.

GEOLOGY.

Geologically, the area surrounding Shuswap Lake is very complex, and a full discussion is given in the Canadian Geological Survey Memoir No. 68 (Daly, 1915). Three major events are of interest: (1) The extension of an arm of the ocean into the area in very early geological time; (2) a later uplift to the extent of 2,000 feet; (3) glaciation by an ice-sheet, 6,000 feet in thickness.

SOUNDINGS.

Soundings were taken across the arm at various places and at a few isolated points. The positions were located by means of cross-sights from two known positions on shore. The locations and depths (in feet) are shown in Fig. 1. The five soundings in parentheses are the only ones previously on record, and it will be observed that depths up to 345 feet have been found. Probable positions of the 50-, 100-, and 150-foot contours of the bottom are indicated. The bottom in the deeper parts consists of grey clayey ooze with a brownish surface, while toward the shore opposite Sorrento it is largely gravel which was probably brought down by Scotch Creek through an earlier outlet.

PHYSIOCHEMICAL OBSERVATIONS.

On July 17th, 1931, between 3 to 4 p.m. on a hot, clear day, a vertical series of water samples was taken at a point one-half mile south-west of Copper Island. Observations of temperature were made with a reversing thermometer, dissolved oxygen determinations by the Winkler method, and pH determinations by a La Motte colour-comparison set. On September 5th, 1931, another series of observations was made off Sorrento when a strong north wind was blowing. These two sets of data are given in Table I.

TABLE I.—Temperature, Oxygen, and pH Data, Shuswap Lake, 1931.

	Temperature in Degrees Centigrade.	Oxygen in c.c. per Litre.	pH.
July 17, 1931:			
Surface	19.2°	6.5	7.65
2 m.	18.4	------	7.75
5 m.	17.7	------	7.7
7.5 m.	16.9	------	------
10 m.	15.2	------	7.5
15 m.	11.4	------	------
17.5 m.	9.9	------	------
20 m.	8.0	7.6	7.45
29 m.	6.6	------	------
44 m.	5.8	7.3	------
64 m.	5.4	7.3	7.35

TABLE I.—TEMPERATURE, OXYGEN, AND pH DATA, SHUSWAP LAKE, 1931—*Continued.*

	Temperature in Degrees Centigrade.	Oxygen in c.c. per Litre.	pH.
Sept. 5, 1931:			
Surface	19.2	7.5	7.7
10 m.	19.2	-----	-----
12.5 m.	19.2	-----	-----
15.0 m.	15.1	-----	-----
17.5 m.	10.5	-----	-----
20.0 m.	8.6	-----	-----
30.0 m.	5.8	6.4	7.2

On July 23rd, 1931, a vertical series was taken at a point south-west of Copper Island by the men attending the course. Owing to the number of observers and lack of experience the results may not be absolutely accurate, but they afford a general picture of existing conditions. A second series was taken on July 8th, 1932, at a point 1 mile north-east of Sorrento, by the second group of hatchery officers. These two sets of data are shown graphically in Fig. 2, along with oxygen and pH records obtained at the same time.

It will be noted that on July 17th, 1931, the change in temperature between 8 and 18 metres (8.7 and 19.7 yards) constitutes a thermocline in the strict sense of the term. In spite of this stratification the lower water has more than 7 c.c. per litre of dissolved oxygen and there is no indication of stagnation. Immediately prior to September 5th, 1931, strong winds had brought about a thorough mixing of the upper 12 metres (13 yards) of water so that the thermocline on that date occurs between 13 and 20 metres (14.2 and 21.8 yards). The oxygen content of the hypolimnion was still more than 6 c.c. per litre at 30 metres (32.8 yards). The great volume of the hypolimnion in Shuswap Lake provides a large store of oxygen.

HIGHER AQUATIC VEGETATION.

The shore-line in general is stony and while potamogetons occur to some extent offshore, abundant growths of aquatic plants occur only in the sheltered bays. In some areas *Chara* occurred more or less sparsely. The following forms were collected: *Equisetum variegatum, Isotes bolanderi, Potamogeton epihydrus, P. heterophyllus, P. americanus, P. richardsoni, Triglochin palustris, Sagittaria latifolia, Ranunculus aquatilis* var. *capillaceus, Hippurus vulgaris, Myriophyllum spicatum, Utricularia intermedia.* The various species were abundant in Blind Bay and in a backwater near Scotch Creek landing—the potamogetons and bladderwort particularly so.

PLANKTON.

The plankton in the open waters was relatively small in amount and in number of species, but in sheltered bays it was considerably more abundant. A total vertical haul with a large No. 20 net on July 17th, 1931, gave 2.55 c.c. of plankton and on September 5th, 1931, 1.95 c.c., an average of 2.25 c.c. The average of eight similar hauls in Paul Lake in July and August, 1931, was 4.4 c.c. (Rawson, 1934), and the average of eleven similar hauls in Okanagan Lake in July and August, 1935, was 1.4 c.c. (manuscript). The following forms occurred:—

Algæ: *Glœothece, Glœacapsa, Anabæna, Melosira, Stephanodiscus, Synedra, Fragillaria, Asterionella, Tabellaria, Desmidium, Staurastrum, Spirogyra, Mougeotia.*

Protozoa: *Ceratium hirundinella, Dinobryon sertularia.*

Rotifera: *Conochilus, Keratella cochlearis* var. *macracantha, Notholca longispina, Polyarthra.*

Copepoda: *Cyclops bicuspidatus, Diaptomus ashlandi, Epischura nevadensis, Canthocamptus minutus.*

Cladocera: *Sida crystallina, Diaphanosoma brachyurum, Holopedium gibberum, Daphnia longispina, Simocephalus vetulus, Scapholeberis mucronata, Ceriodaphnia reticulata, Bosmina longispina, Eurycercus lamellatus, Chydorus sphæricus, Acroperus harpæ, Alona costata, Alona affinis, Pleuroxus denticulatus, Pleuroxus procurvatus, Leptodora kindtii.* Mr. G. M. Neal took the following in Salmon Arm in July, 1935: *Daphnia pulex, Ceriodaphnia megalops, Kurzia latissima.*

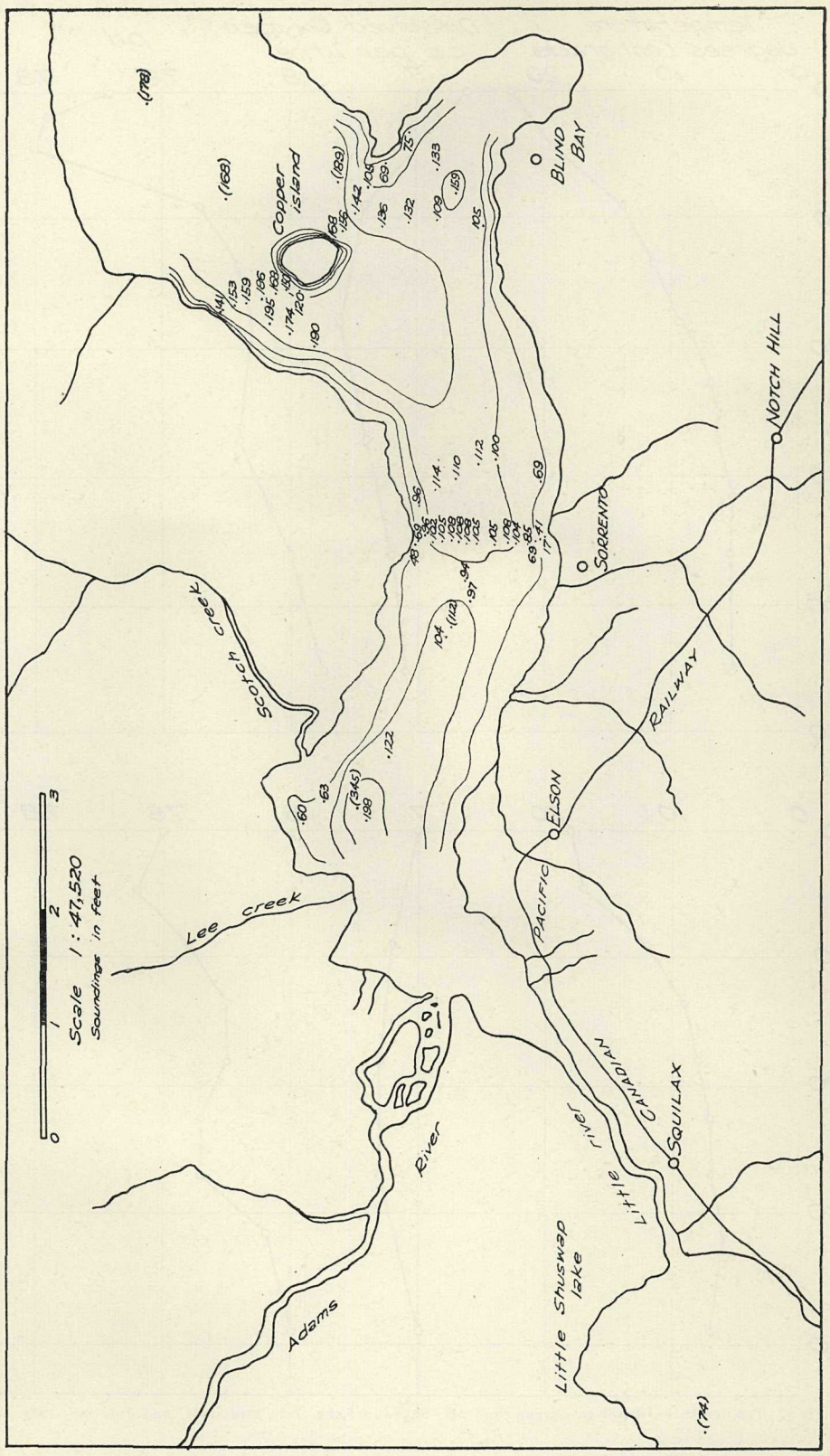

Fig. 1. Sketch-map of the western arm of Shuswap Lake, B.C.

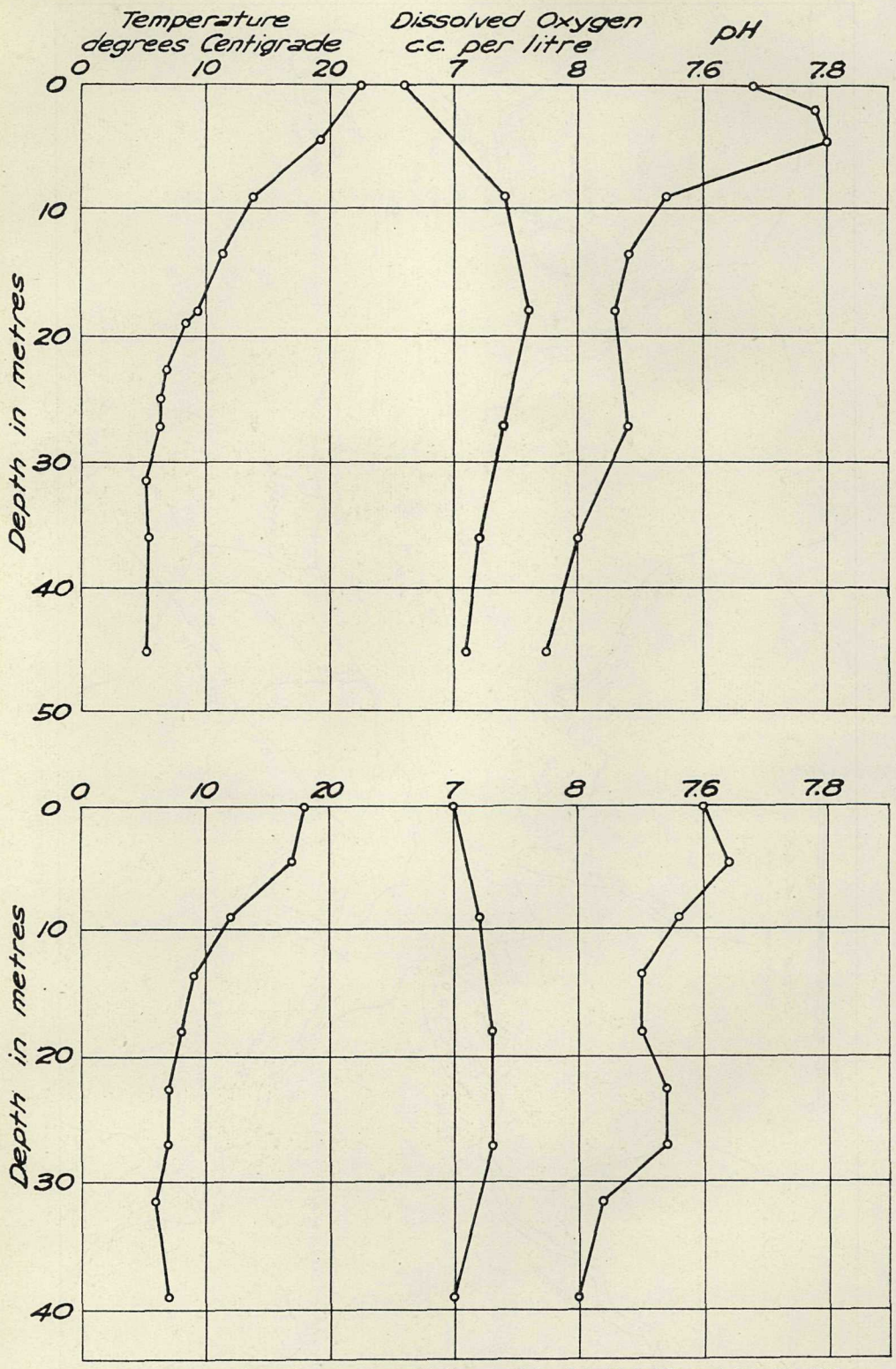

Fig. 2. Temperatures, dissolved oxygen, and pH, Shuswap Lake, July 23rd, 1931, and July 8th, 1932.

SHORE INVERTEBRATES.

Aquatic invertebrates, exclusive of plankton forms, were abundant among the aquatic vegetation, and certain species were found in considerable numbers clinging to the stones along the general shore-line. It has not been possible to obtain identifications in all groups, but the examinations which have been completed are as follows:—

Hirudinea: *Helobdella stagnalis, Glossiphonia heteroclita, Erpobdella punctata.*

Crustacea: *Hyalella azteca.*

Ephemeroptera: *Hexagenia limbata, Heptagenia, Ephemerella doddsi, Cænis, Trichorythodes, Centroptilum, Chlœon, Bætis, Callibætis, Siphlonurus occidentalis.* From Scotch Creek: *Iron, Cinygmula, Rhithrogena, Ephemerella doddsi, Ephemerella coloradensis.*

Hemiptera: *Arctocorixa modesta, Arctocorixa* sp. near *alternata.*

Trichoptera: *Limnephilidæ, Polycentropidæ, Leptoceridæ, Lepidostomatinæ.*

Coleoptera: *Rhantus binotatus, Tropisternus* sp. near *lateralis, Berosus, Laccophilus maculosus, Gyrinus confinis, Hydroporus septentrionalis, H. signatus, H. striatillus, Halipus leechi, Eurygenius campanulatus.*

Mollusca: *Musculium truncatum, Valvata lewisi, Gyraulus vermicularis, Physa, Helisoma subcrenatum, Stagnicola johnsoni.*

BOTTOM ORGANISMS.

By means of an Ekman grab-dredge, bringing up 81 square inches of bottom, a quantitative study was made of the distribution of bottom invertebrates. In 1931, a series of eleven dredgings was taken across the arm from the Scotch Creek ferry landing to Sorrento. Again in 1932 a series of twenty-eight samplings was taken at five stations extending from Sorrento toward the Scotch Creek ferry landing. The results have been combined and calculated on the basis of a square yard of bottom and are shown in Table II. and Fig. 3. It will be seen that from the south shore, the crop of bottom organisms was most abundant at about the 25-foot depth. There was a sparse growth of Chara and Potamogetons in this area and young spring salmon, lake chub, and squawfish were abundant here.

The number of bottom organisms varies from 128 to 449 per square yard, an average of 254. This is rather low in comparison with Okanagan with 304 bottom organisms in 1935 and Paul Lake with 1,136 in 1931.

TABLE II.—Bottom Organisms per Square Yard, Shuswap Lake, 1931 and 1932.

	From South Shore (Sorrento).					From North Shore (Scotch Creek).				
Dredging number	1	2	3	4	5	5	4	3	2	1
Distance from shore	125 ft.	250 ft.	500 ft.	1,000 ft.	1,500 ft.	1,300 ft.	300 ft.	200 ft.	150 ft.	100 ft.
Depth	15 ft.	25 ft.	50 ft.	80 ft.	100 ft.	140 ft.	80 ft.	30 ft.	10 ft.	6 ft.
Character of bottom	Silt	Silt	Silt	Silt	Silt	Ooze	Ooze-clay	Mud	Gravel	Sand
Worms (Oligochæta)	5	21	141	76	43	48	48	.....	.....	.....
Shrimps (Hyalella)	8	36	3	.....	.....	.....	.....	32	.....	16
Mites (Hydracarina)	5	3	3	.....	.....	.....	.....	.....	.....	16
Mayfly Nymphs (Ephemeroptera)	11	3	.....	.....	.....	.....	.....	.....	.....	.....
Caddis larvæ (Trichoptera)	8	99	5	.....	.....	.....	.....	.....	.....	.....
Midge larvæ (Chironomidæ)	85	103	77	56	123	64	240	128	272	208
Snails (Gastropoda)	51	105	8	1	.....	.....	.....	48	16	16
White clams (Sphæriidæ)	5	36	40	.....	.....	.....	.....	64	48	.....
Miscellaneous	8	43	3	.....	.....	16	.....	.....	16	32
	186	449	280	133	166	128	288	272	352	288

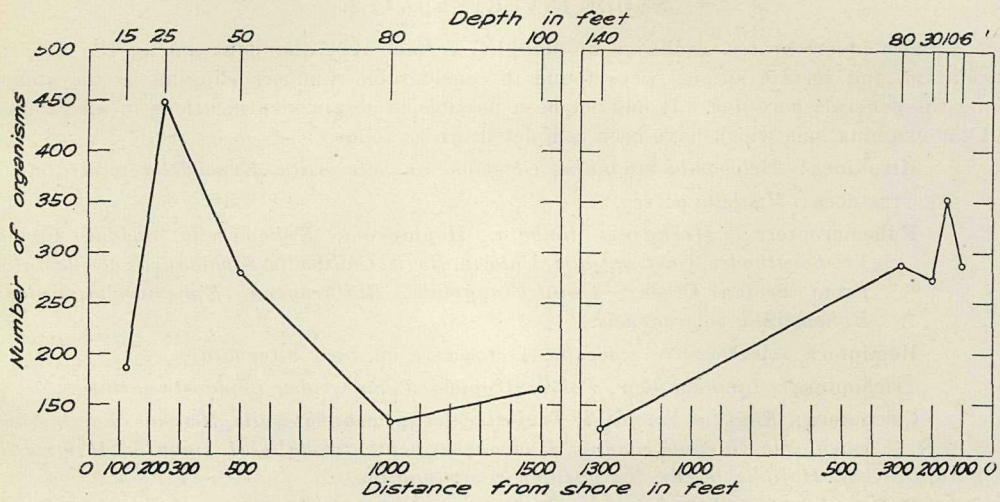

Fig. 3. Distribution of bottom organisms, Shuswap Lake, 1931 and 1932.

FISH.

Collections of fish were made by means of seine hauls and gill-net settings and the following species were obtained:—

Coarse-scaled sucker (*Castostomus macrocheilus*), fine-scaled sucker (*Catostomus catostomus*), lake chub (*Mylocheilus caurinus*), squawfish (*Ptychocheilus oregonensis*), lake shiner (*Richardsonius balteatus*), dace (*Apocope falcata*), carp (*Cyprinus carpio*), Eastern whitefish (*Coregonus clupeaformis*), Rocky Mountain whitefish (*Prosopium williamsoni*), young spring salmon (*Oncorhynchus tschawytscha*), young coho salmon (*O. kisutch*), young sockeye salmon (*O. nerka*), kokanee (*O. nerka kennerlyi*), Kamloops trout (*Salmo gairdneri kamloops*), Dolly Varden char (*Salvelinus malma*), ling (*Lota maculosa*), sculpin (*Cottus asper*).

Shuswap Lake has always been a very important salmon-spawning area. Spring salmon spawn in various tributaries and the young spend several months in the lake before commencing their seaward migration. In both 1931 and 1932, very large numbers of these young fish, about 3¼ inches in length, were feeding along the entire shore length of the portion of the lake under observation, breaking the surface of the water everywhere in the evenings. Examination of stomach contents showed the food to consist largely of midge pupæ, water boatmen, and water fleas, chiefly *Daphnia* (Clemens, 1934). Large numbers of these fish were leaving the lake during July, and Kamloops trout were apparently feeding extensively upon them at the mouth of Little River. Anglers were making good catches of the trout by the use of a silvery lure.

Coho salmon also spawn extensively in the tributaries of the lake, particularly in Eagle River. The young usually spend a year in the streams and lakes before going to sea.

In earlier days, Shuswap Lake was one of the most important sockeye-salmon spawning areas in British Columbia. The adult sockeye in their red spawning livery formed during August and September a continuous procession in the South Thompson River and were referred to as the "long red line." They passed into all the tributary streams in almost incredible numbers. The following account by Mr. D. S. Mitchell is of interest: "Many years ago I rowed in the moonlight up the Salmon River. About a mile from its mouth I tied the bow to a long stake that was driven in the bed of the stream. There was no sign of salmon. I unrolled my blankets in the stern and went to sleep. In the grey of early morning I was aroused by a commotion and found the river full of sockeye salmon running up-stream. I put in an oar and felt that the river was half fish. The increasing light soon showed that it was red from bank to bank. Then a stampede or panic occurred and salmon came surging down but the river was so full of ascending fish that they blockaded and made a great, flat

wriggling dam. So jammed were they that they were crowded out and pushed up the sloping banks out of water. Where the banks steepened these struggling, flapping fish were rolled down on to the backs of the fish in the river, into the mass of which they would again sink. The fish lower down stream, suffocating for oxygen, had turned and were rushing back to the lake to breathe fresh water through their gills. They rushed down-stream creating a great noise like the roar of a storm or the noise of thousands of wild ducks rising from a lake, and followed down-stream by a succession of waves. The river was quiet again, flowing by the stake 14 inches below the wet high-water mark reached a few minutes before. Not a fish was in sight, but in twenty minutes or so they came back filling the river again from bank to bank."

Since the time of the rock-slide in the Fraser River Canyon at Hell's Gate in 1913, the runs to the upper areas of the Fraser River, including Shuswap Lake, have been small. The first large escapement in recent years took place in 1926, when several hundred thousand spawned in Adams River and large numbers have appeared in the succeeding cycle-years, namely, 1930 and 1934.

The young of the sockeye spend a year in the lake and feed largely upon the zoo-plankton. The productive capacity of the lake in plankton must have been enormous to support the hundreds of millions of young fish. Since all the Pacific salmon die after spawning the decomposition of the carcasses may have contributed very much to the fertility of the waters.

Many of the sockeye do not go to sea, but complete their life-cycle in the lake and spawn in the tributary streams as do the sea-run sockeye. These fish are called kokanees and constitute a subspecies of the sockeye under the name *Oncorhynchus nerka kennerlyi*. They are known to spawn in Eagle River, and undoubtedly they make use of many other streams.

The Kamloops trout is abundant in the lake and provides an excellent angling fishery. The Dolly Varden char is also abundant and taken frequently by anglers.

The Rocky Mountain whitefish is common and the young were taken regularly in the seine hauls. A single specimen of the Eastern whitefish, approximately 15 inches in length, was taken in a gill-net. While there is no official record of this species having been introduced into Shuswap Lake, there are rumours to the effect that a planting was made years ago during the period when whitefish eggs were being brought from Manitoba and Ontario. It is probable that the species now occurs in limited numbers as it does in Okanagan Lake.

Suckers, minnows, and sculpins are particularly abundant. The origin of the carp is not known but it has become rather common in the vicinity of Salmon Arm.

The ling is also reported to be abundant in the lake, and considerable numbers appear in Eagle River in the autumn at the time of salmon spawning.

It is hoped that the account of the natural history of a limited portion of Shuswap Lake, incomplete as it is, may form the basis for a more extensive study of this interesting and important body of water.

We wish to gratefully acknowledge the assistance of the following persons in the identification of plants and animals: Dr. F. C. Baker, Dr. C. Betten, Dr. G. C. Carl, Professor J. Davidson, Professor J. R. Dymond, Dr. F. P. Ide, Dr. J. McDunnough, and Dr. J. Percy Moore.

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RAWSON, D. S. Bull, XLII., Biol. Bd. Can., 1934.

ANNUAL REPORT BRITISH COLUMBIA SALT-FISH BOARD, 1937–38 SEASON.

Following the decision of the Privy Council in January, 1937, that the "Natural Products Marketing Act, 1934," was *ultra vires* the Parliament of Canada, the salt-fish producers of this Province, comprising the majority of the industry, made application through the Meal, Oil, and Salt-fish Section, B.C. Division, Canadian Manufacturers' Association, and the Canadian Salt Herring Exporters, Limited, to the Provincial Department of Agriculture for a salt-fish marketing scheme under the provisions of the "Natural Products Marketing (British Columbia) Act."

The application of the producers was granted and the present Board constituted on August 25th, 1937. Under subsection (2) of section 3 of the Scheme the members of the Board appointed for the period until September 30th, 1937, were:—

Mr. Hugh Dalton, Vancouver, B.C. (Chairman).
Mr. Geo. E. Crawford, Vancouver, B.C.
Mr. A. J. Blackwell, Vancouver, B.C.
Mr. K. Kimura, Vancouver, B.C.
Mr. T. Matsuyama, Vancouver, B.C.

On August 30th, 1937, the above Board held its first meeting, at which time Mr. G. R. Clark was appointed Secretary. The Board at its inaugural meeting instructed that cables be dispatched to the Canadian Government Trade Commissioners at Tokyo, Kobe, and Hong Kong advising them of the setting-up of the Board under the "Natural Products Marketing (British Columbia) Act," and requesting them to cable an indication of the quantity of dry-salt herring and dry-salt salmon which could be handled in their respective territories during the 1937–38 season.

At the outset the Board was faced with difficult conditions in the Orient due to the outbreak of hostilities between Japan and China. On receipt of replies from the different Canadian Trade Commissioners, including the one located at Shanghai, who had been forwarded the information as to the constitution of the Board through Hong Kong, it became apparent that the 1937–38 season was going to be an exceptionally difficult one from the standpoint of marketing and obtaining payment for the goods. The Board, however, undertook every effort to ensure orderly marketing of the products, bearing in mind always the desire to market as large a volume as possible consistent with the ability to obtain the necessary funds from the Orient which would show a reasonable return to the producers.

In accordance with the provisions of subsection (3) of section 3 of the Scheme, the following were appointed members of the Board for the period October 1st, 1937, to September 30th, 1938:—

Appointees of the Meal, Oil, and Salt-fish Section, B.C. Division, Canadian Manufacturers' Association: Mr. Geo. E. Crawford, foot Gore Avenue, Vancouver, B.C.; Mr. A. J. Blackwell, 119 Pender Street West, Vancouver, B.C.

Appointees of Messrs. Canadian Salt Herring Exporters, Limited: Mr. K. Kimura, 217 Dunlevy Avenue, Vancouver, B.C.; Mr. K. Shiraishi, 217 Dunlevy Avenue, Vancouver, B.C.

Mr. Hugh Dalton, of Vancouver, B.C., was appointed Chairman of the Board by the Honourable the Commissioner of Fisheries, and Mr. G. R. Clark continued as Secretary of the Board.

From the initial meeting of the Board on August 30th every effort was made to secure as much information as possible relative to marketing conditions in the Orient, and as dry-salt salmon was the product requiring immediate attention the Board devoted its time to working out some plan which would ensure orderly marketing and at the same time permit the producer to operate on a reasonable basis. Official word was received through the Canadian Government Trade Commissioner at Tokyo that the Japanese Government had imposed currency-exchange restrictions covering imported goods, and as these regulations applied to dry-salt salmon it became necessary to ascertain the total amount of exchange which the Japanese Government would grant permits for covering dry-salt salmon. After lengthy cable exchanges, the Board was advised that the total amount of currency exchange which would be permitted for dry-salt salmon was 1,316,000 *yen*, which, converted at a rate of 28½ cents, indicated a total amount of $375,060. On September 28th the Board was advised by

the Provincial Department of Fisheries that a total of twenty-six salmon dry-saltery plant licences had been issued for the 1937–38 season, this being four less than in the previous year.

The Board's task in arriving at equitable individual marketable quantities is, at best, a decidedly difficult one, but was further complicated in the season under review by the fact that due to the currency-exchange restrictions implemented by the Government of Japan the total amount of exchange available had to be taken as the common denominator; i.e., the Board was faced with the problem of granting a marketable quantity to each of the twenty-six licensees which would permit of an economical operation, at the same time keeping in mind the obtaining of a sales price in line with the funds available. One feature of the situation which was deprecated by the Board was the fact that plant licences were issued in some cases to producers having no plants; i.e., the salting operations being conducted on a rented scow. This practice, it is contended, reacts to the disadvantage of those producers having investments in actual plants who are compelled to maintain and repair such plants, pay taxes of various kinds, and otherwise contribute to the general welfare of the industry. In this connection it is suggested by the Board that in future years the Provincial Department of Fisheries give consideration to only issuing salmon dry-saltery plant licences to those producers having *bona-fide* plants. It is further suggested by the Board that a scow operation can be construed as floating equipment and consequently at odds with the present policy of the Department of Fisheries.

Following very careful consideration by the Board, in the light of all the circumstances, on October 4th it was determined that the total marketable quantity of dry-salt salmon of all varieties for the 1937–38 season should be 29,800 boxes, and the Board on this same date proceeded to determine the individual marketable quantities covering the twenty-six holders of Provincial plant licences. As previously stated, the task of arriving at a fair basis of individual marketable quantities was even more difficult in the 1937–38 season. After taking into consideration the past performance of the licensees, the Board determined the individual marketable quantities and was, it is contended, most fair and equitable in its method. Following the announcement of the Board's determination of individual marketable quantities one producer expressed himself as being dissatisfied. It was, however, pointed out by the Board that the plan followed in arriving at marketable quantities was the fairest one which could be devised in the interests of all concerned.

Under section 5, subsection (*h*), all producers are required to be registered with the Board, and in forwarding registration certificates to the twenty-six producers, indicating their individual marketable quantities, the Board advised that the determination of the total marketable quantity of dry-salt salmon of 29,800 boxes for the 1937–38 season turned on the question of securing the maximum return for producers, in so far as possible in view of the fact that twenty-six plant licences had been taken out with the Provincial Department of Fisheries, or authorizing a much larger quantity which would have made the production and marketing of the product a distinctly unprofitable venture for the licensees. Further, that the marketable quantity indicated in the registration certificate represented the best compromise which the Board could arrive at, being designed to secure the maximum price for producers in relation to the fixed amount of money available to cover marketing during the season under review.

Under the authority of section 2 of the Scheme, the Board, on October 8th, 1937, designated the following companies as its marketing agencies covering the marketing of dry-salt salmon: Messrs. Salt Salmon Exporters of B.C., Limited, 217 Dunlevy Avenue, Vancouver, B.C.; Messrs. Producers' Salt Fish Sales, Limited, 355 Burrard Street, Vancouver, B.C.

The Board determined that the terms of marketing covering dry-salt salmon should be on consignment, with a minimum guaranteed advance to the producer covered by irrevocable letters of credit without recourse and that the net-weight basis should be not less than 440 lb. (fish and salt) per box.

After full consideration by the marketing agencies they reported that the following minimum guaranteed advances had been agreed upon, same being approved by the Board:—

Dry-salt Chum Salmon.—Fraser River, $14.50 per box U.S. funds, c.i.f. Yokohama, per box of not less than 440 lb. net shipping weight (fish and salt); Island, $13 per box U.S. funds, c.i.f. Yokohama, per box of not less than 440 lb. net shipping weight (fish and salt); Queen

Charlotte, $12.50 per box U.S. funds, c.i.f. Yokohama, per box of not less than 440 lb. net shipping weight (fish and salt).

It was decided with respect to varieties of dry-salt salmon other than chums that the marketing price should be subject to the approval of the Board as the necessity arose. Dry-salted chum salmon is the most important species as far as the Japanese market is concerned; other varieties such as springs, pinks, sockeye, and cohoe being in limited demand. It is also unfortunate that the only available market for British Columbia dry-salted salmon is Japan. Japan herself is a large producer of dry-salt salmon and in view of the difficult conditions obtaining in the Orient, which as the season advanced became worse, it was only by strenuous efforts on the part of the Board and its marketing agencies that the interests of the producers were protected.

In the 1936–37 season the minimum guaranteed advances secured for the producers were: Fraser River, $12.50 per box; Island, $10 per box; and Queen Charlotte, $9.50 per box; a total marketable quantity of 31,950 boxes having been determined. In that season the Japanese market for our dry-salt salmon was particularly weak, due to a very heavy production of Japanese dry-salt salmon. The experience of the 1937–38 season, however, is really not comparable with any other year for the reason that the Board, in order to secure the maximum return to the producers for the amount of exchange available, was forced to curtail the marketable quantity. It developed that the run of chum salmon in British Columbia was not particularly heavy and there being a demand for the fish for other processing, such as canning and freezing, raw-fish prices rose to the point where the salters could not operate economically, resulting in the pack falling short of the total marketable quantity determined by the Board. The final production and marketing of dry-salt salmon in the 1937–38 season showed a total of 22,843 boxes, of which 323 boxes were pinks, the balance being chums.

DRY-SALT HERRING.

The British Columbia production of dry-salt herring is consumed entirely in the Orient—the three main distributing territories being Kobe, Japan; Shanghai, China; and Hong Kong. Since the inception of the original Salt-fish Board in 1934 under the Dominion "Marketing Act," it has been the purpose of the Board to establish the system of marketing total given quantities to each of the three distributing centres. The marketing agencies of the Board were finally successful in effecting such arrangements with all three ports during the 1936–37 season; Kobe having taken a total of 10,000 tons; Shanghai, 6,500 tons; and Hong Kong, 2,400 tons. These quantities were fully covered by irrevocable letters of credit without recourse established in Vancouver banks, an achievement never before known in the history of the dry-salt herring trade.

The position facing the Board at the commencement of the 1937–38 season was, however, a most complicated and difficult one. Hostilities between Japan and China were at their height, particularly in the Shanghai area. As a matter of fact, it was not possible at this time to communicate direct with Shanghai, cable connections being routed via Hong Kong and at best were uncertain; trans-Pacific steamship lines had eliminated Shanghai as a port of call with no immediate prospect of the situation clarifying. The situation in Japan, in so far as dry-salt herring was concerned, was much the same as that for dry-salt salmon; namely, that the Japanese Government had placed currency-exchange restrictions on the purchase of our product. It was expected that Hong Kong, being the only uninterrupted market, would purchase in fair quantity, but general conditions in the Orient tended to weaken the Hong Kong situation to a marked degree.

Five plants were licensed by the Provincial Department of Fisheries to produce dry-salt herring, all being located on the east coast of Vancouver Island. The information obtained by the Board from the Canadian Trade Commissioners in the Orient as to the marketing prospects had been passed on to the producers, and, as a result of the uncertain situation, groups of producers joined together in securing a plant licence from the Government, thus effecting joint operations which, in view of the conditions, paved the way for economic production. The producers also informed the Board, through their respective associations, that they would not produce any quantity of dry-salt herring until such time as firm orders were received and approved by the Board.

On November 4th the Board designated the following companies as its marketing agencies covering the marketing of dry-salt herring for the 1937–38 season: Messrs. Canadian

Salt Herring Exporters, Limited, 217 Dunlevy Avenue, Vancouver, B.C.; Messrs. Producers' Salt Fish Sales, Limited, 355 Burrard Street, Vancouver, B.C.

During the intervening period negotiations were being carried on with a group of importers in Japan for the purchase of a block of dry-salt herring under an exclusive arrangement. Information was received to the effect that the Japanese Government would grant an import permit covering dry-salt herring to the value of 869,000 *yen*, this at an exchange rate of 28½ cents being equivalent to $247,665. Following further negotiations with the importers in Japan a contract was consummated by the marketing agencies for a total of 8,000 tons of dry-salt herring. A monthly schedule of shipments and prices was submitted and approved by the Board as follows:—

November	1,600 tons	at	$33.50	=	$53,600.00
December	2,300 tons	at	30.50	=	70,150.00
January	2,400 tons	at	28.00	=	67,200.00
February and March	1,700 tons	at	26.50	=	40,050.00
	8,000 tons	at	$29.50 (av.)		$236,000.00

The condition of marketing the above quantity was subject to the establishment of an irrevocable letter of credit without recourse in United States funds in a Vancouver bank, as well as the drawing-up of a formal contract for the approval of the Board. These conditions were adhered to, the first shipment going forward to Kobe, Japan, on November 18th, 1937. Having in hand the definite marketing of at least 8,000 tons of dry-salt herring the Board, on November 4th, determined that the total marketable quantity of dry-salt herring for the 1937–38 season should be 10,000 tons. In view of the extremely precarious position of the Shanghai market and the weakened situation obtaining in Hong Kong, the Board felt that extreme caution should be exercised by the producers in only having supplies available which could be marketed. The operators concurred with the Board's view in this respect, and in order that all five licensed plants should participate in the average proceeds of all sales consummated by the marketing agencies the Board with the consent of the producers established a pooling arrangement on a *pro rata* basis to the marketable quantity determined for each licensee.

During this time the marketing agencies had been in communication with the buyers in Hong Kong, it developing that it was impossible to consummate a "single" or *en bloc* sale. It transpired that the Hong Kong buyers purchased on a steamer-to-steamer basis, the total tonnage involved amounting to 830 tons over the season, which worked out to an average price of $36.27 per ton.

Towards the end of December conditions in Shanghai had improved to the point where certain of the steamship companies had again placed this port on their schedules. Inquiries had been received from different Shanghai buyers and the marketing agencies were finally successful in effecting sales to the Shanghai territory, the first shipment going forward on January 6th, 1938. In all a total of 1,170 tons was finally marketed in Shanghai at an average c.i.f. price of $31.57.

The following table indicates the distribution of British Columbia dry-salt herring during the 1937–38 season:—

Port.	Quantity (Tons).	Average C.I.F. Price.
Kobe, Japan	8,000	$29.50
Hong Kong	830	36.27
Shanghai, China	1,170	31.57
Total	10,000	$30.30

The Board's survey of the quantity which could be profitably marketed in the 1937–38 season proved correct. Under the abnormal conditions obtaining in the Orient it is felt that the Board's determination of a total marketable quantity of 10,000 tons was justified, and it is known that the producers were enabled to operate at a small profit. Had production been unlimited, however, the results would have been entirely different and would have meant the carrying-over in storage of a large quantity of unsold stock.

SUMMARY.

The Board has endeavoured, since its original inception under the Federal "Natural Products Marketing Act" in 1934, to secure the maximum returns for the producers consistent with orderly marketing of the two products. Experience has shown that the vagaries of the Oriental market, both for dry-salt salmon and dry-salt herring, cannot be judged by any set rules or regulations; the flexible policy of the Board in meeting and adjusting its determinations from season to season is felt to be the only method whereby the interests of the producers can be fully protected. In the case of dry-salt herring consignment shipments have been entirely eliminated, and by joint operations the producers have demonstrated that the business can be continued on a reasonably profitable basis. The following average c.i.f. prices, per ton, for dry-salt herring indicates the progressive rise in the returns to the producers. The last four years noted below cover the period of the Board's operation, commencing with the setting-up of the Board originally under the Dominion "Marketing Act."

Year.	Average C.I.F. Price per Ton.
1927	$28.31
1928	27.80
1929	27.03
1930	23.85
1931	19.70
1932	15.85
1933	19.85
1934	27.11
1935	28.45
1936	29.28
1937	30.30

In so far as dry-salt salmon is concerned, as mentioned earlier in this report, British Columbia is dependent entirely upon the Japanese market for the sale of her dry-salt salmon. Conditions peculiar to the dry-salt salmon trade exist and it has not as yet been possible to eliminate entirely the shipping of the product on consignment. The Board has, however, endeavoured to secure for the producers, through the marketing agencies, a guaranteed minimum advance per box as nearly in line as is possible with the value of the product, such advances being covered by irrevocable letters of credit without recourse. The prices obtained are governed usually by the law of supply and demand, although in the year under review the restrictions imposed by the Japanese Government added another hazard to the business. The underquoted table is a comparative statement of the minimum advances obtained in recent years for our dry-salt salmon:—

Year.	Fraser River Quality.	Island Quality.	Queen Charlotte Quality.
1931	$13.50	$11.00	$10.00
1932	6.50	5.50	5.50
1933	6.50	6.00	6.00
1934	13.00	12.00	10.00
1935	15.00	13.00	12.50
1936	12.50	10.00	9.50
1937	14.50	13.00	12.50

The work of the Board was conducted in the most friendly spirit, the members devoting their energy and time to the furtherance of the interests of the producers at all times. A total of sixteen meetings was held by the Board during the period under review.

The marketing charges levied by the Board during the 1937–38 season were the same as the previous season; namely, 10 cents per box on dry-salt salmon and 8 cents per box on dry-salt herring, equal to 40 cents per ton for each of the regulated products.

In addition to the recommendation in regard to the restricting of salmon dry-saltery plant licences to *bona-fide* plants, the Board desires to point out at this time, in connection with the marketing of dry-salt fish during the 1938–39 season, that advices from official

sources in the Orient clearly indicate that with exchange restrictions imposed by the Japanese Government and with rapidly declining exchange in China, which latter may place the landed cost beyond the purchasing power of Oriental buyers, the volume which can be marketed in Japan and China this coming year is likely to be still further restricted. Therefore, the Board may find it necessary, as the operating season approaches, to recommend to the Provincial Department of Fisheries the withholding of production plant licences within limits which will correspond with the quantity of salt fish which can be produced and marketed profitably and with the assurance that the producers will be paid for quantities which may be shipped.

In conclusion, the Board wishes to record its sincere appreciation for the co-operation extended by the Provincial Department of Fisheries. Also, the Board desires to take this opportunity of expressing its warmest thanks for the extremely valuable assistance rendered by the Canadian Government Trade Commissioners at Tokyo, Kobe, Shanghai, and Hong Kong. Had it not been for the prompt and efficient service rendered by these Commissioners in dealing and answering the many inquiries directed to them, the Board's efforts would have been very seriously nullified.

Respectfully submitted.

BRITISH COLUMBIA SALT-FISH BOARD.

HUGH DALTON, *Chairman.*
GEO. E. CRAWFORD, *Member.*
A. J. BLACKWELL, *Member.*
K. KIMURA, *Member.*
R. SUZUMOTO, *Member.*

G. R. CLARK,
Secretary.

Vancouver, B.C.,
July 28th, 1938.

REPORT ON INSPECTION OF SALMON-SPAWNING GROUNDS, 1937.

By J. A. Motherwell.

QUEEN CHARLOTTE ISLANDS.

Sockeye are not a real factor in the supplies of salmon to this area, although there is a small run to Copper Bay and to Masset Inlet. This variety is used principally for food purposes by the Indians.

In the case of the cohoes the runs are always light and the year under review was no exception.

This was the " off " year in the case of pinks and the situation was comparable to other odd-numbered years.

The chum-supply was an average one, with apparently a larger percentage passing safely to the spawning-grounds.

NASS AREA.

On the whole the escapement of sockeye was found to be quite good, particularly that portion reaching the main spawning-grounds in the Meziadin Lake District in the early part of the season. The Nass appears to be holding up well.

The upper reaches of this area are inaccessible, and it is still felt that the cost and difficulties of a more comprehensive examination is not justified.

The fishway was found to be in good condition and the salmon have no difficulty in passing into the lake.

Quite a satisfactory supply of springs was found, similar to the run of the preceding season. A fairly heavy escapement of cohoes was observed in all the streams frequented by this variety, and the situation is considered satisfactory.

The pink-run was quite light, and did not equal the small escapement of the brood-year of 1935. The poor seeding cannot be attributed to the fishing operations on the Canadian side of the International boundary, at any rate, but it is possible that the heavy tolls taken by the numerous seines and traps off the Alaskan shores may be the cause. It is also observed that in some years, for no apparent reason, pinks seem to avoid streams usually frequented by them and pass to other areas close by; for instance, in the year of a recent failure at Masset Inlet there was an abnormally large run of pinks which reached the streams immediately to the north of the International boundary and came as a surprise to Alaskan authorities.

The Nass is not a large producer of chum salmon but the run of this variety was normal.

SKEENA RIVER.

An excellent escapement of sockeye occurred to the principal spawning-areas of Babine Lake, Babine River, and Lakelse Lake. Due to bad weather, real inspections of the Kispiox River and Morice Lake systems had to be abandoned, but the catches of sockeye taken by the Indians at several points leading to these spawning-grounds, however, would appear to indicate a good escapement. A larger percentage than usual of the sockeye in the Babine area ascended to the spawning-grounds, due to the fact that the Indians were not able this year to take such a large toll of the run as the result of the bad weather for haying which delayed these operations, and also due to considerable sickness.

The supply of springs was good, both at Babine River and at Ocstahl River.

The cohoes were also found to be reasonably plentiful, generally speaking, no doubt partly as the result of all fishing closing on September 25th.

The pink-run was reported as heavy to the Babine River and Lakelse Lake areas, and greater than the cycle-year of 1935; in fact, the inspecting officer states that it is the largest he has observed since 1929.

The Skeena is not a heavy producing area in the case of chums. The escapement was normal.

LOWE INLET.

The sockeye-supply was found to be quite good and better than the brood-year.

The cohoe escapement was light, for some reason not apparent.

This was an " off " year for the pinks in the area, but the supply was smaller than in 1935.

This is quite a heavy producer of chum salmon and the escapement was even better than usual.

BUTEDALE AREA.

Sockeye have not been a real factor in this area, apart from Gardner Canal. The spawning-ground conditions were found to be normal.

The escapement of cohoes was found to be only fair, and in this respect was similar to most areas along the Pacific Coast.

The pink-run, and the escapement, was disappointing in the northern portion of the district, but was somewhat better in the southern part.

This district will be watched closely in the future.

The escapment of chums was considered fair and compares favourably with recent years.

BELLA BELLA AREA.

Due to practically continuous rains during the sockeye-run, the bulk of the supply passed safely to the spawning-grounds and the seeding was satisfactory.

The cohoe-supply was smaller than usual and cannot be regarded as particularly satisfactory.

The pink-spawning was entirely satisfactory and comparable with the escapement of 1935, the brood-year.

The chum escapement was quite heavy and the seeding very good.

BELLA COOLA AREA.

The inspecting officer reports that the season's supply of parent salmon on the spawning-grounds of his area is entirely satisfactory. In addition to adequate supplies being observed the spawning took place under most favourable conditions.

The sockeye areas of Kimsquit Lake and Atnarko River were well supplied with spawners, the former being quite equal to that of the brood-year and the Atnarko supply considerably exceeding that of 1933. The Inspector reports, however, that in the Atnarko area the number of undersized sockeye appears to be increasing from year to year. This year hundreds of fish were noticed that would not weigh over 1 lb., all apparently mature and spawning normally. These small fish evidently do not appear in the Kimsquit system.

The supply of springs was found to be quite good. Practically the whole run which reached the mouths of the rivers in this area passed safely up as they are not fished in the district to any extent.

The cohoe-supply was found to be quite a good one as compared with recent years.

The numbers of pinks found on the spawning-grounds are classed as very heavy, and better than the excellent run of 1935, the brood-year.

The chum-supply was also heavy, and better than that of recent seasons.

RIVERS INLET AREA

The inspecting officer, who has had considerable experience on the inlet, sums up the sockeye-spawning conditions in this area by saying that he is well satisfied with the evidence of escapement.

The conditions on the spawning-grounds are equal to those of 1933 and an improvement over those of 1932.

The most satisfactory conditions were found in Genesi, Nookins, Dallec, Quap, and Whonnock Rivers.

The rivers at the head of the lake were somewhat disappointing, but not really poor, other than the Waukwash, which was a failure because of the diversion of the stream caused by a freshet.

There is usually a small run of spring salmon to the Waukwash River, but the spawning area in that stream is not now available, but no doubt the springs spawned somewhere else.

The cohoe-supply was light and similar to that in most other areas.

Rivers Inlet is not an important area from the standpoint of pink salmon and most of the run escapes year after year to the spawning-grounds unmolested.

The same remarks apply in the case of chums. The scarcity is not the result of intensive fishing in the district.

SMITH INLET AREA.

Two inspections were made of this area also and the escapement of sockeye was found to be good in the Geluck and rather poor in the Delabah River. There was still a supply of sockeye in the lake after the second inspection, which is not an unusual condition, but it is difficult to estimate just what the supplies were compared with other years, in the lake.

The conditions are not as satisfactory as hoped for and are no doubt influenced to some extent by the freshet conditions of 1932 from which the five-year run originated. It is felt that any reduction in the percentage of escaping fish is not due to overfishing, and in any event the boundary at Quashela Creek may be depended upon to allow of a good percentage of any run to pass safely to the spawning-grounds.

The Delabah is the main spawning-stream and there apparently was found an adequate supply of spawning sockeye there.

There was a satisfactory supply of springs found, although these are of a variety which is not in particular demand and is not intensively fished.

The cohoes, pinks, and chums do not frequent the area in large numbers, but the supplies found were normal.

FRASER RIVER WATERSHED.

SOCKEYE.

The season 1937 was of a cycle which years ago produced immense runs of the highest quality of sockeye salmon. Since 1913, however, as the result of the slide at Hell's Gate, and undoubtedly due in part also to intensive fishing, this run has dropped to proportions very similar to those of other years.

In 1936 there was an unexpectedly large run of sockeye to the Fraser, and this year has also been comparatively good. An encouraging feature of this satisfactory run in the last two years has been the fact that for some reason or other they did not remain off the mouth of the river for any considerable period, but evidently finding conditions suitable passed without delay up to the spawning-grounds.

A detailed report by areas is given below.

Stuart Lake Area.—Whilst some 6,000 spawning sockeye were reported in this area, and this quantity was larger than seen for some seasons, including the brood-year, the run cannot be considered as good when compared with those of the years previous to 1913. However, there would appear to be reason to believe that the cycle is gradually building up.

The first sockeye were observed in Stuart Lake about August 1st, but what is referred to as the second run commenced about September 9th. The latter run apparently spawned in the Tachie and Middle Rivers and did not enter the streams to which the earlier supply ascended. This variety of salmon goes as far as the Driftwood River, at the head of Takla Lake.

Francois Lake System.—The return of sockeye this year was not as great as was expected in view of the increase in parent sockeye which reached the area in 1933. This season's return is estimated at not more than 30 per cent. of that four years previous.

Quesnel Area.—Bowron Lake and Quesnel Lake systems showed some improvement over recent seasons, including the brood-year, and although the numbers were small yet the percentage of increase was encouraging.

Adult salmon were observed in Bowron River, Mitchell River, and Horsefly River.

The Chilco Lake run was very satisfactory, and exceeded the splendid run of the brood-year by approximately 10 per cent. The local officer, who has had a considerable number of years' experience in the examination of these spawning-beds, reports having seen this season at least 110,000 spawning sockeye. They arrived in good condition and spawned under favourable conditions. The guardian suggests that this is the largest quantity seen since 1922.

North Thompson River Area.—Raft River and Finn Creek contained light runs showing no increase over those of the fourth year previous.

Kamloops Area.—The principal sockeye-spawning beds in this district are to be found in Adams River and Middle River. These were found to contain quantities very similar to the runs of the brood-year, and spawned under good conditions.

Seton-Anderson Lake System.—A remarkably fine return of sockeye to this area was observed, the local Inspector estimating the quantity at approximately 60,000 adults, compared with some 10,000 the preceding year, and practically nothing in the brood-year of 1933.

It is interesting to note in connection with this area that for years the Federal Department of Fisheries has been endeavouring, by means of eyed eggs and fry, to build up a run of sockeye similar to that occurring previous to 1913. The last two years are the first real encouragement observed.

At the commencement of the run this season it was observed that a small percentage of the females were dying unspawned, and although samples were immediately forwarded to the Biological Station, no cause for this loss was found.

Harrison-Birkenhead System.—The supply of parent sockeye during the season under review was considerably greater than expected, in view of the disappointing conditions of 1933 in the Birkenhead system. Satisfactory spawning has taken place.

In the streams tributary to Harrison Lake, supplies similar to those of recent years were found on the spawning-grounds, with the exception of Morris Creek, where the numbers were greater than for several seasons previous to 1936.

Cultus Lake-Chilliwack Lake System.—The quantity of sockeye returning to Cultus Lake was for some reason smaller than anticipated, the total reaching only 3,055 compared with 3,425 in the brood-year of 1933, by actual count. There was a normal supply in the Chilliwack Lake system.

Pitt Lake System.—The inspecting officer reports the supply in this district was greater that the preceding season, and considerably better than found in the brood-year of 1933.

Spring Salmon.

On the whole the supply of spring salmon found on the spawning-grounds was considered to be about normal.

Cohoes.

The supply of this variety seems to have been short, in common with other districts along the Pacific Coast. A special closed period, however, enforced in District No. 1, permitted a larger percentage of the run to pass to the spawning-grounds and the seeding, while not heavy, was fair.

Pinks.

This was the year of the big run of pink salmon to the Lower Mainland District, and whilst the early portion of the run was disappointing, the special closed time enforced in District No. 1 provided a satisfactory seeding of the spawning-grounds. The escapement to the Chilliwack River, Harrison River District, Burrard Inlet streams, and those of Howe Sound was very good.

Chums.

The early run of this variety was also disappointing, but again the special closed time provided for an escapement sufficient to seed the spawning-grounds.

ALERT BAY AREA.

The early run of sockeye to the Nimpkish River system, which is the principal spawning-ground of this variety, was rather light, but improved greatly as the season advanced. The water conditions were such as to permit the salmon to pass safely up-stream as they arrived. Whilst weather conditions prevented the usual comprehensive examination of this area, reliable information received shows that the spawning was quite satisfactory. At Port Neville the escapement was quite good, whilst at Keough River, Mackenzie Sound, Shushartie, and Nahwitti the escapement was fairly light.

The cohoe spawning was comparatively light, although early closing permitted a larger percentage of the run to pass up-stream.

This being an "off" year for pinks, the escapement was quite light.

In the case of chums, there was a heavy seeding at Viner Sound although other chum streams in the area were only fairly well seeded.

QUATHIASKI AREA.

The only sockeye areas in this sub-district are Hayden Bay and Phillips Arm. The seeding of the former was unusually good, but there was only a light supply at the latter point.

The spawning of springs was very satisfactory, particularly at Campbell River where fishing is so intensive by sportsmen.

The cohoe seeding was not as good as could be wished, but was comparatively satisfactory.

This was an " off " year in this area also for the pink variety, but the escapement was quite good comparatively.

A satisfactory seeding was observed in the case of the chums.

COMOX AREA.

There are no sockeye in this subdivision.

The seeding of springs, however, was better than in an average year, particularly at the Puntledge River, which is the main spring-salmon stream in the area.

The cohoe-supply on the spawning-grounds was not up to expectations; and 1937 being an " off " year for pinks there was only a light supply, with the exception of Oyster River, where the seeding was better than the last two years. In the Tsolum River, also, an unexpectedly large run reached the spawning-grounds.

The supply of chums was an average one.

PENDER HARBOUR AREA.

Sockeye appear only commercially at Saginaw Creek. The escapement this year was not as good as usual. The run to this point, however, is never large.

There was an average escapement of springs, but the seeding of the cohoe variety was lighter than usual.

The pinks, on the other hand, showed a decided increase over the brood-year of 1935. This is particularly the case in the streams tributary to Jervis Inlet.

The chum-supply was found to be only fair.

NANAIMO AREA.

Whilst this is not a sockeye area, the attempt was made by the Department to establish a run of this variety at the Nanaimo River by the planting of sockeye-eggs taken from Rivers Inlet. Over 100 parent sockeye were observed passing up to the spawning-grounds, and it is assumed that these are the result of the Department's efforts.

The work done during the year by the Department in providing easier access to the spawning-grounds past the falls in the Nanaimo River permitted a larger percentage of parent salmon than usual to pass safely up-stream.

The spring-supply, for instance, was found to be greater than for several years past.

The same condition obtained in the case of the cohoes and pinks, although the pink-run is never large.

LADYSMITH AREA.

Springs, cohoes, and pinks were found in this area in quantities about normal, and a good run of chums passed up the Chemainus River.

COWICHAN AREA.

The supply of springs in this area was better than the average.

The cohoe escapement was about normal, and the chums a medium supply.

The supply of steelheads was found to be fully equal to the best of the runs in recent years.

VICTORIA AREA.

Light supplies of cohoes and chums appeared on the spawning-grounds, but the situation is not considered in any way alarming.

ALBERNI AREA.

Again this year there was ample evidence to show that the Department's efforts in the way of rehabilitating the sockeye-runs to the Great Central, Sproat, and Anderson Lakes systems have been very successful. Continued high water during the run of this variety resulted in a smaller catch but an excellent escapement. At Anderson Lake the supply was estimated at 50 per cent. greater than that of the brood-year. Conditions found at Hobarton River, in the Nitinat area, were also good. The spring-supply in the Somass and Nitinat systems was better than in recent years and the seeding at Sarita, Toquart, and Nitinat Rivers was eminently satisfactory.

The cohoe-supply was found to be normal, but the pinks did not appear in any quantities, apart from the San Juan River. This is not, however, an important pink area. In the case of chums, the seeding was better than usual.

CLAYOQUOT AREA.

The seeding of sockeye in the Kennedy Lake system was better than that of the brood-year of 1933. This applies also to the smaller supply at Medgin River.

Springs were not so numerous, but the cohoes were found to be more plentiful than during normal years.

This is not an important pink area, but the seeding was an average one.

The conditions in the case of the chums were found to be average.

NOOTKA AREA.

Few sockeye frequent this area, but the usual run to the Gold River spawning-grounds was observed. Normal conditions applied in the case of springs and cohoes.

Pinks do not appear in commercial quantities.

The spawning of chums was found to be exceptionally good.

KYUQUOT AREA.

Only small runs of the creek variety of sockeye appear on the spawning-grounds of this area and the spawning was normal.

The seeding in the case of the spring salmon is estimated as being about 100 per cent. greater than during the previous season and as satisfactory.

The cohoe-supply was also found to compare favourably with that of other years.

In the case of chums, the situation is not so satisfactory, although special precautions by means of early closure were taken to assure of the escapement of a larger percentage of the run.

QUATSINO AREA.

The small supply of the creek variety of sockeye usually found was present.

The seeding of springs at Marble Creek was not up to normal.

The cohoe seeding was fair, but the pinks were few, due to the fact that this was an "off" year.

Heavier supplies of chums were observed in the streams of the south-east arm, and the seeding throughout the district was satisfactory.

SOCKEYE-SALMON FISHERIES CONVENTION.

CONVENTION BETWEEN CANADA AND THE UNITED STATES FOR THE PROTECTION, PRESERVATION, AND EXTENSION OF THE SOCKEYE-SALMON FISHERIES IN THE FRASER RIVER SYSTEM, SIGNED AT WASHINGTON ON MAY 26TH, 1930.

The conditions under which the Fraser River Sockeye-salmon Treaty was approved by Canada and the United States are as follows:—

(1.) That the International Pacific Salmon Fisheries Commission shall have no power to authorize any type of fishing gear contrary to the laws of the State of Washington or the Dominion of Canada;

(2.) That the Commission shall not promulgate or enforce regulations until the scientific investigations provided for in the convention have been made, covering two cycles of sockeye-salmon runs, or 8 years; and

(3.) That the Commission shall set up an advisory committee composed of five persons from each country who shall be representatives of the various branches of the industry (purse-seine, gill-net, troll, sport-fishing, and one other), which advisory committee shall be invited to all non-executive meetings of the Commission and shall be given full opportunity to examine and to be heard on all proposed orders, regulations, or recommendations.

SOCKEYE-SALMON FISHERIES CONVENTION.

His Majesty the King of Great Britain, Ireland, and the British Dominions beyond the Seas, Emperor of India, in respect of the Dominion of Canada, and the President of the United States of America, recognizing that the protection, preservation, and extension of the sockeye-salmon fisheries in the Fraser River system are of common concern to the Dominion of Canada and the United States of America; that the supply of this fish in recent years has been greatly depleted and that it is of importance in the mutual interest of both countries that this source of wealth should be restored and maintained, have resolved to conclude a Convention and to that end have named as their respective plenipotentiaries:—

His Majesty, for the Dominion of Canada:

The Honourable Vincent Massey, a member of His Majesty's Privy Council for Canada and His Envoy Extraordinary and Minister Plenipotentiary for Canada at Washington; and

The President of the United States of America:

Mr. Henry L. Stimson, Secretary of State of the United States of America;

Who, after having communicated to each other their full powers, found in good and due form, have agreed upon the following Articles:

ARTICLE I

The provisions of this Convention and the orders and regulations issued under the authority thereof shall apply, in the manner and to the extent hereinafter provided in this Convention, to the following waters:

1. The territorial waters and the high seas westward from the western coast of the Dominion of Canada and the United States of America and from a direct line drawn from Bonilla Point, Vancouver Island, to the lighthouse on Tatoosh Island, Washington—which line marks the entrance to Juan de Fuca Strait,—and embraced between 48 and 49 degrees north latitude, excepting therefrom, however, all the waters of Barklay Sound, eastward of a straight line drawn from Amphitrite Point to Cape Beale and all the waters of Nitinat Lake and the entrance thereto.

2. The waters included within the following boundaries:

Beginning at Bonilla Point, Vancouver Island, thence along the aforesaid direct line drawn from Bonilla Point to Tatoosh Lighthouse, Washington, described in paragraph numbered 1 of this Article, thence to the nearest point of Cape Flattery, thence following the southerly shore of Juan de Fuca Strait to Point Wilson, on Quimper Peninsula, thence in a

straight line to Point Partridge on Whidbey Island, thence following the western shore of the said Whidbey Island, to the entrance to Deception Pass, thence across said entrance to the southern side of Reservation Bay, on Fidalgo Island, thence following the western and northern shore line of the said Fidalgo Island to Swinomish Slough, crossing the said Swinomish Slough, in line with the track of the Great Northern Railway, thence northerly following the shore line of the mainland to Atkinson Point at the northerly entrance to Burrard Inlet, British Columbia, thence in a straight line to the southern end of Bowen Island, thence westerly following the southern shore of Bowen Island to Cape Roger Curtis, thence in a straight line to Gower Point, thence westerly following the shore line to Welcome Point on Seechelt Peninsula, thence in a straight line to Point Young on Lasqueti Island, thence in a straight line to Dorcas Point on Vancouver Island, thence following the eastern and southern shores of the said Vancouver Island to the starting point at Bonilla Point, as shown on the British Admiralty Chart Number 579, and on the United States Coast and Geodetic Survey Chart Number 6300, as corrected to March 14, 1930, copies of which are annexed to this Convention and made a part thereof.

3. The Fraser River and the streams and lakes tributary thereto.

The High Contracting Parties engage to have prepared as soon as practicable charts of the waters described in this Article, with the above described boundaries thereof and the international boundary indicated thereon. Such charts, when approved by the appropriate authorities of the Governments of the Dominion of Canada and the United States of America, shall be considered to have been substituted for the charts annexed to this Convention and shall be authentic for the purposes of the Convention.

The high Contracting Parties further agree to establish within the territory of the Dominion of Canada and the territory of the United States of America such buoys and marks for the purposes of this Convention as may be recommended by the Commission hereinafter authorized to be established, and to refer such recommendations as the Commission may make as relate to the establishment of buoys or marks at points on the international boundary to the International Boundary Commission, Canada and United States-Alaska, for action pursuant to the provisions of the Treaty between His Majesty in respect of Canada and the United States of America, respecting the boundary between the Dominion of Canada and the United States of America, signed February 24, 1925.

Article II

The High Contracting Parties agree to establish and maintain a Commission to be known as the International Pacific Salmon Fisheries Commission, hereinafter called the Commission, consisting of six members, three on the part of the Dominion of Canada, and three on the part of the United States of America.

The Commissioners on the part of the Dominion of Canada shall be appointed by His Majesty on the recommendation of the Governor General in Council. The Commissioners on the part of the United States of America shall be appointed by the President of the United States of America.

The Commissioners appointed by each of the High Contracting Parties shall hold office during the pleasure of the High Contracting Party by which they were appointed.

The Commission shall continue in existence so long as this convention shall continue in force, and each High Contracting Party shall have power to fill and shall fill from time to time vacancies which may occur in its representation on the Commission in the same manner as the original appointments are made. Each High Contracting Party shall pay the salaries and expenses of its own Commissioners, and joint expenses incurred by the Commission shall be paid by the two High Contracting Parties in equal moieties.

Article III

The Commission shall make a thorough investigation into the natural history of the Fraser River sockeye salmon, into hatchery methods, spawning ground conditions and other related matters. It shall conduct the sockeye salmon fish cultural operations in the waters described in paragraphs numbered 2 and 3 of Article I of this Convention, and to that end it shall have power to improve spawning grounds, construct, and maintain hatcheries, rearing ponds and other such facilities as it may determine to be necessary for the propagation of

sockeye salmon in any of the waters covered by this Convention, and to stock any such waters with sockeye salmon by such methods as it may determine to be most advisable. The Commission shall also have authority to recommend to the Governments of the High Contracting Parties removing or otherwise overcoming obstructions to the ascent of sockeye salmon, that may now exist or may from time to time occur, in any of the waters covered by this Convention, where investigation may show such removal of or other action to overcome obstructions to be desirable. The Commission shall make an annual report to the two Governments as to the investigations which it has made and other action which it has taken in execution of the provisions of this Article, or of other Articles of this Convention.

The cost of all work done pursuant to the provisions of this Article, or of other Articles of this Convention, including removing or otherwise overcoming obstructions that may be approved, shall be borne equally by the two Governments, and the said Governments agree to appropriate annually such money as each may deem desirable for such work in the light of the reports of the Commission.

Article IV

The Commission is hereby empowered to limit or prohibit taking sockeye salmon in respect of all or any of the waters described in Article I of this Convention, provided that when any order is adopted by the Commission limiting or prohibiting taking sockeye salmon in any of the territorial waters or on the High Seas described in paragraph numbered 1 of Article I, such order shall extend to all such territorial waters and High Seas, and, similarly, when in any of the Canadian waters embraced in paragraphs numbered 2 and 3 of Article I, such order shall extend to all such Canadian waters, and when in any of the waters of the United States of America embraced in paragraph numbered 2 of Article I, such order shall extend to all such waters of the United States of America, and provided further, that no order limiting or prohibiting taking sockeye salmon adopted by the Commission shall be construed to suspend or otherwise affect the requirements of the laws of the Dominion of Canada or of the State of Washington as to the procuring of a licence to fish in the waters on their respective sides of the boundary, or in their respective territorial waters embraced in paragraph numbered 1 of Article I of this Convention, and provided further that any order adopted by the Commission limiting or prohibiting taking sockeye salmon on the High Seas embraced in paragraph numbered 1 of Article I of this Convention shall apply only to nationals and inhabitants and vessels and boats of the Dominion of Canada and the United States of America.

Any order adopted by the Commission limiting or prohibiting taking sockeye salmon in the waters covered by this Convention, or any part thereof, shall remain in full force and effect unless and until the same be modified or set aside by the Commission. Taking sockeye salmon in said waters in violation of an order of the Commission shall be prohibited.

Article V

In order to secure a proper escapement of sockeye salmon during the spring or chinook salmon fishing season, the Commission may prescribe the size of the meshes in all fishing gear and appliances that may be operated during said season in the Canadian waters and/or the waters of the United States of America described in Article I of this Convention. At all seasons of the year the Commission may prescribe the size of the meshes in all salmon fishing gear and appliances that may be operated on the High Seas embraced in paragraph numbered 1 of Article I of this Convention, provided, however, that in so far as concerns the High Seas, requirements prescribed by the Commission under the authority of this paragraph shall apply only to nationals and inhabitants and vessels and boats of the Dominion of Canada and the United States of America.

Whenever, at any other time than the spring or chinook salmon fishing season, the taking of sockeye salmon in Canadian waters or in waters of the United States of America is not prohibited under an order adopted by the Commission, any fishing gear or appliance authorized by the laws of the Dominion of Canada may be used in Canadian waters by any person thereunto duly authorized, and any fishing gear or appliance authorized by the State of Washington may be used in waters of the United States of America by any person thereunto authorized by the State of Washington. Whenever the taking of sockeye salmon on the High Seas embraced in paragraph numbered 1 of Article I of this Convention is not pro-

hibited, under an order adopted by the Commission, to the nationals or inhabitants or vessels or boats of the Dominion of Canada or the United States of America, only such salmon fishing gear and appliances as may have been approved by the Commission may be used on such High Seas by said nationals, inhabitants, vessels or boats.

ARTICLE VI

No action taken by the Commission under the authority of this Convention shall be effective unless it is affirmatively voted for by at least two of the Commissioners of each Contracting Party.

ARTICLE VII

Inasmuch as the purpose of this Convention is to establish for the High Contracting Parties, by their joint effort and expense, a fishery that is now largely nonexistent, it is agreed by the High Contracting Parties that they should share equally in the fishery. The Commission shall, consequently, regulate the fishery with a view to allowing, as nearly as may be practicable, an equal portion of the fish that may be caught each year to be taken by the fishermen of each High Contracting Party.

ARTICLE VIII

Each High Contracting Party shall be responsible for the enforcement of the orders and regulations adopted by the Commission under the authority of this Convention, in the portion of its waters covered by the Convention.

Except as hereinafter provided in Article IX of this Convention, each High Contracting Party shall be responsible, in respect of its own nationals and inhabitants and vessels and boats, for the enforcement of the orders and regulations adopted by the Commission, under the authority of this Convention, on the High Seas embraced in paragraph numbered 1 of Article I of the Convention.

Each High Contracting Party shall acquire and place at the disposition of the Commission any land within its territory required for the construction and maintenance of hatcheries, rearing ponds and other such facilities as set forth in Article III.

ARTICLE IX

Every national or inhabitant, vessel or boat of the Dominion of Canada or of the United States of America, that engages in sockeye salmon fishing on the High Seas embraced in paragraph numbered 1 of Article I of this Convention, in violation of an order or regulation adopted by the Commission, under the authority of this Convention, may be seized and detained by the duly authorized officers of either High Contracting Party, and when so seized and detained shall be delivered by the said officers, as soon as practicable, to an authorized official of the country to which such person, vessel or boat belongs, at the nearest point to the place of seizure, or elsewhere, as may be agreed upon with the competent authorities. The authorities of the country to which a person, vessel or boat belongs alone shall have jurisdiction to conduct prosecutions for the violation of any order or regulation, adopted by the Commission in respect of fishing for sockeye salmon on the High Seas embraced in paragraph numbered 1 of Article I of this Convention, or of any law or regulation which either High Contracting Party may have made to carry such order or regulation of the Commission into effect, and to impose penalties for such violations; and the witnesses and proofs necessary for such prosecutions, so far as such witnesses or proofs are under the control of the other High Contracting Party, shall be furnished with all reasonable promptitude to the authorities having jurisdiction to conduct the prosecutions.

ARTICLE X

The High Contracting Parties agree to enact and enforce such legislation as may be necessary to make effective the provisions of this Convention and the orders and regulations adopted by the Commission under the authority thereof, with appropriate penalties for violations.

ARTICLE XI

The present Convention shall be ratified by His Majesty in accordance with constitutional practice and by the President of the United States of America, by and with the advice and

consent of the Senate thereof, and it shall become effective upon the date of the exchange of ratifications which shall take place at Washington as soon as possible and shall continue in force for a period of sixteen years, and thereafter until one year from the day on which either of the High Contracting Parties shall give notice to the other of its desire to terminate it.

In witness whereof, the respective plenipotentiaries have signed the present Convention, and have affixed their seals thereto.

Done in duplicate at Washington, the twenty-sixth day of May, one thousand nine hundred and thirty.

VINCENT MASSEY,
HENRY L. STIMSON.

PACK OF BRITISH COLUMBIA SALMON, SEASON 1937.

SHOWING THE ORIGIN OF SALMON CAUGHT IN EACH DISTRICT.

District.	Sockeye.	Springs.	Steel-heads.	Cohoes.	Pinks.	Chums.	Grand Total (Cases).
Fraser River	100,272	5,444	.....	11,244	94,010	20,878	231,848
Queen Charlotte Islands	2	140	.....	4,631	13	72,689	77,475
Nass River	17,567	1,251	46	12,067	8,031	10,080	49,042
Skeena River	42,491	4,401	21	15,514	59,400	10,811	132,638
Rivers Inlet	84,832	917	70	6,012	7,536	9,415	108,782
Smith Inlet	25,258	21	5	241	483	9,494	35,502
Central Area	29,987	1,641	614	25,009	97,321	110,493	265,065
Vancouver Island	25,427	2,359	88	58,244	318,780	203,900	608,798
Alaska	.....	.....	.....	527	.....	.....	527
Totals	325,836	16,174	844	133,489	585,574	447,760	1,509,677

19,226 cases of bluebacks are combined with cohoes in this table.

72 cases of sockeye caught in State of Washington waters are shown in the Fraser River pack.

STATEMENT SHOWING THE SALMON-PACK OF THE PROVINCE, BY DISTRICTS AND SPECIES, FROM 1922 TO 1937, INCLUSIVE.

FRASER RIVER.

	1937.	1936.	1935.	1934.	1933.	1932.	1931.	1930.
Sockeyes	100,272	184,854	62,822	139,238	52,465	65,769	40,947	103,692
Springs, Red	3,706	6,675	4,205	5,150	5,579	18,298	9,740	11,366
Springs, White	1,738	8,451	5,196	11,068	.....	10,403	.....	9,761
Chums	20,878	31,565	8,227	104,092	34,391	14,948	251	68,946
Pinks	94,010	.....	111,328	2,199	92,746	385	13,307	30,754
Cohoes	11,244	28,716	24,950	11,392	13,901	16,815	8,165	25,585
Bluebacks and Steelheads	.....	.....	.....	.....	.....	23	657	27,879
Totals	231,848	260,261	216,728	273,139	199,082	126,641	73,067	277,983

	1929.	1928.	1927.	1926.	1925.	1924.	1923.	1922.
Sockeyes	61,569	29,299	61,393	85,689	35,385	39,743	31,655	51,832
Springs, Red	3,305	1,173	7,925	12,783	7,989	2,982	3,854	10,561
Springs, White	6,699	3,909	10,528	20,169	25,701	4,648	4,279	6,300
Chums	144,159	193,106	67,259	88,495	66,111	109,495	103,248	17,895
Pinks	158,208	2,881	102,536	32,256	99,800	31,968	63,645	29,578
Cohoes	40,520	27,061	24,079	21,783	36,717	21,401	20,173	23,587
Bluebacks and Steelheads	12,013	795	10,658	13,776	5,152	1,822	15	817
Totals	426,473	258,224	284,378	274,951	276,855	212,059	226,869	140,570

STATEMENT SHOWING THE SALMON-PACK OF THE PROVINCE, BY DISTRICTS AND SPECIES, FROM 1922 TO 1937, INCLUSIVE—*Contd.*

Skeena River.

	1937.	1936.	1935.	1934.	1933.	1932.	1931.	1930.
Sockeyes	42,491	81,973	52,879	70,655	30,506	59,916	93,023	132,372
Springs	4,401	4,551½	4,039	8,300	3,297	28,269	9,857	7,501
Chums	10,811	15,297½	8,122	24,388	15,714	38,549	3,893	5,187
Pinks	59,400	91,389	81,868	126,163	95,783	58,261	44,807	275,642
Cohoes	15,514	25,390	23,498	54,456	39,896	48,312	10,637	29,617
Steelhead Trout	21	33	14	114	267	404	768	58
Totals	132,638	218,634	170,420	284,096	185,463	233,711	162,986	450,377

	1929.	1928.	1927.	1926.	1925.	1924.	1923.	1922.
Sockeyes	78,017	34,559	83,996	82,360	81,146	144,747	131,731	96,277
Springs	4,324	6,420	19,038	30,594	23,445	12,028	12,247	14,176
Chums	4,908	17,716	19,006	63,527	74,308	25,588	16,527	39,758
Pinks	95,305	209,579	38,768	210,081	130,079	181,313	145,973	301,655
Cohoes	37,678	30,194	26,326	30,208	39,168	26,968	31,967	24,699
Steelhead Trout	13	241	582	754	713	214	418	1,050
Totals	220,245	298,709	187,716	407,524	348,859	390,858	338,863	477,915

Rivers Inlet.

	1937.	1936.	1935.	1934.	1933.	1932.	1931.	1930.
Sockeyes	84,832	46,351	135,038	76,923	83,507	69,732	76,428	119,170
Springs	917	581½	429	436	449	459	325	434
Chums	9,415	11,505	7,136	895	677	944	429	492
Pinks	7,536	6,432½	4,554	2,815	5,059	3,483	5,089	18,023
Cohoes	6,012	7,122½	8,375	4,852	3,446	7,062	6,571	756
Steelhead Trout	70	19	39	79	82	29	32	105
Totals	108,782	72,011½	155,571	86,000	93,220	81,709	88,874	138,980

	1929.	1928.	1927.	1926.	1925.	1924.	1923.	1922.
Sockeyes	70,260	60,044	65,269	65,581	192,323*	94,891	116,850	53,584
Springs	342	468	608	685	496	545	599	323
Chums	989	3,594	1,122	11,727	11,510	4,924	3,242	311
Pinks	2,386	16,546	671	12,815	8,625	15,105	10,057	24,292
Cohoes	1,120	868	2,094	7,286	4,946	1,980	1,526	1,120
Steelhead Trout	29	7	9	11	----------	----------	----------	82
Totals	75,126	81,527	69,773	98,105	217,900	117,445	132,274	79,712

* 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 1922 TO 1937, INCLUSIVE—*Contd.*

Smith Inlet, 1926–37.*

	1937.	1936.	1935.	1934.	1933.	1932.
Sockeyes	25,258	12,788	31,648	14,607	37,369	25,488
Springs, Red	21	2	214	164	354	46
Springs, White	.....	28	2	.....	.....	2
Cohoes	241	310	1,201	3,941	5,068	273
Pinks	483	65	4,412	6,953	19,995	1,148
Chums	9,494	1,653	12,427	15,548	8,841	165
Bluebacks and Steelheads	5	42	24	43	87	20
Totals	35,502	14,888	49,928	41,256	71,714	27,142

	1931.	1930.	1929.	1928.	1927.	1926.
Sockeyes	12,867	32,057	9,683	33,442	22,682	17,921
Springs, Red	122	268	18	108	270	73
Springs, White	.....	22	60	178	79	39
Cohoes	112	1,460	275	230	2,990	164
Pinks	824	16,615	853	167	732	689
Chums	133	1,660	113	19	2,605	31
Bluebacks and Steelheads	36	103	12	6	8	.....
Totals	14,094	52,185	11,014	34,150	29,366	18,917

* Previously reported in Queen Charlotte and other Districts.

Nass River.

	1937.	1936.	1935.	1934.	1933.	1932.	1931.	1930.
Sockeyes	17,567	28,562½	12,712	28,701	9,757	14,154	16,929	26,405
Springs	1,251	2,167	560	654	1,296	4,408	1,439	1,891
Chums	10,080	20,620½	17,481	2,648	1,775	14,515	392	3,978
Pinks	8,031	75,887½	25,508	32,964	44,306	44,629	5,178	79,976
Cohoes	12,067	11,842	21,810	9,935	3,251	7,955	8,943	1,126
Steelhead Trout	46	496	143	311	49	10	.....	84
Totals	49,042	139,575½	78,214	75,213	60,434	85,671	32,881	113,460

	1929.	1928.	1927.	1926.	1925.	1924.	1923.	1922.
Sockeyes	16,077	5,540	12,026	15,929	18,945	33,590	17,821	31,277
Springs	352	1,846	3,824	5,964	3,757	2,725	3,314	2,062
Chums	1,212	3,538	3,307	15,392	22,504	26,612	25,791	11,277
Pinks	10,342	83,183	16,609	50,815	35,530	72,496	44,165	75,687
Cohoes	1,202	10,734	3,966	4,274	8,027	6,481	7,894	3,533
Steelhead Trout	.....	36	96	375	245	1,035	595	235
Totals	29,185	104,877	39,828	92,749	89,008	142,939	99,580	124,071

STATEMENT SHOWING THE SALMON-PACK OF THE PROVINCE, BY DISTRICTS AND SPECIES, FROM 1922 TO 1937, INCLUSIVE—*Contd.*

VANCOUVER ISLAND DISTRICT, 1927–37.

	1937.	1936.	1935.	1934.	1933.	1932.
Sockeyes	25,427	32,696½	22,928	27,282	18,397	27,611
Springs	2,359	6,340	6,525	1,630	4,875	10,559
Chums	203,900	347,951	143,960	210,239	96,642	70,629
Pinks	318,780	82,028½	191,627	54,526	172,945	33,403
Cohoes	52,244	90,625	104,366	78,670	60,019	35,132
Steelheads and Bluebacks	88	105	21	.....	147	28,596
Totals	608,798	559,746	469,427	372,347	353,025	205,930

	1931.	1930.	1929.	1928.	1927.
Sockeyes	22,199	24,784	10,340	14,248	24,835
Springs	4,055	3,431	1,645	2,269	6,769
Chums	16,329	177,856	162,246	303,474	220,270
Pinks	81,965	89,941	74,001	41,885	52,561
Cohoes	26,310	30,206	35,504	23,345	58,834
Steelheads and Bluebacks	24,638	14,177	11,118	5,249	10,194
Totals	175,541	340,395	294,854	390,470	373,463

QUEEN CHARLOTTE AND CENTRAL AREA.

	1937.	1936.	1935.	1934.	1933.	1932.	1931.	1930.
Sockeyes	31,987	27,584	32,417	20,438	26,106	21,685	29,071	39,198
Springs	1,781	1,057	750	2,374	4,416	3,514	1,608	1,852
Chums	183,182	168,896	212,251	155,371	135,590	167,011	34,570	143,781
Pinks	97,334	335,733	95,669	210,734	101,701	82,449	55,825	600,986
Cohoes	29,640	65,744	47,292	62,165	33,471	44,977	16,141	61,418
Steelheads	614	373	355	733	827	591	466	1,204
Totals	342,540	599,387	388,734	451,815	302,111	320,227	137,661	848,439

	1929.	1928.	1927.	1926.	1925.	1924.	1923.	1922.
Sockeyes	35,331	59,852	60,533	62,383*	49,962	40,926	24,584	47,107
Springs	1,020	2,806	7,826	3,650	5,002	4,245	2,711	4,988
Chums	111,263	341,802	252,230	348,682	305,256	195,357	148,727	80,485
Pinks	136,758	438,298	36,481	380,243	120,747	141,878	146,943	113,824
Cohoes	56,938	58,455	47,433	47,183	40,269	26,031	29,142	31,331
Steelheads	575	609	973	973	1,520	497	732	409
Totals	341,873	901,822	405,476	844,114	522,756	408,934	352,839	278,144

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

STATEMENT SHOWING THE SALMON-PACK OF THE PROVINCE, BY DISTRICTS AND SPECIES, FROM 1922 TO 1937, INCLUSIVE—*Contd.*

TOTAL PACKED BY DISTRICTS IN 1922 TO 1937, INCLUSIVE.

	1937.	1936.	1935.	1934.	1933.	1932.	1931.	1930.
Fraser	231,848	260,261	216,728	273,139	199,082	126,641	73,067	277,983
Skeena	133,165	218,634	170,420	284,096	185,463	233,711	162,986	450,377
Rivers Inlet	108,782	72,011½	155,571	86,000	93,220	81,709	88,874	138,980
Smith Inlet	35,502	14,888	49,928	41,256	71,714	27,142	14,094	52,185
Nass River	49,042	139,575½	78,214	75,213	60,434	85,671	32,881	113,460
Vancouver Island	608,798	559,746½	469,427	372,347	353,025	205,930	175,541	340,395
Other Districts	342,350	599,387	388,734	451,815	302,111	320,227	137,661	848,439
Grand totals	1,509,677†	1,864,503½	1,529,022	1,583,866	1,265,049	1,081,031	685,104	2,221,819

	1929.	1928.	1927.	1926.	1925.	1924.	1923.	1922.
Fraser	426,473	258,224	284,378	274,951	276,855	212,059	226,869	140,570
Skeena	220,245	298,709	187,716	407,524	348,859	390,858	338,863	477,915
Rivers Inlet	75,126	81,527	69,773	98,105	217,900	117,445	132,274	79,712
Smith Inlet	11,014	34,150	29,366	18,917	33,998	11,776	11,979	5,862
Nass River	29,185	104,877	39,828	92,749	89,008	142,939	99,580	124,071
Vancouver Island	294,854	390,470	373,463	347,722	263,904	277,267	191,252	185,524
Other Districts	341,873	901,822	405,476	844,139*	522,756	604,745	352,839	278,144
Grand totals	1,398,770	2,035,629	1,360,634	2,065,190	1,719,282	1,745,213	1,341,677	1,285,946

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

† Including 527 cases of Alaska cohoe packed at Skeena River.

STATEMENT SHOWING THE SOCKEYE-PACK OF THE ENTIRE FRASER RIVER SYSTEM FROM 1894 TO 1937, INCLUSIVE.

	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Fraser River, B.C.	363,967	395,984	356,984	860,459	240,000	486,409	170,889	974,911	293,477
State of Washington	41,781	65,143	72,979	312,048	252,000	499,646	228,704	1,105,096	339,556
Totals	405,748	461,127	429,963	1,172,507	492,000	986,055	399,593	2,080,007	633,033

	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.
Fraser River, B.C.	204,809	72,688	837,489	183,007	59,815	74,574	585,435	150,432	58,487
State of Washington	167,211	123,419	837,122	182,241	96,974	170,951	1,097,904	248,014	127,761
Totals	372,020	196,107	1,674,611	365,248	156,789	245,525	1,683,339	398,446	186,248

	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1920.
Fraser River, B.C.	123,879	719,796	198,183	91,130	32,146	148,164	19,697	38,854	48,399
State of Washington	184,680	1,673,099	335,230	64,584	84,637	411,538	50,723	64,364	62,654
Totals	308,559	2,392,895	533,413	155,714	116,783	559,702	70,420	103,200	111,053

	1921.	1922.	1923.	1924.	1925.	1926.	1927.	1928.	1929.
Fraser River, B.C.	39,631	51,832	31,655	39,743	35,385	85,689	61,393	29,299	61,569
State of Washington	102,967	48,566	47,402	69,369	112,023	44,673	97,594	61,044	111,898
Totals	142,598	100,398	79,057	109,112	147,408	130,362	158,987	90,343	173,464

	1930.	1931.	1932.	1933.	1934.	1935.	1936.	1937.	
Fraser River, B.C.	103,692	40,947	65,769	52,465	139,238	62,822	184,854	100,272	.....
State of Washington	352,194	87,211	81,188	126,604	352,579	54,677	59,505	60,259	.....
Totals	455,886	128,158	146,957	179,069	491,817	117,499	244,359	160,531	.....

STATEMENT SHOWING THE SOCKEYE-PACK OF THE PROVINCE, BY DISTRICTS, 1922 TO 1937, INCLUSIVE.

	1937.	1936.	1935.	1934.	1933.	1932.	1931.	1930.
Fraser River	100,272	183,120	62,822	139,238	52,465	65,769	40,947	103,692
Skeena River	42,491	81,973	52,879	70,655	30,506	59,916	93,023	132,372
Rivers Inlet	84,832	46,351	135,038	76,923	83,507	69,732	76,428	119,170
Smith Inlet	25,258	12,788	31,648	14,607	37,369	25,488	12,867	32,057
Nass River	17,567	28,562½	12,712	28,701	9,757	14,154	16,929	26,405
Vancouver Island	25,427	34,430½	22,928	27,282	18,397	27,611	22,199	24,784
Other Districts	29,989	27,584	32,417	20,438	26,106	21,685	29,071	39,198
Totals	325,836	414,809	350,444	377,844	258,107	284,355	291,464	477,678

	1929.	1928.	1927.	1926.	1925.	1924.	1923.	1922.
Fraser River	61,569	29,299	61,393	85,689	35,385	39,743	31,655	51,832
Skeena River	78,017	34,559	83,996	82,360	81,146	144,747	131,731	96,277
Rivers Inlet	70,260	60,044	65,269	65,581	192,323	94,891	116,850	53,584
Smith Inlet	9,683	33,442	22,682	17,921	33,764	11,435	11,864	.....
Nass River	16,077	5,540	12,026	15,929	18,945	33,590	17,821	31,277
Vancouver Island	10,340	14,248	24,835	25,070	14,757	15,618	12,006	15,147
Other Districts	35,331	26,410	37,851	44,462	16,198	20,579	12,720	47,107
Totals	281,277	203,542	308,052	337,012	392,518	369,603	334,647	295,224

216 cases of Alaska sockeye packed in British Columbia canneries are not shown in the above table for the year 1936.

STATEMENT SHOWING THE PILCHARD INDUSTRY OF THE PROVINCE, 1920 TO 1936, INCLUSIVE.

Year.	Total Catch.	Canned.	Used in Reduction.	Oil.	Meal.	Bait.
	Cwt.	Cases.	Cwt.	Gals.	Tons.	Bbls.
1920	88,050	91,929	.....	.....	.....	9,937
1921	19,737	16,091	.....	.....	.....	4,232
1922	20,342	19,186	.....	.....	.....	3,125
1923	19,492	17,195	.....	.....	.....	3,625
1924	27,485	14,898	.....	.....	.....	923
1925	318,973	37,182	220,000	495,653	2,083	4,045
1926	969,958	26,731	940,000	1,898,721	8,481	2,950
1927	1,368,582	58,501	1,310,000	2,610,120	12,145	1,737
1928	1,610,252	65,097	1,560,000	3,997,656	14,502	2,149
1929	1,726,851	98,821	1,654,575	2,856,579	15,826	1,538
1930	1,501,404	55,166	1,438,840	3,204,058	13,934	926
1931	1,472,085	17,336	1,456,846	2,551,914	14,200	1,552
1932	886,964	4,622	876,700	1,315,864	8,842	1,603
1933	120,999	2,946	119,545	275,879	1,108	20
1934	860,103	35,437	845,849	1,635,123	7,628	40
1935	911,411	27,184	896,586	1,634,592	8,666	521
1936	889,037	35,007	863,373	1,217,097	8,715	580

PRODUCTION OF FISH OIL AND MEAL, 1920 TO 1937 (OTHER THAN FROM PILCHARD).

Year.	From Whales.			From other Sources.	
	Whalebone and Meal.	Fertilizer.	Oil.	Meal and Fertilizer.	Oil.
	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	347	835	556,939	2,468	354,853
1926	340	666	468,203	1,752	217,150
1927	345	651	437,967	1,948	250,811
1928	376	754	571,914	3,205	387,276
1929	417	780	712,597	3,626	459,575
1930	273	581	525,533	3,335	243,009
1931	.....	.....	.....	5,647	352,492
1932	.....	.....	.....	6,608	231,690
1933	249	223	509,310	5,583	497,643
1934	340	631	813,724	5,028	441,735
1935	211	354	426,772	7,509	588,629
1936	332	687	763,740	13,197	1,143,206
1937	268	527	662,355	.....	.....

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