PROVINCE OF BRITISH COLUMBIA

REPORT

OF THE

PROVINCIAL FISHERIES DEPARTMENT

FOR THE YEAR ENDED DECEMBER 31ST, 1940

WITH APPENDICES

PRINTED BY
AUTHORITY OF THE LEGISLATIVE ASSEMBLY.

VICTORIA, B.C.:
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1941.

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, 1940, with Appendices.

GEORGE SHARRATT 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, 1940, together with Appendices.

I have the honour to be,

Sir,

Your obedient servant,

GEO. J. ALEXANDER,
Assistant Commissioner.

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REPORT OF THE PROVINCIAL FISHERIES DEPARTMENT FOR 1940.

VALUE OF CANADIAN FISHERIES AND THE STANDING OF THE PROVINCES, 1939.

The value of the fisheries products of Canada for the year 1939 totalled $40,072,976. During that year British Columbia produced fisheries products to the value of $17,698,980, or 44 per cent. of Canada's total.

British Columbia in 1939 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 $8,945,432.

The market value of the fisheries products of British Columbia in 1939 was $973,770 less than in the previous year. There was a decrease in the value of salmon amounting to $1,496,473.

The capital invested in the fisheries of British Columbia in 1939 was $22,477,626, or 56 per cent. of the total capital employed in fisheries in all of Canada. Of the total invested in the fisheries of British Columbia in 1939, $8,154,350 was employed in catching and handling the catches and $14,323,276 invested in canneries, fish-packing establishments, and fish-reduction plants.

The number of persons engaged in British Columbia fisheries in 1939 was 15,880, or 19 per cent. of Canada's total fishery-workers. Of those engaged in British Columbia, 9,609 were employed in catching and handling the catches and 6,271 in packing, curing, and in fish-reduction plants. The total number engaged in the fisheries in British Columbia in 1939 was 537 less 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 1935 to 1939, inclusive:—

Province.	1935.	1936.	1937.	1938.	1939.
British Columbia	$15,169,529	$17,231,534	$16,155,439	$18,672,750	$17,698,980
Nova Scotia	7,852,899	8,905,268	9,229,834	8,804,231	8,753,548
New Brunswick	3,949,615	4,399,735	4,447,688	3,996,064	5,082,393
Ontario	2,852,007	3,209,422	3,615,666	3,353,775	3,007,315
Quebec	1,947,259	2,108,404	1,892,036	1,957,279	2,010,953
Manitoba	1,258,335	1,667,371	1,796,012	1,811,124	1,655,273
Prince Edward Island	899,685	953,029	870,299	930,874	950,412
Saskatchewan	252,059	367,025	527,199	468,646	478,511
Alberta	225,741	309,882	433,354	492,943	430,724
Yukon	20,725	13,385	8,767	5,290	4,867
Totals	$34,427,854	$39,165,055	$38,976,294	$40,492,976	$40,072,976

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 1935 to 1939, inclusive, is given in the following table:—

Species.	1935.	1936.	1937.	1938.	1939.
Salmon	$12,099,275	$13,387,344	$11,907,905	$14,491,285	$12,994,812
Halibut	860,349	943,568	1,094,214	1,041,165	1,305,542
Halibut-livers	80,513	96,311	95,842	231,220	193,148
Herring	580,031	1,142,397	1,181,466	855,265	2,198,912
Pilchard	670,328	667,313	902,619	867,007	100,693
Cod, ling	382,490	418,142	318,769	351,324	357,990
Clams	61,886	88,422	95,371	162,508	50,937
Black cod	65,862	53,497	95,251	71,297	79,419
Carried forward	$14,800,734	$16,796,994	$15,691,437	$18,071,071	$17,281,453

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

Species.	1935.	1936.	1937.	1938.	1939.
Brought forward	$14,800,734	$16,796,994	$15,691,437	$18,071,071	$17,281,453
Crabs	44,525	38,855	52,188	54,572	61,633
Soles	30,808	37,019	33,201	37,679	39,826
Shrimps	25,492	9,827	15,430	18,985	12,246
Oysters	41,609	59,687	36,199	37,453	59,976
Abalones	.....	34	477	.....	1,340
Flounders	3,773	3,332	2,339	6,767	5,934
Red cod	10,409	13,875	7,990	22,286	10,693
Perch	5,054	7,633	3,722	3,942	3,752
Smelt	9,578	7,621	3,523	6,884	4,388
Sturgeon	6,936	2,053	1,386	3,013	2,459
Octopus	1,094	982	923	1,016	441
Skate	3,363	3,233	2,438	2,467	3,026
Oolachans	1,110	803	337	760	1,792
Whiting	170	69	50	62	32
Trout	.....	.....	.....	.....	.....
Grayfish, etc.—					
Fresh	.....	68	1,274	2,310	.....
Oil	23,744	34,745	38,776	68,073	44,072
Meal	22,924	34,906	26,740	42,807	36,322
Whales	105,360	172,201	220,251	184,074	.....
Fur-seals	1,671	5,664	12,431	3,076	1,465
Miscellaneous	31,175	1,933	4,327	105,453	77,515
Anchovies	.....	.....	.....	.....	10,417
Tuna	.....	.....	.....	.....	40,198
Totals	$15,169,529	$17,231,534	$16,155,439	$18,672,750	$17,698,980

VALUE OF BRITISH COLUMBIA'S FISHERIES SHOWS AN INCREASE IN 1940.*

The value of the fisheries production of British Columbia in 1940 records an advance of $4,000,000 over the value shown in the preceding year. The totals for the two years are: 1940, $21,710,167 and 1939, $17,698,989. The 1940 value is the highest shown for any year since 1930. The salmon-fishery of British Columbia, which is the most important fishery in the Dominion, had a production value of $13,757,091, an increase over the preceding year of $762,279 or 6 per cent. The canned salmon was valued at $11,427,923, and the salmon marketed for consumption fresh at $2,056,020. Herring, second on the list of British Columbia's chief commercial fishes, had a value of $4,426,390, an increase of $2,227,478 or 101 per cent.; canned herring and oil and meal are the principal products of this fishery. Third on the list is halibut, with a value of $1,570,998; the greater part of the catch of halibut is marketed for consumption fresh.

The total quantity of fish of all kinds, including shell-fish, taken by British Columbia fishermen during the year was 5,906,896 cwt., with a value at the point of landing of $9,067,279, compared with 4,172,224 cwt. and a landed value of $7,890,854 in 1939. The increase in the total catch is due chiefly to the larger amount of herring taken.

CAPITAL, EQUIPMENT, AND EMPLOYEES.

Capital.—The amount of capital invested in the fisheries of British Columbia in 1940 was $24,661,022, apportioned as follows: In the vessels, boats, nets, piers, and wharves, etc., used in the primary operations of catching and landing the fish, $9,182,425; and in fish canning and curing, $15,478,597. The total value in the preceding year was $22,480,127, of which $8,156,851 is credited to the primary operations and $14,323,276 to the fish canning and curing.

Employees.—The number of fishermen employed during the fishing season was 10,444 and the number of persons engaged in work in the fish-processing plants, 7,449, or a total of 17,893 compared with a total of 15,880 in 1939.

* 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 FOR 1940.

The total pack of all species of salmon canned in British Columbia in 1940 amounted to 1,467,216 cases. This was 71,847 cases less than in 1939 and was also 150,435 cases less than the five-year average, 1936–40. The pack in 1940 was the smallest since 1933 when 1,265,049 cases were canned, but was 43,984 cases greater than the average annual pack of all varieties for the previous ten years. In this ten-year average, however, the year 1931 is included, in which year, due to the depression, the industry curtailed its operations to such an extent that only 685,104 cases of salmon were canned. If the pack for 1931 is excluded, the total pack of all varieties of salmon canned in British Columbia in 1940 was 38,031 cases less than the average for the past nine years.

In 1940 the canned-salmon pack consisted of 366,402 cases of sockeye, 17,740 cases of springs, 1,207 cases of steelheads, 224,522* cases of cohoes, 213,904 cases of pinks, and 643,441 cases of chums.

Examination of these pack figures by species shows that the total sockeye-pack for 1940, amounting to 366,402 cases, was 96,515 cases greater than in 1939 and, for the year in question, was 28,321 cases above the ten-year average annual pack of this species.

The spring-salmon pack in 1940, amounting to 17,740 cases, was 1,642 cases higher than in the previous year but was 9,306 cases below the average for the previous ten-year period. In considering the figures for this species it should be pointed out that the figures are not truly indicative of the quantity available in any given year, as the amount canned is conditioned by the requirements of the fresh, frozen, and mild-cure trade.

While steelhead trout are not salmon, nevertheless a few are caught incidental to salmon-fishing and these are canned; therefore, the figures are given here. In 1940 there were canned 1,207 cases of steelheads, compared with 796 cases of this species in 1939 and 1,036 cases in 1938.

The 1940 pack of canned-cohoe salmon, amounting to 224,522 cases, was 20,575 cases less than were packed in 1939 and 2,266 cases less than the five-year average annual pack of this species. The five-year average, however, includes 1938, in which year the record pack of 301,081 cases was made. If a ten-year average is taken the pack is found to be 20,410 cases above the average for this species. As pointed out in the foot-note, the figures given for the 1940 cohoe-pack include 23,277 cases of bluebacks and 20,489 cases of cohoe imported from Alaska.

The pack of pink salmon in British Columbia in 1940 was most disappointing in that the 213,904 cases canned represents the smallest pack of this species of salmon canned in British Columbia in comparatively recent years. It is compared with 620,595 cases canned in the previous year, and is 268,593 cases less than the pack for the previous five years and 218,805 cases less than the average annual pack for the previous ten years. In other words, the pink-pack in 1940 amounted to less than half the average pack for this species for the years 1931 to 1940, inclusive. The reader is referred to the next section for a closer analysis of these figures.

The canned pack of chum salmon, amounting to 643,441 cases, was the largest pack of canned chums put up in British Columbia in comparatively recent years. This figure is compared with 386,590 cases packed in 1939 and with 523,419 cases, the previous five-year average, and is 223,814 cases greater than the average for the previous ten years.

BRITISH COLUMBIA'S CANNED-SALMON PACK BY DISTRICTS.

Fraser River System.

Sockeye Salmon.—The total pack of sockeye salmon on the Fraser River in 1940 amounted to 158,363 cases. Of this amount 99,009 cases were canned in British Columbia and 59,354 cases were canned in the State of Washington. The percentages are 62½ and 37½ respectively. It will be noted that the Canadian fishermen again caught the greater portion of the

* Note.—Included in this figure are 23,277 cases of bluebacks and 20,489 cases of cohoes imported from Alaska.

Fraser River sockeye. The percentages for the past twelve years are tabulated below for convenience.

	American. Per Cent.	Canadian. Per Cent.
1929	64.0	36.0
1930	78.0	22.0
1931	68.0	32.0
1932	55.0	45.0
1933	71.0	29.0
1934	72.0	28.0
1935	47.0	53.0
1936	25.0	75.0
1937	38.0	62.0
1938	42.0	58.0
1939	44.5	55.5
1940	37.5	62.5

The Canadian pack of Fraser River sockeye in 1940, amounting to 99,009 cases, was 85,845 cases below the pack produced in British Columbia in the cycle-year 1936, but was 33,240 cases greater than the corresponding pack in the cycle-year 1932. The total pack of Fraser River sockeye, Canadian and American, in 1940, however, was 85,996 cases below the total canned in 1936, the cycle-year, but was 11,406 cases greater than in the cycle-year 1932. The total Fraser River pack in 1940 was also 8,536 cases greater than the average for the five cycle-years 1924, 1928, 1932, 1936, and 1940.

When considering the production figures for a river system, the pack figures must be considered in conjunction with the escapement to the spawning-beds. In the Appendix to this report there is published " Spawning Report, British Columbia, 1940," which is furnished by Major J. A. Motherwell, Chief Supervisor of Fisheries for British Columbia for the Federal Department of Fisheries. The reader is referred to this report for a detailed description of the conditions obtaining on the various spawning-beds. Generally speaking, it would appear that the principal spawning-beds of the Fraser River system were satisfactorily taken care of, while an improvement is noted in the numbers spawning in the Prince George area and a satisfactory increase is credited to the number of spawners frequenting the Quesnel-Bowron River area. An outstanding feature of the sockeye run to the Fraser River system in 1940 was the excellent showing on the Chilko River spawning-beds. It was estimated that in the cycle-year 1936 some 74,000 sockeye spawned in this system, while in 1940 it is estimated that close to 350,000 sockeye spawned in this area. In the Pemberton area a decrease in the number of spawners is noted, as is also the case in the Anderson-Seton Lake system. A normal seeding was observed in the Hope area while, generally speaking, the spawning on the lower reaches of the Fraser River watershed were reasonably satisfactory.

Spring Salmon.—There were 4,504 cases of spring salmon packed by Canadian canners on the Fraser River in 1940, compared with 5,993 cases in 1939 and 4,308 cases in 1938. The 1940 pack was 2,573 cases less than the average pack for this variety in the previous five years. In the case of springs, however, the canned-salmon pack figures are not necessarily an indication of the size of the run, as spring salmon find an outlet in many other markets. Generally speaking, the reports from the Fraser River spawning-beds frequented by spring salmon indicate that the run was satisfactory, except in the case of the Harrison Lake area.

Cohoe Salmon.—The cohoe-salmon pack on the Fraser River amounted to 13,028 cases, which figure is 1,784 cases greater than was the pack in the cycle-year 1937. The pack in 1940, however, was 1,150 cases less than the average for the previous five cycle-years and was 5,706 cases below the average annual pack of this species for the previous five years. In connection with the escapement of this variety to the spawning-grounds, it would appear that the number of cohoes reaching the spawning-beds was unsatisfactory.

Pink Salmon.—There was no run of pink salmon to the Fraser River in 1940. This species frequents the Fraser River only in the odd-numbered years.

Chum Salmon.—There were canned on the Fraser River in 1940, 35,665 cases of chum salmon. This was 5,515 cases greater than the pack for the year previous and 4,100 cases greater than in the cycle-year 1936. The pack of chums on the Fraser River for the year in question exceeds the five-year average annual pack for this species by 258 cases.

In comparing the chum-salmon pack on the Fraser River for 1940 with those packs of previous years, the figures alone do not tell a complete story. Heretofore, considerable numbers of chum salmon have found an outlet in the dry-salt trade. No salting took place in 1939 and 1940. Consideration must also be given to the fact that, owing to the war and the demand thus created for cheap canned food, the salmon-canners expended every effort to put up as large a pack of chum salmon as possible. The quantity of chum salmon frozen in 1940 was as great, if not greater, than is usual for this variety. When these circumstances are considered the pack of canned chums in 1940 does not appear as favourable as at first sight. In most cases the spawning-beds are considered to be reasonably well seeded by this variety, although in some cases the seeding is reported to be only fair.

Skeena River.

The total pack of all varieties of salmon canned on the Skeena River in 1940 amounted to 195,355 cases, which was 10,249 cases less than the total pack for this river in the year previous. The 1940 pack was composed of 116,507 cases of sockeye, 6,118 cases of springs, 133 cases of steelheads, 20,614 cases of cohoe, 47,301 cases of pinks, and 4,682 cases of chums.

Sockeye Salmon.—The Skeena River sockeye-salmon pack in 1940, amounting to 116,507 cases, is compared with 68,485 cases in 1939 and was 45,164 cases greater than the average pack for the previous five-year period. This was also the largest pack for the four-year cycle since 1924, when 144,747 cases were canned. This river system in recent years has been passing through a period of comparatively low production of sockeye. The increase in the size of the pack in 1939 was noted in this Department's report. It is encouraging to note a continued increase in 1940. This, taken in conjunction with encouraging reports from the spawning-grounds, would seem to indicate that the measures taken a few years ago by the Federal Department of Fisheries are producing the desired effect.

Spring Salmon.—Spring salmon are canned on the Skeena River only incidental to the canning of other varieties. In 1940 there were 6,118 cases of this variety canned, compared with 4,857 cases in 1939, 4,318 cases in 1938, and 4,401 cases in 1937. As in other districts, the pack of spring salmon on the Skeena River is not indicative of the run.

Cohoe Salmon.—There were 20,614 cases of cohoe canned on the Skeena River in 1940. This was 8,584 cases less than were packed in 1939 and 8,093 cases below the average for the previous five-year period. In addition to the 20,614 cases of cohoe canned on the Skeena River from Skeena River fish in 1940, there were also canned in Skeena River canneries 19,360 cases of this variety which were imported from Alaska. The escapement of cohoe to the spawning-beds was reported as light.

Pink Salmon.—The pack of pink salmon on the Skeena River in 1940, amounting to 47,301 cases, was the smallest pack of this species since 1931, when the pack amounted to 44,807 cases. It will be remembered, however, that in 1931 the small pack was probably caused by curtailment of operations due to economic conditions prevailing at that time. The 1940 pack was 22,309 cases less than was packed on this river in 1938, the cycle-year, and was also 31,244 cases less than the average for the previous five cycle-years. Notwithstanding the small pack, reports from the spawning-beds indicate that, in that portion of the river system which is frequented by pink salmon in the even-numbered years, the escapement was "abundant and the seeding better than in the brood-year of 1938."

Chum Salmon.—The Skeena River is not a heavy producer of chum salmon. The pack of 4,682 cases of this variety in 1940, however, was considerably below the quantities of this species usually packed on the Skeena River and was the smallest pack of chums since 1931. The pack is compared with 7,773 cases for 1939, 16,758 cases for 1938, 10,811 cases for 1937, and 15,297 cases in 1936. The escapement was also disappointing.

Nass River.

The total pack of all species of salmon caught on the Nass River in 1940 amounted to 60,441 cases, which was 4,495 cases greater than the amount packed in the year previous, when 55,946 cases of all varieties were caught. The 1940 pack consisted of 13,809 cases of sockeye, 1,716 cases of springs, 117 cases of steelheads, 10,060 cases of cohoe, 29,278 cases of pinks, and 5,461 cases of chums.

Sockeye Salmon.—The pack of sockeye salmon caught on the Nass in 1940, amounting to 13,809 cases, was 10,548 cases less than in 1939 and was also 7,342 cases less than the average

pack for the previous five years. The 1940 pack was the smallest pack of sockeye on the Nass River since 1935. Due to the complicated nature of the age-groups comprising the runs of sockeye to the Nass River system, it is difficult to compare the pack in any given year with the pack of the cycle-year. One cannot help commenting, however, that the 1940 pack was 5,322 cases less than the average for the previous five four-year cycles. Reports from the spawning-areas of the Nass River which were examined indicate that the seeding of the principal spawning-grounds of Meziaden Lake was light to medium, although it is reported considerable quantities escaped the commercial-fishing gear.

Spring Salmon.—The spring-salmon pack on the Nass River is never large and the pack of 1,716 cases in 1940 was no exception, although slightly larger than the two immediately preceding years. The spring-salmon pack on the Nass River simply represents those few spring salmon caught incidental to fishing for other species.

Cohoe Salmon.—There were caught on the Nass River in 1940, 10,060 cases of cohoe salmon. This was 2,007 cases more than the pack of the cycle-year 1937 and 8,064 cases greater than the quantity taken in the year previous and was equal to the average annual pack for the previous five years. A good escapement of cohoe to the spawning-beds was reported for 1940.

Pink Salmon.—The pack of pink salmon on the Nass River in 1940, amounting to 29,278 cases, was disappointing. The packs in the preceding cycle-years were such that a very much larger pack was expected in 1940. The 1938 pack of 61,477 cases was 32,199 cases or more than twice the pack of 1940, while in the cycle-year 1936 the pack of pinks amounted to 75,887 cases. The 1940 pink-salmon pack on the Nass River was 29,278 cases, or less than half the average pack for the previous five cycle-years. While reports from certain parts of the spawning-grounds indicate that the seeding was good, in other areas the seeding was reported as being light. Altogether, the pink-salmon run to the Nass River in 1940 cannot be considered as satisfactory.

Chum Salmon.—The Nass River is not a large chum-salmon producer, although the 5,461 cases of this species packed in 1940 was definitely below what might be reasonably expected. The average annual pack for the previous five years amounted to 10,914 cases. In connection with this species, seeding was reported as light.

Rivers Inlet.

In 1940 there were caught in Rivers Inlet a total of 88,665 cases of all species of salmon. This total pack was composed of 63,469 cases of sockeye, 1,226 cases of springs, 55 cases of steelheads, 11,561 cases of cohoe, 3,329 cases of pinks, and 9,025 cases of chums.

Sockeye Salmon.—The sockeye-salmon run to Rivers Inlet in 1940, which produced a pack of 63,469 cases, may be considered by some as unsatisfactory, due to the small pack and heavy escapement in 1936, the four-year cycle-year. It will be recalled that a strike of fishermen in 1936 extensively curtailed fishing in this inlet, which permitted a heavy escapement. In the same year, however, a heavy freshet, the heaviest in many years, occurred and there can be little doubt now that a part of the spawning of 1936 was destroyed. The 1940 pack of 63,469 cases is compared with the packs in the previous four four-year cycles: 1936, 46,351 cases; 1932, 69,732 cases; 1928, 60,044 cases; and 1924, 94,891 cases. While the commercial catch was probably smaller than anticipated, nevertheless the escapement was reported to have been excellent. Although the seeding was probably not as heavy as in 1936, it was reported as decidedly satisfactory.

Spring Salmon.—Spring salmon are never packed in large numbers in Rivers Inlet, the catch being entirely incidental to fishing for other varieties. The pack in 1940, amounting to 1,226 cases, is compared with 745 cases in 1939, 1,209 cases in 1938, and 917 cases in 1937.

Cohoe Salmon.—The pack of cohoes on Rivers Inlet in 1940, amounting to 11,561 cases, was considerably above the average for this variety and 5,549 cases greater than the pack of cohoes in Rivers Inlet in the cycle-year 1937. The escapement of this variety to the spawning-beds was considered only fairly satisfactory.

Pink Salmon.—Pink salmon are never a large factor in the total Rivers Inlet pack, but are canned each year in varying amounts. In 1939 the pack of pinks in Rivers Inlet was considerably below the packs of recent past years and was the lowest since 1934. The 1940 pack is compared with 9,063 cases in 1938, the cycle-year, and 6,432 cases in 1936. The 1940

pack is also compared with 7,691 cases, the average for the previous five-year period. The remarks in respect to the escapement of cohoes in the above paragraph also apply to pinks and chums.

Chum Salmon.—The pack of chums in 1940, amounting to 9,025 cases, was slightly less than four years ago when 11,505 cases of this species were packed. The 1940 figure is compared with 5,462 cases of chums in 1939, 7,759 cases in 1938, and 9,415 cases in 1937.

Smith Inlet.

Smith Inlet, like the adjacent Rivers Inlet, is primarily a sockeye area and, while some seining is done in this inlet for fall fish, the bulk of the pack is caught and canned during the sockeye-fishing season. In 1940 the total pack of all varieties caught in Smith Inlet amounted to 33,998 cases, made up as follows: Sockeye, 25,947 cases; springs, 142 cases; cohoes, 1,102 cases; pinks, 755 cases; chums, 6,015 cases; steelheads, 37 cases.

Sockeye Salmon.—The sockeye-salmon pack in 1940, consisting of 25,947 cases, was considerably in excess of the pack in the four-year cycle, 1936, but was less than the five-year cycle pack of 1935, the packs for these two years being 12,788 cases and 31,648 cases respectively. The 1940 pack also exceeded the pack of 1939 by 8,114 cases and was 2,803 cases greater than the average for the previous five-year period. A perusal of the report on the spawning-grounds indicates that this inlet, like the spawning-grounds of Rivers Inlet, was exceptionally well seeded and it was also noted that the fish were extra large.

Spring Salmon.—Spring salmon are not specifically fished for in Smith Inlet, the catch being incidental to the sockeye-fishery. In 1940, 142 cases were canned. This figure is compared with 215 cases in 1939 and 68 cases in 1938.

Cohoe Salmon.—This species, like spring salmon, are never a large factor in the output of Smith Inlet. The cohoe-pack in 1940, amounting to 1,102 cases, compares with the packs of recent past years as follows: 1939, 3,880 cases; 1938, 1,058 cases; 1937, 241 cases; 1936, 310 cases. The escapement of cohoe salmon to the spawning-beds of Rivers Inlet in 1940 is reported as being disappointing.

Pink Salmon.—There were 755 cases of pink salmon canned in Smith Inlet in 1940, which were caught incidental to the sockeye-fishery. This is less than in 1939 when 3,978 cases were canned and also less than in 1938 when 1,761 cases were canned. As previously stated, while this is not a pink-salmon area, the seeding of the spawning-beds was considered as good.

Chum Salmon.—Some seining for chum salmon is conducted in Smith Inlet in the fall of the year. The pack of 1940, amounting to 6,015 cases, was 3,244 cases greater than 1939, but was 413 cases above the average annual pack of this species for the previous five-year period.

Queen Charlotte Islands.

Salmon-seining in the Queen Charlotte Islands is confined almost exclusively to pink and chum salmon. Other varieties canned in this district are caught incidental to the pink- and chum-salmon fisheries. Chum salmon are fished each year, while spring salmon only put in an appearance in the Queen Charlotte Islands every alternate year, the runs coinciding with the even-numbered years. The total pack of all varieties of salmon canned in the Queen Charlotte Islands in 1940 amounted to 218,852 cases, of which 164,911 cases were chum salmon and 44,966 cases pink salmon. The balance of the pack consisted of 8,897 cases of cohoes, 62 cases of springs, and 16 cases of sockeye.

Pink Salmon.—The pack of pink salmon in the Queen Charlotte Islands in 1940, amounting to 44,966 cases, was, from the canners' standpoint, disappointing. This figure is compared with 57,952 cases packed in 1938, the immediately preceding cycle-year, while the pack in 1936 amounted to 89,355 cases. It will be recalled that the pink-salmon pack in 1932 amounted to only 2,415 cases, while in 1934 the pack increased to 53,398 cases. Notwithstanding the small pack in 1940, the seeding in certain of the spawning-beds was reported as unsatisfactory, although in the Yakoun River area the seeding was considered as generally satisfactory.

Chum Salmon.—In 1940 the Queen Charlotte Islands produced a pack of chum salmon amounting to 164,911 cases, which was considerably above the packs of this species produced in this district in recent past years. The pack in 1939 amounted to 45,519 cases, while in 1938 the pack of chum salmon for Queen Charlotte Islands was 40,882 cases. In 1937, 72,689 cases were packed. The 1940 pack was 86,250 cases above the average annual pack for the previous

five years. Reports from the chum spawning-beds indicate that the supply at Naden Harbour was exceptionally good, while a failure occurred in the Masset Inlet area. The balance of the chum-salmon streams of the Queen Charlotte Islands are reported to have been satisfactorily seeded.

Cohoe Salmon.—There were packed in the Queen Charlotte Islands in 1940, 8,897 cases of cohoe, compared with 3,020 cases in 1939 and 16,616 cases in 1938. The pack in 1937, the cycle-year, amounted to 4,631 cases. The 1940 pack was 1,720 cases less than the average annual pack for this species for the previous five-year period.

In addition to the above there were 16 cases of sockeye and 62 cases of springs canned in this district in 1940.

Central Area.

The Central area includes all the salmon-fishing areas from Cape Calvert to the Skeena River, except Rivers Inlet. The total pack of all varieties of salmon canned in this area in 1940 amounted to 274,232 cases and consisted of 32,042 cases of sockeye, 1,518 cases of springs, 506 cases of steelheads, 49,886 cases of cohoes, 54,478 cases of pinks, and 135,802 cases of chums. In 1939 there was a total of 301,513 cases of salmon canned in this area.

Sockeye Salmon.—The principal fishing-grounds in the Central area for sockeye salmon are Fitzhugh Sound, Burke and Dean Channels. In addition to these areas some sockeye are taken in the vicinity of Banks Island and Principe Channel, while some sockeye are also caught in Gardner Canal. The sockeye-pack in the Central area in 1940 of 32,042 cases was 5,884 cases greater than in the year previous, but was 4,136 cases less than were canned in this area in 1938. The 1940 pack, however, was 1,667 cases greater than the average annual pack of sockeye in this area for the previous five-year period.

Spring Salmon.—Spring salmon are canned in this area, but the fish entering the canneries are caught incidental to fishing for other species. The spring-salmon pack in 1940, amounting to 1,518 cases, is compared with 655 cases in 1939, 540 cases in 1938, and 1,641 cases in 1937.

Cohoe Salmon.—There were 49,886 cases of cohoes canned in 1940, which were 5,460 cases greater than the pack of this species in the previous year. The 1940 pack was 6,830 cases less than the exceptionally large pack of cohoes put up in this district in 1938, but was 5,514 cases greater than the average annual pack canned in this district for the previous five years. Generally speaking, the escapement to the spawning-beds, according to the report of the Chief Supervisor of Fisheries of the Federal Government, may be considered as fairly satisfactory.

Pink Salmon.—The pink-salmon pack in the Central area in 1940, amounting to 54,478 cases, was considered a failure when compared with 130,842 cases in 1938, the cycle-year, and 246,378 cases in 1936. The 1940 fishing season was considered the wettest season this district has experienced for a great number of years which, no doubt, had some adverse effect on the catch, but whether the wet season can be blamed *in toto* for the exceedingly small pack is problematical. The 1940 pack of pink salmon for this area was considerably smaller than the pack of this species for the year previous, when 150,498 cases were canned. The cycle to which 1939 belongs is considered the small cycle for this area. The 1940 pack was 45,429 cases below, or less than half, the five-year average annual pack for the small cycle.

Chum Salmon.—The pack of chum salmon, amounting to 135,802 cases, was considerably greater than the pack of four years ago when 99,592 cases of this species were canned, and is also greater by 25,330 cases than the average annual pack for the previous five-year period. The pack of chums in 1940 reflects to some extent the great effort on the part of the canners to put up as much of the cheaper fish as possible owing to war-time demand.

Vancouver Island.

The total canned-salmon pack credited to Vancouver Island for 1940 was 419,579 cases and consisted of 15,177 cases of sockeye, 2,454 cases of springs, 214 cases of steelheads, 88,885 cases of cohoes (with which are included 23,277 cases of bluebacks), 33,785 cases of pinks, and 279,064 cases of chums.

Sockeye Salmon.—In 1940 the sockeye-pack credited to Vancouver Island, amounting to 15,177 cases, is compared with the year previous in which 16,259 cases were canned. The 1940 pack was 17,519 cases less than the pack credited to Vancouver Island in 1936, the cycle-year. The small pack of 1940 was also 8,327 cases less than the average annual pack for the previous

five years. The reader is referred to the " Spawning Report, 1940," which is included in the Appendix to this report, for a detailed account of the spawning conditions in the various salmon-streams in the Vancouver Island area. Generally speaking, and with the exception of the Alberni area, the sockeye-seeding was reasonably satisfactory. In the latter area, however, the seeding was reported as being very disappointing.

Spring Salmon.—Vancouver Island was credited with a pack of 2,454 cases of spring salmon in 1940, compared with 2,889 cases in the year previous and 4,254 cases in 1938. The catch of spring salmon in the waters adjacent to Vancouver Island is taken principally by trolling-gear and this output finds a market in the fresh- and frozen-fish trade. The canned-pack of this species reported in this column represents principally those spring salmon caught incidental to fishing for other species.

Cohoe Salmon.—There were 88,885 cases of cohoes packed from fish caught in the Vancouver Island district in 1940. This figure includes 23,277 cases of bluebacks. The cohoe-pack in 1940 is compared with the 1939 pack of 123,388 cases, with which figure is combined 48,209 cases of bluebacks caught in the Vancouver Island district in that year. In 1938 the pack amounted to 89,471 cases, 27,417 cases of these being bluebacks.

Pink Salmon.—The pink-salmon pack credited to Vancouver Island in 1940 amounted to 33,785 cases. This was one of the smallest packs of this species since 1932 and was 36,323 cases less than were packed in 1938, the cycle-year. It was, however, 20,985 cases greater than the average for the previous five cycle-years.

Chum Salmon.—The pack of chum salmon credited to Vancouver Island, amounting to 279,064 cases, was 66,115 cases greater than were packed in the previous year and the largest pack since the cycle-year 1936, in which year there were 347,951 cases canned. The 1940 pack was 16,978 cases less than the average annual pack of this species for the previous five years. In considering the chum-salmon pack for Vancouver Island, one is reminded that, previous to 1939, considerable numbers of chum salmon caught in the waters off Vancouver Island found a market in the salt-fish trade. There were no salmon-salteries operated in 1939 or in 1940. The lack of this outlet is, no doubt, reflected in the canned-salmon figures. Another factor which would, no doubt, increase the chum-salmon pack figures credited to this district for 1940 was the increased demand for low-priced canned fish, which increased demand was largely occasioned by the hostilities in Europe.

In all cases where not specifically mentioned, the reader is referred to Major Motherwell's report on the condition of the salmon spawning-grounds for detailed information in respect to escapements.

REVIEW OF BRITISH COLUMBIA'S SALMON-CANNING INDUSTRY, 1940.

In 1940 there were thirty-eight salmon-canneries licensed to operate in the Province of British Columbia. This was three more than were operated in 1939. The operating canneries were situated in the various districts, as follows:—

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

From the above it will be noted that there was one more cannery operated in the Queen Charlotte Islands in 1940 than operated in that district in 1939, also there was one more cannery operated on the Skeena River in 1940 than in the previous year. Johnstone Strait also had one more operating cannery in 1940 than in 1939. The fact that 1940 was a pink-salmon year in the Queen Charlotte Islands no doubt accounts for the extra cannery operating in that district. The one extra cannery in the Skeena River District in 1940 is accounted for by the establishment of a new salmon-cannery at Prince Rupert, while the fourth cannery to operate in Johnstone Strait in 1940, over the three in the previous year, is accounted for by the reopening of the Alert Bay Cannery. It will be noted also that there were no salmon-canning operations conducted in Smith Inlet in 1940. The three canneries which formerly

canned salmon in this area were again operated as net-camps and the fish transported to other canneries, principally to Rivers Inlet. It would seem that Smith Inlet, in 1939, passed out of the picture as the location for active salmon-canneries, at least for the present. The year 1940, being an even-numbered year, coincides with the run of pink salmon to the Queen Charlotte Islands and, as mentioned in a previous paragraph, this, no doubt, accounts for the extra salmon-canning activity in these islands in 1940.

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

Pilchard.—The pilchard-canneries located on the west coast of Vancouver Island have shown a tendency to increased production in recent past years. Unfortunately, in 1939 the long haul from the fishing-grounds to the canneries made it most difficult to secure a sufficient quantity of pilchards of canning quality and, as a result, only 7,300 cases were canned. In 1940 the pack of canned pilchards amounted to 73,164 cases. This figure includes an experimental pack of young pilchards which were put up by one cannery in the form of sardines. These "sardines" were packed from the run of young pilchards which appeared off the British Columbia coast in 1940 for the first time.

There were four canneries licensed to can pilchards in British Columbia in 1940.

Herring.—Previous to 1939 herring were canned in British Columbia to some extent but the pack was never large, owing to the limited market. In 1939, due largely to orders arising on account of hostilities in Europe, the canning of herring assumed the proportions of a major industry and in that year there were canned 418,021 cases. In 1940 the military authorities, both in Britain and Canada, came forward with large orders for canned herring and, as a result, sixteen herring-canneries were licensed to operate. According to the returns made to the Provincial Fisheries Department, these sixteen canneries produced a pack of 640,252 cases during the herring-fishing season, which season includes the months of January, February, and March of 1941. The large increase in the canned-herring pack is due directly to the increased demand for a cheap highly protein food, which demand is created by the war. There is, however, the possibility that, provided the canners maintain quality and put forth the necessary effort, a good portion of this new business could be retained after the cessation of hostilities.

Canned Sardines.—Early in 1940 there appeared in the inshore waters along the coast of British Columbia large quantities of young pilchards. These young fish have not been known in these waters heretofore and, owing to the large numbers and the fact that they made their appearance in nearly every district along the coast, a great deal of speculation has occurred as to where they came from, also whether we might expect them to remain and mature. In the meantime, at least one of the British Columbia canneries conducted an experiment and put up a small pack of these fish in ¼-lb. ovals. These were offered to the trade as Pacific sardines and were of two varieties, namely, in tomato sauce and in oil. It is understood that the experimental pack was favourably received. If young pilchards continue to appear in our local waters, there is no doubt but what other canneries will endeavour to exploit these schools of young fish and possibly build up a trade in canned sardines.

Shell-fish.—Shell-fish, namely, clams and oysters, are canned to some extent in British Columbia. The operation, however, is never large, although in some years the production is considerably higher than in others. In 1940 the five plants licensed to operate produced 11,482 cases of clams, 285 cases of oysters, 3,700 cases of crabs, and 285 cases of abalone.

Tuna-fish.—In 1939 there was a very small experimental pack of tuna-fish canned in British Columbia. In 1940, however, no cannery made returns showing that any of this species was canned.

MILD-CURED SALMON.

In 1940 four plants were licensed to mild-cure salmon in the Province, compared with six plants in the year previous. The total pack of mild-cured salmon in 1940 amounted to only 767 tierces, compared with 2,594 tierces in the year previous.

DRY-SALT SALMON.

In each year previous to 1939, there have been varying amounts of chum salmon dry-salted for shipment to Japan. In some years the production of dry-salt salmon has reached fairly large proportions and in recent past years this industry has been controlled and

regulated by the British Columbia Salt-fish Board, which Board is a scheme set up under the "Natural Products Marketing (British Columbia) Act." Chum salmon, normally, are fished in quantity in the fall of the year. There is, however, a considerable pack of canned chum salmon put up during the summer and the early autumn months. Due largely to the increased demand occasioned by the war for inexpensive protein foods, such as canned chum salmon, the Provincial Government declined to issue salmon dry-saltery licences in 1939. For similar reasons the issuance of licences covering salmon dry-salteries was again refused by the Provincial Government in 1940. There were, therefore, no salt salmon produced in the year under review, the total catch being diverted to canning and freezing.

DRY-SALT HERRING.

The production of dry-salt herring in 1940 was again regulated by the British Columbia Salt-fish Board under the "Natural Products Marketing (British Columbia) Act." The total production of this commodity is exported to the Orient, particularly to Japan, and from there quantities are re-exported to Manchukuo and China. Continued unsettled conditions in the Orient, particularly in China, which previously was the only market for this commodity, together with the exchange restrictions placed on the export of currency by the Japanese Imperial Government, have caused some reduction each year in the quantity of salt-herring marketed. In past years British Columbia has exported to the Orient as much as 60,000 tons of dry-salt herring in a single year. The business has gradually diminished and in 1940 only two salteries were licensed to operate. These two salteries produced a pack of 5,039 tons compared with 7,596 tons in the year previous.

For particulars of the marketing of the 1940 pack of dry-salt herring, the reader is referred to the report of the British Columbia Salt-fish Board which is published in the Appendix to this report.

PICKLED HERRING.

Owing to the outbreak of hostilities in Europe, certain markets in the United States which obtained their supplies of pickled herring from European countries suddenly found themselves without a source of supply and, as a result, some pickled herring was produced in British Columbia during the 1939–40 season. The quantity produced, however, was small, and that pack may be considered as of an experimental nature. The experiment, however, was apparently a success, for in the 1940–41 season the Provincial Fisheries Department licensed five pickled-herring plants to operate in British Columbia. These five plants produced 5,500 barrels of pickled herring, or the equivalent of 890 tons. These fish are put up in barrels in a special vinegar pickle and the entire product is shipped to United States markets, where the contents are repacked into other containers for final distribution to the consumer.

While this branch of the fishery is still small, the market is a fairly large one and British Columbia packers would do well to investigate the possibilities, with a view to not only extending this market during war-time but with the idea of retaining it when peace is restored.

HALIBUT PRODUCTION.

The total halibut-landings on the Pacific Coast of North America are regulated by the International Fisheries Commission. On this account there is very little fluctuation in the amount landed from year to year. For the purpose of regulation, the coast is divided into four areas. The principal areas, from the standpoint of production, are 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.

In 1940 the catch-limits set by the International Fisheries Commission were: For Area No. 2, 22,700,000 lb. and for Area No. 3, 25,300,000 lb.—a total of 48,000,000 lb. These catch-limits were the same as those prevailing in 1939. In addition to the 48,000,000 lb. permitted, as mentioned above, the International Fisheries Commission issues permits which allow vessels to land halibut caught incidental to fishing for other species in an area closed to halibut-fishing while halibut-fishing is permitted in another area. The regulations of the International Fisheries Commission permit the landing of halibut caught in Area No. 1 so long as Area No. 2 is open to fishing, and halibut caught in Area No. 4 may be landed so long as Area No. 3 is open to fishing. Catch-limits, however, are set only in Areas Nos. 2 and 3. The production from Areas Nos. 1 and 4 is comparatively small.

The total landings of all vessels in 1940 amounted to 53,240,495 lb., which is 2,503,246 lb. more than the total landings of all vessels in 1939. The 53,240,495 lb. landed in 1940 includes 769,103 lb. landed from Area No. 1. Of the balance, 25,492,835 lb. were caught in Area No. 2 and 26,978,557 lb. were caught in Area No. 3. The total halibut-landings at Canadian ports by all vessels, Canadian and American, amounted to 23,885,119 lb., and of this total 12,885,211 lb. were caught in Area No. 2 while 10,999,908 lb. were caught in Area No. 3. The Canadian fleet caught and landed in Canadian ports, 11,097,288 lb. from Area No. 2 and 1,577,091 lb. from Area No. 3, making a total of 12,674,379 lb. landed by Canadian vessels in Canadian ports. This is 696,348 lb. less than the Canadian catch landed in Canadian ports in 1939. In addition to the above, Canadian vessels landed 5,223 lb. of halibut in American ports.

The unweighted average price for Canadian halibut in Prince Rupert in 1940 was 8.4 cents per lb., compared with 6.2 cents per pound in 1939. Attention is directed to the fact that these prices are based on the unweighted average prices for all Canadian landings at Prince Rupert and should be used with distinct caution. They are quoted principally as indicating the trend.

Halibut-livers in 1940 were again in demand by pharmaceutical houses as a valuable source of concentrated vitamins. The livers, which were formerly thrown away, are now producing a considerable sum to the fishermen which, in 1940, amounted to $467,216 to the halibut fishermen of the Pacific. This amount is $22,469 greater than was shared from this commodity in the year previous.

The above figures are compiled from information supplied by the International Fisheries Commission, which are hereby gratefully acknowledged.

FISH OIL AND MEAL.

The production of fish-oil and edible fish-meal from various species of British Columbia fish has become an important branch of the fishing industry of the Province. Pilchard and herring are the principal species used for the production of oil and meal, but considerable quantities of these products are also produced from dogfish and cannery waste. Contrary to general belief, British Columbia's reduction plants produce fish-oil and an edible meal, not a fertilizer, as this product is erroneously referred to. The oil is used in numerous manufacturing processes, principally in the making of soaps, paints, linoleum, etc. There is also a continually growing outlet for certain grades of fish-oil for the feeding of poultry and other live stock due to the high vitamin content of the oil. In recent years, particularly since the outbreak of the war in Europe, a number of plants have been established in British Columbia specializing in the production of medicinal fish-oil from fish-livers. This oil is supplying the needs of Canada for a high vitamin content oil which formerly was imported, to a large extent, from northern European countries. Plants are now established in British Columbia which specialize in the refining and blending of British Columbia produced oils and are capable of supplying feeding or medicinal oils of guaranteed vitamin content.

Pilchard Reduction.—The pilchard-fishery of British Columbia is conducted principally off the west coast of Vancouver Island. At the commencement of this fishery in 1925–26, pilchards were taken mostly in the inlets, but latterly, with improved types of fishing vessels and gear, the fishing has proceeded farther to sea and now practically all British Columbia pilchards are caught well offshore. Fishing for pilchards generally commences about the first week in July and continues until the first fall storms, usually early in September.

The production of pilchards in British Columbia in 1940 was decidedly not up to expectations. The fish did not appear off the coast of Vancouver Island in their usual numbers, which necessitated the fleet proceeding well down off the coast of Washington for their catches. Six plants were licensed to operate on the west coast, which was one more than operated in 1939. These six plants produced 4,853 tons of meal and 890,926 imperial gallons of oil. This production is compared with the year previous, when 900 tons of meal were produced and 181,473 imperial gallons of oil. In 1938 the production figures were 8,899 tons of meal and 2,215,823 imperial gallons of oil. It might be mentioned here that the pilchard-fishery in 1939 was considered virtually a failure.

Herring Reduction.—The reduction of herring in British Columbia is now an important branch of our winter fishery. Herring are caught from October through to March and, while heretofore the fishery was conducted largely on the west coast and south-east coast of Van-

couver Island and in the vicinity of Prince Rupert, in recent years the fishery has been extended to practically the whole of the British Columbia coast. In 1940 there were fifteen herring-reduction plants licensed to operate, which were two more than in the year previous. These fifteen plants produced 10,886 tons of meal and 923,137 imperial gallons of oil. These figures are compared with the production in 1939, which amounted to 22,870 tons of meal and 1,677,736 imperial gallons of oil.

Whale Reduction.—Only one company conducts whaling operations in British Columbia. This company operated one of its whaling-stations in 1940, namely, Rose Harbour. A total of 220 whales were killed and these produced 181 tons of meal, 434 tons of fertilizer, and 361,820 imperial gallons of oil.

Miscellaneous Reduction.—As mentioned in a previous paragraph, considerable quantities of meal and oil are produced from cannery waste, dogfish, and other sources. This production is lumped together under " miscellaneous." In 1940 the eleven plants licensed produced 4,061 tons of meal and 378,957 imperial gallons of oil.

In addition to this meal and oil produced from cannery waste and dogfish, etc., four reduction plants operated for a short season on anchovies, producing 937 tons of meal and 36,899 imperial gallons of oil.

CONDITION OF BRITISH COLUMBIA'S SPAWNING-GROUNDS.

Owing to this Department having discontinued making inspections of the various salmon-spawning areas in the Province, we are indebted to Major J. A. Motherwell, Chief Supervisor of Fisheries, and the officers of his Department who conducted the investigations, for furnishing us with a copy of his Department's 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. 26.)

In the Appendix to this report we publish paper No. 26 in the series " Contributions to the Life-history of the Sockeye Salmon." This paper is again the work of Dr. W. A. Clemens, formerly Director of the Pacific Biological Station, Nanaimo, B.C., and now head of the Department of Zoology at the University of British Columbia.

In paper No. 26 the author points out that in 1940 the packs of sockeye on Rivers Inlet and the Nass River were below the average, while the pack on the Skeena River was well above the average for the previous thirty-three years.

In connection with the escapement to the spawning-beds, it is pointed out that the escapements to Rivers Inlet and Skeena River were reported as large, while the escapement to the Nass River was medium to light. Attention is also directed to reports that, in all three systems, the sockeye run was early and that considerable numbers of fish had proceeded through the fishing areas before the commencement of the fishing season. Dr. Clemens remarks on the exceptionally large size of the sockeye in the samples taken from all three areas on which reports are made.

Commenting specifically on the particular river systems, Dr. Clemens points out, as follows:—

Rivers Inlet Sockeye Run, 1940.

The pack of 63,469 cases of sockeye salmon on Rivers Inlet in 1940 was considered a medium-sized pack as it fell between the figures of 60,000 and 100,000 cases. The bulk of the run was composed of four-year-old fish and was the product of the spawning of 1936. It is suggested that the severe freshet in the fall of that year in all probability had an adverse effect on the numbers of fish returning in 1940 and, while the Rivers Inlet run was composed of four- and five-year-old fish, it is still thought possible that considerable numbers of five-year-old fish may appear in 1941. Although the 1936 spawning has already produced a considerable return of four-year-old fish, it is difficult to foretell what the return may be in 1941.

The sockeye appearing in the Rivers Inlet samples were, generally speaking, very much larger than usual. Certain age-groups were close to the average for the past twenty-five years, while other age-groups were over 1 lb. larger than the average for that age-group.

Skeena River Sockeye Run, 1940.

The pack of sockeye salmon on the Skeena River, amounting to 116,507 cases, was the highest since 1930 and was considered good. Dr. Clemens points out that the 1940 run was comprised of 80 per cent. four-year-old fish, and as the spawning of 1936 has already produced such a large run of four-year-old fish it cannot be expected to produce a very large number of five-year-old fish in 1941. It would seem, therefore, that the size of the run in 1941 will depend largely upon the success of the production from the 1937 spawning and the number of fish maturing at four years of age.

On the Skeena River, as at Rivers Inlet, Dr. Clemens notes that the average length and weight of the samples were considerably above the average for recent past years and, in certain age-groups, established new high records. It is noted that the increase in the weight for some of the age-groups was as much as 1¼ lb.

Nass River Sockeye Run, 1940.

On the Nass River the run produced a pack of 13,809 cases of sockeye salmon, which pack was not large, although it is pointed out that the escapement was described as good. It is suggested that the run of 1941 will be derived from the spawnings of 1936 and 1937 and, as this brood-year produced a considerable percentage of four-year-old fish, there is a possibility of a good return of five-year-old fish, as it is pointed out that the runs of sockeye to the Nass River are largely comprised of five-year-old fish.

The average length and weight of both sexes in the various age-groups comprising the Nass River sockeye run, as in the case of Rivers Inlet and the Skeena River, are shown to be considerably above the average for the past twenty-eight years and establish new high records. Dr. Clemens remarks: ". . . The data of all three river systems agree in demonstrating that the sockeye proceeding to them in 1940 were exceptionally large. Undoubtedly food and water temperatures are the factors involved."

PILCHARD AND HERRING INVESTIGATIONS.

The joint agreement between the Fisheries Research Board of Canada and the Provincial Fisheries Department for carrying out an investigation of pilchard and herring fisheries was continued during 1940. In this investigation most of the emphasis has been laid on herring programmes, which have included numerous methods of attacking the problems connected with the supply of herring for the British Columbia fishery. The pilchard sampling and tagging programmes have, however, been maintained and new studies dealing with immature pilchards have been initiated. The work has been under the direction of Dr. J. L. Hart and Dr. A. L. Tester, and has been carried out by them and their associates, Dr. R. V. Boughton and Mr. J. L. McHugh.

Pilchards.

The pilchard-fishery was more successful than in 1939, but the catch was only some 60 or 70 per cent. of what might be regarded as a satisfactory season. The catch per boat for the season was rather less than 1,200 tons, which may be compared with approximately 200 tons in 1939 and approximately 2,100 tons in 1938.

The report on the pilchard-tagging programme is given in the Appendix. In it are presented data on the insertion of some 2,600 tags in connection with the British Columbia fishery. From these and other tags used at other times and places eighty-six were recovered, of which thirty-nine had been inserted in California. The inter-relationship of the California and Canadian fisheries becomes increasingly evident.

Pilchard sampling was continued and it was found that the decline in average length of the fish taken by the fishery was continued into 1940, the average lengths being 236.7 millimetres for males and 241.9 millimetres for females. There was definite evidence of gradation in length with latitude on the fishing-grounds, fish captured in more northerly areas averaging several millimetres longer than those caught farther south.

A start has been made in collecting and organizing data for a history of the pilchard-fishery in relation to the biology of the fish supplying the catch.

As far as circumstances permitted, a study was made of the young pilchards which were found abundantly in British Columbia waters during the summer of 1940. General growth-studies indicate that between the time of first appearance in May and the close of the growing

season in November the weight of these young pilchards increased by about 200 per cent. One thousand of the young fish were tagged on the east coast of Vancouver Island.

HERRING.

The British Columbia herring-fishery has continued to expand and has assumed increasing economic importance, particularly in relation to the need for canned fish-food and other fishery products created by the present war-time emergency. In 1939–40, the total catch was the largest in the history of the fishery and amounted to over 150,000 tons, of which 31 per cent. was taken on old-established fishing-grounds on the east and west coasts of Vancouver Island, 13 per cent. from newly exploited areas in the vicinity of Discovery Passage and Queen Charlotte Sound, and the remaining 56 per cent. from recently established fishing-grounds along the central and northern coast-lines and on the east coast of the Queen Charlotte Islands. As usual, most of the catch was reduced to oil and meal, but there was a noteworthy increase in the quantity canned (413,659 cases).

During the 1939–40 season the system of Pilot House Record Books was continued. This provides for the collection of daily catch statistics whereby the availability of herring to the fishermen may be calculated as the catch per seine per day's active fishing. Comparison of the apparent abundance of herring in the respective areas with previous years, as indicated by availability figures during the fishing season, shows that on the south-east coast of Vancouver Island herring were less abundant and individual sets were smaller; on the west coast of Vancouver Island, while still very poor, the fishing improved slightly; in the Central area fishing was good but the availability was less than in the previous season; in Prince Rupert Harbour, fishing was relatively very good. Excellent catches were made in the vicinity of Discovery Passage in late January and early February, while in the fall and winter the prospecting of the Queen Charlotte Sound waters yielded good results. For the Queen Charlotte Islands area, summer fishing on the east and west coasts resulted in low catches, but from December to March east coast fishing was fairly successful.

With the enthusiastic co-operation of the Dominion Department of Fisheries and its field officers, the very informative surveys of herring-spawning grounds were continued in 1940. From estimates of the intensities of egg-deposition and the extent of the grounds spawning intensity indices have been calculated. These show that in most general districts spawning in 1940 was somewhat heavier than in 1939. A much greater spawning acreage in the Strait of Georgia presumably indicates why this region is more productive than the west coast of Vancouver Island. Most of the reports agree that mortality of the eggs was lower than usual on Strait of Georgia spawning-grounds because of favourable weather conditions and a reduced number of feeding birds. As usual, the feeding of birds caused a high mortality on the west coast of Vancouver Island and also on some spawning-grounds in the Central area. February storms were also destructive on the west coast of Vancouver Island. According to the reports, frost during the spawning season in the Central and probably also the Northern area did not constitute the usual hazard in 1940.

During the 1939–40 fishing season a total of 137 samples of herring were collected and examined in order to determine age composition, size, and growth rate—knowledge which is essential to a clear understanding of the trend of the fishery. Some 14,000 fish were thus studied. The general findings from these data are:—

South-east Coast of Vancouver Island.—An unusual abundance of II.-year fish (in their second year) as in 1938–39 and a greater average length for each age-class characterized the fish sampled in 1939–40. The presence of II.'s may represent an unusually early addition of recruits to the fishery or the presence of an unusually abundant year-class. The fish taken at Nanoose Bay were of greater average length and age than those taken on more southerly grounds.

West Coast of Vancouver Island.—There was considerable variation in age composition between areas. In Barkley Sound and Quatsino Sound, III.'s predominated; in Nootka Sound and Kyuquot Sound, II.'s predominated. There appears to have been a decrease in the relative abundance of fish of age IV. and older and a great increase in the relative abundance of fish of age II. during the past two seasons. Other evidence indicates that fish of age II. were only relatively and not actually of great abundance. Both II.'s and III.'s of 1939–40 were of exceptionally large size for their age.

Queen Charlotte Sound and Adjacent Waters.—The fish of this newly exploited region were found to be very small and slow growing. Fish of age VII. at Belleisle Sound were smaller than fish of age III. on the south-east coast of Vancouver Island. An exceptionally large percentage of older age-groups occurred, as would be expected in the case of a virgin population.

Central and Northern Areas.—Great variation occurred between localities, both in size and age composition. Fish of age VI. were the predominating group at Laredo Inlet, Prince Rupert Harbour, and Scudder Point; fish of age V. predominated at Inskip Channel; fish of age III. constituted the predominating group at Kwakshua Passage, Skaat Harbour, and Sewell Inlet-Lagoon Bay area; and fish of age II. predominated at Klemtu Passage.

To ascertain the general effect of a decline of both size and age-classes as a result of severe commercial exploitation, the fecundity of herring was investigated with particular reference to the correlation of number of eggs to size and age. A definite tendency for the average egg-count per fish to increase with size was found. The egg-count for a given length varied, however, in different areas and this variation was attributed to differences in the " condition " of the fish. Seasonal changes in egg weight were also studied.

A study of the vertebral number of young herring on the south-east coast of Vancouver Island has been completed. Among the results arising from this study is the discovery that fish from individual spawnings may have radically different mean vertebral counts. This has an important bearing on the interpretation of the results of variation of mean vertebral number in the adults. Another study, dealing with abnormal vertebræ, has been presented for publication.

Racial work on herring supplying the commercial fisheries has been continued and an account of the results of an extensive analysis of vertebral number in relation to the question of intermingling of the runs on the west coast of Vancouver Island is being prepared. Vertebral and other data strongly indicate the essential isolation of the runs supplying the fishing-grounds of the Central, Northern, and Queen Charlotte Island areas.

The herring-tagging investigation upon which a full report is presented in the Appendix has been continued actively and has been instrumental in increasing knowledge concerning the habits of herring. The results of former years, indicating the definite segregation of the herring populations of major fishing areas, and the partial segregation of herring on fishing-grounds within major fishing areas have been confirmed, but it would appear that intermingling during the 1940–41 season was somewhat less restricted than in the earlier years of the investigation. The considerable dependence of the fishery in the Discovery Passage fishing-grounds upon fish which spawned during the previous year in the Strait of Georgia is again demonstrated. The one year's tagging results present strong evidence for believing in the practical independence of the fishing-grounds of the Queen Charlotte Sound area from those of other major areas.

THE CLAM INVESTIGATION.

In order to ascertain the conditions prevailing on some of the clam-beaches of British Columbia, particularly those which have been exploited commercially for some considerable length of time, an investigation has been undertaken by the Fisheries Research Board and financed jointly by that Board and the Provincial Fisheries Department. In the Appendix to the report for 1939 there appeared a preliminary report on the investigation by Mr. Quayle, who is in charge of the scientific work. While the investigation is primarily for the purpose of obtaining information on the clams of the Province, it is broad enough to include shell-fish generally.

In order that the general public may know something of the molluscs of the Province, Mr. Quayle describes the various edible species found in British Columbia in a paper which will be found in the Appendix to this report, entitled " The Edible Molluscs of British Columbia." Mr. Quayle points out that, while nearly all the molluscs found on the coast of British Columbia are edible, nevertheless many are small in size or difficult to obtain. He next describes the various species, referring particularly to those species which are used as food. Various diagrams are used for identifying the forms described.

INTERNATIONAL FISHERIES COMMISSION, 1940.

Under authority of the treaty of January, 1937, between Canada and the United States, the International Fisheries Commission continued the regulation of the Pacific halibut-fishery and carried on the scientific investigations of the life-history of the halibut and of the halibut-fishery, which are indispensable to rational regulation.

The representation of the United States on the Commission was changed during the year. Mr. Frank T. Bell, who had been a member of the Commission since 1933, resigned. Mr. Charles E. Jackson, Acting Commissioner of the United States Bureau of Fisheries, was appointed as his successor. The members of the Commission at the end of the year were: Mr. L. W. Patmore (chairman) and Mr. A. J. Whitmore, for Canada; Mr. Edward W. Allen (secretary) and Mr. Charles E. Jackson, for the United States.

Hearings were held in late November and early December at Seattle, Vancouver, Prince Rupert, Ketchikan, Petersburg, and Juneau to ascertain the present views of the halibut fleets upon the provisions of a draft treaty which was prepared in 1938 at their urgent request and which was designed to give legal support to their voluntary system of control of the rate of halibut-landings. At these hearings, the scientific findings of the Commission were also explained and matters relating to regulation were discussed.

A meeting of the Commission was held at Vancouver in September. During and immediately following the hearings, other meetings were held at Prince Rupert and on board the United States Fisheries Service vessel "Brant," which was generously placed at the service of the Commission for the trip to Northern British Columbia and Alaska. At the September meeting the resignation of Dr. W. F. Thompson, who had been Director of Investigations from the formation of the Commission, was accepted and Mr. H. A. Dunlop, Assistant Director, was appointed to succeed him.

Regulations governing halibut-fishing in 1940 were in most respects similar to those of 1939. The catch-limits of 22,700,000 lb. for Area 2 and 25,300,000 lb. for Area 3 were retained. A few changes were made to facilitate enforcement. Clearance for fishing was limited to a single regulatory area during any one trip. Provision was made for the examination of all records dealing with the landing, purchase, and sale of halibut. The possession of halibut weighing less than 5 lb. was prohibited. At the request of the fishing fleet, the method of closure of Area 3 was made the same as for Area 2, namely, by the announcement of a last date of fishing only.

The 1940 fishing season was opened for all areas on April 1 as in the previous year. The catch-limit for Area 2 was attained and Areas 1 and 2 were closed to halibut-fishing at midnight of July 13th, sixteen days earlier than in 1939. The Area 3 catch-limit was reached and Areas 3 and 4 were closed at midnight of September 26th, thirty-two days earlier than the previous year. Permits for the retention of halibut caught incidentally during fishing for other species in Areas 1 and 2 after closure to halibut-fishing became invalid at midnight of September 30th.

The earlier attainment of the catch-limits in Areas 2 and 3 and the consequent earlier closure of the areas were the result of several factors which increased the rate of landings. In Area 2 these were an increase in the number of boats fishing, an increase in the size of trip permitted under the fishermen's own agreement for the control of the rate of landing of the catch, and the restriction of fishing to a single area per trip which reduced the incorrect reporting of the area of origin of catches. The principal factors contributing to the shorter Area 3 season were the change in the method of closure of that area which was made at the request of the fishermen and the landing of a greater proportion of the trips at ports close to the fishing-grounds, which reduced the length of many trips and increased their frequency.

The landings of halibut reported during the year amounted to 53,239,270 lb. Of this amount, 768,878 lb. were reported from Area 1, to the south of Willapa Harbour, Washington; 25,492,835 lb. from Area 2, between Willapa Harbour and Cape Spencer, Alaska; and 26,978,557 lb. from Area 3, between Cape Spencer and the Aleutian Islands. No fishing was done in Area 4, which is in the Bering Sea region. The Area 2 landings included 300,554 lb. taken under permit while fishing for other species after the closure of that area to halibut-fishing.

The Canadian halibut fleet was augmented by a number of small boats during the year. However, this additional fishing capacity was more than offset by the temporary removal of

several large vessels from the fishery to engage in naval patrol duties. As a result, Canadian vessels took 43 per cent. of the Area 2 catch and 6 per cent. of the Area 3 catch as compared to 45 per cent. and 10 per cent. respectively in 1939.

Scientific investigations of the Commission were continued where necessary for the fulfilment of the purposes of the treaty. They included the collection and analysis of current biological and statistical data, by which the success of past regulation is determined and on which future regulations must be based. The collection of biological data at sea made vessel operations necessary.

Study of the changes taking place in the stocks of adult halibut as a result of regulation was continued by means of measurements of the fish in the commercial catches. More than 81,000 halibut from representative trips were measured at Seattle. Of these, 35,700 were from banks off the coast of British Columbia in Area 2 and 45,700 were from western banks in Area 3. Materials for the study of age composition were taken simultaneously. The measurements showed that fish of spawning size were abundant in Area 3 but not in Area 2. Analysis of the measurements from Area 2 failed for the third consecutive year to show any significant increase in the average size of the fish or in the proportion of larger sizes which contain the spawning females that determine the production of young fish.

Vessel operations for the tagging of mature halibut and for the collection of biological materials and data for the study of the spawning stocks in the northern part of Area 2 were conducted during the spawning season in the winters of 1939–40 and 1940–41. Between December, 1939, and February, 1940, 875 halibut were tagged near Cape St. James and 428 off the coast of south-eastern Alaska. An additional 497 were tagged in the latter region in November and December, 1940. The fishing which was carried on for tagging purposes proved that spawning halibut were still relatively scarce in Area 2. Even on the spawning-grounds a high proportion of the fish were found to be immature.

The condition of the stocks of halibut, as indicated by the catch per unit of fishing effort, showed some improvement during the year. The average catch per skate in Area 3, which was approximately 116 lb. in both 1938 and 1939, increased to 121 lb. in 1940. In Area 2 the catch per skate increased from 60 lb. in 1939 to 64 lb. in 1940 but failed to reach the 1938 average of 69 lb. The catch per unit of fishing effort in Areas 2 and 3 were 84 and 89 per cent. greater respectively in 1940 than in 1930, when the abundance of halibut reached the lowest point in the history of the fishery.

The quantitative determination of the production of spawn, the most practical and direct way of determining changes in the spawning stock as soon as they occur, was continued in Area 2. The operations of the halibut vessel " Eagle " which were begun in December, 1939, were continued until the middle of February, 1940, in the vicinity of Cape St. James, British Columbia. During that time, 389 net-hauls were made at 140 different stations to determine the abundance and distribution of eggs and larvæ. Hydrographic samples were taken at seventeen stations to ascertain the conditions prevailing where the eggs and larvæ were found. Similar operations were again undertaken in December, 1940.

Analysis of the catches of eggs and larvæ during the 1939–40 spawning season and comparison of the results with those of previous years were carried out by approved methods. The production of eggs was 44 per cent. greater than in 1938–39, but 11 per cent. and 38 per cent. less than in 1937–38 and 1936–37 respectively. The cessation of the sharp decline in spawning which occurred in Area 2 during the 1937–38 and 1938–39 seasons and the partial recovery during 1939–40 are encouraging in view of the very limited amount of spawning in that region. However, because of short-time fluctuations that occur in the production of spawn by marine fishes, decision as to the present trend of abundance of the spawning stock must await subsequent observations of the success of spawning.

The investigations of the Commission continued to measure and explain the changes taking place in the stocks of halibut. They showed that the condition of the stock in Area 3 was good and was still improving, but that improvement had virtually ceased in the Area 2 stock, which is still in a critical condition. They indicated that catches in excess of the Area 2 catch-limit, which have arisen from various circumstances and have interfered with recovery there, must be eliminated to make certain the maintenance of the improvements already made and to make possible the further improvements, necessary to put the Area 2 stock in a sound condition.

THE INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION, 1940.

Under the treaty between Canada and the United States, known generally as the "Sockeye Treaty," there was set up in 1937 the International Pacific Salmon Fisheries Commission, which Commission is charged with investigating the various problems connected with the sockeye-salmon runs to the Fraser River. The scientific work of this Commission is under the direction of Dr. W. F. Thompson, who formerly directed the scientific work of the International Fisheries Commission dealing with the halibut-fishery of the Pacific. We have prevailed upon Dr. Thompson to briefly review the scientific work in connection with the International Pacific Salmon Fisheries Commission covering the year 1940. Dr. Thompson's report will be found in the Appendix to this report.

APPENDICES.

CONTRIBUTIONS TO THE LIFE-HISTORY OF THE SOCKEYE SALMON.

(No. 26.)

By W. A. Clemens, Department of Zoology, The University of British Columbia, Vancouver, B.C.

INTRODUCTION.

The pack of sockeye salmon on Rivers Inlet in 1940 was of medium size, amounting to 63,469 cases. This is somewhat below the average of the past thirty-three years, namely 83,399 cases. On the Skeena River the pack was 116,507 cases and well exceeds the average of 91,102 cases for the past thirty-three years. The Nass River pack of 13,809 cases was low as compared with the twenty-eight-year average of 22,122 cases.

The escapements to Rivers Inlet and the Skeena River were reported as large and that to the Nass River as possibly medium to light.

Observers in all three districts reported that the sockeye appeared in the rivers early and that considerable numbers of fish passed to the fishing areas before the commencement of fishing. This was apparently confirmed by the reports of very early arrivals of fish in the spawning areas.

Observers also remarked on the large size of the fish in all three river systems and the data presented later in this report show that the sockeye were exceptionally large.

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 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 RIVERS INLET SOCKEYE RUN OF 1940.

(1.) General Characteristics.

The pack of sockeye salmon at Rivers Inlet in 1940 amounted to 63,469 cases. On the basis of a classification suggested some years ago wherein a pack of less than 60,000 cases may be considered small, a pack of 60,000 to 100,000 medium, and a pack of over 100,000 cases large, the pack of 1940 falls in the medium class.

The bulk of the run was composed of four-year-old fish which were the product of the spawning of 1936. In this year there was a pack of only 46,351 cases but a very large escapement. This situation was the result of a strike of fishermen at the height of the fishing season and under ordinary circumstances might have resulted in an exceptional return in 1940. However, a severe freshet occurred during the autumn of 1936 and fishery officers expressed the belief that considerable damage had been done to the spawning-beds. The two factors, large escapement and freshet damage, would tend to counterbalance one another and

probably did so in that the 1940 pack, which was composed largely of four-year-old fish, was seemingly small in relation to the very large escapement in 1936. It is still possible that considerable numbers of five-year-old fish may appear in 1941.

The return in 1941 will be the result of the spawnings in 1936 and 1937. In the former year the pack was 46,351 cases and the escapement was very large. The fishermen's strike and the autumn freshet have been mentioned previously. The 1936 spawning has already produced a considerable return of four-year-old fish in 1940 and may or may not produce a considerable return of five-year-old fish in 1941. It is impossible to foretell what the return may be.

In 1937, the pack was 84,832 cases and the escapement was reported as satisfactory. There would seem to be no reason why there should not be a good return of four-year-old fish.

(2.) Age-groups.

The material for this year's study was obtained from 1,109 individuals taken in twenty-four random samplings from July 1st to July 30th. The 4_2 age-group predominates with 763 individuals forming 69 per cent. The 5_2 age-group is represented by 309 individuals or 28 per cent., the 5_3 by 33 or 3 per cent., and the 6_3 by 3 fish (Table I.). In addition there is one individual of the 3_2 age-group. As pointed out previously, the run is composed predominantly of four-year-old fish produced from the spawnings of 1936 in spite of possible adverse effects by severe freshets.

(3.) Lengths and Weights.

The average length of the males of the 4_2 age-group is slightly below the average of the past twenty-eight years and slightly above any previous record.

The average weights parallel the average lengths. In the 4_2 age-group the average weights of both males and females are close to the averages of the past twenty-five years. The average weights of the 5_2 age-group are over a pound greater than the twenty-five-year averages and in the case of the males much above any previous record (Tables IV. and V.).

The data concerning the distribution of lengths and weights are given in Tables II. and III.

(4.) Distribution of the Sexes.

The total number of males in the samplings is 579 and of females 530, percentages of 52 and 48 respectively. There is no significant deviation from the average percentages for the twenty-six years of record, which are 50 and 50 respectively. In the 4_2 age-group the males predominate with a percentage of 63 while in the 5_2 age-group the females predominate with a percentage of 77, which is somewhat above the average of 65 (Table VI.).

Table I.—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	----
1938 (87,942 cases)	27	70	1	2
1939 (54,143 cases)	67	32	1	----
1940 (63,469 cases)	69	28	3	----

Table II.—Rivers Inlet Sockeyes, 1940, 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.	
18½	1	-----	-----	-----	-----	-----	-----	-----	1
19	2	-----	-----	-----	-----	-----	-----	-----	2
19½	9	1	-----	-----	-----	-----	-----	-----	10
20	30	3	-----	-----	1	-----	-----	-----	34
20½	38	18	-----	-----	1	-----	-----	-----	57
21	67	30	-----	-----	5	-----	-----	-----	102
21½	53	46	-----	-----	-----	2	-----	-----	101
22	60	50	-----	1	-----	2	-----	-----	113
22½	58	33	-----	-----	2	5	-----	-----	98
23	62	34	1	8	1	2	-----	-----	108
23½	42	24	3	17	1	4	-----	-----	91
24	36	15	2	20	1	-----	-----	-----	74
24½	11	5	6	18	1	-----	-----	1	42
25	7	8	4	30	2	1	-----	-----	52
25½	3	1	2	29	2	-----	-----	-----	37
26	6	4	10	37	-----	-----	-----	1	58
26½	3	1	7	25	-----	-----	-----	1	37
27	1	-----	11	21	-----	-----	-----	-----	33
27½	-----	1	9	14	-----	-----	-----	-----	24
28	-----	-----	4	7	-----	-----	-----	-----	11
28½	-----	-----	2	3	-----	-----	-----	-----	5
29	-----	-----	3	7	-----	-----	-----	-----	10
29½	-----	-----	4	-----	-----	-----	-----	-----	4
30	-----	-----	2	-----	-----	-----	-----	-----	2
30½	-----	-----	1	-----	-----	-----	-----	-----	1
31	-----	-----	-----	-----	-----	-----	-----	-----	-----
31½	-----	-----	1	-----	-----	-----	-----	-----	1
Totals	489	274	72	237	17	16	-----	3	1,108
Ave. lengths	22.0	22.5	26.7	25.6	22.7	22.8	-----	25.7	-----

Table III.—Rivers Inlet Sockeyes, 1940, 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.	
2½	-----	-----	-----	-----	-----	-----	-----	-----	-----
3	8	-----	-----	-----	-----	-----	-----	-----	8
3½	65	14	-----	-----	3	-----	-----	-----	82
4	117	60	-----	-----	3	2	-----	-----	182
4½	89	69	-----	4	3	1	-----	-----	166
5	68	56	3	3	1	4	-----	-----	135
5½	65	47	3	18	1	4	-----	-----	138
6	47	19	6	26	2	5	-----	-----	105
6½	20	4	4	33	2	-----	-----	-----	63
7	8	3	8	28	1	-----	-----	2	50
7½	2	1	4	33	1	-----	-----	-----	41
8	-----	1	4	28	-----	-----	-----	1	34
8½	-----	-----	6	28	-----	-----	-----	-----	34
9	-----	-----	8	21	-----	-----	-----	-----	29
9½	-----	-----	11	11	-----	-----	-----	-----	22
10	-----	-----	7	1	-----	-----	-----	-----	8
10½	-----	-----	5	3	-----	-----	-----	-----	8
11	-----	-----	2	-----	-----	-----	-----	-----	2
11½	-----	-----	1	-----	-----	-----	-----	-----	1
Totals	489	274	72	237	17	16	-----	3	1,108
Ave. weights	4.7	4.8	8.2	7.3	5.1	5.3	-----	7.3	-----

Table IV.—Rivers Inlet Sockeyes, Average Lengths in Inches of the 4_2 and 5_2 Groups, 1912 to 1940.

Year.	4_2		5_2	
	M.	F.	M.	F.
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
1937	22.0	21.9	24.5	24.0
1938	23.1	22.8	26.6	25.5
1939	22.0	21.9	25.3	24.5
Average lengths	22.5	22.4	25.4	24.7
1940	22.0	22.5	26.7	25.6

Table V.—Rivers Inlet Sockeyes, Average Weights in Pounds of the 4_2 and 5_2 Groups, 1914 to 1940.

Year.	4_2		5_2	
	M.	F.	M.	F.
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
1937	4.6	4.4	6.1	5.8
1938	4.7	4.5	7.1	6.4
1939	4.4	4.2	6.5	5.9
Average weights	4.9	4.8	7.0	6.4
1940	4.7	4.8	8.2	7.3

Table VI.—Rivers Inlet Sockeyes, Percentages of Males and Females of the 4_2 and 5_2 Age-groups, 1915 to 1940.

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	36	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
1938	49	51	32	68	37	63
1939	56	44	37	63	50	50
1940	64	36	23	77	52	48
Average	63	37	35	65	50	50

2. THE SKEENA RIVER SOCKEYE RUN OF 1940.

(1.) General Characteristics.

The pack of sockeye salmon on the Skeena River in 1940 amounted to 116,507 cases, which was the highest since 1930, when 132,372 cases were taken. The escapements to the two main spawning areas, Babine and Lakelse, were large. It would appear, therefore, that the return to the Skeena River in 1940 was a very good one.

It is interesting to note that the run of 1940 was comprised of 80 per cent. four-year-old fish. In the brood-year, 1936, the pack was 81,973 cases and the escapement was reported as "comparatively large."

The run of 1941 will be the production of the brood-years 1936 and 1937. Since, as pointed out above, the 1936 spawning has already produced a large number of four-year-old fish, it cannot be expected to produce a very large number of five-year-old fish in 1941. The run of 1937 provided a pack of 42,491 cases and the escapement was very good. It would seem that the size of the run in 1941 will depend largely upon success of the production from the 1937 spawning and the percentage of the fish maturing at four years of age.

(2.) Age-groups.

The length, weight, and sex data and scale collections were obtained from 2,248 fish in forty random samplings from July 2nd to August 16th. The 4_2 age-group is represented by 1,805 individuals or 80 per cent. This is the highest percentage of four-year-old fish on record, the previous high being 70 per cent. in 1922. The other age-classes occur as follows: 5_2, 326 individuals or 15 per cent.; 5_3, 91 individuals or 4 per cent.; 6_3, 23 individuals or 1 per cent.; 3_2, 3 individuals. These three age-groups together comprise but 20 per cent. of the sampling (Table VII.).

(3.) Lengths and Weights.

The average lengths of the males and females of the 4_2 and 5_3 age-groups are very slightly above the averages of the past twenty-eight years. The average lengths of both sexes of the 5_2 and 6_3 age-groups are, however, an inch or more above those of the past years and in each case are the highest on record.

Likewise, the average weights of the 4_2 and 5_3 age-groups are approximately equal to the averages of the past twenty-six years, while those of the 5_2 and 6_3 age-groups are very much above the averages of the past years and establish new high records. In the cases of the males of both these groups, the increase in weight is 1.4 lb. (Tables X. and XI.).

The condition on the Skeena River thus closely parallels that on Rivers Inlet.

The distribution of lengths and weights are given in Tables VIII. and IX.

(4.) Distribution of the Sexes.

The total number of males in the sampling is 862 and of females 1,386, percentages of 38 and 62 respectively. Females predominate in the 4_2, 5_2, and 5_3 age-groups with percentages of 62, 61, and 57 respectively. The 6_3 age-group are represented by 15 males and 8 females and the 3_2 by 2 males and 1 female (Table XII.).

While the representation of females in 1940 is high, it is not exceptionally so. During the past eight years a considerable excess of females has occurred. In the early years of record the sex ratios were approximately equal and the change in recent years is believed to be related to changes in the size of the mesh of the gill-nets.

Table VII.—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
1938 (47,257 cases)	64	15	16	5
1939 (68,485 cases)	50	35	11	4
1940 (116,507 cases)	80	15	4	1

Table VIII.—Skeena River Sockeyes, 1940, grouped by Age, Sex, and Length, and by their Early History.

Length in Inches.	Number of Individuals.								Total.
	4_2		5_2		5_3		6_3		
	M.	F.	M.	F.	M.	F.	M.	F.	
20	1	1	-----	-----	-----	-----	-----	-----	2
20½	11	3	-----	-----	-----	-----	-----	-----	14
21	10	5	-----	-----	-----	-----	-----	-----	15
21½	24	33	-----	-----	-----	1	-----	-----	58
22	32	95	-----	-----	2	2	-----	-----	131
22½	48	156	-----	3	2	6	-----	-----	215
23	58	240	1	2	6	13	-----	-----	320
23½	76	217	2	8	4	6	-----	-----	313
24	106	175	1	11	4	10	-----	1	308
24½	107	99	2	22	7	5	-----	2	244
25	104	57	4	28	6	4	2	-----	205
25½	66	16	6	36	1	3	1	1	130
26	42	3	13	46	5	-----	1	1	111
26½	13	2	12	28	1	1	5	-----	62
27	4	-----	11	20	-----	1	2	-----	38
27½	1	-----	24	15	1	-----	1	1	43
28	-----	-----	9	2	-----	-----	-----	-----	11
28½	-----	-----	12	2	-----	-----	1	2	17
29	-----	-----	6	-----	-----	-----	-----	-----	6
29½	-----	-----	-----	-----	-----	-----	1	-----	1
30	-----	-----	-----	-----	-----	-----	-----	-----	-----
30½	-----	-----	-----	-----	-----	-----	-----	-----	-----
31	-----	-----	-----	-----	-----	-----	-----	-----	-----
31½	-----	-----	-----	-----	-----	-----	1	-----	1
Totals	703	1,102	103	223	39	52	15	8	2,245
Ave. lengths	24.0	23.3	27.0	25.7	24.3	23.8	27.0	26.1	-----

Table IX.—Skeena River Sockeyes, 1940, 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	3	-----	-----	-----	-----	-----	-----	-----	3
3½	17	10	-----	-----	-----	-----	-----	-----	27
4	51	112	-----	-----	-----	5	-----	-----	168
4½	77	264	1	4	8	11	-----	-----	365
5	104	320	3	7	8	13	-----	-----	455
5½	115	216	-----	26	6	9	-----	2	374
6	148	129	6	30	5	7	-----	1	326
6½	88	33	6	29	5	5	2	1	169
7	65	14	13	37	3	1	3	-----	136
7½	26	4	5	41	3	1	3	2	85
8	6	-----	19	23	1	-----	2	2	53
8½	3	-----	15	18	-----	-----	1	-----	37
9	-----	-----	19	6	-----	-----	-----	-----	25
9½	-----	-----	5	2	-----	-----	2	-----	9
10	-----	-----	8	-----	-----	-----	-----	-----	8
10½	-----	-----	2	-----	-----	-----	1	-----	3
11	-----	-----	1	-----	-----	-----	-----	-----	1
11½	-----	-----	-----	-----	-----	-----	-----	-----	-----
12	-----	-----	-----	-----	-----	-----	-----	-----	-----
12½	-----	-----	-----	-----	-----	-----	1	-----	1
Totals	703	1,102	103	223	39	52	15	8	2,245
Ave. weights	5.6	5.1	8.2	6.9	5.7	5.2	8.2	6.8	-----

Table X.—Skeena River Sockeyes, Average Lengths in Inches of Principal Age-groups, 1912 to 1940.

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
1937	23.5	22.9	26.2	25.1	24.9	24.1	26.9	25.5
1938	23.3	22.5	25.3	24.4	23.6	23.1	25.6	24.3
1939	24.1	23.9	26.1	25.4	24.8	24.1	26.3	25.1
Average lengths	23.7	23.1	25.7	24.8	24.1	23.4	25.7	24.7
1940	24.0	23.3	27.0	25.7	24.3	23.8	27.0	26.1

Table XI.—Skeena River Sockeyes, Average Weights in Pounds of Principal Age-groups, 1914 to 1940.

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
1937	4.9	4.6	6.4	5.8	5.7	5.1	7.0	6.1
1938	5.2	4.6	6.6	6.1	5.3	5.0	6.9	5.9
1939	4.9	4.7	6.3	5.7	5.4	4.9	6.6	5.5
Average weights	5.4	5.0	6.8	6.1	5.7	5.1	6.8	5.9
1940	5.6	5.1	8.2	6.9	5.7	5.2	8.2	6.8

Table XII.—Skeena River Sockeyes, Percentages of Males and Females of the 4_2 and 5_2 Age-groups, 1915 to 1940.

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
1938	40	60	51	49	42	58
1939	34	66	42	58	37	63
1940	38	62	39	61	38	62
Average	48	52	43	57	46	54

3. THE NASS RIVER SOCKEYE RUN OF 1940.

(1.) General Characteristics.

The run of sockeye to the Nass River in 1940 produced a pack of 13,809 cases and an escapement which may have been relatively small. Possibly the extent of the return was all that could be expected in that the pack in 1935 was only 12,712 cases with an escapement described as "good."

The run of 1941 will be derived from the spawnings of 1936 and 1937. In the former year the pack was 28,562 cases and the escapement was recorded as exceptionally large. This brood-year produced a considerable percentage of four-year-old fish and possibly presages a good return of five-year-old fish. It is this production which is important because the Nass River sockeye are predominantly five-year-old fish, the 5_3 age-group contributing an average of 67 per cent. and the 5_2 age-group 12 per cent. over the period of the past twenty-nine years. In 1937 the pack was 17,567 cases and the escapement was reported as "quite good on the whole." In no year have the four-year-old fish comprised over 35 per cent. of the run and the average over a period of twenty-nine years has been 16 per cent.

(2.) Age-groups.

The analysis of the run of 1940 is based upon data for 1,306 fish obtained in thirty-five random samplings from July 1st to August 16th. The 5_3 age-group has the highest representation with 772 fish or 59 per cent. This percentage is somewhat lower than usual due to an increase in the numbers of 4_2 and 6_3 fish. The other age-groups occurred as follows: 4_2, 296 individuals or 23 per cent.; 5_2, 107 individuals or 8 per cent.; and 6_3, 131 individuals or 10 per cent. (Table XIII.).

(3.) Lengths and Weights.

The average lengths of both sexes in all the age-groups are much above the averages of the past twenty-eight years and establish new high records. The fish of the 4_2 and 5_3 age-

groups are approximately 1 inch above average while those of the 5_2 and 6_3 age-groups are approximately 2 inches above average.

Similarly the average weights of both sexes in all the age-groups are greatly above the averages for the past twenty-six years and set new high records throughout. In the cases of the 4_2 and 5_3 age-groups the weights are approximately 1 lb. above average and for the 5_2 and 6_3 age-groups the increase is approximately 1½ lb.

The data of all three river systems agree in demonstrating that the sockeye proceeding to them in 1940 were exceptionally large. Undoubtedly food and water temperatures are the factors involved.

(4.) Proportions of the Sexes.

The total number of males in the samplings is 669 and of females 637, percentages of 51 and 49 respectively. As a rule the number of females exceeds that of the males in the Nass River population, the average representation over a period of twenty-six years being 53 per cent. The increases in the number of males in 1940 occur in the 5_2, 5_3, and 6_3 age-classes, but in no case with particular significance. The females are in the majority in the 4_2 and 5_3 age-groups with percentages of 52 and 51 respectively, while the males are in the majority in the 5_2 and 6_3 age-groups with percentages of 60 and 68 respectively.

Table XIII.—Nass River Sockeyes, Percentages of Principal Age-groups from 1912 to 1940 and Packs.

Year.	Percentage of Individuals.			
	4_2	5_2	5_3	6_3
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
1938 (21,462 cases)	21	4	70	5
1939 (24,357 cases)	14	13	66	7
1940 (13,809 cases)	23	8	59	10

Table XIV.—Nass River Sockeyes, 1940, 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.	
21½	1	.....	.....	.....	.....	1	.....	.....	2
22	.....	1	.....	.....	.....	.....	.....	.....	1
22½	.....	3	.....	.....	.....	.....	.....	.....	3
23	1	9	.....	1	.....	5	.....	.....	16
23½	1	16	.....	.....	1	3	.....	.....	21
24	9	34	.....	1	2	7	.....	.....	53
24½	7	28	.....	.....	3	8	.....	.....	46
25	20	27	.....	1	4	37	.....	.....	89
25½	27	16	1	8	17	46	1	.....	116
26	32	13	2	6	37	80	.....	.....	170
26½	23	3	6	6	52	75	1	3	169
27	11	4	7	3	82	85	3	3	198
27½	8	1	9	6	61	24	3	6	118
28	1	.....	10	4	79	19	7	11	131
28½	.....	.....	9	2	25	7	7	10	60
29	.....	.....	6	2	9	.....	18	9	44
29½	.....	.....	5	3	2	.....	18	.....	28
30	.....	.....	6	.....	1	.....	12	.....	19
30½	.....	.....	2	.....	.....	.....	10	.....	12
31	.....	.....	1	.....	.....	.....	5	.....	6
31½	.....	.....	.....	.....	.....	.....	4	.....	4
Totals	141	155	64	43	375	397	89	42	1,306
Average lengths	25.6	24.6	28.2	26.8	27.2	26.1	29.3	28.1	.....

Table XV.—Nass River Sockeyes, 1940, 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.	
4	.....	2	.....	.....	.....	.....	.....	.....	2
4½	1	2	.....	.....	.....	1	.....	.....	4
5	3	16	.....	.....	.....	10	.....	.....	29
5½	3	28	.....	2	.....	18	.....	.....	51
6	17	56	.....	.....	6	37	.....	.....	116
6½	25	31	1	4	18	52	.....	.....	131
7	32	15	3	3	49	116	1	3	222
7½	34	3	3	14	72	89	2	5	222
8	20	2	10	7	88	52	4	10	193
8½	2	.....	14	5	80	16	9	5	131
9	1	.....	10	5	41	4	13	9	83
9½	.....	.....	10	2	15	.....	16	7	50
10	.....	.....	5	1	4	.....	24	1	35
10½	.....	.....	4	.....	2	.....	11	.....	17
11	.....	.....	1	.....	.....	.....	6	.....	7
11½	1	.....	1	.....	.....	.....	2	.....	4
12	.....	.....	1	.....	.....	.....	1	.....	2
12½	.....	.....	1	.....	.....	.....	.....	.....	1
Totals	139	155	64	43	375	395	89	40	1,300
Average weights	6.9	6.0	8.9	7.8	8.0	7.0	9.5	8.5	.....

Table XVI.—Nass River Sockeyes, Average Lengths in Inches of Principal Age-groups, 1912 to 1940.

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
1937	23.8	23.3	26.0	24.5	25.0	24.2	27.2	26.3
1938	24.1	23.5	26.0	24.8	25.2	24.4	26.6	26.1
1939	24.9	24.2	26.9	25.8	26.1	25.3	27.9	26.6
Average lengths	24.5	23.7	26.2	25.1	26.1	25.3	27.6	26.3
1940	25.6	24.6	28.2	26.8	27.2	26.1	29.3	28.1

Table XVII.—Nass River Sockeyes, Average Weights in Pounds of Principal Age-groups, 1914 to 1940.

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
1937	5.5	5.2	6.8	6.1	6.2	5.5	7.8	7.0
1938	5.9	5.8	7.4	6.3	6.5	5.8	7.6	6.8
1939	5.3	5.0	6.8	6.1	6.0	5.3	7.1	6.1
Average weights	5.9	5.4	7.2	6.4	6.9	6.1	8.0	6.9
1940	6.9	6.0	8.9	7.8	8.0	7.0	9.5	8.5

Table XVIII.—Nass River Sockeyes, Percentages of Males and Females of the 4_2, 5_2, 5_3, and 6_3 Age-groups, 1915 to 1940.

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
1938	51	49	52	48	40	60	58	42	44	56
1939	51	49	51	49	46	54	61	39	48	52
1940	48	52	60	40	49	51	68	32	51	49
Average	49	51	47	53	45	55	62	38	47	53

TAGGING BRITISH COLUMBIA PILCHARDS (*SARDINOPS CÆRULEA* (GIRARD)): INSERTIONS AND RECOVERIES FOR 1940–41.

By John Lawson Hart, Ph.D., Pacific Biological Station, Nanaimo, B.C.

INTRODUCTION.

The programme of pilchard-tagging and tag-recovery was continued during 1940. The fishery, while definitely better than that during the 1939 season, was not very productive and in consequence opportunities for recovery of tags were correspondingly reduced. The number of tags put out during the course of the season was only some twenty-six hundred. This number, roughly equal to that used in the 1939 season, is only about half that of the tags put out in the seasons 1936–38. The sparse tagging has reduced the number of returns. This report, the fifth in an annual series, covers the tags put out from Canadian fishing-boats during 1940 and returns of Canadian tags made during the summer of 1940 and winter of 1940–41, and all recoveries made in Canadian plants during the summer of 1940.

METHODS.

The methods employed in tagging pilchards agree in essentials with those employed in former years and described in previous reports (Hart, 1937; 1938*a*). The tagger lived on the seine-boat. When a set was made tagging operations were carried out from the seine-boat skiff. Serially numbered nickel-plated iron tags were placed in the body-cavity of the pilchards by the use of a tagging-gun (Hart and Tester, 1938).

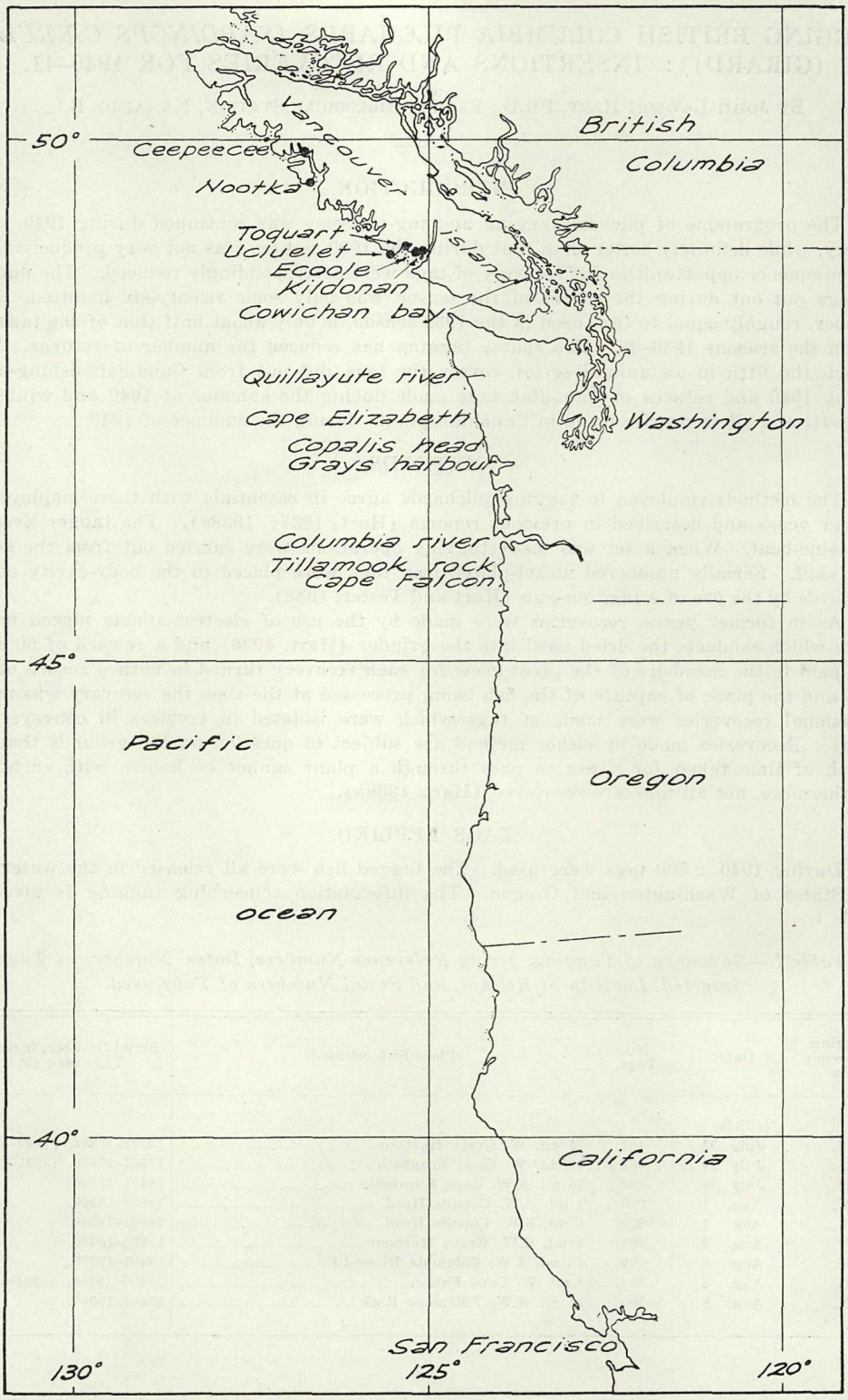
As in former years, recoveries were made by the use of electromagnets placed in the chute which conducts the dried meal into the grinder (Hart, 1936) and a reward of 50 cents was paid to the members of the plant crew for each recovery turned in with a record of the date and the place of capture of the fish being processed at the time the recovery was made. Occasional recoveries were made of tags which were isolated in crevices in conveyers or driers. Recoveries made by either method are subject to question on the grounds that the length of time taken for a tag to pass through a plant cannot be known with certainty. Furthermore, not all tags are recovered (Hart, 1938*b*).

TAGS APPLIED.

During 1940, 2,590 tags were used. The tagged fish were all released in the waters off the States of Washington and Oregon. The information concerning tagging is given in Table I.

Table I.—Summary of Tagging, giving Reference Numbers, Dates, Numbers of Tags inserted, Locality of Release, and Serial Numbers of Tags used.

Tagging Reference No.	Date.	No. Tags.	Place Fish released.	Serial Number, including Tags used (P.).
	1940.			
I.	July 23	497	15 mi. W. Grays Harbour	17201–17300, 17601–18000.
II.	July 29	498	10 mi. W. Cape Elizabeth	17501–17600, 18001–18400.
III.	July 30	200	15 mi. S.W. Cape Elizabeth	18401–18600.
IV.	Aug. 1	300	4 mi. S.W. Copalis Head	18601–18900.
V.	Aug. 1	299	6 mi. S.W. Copalis Head	18901–19200.
VI.	Aug. 2	198	8 mi. S.W. Grays Harbour	19201–19400.
VII.	Aug. 8	100	16 mi. S.W. Columbia River Lt.	19401–19500.
VIII.	Aug. 8	398	8 mi. W. Cape Falcon	19501–19800, 19901–20000.
IX.	Aug. 9	100	15 mi. S.W. Tillamook Rock	19801–19900.


Vancouver
Island
British
Columbia
Ceepeecee
Nootka
Toquart
Ucluelet
Ecoole
Kildonan
Cowichan bay
Quillayute river
Cape Elizabeth
Copalis head
Grays harbour
Washington
Columbia river
Tillamook rock
Cape Falcon
Pacific
ocean
Oregon
California
San Francisco
50°
45°
40°
130°
125°
120°

RECOVERIES.

During the 1940 season six reduction plants in British Columbia processed some 28,000 tons of pilchards. The British Columbia recoveries listed in Table II. were made from these fish. Thirty-nine recoveries were made of tags used in California waters, three of tags put out by the Oregon Fish Commission. No recoveries were made during the unsuccessful season in Washington and eight returns were made by Oregon plants. One return was made from California, at San Francisco, of a tag used off the Quillayute River during July, 1938. It is noticeable that, in general, taggings carried out from Canadian fishing-boats working off the Washington and Oregon coasts have been relatively unsuccessful in producing returns from California during the succeeding winter. Whether this is a result of unfavourable conditions for tagging or is brought about by the movements of the fish cannot be stated at present.

Table II.—Summary of Tag Recoveries during the 1940 Season in British Columbia and of Canadian Tags during the 1940–41 Season in California and Oregon, giving the Year of Tagging and the Political Division making the Recovery.

	Washington.	Oregon.	California.	British Columbia.	Total.
Canadian tags—					
1938	0	0	1	0	1
1939	0	0	0	2	2
1940	0	8	0	33	41
Oregon tags	----	----	----	3	3
California tags	----	----	----	39	39
					86

All of the tagging was done in connection with the fishing during the early part of the season which was carried on off the Washington and Oregon coasts. A considerable number of returns from these taggings were made during the later part of the season by several plants from fish taken off the Vancouver Island coast. These returns appear to be too numerous and to be made by too many plants all to be regarded as having been held up for several weeks in the reduction plants and they consequently establish the movements of fish from the southerly coast of Washington to those fishing-grounds off Vancouver Island frequented during the later part of the season.

TAGGING OF SMALL PILCHARDS.

The pilchard-tagging recorded in this and previous reports of the series has been confined to the rather uniformly large fish which comprise the usual commercial catch. During the autumn of 1940 opportunity was taken to tag a sample of small fish averaging 146 mm. (5¾ in.) in body-length which were abundant in the inshore waters of British Columbia at the time.

The fish for this tagging were caught with a small bait purse-seine and held in the net while tagging was carried out. The tags used were of the same shape but smaller than those used for tagging larger fish and had the following dimensions: 13.1 mm. (approx. ½ in.) long, 1.3 mm. (1/20 in.) wide, 0.70 mm. (1/36 in.) thick, and 0.25 grams (7/1000 oz.) in weight. The method of inserting the tags was similar to that employed in putting the larger tags in larger fish when a gun is not employed (Hart, 1937).

In all, 1,000 tags were used on September 10th, 1940. The fish were caught, tagged, and released in Cowichan Bay and the serial numbers of the tags were from K3000–K3999.

The fish were in good condition at the time of tagging and did not appear to be damaged as a result of handling. However, it is impossible to calculate the extent to which the tagged fish may have contributed to the heavy mortality among the species observed in the general vicinity some four months later.

ACKNOWLEDGMENTS.

The pilchard-tagging programme has continued under the combined sponsorship of the Fisheries Research Board of Canada and the Department of Fisheries of the Province of

British Columbia. The financial aid of both organizations and the encouragement of the executive officers concerned, Dr. W. A. Clemens and Dr. R. E. Foerster, of the Pacific Biological Station, and Mr. George J. Alexander, Assistant Commissioner of Fisheries of British Columbia, is gratefully acknowledged.

Again the work has been forwarded through the co-operation of State fisheries officials in Washington, Oregon, and California who have attended to the recovery of tags in their divisions and have freely supplied information on the fishery producing them. The tags used in tagging small fish were supplied by the California State Fisheries Laboratory.

Acknowledgment is made of the help of the companies who have arranged to install magnets in reduction plants and of reduction-plant employees who have attended to the actual recovery of tags.

Many thanks are due to Mr. Lennard Quickenden, who carried out the arduous work of tagging, and to Captain John Dale and the crew of the "Pacific Queen," from which tagging operations were conducted.

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THE TAGGING OF HERRING (*CLUPEA PALLASII*) IN BRITISH COLUMBIA: INSERTIONS AND RECOVERIES DURING 1940–41.

By John Lawson Hart, Ph.D., Albert L. Tester, Ph.D., and J. L. McHugh, M.A.,
Pacific Biological Station, Nanaimo, B.C.

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INTRODUCTION.

The fifth year of the herring-tagging programme has been completed and this annual report on the work covers the results obtained during the past twelve months. The investigation is intended to (1) test the validity of the assumed existence of local populations deduced as a result of racial studies, (2) determine the extent of herring movements, and (3) further knowledge generally in regard to the herring which supply the British Columbia fishery.

The methods used during the past year were the same as those described in the early papers of the series (Hart and Tester, 1937; 1938; and 1939). They are, however, outlined in the following paragraphs for the benefit of those who have not ready access to the earlier accounts.

TAGGING.

The methods employed in tagging were essentially the same as those of previous years. Herring were captured in beach-seines, small bait purse-seines, or by the use of a large dip-net. They were held for tagging in a bight of the seine, in slat live-boxes, or in the bait-tank of the "Whiff" (Hart and Tester, 1939). Smooth nickel-plated serially numbered magnetic metal tags were inserted in the body-cavities of the fish by the use of a tagging-gun (Hart and Tester, 1938) or a specially designed knife (Hart and Tester, 1937). The gear used in catching the fish for tagging and the methods in tagging are indicated in Table I.

During the past season the tagging of herring on the fishing-grounds was again curtailed. The taggings during the spawning season, however, on the west coast of Vancouver Island and in Central and Northern British Columbia were the most satisfactory in the experience of the investigation. On the other hand, the tagging in the Discovery Passage and Queen Charlotte Sound areas was disappointing, the former because of a comparative failure in herring spawning in the area and the latter because of unfortunate timing of the tagging trip through the area.

Table I.—Summary of the Tagging Data for Taggings producing Returns during the 1940–41 Fishing Season and for Tags inserted during the 1940–41 Fishing Season and the 1941 Spawning Season.

Tagging Code.	Date.	No. of Tags inserted.	Method of Capture of Fish.*	Tagging Method.†	Place of Tagging.
2E	Nov. 18, 25, 1937	700	C.S.	G (?)	Rainy Bay, Barkley Sound.
2I	Mar. 9, 1938	899	B.S.	G, K′ (?)	Calm Creek, Clayoquot Sound.
2K	Mar. 12, 1938	995	B.S.	G	Plumper Harbour, Nootka Sound.
2M	Mar. 25, 1938	1,395	B.S.	G	Bella Bella, Milbanke Sound.
2Q	Mar. 16, 17, 1938	799	S.S.	G, K′	False Narrows, N.W. side.
2S	Apr. 2, 3, 1938	1,196	S.S.	G	Union Bay, Baynes Sound.
3B	Oct. 11, 1938	1,078	C.S.	G	Swanson Channel.
3F	Jan. 11, 1939	197	C.S.	G	Boat Pass, Nootka Sound.
3I	Jan. 15, 16, 17, 19, 20, 1939	1,195	C.S.	G	Kwakshua Passage, Calvert Island.
3J	Mar. 6, 7, 1939	1,299	C.S.	G, K′	Laredo Inlet.
3K	Mar. 2, 5, 1939	945	S.S.	G, K°	Departure Bay, near Nanaimo.
3M	Mar. 9, 1939	997	S.S.	G, K°	Kuleet Bay, near Ladysmith.
3O	Mar. 26, 1939	999	S.S.	G, K°	Pender Harbour (Bargain Harbour).
3P	Mar. 29, 1939	997	S.S.	G, K°	Dodd Narrows, near Boat Harbour.
3R	Mar. 19, 1939	2,192	B.S.	G, K°	Campbell Island, near Brown Narrows.
3S	Mar. 22, 1939	1,797	B.S.	G, K°	Duncan Bay, near Prince Rupert.
3T	Mar. 25, 1939	899	C.S.	G, K°	Butler Cove, near Prince Rupert.
3U	Mar. 7, 1939	1,494	B.S.	G, K′	Toquart Bay, Barkley Sound.
3V	Mar. 19, 1939	1,599	B.S.	G, K′	Off Markdale, Kyuquot Sound.
3W	Mar. 21, 22, 1939	1,491	B.S.	G, K′	Kendrick Arm, Nootka Sound.
3X	Mar. 28, 1939	681	C.S.	K′	Matilda Inlet, Clayoquot Sound.
3Y	Mar. 29,1939	682	C.S.	G, K′	Sydney Inlet.
4A	Oct. 6, 1939	897	S.T.	G	Otter Point, near Sooke.
4B	Oct. 8, 1939	298	C.S.	G	Swanson Channel.
4D	Feb. 15, 1940	200	C.S.	G	Lagoon Bay, Queen Charlotte Islands.
4E	Feb. 17, 1940	200	C.S.	G	Skaat Harbour, Queen Charlotte Islands.
4F	Feb. 27, 1940	1,200	B.S.	G, K′°	Kuleet Bay, near Ladysmith.
4G	Mar. 3, 1940	1,499	B.S.	G, K′°	Ganges Harbour, Saltspring Island.
4H	Mar. 8, 1940	987	B.S.	G, K′°	Off Lantzville.
4I	Mar. 9, 1940	1,199	B.S.	G, K′°	Nanoose Bay, at black buoy.
4J	Mar. 4, 5, 1940	1,799	C.S.	G, K′	Laredo Inlet.
4K	Mar. 13, 1940	1,197	D.N.	G, K′°	Deep Bay, Baynes Sound.
4L	Mar. 17, 18, 1940	1,797	B.S.	G, K′°	Cutter Creek, near Minstrel Island.
4M	Mar. 19, 1940	1,000	B.S.	G, K′°	Shoal Harbour, Gilford Island.
4N	Mar. 21, 1940	999	B.S.	G, K′°	Bend Island, Clio Channel.
4O	Mar. 23, 24, 1940	500	B.S.	K′	Von Donop Creek, Cortes Island.
4P	Mar. 16, 17, 18, 1940	1,150	B.S.	G, K′	Whitepine Cove, Clayoquot Sound.
4Q	Mar. 18, 1940	1,000	B.S.	K′	Refuge Cove, Sydney Inlet.
4R	Mar. 19, 1940	1,199	B.S.	K′	Kendrick Arm, Nootka Sound.
4S	Mar. 20, 1940	996	B.S.	K′	Queens Cove, Esperanza Inlet.
4T	Mar. 21, 1940	1,000	B.S.	K′	Clanninick Cove, at entrance to Kyuquot Sound.
4U	Mar. 24, 1940	1,595	B.S.	K′	Winter Harbour, Quatsino Sound.
4W	Mar. 18, 1940	1,399	B.S.	G, K′	Campbell Island, near Brown Narrows.
4X	Mar. 20, 1940	1,499	B.S.	G, K′	Big Bay, near Prince Rupert.
4Y	Mar. 21, 1940	800	C.S.	G, K′	Butler Cove, near Prince Rupert.
4Z	Mar. 23, 1940	798	B.S.	G, K′	Lake Island, Milbanke Sound.
4AA	Mar. 28, 29, 1940	1,397	B.S.	K′	Head of Toquart Bay, Barkley Sound.
4BB	Apr. 5, 1940	998	B.S.	G, K′°	Melanie Cove.
4CC	Apr. 7, 1940	997	B.S.	G, K′°	Cahnish Bay.
5A	Oct. 23, 1940	200	C.S.	K′	Swanson Channel.
5B	Nov. 25, 26, 1940	997	C.S.	G, K′	Satellite Channel and Fulford Harbour.
5C	Mar. 6, 1941	1,000	B.S.	G, K′	Gabriola Bluff, near Dodd Narrows.
5D	Mar. 8, 1941	975	B.S.	G, K′	Hammond Bay.
5E	Mar. 10, 1941	1,000	B.S.	G, K′	Entrance to Nanoose Bay.
5F	Mar. 11, 1941	974	B.S.	G	Breakwater Island, Gabriola Pass.
5G	Mar. 17, 1941	998	B.P.	G	Bargain Harbour.
5H	Mar. 21, 1941	200	D.N.	K′	Thomas Point, Kingcome Inlet.

* C.S.=commercial seine; B.S.=bait-seine; S.S.=shore-seine; S.T.=salmon-traps; D.N.=dip-net.

† G=gun; K′=fish held with one hand while knife and tag are manipulated with other hand; K°=fish held by one man while another manipulates knife and tag; K′°=both types of knife-tagging used.

Table I.—Summary of the Tagging Data—Continued.

Tagging Code.	Date.	No. of Tags inserted.	Method of Capture of Fish.*	Tagging Method.†	Place of Tagging.
5I	Mar. 17, 1941	1,488	S.S.	G, K′	Campbell Island, near Brown Narrows.
5J	Mar. 20, 1941	1,704	S.S.	G, K′	Duncan Bay, near Prince Rupert.
5K	Mar. 23, 1941	787	S.S.	G	Jap Inlet, Porcher Island.
5L	Mar. 28, 1941	1,697	S.S.	G, K′	Laidlaw Island, Laredo Sound.
5M	Mar. 29, 1941	1,197	S.S.	G, K	Deer Passage, near Bella Bella.
5N	Mar. 30, 1941	1,495	S.S.	G, K′	Kwakshua Passage.
5O	Mar. 4, 1941	1,200	B.S.	K′	Lyall Point, Barkley Sound.
5P	Mar. 5, 1941	995	B.S.	K′	Toquart Bay, Barkley Sound.
5Q	Mar. 8, 9, 1941	1,200	B.S.	K′	Kendrick Arm, Nootka Sound.
5U	Mar. 11, 1941	992	B.S.	K′	Queens Cove, Esperanza Inlet.
5V	Mar. 12, 1941	1,192	B.S.	K′	Clanninick Cove, entrance to Kyuquot Sound.
5W	Mar. 13, 1941	1,989	B.S.	K′	Browning Inlet, Quatsino Sound.
5X	Mar. 14, 1941	998	B.S.	K′	Bunsby Islands, entrance to Ououkinsh Inlet.
5Y	Mar. 16, 1941	1,193	B.S.	K′	Refuge Cove, Sydney Inlet.

* C.S.=commercial seine; B.S.=bait-seine; S.S.=shore-seine; S.T.=salmon-traps; D.N.=dip-net.

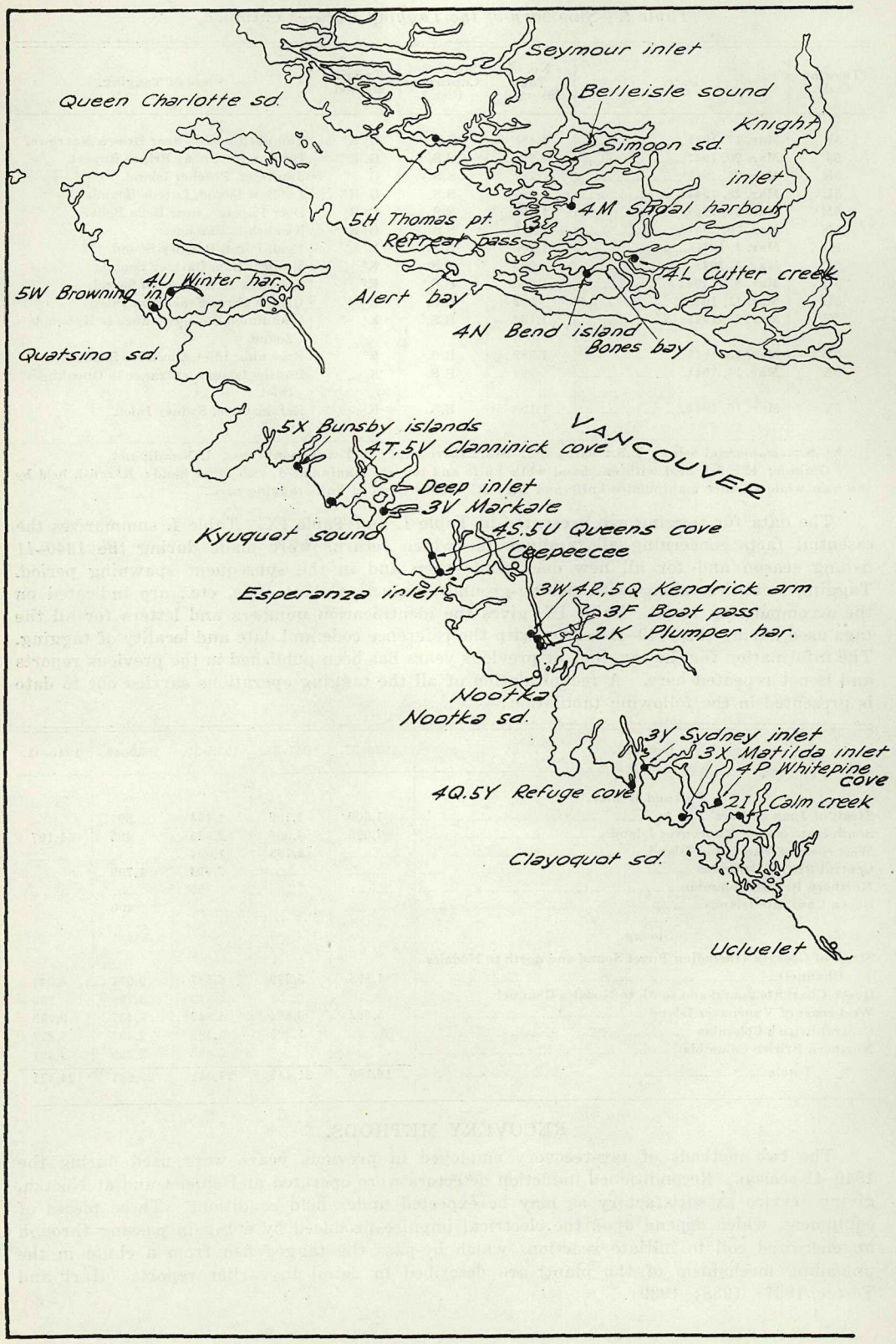
† G=gun; K′=fish held with one hand while knife and tag are manipulated with other hand; K°=fish held by one man while another manipulates knife and tag; K′°=both types of knife-tagging used.

The data for tagging are presented in Table I. and Table IX. Table I. summarizes the essential facts concerning all taggings for which returns were made during the 1940–41 fishing season and for all new ones made then and in the subsequent spawning period. Tagging localities, along with fishing-grounds, reduction-plant sites, etc., are indicated on the accompanying maps. Table IX. gives the identification numbers and letters for all the tags used during the 1940–41 season with the reference code and date and locality of tagging. The information for the taggings of previous years has been published in the previous reports and is not repeated here. A recapitulation of all the tagging operations carried out to date is presented in the following tabulation:—

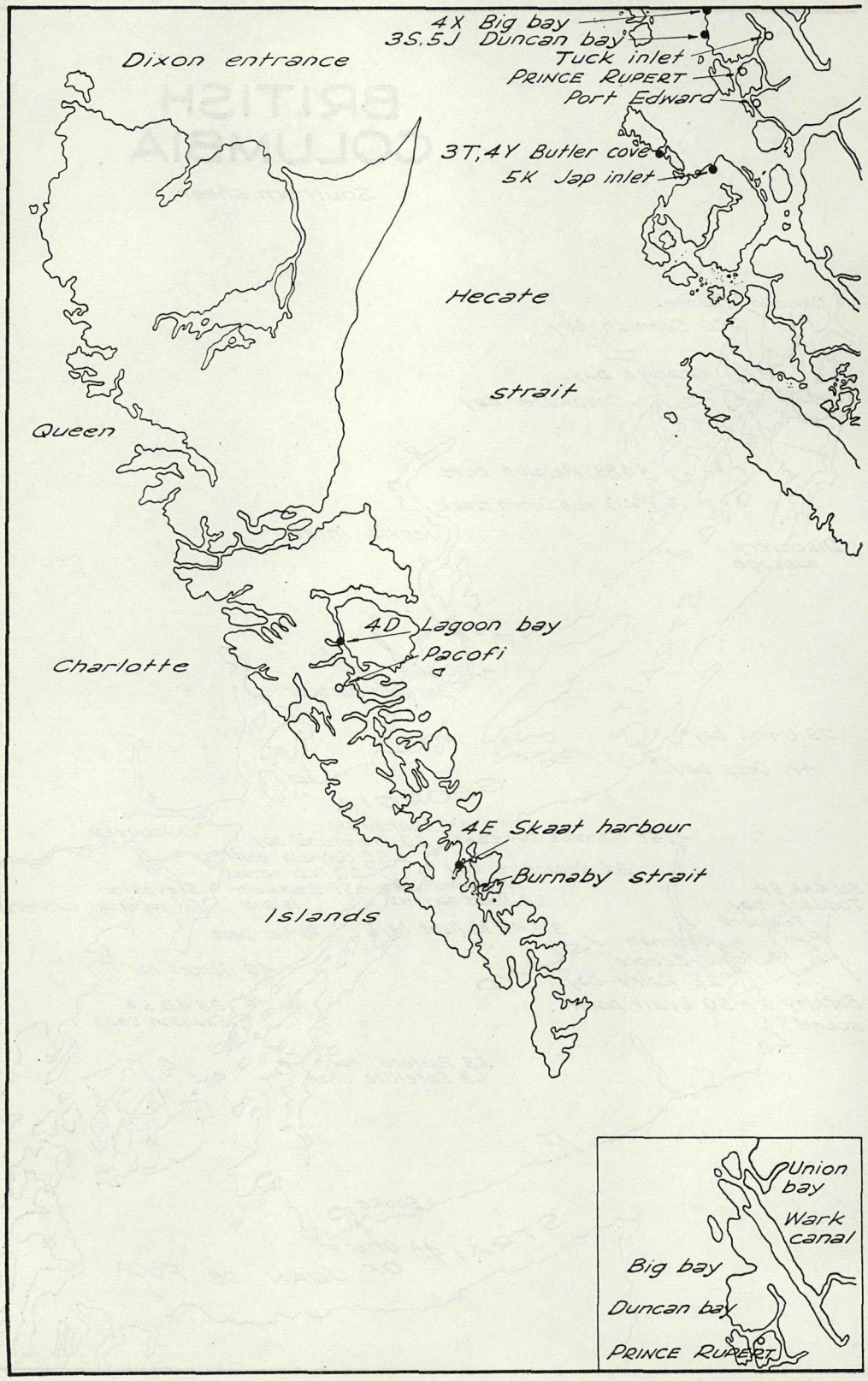
Locality.	1936–37.	1937–38.	1938–39.	1939–40.	1940–41.
Fall and Winter.					
Strait of Juan de Fuca	1,500	1,199	1,454	897	.....
South-east coast of Vancouver Island	7,090	4,086	2,525	495	1,197
West coast of Vancouver Island	.....	2,798	1,094	.....	.....
Central British Columbia	.....	.....	2,494	1,799	.....
Northern British Columbia	.....	.....	755	.....	.....
Queen Charlotte Islands	.....	.....	.....	400	.....
Spring.					
Strait of Georgia (including Puget Sound and north to Nodales Channel)	1,898	5,279	6,587	9,077	4,947
Queen Charlotte Sound and south to Nodales Channel	.....	.....	.....	3,796	200
West coast of Vancouver Island	5,692	6,684	5,947	8,437	9,759
Central British Columbia	.....	1,395	3,489	2,497	5,877
Northern British Columbia	.....	.....	2,696	2,299	2,491
Totals	16,180	21,441	27,041	29,697	24,471

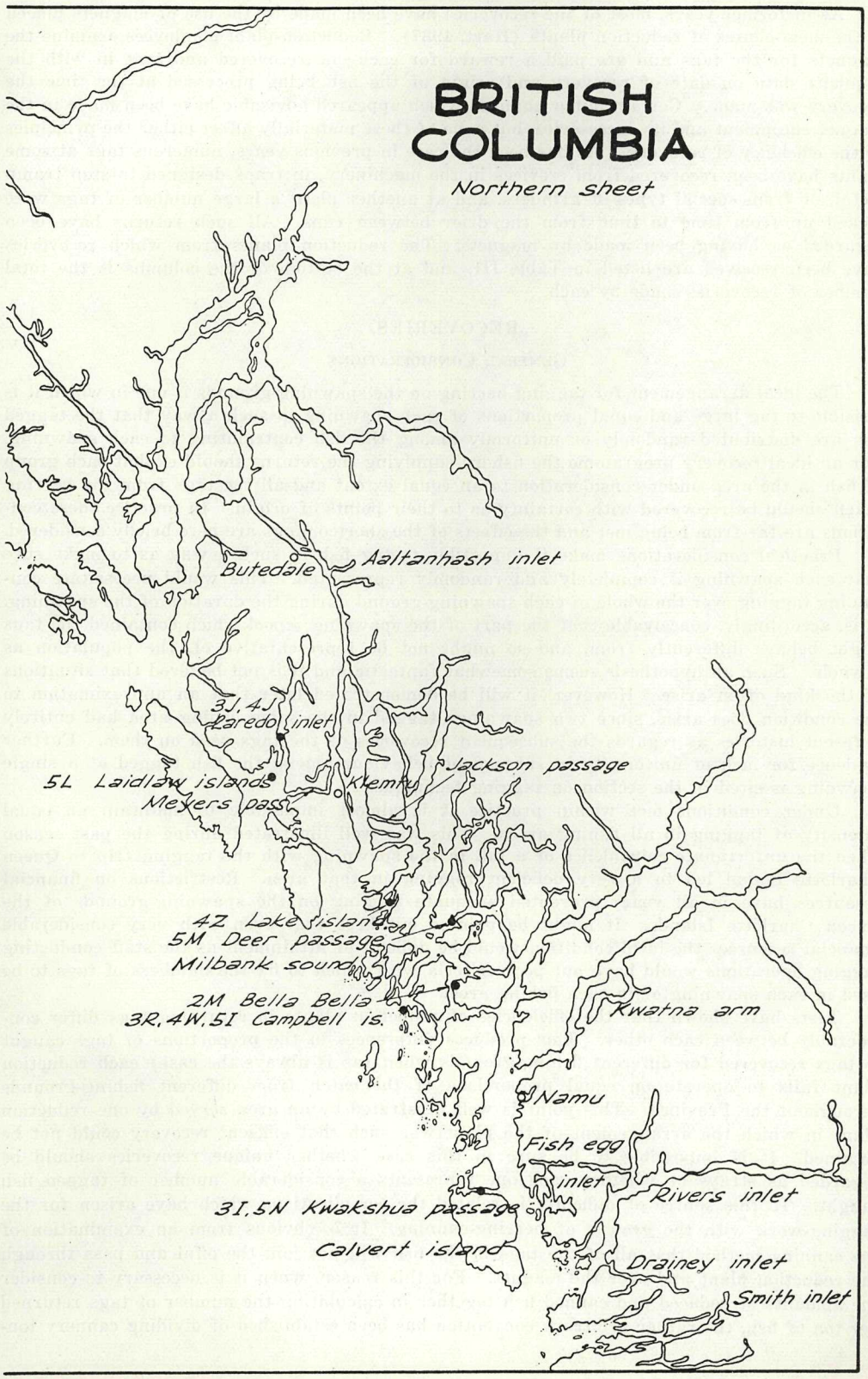
RECOVERY METHODS.

The two methods of tag-recovery employed in previous years were used during the 1940–41 season. Reconditioned induction detectors were operated at Ucluelet and at Nootka, giving service as satisfactory as may be expected under field conditions. These pieces of equipment, which depend upon the electrical impulse produced by a tag in passing through an energized coil to initiate reactions which by-pass the tagged fish from a chute in the unloading mechanism of the plant, are described in detail in earlier reports (Hart and Tester, 1937; 1938; 1939).


Seymour inlet
Queen Charlotte sd.
Belleisle sound
Knight inlet
Simoon sd.
4M Shoal harbour
5H Thomas pt.
Retreat pass
4L Cutter creek
5W Browning in.
4U Winter har.
Alert bay
4N Bend island
Bones bay
Quatsino sd.
VANCOUVER
5X Bunsby islands
4T,5V Clanninick cove
Deep inlet
3V Markale
Kyuquot sound
4S,5U Queens cove
Ceepeecee
Esperanza inlet
3W,4R,5Q Kendrick arm
3F Boat pass
2K Plumper har.
Nootka
Nootka sd.
3Y Sydney inlet
3X Matilda inlet
4P Whitepine cove
4Q,5Y Refuge cove
2I Calm creek
Clayoquot sd.
Ucluelet

BRITISH COLUMBIA
Southern sheet
Okisollo channel
4CC Cahnish bay
Granite bay
Deepwater bay
4BB Melanie cove
4O Von Donop creek
Jervis inlet
Discovery passage
STRAIT OF GEORGIA
3O,5G Bargain harbour
2S Union bay
4K Deep bay
4I,5E Nanoose bay
4H Lantzville
5D Hammond bay
VANCOUVER
5C Gabriola bluff
3K Departure bay
2Q False narrows
Nanaimo
5F Breakwater island
Steveston (Imperial cannery)
3P Dodd narrows
3U,4AA,5P Toquart bay
Toquart
3M,4F Kulleet bay
Portlier pass
Kildonan
ISLAND
Ecoole
2E Rainy bay
4G Ganges har.
Barkley sound
5O Lyall point
3B,4B,5A Swanson chan.
5B Fulford har.
5B Satellite chan.
Sooke
4A Otter pt.
STRAIT OF JUAN DE FUCA


4X Big bay
3S, 5J Duncan bay
Tuck inlet
PRINCE RUPERT
Port Edward
Dixon entrance
3T, 4Y Butler cove
5K Jap inlet
Hecate
strait
Queen
4D Lagoon bay
Pacofi
Charlotte
4E Skaat harbour
Burnaby strait
Islands
Union bay
Wark canal
Big bay
Duncan bay
PRINCE RUPERT


BRITISH COLUMBIA
Northern sheet
Butedale
Aaltanhash inlet
3J, 4J
Laredo inlet
Jackson passage
5L Laidlaw islands
Meyers pass
Klemtu
4Z Lake island
5M Deer passage
Milbank sound
2M Bella Bella
3R, 4W, 5I Campbell is.
Kwatna arm
Namu
Fish egg
inlet
Rivers inlet
3I, 5N Kwakshua passage
Calvert island
Drainey inlet
Smith inlet

As in former years, most of the recoveries have been made by the use of magnets placed in the meal-chutes of reduction plants (Hart, 1937). Reduction-plant employees examine the magnets for the tags and are paid a reward for each one recovered and sent in with the requisite data on date of recovery and origin of the fish being processed at the time the recovery was made. Certain minor changes which appeared advisable have been made in the magnet equipment and its accessories, but none of these materially affect either the principles or the efficiency of recovery. As has been the case in previous years, numerous tags at some plants have been recovered from crevices in the machinery, in traps designed to stop tramp metal, or from special types of grinders, and at another plant a large number of tags were picked up from time to time from the drier between runs. All such returns have been regarded as having been made by magnets. The reduction plants from which recoveries have been received are listed in Table III. and at the bottom of the columns is the total number of recoveries made by each.

RECOVERIES.

General Considerations.

The ideal arrangement for tagging herring on the spawning-grounds is one in which it is possible to tag large and equal proportions of each spawning in such a way that the tagged fish are distributed randomly or uniformly among the fish contributing to each spawning. For an ideal recovery programme the fishery supplying the returns should exploit each group of fish in the area under consideration to an equal extent and all the tags from the herring taken should be recovered with certainty as to their points of origin. In practice these conditions are far from being met and the effects of the shortcomings are here briefly considered.

Practical considerations make it impossible to tag fish in such a way as to make sure that each spawning is completely and randomly represented. This would necessitate continuing tagging over the whole of each spawning-ground during the duration of the spawning. It is, accordingly, conceivable that the part of the spawning school which contained the tags might behave differently from, and so might not be representative of, the population as a whole. Such an hypothesis seems somewhat fantastic and it is not believed that situations of the kind often arise. However, it will be demonstrated later that an approximation to the condition does arise, since two spawnings tagged in the same fishing area had entirely different histories as regards the subsequent recoveries of the tags used on them. Further evidence for lack of uniformity in subsequent behaviour among the fish tagged at a single spawning is cited in the section on tagging technique.

Under conditions met within practice it is almost impossible to maintain an equal intensity of tagging in all fishing areas. This was well illustrated during the past season when the unfortunate coincidence of a lull in the spawning with the tagging trip to Queen Charlotte Sound led to a very deficient tagging in that area. Restrictions on financial resources have in all years prevented adequate tagging on the spawning-grounds of the Queen Charlotte Islands. It might be pointed out here that even with very considerable financial resources the ideal condition would be difficult of attainment as the staff conducting tagging operations would have but poor criteria with which to fix the numbers of tags to be used in each spawning or in each fishing area.

Tests have shown that the efficiencies of reduction plants in returning tags differ considerably between each other. This produces differences in the proportions of tags caught to tags recovered for different fishing-grounds when (as is always the case) each reduction plant fails to operate on equal proportions of the catch from different fishing-grounds throughout the Province. This point is well illustrated by an area served by one reduction plant in which the arrangement of the plant was such that efficient recovery could not be obtained. It is impossible to be sure in this case whether unique recoveries should be regarded as strays or whether each one represents a considerable number of tagged fish caught. To this source of difficulty is related the complications which have arisen for the tagging-work with the growth of herring-canning. It is obvious from an examination of the canning method that all of the tags in the fish will not join the offal and pass through the reduction plant and over the magnet. For this reason, when it is necessary to consider the amounts of reduced and canned fish together in calculating the number of tags returned per ton of fish, the rather arbitrary convention has been established of dividing cannery ton-

nages by two. It will be seen then that a fishing-ground from which a large part of the catch is canned (or especially, if a large part of the catch is salted) will produce fewer tags in proportion to those actually present in the catch than will an area having most or all of its catch passing directly through reduction plants.

Lack of uniformity in the intensity of exploitation is another source of unrandomness in tag-recovery which cannot be avoided in the study of a commercial fishery. The difficulties of this kind can well be illustrated by the situation during the 1940–41 season in which the commercial fishery in Central and Northern British Columbia was so small (about a quarter of that of the previous year) that the opportunity for recovering tags from the fishing-grounds in those areas was correspondingly reduced. This would apply equally to tags which were put out in the spawning-grounds of these areas or to tagged fish which had moved in from other major areas.

There is a wide range in the certainty with which the fishing-ground producing a tag can be fixed. In the case of recoveries made by the induction detectors the degree of certainty is practically perfect. So, too, in the case of certain recoveries made by magnets. In each season of the investigation there have been plants which operated in such a way as to provide absolute certainty concerning the sources of at least some of the tags recovered by it. However, as far as the life-history of the herring is concerned the locations of the induction detectors or the location of the plants producing positive returns are matters of chance, so that the number of positive returns from a particular fishing-ground is not particularly related to the migrations of fish to or from the area. During the past season ninety-two tags were ascribed with certainty to Barkley Sound fishing-grounds, whereas only four recoveries were ascribed with certainty to the Queen Charlotte Sound area. This does not mean that more tags were recovered in Barkley Sound than in the Queen Charlotte Sound area. It is merely a reflection of the opportunity for the positive identification of the origin of the tags.

The foregoing qualifications on the tagging method have been kept in mind in applying the results of the interpretations which follow to conclusions concerning the movements of fish.

Induction Detectors.

One hundred and eight fish were recovered by induction detectors. All of them were fish which had been tagged for six months or more. The recoveries are summarized in Table II., from which it can be seen that all of the tags were from west coast of Vancouver Island taggings and that all were recovered from west coast fishing-grounds. Induction detectors were not operated upon fish from other areas. A discussion of the interchange of fish between the areas of the west coast of Vancouver Island as indicated by the induction detectors is deferred to be included with the discussion of the magnet recoveries.

Table II.—Tags recovered by Induction Detectors during 1940–41.

Code.	Place and Month of Tagging.	Place of Capture.				Total.
		Barkley Sound.	Clayoquot Sound.	Nootka Sound.	Kyuquot Sound.	
3U	Barkley Sound, March, 1939	8	----	----	1	9
4AA	Barkley Sound, March, 1940	4	----	3	2	9
4P	Clayoquot Sound, March, 1940	----	1	2	----	3
4Q	Sydney Inlet, March, 1940	1	----	4	----	5
3F	Nootka Sound, January, 1939	----	----	1	----	1
3W	Nootka Sound, March, 1939	----	----	6	----	6
4R	Nootka Sound, March, 1940	1	----	19	2	22
4S	Esperanza Inlet, March, 1940	1	----	11	5	17
3V	Kyuquot Sound, March, 1939	----	----	2	----	2
4T	Kyuquot Sound, March, 1940	----	----	8	19	27
4U	Quatsino Sound, March, 1940	----	----	----	7	7
						108

Magnets.

In spite of the reduced tonnages of herring processed and the growth of herring-canning, the recovery of tags by magnets has been the most satisfactory since the inception of the investigation. Six hundred and seventy-six decipherable tags were recovered and all of these had been tagged for six months or more.

A summary of these recoveries by tagging and by plants making recovery is given in Table III. It is obvious that such a table, although illuminating, does not provide the best information available in regard to the sources of the individual tags recovered. To obtain a better understanding of the fishing-grounds from which the tags are derived the returns are considered in association with the fish being processed at the time of recovery and the fish which preceded them in the operations of the plant.

The difficulties in making use of magnet recoveries have been dealt with in previous reports. They are briefly: not all of the tags are recovered, since a certain proportion slide over the magnet without being drawn to it. Of the tags which are recovered not all (and some times not any) reach the magnets during operations on the load of fish with which they enter the plant and recoveries two weeks after the tags enter the plants are relatively common. Tests made on the different reduction plants have defined but not removed the difficulty from these sources (Hart and Tester, 1940). The results of the tests have been kept in mind in preparing the comments on the returns from the various taggings which follow.

Barkley Sound (2E): One return almost certainly from Barkley Sound, although the east coast of Vancouver Island is an alternative possibility.

Clayoquot Sound (2I): Two recoveries, one reported from Barkley Sound and the other from Sydney Inlet. Both of these localities are probably correct, but Kyuquot and Nootka Sounds and east coast of Vancouver Island areas are possible alternatives for the Sydney Inlet return.

Nootka Sound (2K): One recovery reported, probably correctly, from Barkley Sound.

Bella Bella (2M): One recovery probably from Laredo Inlet, although a variety of other fishing-grounds in Central British Columbia and Queen Charlotte Sound are possible sources of the tagged fish.

False Narrows (2Q): One recovery probably from the east coast of Vancouver Island as reported. The areas about Alert Bay and Discovery Passage are possible but improbable sources.

Baynes Sound (2S): One recovery probably from the east coast of Vancouver Island as reported. The Alert Bay and Discovery Passage areas are possible sources.

Swanson Channel (3B): One recovery reported from Barkley Sound. This is probably correct, although localities on the east coast of Vancouver Island are possible sources of the tag.

Nootka Sound (3F): One recovery made by induction detector among fish caught in Nootka Sound.

Kwakshua Passage (3I): One tag recovered. The report that this tag was recovered at Laredo Inlet is probably correct. However, other areas in Central British Columbia—including Smith Inlet, Bella Bella, and Kwakshua Passage—and even the Queen Charlotte Sound area are possible places of origin of the tag.

Laredo Inlet (3J): Two tags were recovered and reported from Laredo Inlet, probably correctly. The same alternatives exist as for the 3I tags in the preceding paragraph.

Departure Bay (3K): Three tags recovered. All recorded from the east coast of Vancouver Island, probably correctly. Alternative localities of origin are Barkley Sound for two and Queen Charlotte Sound area for the other.

Kuleet Bay (3M): Four recoveries. Three reported, probably correctly, from the east coast of Vancouver Island. One of the three had Barkley Sound as a possible locality of origin. The remaining tag was reported from Barkley Sound, evidently correctly.

Bargain Harbour (3O): Three returns, two recorded from east coast of Vancouver Island fishing-grounds and one from Barkley Sound. The Barkley Sound report is correct and the other reported areas of recovery are probably correct, but Barkley Sound is an alternative to both of the east coast recoveries.

Dodd Narrows (3P): Two recoveries. One recorded from Barkley Sound and one from the east coast of Vancouver Island. Both of the returns are probably correct. Considering the condition of the tag and the efficiency of the plant in returning tags it is possible that the Barkley Sound tag is a hold-over from the previous season's east coast fish. For the east coast recovery the Queen Charlotte Sound area is an alternative.

Campbell Island (3R): Ten recoveries, five reported from Kwakshua Passage and five reported from Laredo Inlet, all probably correctly. All of the Kwakshua Passage returns had as alternative possibilities other fishing-grounds in Central British Columbia—including Kwatna Inlet, Drainey Inlet, and Klemtu Passage—and such areas in the Queen Charlotte Sound area as Seymour Inlet. Four of the Laredo Inlet returns had as alternative possible sources the localities mentioned above in addition to Smith Inlet and other fishing-grounds in Central British Columbia. The remaining Laredo return had a variety of localities in Northern British Columbia, including the Queen Charlotte Islands, as possible alternatives.

Duncan Bay (3S): Three recoveries. Two reported from Union Bay and the Portland Canal and one from Burnaby Strait, Queen Charlotte Islands. All of these reports are probably correct, although other localities in Northern British Columbia—such as Pearl Harbour and Wark Canal—and even the vicinity of Butedale are possible points of origin for the tags recorded from the mainland.

Butler Cove (3T): One recovery reported from Union Bay. The record is no doubt correct.

Toquart Bay (3U): Thirty-nine recoveries. Thirty-three of the recoveries were recorded as coming from Barkley Sound fish. Fourteen of these records are certainly correct and the rest are probably all or nearly all so. However, fourteen could have originated from east coast fish and five from Nootka or Kyuquot fish. Ten of the fourteen tags which could have originated from east coast fish had additional alternative probable origins as follows: Nootka Sound, one; Nootka and Kyuquot Sounds and Sydney Inlet, seven; Queen Charlotte Sound area, two. Of the six remaining tags one was recorded from "Barkley and Nootka Sounds" and the remaining five were recorded from east coast of Vancouver Island localities, all under circumstances which make origin from Barkley Sound equally probable.

Nine recoveries were made with induction detectors. Of these eight were made from Barkley Sound fish and one from Kyuquot Sound fish.

Kyuquot Sound (3V): Eleven recoveries reported from the following fishing areas: Barkley Sound, three; Sydney Inlet, three; Nootka Sound, two; Kyuquot Sound, three. Of the Barkley Sound returns two are evidently correct and the other is probably so with east coast of Vancouver Island and Queen Charlotte Sound areas as possibilities. The Sydney Inlet returns are probably correct but may have been brought to the reduction plants with herring from Nootka-Esperanza, Kyuquot, or Discovery Passage fishing-grounds. One of the two returns from Nootka Sound is obviously correct, the other is probably so but may have originated in fish taken at Kyuquot Sound or the Discovery Passage area. The following alternative sources are evident for the three returns recorded as coming from Kyuquot Sound: Nootka Sound; Nootka and Barkley Sounds; Clayoquot, Nootka, and Barkley Sounds; and the east coast of Vancouver Island.

Two 3V tags were recovered by the induction detectors from fish caught in Nootka Sound.

Nootka Sound (3W): Four recoveries were reported from the following localities: Barkley Sound, one; Nootka Sound, one; Kyuquot Sound, two. Any of these records may be correct and the Barkley Sound one is certainly so. However, the tag reported from Nootka Sound may have come from Kyuquot Sound and the Kyuquot Sound recoveries may actually have come from fish taken in Nootka Sound in one case and the Nootka Sound-Esperanza Inlet area, the Sydney Inlet-Clayoquot Sound area, or Discovery Passage in the other.

Six 3W tags were recovered by induction detectors, all from fish taken in Nootka Sound.

Matilda Inlet (3X): Five recoveries; two from Barkley Sound, and one each from Sydney Inlet, Nootka Sound, and Kyuquot Sound. The Barkley Sound reports are no doubt correct and the other recoveries may be correctly reported. However, the following possible alternatives exist: For Sydney Inlet, Nootka Sound-Esperanza Inlet area, and Kyuquot Sound; for Nootka Sound, Kyuquot and Barkley Sounds; for Kyuquot Sound, Nootka Sound-Esperanza Inlet area, and Sydney Inlet.

Sydney Inlet (3Y): One recovery correctly reported from Barkley Sound.

Sooke (4A): Three recoveries; two reported from the east coast of Vancouver Island and one from Nootka Sound. All of these reports are probably correct, but the following alternatives are present: One of the east coast returns might have come from Barkley Sound fish and the other might have come from the Discovery Passage area or the Queen Charlotte Sound area. The tag recorded from Nootka Sound might have originated from Barkley Sound or Kyuquot Sound fish.

Swanson Channel (4B): Two returns, both reported from Barkley Sound under conditions which render east coast of Vancouver Island localities as equally probable.

Lagoon Bay (4D): One recovery from the Queen Charlotte Islands.

Skaat Harbour (4E): Two recoveries. One was a partly defaced tag which belonged either to this or the preceding (4D) tagging. The recoveries were made from Queen Charlotte Island fishing-grounds.

Kuleet Bay (4F): Five recoveries. One recorded from Deepwater Bay, three from the east coast of Vancouver Island, and one from Barkley Sound. Although any of these records may be correct the following alternatives exist: For Deepwater Bay, Queen Charlotte Sound area, and Klemtu Passage; for east coast of Vancouver Island (1) for two of the recoveries the Discovery Passage area (quite probable) and Queen Charlotte Sound, (2) for the remaining east coast of Vancouver Island recovery, Barkley Sound and the Discovery Passage area; for Barkley Sound, east coast of Vancouver Island.

Ganges Harbour (4G): One recovery reported from Barkley Sound. The tagged fish came either from that fishing-ground or from one on the east coast of Vancouver Island.

Lantzville (4H): One recovery recorded from the east coast of Vancouver Island area. This is in all probability correct. However, the Discovery Passage and Queen Charlotte Sound areas are also possible.

Nanoose (4I): Ten recoveries reported as follows: Queen Charlotte Sound or Okisollo Channel, one; Kingcome Inlet, one; Deepwater Bay, two; Barkley Sound, one; Kwakshua Passage, one; east coast of Vancouver Island, four. The recovery from "Queen Charlotte Sound or Okisollo Channel" probably originated at one of those localities, although Quatsino Sound is a possible source. The Kingcome Inlet return may be correct. However, other parts of the Queen Charlotte Sound area and Klemtu are possible sources and Nanoose Bay is rather a probable one. The Discovery Passage returns are probably correct, but Queen Charlotte Sound and Klemtu are alternatives. There is no reason to doubt the authenticity of the Barkley Sound return. The tag reported as coming from Kwakshua Passage may have come from other parts of the Central British Columbia area or from the Queen Charlotte Sound areas. Of the four tags recovered from the east coast of Vancouver Island two might have come from the Discovery Passage area or Queen Charlotte Sound and two might have come from Barkley Sound. It is believed, however, that all four of these tags are correctly reported.

Laredo Inlet (4J): Ten recoveries. Eight are from Central British Columbia at Laredo Inlet or Meyers Pass. These reports are doubtless correct, but six of the returns had other areas in Central British Columbia and Queen Charlotte Sound as possible alternatives and the remaining two had these possibilities and Discovery Passage fishing areas in addition. One tag was returned from Nootka Sound fish and concerning it there is no reasonable possibility of error. One return was recorded from Burnaby Pass, Queen Charlotte Islands. This tag may be correctly reported or it may have entered the plant with fish from Central British Columbia or Northern British Columbia.

Deep Bay (4K): Eleven tags were returned and reported as follows: Queen Charlotte Sound and Okisollo Channel, one; Okisollo Channel, one; Knight Inlet and Belleisle Sound, one; Deepwater Bay, five; east coast of Vancouver Island, three. Of the first three tags listed any might have come from other localities in the Queen Charlotte Sound area and two had Quatsino Sound as a possible alternative. The five reports from Deepwater Bay are probably all correct, but four of these have Klemtu Passage and Queen Charlotte Sound as possible alternative sources. Of the three returns from the east coast of Vancouver Island two had possible alternatives in Deepwater Bay (quite probable in one case) and the Queen Charlotte Sound area, and the other had Barkley Sound and Deepwater Bay as possible sources.

Cutter Creek (4L): One hundred and fifty recoveries. All of these but four were reported as coming from fishing-grounds in Queen Charlotte Sound area or that area

and an alternative such as Okisollo Channel or Union Bay. Most of the recoveries came from Knight Inlet and Bones Bay, although such alternatives as Central British Columbia and the Discovery Passage area are possible. It is believed that all of the Queen Charlotte Sound reports are correct as to major recovery area, even if some of the actual fishing-grounds may be reported incorrectly. Of the tags recorded from outside the Queen Charlotte Sound area the two from Deepwater Bay had Bones Bay, Simoom Sound, and Klemtu Passage as possible alternatives; one recorded from Aaltanhash Inlet had the localities just mentioned and Knight Inlet as possible alternatives; and the one reported from Kwakshua Passage had Queen Charlotte Sound and Kwatna Inlet as possible alternatives as well as Seymour Inlet and Drainey Inlet.

Shoal Harbour (4M): Fifty-five recoveries. All but four of these were recorded from Queen Charlotte Sound fishing-grounds or one of them and an alternative such as Okisollo Channel or Deepwater Bay. Most of the recoveries came from Retreat Passage (19) or "Mackenzie Sound or Retreat Passage" (10). It is probable that all of the reports of tag returns from the Queen Charlotte Sound area are correct although the actual fishing-grounds may not be correctly reported. However, alternative sources for many of the tags exist in Central British Columbia and the Discovery Passage area. Of the four tags not recorded from the area three were reported from Okisollo Channel and one from Deepwater Bay. All of these have the Queen Charlotte Sound area as a reasonable alternative.

Bend Island (4N): Forty-five recoveries. Forty-three were recorded from the Queen Charlotte Sound area or that area and some alternative such as Okisollo Channel or Quatsino Sound, and two were reported from the Discovery Passage area. Although alternatives are possible in many cases, it is believed that all of these tags originated in Queen Charlotte Sound. There is little certainty concerning the actual fishing-grounds from which tags originated, but the reported sources were, in order of importance, Bones Bay, Retreat Passage, and Knight Inlet. Of the two recoveries reported from beyond the limit of the Queen Charlotte Sound areas, either might be correct or either tag might have originated with fish from the Queen Charlotte Sound area. For one there are alternative possible sources in Central British Columbia.

Von Donop Creek (4O): Nine returns reported from the following localities: Knight Inlet, two; Bones Bay and Okisollo Channel, two; Bones Bay, one; Deepwater Bay, three; not specified, but from date of recovery and operation record of plant, Sydney Inlet, Esperanza Inlet, or Deepwater Bay, one. The possible alternatives for the localities listed above are as follows: For Knight Inlet, Deepwater Bay, one; Deepwater Bay, areas in Queen Charlotte Sound area and Central British Columbia, one; for Bones Bay and Okisollo Channel, Quatsino Sound, two; for Bones Bay, other areas in Queen Charlotte Sound, Deepwater Bay, and Quatsino Sound, one; for Deepwater Bay, Queen Charlotte Sound, and Central British Columbia fishing-grounds, one; east coast of Vancouver Island and Queen Charlotte Sound, one; the remaining Deepwater Bay record is doubtless correct. It is believed that most of the tags were recovered with fish taken in Okisollo Channel and Deepwater Bay. It would appear, however, that some of the returns were from the Queen Charlotte Sound area.

Whitepine Cove (4P): Twenty-seven recoveries reported as follows: Esperanza Inlet, one; Sydney Inlet, sixteen; Kyuquot Sound, eight; Barkley Sound, two. The Esperanza Inlet return might have been made from fish taken in Nootka Sound, Sydney Inlet, Kyuquot Sound, or Deepwater Bay. Any of the recoveries reported from Kyuquot Sound could have been made with equal likelihood from Matilda Creek fish. The Barkley Sound reports are probably correct, with alternative sources in the east coast of Vancouver Island for one and this locality and the Queen Charlotte Sound for the other. In interpreting these returns it is worthy of note that the plant operating upon 90 per cent. of the Sydney Inlet fish which reached reduction plants recovered twenty-one of the 4P tags and that the plant operating on the remaining 10 per cent. recovered four 4P tags in the two days following the deliveries.

Induction detectors recovered three 4P tags—one from Matilda Creek fish and two from Nootka Sound fish.

Refuge Cove (4Q): Twenty-four recoveries recorded from the following fishing-grounds: Nootka Sound, two; Kyuquot Sound, four; Barkley Sound, eighteen. The Nootka recoveries may have come from Sydney Inlet, Esperanza Inlet, or Deepwater Bay fish. The Kyuquot Sound returns had alternative possible sources as follows: Nootka Sound, two; Nootka

Sound and Barkley Sound, one; Nootka Sound, Esperanza Inlet, Sydney Inlet, and Deepwater Bay, one. Fourteen of the eighteen Barkley Sound returns are evidently correct. The four remaining have the east coast of Vancouver Island as a possible alternative, and one of them has in addition Nootka and Kyuquot Sounds.

Five 4Q tags were recovered by induction detectors—one from Barkley Sound fish and four from Nootka Sound fish.

Nootka Sound (4R): Forty-seven returns. They were reported from fishing-grounds in the following localities: Esperanza Inlet, three; Nootka Sound, seventeen; Kyuquot Sound, fifteen; Sydney Inlet, two; Barkley Sound, nine; east coast of Vancouver Island, one. It is probable that most of these reports are correct, although the only ones for which there are no alternatives are two for Nootka Sound and three for Barkley Sound. The alternative possible sources are all included among the localities listed above. It is evident that most returns were made from fish taken in the Nootka Sound-Esperanza Inlet area, with Kyuquot Sound and Barkley Sound in order of importance accounting for most of the remainder.

Twenty-two returns were made by induction detectors—nineteen from Nootka Sound, two from Kyuquot Sound, and one from Barkley Sound.

Esperanza Inlet (4S): Thirty-five recoveries were recorded from the following fishing-grounds: Esperanza Inlet, three; Nootka Sound, fifteen; Sydney Inlet, four; Kyuquot Sound, five; Barkley Sound, eight. All of these records may be correct, but the only ones for which there are no alternatives are four from Nootka Sound and six from Barkley Sound. The alternatives are included within the list above except that east coast of Vancouver Island is a possible additional alternative for thirteen of the returns.

Seventeen recoveries were made by induction detectors—eleven from Nootka Sound, five from Kyuquot Sound, and one from Barkley Sound.

Kyuquot Sound (4T): Thirty-eight recoveries recorded as follows: Esperanza Inlet, two; Nootka Sound, fourteen; Kyuquot Sound, twelve; Sydney Inlet, four; Barkley Sound, six. Of these reported areas of recovery, only one from Nootka Sound and two from Barkley Sound can certainly be said to be correct. The alternative possible sources are the areas listed above and in addition nineteen of the recoveries had localities on the east coast of Vancouver Island as possible but improbable points of origin for the tags.

Twenty-seven 4T tags were recovered by the induction detectors. Nineteen of these were recovered from Kyuquot Sound fish and eight from Nootka Sound fish. In view of these recoveries it would appear that a relatively high proportion of the magnet returns (say 70 per cent.) actually came from Kyuquot Sound fish.

Quatsino Sound (4U): Twenty-one recoveries. They were recorded as follows: Belleisle Sound and Quatsino Sound, one; Bones Bay and Okisollo Channel, two; Kyuquot Sound, twelve; Nootka Sound, four; Barkley Sound, one; Meyers Pass, one. Many of the reported localities of recovery are, no doubt, correct although many possible alternatives exist. The records of "Belleisle Sound and Quatsino Sound" and "Bones Bay and Okisollo Channel" came from the only plant to operate on Quatsino Sound fish and were made within a few days of that operation. It is believed that all three tags entered the plant in Quatsino Sound fish. Many but not all of the tags reported from Kyuquot Sound were recovered while fishing was taking place outside the sound proper. It is an interesting speculation as to whether these fish would have moved up to Quatsino Sound for spawning later in the season. Any of the recoveries reported as coming from Kyuquot Sound might have originated from Nootka Sound fish and any of the Nootka recoveries could have originated in Kyuquot Sound fish. Errors of the latter kind are considered more probable. Other alternatives such as Sydney Inlet, Barkley Sound, and the east coast of Vancouver Island are possible but improbable. The Barkley Sound return is evidently correct. The record from Meyers Pass is possibly correct and it is evident that this tag was recovered from some fishing-ground in Central British Columbia or the Queen Charlotte Islands (or possibly Queen Charlotte Sound).

Induction detectors recovered seven 4U tags, all from fish taken outside Kyuquot Sound.

Campbell Island (4W): Ten recoveries reported as follows: Meyers Pass, one; Kwakshua Passage, six; Laredo Inlet, one; Burnaby Passage, two. For the Meyers Pass recovery, Laredo Inlet, Bella Bella are reasonable alternatives with other Central, Northern, Queen Charlotte Sound, and east coast of Vancouver Island areas also possible. The Kwakshua Passage recoveries have the other Central British Columbia fishing-grounds and Queen

Charlotte Sound area as possible alternatives. The recovery reported as coming from Laredo Inlet is probably correct but had a wide range of alternatives in Central British Columbia and Queen Charlotte Sound. The recoveries reported from Burnaby Passage may be correct, but the tags were recovered following a run of Laredo Sound fish, which seems like a probable alternative. For these two tags, areas in Northern British Columbia and other fishing-grounds in Central British Columbia are possible alternatives. It will be noticed that no tags from this tagging were recovered by plants which processed large tonnages of east coast of Vancouver Island herring and Queen Charlotte Sound fish but no fish from the Central area.

Big Bay (4X): Five returns reported as follows: From Aaltanhash Inlet, one; Union Bay, three; and Burnaby Passage, one. Examination of the records indicates that the Aaltanhash Inlet record is probably correct although numerous alternative possibilities in Central British Columbia, Queen Charlotte Sound, and east coast of Vancouver Island exist. No important alternatives appear for one of the Union Bay records; Aaltanhash Inlet is an alternative (but improbable) source for another. For the third Union Bay report (probably correct) Aaltanhash Inlet is the most probable alternative and others are to be found in Central British Columbia, Queen Charlotte Sound, and the east coast of Vancouver Island. The tag reported from Burnaby Passage was recovered immediately following a run of fish from Laredo Inlet. Laredo Inlet is accordingly a probable alternative with Aaltanhash Inlet and Northern British Columbia areas possible but less probable. It may be remarked that no tags from this group were recovered by a plant which operated upon large quantities of Queen Charlotte Sound fish but no fish from the Central or Northern areas.

Butler Cove (4Y): One return recorded from Meyers Pass. This would appear to be the most probable source of the tag, but other areas in Central British Columbia, Queen Charlotte Islands, and Queen Charlotte Sound are possible. There is no reason for believing that the tag could have originated in Northern British Columbia.

Lake Island (4Z): Eleven recoveries reported as follows: Aaltanhash Inlet, one; Laredo Inlet, four; Meyers Pass, five; Burnaby Strait or Laredo Inlet, one. All of these reports are possibly or even probably correct. The Aaltanhash tag might have come from Queen Charlotte Sound area fish, east coast of Vancouver Island fish, or fish caught in other parts of the Central area. The Laredo Inlet and Meyers Pass tags had as possible alternatives various fishing-grounds in the Central area, Queen Charlotte Sound, the Northern area, and Queen Charlotte Islands. Plants which did not operate on fish caught in the Central area did not recover any 4Z tags.

Toquart Bay (4AA): Forty-six recoveries recorded as follows: Barkley Sound, thirty-nine; Kyuquot Sound, two; Nootka Sound, one; east coast, two; Barkley or Nootka Sound, one; Belleisle Sound and Bones Bay, one. Of the recoveries reported from Barkley Sound, twenty-five were correct; eight had the east coast of Vancouver Island as an alternative; two had as alternatives the east coast of Vancouver Island, Nootka Sound, Kyuquot Sound, and Sydney Inlet; one had Nootka Sound; and three had the east coast and Queen Charlotte Sound. The Kyuquot reports had Barkley and Nootka Sounds as possible alternatives. The recovery reported from Nootka might have originated with fish from either Barkley or Kyuquot Sounds. The recoveries reported from the east coast of Vancouver Island might have originated with Barkley Sound fish and probably did so. The recovery reported from Barkley Sound or Nootka Sound probably came from Barkley Sound fish, but there is some possibility that the tag entered the plant with fish caught on the east coast of Vancouver Island. From our records it appears possible that the tag recorded from "Belleisle Sound and Bones Bay" entered the plant with fish caught in Quatsino Sound. Otherwise some such fishing-grounds in the Queen Charlotte Sound area as those mentioned or the Discovery Passage area must have supplied the return. In any case the tag did not originate in Barkley Sound or the adjacent fishing areas although the west coast of Vancouver Island appears as a distinct possibility.

Nine returns were made by induction detectors as follows: Barkley Sound, four; Nootka Sound, three; Kyuquot Sound, two.

Melanie Cove (4BB): Seven recoveries reported from the following localities: Deepwater Bay, one; Knight Inlet and Belleisle Sound, three; Bones Bay and Okisollo Channel, two; Okisollo Channel, one. Although numerous alternatives exist among the Queen Charlotte Sound and Discovery Passage fishing-grounds, it seems likely that the localities as reported fairly represent the localities of actual recovery.

Table III.—Tags from each Tagging recovered by each Plant making Recoveries during the 1940–41 Season.

Code.	Locality of Tagging.	Plant making Recovery. (*See* foot-note for fish processed.)												Total.
		Kildonan.	Toquart.	Ucluelet.	Nootka.	Ceepeecee.	Imperial.	Alert Bay.	Namu.	Butedale.	Port Edward.	Tuck Inlet.	Pacofi.	
2E	Barkley Sound	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
3U	Barkley Sound	14	7	11	5	.....	2	.....	.....	.....	.....	.....	.....	39
4AA	Barkley Sound	25	7	6	4	.....	3	1	.....	.....	.....	.....	.....	46
2I	Clayoquot Sound	1	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	2
3X	Matilda Inlet	2	.....	.....	1	2	.....	.....	.....	.....	.....	.....	.....	5
3Y	Sydney Inlet	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
4P	Whitepine Cove	.....	1	4	.....	21	1	.....	.....	.....	.....	.....	.....	27
4Q	Refuge Cove	14	3	1	3	3	.....	.....	.....	.....	.....	.....	.....	24
2K	Nootka Sound	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
3W	Nootka Sound	1	.....	.....	2	1	.....	.....	.....	.....	.....	.....	.....	4
4R	Nootka Sound	3	1	5	22	15	1	.....	.....	.....	.....	.....	.....	47
4S	Esperanza Inlet	6	1	.....	16	11	1	.....	.....	.....	.....	.....	.....	35
3V	Kyuquot Sound	2	.....	1	3	4	1	.....	.....	.....	.....	.....	.....	11
4T	Kyuquot Sound	2	.....	8	17	11	.....	.....	.....	.....	.....	.....	.....	38
4U	Quatsino Sound	1	.....	1	14	1	.....	3	1	.....	.....	.....	.....	21
2Q	False Narrows	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	1
2S	Baynes Sound	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	1
3B	Swanson Channel	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
3K	Departure Bay	.....	1	1	.....	.....	1	.....	.....	.....	.....	.....	.....	3
3M	Kuleet Bay	1	1	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	4
3O	Bargain Harbour	1	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	3
3P	Dodd Narrows	1	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	2
4A	Sooke	.....	1	.....	1	.....	1	.....	.....	.....	.....	.....	.....	3
4B	Swanson Channel	.....	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
4F	Kuleet Bay	.....	1	1	.....	.....	2	.....	.....	1	.....	.....	.....	5
4G	Ganges Harbour	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
4H	Lantzville	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	1
4I	Nanoose	1	2	.....	.....	.....	2	1	1	3	.....	.....	.....	10
4K	Deep Bay	.....	2	.....	.....	.....	2	3	.....	4	.....	.....	.....	11
4O	Von Donop Creek	.....	1	.....	.....	1	1	4	.....	2	.....	.....	.....	9
4BB	Melanie Cove	.....	.....	.....	.....	.....	.....	6	.....	1	.....	.....	.....	7
4CC	Cahnish Bay	.....	.....	.....	.....	1	.....	1	.....	.....	.....	.....	.....	2
4L	Cutter Creek	.....	.....	.....	.....	.....	.....	113	1	36	.....	.....	.....	150
4M	Shoal Harbour	.....	.....	.....	.....	.....	.....	52	.....	3	.....	.....	.....	55
4N	Bend Island	.....	.....	.....	.....	.....	.....	43	.....	2	.....	.....	.....	45
2M	Bella Bella	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1
3I	Kwakshua Passage	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1
3J	Laredo Inlet	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	2
3R	Campbell Island	.....	.....	.....	.....	.....	.....	.....	9	.....	1	.....	.....	10
4J	Laredo Inlet	.....	.....	.....	1	.....	.....	.....	6	2	.....	1	.....	10
4W	Campbell Island	.....	.....	.....	.....	.....	.....	.....	7	1	2	.....	.....	10
4Z	Lake Island	.....	.....	.....	.....	.....	.....	.....	7	3	1	.....	.....	11
3S	Duncan Bay	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1	1	3
3T	Butler Cove	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1
4X	Big Bay	.....	.....	.....	.....	.....	.....	.....	.....	2	3	.....	.....	5
4Y	Butler Cove	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1
4D	Lagoon Bay	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1
4E	Skaat Harbour	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	2
	Total	77	33	42	89	72	24	227	37	60	9	2	4	676

Kildonan: Barkley Sound.

Toquart: Barkley Sound, east coast of Vancouver Island, Deepwater Bay.

Ucluelet: Barkley Sound, east coast of Vancouver Island, Nootka and Kyuquot Sounds, Sydney Inlet.

Nootka: Nootka and Kyuquot Sounds, Barkley Sound.

Ceepeecee: Nootka and Kyuquot Sounds and Sydney Inlet, Deepwater Bay.

Imperial: East coast of Vancouver Island, Barkley Sound, Queen Charlotte Sound and Discovery Passage, Nootka Sound.

Alert Bay: Queen Charlotte Sound, Discovery Passage, Quatsino Sound.

Namu: Central British Columbia, Queen Charlotte Islands and Queen Charlotte Sound.

Butedale: Central British Columbia, Northern British Columbia, Queen Charlotte Islands and Discovery Passage, east coast of Vancouver Island.

Port Edward: Northern British Columbia, Central British Columbia and Queen Charlotte Islands.

Tuck Inlet: Central British Columbia and Northern British Columbia and Queen Charlotte Islands.

Pacofi: Queen Charlotte Islands.

Table IV.—Summarizing the Supposed Source of Tags from each Tagging producing Returns during the 1940–41 Season.

(The entries in this table represent the authors' interpretation of the data based on the amounts and dates for fish delivered to each plant, the plants which failed to make recoveries from certain taggings, and the behaviour of the respective plants in returning tags as found out by tests. Entries which are italicized include one or more returns about which there are no reasonable doubts. Details of the qualifications concerning the various interpretations are given in the text.)

Code.	Locality of Tagging.	Place of Capture.														Total.
		Barkley Sound.	Clayoquot Sound and Sydney Inlet.	Nootka Sound and Esperanza Inlet.	Kyuquot Sound.	Quatsino Sound.	East Coast of Vancouver Island.	Discovery Passage.	Queen Charlotte Sound.	Kwakshua Passage.	Laredo Inlet, including Myers Passage.	Aaltanhash Inlet.	Union Bay and Wark Canal.	Queen Charlotte Islands.	No Interpretation offered.	
2E	Barkley Sound	1	----	----	----	----	----	----	----	----	----	----	----	----	----	1
3U	Barkley Sound	*33*	----	----	----	----	----	----	----	----	----	----	----	----	6	39
4AA	Barkley Sound	*40*	----	1	2	----	----	----	----	----	----	----	----	----	3	46
2I	Clayoquot Sound	*1*	1	----	----	----	----	----	----	----	----	----	----	----	----	2
3X	Matilda Inlet	2	1	1	1	----	----	----	----	----	----	----	----	----	----	5
3Y	Sydney Inlet	*1*	----	----	----	----	----	----	----	----	----	----	----	----	----	1
4P	Whitepine Cove	2	24	1	----	----	----	----	----	----	----	----	----	----	----	27
4Q	Refuge Cove	*18*	----	2	4	----	----	----	----	----	----	----	----	----	----	24
2K	Nootka Sound	*1*	----	----	----	----	----	----	----	----	----	----	----	----	----	1
3W	Nootka Sound	*1*	----	1	2	----	----	----	----	----	----	----	----	----	----	4
4R	Nootka Sound	*9*	2	*20*	15	----	----	----	----	----	----	----	----	----	1	47
4S	Esperanza Inlet	*8*	4	*18*	5	----	----	----	----	----	----	----	----	----	----	35
3V	Kyuquot Sound	*3*	3	*2*	3	----	----	----	----	----	----	----	----	----	----	11
4T	Kyuquot Sound	*6*	4	10	18	----	----	----	----	----	----	----	----	----	----	38
4U	Quatsino Sound	*1*	----	4	12	3	----	----	----	----	1	----	----	----	----	21
2Q	False Narrows	----	----	----	----	----	1	----	----	----	----	----	----	----	----	1
2S	Baynes Sound	----	----	----	----	----	1	----	----	----	----	----	----	----	----	1
3B	Swanson Channel	1	----	----	----	----	----	----	----	----	----	----	----	----	----	1
3K	Departure Bay	----	----	----	----	----	3	----	----	----	----	----	----	----	----	3
3M	Kuleet Bay	*1*	----	----	----	----	3	----	----	----	----	----	----	----	----	4
3O	Bargain Harbour	*1*	----	----	----	----	2	----	----	----	----	----	----	----	----	3
3P	Dodd Narrows	*1*	----	----	----	----	1	----	----	----	----	----	----	----	----	2
4A	Sooke	----	----	1	----	----	2	----	----	----	----	----	----	----	----	3
4B	Swanson Channel	----	----	----	----	----	----	----	----	----	----	----	----	----	2	2
4F	Kuleet Bay	----	----	----	----	----	3	1	----	----	----	----	----	----	1	5
4G	Ganges Harbour	----	----	----	----	----	----	----	----	----	----	----	----	----	1	1
4H	Lantzville	----	----	----	----	----	1	----	----	----	----	----	----	----	----	1
4I	Nanoose	*1*	----	----	----	----	4	3	1	1	----	----	----	----	----	10
4K	Deep Bay	----	----	----	----	----	3	7	1	----	----	----	----	----	----	11
4O	Von Donop Creek	----	----	----	----	----	----	4	4	----	----	----	----	----	1	9
4BB	Melanie Cove	----	----	----	----	----	----	3	4	----	----	----	----	----	----	7
4CC	Cahnish Bay	----	----	----	----	----	----	1	----	----	----	----	----	----	1	2
4L	Cutter Creek	----	----	----	----	----	----	----	*146*	----	----	----	----	----	4	150
4M	Shoal Harbour	----	----	----	----	----	----	----	51	----	----	----	----	----	4	55
4N	Bend Island	----	----	----	----	----	----	----	43	----	----	----	----	----	2	45
2M	Bella Bella	----	----	----	----	----	----	----	----	----	1	----	----	----	----	1
3I	Kwakshua Passage	----	----	----	----	----	----	----	----	----	1	----	----	----	----	1
3J	Laredo Inlet	----	----	----	----	----	----	----	----	----	2	----	----	----	----	2
3R	Campbell Island	----	----	----	----	----	----	----	----	5	5	----	----	----	----	10
4J	Laredo Inlet	----	----	*1*	----	----	----	----	----	----	8	----	----	----	1	10
4W	Campbell Island	----	----	----	----	----	----	----	----	6	2	----	----	----	2	10
4Z	Lake Island	----	----	----	----	----	----	----	----	----	10	1	----	----	----	11
3S	Duncan Bay	----	----	----	----	----	----	----	----	----	----	----	2	*1*	----	3
3T	Butler Cove	----	----	----	----	----	----	----	----	----	----	----	1	----	----	1
4X	Big Bay	----	----	----	----	----	----	----	----	----	----	1	3	----	1	5
4Y	Butler Cove	----	----	----	----	----	----	----	----	----	1	----	----	----	----	1
4D	Lagoon Bay	----	----	----	----	----	----	----	----	----	----	----	----	*1*	----	1
4E	Skaat Harbour	----	----	----	----	----	----	----	----	----	----	----	----	*2*	----	2
	Total	----	----	----	----	----	----	----	----	----	----	----	----	----	----	676

Cahnish Bay (4CC): Two recoveries reported; one from Bones Bay and Okisollo Channel, and the other from Nootka Sound. The former report is probably correct although alternatives are possible in other parts of the Queen Charlotte Sound and Discovery Passage areas and in Quatsino Sound. The remaining tag had the following possible alternatives: Kyuquot Sound, Esperanza Inlet, Deepwater Bay.

The interpretations given in this section are presented in a simplified form in Table IV. In Table V. the same data are given in a summarized form and in Table VI. all the returns for which interpretations are offered are condensed in such a way as to illustrate the amount of movement to and on the west coast of Vancouver Island.

STABILITY OF POPULATIONS AND MOVEMENTS OF HERRING.

The principal purpose of the herring-tagging programme is to determine the extent of herring movements both as to space and numbers taking part, or, conversely, to find out the extent to which herring in British Columbia form local populations. That there is some tendency to form local populations was demonstrated by Tester (1937) by a study of racial characters. He concluded " that intermingling of the runs of herring in British Columbia is limited in extent and the total stock is divided into a number of essentially discrete units or local populations. . . . The designation of these runs as local populations does not preclude the possibility of a slight degree of intermingling between adjacent or closely situated groups." The tagging investigation may then be considered as an attempt to define more precisely the terms " a slight degree of intermingling " and " closely situated groups."

Table V.—Summary of the Supposed Source of Tags from Taggings producing Returns during the 1940–41 Season, according to Major Areas.

(This table is a further condensation of Table IV. and the same qualifications apply respecting the validity of the interpretations offered.)

General Locality of Tagging.	General Locality of Recovery.							No Interpretation offered.
	West Coast of Vancouver Island.	East Coast of Vancouver Island.	Discovery Passage.	Queen Charlotte Sound.	Central British Columbia.	Northern British Columbia.	Queen Charlotte Islands.	
West Coast of Vancouver Island	399	----	----	----	1	----	----	10
East Coast of Vancouver Island	6	24	11	2	1	----	----	4
Discovery Passage	----	----	8	8	----	----	----	2
Queen Charlotte Sound	----	----	----	240	----	----	----	10
Central British Columbia	1	----	----	----	41	----	----	3
Northern British Columbia	----	----	----	----	2	6	1	1
Queen Charlotte Islands	----	----	----	----	----	----	3	----

Consideration of the previous section and examination of Tables II., III., IV., and V. confirms the conclusions deduced from racial analysis. Table II. shows that of the tags recovered by induction detectors from fish caught on the west coast of Vancouver Island all had been used on the west coast of Vancouver Island and a majority of the tags were returned from the same subdivision of the west coast in which they had been used. Table III., presenting data on the tags recovered by each reduction plant making recoveries, demonstrates the way in which the tags recovered by each plant tend to have been used on the spawning-grounds close to the plant and how to a large extent exceptions to this rule can be readily accounted for by the record of fish carried to the plant from other areas. Table V. indicates that, of the 754 tags for which interpretations are offered, 721 (or 96 per cent.) were recovered from fish caught in the same general area in which they were tagged. Considering Tables V. and VI. it is evident that, of the tags used on the west coast of Vancouver Island, 399 were recovered on west coast fishing-grounds as compared with one recovered elsewhere. Of tags used in other areas, 347 were recovered outside of the west coast area as against seven

returned from within that general region. The conditions in regard to interchange of fish between and within fishing areas are considered in greater detail in the following paragraphs.

West Coast of Vancouver Island.

The lack of movement into and out of the west coast of Vancouver Island area has already been mentioned and the evidence is overwhelmingly in favour of what is practical isolation. For that reason further comments will deal with the recoveries which indicate exceptions to general behaviour.

Table VI.—Summary of the Supposed Source of Tags received during the 1940–41 Fishing Season which were used on the West Coast of Vancouver Island or which are interpreted as having been recovered from that Major Area.

(This table is derived from Table IV. and the qualifications concerning the validity of the interpretations of recovery localities apply to it also.)

Locality of Tagging.	Locality of Recovery.					
	Barkley Sound.	Sydney Inlet and Clayoquot Sound.	Nootka Sound and Esperanza Inlet.	Kyuquot Sound.	Quatsino Sound.	Outside West Coast.
Barkley Sound	86	.....	4	5	.....	.....
Sydney Inlet and Clayoquot Sound	25	27	10	5	.....	.....
Nootka Sound and Esperanza Inlet	21	6	76	29	.....	.....
Kyuquot Sound	9	7	22	40	.....	.....
Quatsino Sound	1	.....	4	19	3	1
Outside West Coast	5	.....	2	.....	.....	347

Six tags are interpreted as having reached the west coast from the east coast of Vancouver Island. Five of these, three of them unquestionably correct, were recovered in Barkley Sound, and the sixth was reported from Nootka Sound. It, certainly, was recovered from some area on the west coast of Vancouver Island. Only one tag used on the west coast of Vancouver Island was interpreted as being returned from outside the area. That the tag was not recovered on the west coast of Vancouver Island is certain. Of the tags for which no interpretation is offered, only one requires comment. It is one used in the Barkley Sound area but reported as coming from fish taken in the Queen Charlotte Sound area. The report may be correct, but the tag was recovered on the same day as fish from Quatsino Sound were received at the plant. It is, accordingly, not possible to be certain that the tag originated with fish taken in Queen Charlotte Sound. If it did not do so, Quatsino Sound is the probable place of recovery. All the rest of the tags for which no interpretation is offered were held in doubt, either as to the particular west coast of Vancouver Island fishing-ground producing them or because they were reported from the east coast of Vancouver Island under circumstances which made entrance to the plant with Barkley Sound herring appear equally probable. It is notable that the plants processing east coast of Vancouver Island fish but none from the west coast made no recoveries of west coast tags. Moreover, all the west coast tags (12) recovered by the plant reducing most east coast herring were recorded as coming from herring shipped from Barkley and Nootka Sounds.

Data given in Tables II., VI., etc., may be used to investigate the amount of movement of tagged herring between areas on the west coast of Vancouver Island. A study of Table II. shows that out of 108 tags recovered by induction detectors, sixty-nine or 64 per cent. were returned from the area of tagging; if the Nootka Sound-Esperanza Inlet area and the Kyuquot Sound area are considered together, this figure becomes eighty-six or 80 per cent. Similar calculations from Table VI. show that, out of 399 west coast recoveries, 232 or 63 per cent. were recovered from the same tagging area, or if Nootka Sound-Esperanza Inlet-Kyuquot Sound is considered as a unit, 283 or 71 per cent. are recovered from the tagging area. It will be noted that these two estimates of the extent of segregation are close and that in both cases the estimates involving interpretation are lower than those for which all the areas of recovery

are certain. This may be taken as an indication that the interpretations are impartial or not unduly, if at all, favouring the view that segregation is the general condition. A comparison of the extent of intermixing indicated in previous seasons with that shown during the 1940–41 fishing season reveals the latter as being considerably greater.

There is definite indication of lack of randomness in the distribution of tags on what has been customarily regarded in these reports as a single fishing-ground. A comparison of the tags recovered by Kildonan with those recovered by other plants situated in Barkley Sound illustrates the point under consideration. A tabulation can be compiled in which Kildonan recoveries are compared with those of the combined Toquart and Ucluelet plants under the headings of the various taggings. For the sake of convenience, the taggings outside of Barkley Sound from which there are less than fifteen returns are combined and the taggings 2E, 4P, 4R, and 4T are excluded, the first because there is only one return and the latter three because it is apparent that the tags for these taggings recovered at Ucluelet may well have entered the plant with fish brought in from Nootka and Kyuquot Sounds.

	Kildonan.	Toquart and Ucluelet.
3U	14	18
4AA	25	13
4Q	14	4
Other west coast areas outside of Barkley Sound, excluding 4P, 4R, and 4T	15	3

This method of setting up the data and the subsequent mathematical treatment eliminate the possibility of obtaining a difference which is significant only of the fact that fish were brought in for processing from other areas. They also eliminate sources of error connected with magnet efficiencies, induction detector operations, loss of tags in cannery operations, and differences in tonnages processed. Mathematical treatment of the data presented shows that recoveries differing as much as those indicated would be encountered by chance only once in approximately seventy-five trials. An examination by a similar procedure of the recoveries from the two Barkley Sound taggings which produced a considerable number of returns gives evidence that these tags were not recovered to the same relative extents at the Ucluelet and Kildonan reduction plants. In the following tabulation Ucluelet induction detector recoveries are added to the magnet returns for the Ucluelet plant.

	3U.	4AA.
Kildonan	14	25
Ucluelet, detector and magnet recoveries	17	9

It is evident from examination that relatively more 3U tags were recovered at Ucluelet and relatively more 4AA tags at Kildonan and calculations establish that such a lack of uniformity of results could occur only once in about fifty trials.

The foregoing calculations establish that herring tagged in Barkley Sound in successive years and that herring reaching Barkley Sound fishing-grounds after having been tagged on spawning-grounds outside of Barkley Sound are not distributed randomly among the schools exploited in the area under consideration. The calculations further suggest that Kildonan fishermen on at least a few occasions fished schools of herring which were not set upon by fishermen from the Ucluelet or Toquart plants. In other words, neither the distribution of fish from various sources as indicated by tagging nor the distribution of fishing effort by the different operators could have been random.

There is evidence indicating differential behaviour of the Barkley Sound taggings (3U and 4AA) in regard to movement out of the particular tagging area. From Tables II. and IV. the following tabulation can be prepared. In the 4AA "outside of Barkley Sound" cell is included the one "no-interpretation-offered" recovery which was certainly not taken in

Barkley Sound, but which might have been recovered in Quatsino Sound or in Queen Charlotte Sound.

Interpreted as recovered	3U.	4AA.
In Barkley Sound	41	44
Outside of Barkley Sound	1	9

Mathematical examination of this table shows that a lack of uniformity as great as that shown would occur only once in forty-five trials if the fish represented by the two lots of tags behaved in the same way. It is apparent, accordingly, that the fish represented by the 4AA tagging became dispersed over the west coast to a greater extent than did the fish tagged in Barkley Sound during the previous year.

The distributions of the returns from the two taggings at Sydney Inlet in 1940 differ radically from one another. Accepting the interpreted localities of recovery as shown in Table IV., the following tabulation may be drawn up (including induction detector recoveries):—

Interpreted as returned from	4P.	4Q.
Within the Clayoquot Sound-Sydney Inlet area	25	0
Outside the Clayoquot Sound-Sydney Inlet area	5	29

The difference in behaviour of the two groups of fish is evident to cursory examination and calculations show that so great a difference could not arise by chance in more than a million trials. It may safely be concluded then that fish of the two groups behaved very differently in respect to the extent of their migrations. This difference in behaviour indicates very clearly that final conclusions concerning the movements of herring should not be drawn on the basis of tagging on one spawning-ground in an area. The difference in the distribution of the returns of the 3U and 4AA taggings demonstrates, moreover, that conclusions cannot safely be based on results obtained from a single year's experiments, as taggings carried on in successive years on the same spawning-grounds may produce different results.

In the report on the herring-tagging investigation for 1939–40 it was shown that while there was considerable mixing of the fish tagged at Nootka and Kyuquot Sounds, there was also a distinct tendency for the fish tagged in these two areas to return to the area in which they had spawned in the previous year. The relative strengths of the mixing and "homing" tendencies is illustrated in the following tabulation, which includes both magnet and induction detector recoveries as interpreted, but excludes data not referring to the west coast of Vancouver Island fishing-grounds. The relatively high values encountered in cells *a* and *e* are indicative of the general tendency for the herring to return to the fishing-grounds adjacent to the spawning-grounds of previous seasons. The substantial numbers of returns represented in cells *b* and *d*, on the other hand, indicate that extensive intermixture takes place.

Place of Tagging.	In Nootka Sound and Esperanza Inlet.	In Kyuquot Sound.	Outside of the Nootka-Kyuquot Area.
Nootka Sound and Esperanza Inlet	(*a*) 76	(*b*) 29	(*c*) 27
Kyuquot Sound	(*d*) 22	(*e*) 40	(*f*) 16
Outside of Nootka-Kyuquot area	(*g*) 18	(*h*) 29	(*i*) 142

The degree of independence of the Nootka-Kyuquot area from other west coast areas can be estimated qualitatively by comparing the sum of the values in cells *a*, *b*, *d*, and *e* (167) and the value in cell *i* (142) with the sum in *c* and *f* (43) and in *g* and *h* (47). It might be said, on the basis of these figures, that the Nootka-Kyuquot area is 71 per cent. independent of the rest of the west coast of Vancouver Island as far as herring is concerned. However, this figure cannot be accepted as an exact estimate on account of the errors involved in lack of randomness in both tagging and recovery.

One of the notable features of the recoveries made during the 1940–41 season is the large number of Quatsino Sound tags (4U) returned from Kyuquot and Nootka Sounds. This observation is all the more surprising since both the tagging investigations in previous years and the racial studies have given particularly strong evidence for believing that the degree of isolation for the Quatsino Sound herring population was high. There can be no reasonable doubt but that the twenty-five recoveries (magnet and induction detector) reported from areas outside Quatsino Sound represent the movement of a very considerable body of fish. However, undue emphasis must not be given to these returns for two reasons. In the first place, many of the recoveries were reported from little frequented fishing-grounds toward the outside of Kyuquot Sound and there is some doubt possible as to whether the fish so captured would have entered Kyuquot Sound or returned to Quatsino Sound. The possibility of the movement of a school or shoal of fish from Quatsino Sound to the area outside Kyuquot Sound appears enhanced by the recovery by one plant on a single day of six 4U tags, and no others, at the same time as most of the 4U tags were being recovered from plants operating on Kyuquot Sound fish by both magnets and induction detectors. The second point concerns the concentration of Quatsino tags in the fish caught off Kyuquot Sound. If all 4U tags concerning which doubt is entertained in regard to their origin in Kyuquot Sound are included with those which are known to have originated in that area it can be calculated that twenty-three tags were recovered from the equivalent of about 3,700 tons of fish; that is to say, there were about 0.63 tags per 100 tons of Kyuquot Sound herring. If the interpretation is accepted in regard to the recovery of the three 4U tags from Quatsino Sound fish, it can be calculated that the concentration of tags in the Quatsino Sound fish was more than four tags per 100 tons. In summary it may be said that the evidence of the tag returns shows that the 4U tags were distributed rather unevenly among the herring caught about Kyuquot Sound and that calculations based on a uniform distribution of the tags indicates a much lower concentration in Kyuquot fish than among those caught in Quatsino Sound. The biological implications of these observations are still obscure.

East Coast of Vancouver Island.

The recovery of tags used on the east coast of Vancouver Island and the recovery of tags from fish caught on the east coast of Vancouver Island has three interesting features: the number of returns in both categories is small; no movements into the east coast region were indicated; a considerable number of tags used on the east coast of Vancouver Island were recovered from fish caught in other areas. Two explanations suggest themselves for the small number of tags recovered. The first of these is that owing to faulty technique a high proportion of tagged fish died and that, accordingly, the number of effective tags put out was comparatively small. This explanation appears improbable in view of the fact that no conscious change in technique was made during the period of tagging and that the same methods employed in another area resulted in remarkably good returns. Moreover, the relatively large number of east coast tags reported outside the area does not suggest a failure in the tagging method. The other explanation deals with the recovery of the tags. During the 1940–41 season, in spite of increases in quota on the east coast, the amount of herring actually reduced was not large. If it is considered that canning cuts down the expectation of recovering a tag by 50 per cent., it may be calculated that meal representing the equivalent of about 10,500 tons of herring passed over magnets. This represents about one-third of the fish caught on the east coast of Vancouver Island. It is believed that the small recovery is related to a small opportunity for recovery and this explanation fits in with the failure to make recoveries from the 5A and 5B taggings and the absence of any recoveries among east coast of Vancouver Island fish from taggings carried out in areas outside the east coast of Vancouver Island region. There is a possibility that the low return of east coast of Vancouver Island tags is related to a partial failure of the schools containing the tagged fish to return to the east coast of Vancouver Island fishing-grounds while fishing was still in progress.

Lack of uniformity in the numbers of returns from different taggings has been characteristic of the recoveries from east coast taggings. This year the return of only one tag from 1,499 used at Ganges Harbour would appear significant were it not for the generally poor returns from east coast taggings. It may be noted that there were no returns in the first year from a tagging done in Ganges Harbour in the spring of 1938 and only one in the

following season. Recoveries from Nanoose Bay and Deep Bay are more numerous than from other spawning-grounds. This difference may be the result of the treatment of the fish, fish carrying Deep Bay and Nanoose Bay tags being taken to reduction plants and those carrying other tags being salted or canned. Whatever the full explanation may be, it is evident that lack of randomness in the fishery or in methods of utilization of the fish could not result in differences in proportions recovered if the fish from different spawning-grounds were thoroughly mixed on the fishing-grounds. It is evident, accordingly, that groups of fish which spawn in different places in the Strait of Georgia do not mix indiscriminately with one another and this in turn suggests that the east coast of Vancouver Island population is a complex one not to be adequately understood or administered by regarding it as a unit.

A substantial proportion of the east coast of Vancouver Island tags recovered and especially of the tags used at Nanoose and Deepwater Bays—the more northerly taggings in the Strait of Georgia area—were reported from Discovery Passage fishing-grounds. These recoveries are in keeping with those of Strait of Georgia tags from the Deepwater Bay fish caught during the 1939–40 season.

A difference in behaviour of fish tagged in 1940 from that of fish tagged in 1939 is noticeable in regard to movements away from the Strait of Georgia. Tags put out in 1939 in the Strait of Georgia and interpreted as being recovered away from east coast of Vancouver Island fishing-grounds were returned from the west coast of Vancouver Island. For the most part tags put out during the 1940 season in the Strait of Georgia and interpreted as being recovered beyond the limits of the east coast of Vancouver Island fishery were reported as being returned from Discovery Passage or Queen Charlotte Sound fishing-grounds. The lack of randomness shown in the tabulation could be encountered by chance less than once in one hundred trials.

Interpreted as recovered	3-Series Tags.	4-Series Tags.
On east coast of Vancouver Island fishing-grounds	9	11
On Discovery Passage and Queen Charlotte Sound fishing-grounds	0	12

Discovery Passage.

During the spring of 1940 herring were tagged on the spawning-grounds at three different localities in the area corresponding to the Discovery Passage area of the Federal Fisheries Department's regulations. For different reasons each of these taggings was carried out under conditions which militate against good returns being produced from it. The Von Donop Creek (4O) tagging was carried out on an isolated school of fish (although the main spawning run entered Von Donop Creek several days later) which were small in size and only 500 fish were available for tagging. The Melanie Cove (4BB) tagging was carried out on an isolated school of fish of small size. The Cahnish Bay (4CC) tagging was carried out close to two bait-pounds and seining operations for bait were continued on the spawning-grounds where the tagged fish were released for some three weeks after tagging took place. It is altogether likely, accordingly, that a large proportion of the tagged herring were used for bait without the tags being discovered or recognized. In spite of these disadvantages, tags were recovered from all three taggings and the number of recoveries from Von Donop Creek tags was higher per thousand tags than that for any other tagging in the Strait of Georgia or Discovery Passage areas. Owing to the differences in the efficiency of recovery of tags from fish caught on different fishing-grounds, it cannot be said with certainty that the higher recovery represents a more severe fishing drain on the fish spawning in Von Donop Creek.

The interpreted areas of recoveries for tags used in the Discovery Passage area are almost equally divided between the Discovery Passage area and Queen Charlotte Sound. Either or both of the two returns for which no interpretations are offered may have originated with fish caught on the west coast of Vancouver Island. Owing to overlapping in the fishing in the Queen Charlotte Sound and the Discovery Passage areas it is not possible to state definitely whether or not fish tagged in the latter region were caught in the former. Con-

sidering all the circumstances surrounding the recoveries, it does seem probable that some of the recoveries were made from the Queen Charlotte Sound fishing-grounds.

It is worthy of remark that while relatively many (11) tags from the east coast of Vancouver Island area were interpreted as coming from Discovery Passage fishing-grounds, there was no evidence of any interchange of fish in the opposite direction. This may reflect features in the movements of the fish or may be another manifestation of the poor tag-recovery for fish caught on the east coast of Vancouver Island.

Queen Charlotte Sound.

The recovery of tags from the three taggings carried out in the Queen Charlotte Sound area has been particularly satisfactory in regard to number of returns. Presumably this is a consequence of good conditions for both tagging and recovery. At the present time it is not possible to say whether it is also dependent on the magnitude of the herring population under exploitation in the area. Of 250 tags returned, 240 are interpreted as having come from the Queen Charlotte Sound area. No interpretations are offered for the remaining ten recoveries. It is possible that some or all of these were returned from the Discovery Passage area. The difficulties related to the close connection between the fisheries in Discovery Passage and Queen Charlotte Sound prevent a certain statement being made on this point. However, it is apparent that the evidence is less strong for a movement from Queen Charlotte Sound into Discovery Passage than it is for a movement in the opposite direction. In general it would appear that the Queen Charlotte Sound population of herring is distinctly independent of the other populations of herring.

In the preceding section under the 4L, 4M, and 4N headings are statements indicating that there may be a tendency of undefined strength for the Queen Charlotte Sound population not to mix randomly within itself. The detailed areas of recovery as recorded with the returned tags seemed to indicate that the Cutter Creek tags were returned more frequently from Knight Inlet and Bones Bay. Shoal Harbour (4M) tags apparently were recovered to a large extent from Retreat Passage (or from "Retreat Passage or Mackenzie Sound"). Bend Island (4N) tags were recorded from the following localities in order of number of recoveries: Bones Bay, Retreat Passage, Knight Inlet. The lack of uniformity in the recoveries from different taggings is evident and it is interesting to note that for each tagging the greatest number of recoveries is noted for the fishing-ground closest to the scene of the tagging.

Central British Columbia.

The number of returns from Central British Columbia was low in comparison with the two previous years and this is almost certainly due to the small tonnage of fish reduced—less than 10,000 tons.

One tag used in Central British Columbia was recovered on the west coast of Vancouver Island and four tags used in other major areas were interpreted as being recovered from fish caught in the Central area. One of the latter originally used in the Northern area (4X) was interpreted as coming from Aaltanhash Inlet. As one Central British Columbia (4Z) tag was also interpreted as coming from Aaltanhash Inlet, it is evident that this fishing-ground cannot at the present time be referred with certainty to either the Central or Northern areas.

In the report on herring-tag recovery for the 1939–40 season, differences in the behaviour of different sets of tags in Central British Columbia were discussed. During the present season the numbers of recoveries are not sufficient to indicate differences as significant. However, reference to the recovery records is of interest. Comparatively small amounts of fish were recorded from Kwakshua Passage, but, in spite of this, the number of Campbell Island (3R) tags recovered there was as great as the number recovered in Laredo Inlet where the tonnages handled were several times larger. For the Campbell Island (4W) tagging, six Kwakshua Passage recoveries are to be compared with two from Laredo Inlet. The returns from the Campbell Island taggings are in contrast with those done at Laredo Inlet (4J) and Lake Island (4Z) which produced eight and ten returns respectively as compared with none from Kwakshua Passage. The results are in keeping with those of last year in that Campbell Island tags were principally recovered from Kwakshua Passage, whereas Laredo Inlet tags showed a strong tendency to be returned from Laredo Inlet. The meagre data available this year suggests that the Lake Island spawning is more closely related to the Laredo run than to the runs around Calvert Island.

Northern British Columbia.

Only ten returns are recorded from fish caught in Northern British Columbia and this small number is doubtless associated with the small amount of fish caught in Northern British Columbia during the fishing season. Six of the recoveries were reported from Union Bay and the Wark Canal. One recovery made in Aaltanhash Inlet has already been discussed. One recovery of a Butler Cove (4Y) tag was certainly from Central British Columbia fishing-grounds. One Duncan Bay (3S) tag was recovered on Queen Charlotte Island fishing-grounds. It would appear that the apparently large amount of movement out of the area, combined with no movement into it, is associated as in the case of the east coast of Vancouver Island with reduced possibility for recovery. As fishing was not general throughout the area, final conclusions are not possible. However, the indications are that fish which spawned in Big Bay and Duncan Bay contributed substantially to the fishing-grounds in the Wark Canal and Union Bay.

Queen Charlotte Islands.

Four recoveries were interpreted as coming from herring taken about the Queen Charlotte Islands. Three of these were of tags used at the Queen Charlotte Islands. The remaining one was a Duncan Bay (3S) tag. One of these tags was recovered in the Queen Charlotte Islands fishery during the previous year. The second recovery under conditions which are not altogether favourable for making returns indicates that the movement represented may be both a regular occurrence and of considerable magnitude. However, conclusions are not yet possible in view of the difficult recovery situation and the small number of tags put out in the Queen Charlotte Island fishing-grounds.

CONSIDERATION OF RECOVERIES IN RELATION TO TAGGING TECHNIQUE.

On several occasions tagging has been done in such a way as to allow comparisons of the various techniques employed. Some of the resulting observations are presented herewith. To facilitate consideration of the results only taggings producing more than twenty returns are dealt with in presenting the data in this section.

Table VII.—Comparison of Three Methods of tagging Fish.

+Tagging.	Tagging Method and Number of Recoveries.			
	*4L.	†4L.	4M.	4N.
1	12 K′	8 G	6 K°	2 K′
2	4 K′	6 G	10 K°	4 K′
3	8 G	14 K°	6 G	5 K′
4	15 G	13 K°	3 G	4 G
5	9 G	8 K′	7 K′	4 G
6	6 G	5 K′	5 K′	9 G
7	8 K′	2 K′	3 K′	6 G
8	10 K′	6 K°	5 G	3 K°
9	.....	8 G	7 G	5 K°
10	.....	8 G	3 K°	3 K°

+ Order of tagging by hundreds.
* First day.
† Second day.
G=Gun.
K′=1-man tagging.
K°=2-man tagging.

In the report for last year (Hart and Tester, 1940) comparisons were made between the returns from taggings using the tagging-gun and those in which the fish were incised with a knife and the tag inserted by hand. The results appeared to be inconclusive or in some cases contradictory. Two sets of returns this year lend themselves to a repetition of the comparisons made last year. Forty-eight recoveries were made of 3U tags, twenty-four of which had been tagged by gun and an equal number by knife. These recoveries resulted from 697 gun-tagged fish and 797 knife-tagged fish. It is evident that the small advantage in favour of the gun-tagging is not significant. Thirty 4P tags were recovered, twelve of which resulted from 400 fish tagged by gun and eighteen of which were produced from 750

fish tagged by knife. In this case again a difference which is not significant favours the gun technique.

Returns bearing on three methods of tagging are available for the taggings 4L, 4M, and 4N. The third method of tagging is one in which one operator holds the fish in his two hands while the other makes the incision and inserts the tag. The results are given in Table VII. Examination of the results indicates that in all cases tagging by gun yields more recoveries than the usual method of knife-tagging. However, the two-man knife-tagging does not appear to be materially different from the gun-tagging in point of effectiveness. These results are interesting in that they more or less reverse those of the previous year in which knife-tagging was indicated as being somewhat more effective for the tagger concerned (Hart).

In the case of one tagging there is evidence of a relationship between the tagging method employed and the effectiveness of different recovery methods. The data for the 3U tagging are set out in the accompanying tabulation.

	Returns from	
	Gun-tagging.	Knife-tagging.
By magnets	23	16
By induction detectors	1	8

It is evident from examining the tabulation that for some reason a higher proportion of knife-tagged fish were recovered by induction detectors and calculations show that evidence for differentiation as strong as that indicated could arise by chance only once in one hundred trials. As no reasonable explanation of the observation suggests itself, the facts are presented here without further comment.

Table VIII.—The Number of Recoveries per Hundred Tags related to the Order of tagging and the Tagger.

Tagging.	4R.		4S.		4T.		4U.	
Tagger.	A.	B.	A.	B.	A.	B.	A.	B.
Numbers of returns from successive hundreds of tags	3	6	5	3	7	8	2	1
	3	7	7	1	8	5	4	3
	3	7	8	6	2	2	3	1
	4	5	5	5	8	5	0	0
	9	13	-----	6	9	5	2	2
	3	6	-----	-----	-----	-----	3	0
	-----	-----	-----	-----	-----	-----	3	0
	-----	-----	-----	-----	-----	-----	2	2
Total	25	44	25	21	34	25	19	9
Number of tags used	600	599	400	497	500	500	798	797
Number of tags returned per hundred	4.2	7.3	6.2	4.2	6.8	5.0	2.4	1.1

It is noticeable in Table VII. that the recoveries for the second day of the 4L tagging are lower than for comparable tagging methods on the first day. This suggests the possibility of deterioration in the quality of the fish with holding in the live-box or net. This possibility may be examined by study of Table VII. or of Table VIII. which has been drawn up for other taggings (carried out entirely by one-man knife-tagging) in such a way as to determine both the effect of holding fish and the effect of unconscious differences in technique between two taggers. In it the returns from each hundred tags are listed in order as the tags were used. The order for each tagger is correct, but as the two taggers worked independently there is no certainty of the exact coincidence in time of the hundreds listed as pairs. It is believed that no great discrepancies in this respect exist.

Table VIII. shows differences in the numbers of returns produced from hundred lots of tags applied by different taggers under comparable conditions. It will be noted, however,

that although these differences are large enough in some cases to approach statistical significance they are not consistent and it seems that they are less likely to be due to differences in technique than to a lack of randomness in the dispersion of fish from the spawning-grounds.

Certain coincidences within pairs in the deviation from the range are to be noticed in Table VIII.; that is, the fifth pair in the 4R column, the third pair in the 4T column, and the fourth pair in the 4U column. Deviations of the extent observed would not be considered of any significance if found occurring alone. The repetition in a second series, however, seems unlikely to be the result of chance and it is probable that the coincidences are connected with variation in the chances for survival (or subsequent recovery of the tags) of the tagged fish due to lack of uniformity of conditions on the spawning-grounds. The time at which the coincidence in the 4R tagging occurred agrees closely with the time of high water. No explanations are suggested for the other coincidences.

SUMMARY OF RESULTS.

The results of the herring tagging and recovery programme during the past year are in keeping with those of former years in indicating a tendency for herring to form rather stable populations in each of the major fishing areas and a less well marked tendency for a restriction of interchange of herring between fishing-grounds within major fishing areas. There is a certain amount of interchange of herring between major areas, but evidently such interchange is of relatively slight importance. Interchange between fishing areas within major areas (such as the west coast of Vancouver Island) is more extensive and apparently reaches a magnitude which may be of considerable economic and administrative importance. Comparisons of the 1940–41 results with those for previous years indicate a somewhat greater mixing than noted in former years.

Additional evidence has been obtained to indicate that the herring-fishing grounds in the so-called Discovery Passage area are supported in part at least and probably largely by fish which have spawned in the previous year in the Strait of Georgia area.

The fishing-grounds of the Queen Charlotte Sound area are indicated as being relatively independent of the spawning-grounds in other major fishing areas.

ACKNOWLEDGMENTS.

The herring-tagging programme has enjoyed the help and co-operation of the fishing industry as a group and of many individuals engaged in it. We are greatly indebted to British Columbia Packers, Limited, and The Canadian Fishing Company, Ltd., for the loan of boats used in tagging operations. Many thanks are due to the companies and also to the crews of the boats, Captains E. Bostrom and J. Bordwick, and Messrs. O. Anderson, Z. Brnjac, M. Carefoot, and W. MacDonald. Mr. S. Vollmers, operating the "Whiff," gave valuable help in the same phase of the investigation.

The continued interest of the companies operating reduction plants as evidenced by permitting the operation of recovery equipment in their conveyers and the help of plant employees who have attended to clearing the magnets and reporting returns are appreciated.

Dr. R. V. Boughton and Mr. L. Quickenden, of the Biological Station staff, have co-operated capably in the investigation and their invaluable help is gratefully acknowledged.

The herring-tagging programme is carried out under a joint arrangement between the Fisheries Research Board of Canada and the Provincial Department of Fisheries. The support of both organizations and that of the respective executive officers, Dr. W. A. Clemens and Dr. R. E. Foerster, and Mr. George J. Alexander, is hereby acknowledged.

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Table IX.—Detailed List of Tags inserted during 1940–41.

Identification Marks.	Date released.	Tagging Code.	Where released.	No. of Tags used.
H88201–H88700	Nov. 25, 1940	5B	Satellite Channel	498
H88701–H89200	Nov. 26, 1940	5B	Fulford Harbour	499
H99401–H99600	Oct. 23, 1940	5A	Swanson Channel	200
AAAA	Mar. 8, 1941	5D	Hammond Bay	975
AABB	Mar. 6, 1941	5C	Gabriola Bluff	1,000
AAHH	Mar. 20, 1941	5J	Duncan Bay	508
AAII	Mar. 8, 1941	5Q	Kendrick Arm	1,000
AAJJ	Mar. 12, 1941	5V	Clanninick Cove	993
AAKK	Mar. 10, 1941	5E	Nanoose Bay	1,000
AALL	Mar. 4, 1941	5O	Lyall Point	1,000
AAMM	Mar. 28, 1941	5L	Laidlaw Islands	1,000
AANN	Mar. 11, 1941	5F	Breakwater Island	974
AAOO	Mar. 13, 1941	5W	Browning Inlet	997
AAPP	Mar. 20, 1941	5J	Duncan Bay	997
AATT	Mar. 17, 1941	5I	Brown Narrows	1,000
AAXX	Mar. 30, 1941	5N	Kwakshua Passage	496
AAZZ	Mar. 11, 1941	5U	Queens Cove	492
AA44	Mar. 23, 1941	5K	Jap Inlet	487
AA66	Mar. 16, 1941	5Y	Refuge Cove, Sydney Inlet	493
BBBB	Mar. 13, 1941	5W	Browning Inlet	493
BBHH	Mar. 29, 1941	5M	Deer Passage	497
BBII	Mar. 28, 1941	5L	Laidlaw Islands	498
BBJJ	Mar. 17, 1941	5G	Bargain Harbour	498
BBKK	Mar. 17, 1941	5G	Bargain Harbour	500
BBNN	Mar. 5, 1941	5P	Toquart Bay	499
BBOO	Mar. 5, 1941	5P	Toquart Bay	496
BBPP	Mar. 14, 1941	5X	Bunsby Islands	500
BBSS	Mar. 13, 1941	5W	Browning Inlet	499
BBUU	Mar. 14, 1941	5X	Bunsby Islands	498
BBXX	Mar. 29, 1941	5M	Deer Passage	500
BBZZ	Mar. 30, 1941	5N	Kwakshua Passage	500
BB44	Mar. 28, 1941	5L	Laidlaw Islands	199
HHAA	Mar. 17, 1941	5I	Brown Narrows	198
HHBB	Mar. 30, 1941	5N	Kwakshua Passage	200
HHJJ	Mar. 23, 1941	5K	Jap Inlet	200
HHKK	Mar. 30, 1941	5N	Kwakshua Passage	200
HHLL	Mar. 21, 1941	5H	Thomas Point	200
HHNN	Mar. 29, 1941	5M	Deer Passage	200
HHOO	Mar. 11, 1941	5U	Queens Cove	200
HHSS	Mar. 16, 1941	5Y	Refuge Cove, Sydney Inlet	200
HHUU	Mar. 16, 1941	5Y	Refuge Cove, Sydney Inlet	200
HHXX	Mar. 4, 1941	5O	Lyall Point	200
HHZZ	Mar. 16, 1941	5Y	Refuge Cove, Sydney Inlet	200
HH44	Mar. 20, 1941	5J	Duncan Bay	199
HH66	Mar. 9, 1941	5Q	Kendrick Arm	200
IIBB	Mar. 12, 1941	5V	Clanninick Cove	100
IIJJ	Mar. 11, 1941	5U	Queens Cove	100
IIKK	Mar. 17, 1941	5I	Brown Narrows	92
IIMM	Mar. 30, 1941	5N	Kwakshua Passage	99
IINN	Mar. 17, 1941	5I	Brown Narrows	99
IITT	Mar. 12, 1941	5V	Clanninick Cove	99
IIXX	Mar. 23, 1941	5K	Jap Inlet	100
II66	Mar. 11, 1941	5U	Queens Cove	100
JJAA	Mar. 11, 1941	5U	Queens Cove	100
JJBB	Mar. 16, 1941	5Y	Refuge Cove, Sydney Inlet	100
VVII	Mar. 17, 1941	5I	Brown Narrows	99
				24,471

THE EDIBLE MOLLUSCS OF BRITISH COLUMBIA.

By D. B. Quayle, Pacific Biological Station, Nanaimo, B.C.

Nearly all the molluscs along the coast of British Columbia are edible. Most, however, are small in size or difficult to obtain; some are unpalatable and hence are seldom eaten, but certain forms are used and valued as food. In the present report a means is presented, chiefly by the use of diagrams, for identifying these latter.

Molluscs vary so radically in form that many are not easily recognizable as such. Clams and oysters are quite common and well-known, yet snails, squids, and octopuses are all true molluscs. Although superficial resemblances are not great, the anatomical details show very clear relationships. To clarify these relationships, molluscs have been divided into a number of classes and, as a general guide, a number of these are described herein.

CLAMS AND OYSTERS.

(Pelecypoda.)

Clams, oysters, and scallops have two shells and are thus called bivalves (Pelecypoda). These have adopted many ways of life. Some burrow into sand, mud, rocks, or wood; some become attached to rocks or other solid objects; others, like the free-living scallops, are able to swim for short distances. The food consists of small plants and animals, and microscopic particles of decayed marine vegetation. These they filter from the water by means of net-like gills.

In identifying bivalves various characteristics of the shell are used, and these are indicated in Figs. 1 and 2. Due to the many types of environment in which a clam may become lodged, considerable variation may exist in the external markings of the shell, but the interior markings and structures are less likely to vary and are thus of greater value for identification purposes.

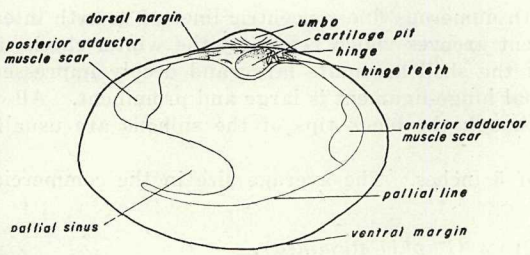


Fig 1

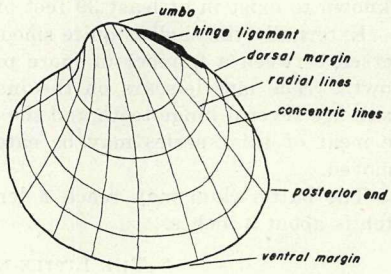


Fig. 2

In the main, anatomical details are neglected, but it might be well for the observer to consider this feature and to become acquainted with the outstanding differences between the various species. Some of these, such as the shape and position of muscles, are reflected in the internal markings of the shell.

The soft body of the bivalve is enclosed in and is protected by the two chalky shells or valves. The shell is composed of three layers of material. The outside layer is of a horny composition and is so thin that in most species it is worn off except around the edges of the shell where new growth may have just taken place. This layer is called the periostracum. The middle layer, of a chalk or limestone composition, is called the prismatic layer and takes up most of the thickness of the shell. The inner layer is very hard and in some species is very shiny. This is the nacre which, in some types of shell-fish, forms mother of pearl. The shells are hinged along the back or dorsal part of the clam by means of a horny elastic material visible from the outside and called the hinge-ligament. This tends to spring the valves apart, which it does when the body of the clam is removed from the shells. In the living animal the shells are held together by two powerful adductor muscles, one at each end of the body. (In scallops and oysters there is only one adductor muscle.) In connection with the ligament there may be an internal cartilage, also horny in composition, which is usually attached to the shells in sunken pits.

Near the hinge-ligament and usually in front of it are knobs or projections of the shell called the umbones. The shape of the bivalve when it was very small can often be seen near the hinge line at the tip of the umbo, which is the oldest part of the shell.

Also on the exterior of the shell is a series of lines whose prominence varies with the species. Some are concentric about the umbones and are fine lines of growth. Among these are dispersed heavier lines indicating winter-checks by which, in some species, the age of the organism may be determined. Other lines may radiate out from the umbo towards the ventral edge of the shell. Concentric lines occur on nearly all species but with varying degrees of prominence, while radiating lines occur only on a few.

The inside of the shell is usually quite smooth except for scars caused by the attachment of muscles to the shells. The adductor-muscle scars are usually more or less circular in outline and are found at the upper part of ends of the shells. Connecting these is a finer line called the pallial line which marks the place of attachment of the mantle to the shell. In the posterior portion of the shell the pallial line is indented to form the pallial sinus. The shape, size, and position of these markings are of considerable importance in identification.

Also on the interior of the shell near the umbo is a heavy ridge which may be studded with projections or teeth of various sizes, shapes, and combinations. The form of these hinge-teeth is constant for each species, so they are also an important means of identification. The purpose of the teeth is to form a locking device to hold the shell together to prevent slipping.

THE BUTTER-CLAM (*Saxidomus giganteus*).

(Plate I.)

The butter-clam, the most abundant of British Columbia clams, is the species used most extensively for canning. It is widely distributed over the Province, and although it may live in many types of soil it occurs most frequently on beaches composed of a mixture of sand and gravel, at a depth of not more than a foot below the surface of the beach. In vertical distribution it occurs in approximately the lower third of the intertidal zone. In one locality it is known to exist in at least 30 feet of water.

Externally the shell is quite smooth, with numerous fine concentric lines of growth interspersed between a number of more prominent grooves which represent the winter-checks in growth. The muscle-scars on the inside of the shell are quite large and deeply impressed. There are several hinge-teeth and the external hinge-ligament is large and prominent. All of the meat of this species may be eaten, although the black tips of the siphons are usually removed.

The butter-clam may reach a length of 5 inches. The average size in the commercial catch is about 3 inches.

THE LITTLE-NECK CLAM (*Paphia staminea*).

(Plate I.)

The little-neck clam or rock-cockle is widely distributed over the British Columbia coast and is found on nearly every type of beach. The typical habitat, however, is a mixture of pebbles and fine mud. Because of its comparatively small size and its ability to close its shells tightly together, thus preventing the loss of moisture, the little-neck clam is most suitable for the fresh market.

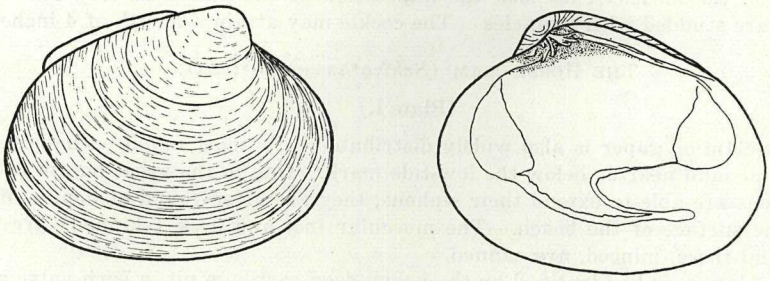
The shells, which are pure white or cream-coloured, with angular brown markings, have numerous fine radiating lines as well as many concentric ones. The muscle-scars are clearly outlined and the hinge-teeth are quite prominent. The average size is about 2 inches but a length of nearly 3 inches may be attained.

THE COCKLE (*Cardium corbis*).

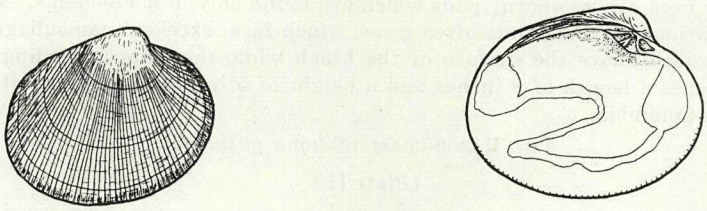
(Plate I.)

The cockle, heart-cockle, or basket-cockle, is distributed generally over the British Columbia coast, but in no great abundance. The typical habitat is a rather sandy or muddy beach. It occurs often among eel-grass on such beaches, over which it can move by the use of its muscular foot.

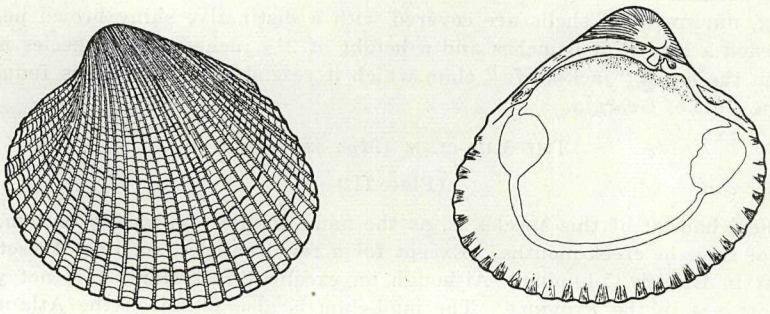
This species is easily identified by the thirty-seven prominent radiating ribs and by the dark brown colour. The external hinge is small, the interior of the shell has a polished



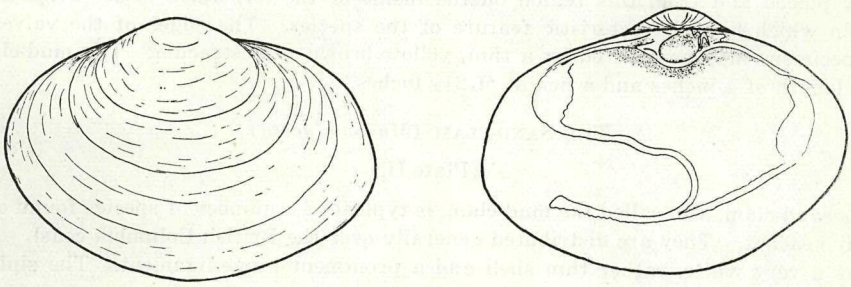
Butter clam



Little neck clam



Cockle



Horse clam

PLATE I.

appearance, and the muscle-scars lack the impression of the pallial sinus. The tips of the short siphons are studded with tentacles. The cockle may attain a length of 4 inches.

THE HORSE-CLAM (*Schizothærus nuttalli*).

(Plate I.)

The horse-clam or gaper is also widely distributed. Its most favoured habitat is a mixture of mud and sand near or below the low-tide mark. Due to the great length to which the larger specimens are able to extend their siphons, they are often found at depths of 2 feet or more below the surface of the beach. The muscular foot and neck (skinned) are the choice edible parts and these, minced, are canned.

The horse-clam may be identified by the heavy deep cartilage pit in each valve and by the manner in which the posterior ends of the shells gape. The very large neck or siphon, which can not be completely withdrawn into the shells, is covered with a thick, dark, wrinkled skin. At the tip of the neck are two horny pads which are found only in horse-clams. On these pads barnacles and various marine plants often grow, which form excellent camouflage for the neck when it is protruded above the surface of the beach while the clam is feeding. The horse-clam, which reaches a length of 8 inches and a height of 5 inches, is the largest bivalve to be found in British Columbia.

THE RAZOR-CLAM (*Siliqua patula*).

(Plate II.)

The razor-clam or razor-neck clam is found only on the sandy surf-swept beaches of the open west coasts of Vancouver and the Queen Charlotte Islands. It is one of the few clams that can burrow into the beach with any degree of rapidity as contrasted with most of the burrowing bivalves, which seldom move once they are entrenched in the sand. This species is canned at infrequent intervals in British Columbia, the supply for these operations coming from Graham Island.

The long, narrow, thin shells are covered with a distinctive shiny brown periostracum. They may reach a length of 6 inches and a height of 2½ inches. This species must not be confused with the small "jack-knife" clam which it resembles and which is found on sandy beaches in the Gulf of Georgia.

THE MUD-CLAM (*Mya arenaria*).

(Plate II.)

The typical habitat of this species is, as the name implies, on muddy bottom, usually in the vicinity of river or creek mouths. Except for a few localities, such as Masset Inlet, it is not abundant in British Columbia. Although an excellent food-clam, it is not yet of commercial importance in the Province. The mud-clam is also found on the Atlantic coast of North America where it is called the soft-shell clam.

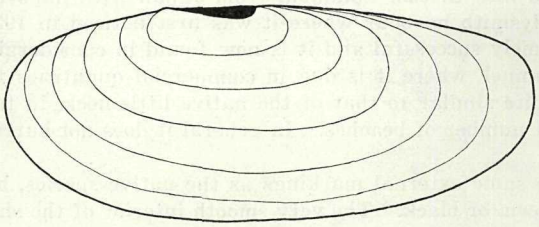
As the alternative name indicates, the shells of this species are thin and easily broken. The posterior end is rather pointed and the anterior end quite blunt. The umbones are centrally placed and from this region on the inside of the left valve issues a spoon-shaped projection which is a characteristic feature of the species. The edges of the valves of the living specimens may be covered by a thin, yellow brown periostracum. The mud-clam may attain a length of 4 inches and a height of 2½ inches.

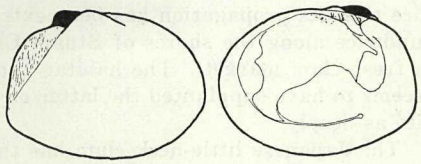
THE SAND-CLAM (*Macoma secta*).

(Plate II.)

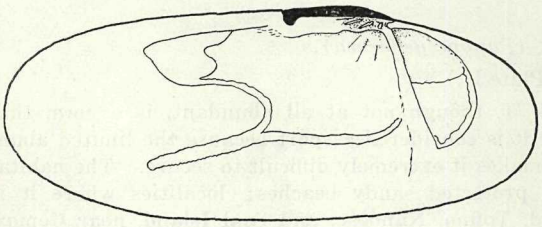
This sand-clam, also called the mud-clam, is typical of a number of species found on sandy or muddy beaches. They are distributed generally over the British Columbia coast. *Macoma secta* has a very white, rather thin shell and a prominent hinge-ligament. The siphons are long and separate.

Despite the fact all species of *Macoma* are edible, they are seldom used here, for most of them are quite small and their abundance is limited. *Macoma secta* may attain a length of 3 inches.



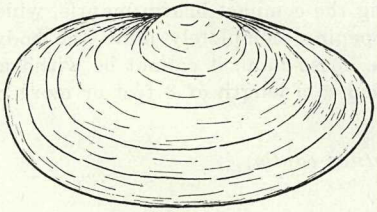


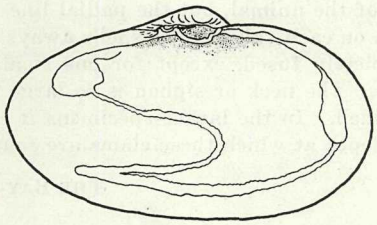
Sand clam



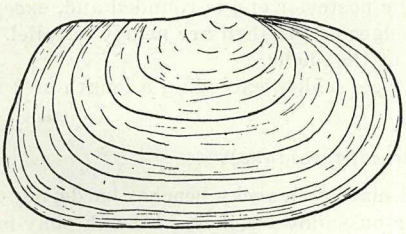
Mud clam, dorsal view

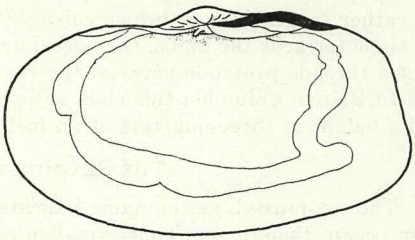
Razor clam





Mud clam





Geoduck

PLATE II.

THE JAPANESE LITTLE-NECK CLAM (*Paphia philippinarum*).

This clam was accidentally introduced into British Columbia from Japan with imported oyster-seed. It became established in Ladysmith harbour where it was first noticed in 1936. Since then its propagation has been extremely successful and it is now found in considerable abundance along the shores of Stuart Channel, where it is dug in commercial quantities for the fresh-clam market. The habitat is quite similar to that of the native little-neck, in fact it seems to have supplanted the latter on a number of beaches. In general it does not burrow quite as deeply.

The Japanese little-neck clam has the same external markings as the native species, but in colour it may be mottled with green, brown, or black. The very smooth interior of the shell has a yellow tinge and the posterior margin may be coloured purple. The length of the shell, seldom exceeding 2 inches, is greater in proportion to the height than in the native "little-neck." One definitely distinguishing feature is the fact that the tip of the siphon is split for a distance of one-quarter of an inch.

THE GEODUCK (*Panope generosa*).

(Plate II.)

The geoduck (pronounced "gooeyduck"), though not at all abundant, is a clam that arouses considerable interest. Digging for it is considered a sport because the limited abundance and the great depth at which it lives makes it extremely difficult to secure. The habitat of the geoduck is confined to fairly well protected sandy beaches; localities where it is definitely known to exist are Sidney Island, Tofino, Nanoose, and Seal Island, near Comox, although it doubtless occurs elsewhere. All of the meat of this mollusc may be utilized, although the exposed parts, siphon and foot, require to be skinned.

The shell of the geoduck is nearly rectangular in shape and the deeply engraved concentric lines give the outside a rugged appearance. The edges of the white shell are covered with a thin, light brown periostracum. The muscle-scars are quite small in proportion to the size of the animal, but the pallial line is very broad with a shallow sinus. There is a single tooth on each valve. The shells aways gape, showing the compact brown mantle, which being completely fused, except for one small posterior opening, completely hides the body of the clam. The neck or siphon is so large that, like the horse-clam, it cannot be withdrawn into the shell. In the larger specimens it can be extended to a length of 3 feet or more, which is the depth at which these clams are found.

THE BAY-MUSSEL (*Mytilus edulis*).

(Plate III.)

The bay, edible, or blue mussel is world-wide in distribution. On this coast it is generally found in more or less sheltered locations attached to rocks, wharves, or piling. The attachment is affected by numerous fibrous threads which collectively are called the byssus. In British Columbia no commercial use is made of this species, although the meat is quite edible. The byssus threads should be removed.

The shape of mussels is very distinctive with the pointed umbones placed at one end of the rather fragile blue or brown coloured shells. The posterior end is rounded and, except for the slope towards the umbo, the dorsal and ventral edges of the shell are nearly parallel. The byssus threads protrude between the ventral edges of the shells.

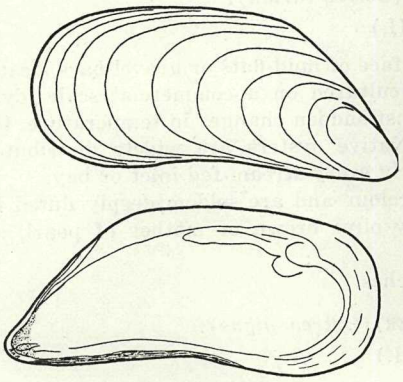
In British Columbia this clam is quite small in size, seldom exceeding a length of 2 inches and a height of three-quarters of an inch.

THE SEA-MUSSEL (*Mytilus californianus*).

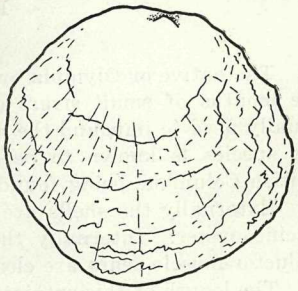
The sea-mussel, as the name indicates, is found mainly on rocky beaches bordering on the open ocean, though sometimes small numbers occur on sandy beaches. Like the bay-mussel, it attaches by means of byssus threads. In some localities, such as Queen Charlotte Sound, it is very abundant, masses of them forming mats which completely cover the rocks.

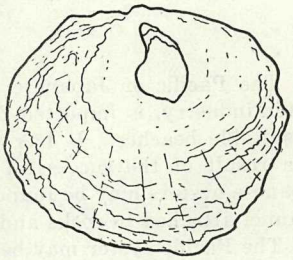
As in the bay-mussel, the umbo is placed at one end of the shell which is covered with a black periostracum. Older specimens, when this covering is worn off, are blue in colour and have an eroded appearance. There are two adductor muscles, the one at the umbo tip of the shell being much reduced in size. The bright orange colour of the flesh is quite distinctive.

The sea-mussel may attain a length of 8 or 10 inches. It is not used commercially.

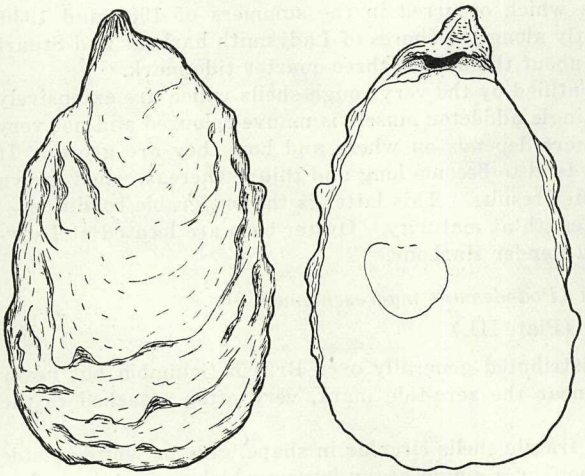


Blue mussel

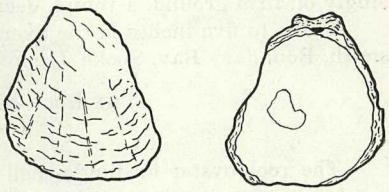




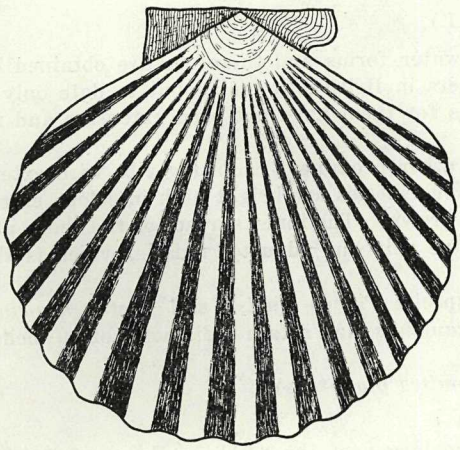
Rock oyster

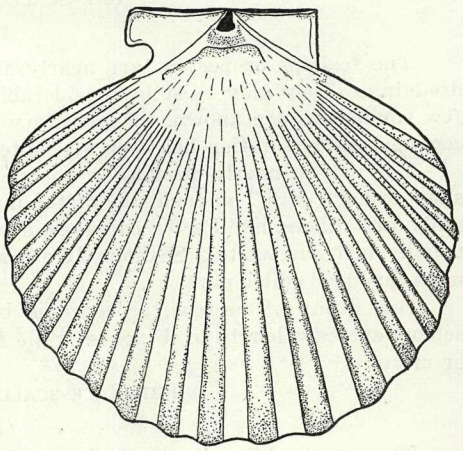


Pacific oyster



Native oyster





Scallop

PLATE III.

THE NATIVE OYSTER (*Ostrea lurida*).

(Plate III.)

The native or Olympia oyster lives on the surface of mud-flats or gravel-bars located near the mouths of small rivers or streams. When cultured on a commercial scale, dykes are usually used to impound the water to guard against sudden changes in temperature, to which the species is known to be very susceptible. Native oysters are widely distributed over British Columbia, being found at the head of nearly every stream-fed inlet or bay.

Externally the shells are grey or purple in colour and are seldom deeply fluted like the Pacific oyster. Internally the shells are a shiny olive brown or mother of pearl, and the adductor-muscle scars are clearly outlined.

The length of this species seldom exceeds 2 inches.

THE PACIFIC OYSTER (*Ostrea gigas*).

(Plate III.)

The Pacific or Japanese oyster, which is the dominant species in the British Columbia oyster industry, is imported from Japan as seed (young oysters) and grown to market size on suitable beaches. It has occasionally propagated, especially in Ladysmith harbour and, as a result of the successful breedings which occurred in the summers of 1932 and 1936, Japanese oysters may be found abundantly along the shores of Ladysmith harbour and Stuart Channel attached to rocks and shells at about the half to three-quarter tide mark.

The Pacific oyster may be easily identified by the very rough shells which are extensively fluted and laminated. The scar of the single adductor muscle is mauve coloured and not very clearly outlined. The shape of the oysters depends on where and how they are grown. If grown in clusters or in mud, the oysters tend to become long and thin; whereas, when grown singly on firm ground, a round, deep oyster results. This latter is the preferable condition.

Three to five inches is the average length at maturity. Oyster-beds are located at Ladysmith, Boundary Bay, Sooke, Comox, and Pender Harbour.

THE ROCK-OYSTER (*Pododesmus macroschisma*).

(Plate III.)

The rock-oyster or jingle-shell is distributed generally over British Columbia but never reaches great abundance. It is found near the zero-tide mark, very often attached to the under-side of rocks.

This so-called oyster has two rather fragile shells circular in shape, grey or white outside and coppery green inside. It fastens itself by a single heavy byssus which passes through a pear-shaped notch in the lower valve. The notch and the bright red flesh are characteristics by which the species may be easily identified. The shells seldom exceed a diameter of 3 inches.

THE SCALLOP (*Pecten caurinus*).

(Plate III.)

The scallops or pectens are nearly all deep-water forms and therefore are obtained by dredging. They may exist in considerable numbers in British Columbia but to date only a few small beds are known. Exploratory searches for them have not been extensive and no commercial exploitation has been attempted.

The valves, nearly circular in outline, have rather prominent radiating ribs with extensions called " ears " on each side of the umbo. Some species are bright pink in colour externally, and others, like *Pecten caurinus*, are golden brown. The inner surface of the shells are usually lustrous white. Scallops, like oysters, have only one adductor muscle, which is the most favoured edible part.

One group of pectens, represented by the species *Pecten hindsii* and *Pecten hericius*, seldom exceed a length of 3 inches, while *Pecten caurinus* may attain a diameter of 10 inches or more.

THE ROCK-SCALLOP (*Hinnites giganteus*).

(Plate IV.)

The purple, hinged rock-scallop is one of the larger of the edible molluscs of British Columbia. It is generally distributed over the whole coast in varying degrees of abundance and tends towards a rocky habitat, at or near the zero-tide mark.

During the early part of its life the rock-oyster or scallop resembles the ordinary scallop in shape and in its ability to swim. When slightly over an inch in diameter it becomes permanently attached to a suitable rock and the two shells become very thick and heavy, the lower one taking the shape of the surface of the rock to which it adheres. The upper valve often becomes riddled with holes made by boring sponges and worms, and may also be encrusted with many forms of plant and animal life. The shape is usually spherical. In the region of the hinge the inside of the shell assumes a distinctive purple colour. As in the pectens, there is only one adductor muscle, but this is very large and forms the main edible portion. The rock-scallop may attain a diameter of 6 inches.

THE ROCK-BORER (*Zirfæa gabbi*).

The rock-borers are clams which burrow into clay and soft stone by a rasping motion of their shells, which are provided with a series of cutting-edges. They are distributed widely over British Columbia wherever the intertidal zone is composed of hard clay or stone soft enough for burrowing.

The shells, usually grey or white in colour, gape very widely at the posterior end to allow the round adhesive foot to protrude for gripping the end of the burrow. When the body of the clam is thus held, strong muscles rotate the shells which wear down the sides and end of the burrow completely enclosing the shells, only the siphon protruding outside. Instead of the usual hinge-ligament there is a freely moving pad, which, though it holds the shells together, allows them to move freely. In the hinge region are long spoon-like extensions for muscle attachments. A line runs dorso-ventrally across the shells, dividing the cutting-section from the rest of the shell.

Zirfæa gabbi may attain a length of 3½ inches in British Columbia. It is frequently used as a shell-fish dish in certain communities along the coast.

SEA-SNAILS.

(GASTROPODA.)

The Gastropoda, including the snails, slugs, limpets, and whelks, is the largest of the mollusc classes. In those forms that have a shell it is single, hence the general name "univalve." Some types are completely free-swimming, some burrow in the sand, but the great majority cling to or crawl about the rocky shore by means of their adhesive muscular foot. All gastropods are equipped with a rasping apparatus in the mouth. Some utilize it for tearing into shreds the marine plants upon which they feed; while others, which are carnivorous, use it for drilling into the shells of other molluscs upon which they subsist.

While practically all gastropods are edible, the small size of most of the species discourages their utilization. In this paper reference is made only to the two most prominent edible forms, the abalones and the limpets.

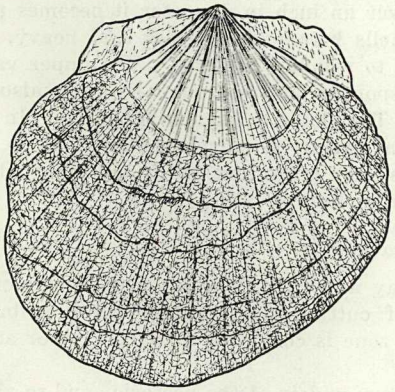
THE ABALONE (*Haliotis kamtchatkana*).

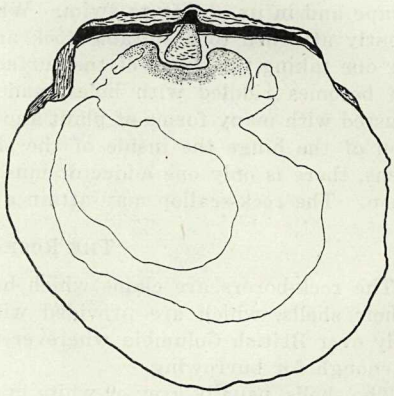
(Plate IV.)

The abalone, often popularly called the "ear-shell" or "Venus' ear," is an edible mollusc of excellent quality that has received scant attention in British Columbia. Fairly extensive beds occur on the rocky shores bordering the open ocean, such as on the west coast of Vancouver Island and the Queen Charlotte Islands, being found from the zero-tide level down to a depth of several fathoms. Little use has been made of abalones in British Columbia, but in California and other parts of the world, where it is common, it is considered (and rightly so) a delicacy.

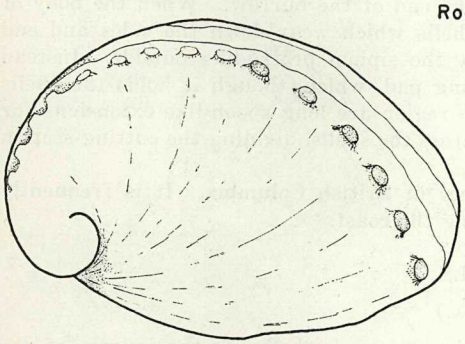
The abalone possesses a rough corrugated single shell, which is often encrusted with many forms of animal and plant life. One edge of the shell, which is turned over and inward, is quite thick and along this side are a number of short stout tubercles or projections, five or six of which are open at the top. They are used as respiratory pores. At one end the shell arises in a short whorl. The internal surface is composed of a beautifully coloured mother of pearl.

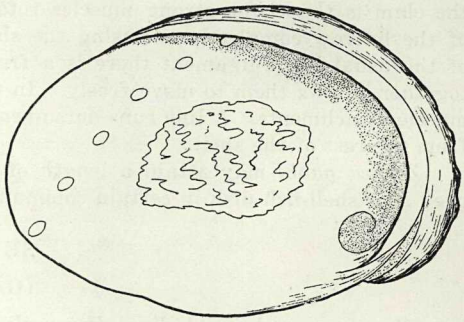
The edible part of the abalone is the muscular foot. In the living animal this covers the whole under-part of the shell and is used for crawling about over the rocks in search of



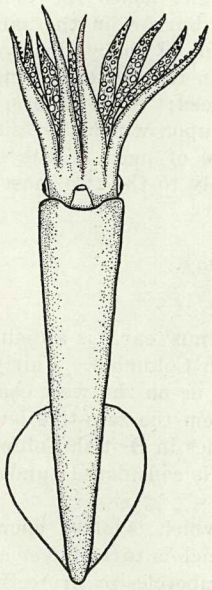


Rock scallop

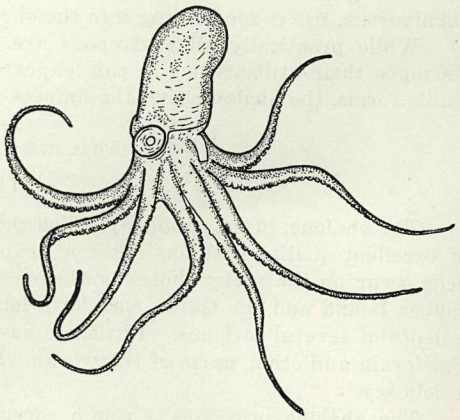




Abalone



Squid



Octopus

PLATE IV.

the algæ upon which the animal feeds. Before cooking, the foot is usually pounded to break up the fibrous muscles, otherwise the meat is very tough.

The average length of the British Columbia species of abalone is 4 to 5 inches.

THE LIMPET (*Acmea mitra*).

The limpet is a gastropod whose shell is oval and conical in shape; in fact, quite like the hats worn by Chinese coolies. Limpets cling to and move about over the rocks in the intertidal zone by means of a muscular foot very similar to that of the abalone. Also like the latter mollusc, unless taken by surprise, they are very difficult to move from their hold-fast.

In the northern part of England where limpets are quite extensively used for food, they are known as "flitters" or "flithers." In British Columbia no use is made of them, for, while it is not difficult to gather enough for a meal, the abundance is not sufficiently great to warrant exploitation on a commercial scale. They rarely exceed 1½ inches in length.

SQUIDS AND OCTOPUSES.

The cephalopods are the most highly developed of the molluscs, indeed of all invertebrate animals. They have well developed eyes, complex nervous systems, and an almost amazing ability to move. The squids have a small internal shell, commonly called cuttle bone; the octopuses lack shell entirely. All cephalopods are characterized by the possession of a number of tentacles studded with suckers, used entirely for clinging. Within the mouth there is found a pair of hard jaws which resemble a parrot's beak, as well as a rasping apparatus like that of the Gastropoda.

THE OCTOPUS (*Polypus hongkongensis*).

(Plate IV.)

The octopus is distributed generally over the British Columbia coast in both deep and shallow waters, where it hides in rock crevices and under rocks. Such a retreat may be discovered by the presence of a near-by pile of empty shells of crabs upon which the beasts usually feed.

The octopus, as the name implies, has eight arms on which are set rows of sucking disks used for holding prey or for clinging to some hold-fast. On each side of the body, which is short and squat in relation to the length of the arms, is placed a prominent, well developed eye. The mouth is situated in the centre of the ring of arms.

The species found most commonly in this Province is apparently *Polypus hongkongensis*. Its average length from tip of arm to tip of body is about 2 feet, although a length of 16 feet has been recorded from some localities.

Octopuses are very much relished by Orientals, the arms, with sucking disks removed, being the parts utilized.

THE SQUID (*Loligo opalescens*).

(Plate IV.)

The squid has a cigar-shaped body provided with two fins at the tail end and a cluster of ten arms about the head. The suckers or adhesive disks on the arms are placed on short flexible stalks and have sharp horny rims. Like the octopus, the squid has a parrot-like beak. Squids may be easily recognized in the water by the manner in which they swim both backwards and forwards at lightning speed and by their ability to change colour to suit the environment.

The species found most commonly in British Columbia is *Loligo opalescens* (opalescent squid). It seldom exceeds a length of 8 inches.

The edible portion of the squid consists of the thick mantle. In California large quantities of squid are sun-dried, after cleaning, and used in soups and other dishes. The tentacles are also often used.

SHELL-FISH POISONING.

In discussing edible molluscs some reference should be made to the possible danger arising through the eating, at certain seasons of the year (summer months chiefly), of fresh shell-fish collected from beaches on the open Pacific Coast.

While known authentic cases of shell-fish poisoning are rare in British Columbia, many instances are recorded from Alaska, Washington, Oregon, and California of serious illness,

sometimes fatal, resulting from the consumption of clams and mussels, particularly the latter, during the summer months. The cause of the poisoning has been found to be due, apparently, to toxic products contained in "red" water, an excessive multiplication of red, one-celled animals called "dinoflagellates," upon which the molluscs actively feed. The toxin is secreted in certain parts of the body of the shell-fish, chiefly the liver and siphon, and is not destroyed by cooking. Molluscs living in sheltered bays do not seem to be affected. In California, therefore, the use of shell-fish from areas bordering the open ocean is prohibited during those summer months when "red" water appears off-shore.

No detailed information is available concerning the occurrence of the toxic dinoflagellate species in British Columbia waters, hence of the possibility of shell-fish poisoning occurring. It may perhaps be quite unlikely in Strait of Georgia and other "inside" waters.

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FISHERY REGULATIONS GOVERNING THE TAKING OF MOLLUSCS IN BRITISH COLUMBIA.

(Excerpts from "The Special Fishery Regulations for the Province of British Columbia for 1940.")

SECTION 1.—ABALONE.

1. No one shall fish for, catch, buy, sell, or have in possession any abalone that measures less than 2½ inches across (that is through) the longest diameter of the shell.

2. The year 1938 and every third year thereafter shall be closed years for abalone-fishing.

3. The fee for an abalone licence shall be one dollar.

SECTION 2.—CLAMS.

1. No one shall dig for or take, have in possession, buy, sell, or expose for sale any butter-clam that measures less than 2½ inches, or any clam other than butter-clam that measures less than 1½ inches across (that is through) the longest diameter of the shell.

2. No one shall dig or take:—

(*a.*) Any little-neck clams in Districts Nos. 1 and 3 from February 1st to March 31st in each year, both days inclusive:

(*b.*) Any razor-clams in District No. 2 from June 20th to August 31st in each year, both days inclusive:

(*c.*) Any butter-clams in Districts Nos. 1 and 3 from July 1st to September 30th in each year, both days inclusive;

provided that the Chief Supervisor may prohibit digging for or taking clams in any area or areas at an earlier date than the beginning of the close times specified herein should he deem such to be necessary for the purpose of conservation.

3. No one shall dig for or take clams of any variety from Seal Island, in the vicinity of Comox, until January 1st, 1945.

SECTION 13.—OYSTERS.

1. Except from areas leased by the Provincial authorities for the culture and cultivation of oysters, no one shall fish for or take oysters during the months of May, June, July, and August in each year.

2. Except by special permission of the Provincial Commissioner of Fisheries, no one shall import into the Province for introduction into areas vested in the Crown in the right of the Province any oysters or oyster-seed.

REPORT ON INVESTIGATIONS OF INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION FOR THE YEAR 1940.

The season of 1940 was the third since the first meeting of the Commission in the late fall of 1937. The first season, of 1938, was one of organization. Because of limited funds, the work done then was of an experimental and preliminary nature to establish facts upon which the programme could be based. That which followed in the succeeding two years has been the programme thus arrived at. Its results will undoubtedly necessitate a recasting of the programme within the next few years.

Action by the Commission might fall in any one of three divisions: (1) To prevent over-fishing, insure a proper escapement to the spawning-grounds; (2) to discover and remove obstructions to the ascent of salmon to their spawning-grounds; and (3) to protect and assist propagation and survival during fresh-water life.

The first division has to do with provision of a proper escapement.

The evidence now available indicates strongly that the number, or percentage, of the fish in each race which escapes to the spawning-ground is determined in large part by the level to which it is economically possible to fish them. The evidence also indicates that this escapement varies greatly with the years. Thus in those years when the migrating salmon pause for long periods (as in 1939) on the fishing-grounds, the toll taken is very large and the escapement small. The reservoir of fish is filled not only in proportion to the number of fish in the run, but in proportion to the time the fish spend there. It appears possible for a relatively small run to fill the grounds just as it would were it delayed in an eddy of the river, as was described in last year's report on Hell's Gate (p. 9). As a result, a larger proportion can be removed and a small proportion is left to escape up the river. When the run passes through more rapidly (as in 1940) a smaller proportion is caught.

Several lines of evidence indicate this. Thus in 1939 the tag returns were 65 per cent., but in 1940 about 50 per cent., reflecting the amount of fishing to which the tagged stocks were subjected. The escapement, as estimated in a preliminary way from the survey of the spawning-grounds, was approximately one fish in ten during 1939 and one in four during 1940. And the tagging returns showed that whereas in 1939 the fish entering through the Strait of Juan de Fuca were found off the mouth of the Fraser for two months or more, there was in 1940 a large proportion which entered Johnstone Strait and passed through the commercial fishery in large part in a few weeks.

In this so-called reservoir action, the numbers observed on the fishing-grounds were increased in accord with the number of entering fish and also in accord with the speed of their passage. There is, in this, cause of great variability in the escapement. The fishery and the habits of migration accordingly become major factors in determining what fish reach the spawning-grounds.

It must also be remembered that the run to the Fraser is made up of races, or strains, each bound for its own spawning-ground. Some are depleted, others in good condition. If these races can be treated differently, so that those needing it can be given preferential consideration, the full effect of proper regulation in multiplying the escapement can be realized where it will do the most good. This has been investigated by tagging experiments which will show to what spawning-grounds the fish are bound and the time during which they are in the catch. This need for racial study provides a second justification for the proper execution of the tagging programme.

This consideration of escapement falls into the first division of Commission research. A second is the discovery and removal of obstructions to the ascent of this escapement of mature fish, the opening of new areas for reproduction, and the safeguarding of the descent of young to the sea. It implies, first of all, a survey of the river, of falls and rapids, of possible dams and fishways, and of the migrating habits of the fish itself.

The greatest problems now faced in conservation of the salmon runs in the great rivers to the south of the Fraser are the dams and water diversions. As in the case of the Columbia and the Sacramento, there have been discussions of dams on the Fraser which will range up

to 500 or more feet in height. The knowledge necessary to evaluate the effect is coming to light during the attempts to perpetuate the runs which are cut off in the Columbia and the Sacramento. These attempts are great experiments, each of them costing many times the total appropriations for this Commission. It will be advisable to watch them closely; in the first place, for their results; in the second, for an idea of the facts which should have been known before they were begun; and in the third, for the procedure which it has been found necessary to adopt.

Certain facts were needed before these attempts to perpetuate the runs were begun. The location and numbers of fish spawning in the different tributaries above a dam must be known, and the proportion of the commercial catch properly assignable to them should be determined. In the Columbia some light was thrown on this by the fish counted over two existing dams, the Bonneville and Rock Island, but in the Fraser the same ends must be attained by direct counts on the spawning-grounds, checked for accuracy and completeness by tagging experiments of the character now being tried in the Harrison-Birkenhead system. It is plain that this requires the same research as is now under way for other purposes, including surveys, estimates of escapement, and statistics.

The care of the runs thus cut off from their spawning-grounds requires, of course, a knowledge of the physical characteristics of the rivers and streams which it may be necessary to use in any programme for retaining ponds, hatcheries, etc. This can be gathered in such manner and detail as will be indicated by the great experiments under way in the Columbia and Sacramento. Fortunately our problems are not so urgent but what we can, year by year, profit in organizing our studies by what the experience of others shows is needed to establish a successful system of artificial propagation.

The third division of the work of the Commission was referred to in the previous reports as follows:—

Assisting and protecting Propagation.—The spawning-grounds and streams leading from and to them must be protected from injury by logging, dredging, pollution, or changes in water-flow. Spawning may be assisted by methods of artificial propagation or stream improvement. Mortality during the early stages may be lessened by retention in ponds or by destruction and control of predatory fish, animals, and poachers. There is required a survey of the river at the time of spawning, a study of the Indians and their fishery, and of the habits of the sockeye and of fishes or other organisms affecting its survival. Means of counting or estimating the number of mature fish, of the fry, and of the yearlings produced must be devised to guide action in their behalf.

In 1940 tagging experiments were carried on at Sooke, in various localities in the Strait of Juan de Fuca, Puget Sound, and the Gulf of Georgia, and at Hell's Gate.

As in the previous years, the tags used were celluloid disks 13.5 mm. in diameter, with a red spot on one side 7 mm. in diameter. The disks were attached on either side of the body immediately below the dorsal fin by means of a nickel pin run through from disk to disk. Upon one of the two disks a number was printed with the address of the Commission and an offer of reward. The red spot of each tag was turned outward when attached, to make the tag vivid and easily seen.

The experiments are discussed according to locality, under three headings:—

(1.) The tagging of sockeye at Sooke traps at the southern end of Vancouver Island was carried on under the same arrangements as in 1938 and 1939, with the co-operation of the trap operators and the Canadian Department of Fisheries.

The number of fish tagged and recovered from this experiment for the three years tagging has been done here is as follows:—

Year.	Tagged.	Recovered.*	Per Cent. Recovered.
1938	980	432*	44.1
1939	1,051	535	50.8
1940	930	415	44.6

* All recoveries as of March 15th, 1941.

The fish tagged in June and early in July were again returned in large part from streams and areas other than the Fraser. They formed 18 per cent. of the total returns of tags placed at Sooke. Those fish tagged on or before July 11th were recovered as follows:—

Skagit Bay	16	Quinault River	2
Issaquah Creek	16	Grandy Creek	1
Pender Harbour	16	Cedar River	1
Baker River	8	Cowichan River	1
Nitinat	7	Rivers Inlet	1
Swinomish Creek	5		—
Barkley Sound	4		78

Only in rare cases were fish tagged after this date taken anywhere but in the Fraser, or presumably *en route* to it. Two fish tagged at Sooke were recovered in Johnstone Strait.

(2.) In 1940 two boats were again employed, one a small seine-boat and the other a small troller. The seine-boat operated for a period of three months, purchasing fish for tagging from the fishermen in the vicinity of the San Juan Islands and catching fish for tagging with a small seine in the Fraser estuary. The trolling-vessel operated for approximately a month, purchasing fish for tagging in the Johnstone Strait area. In addition to this, a shore crew operated for a brief period from Lummi Island, purchasing fish from the reef-netters. Altogether 3,279 fish were tagged. Compared with former years, the numbers tagged and recovered were as follows:—

Year.	Tagged.	Recovered.	Per Cent. Recovered.
1938	2,587	1,231	47.6
1939	6,152	3,990	65.0
1940	3,279	1,614	49.3

(3.) In 1940, sockeye were again tagged at a point just below Hell's Gate as in 1938 and 1939.

The numbers tagged and recovered for these years were as follows:—

Year.	Tagged.	Recovered.	Per Cent. Recovered.
1938	2,128	632	29.0
1939	4,344	2,328	53.7
1940	5,194	1,762	34.0

A considerable number of tags was recovered again in eddies immediately above Hell's Gate, in spite of the fact that rigorous attempts were made to curtail Indian fishing for tags at these points.

Fishing operations were initiated at Hell's Gate on June 22nd this year and continued until November 7th. Fish were present in varying numbers in the eddies during the whole of that time.

Recoveries from the spawning-grounds indicate a distribution of the runs as they pass Hell's Gate as follows:—

Stuart Lake	Before July 27th.
Bowron	July 15th–August 10th.
Chilco	July 22nd–September 28th.
Nechako	July 22nd–September 14th.
Shuswap	September 9th–November 2nd.
Seton-Anderson	August 26th–September 28th.
Raft River	July 22nd–August 17th.
Canyon Streams	July 22nd–September 28th.

This is a preliminary listing only. Final proof must await a thorough analysis of the data on hand.

(4.) During 1940, the statistical activities of the four regular cannery observers engaged in the recovery of tags and sampling of the catch were continued. They were stationed at Steveston, Bellingham, and Anacortes. They recovered tagged fish, took representative samples of sockeye throughout the season, and collected statistics. The services of F. H. Bell were secured for four months, through a joint arrangement with the Halibut Commission, to assist in the organization of a statistical system for the fishery. After the end of the fishing season services of two of the observers were utilized in compiling some of the statistical material.

(5.) The spawning-grounds were again surveyed and estimates made of the number of spawners returning to each, as in 1938 and 1939. Because of the distribution of the spawning population in the 1940 cycle, it was necessary to divide the Fraser River watershed somewhat differently than in the previous two years, the areas being designated as the Stuart Lake, Nechako-Quesnel-Bowron, Chilcotin, Thompson-Seton-Anderson, Harrison-Lillooet, and Canyon-Lower Fraser districts. Every known sockeye-stream was visited during the season and those containing sockeye salmon were patrolled frequently. It was the purpose of each observer to recover all tags possible, to estimate as accurately as possible all sockeye present in the spawning areas, to record the extent of spawning areas, and the progress of the run throughout the season. Obstructions were observed and stream conditions recorded. Dead fish were recovered for information as to size, sex ratio, and the completeness of spawning, and samples were collected for racial studies. As in previous years, close co-operation was maintained with the officers of the Canadian Department of Fisheries who are stationed in the Fraser watershed.

The Chilko run for 1940 was a definite increase over the cycle-year of 1936. Parts of the river were used for spawning which, so far as is known, had not been used before. In addition, dead sockeye were recovered over half-way up the lake, apparently an indication of a considerable lake spawning.

Information from the spawning-stream survey for the past three years has been increasingly complete and has been systematically recorded. It has been utilized in the drawing of detailed maps of each spawning-stream, with references to the current, bottom, trails, landmarks, etc. These will be of great value for our own future reference.

(6.) The experience of the field observers has shown the need for special methods to determine more accurately the numbers of fish spawning and to show the presence of bodies of fish not accessible to observation.

As has been reported before, experiments have been conducted at Cultus Lake with a view to establishing a system by which the number of fish on a spawning-ground could be calculated indirectly by tagging a part of the run. These calculations at Cultus Lake could be checked, as the number of fish in this area was known by actual count through a weir. In 1938 a proportion of the run was tagged and the calculated number of fish arrived at from the proportion of tagged to untagged carcasses found on the spawning-grounds was remarkably near the known figure. This is the more encouraging, as in this area only a very small fraction of the fish known to be present can actually be seen.

In 1939 this experiment was repeated on a much larger run of fish with equally satisfactory results.

In 1939, experiments were instituted in the Harrison-Lillooet River system with the object of applying the methods developed at Cultus Lake to a determination of the sizes of salmon populations in a large river system by means of marking. During the 1940 season these studies were continued and modified on the basis of the results of the 1939 researches.

(7.) The collection and study of the voluminous records of all kinds which have to do with the Fraser River run of sockeye are proceeding as outlined in the report for 1939. It is an extensive task, but is proving well worth while. It cannot be completed for several years, as it can be carried on only while other duties of the staff permit. As pointed out in the first part of this report, this is one of the projects which it is most necessary to complete.

(8.) Cultus Lake. The capture of predatory fish, the counting into the lake of the adult spawning sockeye and the counting out of the resulting fry were continued at Cultus Lake in 1940.

The gill-nets used for the capture of predatory fish were worked continuously from February 5th to June 30th, during which time 4,292 coarse fish were removed from the lake.

The first adult sockeye of the Cultus Lake run arrived at the counting weir on September 1st. The run continued in varying numbers until January 3rd, 1941, when the last sockeye entered the lake. Altogether the run numbered 74,121 fish.

The number of first and second age-group seaward migrants counted out of the lake was 1,374,938.

(9.) An experiment was conducted on the value of the various types of marks on fingerling sockeye. Groups of year-old sockeye were marked on January 11th, 1940, using an electric cauterizing needle, and held in tanks at the University of Washington until April 27th, 1941.

REPORT ON INSPECTION OF SALMON-SPAWNING GROUNDS, 1940.

By J. A. Motherwell.

GENERAL.

An endeavour is made each year to have each salmon-stream inspected, although, in view of the fact that there are in the vicinity of 800 such streams the task of a thorough inspection in each case is often beyond the capabilities of the staff available.

Inspections are made with a view to ascertaining information under the following headings:—

(1.) *Intensity of Seeding.*—It is necessary to know each year just how the seeding of each variety of salmon compares with that of other years, particularly the brood-year. With this information in hand it is usually possible to take any necessary measures in the later cycle-years to correct depletion.

(2.) *Obstructions to the Ascent of Salmon.*—These include natural falls and rapids in the several streams, the construction of power dams, or log-jams formed as a result of freshets or logging operations.

(3.) *Pollutions.*—Under this heading come the effluents of pulp-mills, the discharge of sawdust from sawmills, and the effluents from mining operations.

(4.) *Enemies of Salmon.*—These consist of bears, wolves, trout, gulls, ducks, eagles, and other bird-life which prey on the spawning salmon.

(5.) *Freshets.*—In numerous parts of the Province, particularly the mountainous portions, heavy rains during the fall cause the streams and lakes to rise very rapidly, resulting in a great outrush of water which often destroys the spawn which may have been deposited by the salmon.

There are some areas where the conditions of the country are such as to preclude regular inspections of the spawning areas. The upper portion of the Nass River system, for instance, cannot receive the attention desired. This also applies to a section of the Skeena River watershed. Conditions of travel, from the standpoint of hazard to life, time consumed, and expense, make these inspections prohibitive.

SOCKEYE.

Generally speaking, the supplies of sockeye found on the spawning-grounds this year were entirely satisfactory, notwithstanding the poor catches in certain areas. The case of Rivers Inlet is interesting in this connection as the commercial catch was small, but the conditions on the spawning-grounds showed that without doubt an unusual proportion of the run passed safely beyond the commercial fishing areas. In the Nass, Skeena, Bella Coola, and Rivers Inlet areas there is every reason to believe that the sockeye runs were early and well under way by the time fishing was opened on July 1st.

In the Chilko watershed of the Fraser River system an unusually large supply of spawning sockeye was observed. In the Barkley Sound and Nitinat areas, however, the spawning of this variety was poor.

SPRINGS.

The supplies of this variety on the spawning-grounds were not as good as could be wished, although in certain areas conditions were quite good.

COHOES.

The spawning of this variety was, generally speaking, unsatisfactory along the whole coast. Off the west coast of Vancouver Island appeared the largest run of cohoes that could be remembered in recent years, and the trollers obtained splendid catches well offshore.

PINKS.

The greatest disappointment was in these supplies, the pack being less than 50 per cent. of what might reasonably have been expected. The conditions on the spawning-grounds in the brood-year of 1938, in many areas, were excellent, but the return this year, for some unknown reason, was largely a failure. Particular mention is made of the Bella Coola area, where, in

1938, such an excellent spawning occurred. There were no serious freshets in that year and spawning conditions generally were good. Notwithstanding this the return this year was negligible. This was the " off " year, of course, for the Fraser River district.

CHUMS.

Notwithstanding the unusually intensive fishing for this variety of salmon, the spawning-grounds, generally speaking, were well supplied.

More detailed descriptions of conditions found are as follows:—

QUEEN CHARLOTTE ISLANDS.

All varieties of salmon, with the exception of sockeye, frequent this area in commercial quantities. A few sockeye reach Masset Inlet and Copper River each season, but the quantity is not sufficiently large to justify commercial operations.

The pink seeding in the Masset area is reported as being generally satisfactory, particularly in the Yakoun River, which is the largest stream in the area. It is suggested by the local officer that this year's seeding is heavier than any since 1930. Most of the supply on the spawning-grounds appears to have been from the late run as the earlier run was very intensively fished. In Juskatla Inlet, although there was no fishing there, the supply on the spawning-grounds was found to be unsatisfactory. The supply on the Naden Harbour spawning-grounds was light. The seeding of the beds in the balance of the Queen Charlotte district was poor. The cohoe-supply is reported to be poor in comparison with the spawning of other years. Springs frequent the Yakoun River only and the runs showed a slight improvement. The chum-supply in the Naden Harbour district was exceptionally good. That in the Masset Inlet area, however, is reported as a failure. The creeks in the balance of the Queen Charlotte Islands, apart from the west coast, were satisfactorily seeded.

NASS AREA.

The early run of sockeye to the Meziadin Lake district, the principal spawning-ground, was only medium, and the later run is reported as light. The escapement past the commercial fishing area was reported as good and certainly much better than would appear from the report of the Meziadin district. There are considerable portions of the Nass River district, however, to which sockeye are known to proceed, but, due to the difficulty of travel, these have not been inspected in recent years. It is very probable that these areas were well supplied, particularly as the run, in common with some other areas, was early and was practically at its height when fishing opened on July 1st.

The inspecting officers commented on the large size of the individual fish in this year's run.

The supply of springs in the Meziadin area was reported as only medium, although the escapement past the upper river fishing boundary was a good average one. The cohoe run in the Meziadin area had only commenced at the time of inspection, but the escapement past the commercial boundaries is reported as having been very good. The seeding generally by this variety might be termed medium. The pink spawning at Khutzeymateen Creek is reported as being very good. This also applies to Ikgiik and Kincolith Creeks, and Quinnimas and Toon Rivers. The seeding in other creeks was light. The chum seeding is reported as light also. This has never been a prolific chum area.

The Meziadin fishway is reported as being in good condition and functioning satisfactorily.

SKEENA AREA.

The Inspector for the Babine district, the main spawning area, reports that taken as a whole the sockeye run was a very heavy one and better than that of 1936. The highlights were the heavy runs on the Babine and Fulton Rivers, as well as at Morrison Creek and several other smaller streams. Apparently the spawning-beds at the Babine and Fulton Rivers received the heaviest seeding for some years and the whole situation, in so far as sockeye are concerned, in the Babine area is eminently satisfactory.

There was no doubt some loss of eggs in several of the more important streams, due to the large quantities of spawning females which, as the later runs arrived, dug up the eggs of those which had arrived previously. In addition, due to high-water conditions some further loss is expected as eggs were deposited in portions of the creeks which went dry as soon as the

water dropped to normal condition. Notwithstanding these losses, however, there has evidently been an excellent seeding.

The sockeye-supplies on the spawning-grounds of the Lakelse Lake system, tributary to the Skeena River, were also abundant, showing improvement over the cycle-years of 1935 and 1936. There was a heavy run of sockeye to the Morice Lake district. In the Ocstahl section a good supply of sockeye was observed, an improvement over the cycle-years of 1935 and 1936. The seeding of springs was found to be not more than medium. In the Ocstahl section the supply was adequate, however, but the seeding of the Morice Lake area is reported as heavy. The cohoe run was light. This also applies to this variety in the Ocstahl and Morice Lake systems.

The year under review was an " off " one for pinks in the Babine section of the system and the quantity observed was stated by the inspecting officer to be medium, under the conditions. In the Lakelse Lake section, however, the pinks were found to be abundant and the seeding better than in the brood-year of 1938. In the Ocstahl system, whilst the quantity of pinks was found to be only medium, yet it was an improvement over the brood-year of 1938. The chum-supply in the Ocstahl system was found to be disappointing, although the Skeena system has never been an important one for this variety.

It is interesting to remember that this season is the first which could be expected to show the effects of the moving of the fishing boundary on the Skeena River 7 miles down towards salt water. This conservation measure has undoubtedly been fully justified by results found on the spawning-beds.

LOWE INLET AREA.

The sockeye-supply to most of the streams in this area is reported as lighter than usual. The escapement, however, was larger in proportion to the catch. This was due to high-water conditions. The cohoe-supply was found to be fairly good, particularly in the streams on the west coast of Banks Island, although many streams in the area were poorly seeded. The pink spawning in this area was also disappointing, particularly in the streams in the southern part of the area, in the vicinity of Gil Island. The streams in the North Grenville and Ogden Channel areas were much better than usual, although not as good as in 1938. Unless flood conditions in 1938 are the cause, there is no apparent reason why this year's run of pinks should not have been better. The chum-supply is reported as being fairly good, although the streams in the Kitkatlah Inlet portion of the area will require some further protective measures. This area is not a heavy producer of this variety.

BUTEDALE AREA.

The weather in this area was reported as the wettest season on record. This would, of course, cause flooding in the salmon-spawning streams, and possibly some damage to the eggs. It also made the examination of the spawning areas difficult.

The sockeye spawning was found to be normal and compared favourably with the brood-year of 1936. The escapement to Kwakwa Inlet spawning-grounds was particularly heavy. The spring-supply was slightly better, but the run of this variety is not of much importance in the area. On the other hand the cohoe spawning is reported as being very satisfactory. In the case of the pinks, for some unknown reason, the supply was the smallest on record for an " even " year. This applies particularly to the northern part of the area, the southern portion being considerably better. Some streams received quite heavy supplies. The chum seeding was found to be poor, with the exception of a few streams.

BELLA BELLA AREA.

The escapement of sockeye, cohoe, and pink salmon to this area was light during the season under review, notwithstanding the unusual curtailment of fishing-time. Out of forty-three salmon-streams inspected the only exceptions were Tinkey River where a heavy escapement of sockeye was found, Gull Chuck and Howyet Rivers, with a heavy escapement of cohoe, and Koeye River with a medium escapement of pinks. The chum-supply was also found to be light, although after the fishing season closed there was a further run which proceeded unmolested to the spawning-grounds.

It will be remembered that although 1938 was what is known as an " off " year for pink salmon in this area, the escapement was quite heavy and the spawning-beds in all streams of

importance were reported as being well seeded with spawning pinks. In view of this fact it is difficult to understand the shortage this year.

BELLA COOLA AREA.

The sockeye spawning is reported as being very satisfactory and a substantial increase over that of the brood-year. This probably is due largely to the fact that the run was early and that by the time fishing opened the run was at the height, permitting a large escapement, unmolested by fishing operations. An unusually abundant supply of spring salmon was also found. The cohoe seeding was normal, with the usual run passing safely up-stream after the fishing was over. In the case of the pinks, the spawning was found to be most disappointing, notwithstanding that fishing operations were not intensive. This is not understood, in view of the good spawning conditions in the brood-year of 1938. In the case of Quatna River, for instance, specifically mentioned by the inspecting officer, notwithstanding excellent spawning facilities and an abundant seeding in 1938, with no freshet damage and very little fishing in the vicinity this year, the run was a failure. The chum-supply was found to be very fair but not up to expectations. Most of the smaller streams were well supplied, however.

Up to November 1st no appreciable flood damage had been observed in the area.

RIVERS INLET AREA.

Notwithstanding a most disappointing commercial catch of sockeye, conditions on the spawning-grounds were found to be excellent. Possibly the seeding was not as good as the splendid conditions obtaining in 1935 and 1936, but decidedly satisfactory. Particularly good supplies were found at Waukwash, Shumahault, Quap, and Whonnock Rivers. Speaking of the Quap, the inspecting officer states, " The river was loaded from stem to stern." The run appeared to have been at its peak when fishing opened on June 29th.

There was a very heavy flood between October 17th and 20th, resulting in the lake rising to such a height that there was 4 feet of water on the floor of the old hatchery building. Due to the early date and the low-water conditions in the lake before the freshet, it is estimated that the detrimental effect on the spawning was of a minor degree.

A great proportion of the spawning salmon were found to be very large individually; in fact, the inspecting officer reports that he is satisfied the average size of mesh used in sockeye-fishing in Rivers Inlet during the season could not have gilled these large specimens. Many were found showing net-marks, indicating that their progress towards the spawning-grounds had been interrupted temporarily.

The serious floods of 1936 obviously affected the four-year cycle.

It was found that the Waukwash River, which, some years ago had changed its course near the mouth with the possibility of some detrimental effect on spawning conditions in future years, had returned to its original channel and is now as good a spawning-stream as ever.

The supplies of fish on the spawning-grounds of the several streams entering directly into Rivers Inlet were found to be only fairly satisfactory. This refers to cohoes, pinks, and chums.

SMITH INLET AREA.

The remarks regarding Rivers Inlet apply largely to this area also, for notwithstanding the disappointing commercial catch the escapement and spawning of sockeye was good. In the Geluck River sockeye were reported as being present on every bar in good numbers. The fish here also were found to be large in size individually. The Delabah River, the other important sockeye-stream, was well seeded.

The cohoe seeding in the area was poor but the pink seeding in Nekite River was good. A heavy escapement of chums to the Takusk River was found. This is the principal chum-spawning area in the district.

FRASER RIVER WATERSHED.

Prince George Area.—Whilst the quantity of sockeye observed on the spawning-grounds was found to be still few compared with the quantities of years ago, yet this season's spawning showed an improvement over that of the brood-year. The fish were in good physical condition on arrival, although many were reported as being three-year-olds. The inspecting officer

mentions a large increase in the number of spring salmon this year in the main spawning-beds of the Stuart and Nechako Rivers.

Quesnel Area.—A satisfactory increase in the number of sockeye spawners over the brood-year is reported in both the Bowron River and Chilco Lake systems. The increase at these points is estimated at 300 per cent.

The outstanding feature of the 1940 sockeye spawning conditions on the Fraser system is the abundant supply observed in the Chilco Lake area. In the brood-year of 1936 it is estimated that 74,000 sockeye spawned in the system, but in the year under review the total was close to 350,000. Conditions in the rivers on the way to the spawning-beds were apparently good as the spawning fish arrived in excellent condition. The spring-salmon supply was normal.

Kamloops Area.—At Raft River the seeding of sockeye was excellent. It is possible, however, that some damage may have been done by the freshet which occurred after the eggs had been deposited. At Adams River and Little River the spawning was heavier than in the brood-year of 1936. The seeding of springs was estimated to be normal, but the cohoe-supply was not up to expectations.

Pemberton Area.—It is estimated that 20,000 sockeye reached the spawning-grounds in the Birkenhead River. This was a decrease of approximately 50 per cent. from that of the brood-year.

Sockeye returned to the Anderson-Seton Lake system again, although not in as large numbers as in the brood-year. The supply of springs was normal. This also applies to the cohoe species. The run of chums to the Squamish River showed in smaller numbers than in recent seasons, yet it is expected that the seeding will be adequate. Freshet conditions may, however, have resulted in some loss of eggs.

Hope Area.—A normal seeding of sockeye was observed in Coquihalla River and Spuzzum Creek. Cohoes and chums were found in fair numbers. Steelheads were numerous. Conditions at Hell's Gate were reasonably good and although, as usual, salmon were delayed from time to time for short periods, there appears no reason to believe that they did not all succeed in passing beyond this point.

Chilliwack Area.—The main sockeye portion of this area is the Cultus Lake system, where approximately 74,000 spawning fish were counted over the fence operated by the International Pacific Salmon Fisheries Commission. This run was the result of the hatchery operations in 1936, when all sockeye were spawned by the hatchery staff, none being permitted to spawn naturally. The supply of springs was normal and the cohoe fair. This also applies to the chums. The steelhead trout seeding was very good.

Harrison Lake Area.—A good spawning of sockeye was observed in Silver Creek and Morris Creek and at the rapids in Harrison River. These supplies show an improvement over those of recent years. The spring, cohoe, and chum seeding cannot be considered as satisfactory.

Pitt Lake Area.—The seeding of sockeye showed an improvement over that of the brood-year and spawning conditions were favourable. Normal supplies of springs, cohoes, and chums were observed.

Lower Fraser Area.—In the several streams such as the Alouette, Coquitlam, Bear, and Salmon Rivers, emptying into the lower portion of the Fraser River, the cohoe-supply was found to be disappointing. The chum seeding was also not up to expectations.

North Vancouver Area.—The cohoe spawning was fair, and although the quantity of chums appearing was not as great as expected, yet the seeding was reasonably satisfactory. A great improvement was observed in the chum-supply at Nelson Creek, where a large boulder which had obstructed the passage of the fish last year had been removed. The seeding of steelheads was not up to expectations.

ALERT BAY AREA.

The sockeye spawning-beds were heavily seeded in the Nimpkish River, which is the most important stream in the district. Conditions here were quite equal to the satisfactory ones of the brood-year of 1936. The run to Fulmore River, Port Neville, did not compare with the unusually heavy run of 1936. In the other sockeye-streams, such as Keogh, McKenzie, and Kahweiken Rivers, the supplies were normal, but at Nahwitti and Shushartie Rivers, light. At Kleena Kleene River, head of Knight Inlet, the largest quantity yet observed was found,

although this is not a particularly important sockeye-stream. Sockeye-spawning conditions, generally, over the district were satisfactory.

The supply of springs was somewhat better than that of the brood-year, except at Adams River where a decrease was found.

A heavy supply of pinks was observed at Kingcome, Adams, Glendale, and Quatse Rivers, and Embley Lagoon. A slight increase over the brood-year was also found at Bond Sound, Thompson Sound, and Wakna Cove. The supplies at Shushartie River, Cache Creek, Kluck-sivi, Hoeye, and Wakeman Rivers were again light.

The spawning of cohoes was satisfactory at practically all streams on the mainland portion of the district, except at Wakeman and Kingcome Rivers. The spawning in the first-mentioned streams was estimated at 50 per cent. better than in that of the year 1937. In the streams on the Vancouver Island side an increase of at least 25 per cent. over the spawning of 1937 was observed.

Chums were found to be plentiful on the spawning-grounds with heavy supplies at Nimpkish, Fulmore, Bond, and Glendale Rivers, and in practically all streams in Seymour Inlet. Medium supplies are reported at most other streams, with good spawning conditions.

As the fishing operations were concentrated largely in the Broughton and Johnstone Straits portions of the Alert Bay area, distant from the spawning-streams, the escapement to the numerous streams was very good.

QUATHIASKI AREA.

An excellent supply of spawning sockeye was found on the Hayden Bay spawning-beds and a very good one at Phillips Arm. The improvement in both areas over that of the brood-year was very considerable. A normal supply of springs was observed. The cohoe-supply was found to be rather light. Pinks were definitely scarce, particularly in view of the fact that 1940 appeared to have been a good year. The exceptions were Bear River and the stream entering into Grassie Bay. A very heavy seeding of chums is reported in all streams.

COMOX AREA.

The seeding of springs is reported as much lighter than that of an average year. The cohoe seeding is reported as being only medium, but definitely better than that of 1937. This system does not appear to have yet fully recovered from the severe freshets of 1934. At Oyster and Puntledge Rivers and all streams flowing into Baynes Sound the supply was light. At Tsolum, Big and Little Qualicum, and Englishman Rivers the cohoe-supplies were found to be good. The chum seeding is described as light, with the exception of Englishman River and French Creek where the supplies were found to be satisfactory, and at Little Qualicum with a reported heavy seeding and Big Qualicum with an exceptionally heavy seeding. Apparently the steelhead runs in this sub-district are being well maintained.

PENDER HARBOUR AREA.

Whilst this is not a prolific sockeye area, yet, an unusually abundant seeding was found in the Saginaw Lake system. The cohoe-supply was found to be, generally speaking, normal, with a slight increase in Sliammon River. The supply of springs was light. The year under review was an " off " one for the pink variety in this area. An excellent supply of chums was observed throughout the district, especially to the Sliammon River system.

NANAIMO AREA.

In the various small streams lying between Englishman River and Nanaimo the return of parent cohoes was about the same as during the brood-year. This also applies to chum salmon and steelhead.

LADYSMITH AREA.

The seeding of springs was found to be normal and that of cohoes quite satisfactory. This is not a pink area. The chum seeding was found to be adequate.

COWICHAN AREA.

The seeding of springs is reported as being an improvement over that of 1939 and fully equal to a good average year. This is particularly satisfactory in view of the mortality

amongst this variety in the Cowichan Bay area, due to conditions which were the subject of an investigation by the officers of the Fisheries Research Board.

The supply of cohoes was found to be normal, and whilst the chum seeding was not as heavy as that of the preceding season it is considered satisfactory. The steelhead seeding is reported as being very good. The inspecting officer states that it is evident the annual runs of this variety are not only being well maintained but are increasing noticeably.

VICTORIA AREA.

The only varieties frequenting this sub-district in commercial quantities are the cohoes and chums. The seeding of the former variety was somewhat lighter than that of the average year, but supplies of the latter variety were found to be satisfactory. The steelhead seeding was normal.

ALBERNI AREA.

The watersheds frequented by sockeye salmon are those of the Somass, Anderson, and Hobarton Rivers. The supplies in the first-mentioned area are reported as being very disappointing compared with the brood-year of 1936. This is not understood in view of the good seeding four years ago. The same remarks apply to Anderson River and Lake where the seeding was found to be very poor. Very similar conditions obtained at Hobarton River. The seeding of springs is reported as being very satisfactory, with the exception of the Nitinat. The cohoe seeding is reported as being exceptionally good this year in the streams generally frequented by this variety, such as the Somass, Nahmint, Toquart, Sarita, San Juan, and Nitinat. The chum-supply was very disappointing, notwithstanding the heavy seeding of four years ago.

CLAYOQUOT AREA.

The sockeye seeding in the Clayoquot River portion of the Kennedy Lake area is reported as being very satisfactory, corresponding with that of the exceptionally heavy run of the brood-year of 1936. In the Elk River, a tributary, the supplies were not so large, but adequate. The Medgin River spawning was normal. The seeding of springs is reported as good. The inspecting officer reports that this variety has been on the increase during the last two years. The cohoe seeding was very good. The chum seeding is reported as being satisfactory, far ahead of that of last year, and compared well with the seeding of the brood-year.

NOOTKA AREA.

The spring-supply was found to be only fair, and although the cohoe seeding is usually small in this area the 1940 supply was satisfactory. The chum run is the most important in this area but in the season under review the seeding was found to be disappointing, particularly after the excellent seeding of 1936. Unusual conservation measures permitted a good percentage of the run to pass to the spawning-grounds.

KYUQUOT AREA.

The sockeye run to this area is not of commercial importance. The seeding of springs was found to be a fair average. This also applies to the cohoes. The chum seeding was found to be disappointing as in the brood-year the seeding was good.

QUATSINO AREA.

The small sockeye run to this area is of little commercial value. In the Marble Creek watershed, to which 75 per cent. of the springs in this area run the seeding was found to be above average. The pink-supply was not as good as usual, with the exception of Rupert Creek, where they are reported as being very heavy, and in East Creek and Klashkish River, where the seeding is also reported as heavy. The chum run was below normal but the escapement, due to special conservation measures, was an average one.

ANNUAL REPORT OF THE BRITISH COLUMBIA SALT-FISH BOARD, 1940–41 SEASON.

We have the honour to submit herewith the report in respect to the marketing conditions obtaining for dry-salt salmon and dry-salt herring during the 1940–41 season; these products being controlled for marketing purposes by a scheme under the "Natural Products Marketing (British Columbia) Act," and administered by this Board.

ORGANIZATION.

The following appointments to the Board were recorded at a meeting held in Vancouver on September 20th, 1940:—

Appointed to represent the Meal, Oil, and Salt-fish section of the Canadian Manufacturers' Association (British Columbia Division):—

Mr. R. Nelson, 325 Howe Street, Vancouver, B.C., and Mr. G. R. Clark, foot of Gore Avenue, Vancouver, B.C.

Alternates: Mr. S. M. Rosenberg, 525 Seymour Street, Vancouver, B.C., and Mr. A. J. McCallum, Wall Street Fish Dock, Seattle, Wash.

Appointed to represent the Canadian Salt Herring Exporters, Limited:—

Mr. K. Kimura, 217 Dunlevy Avenue, Vancouver, B.C., and Mr. R. Suzumoto, 193 Hastings Street East, Vancouver, B.C.

Alternates: Mr. T. Matsuyama, 467 Powell Street, Vancouver, B.C., and Mr. T. Takenaka, 219 Dunlevy Avenue, Vancouver, B.C.

Mr. Hugh Dalton, of Vancouver, B.C., was reappointed by the Commissioner of Fisheries, under date of August 22nd, 1940, as Chairman of the Marketing Board, as from October 1st, 1940, to September 30th, 1941. Mr. J. B. Sutherland, 608 Marine Building, Vancouver, B.C., was appointed Secretary.

During the period under review, a total of six meetings were held. The Chairman and Messrs. Nelson, Clark, and Kimura attended all meetings; Mr. Matsuyama attending one.

The marketing agencies appointed by the Board for the season were:—

Producers' Salt Fish Sales, Limited, 608 Marine Building, Vancouver, B.C.

Canadian Salt Herring Exporters, Limited, 217 Dunlevy Avenue, Vancouver, B.C.

GENERAL MARKET SITUATION.

During previous seasons, considerable effort was made to find markets for the products under control of the Board in the South Sea Islands, Singapore, and Central and South America; but it was the general opinion of the Board, in view of correspondence received from firms in these markets and from the offices of the Canadian Government Trade Commissioners, that it did not appear that any of these markets were suitable for our product. with the possible exception of Singapore and Panama.

It was felt that further efforts should be made in these two countries if conditions warranted them later on during the season.

An inquiry was received during the season from the Canadian Government Trade Commissioner in Singapore for a quotation on 50 tons of dry-salt herring in the style of packing common to that market. Due to the large extra cost involved in this type of packing and the very high freight rate to that market, the Board could not see its way clear to authorizing a quotation of less than U.S. $60, c.i.f. Singapore, war risk insurance and any increase in the freight for buyers' account.

The Board cabled this price, but no interest was evinced by the buyers and consequently no business was done.

The Board was advised by Mr. Kimura that the Japanese Government had allotted approximately 500,000 *yen* for the purchase of dry-salt herring; but that efforts were being made by the importers to have this amount increased. The Board was further advised that the Japanese Government would control the retail price at which dry-salt herring would be sold in Japan.

In addition to Japan, it appeared that a certain tonnage of dry-salt herring could be sold through Shanghai.

As far as Hong Kong was concerned, the buyers displayed little, if any, interest.

In so far as dry-salt salmon was concerned, while the Board understood that the Japanese Government were prepared to establish credits, inasmuch as the Provincial Government had decided not to issue licences for the salting of salmon, no negotiations were carried on in this direction.

Saltery licences were issued by the Provincial Government to the following firms: B.C. Fish Salteries, Limited, Otter Bay, and Canadian Saltery, Limited, North Galiano Island. Plant registration certificates were accordingly issued to these two companies by the Board.

The Board decided that tolls on herring should be the same as last year; namely, 15 cents per box.

DRY-SALT HERRING.

CHINA.

After considerable cabling with the Canadian Government Trade Commissioner at Shanghai, it was agreed that we should indicate a price of U.S. $40 a ton, c.i.f. Shanghai; any increase in freight or war risk insurance to be for buyers' account: this on an indication that Shanghai would take approximately 1,000 tons. Buyers in Shanghai countered with a price of U.S. $35 per ton, on 1,250 tons. The Board then countered with an offer of U.S. $37.50 for a minimum of 1,250 tons. After a further exchange of cables, on October 8th definite orders were received and accepted for 1,000 tons at a price of U.S. $37.50, c.i.f. Shanghai.

This order was received from Dodwell & Company for 500 tons and the China Union Trading Company for 500 tons, to be purchased through their brokers, Messrs. Powell & Russell and Messrs. Shafer-Haggart, Limited, respectively. One stipulation of this order was that no further direct shipments should be made to Shanghai within thirty days of our final shipment in early December.

In late November it was necessary to cable the Canadian Government Trade Commissioner in Shanghai, advising him that the two ships, the "Talthybius" and the "Ixion," which we had contemplated using for space, had been commandeered by the British Ministry of Shipping and that it would likely be necessary to ship on a Japanese boat. In this case the Board would try to persuade the shipping company to continue on to Shanghai, rather than to have the cargo transhipped at Kobe, where it might possibly lie for some considerable time on the docks.

It was also pointed out that it might be possible to ship direct to Shanghai on an American Mail Line boat, but this would mean that the ship would not go until some time in January and that the freight would be in U.S. funds, which would increase the price to the buyers; also the Board could not guarantee to make no further shipments within thirty days, as would be the case if shipment was made on a Japanese vessel which would sail in December.

The buyers replied that they were willing to have the shipment go forward on a Japanese vessel, provided that direct shipment was made; and also advised that January shipment would be too late for the market.

The Board exerted every effort they could to induce the shipping company to go direct to Shanghai, but eventually were forced to advise the buyers in Shanghai that the best arrangement that could be effected was transhipment at Kobe; and that the Japanese steamship line would give an undertaking that the transhipment would be properly handled. The Board further guaranteed to extend their thirty-day undertaking to cover this shipment.

This was satisfactory, in view of all conditions prevailing, to the buyers; and shipment was made accordingly of this 1,000 tons, or 5,000 boxes. In addition, a further quantity of 600 boxes was also shipped at the same time to the Union Trading Company, Hong Kong. After the expiry of the thirty-day clause, a further shipment of 1,250 boxes was made to Shanghai through Mitsui Bussan Kaisha, at the same price as the previous shipments. This meant that a total of 6,850 boxes was shipped to the China market.

Advice from the Canadian Government Trade Commissioner was received earlier this year to the effect that everything went very well for the buyers in Shanghai, and that all business for this season had been cleared up quite satisfactorily.

During the season an inquiry was received from the Canadian Government Trade Commissioner from one of the buyers in Shanghai, who thought that there might be a possibility

of a market in that territory for dry-salt salmon-heads. Two boxes of these were packed and forwarded to Shanghai, but the report of the Canadian Government Trade Commissioner was that they were a rather unsatisfactory proposition, as compared with the dry-salt herring, and that unless they could be sold at a very much lower price than salt herring it did not appear that there was any likelihood of developing a market.

In view of the fact that these heads have a market here in the reduction plants, it was not felt that it would be possible to develop this business.

JAPAN.

After the Board had advised the Japanese Government through the Canadian Legation in Japan that it was imperative that the Japanese Government state the amount of exchange they would allot for the purchase of dry-salt herring from British Columbia at the earliest moment, in view of the fact that much tonnage of herring was being caught and canned for the United Kingdom requirements, we were advised by the Canadian Legation that they had been informed that credit would be established for Japanese requirements.

The Board set a price of U.S. $28.50 on the same terms as the previous year; namely, U.S. $28.50, f.o.b. Vancouver, including 25 per cent. of the ocean freight prepaid. The credit was established, in the amount of 421,000 *yen*, and shipment was made to the extent of 17,358 boxes. In addition to this, 25 boxes of dry-salt herring were shipped as a gift by the Canadian Japanese Citizens' Association and the Steveston Young Men's Buddhist Association for charitable purposes in Japan.

TSINGTAO.

The market in Tsingtao took 400 tons—i.e., 2,000 boxes—at the price set by the Board for that market, of U.S. $28.50, f.o.b. Vancouver, including 25 per cent. of the ocean freight prepaid, plus transhipment charges for the buyers' account.

A total of 26,234 boxes, or 5,246⅘ tons, was shipped during the season under review.

It is the desire of the British Columbia Salt-fish Board to take this opportunity of thanking the Canadian Government Trade Commissioners and the staff of the Canadian Legation at Tokio for their continued invaluable assistance during the past season. We would also like to express our appreciation at this time for the co-operation received from the Provincial Department of Fisheries, which has been of great assistance to the Board in discharging its duties.

Respectfully submitted.

BRITISH COLUMBIA SALT-FISH BOARD.

HUGH DALTON, *Chairman.*
T. TAKENAKA, *Member.*
K. KIMURA, *Member.*
G. R. CLARK, *Member.*
R. NELSON, *Member.*

J. B. SUTHERLAND,
Secretary.

Vancouver, B.C., August 13th, 1941.

PACK OF BRITISH COLUMBIA SALMON, SEASON 1940.

SHOWING THE ORIGIN OF SALMON CAUGHT IN EACH DISTRICT.

District.	Sockeye.	Springs.	Steel-heads.	Cohoes.	Pinks.	Chums.	Grand Total (Cases).
Fraser River	99,009	4,504	145	13,028	12	35,665	152,363
Queen Charlotte Islands	16	62	.....	8,897	44,966	164,911	218,852
Nass River	13,809	1,716	117	10,060	29,278	5,461	60,441
Skeena River	116,507	6,118	133	20,614	47,301	4,682	195,355
Rivers Inlet	63,469	1,226	55	11,561	3,329	9,025	88,665
Smith Inlet	25,947	142	37	1,102	755	6,015	33,998
Central Area	32,042	1,518	506	49,886	54,478	135,802	274,232
*Vancouver Island	15,177	2,454	214	88,885	33,785	279,064	419,579
Alaska	426	.....	.....	20,489	.....	2,816	23,731
Totals	366,402	17,740	1,207	224,522	213,904	643,441	1,467,216

* 23,277 cases of bluebacks are included with the cohoe-pack for Vancouver Island.

STATEMENT SHOWING THE SALMON-PACK OF THE PROVINCE, BY DISTRICTS AND SPECIES, FROM 1925 TO 1940, INCLUSIVE.

FRASER RIVER.

	1940.	1939.	1938.	1937.	1936.	1935.	1934.	1933.
Sockeyes	99,009	54,296	186,794	100,272	184,854	62,822	139,238	52,465
Springs, Red	3,725	4,426	3,754	3,706	6,675	4,205	5,150	5,579
Springs, White	779	1,567	554	1,738	8,451	5,196	11,068	.....
Chums	35,665	30,150	58,778	20,878	31,565	8,227	104,092	34,391
Pinks	12	95,176	63	94,010	.....	111,328	2,199	92,746
Cohoes	13,028	13,557	27,127	11,244	28,716	24,950	11,392	13,901
Steelheads	145	69	14	.....	.....	.....	.....	.....
Totals	152,363	199,241	277,084	231,848	260,261	216,728	273,139	199,082

	1932.	1931.	1930.	1929.	1928.	1927.	1926.	1925.
Sockeyes	65,769	40,947	103,692	61,569	29,299	61,393	85,689	35,385
Springs, Red	18,298	9,740	11,366	3,305	1,173	7,925	12,783	7,989
Springs, White	10,403	.....	9,761	6,699	3,909	10,528	20,169	25,701
Chums	14,948	251	68,946	144,159	193,106	67,259	88,495	66,111
Pinks	385	13,307	30,754	158,208	2,881	102,536	32,256	99,800
Cohoes	16,815	8,165	25,585	40,520	27,061	24,079	21,783	36,717
Steelheads	23	657	27,879	12,013	795	10,658	13,776	5,152
Totals	126,641	73,067	277,983	426,473	258,224	284,378	274,951	276,855

STATEMENT SHOWING THE SALMON-PACK OF THE PROVINCE, BY DISTRICTS AND SPECIES, FROM 1925 TO 1940, INCLUSIVE—*Contd.*

Skeena River.

	1940.	1939.	1938.	1937.	1936.	1935.	1934.	1933.
Sockeyes	116,507	68,485	47,257	42,491	81,973	52,879	70,655	30,506
Springs	6,118	4,857	4,318	4,401	4,551½	4,039	8,300	3,297
Chums	4,682	7,773	16,758	10,811	15,297½	8,122	24,388	15,714
Pinks	47,301	95,236	69,610	59,400	91,389	81,868	126,163	95,783
Cohoes	20,614	29,198	52,821	15,514	25,390	23,498	54,456	39,896
Steelheads	133	55	42	21	33	14	114	267
Totals	195,355	205,604	190,806	132,638	218,634	170,420	284,096	185,463

	1932.	1931.	1930.	1929.	1928.	1927.	1926.	1925.
Sockeyes	59,916	93,023	132,372	78,017	34,559	83,996	82,360	81,146
Springs	28,269	9,857	7,501	4,324	6,420	19,038	30,594	23,445
Chums	38,549	3,893	5,187	4,908	17,716	19,006	63,527	74,308
Pinks	58,261	44,807	275,642	95,305	209,579	38,768	210,081	130,079
Cohoes	48,312	10,637	29,617	37,678	30,194	26,326	30,208	39,168
Steelheads	404	768	58	13	241	582	754	713
Totals	233,711	162,986	450,377	220,245	298,709	187,716	407,524	348,859

Rivers Inlet.

	1940.	1939.	1938.	1937.	1936.	1935.	1934.	1933.
Sockeyes	63,469	54,143	87,942	84,832	46,351	135,038	76,923	83,507
Springs	1,226	745	1,209	917	581½	429	436	449
Chums	9,025	5,462	7,759	9,415	11,505	7,136	895	677
Pinks	3,329	12,095	9,063	7,536	6,432½	4,554	2,815	5,059
Cohoes	11,561	10,974	16,285	6,012	7,122½	8,375	4,852	3,446
Steelheads	55	83	105	70	19	39	79	82
Totals	88,665	83,502	122,363	108,782	72,011½	155,571	86,000	93,220

	1932.	1931.	1930.	1929.	1928.	1927.	1926.	1925.
Sockeyes	69,732	76,428	119,170	70,260	60,044	65,269	65,581	192,323*
Springs	459	325	434	342	468	608	685	496
Chums	944	429	492	989	3,594	1,122	11,727	11,510
Pinks	3,483	5,089	18,023	2,386	16,546	671	12,815	8,625
Cohoes	7,062	6,571	756	1,120	868	2,094	7,286	4,946
Steelheads	29	32	105	29	7	9	11	.....
Totals	81,709	88,874	138,980	75,126	81,527	69,773	98,105	217,900

* 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 1925 TO 1940, INCLUSIVE—*Contd.*

Smith Inlet, 1926–40.*

	1940.	1939.	1938.	1937.	1936.	1935.	1934.	1933.
Sockeyes	25,947	17,833	33,894	25,258	12,788	31,648	14,607	37,369
Springs, Red	116	44	68	21	2	214	164	354
Springs, White	26	171	.....	.....	28	2	.....	.....
Cohoes	1,102	3,880	1,058	241	310	1,201	3,941	5,068
Pinks	755	3,978	1,761	483	65	4,412	6,953	19,995
Chums	6,015	2,771	8,076	9,494	1,653	12,427	15,548	8,841
Steelheads	37	50	64	5	42	24	43	87
Totals	33,998	28,727	44,921	35,502	14,888	49,928	41,256	71,714

	1932.	1931.	1930.	1929.	1928.	1927.	1926.
Sockeyes	25,488	12,867	32,057	9,683	33,442	22,682	17,921
Springs, Red	46	122	268	18	108	270	73
Springs, White	2	.....	22	60	178	79	39
Cohoes	273	112	1,460	275	230	2,990	164
Pinks	1,148	824	16,615	853	167	732	689
Chums	165	133	1,660	113	19	2,605	31
Steelheads	20	36	103	12	6	8	.....
Totals	27,142	14,094	52,185	11,014	34,150	29,366	18,917

* Previously reported in Queen Charlotte and other Districts.

Nass River, 1925–40.

	1940.	1939.	1938.	1937.	1936.	1935.	1934.	1933.
Sockeyes	13,809	24,357	21,462	17,567	28,562½	12,712	28,701	9,757
Springs	1,716	708	773	1,251	2,167	560	654	1,296
Chums	5,461	2,500	15,911	10,080	20,620½	17,481	2,648	1,775
Pinks	29,278	26,370	61,477	8,031	75,887½	25,508	32,964	44,306
Cohoes	10,060	1,996	14,159	12,067	11,842	21,810	9,935	3,251
Steelheads	117	15	188	46	496	143	311	49
Totals	60,441	55,946	113,970	49,042	139,575½	78,214	75,213	60,434

	1932.	1931.	1930.	1929.	1928.	1927.	1926.	1925.
Sockeyes	14,154	16,929	26,405	16,077	5,540	12,026	15,929	18,945
Springs	4,408	1,439	1,891	352	1,846	3,824	5,964	3,757
Chums	14,515	392	3,978	1,212	3,538	3,307	15,392	22,504
Pinks	44,629	5,178	79,976	10,342	83,183	16,609	50,815	35,530
Cohoes	7,955	8,943	1,126	1,202	10,734	3,966	4,274	8,027
Steelheads	10	.....	84	.....	36	96	375	245
Totals	85,671	32,881	113,460	29,185	104,877	39,828	92,749	89,008

STATEMENT SHOWING THE SALMON-PACK OF THE PROVINCE, BY DISTRICTS AND SPECIES, FROM 1925 TO 1940, INCLUSIVE—*Contd.*

Vancouver Island District, 1927–40.

	1940.	1939.	1938.	1937.	1936.	1935.	1934.
Sockeyes	15,177	16,259	27,965	25,427	32,696½	22,928	27,282
Springs	2,454	2,889	4,254	2,359	6,340	6,525	1,630
Chums	279,064	212,949	266,566	203,900	347,951	143,960	210,239
Pinks	33,785	235,119	70,108	318,780	82,028½	191,627	54,526
*Cohoes	88,885	123,388	62,054	52,244	90,625	104,366	78,670
Steelheads	214	132	27,607	88	105	21	.....
Totals	419,579	590,736	458,554	608,798	559,746	469,427	372,347

	1933.	1932.	1931.	1930.	1929.	1928.	1927.
Sockeyes	18,397	27,611	22,199	24,784	10,340	14,248	24,835
Springs	4,875	10,559	4,055	3,431	1,645	2,269	6,769
Chums	96,642	70,629	16,329	177,856	162,246	303,474	220,270
Pinks	172,945	33,403	81,965	89,941	74,001	41,885	52,561
Cohoes	60,019	35,132	26,310	30,206	35,504	23,345	58,834
Steelheads and Bluebacks	147	28,596	24,638	14,177	11,118	5,249	10,194
Totals	353,025	205,930	175,541	340,395	294,854	390,470	373,463

* 23,277 cases of bluebacks are included with the cohoe-pack for Vancouver Island.

Queen Charlotte Islands, 1932–40.

	1940.	1939.	1938.	1937.	1936.	1935.	1934.	1933.	1932.
Sockeyes	16	1	179	2	85	.....	.....	.....	.....
Springs	62	36	66	140	227	63	258	3,575	278
Chums	164,911	45,519	40,882	72,689	69,304	86,298	38,062	6,988	358
Pinks	44,966	2,123	57,952	13	89,355	1,479	53,398	.....	2,415
Cohoes	8,897	3,020	16,616	4,631	19,920	5,461	8,315	.....	3,805
Steelheads	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals	218,852	50,699	115,695	77,475	178,891	93,301	100,033	10,563	6,856

Central Area, 1932–40.

	1940.	1939.	1938.	1937.	1936.	1935.	1934.	1933.	1932.
Sockeyes	32,042	26,158	36,178	29,987	27,499	32,417	20,438	26,106	21,685
Springs	1,518	655	540	1,641	830	687	2,116	841	3,236
Chums	135,802	79,384	127,089	110,493	99,592	125,953	117,309	128,602	166,653
Pinks	54,478	150,498	130,842	97,321	246,378	94,190	157,336	101,701	80,034
Cohoes	49,886	44,426	56,716	25,009	45,824	41,831	53,850	33,471	41,172
Steelheads	506	392	433	614	373	355	733	827	591
Totals	274,232	301,513	351,798	265,065	420,496	295,433	351,782	291,548	313,371

STATEMENT SHOWING THE SALMON-PACK OF THE PROVINCE, BY DISTRICTS AND SPECIES, FROM 1925 TO 1940, INCLUSIVE—*Contd.*

TOTAL PACKED BY DISTRICTS IN 1925 TO 1940, INCLUSIVE.

	1940.	1939.	1938.	1937.	1936.	1935.	1934.	1933.
Fraser	152,363	199,241	277,084	231,848	260,261	216,728	273,139	199,082
Skeena	195,355	205,604	223,413	133,165	218,634	170,420	284,096	185,463
Rivers Inlet	88,665	83,502	122,363	108,782	72,011½	155,571	86,000	93,220
Smith Inlet	33,998	28,727	44,921	35,502	14,888	49,928	41,256	71,714
Nass River	60,441	55,946	113,970	49,042	139,575½	78,214	75,213	60,434
Vancouver Island	419,579	590,736	458,554	608,798	559,746½	469,427	372,347	353,025
Other Districts	516,815	375,307	467,493	342,350	599,387	388,734	451,815	302,111
Grand totals	1,467,216	1,539,063	1,707,798‡	1,509,677†	1,864,503½	1,529,022	1,583,866	1,265,049

	1932.	1931.	1930.	1929.	1928.	1927.	1926.	1925.
Fraser	126,641	73,067	277,983	426,473	258,224	284,378	274,951	276,855
Skeena	233,711	162,986	450,377	220,245	298,709	187,716	407,524	348,859
Rivers Inlet	81,709	88,874	138,980	75,126	81,527	69,773	98,105	217,900
Smith Inlet	27,142	14,094	52,185	11,014	34,150	29,366	18,917	33,998
Nass River	85,671	32,881	113,460	29,185	104,877	39,828	92,749	89,008
Vancouver Island	205,930	175,541	340,395	294,854	390,470	373,463	347,722	263,904
Other Districts	320,227	137,661	848,439	341,873	901,822	405,476	844,139*	522,756
Grand totals	1,081,031	685,104	2,221,819	1,398,770	2,035,629	1,360,634	2,065,190	1,719,282

* Including 17,921 cases of sockeye packed at Smith Inlet.
† Including 527 cases of Alaska cohoe packed at Skeena River.
‡ Including 5,779 cases of Alaska sockeye and 26,828 cases of Alaska cohoe packed at Skeena River.

STATEMENT SHOWING THE SOCKEYE-PACK OF THE ENTIRE FRASER RIVER SYSTEM FROM 1894 TO 1940, INCLUSIVE.

	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Fraser River, B.C.	363,967	395,984	356,984	860,459	240,000	486,409	170,889	974,911	293,477	204,809
State of Washington	41,781	65,143	72,979	312,048	252,000	499,646	228,704	1,105,096	339,556	167,211
Totals	405,748	461,127	429,963	1,172,507	492,000	986,055	399,593	2,080,007	633,033	372,020

	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.
Fraser River, B.C.	72,688	837,489	183,007	59,815	74,574	585,435	150,432	58,487	123,879	719,796
State of Washington	123,419	837,122	182,241	96,974	170,951	1,097,904	248,014	127,761	184,680	1,673,099
Totals	196,107	1,674,611	365,248	156,789	245,525	1,683,339	398,446	186,248	308,559	2,392,895

	1914.	1915.	1916.	1917.	1918.	1919.	1920.	1921.	1922.	1923.
Fraser River, B.C.	198,183	91,130	32,146	148,164	19,697	38,854	48,399	39,631	51,832	31,655
State of Washington	335,230	64,584	84,637	411,538	50,723	64,364	62,654	102,967	48,566	47,402
Totals	533,413	155,714	116,783	559,702	70,420	103,200	111,053	142,598	100,398	79,057

	1924.	1925.	1926.	1927.	1928.	1929.	1930.	1931.	1932.	1933.
Fraser River, B.C.	39,743	35,385	85,689	61,393	29,299	61,569	103,692	40,947	65,769	52,465
State of Washington	69,369	112,023	44,673	97,594	61,044	111,898	352,194	87,211	81,188	126,604
Totals	109,112	147,408	130,362	158,987	90,343	173,464	455,886	128,158	146,957	179,069

	1934.	1935.	1936.	1937.	1938.	1939.	1940.
Fraser River, B.C.	139,238	62,822	184,854	100,272	186,794	54,296	99,009
State of Washington	352,579	54,677	59,505	60,259	134,641	43,511	59,354
Totals	491,817	117,499	244,359	160,531	321,435	97,807	158,363

STATEMENT SHOWING THE SOCKEYE-PACK OF THE PROVINCE, BY DISTRICTS, 1925 TO 1940, INCLUSIVE.

	1940.	1939.	1938.	1937.	1936.	1935.	1934.	1933.
Fraser River	99,009	54,296	186,794	100,272	183,120	62,822	139,238	52,465
Skeena River	116,507	68,485	47,257	42,491	81,973	52,879	70,655	30,506
Rivers Inlet	63,469	54,143	87,942	84,832	46,351	135,038	76,923	83,507
Smith Inlet	25,947	17,833	33,894	25,258	12,788	31,648	14,607	37,369
Nass River	13,809	24,357	21,462	17,567	28,562½	12,712	28,701	9,757
Vancouver Island	15,177	16,259	27,965	25,427	34,430½	22,928	27,282	18,397
Other Districts	32,484	34,514	36,357	29,989	27,584	32,417	20,438	26,106
Totals	366,402	269,887	441,671*	325,836	414,809	350,444	377,844	258,107

	1932.	1931.	1930.	1929.	1928.	1927.	1926.	1925.
Fraser River	65,769	40,947	103,692	61,569	29,299	61,393	85,689	35,385
Skeena River	59,916	93,023	132,372	78,017	34,559	83,996	82,360	81,146
Rivers Inlet	69,732	76,428	119,170	70,260	60,044	65,269	65,581	192,323
Smith Inlet	25,488	12,867	32,057	9,683	33,442	22,682	17,921	33,764
Nass River	14,154	16,929	26,405	16,077	5,540	12,026	15,929	18,945
Vancouver Island	27,611	22,199	24,784	10,340	14,248	24,835	25,070	14,757
Other Districts	21,685	29,071	39,198	35,331	26,410	37,851	44,462	16,198
Totals	284,355	291,464	477,678	281,277	203,542	308,052	337,012	392,518

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

* 5,779 cases of Alaska sockeye packed at Skeena River are not shown in the above table for the year 1938.

STATEMENT SHOWING THE SPRING-SALMON PACK OF THE PROVINCE, BY DISTRICTS, 1930 TO 1940, INCLUSIVE.

	1940.	1939.	1938.	1937.	1936.	1935.
Fraser River	4,504	5,993	4,308	5,444	15,126	9,401
Queen Charlotte Islands	62	36	66	140	227	63
Nass River	1,716	708	773	1,251	2,167	560
Skeena River	6,118	4,857	4,318	4,401	4,551½	4,039
Rivers Inlet	1,226	745	1,209	917	581½	429
Smith Inlet	142	215	68	21	30	216
Central Area	1,518	655	540	1,641	830	687
Vancouver Island	2,454	2,889	4,254	2,359	6,340	6,525
Alaska	.....	.....	.....	.....	.....	.....
Totals	17,740	16,098	15,536	16,174	29,853	21,920

	1934.	1933.	1932.	1931.	1930.
Fraser River	16,218	5,579	28,701	9,740	21,127
Queen Charlotte Islands	258	3,575	278	854	131
Nass River	654	1,296	4,408	1,439	1,891
Skeena River	8,300	3,297	28,269	9,858	7,501
Rivers Inlet	436	449	459	325	434
Smith Inlet	164	354	48	122	290
Central Area	2,116	841	3,236	754	1,721
Vancouver Island	1,630	4,875	10,559	4,055	3,431
Alaska	.....	.....	.....	.....	.....
Totals	29,776	20,266	75,958	27,147	36,526

STATEMENT SHOWING THE COHOE-SALMON PACK OF THE PROVINCE, BY DISTRICTS, 1930 TO 1940, INCLUSIVE.

	1940.	1939.	1938.	1937.	1936.	1935.
Fraser River	13,028	13,557	27,127	11,244	28,716	24,950
Queen Charlotte Islands	8,897	3,020	16,616	4,631	19,920	5,461
Nass River	10,060	1,996	14,159	12,067	11,842	21,810
Skeena River	20,614	29,198	52,821	15,514	25,390	23,498
Rivers Inlet	11,561	10,974	16,285	6,012	7,122½	8,375
Smith Inlet	1,102	3,880	1,058	241	310	1,201
Central Area	49,886	44,426	56,716	25,009	45,824	41,831
Vancouver Island	88,885	123,388	89,471	58,244	90,625½	104,366
Alaska	20,489	14,658	26,828	527	.....	.....
Totals	224,522	245,097	301,081	133,489	229,750	231,492

	1934.	1933.	1932.	1931.	1930.
Fraser River	11,392	13,901	16,815	8,818	25,585
Queen Charlotte Islands	8,315	.....	3,805	5,335	7,091
Nass River	9,935	3,251	7,955	8,943	1,126
Skeena River	54,476	39,896	48,312	10,637	29,617
Rivers Inlet	4,852	3,446	7,062	6,571	756
Smith Inlet	3,941	5,068	273	112	1,460
Central Area	53,850	33,471	41,172	10,806	54,327
Vancouver Island	78,670	60,019	63,637	50,953	30,206
Alaska	.....	.....	.....	.....	.....
Totals	225,431	159,052	189,031	102,175	150,168

STATEMENT SHOWING THE PINK-SALMON PACK OF THE PROVINCE, BY DISTRICTS, 1930 TO 1940, INCLUSIVE.

	1940.	1939.	1938.	1937.	1936.	1935.
Fraser River	12	95,176	63	94,010	.....	111,328
Queen Charlotte Islands	44,966	2,123	57,952	13	89,355	1,479
Nass River	29,278	26,370	61,477	8,031	75,887½	25,508
Skeena River	47,301	95,236	69,610	59,400	91,389	81,868
Rivers Inlet	3,329	12,095	9,063	7,536	6,432½	4,554
Smith Inlet	755	3,978	1,761	483	65	4,412
Central Area	54,478	150,498	130,842	97,321	246,378	94,190
Vancouver Island	33,785	235,119	70,108	318,780	82,028½	191,627
Alaska	.....	.....	.....	.....	.....	.....
Totals	213,904	620,595	400,876	585,574	591,535½	514,966

	1934.	1933.	1932.	1931.	1930.
Fraser River	2,199	92,746	385	13,307	30,754
Queen Charlotte Islands	53,398	.....	2,415	.....	224,902
Nass River	32,964	44,306	44,629	5,178	79,976
Skeena River	126,163	95,783	58,261	44,807	275,642
Rivers Inlet	2,815	5,059	3,483	5,089	18,023
Smith Inlet	6,953	19,995	1,148	824	16,615
Central Area	157,336	101,701	80,034	55,825	376,084
Vancouver Island	54,526	172,945	33,403	81,965	89,941
Alaska	.....	.....	.....	.....	.....
Totals	436,354	532,535	223,758	206,995	1,111,937

STATEMENT SHOWING THE CHUM-SALMON PACK OF THE PROVINCE, BY DISTRICTS, 1930 TO 1940, INCLUSIVE.

	1940.	1939.	1938.	1937.	1936.	1935.
Fraser River	35,665	30,150	58,778	20,878	31,565	8,227
Queen Charlotte Islands	164,911	45,519	40,882	72,689	69,304	86,298
Nass River	5,461	2,500	15,911	10,080	20,620½	17,481
Skeena River	4,682	7,773	16,758	10,811	15,297½	8,122
Rivers Inlet	9,025	5,462	7,759	9,415	11,505	7,136
Smith Inlet	6,015	2,771	8,076	9,494	1,653	12,427
Central Area	135,802	79,384	127,089	110,493	99,592	125,953
Vancouver Island	279,064	212,949	266,566	203,900	347,951	143,960
Alaska	2,816	82	.....	.....	.....	.....
Totals	643,441	386,590	541,819	447,760	597,488	409,604

	1934.	1933.	1932.	1931.	1930.
Fraser River	104,092	34,391	14,948	251	68,946
Queen Charlotte Islands	38,062	6,988	358	.....	39,010
Nass River	2,648	1,775	14,515	392	3,978
Skeena River	24,388	15,714	38,549	3,893	5,187
Rivers Inlet	895	677	944	429	492
Smith Inlet	15,548	8,841	165	113	1,660
Central Area	117,309	128,602	166,653	34,570	104,771
Vancouver Island	210,239	96,642	70,629	16,239	177,856
Alaska	.....	.....	.....	.....	.....
Totals	513,181	293,630	306,761	55,997	401,900

STATEMENT SHOWING THE PILCHARD INDUSTRY OF THE PROVINCE, 1920 TO 1939, 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	1,468,840	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
1937	961,485	40,975	930,713	1,707,276	8,483	1,045
1938	1,035,369	69,473	986,118	2,195,850	8,891	310
1939	110,453	7,300	105,303	178,305	906	20

* Authority: Advance Report of the Fisheries of British Columbia, Ottawa.

PRODUCTION OF FISH OIL AND MEAL, 1920 TO 1940 (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	468,206	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	17,147	1,578,204
1938	273	512	543,378	12,115	1,157,315
1939	.....	.....	.....	26,129	1,990,901
1940	181	434	361,820	15,884	1,338,993

STATEMENT SHOWING THE HERRING INDUSTRY OF THE PROVINCE, 1935 TO 1940.

Year.	Canned.	Dry-salted.	Pickled.	Oil.	Meal.
	Cases.	Tons.	Tons.	Gals.	Tons.
1935	26,143	14,983	.....	328,639	5,313
1936	20,914	16,454	.....	786,742	10,340
1937	27,365	10,230	.....	1,333,245	14,643
1938	23,353	7,600	.....	1,526,117	18,028
1939	418,021	7,596	.....	1,677,736	22,870
1940	640,252	5,039	892	923,137	10,886

The above figures are for the season October to March 31st annually.

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