PROVINCE OF BRITISH COLUMBIA

Provincial Department of Fisheries

REPORT

WITH APPENDICES

For the Year Ended December 31st

1951

VICTORIA, B.C.
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1952

To His Honour COLONEL CLARENCE WALLACE, C.B.E.,
Lieutenant-Governor of the Province of British Columbia.

MAY IT PLEASE YOUR HONOUR:

I beg to submit herewith the Annual Report of the Provincial Department of Fisheries for the year ended December 31st, 1951.

WILLIAM RALPH TALBOT CHETWYND,
Minister of Fisheries.

Department of Fisheries,
Minister of Fisheries' Office,
Victoria, B.C.

The Honourable William Ralph Talbot Chetwynd,
Minister of Fisheries, Victoria, B.C.

SIR,—I have the honour to submit herewith the Annual Report of the Provincial Department of Fisheries for the year ended December 31st, 1951.

I have the honour to be,
Sir,
Your obedient servant,

GEORGE J. ALEXANDER,
Deputy Minister.

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VALUE OF BRITISH COLUMBIA'S FISHERIES IN 1951 SHOWS AN INCREASE

The total marketed value of the fisheries products of British Columbia for 1951 amounted to $83,812,704. This was an increase over the year previous of $14,991,346, or approximately 21.7 per cent more than the marketed value of fisheries products in 1950.

The principal species, as marketed in 1951, were salmon, with a value of $60,749,658; herring, with a value of $10,639,653; and halibut, with a marketed value of $5,762,151. The salmon production in 1951 was $12,048,075 more than the production in 1950. The value of herring production in 1951 showed an increase over the year previous of $1,326,206, and the value of the 1951 halibut-catch was increased by $210,612.

In 1951 the total fish and shell-fish landed amounted to 5,957,580 hundredweight.

The total value of vessels, boats, premises, gear, and other equipment employed in catching and landing fish in British Columbia in 1951 amounted to $36,934,000. This figure is compared with $36,581,621 for capital similarly employed in 1950.

In 1951 there was a total of 13,213 persons employed in catching and landing the fish in British Columbia. These employment figures are compared with a total of 12,159 persons similarly employed in 1950. The number of persons engaged in processing plants, canneries, etc., in 1951 was not available at the time of going to press.

The above figures were supplied by the Dominion Bureau of Statistics, Ottawa, and are hereby gratefully acknowledged.

THE CANNED-SALMON PACK FOR BRITISH COLUMBIA, 1951

The total canned-salmon pack for British Columbia for 1951 amounted to 1,957,520 cases, according to the annual returns submitted to the Provincial Department of Fisheries by those salmon-canners licensed to operate. The 1951 salmon-pack was the largest since 1941, in which year 2,295,433 cases were canned and, excluding 1941, the 1951 pack was larger than in any other year since 1928, when 2,035,629 cases were canned. The 1951 total salmon-pack was 450,310 cases greater than the average annual pack for the past ten years. The 1951 pack was composed of 428,299 cases of sockeye, 13,698 cases of springs, 3,655 cases of steelheads, 313,674 cases of cohoes, 736,093 cases of pinks, and 462,101 cases of chums. The above figures include 13,237 cases of bluebacks, which are combined with the cohoe-pack.

In evaluating the total canned-salmon pack for British Columbia for 1951, due consideration must be given to the fact that the Federal Department of Fisheries was forced, for conservation reasons, to close all fishing in British Columbia for a two-week period during the height of the salmon-fishing season owing to the extremely dry weather and lack of water in many of the streams, which prevented the salmon from getting up the fresh-water streams to spawn. This two-week loss of fishing time at the height of the season no doubt had some effect on the total pack.

The total sockeye-pack in 1951, amounting to 428,299 cases, was the largest pack in the Province since 1946, in which year 543,027 cases were canned. The sockeye-pack in 1951 was 99,538 cases greater than the average annual pack for the previous five years.

In 1951 the spring-salmon pack amounted to 13,698 cases. The size of the spring-salmon pack is never indicative of the size of the run, but for comparative purposes the 1951 pack is compared with the previous five years, in which the following quantities were canned: 1950, 9,233 cases; 1949, 21,184 cases; 1948, 16,445 cases; and 1947, 10,025 cases. On a five-year average basis, the 1951 pack of springs was 419 cases less than the five-year average for that period.

Steelheads are not salmon, but a few are canned each year—those which are caught incidentally while fishing for other species. In 1951 the total pack of steelheads amounted to 3,655 cases. This is compared with 3,227 cases in 1950 and 2,373 cases in 1949. The size of the steelhead-pack is nowise indicative of the size of the run of this species.

In 1951 the cohoe-pack amounted to 313,674 cases. This was considerably larger than the pack in recent past years. It was the largest pack of cohoe since 1941 and was 109,405 cases above the five-year average for this species.

Pink salmon were canned in 1951 to the extent of 736,093 cases. This was 26,106 cases more than in the cycle-year 1949, and 135,486 cases above the previous cycle-year, 1947. The 1951 pack of pinks, however, was 89,420 cases below the large pack in the cycle-year 1945, when 825,513 cases were canned. The 1951 pack was 173,084 cases greater than the average annual pack for this species in the previous five-year period.

In 1951 chum salmon were canned to the extent of 462,101 cases. This was 45,510 cases less than were canned in 1950 and 22,444 cases above the average annual pack of chums in British Columbia for the previous five years. The pack of chum salmon in recent years, however, is not necessarily an indication of the size of the run of this species. Large quantities of chum salmon are frozen each season for the winter trade, and also in recent years large quantities have found a market in the fresh condition south of the border. This was brought about by the fact that American canners are able to pay higher prices for chum salmon in the fall of the year, and, as a consequence, large quantities of this species, which ordinarily would be canned in Canadian canneries, were exported to Puget Sound for canning there.

In comparing the pack figures for any species of salmon canned in British Columbia, the reader is referred to the text in the next section of this Report for a breakdown of the fisheries of each species by districts. The reader should also take into consideration the escapement to the spawning-beds.

In the Appendix to this Report will be found " Salmon-spawning Report, British Columbia, 1951," which was supplied by the Chief Supervisor for the Federal Department of Fisheries and is hereby gratefully acknowledged.

BRITISH COLUMBIA'S CANNED-SALMON PACK BY DISTRICTS

Fraser River

The total canned-salmon pack for the Fraser River in 1951 amounted to 268,233 cases. This was 128,512 cases greater than was credited to this river system for the year previous. It will be recalled that pink salmon appear in the Fraser River run in the odd-numbered years, and the pink-salmon pack accounted largely for the increase over the year previous, although sockeye, cohoe, and chum salmon also showed increases.

The total pack on the Fraser River in 1951 was the largest for this river system since 1946, when the total pack amounted to 413,542 cases. In 1951 the pack was composed of 145,231 cases of sockeyes, 5,719 cases of springs, 230 cases of steelheads, 14,848 cases of cohoes, 66,673 cases of pinks, and 35,530 cases of chums, half-cases having been dropped in each instance.

Sockeye Salmon.—The Fraser River in 1951 produced a pack of sockeye salmon amounting to 145,231 cases. This was 37,008 cases greater than were canned in the year previous. The Fraser River sockeye runs are made up of 4- and 5-year-old fish. In 1947, the previous four-year cycle, the pack was 33,952 cases, while in 1946, the five-year cycle for this run, the pack amounted to 341,957 cases. The 1951 sockeye-salmon pack credited to the Fraser River was 55,553 cases higher than the average annual pack for this species in this river system for the previous five years.

According to reports, the spawning-beds in the Upper Fraser River were all well seeded and, in many cases, the best seeding which had occurred for a number of years. Similar reports from most of the Lower Fraser River spawning areas would indicate that the sockeye runs to the Fraser River, as indicated by the pack and the spawning, are definitely improving, which, no doubt, can be attributed largely to the success of the programme of the International Pacific Salmon Fisheries Commission and the conservation methods adopted by the Federal Department of Fisheries.

The Fraser River sockeye-salmon fishery is regulated by an international commission under treaty between Canada and the United States. This fishery is an international one, in that the sockeye salmon comprising this fishery pass through both Canadian and United States territorial waters before reaching the Fraser River and hence the nationals of both countries share in the catch. The Commission is composed of six members, three of whom are appointed by the United States Government and three by the Canadian Government. According to figures published by the International Pacific Salmon Fisheries Commission in its annual report for 1951, the total sockeye-salmon pack for the Fraser River amounted to 252,551 cases. Of this total, Canadian gear took 134,400 cases, while American fishermen caught 118,151 cases. The percentages are: Canadian fishermen caught 53.22 per cent and United States fishermen caught 46.78 per cent.

There is some discrepancy in the figures supplied by the International Pacific Salmon Fisheries Commission and the figures computed from returns made by the licensed canners to the Provincial Department of Fisheries, due to the fact that the Canadian figures include the sockeye salmon caught in Johnstone Strait, which are known to be proceeding to the Fraser River.

For convenience a table is included in this section showing the American and Canadian catches by percentages from 1935 to 1951, inclusive:—

	American (Per Cent)	Canadian (Per Cent)
1935	47.00	53.00
1936	25.00	75.00
1937	38.00	62.00
1938	42.00	58.00
1939	44.50	55.50
1940	37.50	62.50
1941	39.30	60.70
1942	37.20	62.80
1943	37.42	62.58
1944	29.77	70.23
1945	39.90	60.10
1946	43.90	56.10
1947	16.60	83.40
1948	59.47	40.53
1949	49.98	50.02
1950	57.70	42.30
1951	46.78	53.22

The percentages for 1951 are based on figures supplied by the International Pacific Salmon Fisheries Commission.

The reader will find in the Appendix to this Report a table showing the total sockeye-salmon packs of the Fraser River, arranged in accordance with the four-year cycle, from 1895 to 1951, inclusive, showing the catches made by British Columbia and Washington fishermen in the respective years.

Spring Salmon.—In 1951 there were 5,719 cases of spring salmon canned from fish caught on the Fraser River. This is compared with the spring-salmon pack of the previous few years, as follows: 1950, 1,818 cases; 1949, 9,889 cases; 1948, 2,955 cases; and 1947, 1,455 cases. The canned-salmon pack of spring salmon from the Fraser River is in nowise indicative of the size of the catch of this species, as spring salmon find a large outlet in other than the canned state. The fresh- and frozen-fish trade takes large quantities of spring salmon.

Cohoe Salmon.—The Fraser River produced a total pack of 14,848 cases of cohoe in 1951. This was the largest pack of cohoe on the Fraser since 1948, when 16,102 cases were canned. The 1951 Fraser River cohoe-pack was 4,175 cases above the average annual pack for the previous five-year period. It must be remembered that the pack figures quoted for springs, cohoes, pinks, and chums are for Canadian catches only. The United States catches of each species proceeding to the Fraser River are not included in these figures. In the case of cohoe it should be remembered that large quantities are frozen for the winter trade, and these, of course, are in addition to the catch as indicated by the canned-salmon pack.

Pink Salmon.—The pink-salmon run to the Fraser River occurs in the odd-numbered years only. There is no pink-salmon run to the Fraser in the even-numbered years. In 1951 the pack of pink salmon from fish caught in the Fraser River amounted to 66,673 cases. The pack in 1949, the cycle-year for this run, was 66,626 cases. Practically all pink salmon caught are canned, and if the canned-salmon pack is indicative of the size of the run, it would appear that the run in 1951 was very similar to that in 1949. In 1947 the pink-salmon run to the Fraser produced a pack of 113,136 cases, while in 1945 there were 95,748 cases of pink salmon canned. The pink-salmon pack in 1951 was 7,836 cases less than the average for the previous five cycle-years for this river system.

Chum Salmon.—In 1951 the 35,530 cases of chum salmon packed on the Fraser River were 12,188 cases less than this river produced in the year previous. The 1951 pack of chums was 15,066 cases higher than the average annual pack for this species for the previous five-year period. The canned-salmon pack figures for chum salmon packed on the Fraser River in recent past years are not indicative of the size of the run of this species. In recent past years United States canners have been able to pay much higher prices for chum salmon than Canadian packers, and, as a result, large quantities of Canadian-caught chum salmon are exported each year for canning in United States canneries. Another factor which must be taken into consideration is the fact that chum salmon find a ready market in the frozen-fish trade, and large quantities are frozen each year.

Any consideration of the canned-salmon pack as a measure of the total run must take into account the escapement to the spawning-beds. The escapement to the various spawning-beds of the Province is reported each year by the Chief Supervisor of Fisheries for the Federal Government, and his report is contained in the Appendix to this Report. The reader is referred to this spawning-bed report when appraising the salmon runs to the different river systems.

Skeena River

The Skeena River in 1951 produced a total salmon-pack of 130,681 cases. This was 32,792 cases greater than the pack in 1950 and was the largest pack for the Skeena since 1948, when 193,435 cases were canned. The Skeena River pack in 1951 was composed of 61,694 cases of sockeyes, 2,055 cases of springs, 1,819 cases of steelheads, 19,977 cases of cohoes, 30,356 cases of pinks, and 14,778 cases of chums, half-cases being dropped in each instance.

Sockeye Salmon.—The Skeena River in 1951 produced a sockeye-pack of 61,694 cases. This is compared with the previous year's pack of 47,479 cases. The 1951 sockeye-pack on the Skeena was 88 cases less than the average annual pack for this river system for the previous five-year period.

The sockeye runs to the Skeena River have been the subject of very close observation in recent past years by the Federal fisheries biologists, owing to the fact that the Skeena River, in latter years, has been in a period of low production. An investigation conducted by the biologists indicated certain remedial measures which it was hoped would improve the Skeena River sockeye production. While it may be too early to notice any improvement, the 1951 run to the Babine received a severe blow in the nature of a rock-slide which occurred on the Babine River about 12 miles from that river's junction with the main Skeena. It should be remembered that probably 60 per cent of the total sockeye run to the Skeena spawns in the Babine watershed. The slide effectively blocked a very large portion of the Babine run in 1951. Reporting on this obstruction, the Chief Supervisor of Fisheries for the Federal Government reports as follows:—

"A large rock-slide occurred in a narrow canyon of the Babine River at a point some 12 miles above its confluence with the Skeena. It created a block to the main run of sockeye going to the Babine watershed, where at least 60 per cent of the portent Skeena River sockeye run normally spawns. At least two-thirds of the sockeye run to the Babine area or about 50 per cent of the Skeena River run was affected and also, in varying proportion, were the runs of other salmon species to this system. Due to the inaccessible character of the terrain and distance from existing roads, nothing could be done to assist or salvage this year's run at the obstruction. Steps were taken at once looking to earliest feasible action. Work on an access road was commenced and has progressed favourably. It is hoped that before the spring high water of 1952, it will have been possible to have essential heavy equipment on the ground to undertake remedial action to ensure passage of the 1952 run. In all, some 152,457 sockeye passed the obstruction and through the counting-fence maintained in the Babine River by the Fisheries Research Board of Canada. Of these, 27.4 per cent were damaged and 9.2 per cent were jacks. It is estimated that 20,000 of this number died before spawning. There is some doubt as to the productive efficiency of spawn deposited by the remainder. Supplies of sockeye to the early streams flowing into Babine Lake were comparable to other years."

It is yet too early to know what detrimental effect this slide will have on the future sockeye runs to this river system. Latest reports indicate that the access road to the slide has been practically completed, and that measures will be taken to assist the 1952 run over the obstruction.

Spring Salmon.—As on other river systems in the Province of British Columbia, the spring-salmon pack is never indicative of the size of the run, and in the northern waters, generally speaking, spring salmon are canned from those fish which are caught incidental to fishing for other species. In 1951 the Skeena River spring-salmon catch produced a pack of 2,055 cases. This is compared with the 1950 pack, when 1,758 cases were canned, and with 1949, in which year 2,507 cases were canned. The canned-salmon pack of springs on the Skeena in 1948 amounted to 4,018 cases.

Cohoe Salmon.—The Skeena River is never a large producer of cohoe salmon, and the 1951 pack of this species, amounting to 19,977 cases, must be considered a normal one. The 1951 pack was 10,196 cases greater than the pack in the previous year, and 1,356 cases less than were canned on the Skeena River in 1949, and 1,022 cases greater than the average annual pack of Skeena River cohoe in the previous five-year period.

Pink Salmon.—The 1951 pack of pink salmon produced on the Skeena River, amounting to 30,356 cases, while greater by 4,100 cases than the 1950 pack, was, nevertheless, 2,713 cases less than were canned in 1949, the cycle-year. The odd-year cycle of pink-salmon runs to the Skeena has always been less than the cycle of the even-

numbered years. In the past years, however, this cycle has produced much larger runs. In 1945 the Skeena River produced a pack of 69,783 cases of pink salmon, while in 1943 the pack was 54,509 cases. This cycle produced a pack of 95,236 cases in 1939.

Chum Salmon.—Chum salmon are never canned in large quantities on the Skeena River, and 1951 was no exception. In that year there were canned 14,778 cases of chum salmon from fish caught in the Skeena River. While this number is not large in itself, the pack, however, was the largest pack of chum salmon on the Skeena River since 1938, when 16,758 cases were canned. The 1951 pack was also 4,630 cases above the average five-year pack for this species.

Nass River

The total canned-salmon pack produced from fish caught in the Nass River in 1951 amounted to 152,742 cases. This is probably a record for this river system. The Nass has produced packs of over 100,000 cases on numerous occasions, but it would appear that the 1951 pack was a record for this river system. In 1942 the pack on the Nass amounted to 100,142 cases, in 1938 the pack was 113,970 cases, and in 1936 the total pack was 139,575 cases. In 1930 the pack was 113,460 cases, and in 1924 a total of 142,939 cases was canned. The 1951 pack was composed of 24,405 cases of sockeyes, 596 cases of springs, 407 cases of steelheads, 18,711 cases of cohoes, 70,880 cases of pinks, and 37,742 cases of chums.

Sockeye Salmon.—In 1951 the total pack of sockeye caught in the Nass River was 24,405 cases, which was 2,881 cases less than were canned on this river system in the previous season. The 1951 pack was the largest pack of sockeye on the Nass River since 1936, when in that year the pack amounted to 28,562 cases. The 1951 pack on the Nass was 7,407 cases above the average annual pack for the previous five years. The sockeye runs to the Nass River are 4- and 5-year-old fish, and because of this it is difficult to compare any one year's catch with the cycle-year. It is interesting to note, however, that the 1951 run was the progeny of 1947 and 1946. In 1947 the pack on the Nass amounted to 10,849 cases, while the 1946 pack was 12,511 cases. It would appear that the success of the spawning of one or both of these years was very good.

Spring Salmon.—Spring salmon are caught and canned on the Nass River incidental to fishing for other species and, consequently, the size of the canned-salmon pack is not indicative of the size of the run. In 1951 there were 596 cases of spring salmon canned on the Nass River, while in 1950 the canned pack of this species amounted to 798 cases. In 1949 the pack was 174 cases, while 416 cases of spring salmon were canned in 1948.

Cohoe Salmon.—The Nass River has produced some fairly substantial packs of cohoe salmon in years gone by, but in recent years the cohoe-packs have not been large. In 1951 the Nass River produced a pack of canned cohoe amounting to 18,711 cases. This was the largest pack of cohoe on the Nass River since 1935, when 21,810 cases were canned. The 1951 cohoe-pack on the Nass is compared with packs of recent past years, as follows: 1950, 2,737 cases; 1949, 6,665 cases; 1948, 8,954 cases; and 1947, 4,075 cases. The cohoe-pack on the Nass in 1942 was 15,487 cases, while 1941 produced a pack of 16,648 cases.

From the above figures it will be noted that the cohoe-packs on the Nass River have been very erratic.

Pink Salmon.—The 70,880 cases of pink salmon canned on the Nass River in 1951 was the largest pack of this species on this river system since 1936, when 75,888 cases were canned. The next year previous in which the pack was more than 50,000 cases was 1930, when 79,976 cases of pink salmon were canned from fish caught in the Nass River. The 1951 pack exceeded the cycle-year 1949 by 36,556 cases and was 44,600 cases greater than the average annual pack for this species in the previous five years.

Chum Salmon.—Chum salmon are never a large factor in the Nass River canned-salmon production. However, the 1951 pack of 37,742 cases of this species was much

greater than in any recent past year and was probably responsible for the large total pack of this species on the Nass River in the year under review. The 1952 pack of chums on the Nass exceeded the year previous by 23,421 cases and was 22,519 cases higher than the average annual pack of this species for the previous five-year period.

In commenting on the spawning-bed conditions on the Nass River in 1951, the Chief Supervisor remarks that the escapement of pink salmon to the Nass River system was heavy and chum-salmon supplies were strong over the area, showing improvement over the brood-year. It would appear that, in addition to the large pack, the escapement was better than usual.

Rivers Inlet

In Rivers Inlet in 1951 the total canned-salmon pack amounted to 148,996 cases of all species. This was 23,111 cases less than were packed in Rivers Inlet in 1950, but the 1951 pack was 22,523 cases above the average annual pack in this area for the previous five-year period. The 1951 pack was composed of 102,565 cases of sockeyes, 937 cases of springs, 274 cases of steelheads, 12,146 cases of cohoes, 20,960 cases of pinks, and 11,842 cases of chums, half-cases being dropped in each instance.

Sockeye Salmon.—Rivers Inlet is predominantly a sockeye-fishing area, and in 1951 the total sockeye-pack for this area was 102,565 cases. This was 40,145 cases less than were canned in the previous season and 37,512 cases less than were canned there in 1947, the cycle-year for the 1951 run. The 1951 pack of sockeye in Rivers Inlet was 10,061 cases higher than the average annual pack of this species for this river system for the previous five-year period.

In comparing averages one should remember that the Rivers Inlet production of sockeye has been comparatively low during recent past years. This inlet has produced well over 100,000 cases for a number of years, but until 1950 the inlet has not produced a pack exceeding 100,000 cases since 1935. The run in 1951 must be considered as satisfactory.

Spring Salmon.—Spring salmon in Rivers Inlet, like other gill-net fishing areas, is not an important fishery. A few springs are caught each season incidental to fishing for sockeye. In 1951 there were 937 cases of spring salmon canned in Rivers Inlet, compared with 619 cases in 1950, 743 cases in 1949, 899 cases in 1948, and 475 cases in 1947.

Cohoe Salmon.—Rivers Inlet is never a large producer of cohoe salmon, and the 12,146 cases of cohoes canned there in 1951 was the largest pack for any year since 1945, when 17,516 cases were canned in this inlet. The 1951 pack of cohoe was 7,410 cases greater than in the year previous and 4,003 cases greater than 1948, the cycle-year. The 1951 pack of cohoes in this area was 706 cases above the average annual pack of this species for the previous five years.

Pink Salmon.—The pink-salmon pack in Rivers Inlet is never a large factor in the canned-salmon production of the area, and the 20,960 cases packed in 1951 was considerably above the usual pack of pinks for this area. The pack in 1950 was 12,864 cases; in 1949, 11,937 cases; in 1948, 13,491 cases; while in 1947 the pack was only 9,025 cases. In 1946 the inlet produced a pack of pink salmon amounting to 1,641 cases. Not since 1930 has the pink-salmon pack in Rivers Inlet approached 20,000 cases, and in that year 18,023 cases of pinks were canned.

Chum Salmon.—Rivers Inlet was not a producer of chum salmon up until the year 1935, and in that year a small fall fishery was introduced for the first time. Since then there have been chum salmon fished in Rivers Inlet each year, and in 1951 the total chum-salmon production for this area was 11,842 cases. In 1950 the chum-salmon pack was 10,041 cases, and in 1949 the pack amounted to 11,819 cases. The pack in 1948 was 11,486 cases, while in 1947 it was 13,873 cases. It will be observed from the above figures that the 1951 pack of chums in Rivers Inlet was an average one.

Smith Inlet

Smith Inlet, like Rivers Inlet, is very largely a sockeye-producing area. Other species caught there are generally caught incidentally while fishing for sockeye. The total canned-salmon pack in Smith Inlet in 1951 was 58,022 cases and was composed of 49,473 cases of sockeyes, 174 cases of springs, 103 cases of steelheads, 3,259 cases of cohoes, 2,482 cases of pinks, and 2,530 cases of chums.

Sockeye Salmon.—The sockeye-salmon pack in Smith Inlet in 1951 was the largest ever recorded, being 7,038 cases above the all-time record pack of sockeye in Smith Inlet in 1950. From reports received in connection with the escapement to the spawning-grounds, the runs of both 1950 and 1951 were quite large indeed, as the escapement to the spawning-beds was reported to be much better than average. The Chief Supervisor of Fisheries, in his report on the spawning-beds for 1951, remarked on the exceedingly large size of the Smith Inlet sockeye in 1951.

Spring Salmon.—Spring salmon are caught and canned in Smith Inlet incidental to fishing for other species, and the pack in 1951, amounting to 174 cases, is compared with the 71-case pack in 1950, the pack of 159 cases in 1949, and the pack of 186 cases in 1948.

Cohoe Salmon.—Cohoes, like spring salmon, are not fished for in Smith Inlet. A few are caught, however, while fishing for other species. These are canned, and in 1951 the pack of cohoes in this area was 3,259 cases. The pack in 1950 was 397 cases and 785 cases in 1949. The comparatively large pack of cohoes in Smith Inlet in 1951 was something of a record for this species.

Pink Salmon.—Pink salmon, like cohoe salmon, are caught only incidentally in Smith Inlet. In 1951 the pack of this species amounted to 2,482 cases, compared with 5,308 cases in 1950, 2,533 cases in 1949, 1,481 cases in 1948, and 1,054 cases in 1947.

Chum Salmon.—The small chum-salmon fishery which has been conducted by the seine fleet in Smith Inlet in the fall of the year was continued in 1951, and the reports indicate that fishing was not particularly good during that season, the pack amounting to 2,530 cases. This is compared with the previous year when 4,499 cases were canned and 1949 when 2,361 cases were packed. The 1948 pack was 1,521 cases, while that of 1947 amounted to 7,910 cases of this species. The size of the canned chum-salmon pack in Smith Inlet is not considered in any way indicative of the size of the run of this species.

Queen Charlotte Islands

There are two species of salmon fished in the Queen Charlotte Islands district exclusively for canning purposes. These are pinks and chums. Chum salmon are taken every year in the Queen Charlotte Islands, but pink salmon are caught only every alternate year, the runs coinciding with the even-numbered years. There was no run of pink salmon to the Queen Charlotte Islands in 1951. In addition to the salmon which are fished for in the Queen Charlotte Islands area exclusively for canning, there is a large spring- and cohoe-salmon fishery for the fresh- and frozen-fish trade. This is a troll fishery and is not considered in these reports of the canned-salmon packs. A few cohoes are caught incidentally while fishing for chum salmon, and these find an outlet in the canneries and are recorded. The canned cohoe-pack, however, is not in any way indicative of the quantity of this species caught in the Queen Charlotte Islands area.

In 1951 the total canned-salmon pack for the Queen Charlotte Islands was 88,240 cases of all species. This must be considered as a fairly good pack for the off-year for pinks in this district. The 1951 pack was composed of 510 cases of sockeyes, 22,579 cases of cohoes, 3,455 cases of pinks, and 61,696 cases of chums, half-cases being dropped in each instance.

Cohoe Salmon. — The 22,579 cases of cohoes caught and canned from Queen Charlotte Islands fish in 1951 is something of a record for this species in this area,

particularly in recent past years. The 1951 pack was the largest pack of cohoes credited to the Queen Charlotte Islands since 1941, when 27,421 cases were canned. The cohoe-pack in 1951 is compared with 9,021 cases in 1950, 8,141 cases in 1949, 4,145 cases in 1948, and 392 cases in 1947. As pointed out above, the size of the cohoe-pack in the Queen Charlotte Islands is in no way indicative of the size of the run to the local streams. It is, rather, a reflection of various economic conditions prevailing in the industry at the time the fish were caught. Sometimes it is more convenient to can the few cohoes caught incidental to chum-salmon fishing than it is at other times, hence the extreme variation in the size of the cohoe-pack from year to year.

Pink Salmon.—There was no pink-salmon run to the Queen Charlotte Islands in 1951. The 3,455 cases of this species canned from this district were stragglers caught incidentally while fishing for other varieties.

Chum Salmon.—The 61,696 cases of chum salmon canned from fish caught in the Queen Charlotte Islands district in 1951 was considerably smaller than the pack of this species in the year previous when 148,669 cases were canned. The 1951 pack of chum salmon was 2,424 cases below the average annual pack for this area for the previous five years.

Central Area

For the purpose of this Report the Central Area comprises all of the salmon-fishing areas off the coast of British Columbia between Cape Calvert and the Skeena River, except Rivers Inlet. Salmon-fishing in this area is conducted on many different runs of salmon in the various parts of the district and, as a consequence, the size of the pack in this area is no indication of the magnitude of the different runs to the various streams, but rather reflects the size of the runs generally within the geographical limits of the area.

In 1951 the total canned-salmon pack credited to the Central Area amounted to 513,926 cases. This is compared with the packs in this district in recent past years, as follows: 1950, 372,781 cases; 1949, 351,420 cases; 1948, 439,995 cases; and 1947, 440,951 cases. The 1951 pack in this area was composed of 22,312 cases of sockeyes, 1,082 cases of springs, 706 cases of steelheads, 61,423 cases of cohoes, 237,559 cases of pinks, and 190,843 cases of chums, half-cases being dropped in each instance.

Sockeye Salmon.—The 1951 pack of sockeye salmon in the Central Area, amounting to 22,312 cases, was 3,685 cases above the pack of this species in 1950 and 1,305 cases above the average annual pack of sockeye in the Central Area for the previous five years. Sockeye salmon caught in the Central Area are not the product of one individual river system, but rather of a number of streams, and while the pack figures do not necessarily reflect the condition of any individual stream, it would seem to indicate that the district in general is maintaining its average production. The sockeye-salmon runs to the streams in this district are apparently being maintained.

Spring Salmon.—Spring salmon are caught and canned in the Central Area to some extent, but, as in other areas, the canned spring-salmon pack is made up of fish which are caught incidentally while fishing for other species, and the pack is not a measure of the size of any of the runs in the district. In 1951 there were 1,082 cases of spring salmon canned in the Central Area. This is compared with 776 cases in 1950, 1,007 cases in 1949, 1,195 cases in 1948, and 514 cases in 1947.

Cohoe Salmon.—In 1951 there were 61,423 cases of cohoes canned in the Central Area. This was something of a record. The 1951 pack was the largest pack of cohoes in the Central Area for some considerable time and was 4,707 cases above the previous large pack in 1938, when 56,716 cases were canned. The 1951 pack of cohoes in the Central Area was 23,774 cases above the average annual pack of this species for the previous five-year period.

Pink Salmon.—The Central Area has always been considered a high producer of pink salmon, and, as pointed out in previous issues of this Report, the area has produced

as high as 370,000 cases of pink salmon in a single season. In comparatively recent years, however, the pack figures for pink salmon in this area have been consistently smaller. It is encouraging to note that the pack of this species in 1951 showed a material increase over recent past years.

In the year under review, the Central Area produced a pack of pink salmon amounting to 237,559 cases. This is compared with 1950, when the pack amounted to 163,301 cases, 1949 with a pack of 173,456 cases, and 1948 with 152,200 cases. The 1951 season was the first time in which the pink-salmon pack for the Central Area exceeded 200,000 cases since 1943, when the pack in that year amounted to 288,109 cases. The 1951 pack was 72,008 cases higher than the average annual pack of this species for the previous five-year period.

Chum Salmon.—In 1951 there were canned in the Central Area 190,843 cases of chums. This was 25,959 cases above the year previous and was 7,219 cases less than the average annual pack of chum salmon in the Central Area for the previous five years.

In considering the size of the chum-salmon pack, and to some extent the pink-salmon pack in the Central Area for 1951, the reader must take into consideration the extremely dry weather conditions which prevailed in this area during most of the fishing season. Most of the streams were below normal and, as a consequence, pink and chum salmon found it difficult in many cases to ascend the streams to spawn. This made the fish easier to catch and may have had some bearing on the size of the canned packs of these two species in the year under review. The exceptionally dry season in the Central Area made it necessary for the Federal Department of Fisheries to impose extraordinary restrictions on fishing in order to protect sufficient fish to properly seed the spawning areas.

Vancouver Island

In 1951 Vancouver Island and the adjacent Mainland waters produced a total pack of canned salmon amounting to 585,240 cases. This is compared with 347,996 cases in 1950, 538,370 cases in 1949, 317,572 cases in 1948, and 552,940 cases in 1947. The 1951 pack was composed of 22,107 cases of sockeyes, 3,133 cases of springs, 114 cases of steelheads, 151,325 cases of cohoes, 303,102 cases of pinks, and 105,458 cases of chums. Vancouver Island, like the Central Area, supports numerous races of salmon running to the different watersheds. In this breakdown no attempt is made to deal with the various races separately. It should be mentioned, however, that the sockeye salmon caught in the Sooke traps are not credited to Vancouver Island, but to the Fraser River, where most of them are known to migrate. Similarly, sockeye salmon caught in Johnstone Strait, between Vancouver Island and the Mainland, are also credited to the Fraser River in this Report and not to Vancouver Island.

Sockeye Salmon.—Except as noted in the immediately preceding paragraph, Vancouver Island produced a total sockeye-salmon pack in 1951 of 22,107 cases. This was 8,301 cases greater than in the year previous and was 6,121 cases greater than the average annual pack in the previous five-year period.

Spring Salmon.—Large quantities of spring salmon are caught each year by trolling in the waters off the west coast of Vancouver Island. Most of these fish, however, find a market in the fresh- and frozen-fish trade or as mild-cured salmon. The troll-caught salmon on the lower west coast of Vancouver Island also find a market principally as fresh, frozen, or mild-cured. Because of these outlets the canned-salmon pack figures for spring salmon in the Vancouver Island district are in nowise indicative of the size of the catch of this species. In 1951 there were 3,133 cases of spring salmon canned from fish caught in the Vancouver Island district. This is compared with 3,343 cases in 1950, 6,361 cases in 1949, 6,622 cases in 1948, and 4,942 cases in 1947.

Cohoe Salmon.—Cohoe salmon, like spring salmon, find a market other than in cans, and for this reason the canned-salmon pack is not necessarily indicative of the size

of the catch or of the run. In the Vancouver Island district in 1951 the cohoe-pack was 151,325 cases, which was considerably larger than in recent past years. The 1951 pack was 49,170 cases above the average annual pack of cohoes credited to the Vancouver Island district for the previous five-year period. The 1951 cohoe-pack was the largest in this district since 1941, in which year the pack amounted to 166,908 cases.

Pink Salmon.—The pink-salmon pack in 1951 credited to Vancouver Island was 303,102 cases. This was 71,086 cases more than were canned in 1950 but was 58,681 cases less than in 1949, the cycle-year for this species. The run of pink salmon to the Vancouver Island district in 1947 produced a pack of 355,992 cases.

Chum Salmon.—In 1951 Vancouver Island and the adjacent Mainland produced a catch of chum salmon sufficient to fill 105,458 cases, over and above the quantity that found a ready market in the frozen-fish trade and the fairly substantial quantity which, in latter years, has been shipped fresh to United States markets. Because of these factors the canned-salmon figures for chums for the Vancouver Island district are not indicative of the catch. The pack in 1950 was 125,833 cases, while in 1949 Vancouver Island and the adjacent Mainland was credited with a pack of 51,629 cases and 147,227 cases in 1948.

REVIEW OF BRITISH COLUMBIA'S SALMON-CANNING INDUSTRY, 1951

There was a total of twenty-three salmon-canneries licensed to operate by the Provincial Department of Fisheries in 1951. This was one less than the number licensed in 1950. The operating canneries were located as follows: Skeena River, 6; Central Area, 3; Rivers Inlet, 1; Vancouver Island, 1; and Fraser River and Lower Mainland, 12.

The distribution of the salmon-canneries operated in 1951 was similar to that of 1950, with one exception. In 1950 two canneries operated on Vancouver Island, while in 1951 only one cannery operated in this area. All of the other areas supported the same number of operating canneries as in 1950. Again in 1951 there were no salmon-canning operations on the Nass River or in the Queen Charlotte Islands. Smith Inlet also did not have an operating cannery in 1951. All three of these areas formerly supported operating canneries. The salmon-catch from these areas is now transported to other areas for canning. This tendency has been remarked on in previous issues of this Department's Report, and apparently the policy of concentrating the packing of salmon in fewer canneries is continuing. The liberal use of ice during the salmon-canning season, together with modern, fast packers, has made it possible for the operators to transport fresh salmon over increasingly greater distances. This practice is no doubt encouraged by the necessity of lowering production costs, and in recent years companies have been concentrating their canning operations in fewer canneries. While this practice may serve as some measure of economy in production costs, benefits are bound to be limited. The major portion of the cost of a case of canned salmon is the price of the raw fish, and until raw-fish prices decline or level off, the cost of producing a case of canned salmon will remain high, regardless of the concentration of operating canneries.

Since 1947 the export of fresh salmon after September 1st has been permitted in each year, and owing to the fact that American canners are able to pay higher prices for Canadian fish for canning purposes than the Canadian canners, there has been a movement of large quantities of chum salmon to the United States for processing in Puget Sound canneries. In so far as the Canadian canned-salmon pack is concerned, Canadian canneries might as well have closed down after September 1st, as practically all of the chum salmon caught for canning purposes after that date found a market in the United States and were canned there. This applies to canning fish only. Large quantities of Canadian-caught chum salmon after September 1st in each year find a market in Canadian freezes. The point is, however, that the export of raw fish, which would ordinarily be canned in British Columbia, has had the effect of reducing the canned-salmon pack

for this Province to less than what it would have been if all the fish caught in British Columbia waters had been canned here. This, of course, has had the effect of reducing the number of employees and the time employed in Canadian canneries.

In considering the current pack figures for the canneries of the Lower Mainland, it should be kept in mind that the export of raw fish reduced the pack by the equivalent of the amount exported. Due allowance should therefore be made for these quantities when comparing the canned-salmon pack figures with years previous to 1947.

Probably the most outstanding feature of the 1951 salmon-fishing season was the extremely dry weather during the fishing season. This, of course, had the effect of lowering many of the coastal streams to the point where salmon reaching the streams could not ascend them to spawn. This condition became so acute that the Federal Department of Fisheries was forced to close all salmon-fishing for a period until the early rains came in the Central Area, which permitted an escapement to the spawning-beds.

OTHER CANNERIES

Pilchard-canneries.—There has been no run of pilchards off the west coast of Vancouver Island since 1949, and, as a consequence, again in 1951 no pilchard-cannery licences were issued.

Herring-canneries.—In 1951 there were three herring-canneries licensed, and all of these operated. This was one more than operated in 1950. In 1949 five herring-canneries operated. The three canneries operating in 1951 produced a pack of 103,928 cases of canned herring. This is compared with 56,798 cases canned in 1950 and with 77,913 cases canned by the five canneries in 1949. The variation in the canned-herring pack from year to year is not a function of the size of the run, but rather reflects the market conditions prevailing at the time the herring are available. During the war years, and immediately following the war, the canned-herring business in British Columbia attained quite large proportions. In 1947, for instance, eighteen herring-canneries produced a pack of 1,283,670 cases. Since then, however, the canned-herring industry has reached what might be considered its normal production. During pre-war years British Columbia herring were canned to the extent of from 25,000 to 40,000 cases annually.

Tuna-fish Canneries.—The first commercial tuna-fish canning operations in British Columbia were licensed in 1948. Tuna were caught off the British Columbia coast previous to this date, but the catch was largely frozen and shipped to United States canneries. In 1951 there were five plants licensed to can tuna, and all of these operated. This is compared with three in 1950. The five plants operating in British Columbia in 1951 produced a pack amounting to 102,132 cases of 7-ounce cans and 2,289 cases of 4-ounce cans. These figures are compared with a total pack of 77,328 cases of tuna in 1950.

The tuna-fishery off the British Columbia coast has not yet stabilized itself, and we may expect some fairly wide fluctuations in the size of the tuna-pack until the fishery becomes stable.

Shell-fish Canneries.—Under this heading those plants which are concerned with the canning of various species of shell-fish are reviewed. In 1951 there were nine plants licensed by the Provincial Department of Fisheries, all of which operated. There were two more canneries operated in 1951 than in the year previous. The pack of the shell-fish canneries is listed below:—

Clams: 4,917 cases of 48/½'s, 14,568 cases of 24/1's, and 1,696 cases of 6/10's.

Crabs: 8,709 cases of 48/½'s.

Oysters: 486 cases of 48/10-oz. and 11 cases of 96/¼'s.

Abalone: 130 cases.

The above figures for 1951 are compared with the pack in 1950, which was as follows:—

Clams: 2,352 cases of 48/½'s, 10,144 cases of 24/1's, 6,776 cases of 48/6-oz., and 778 cases of 6/10's.
Crabs: 8,418 cases of 48/½'s.
Oysters: 3,442 cases of 48/½'s.
Abalone: 76 cases of 48/1's.

MILD-CURED SALMON

In 1951 there were three plants licensed, and all operated on mild-cured salmon. This is compared with five plants which operated in the year previous. The three operating plants in 1951 produced 821 tierces of mild-cured salmon, compared with 886 tierces in 1950.

DRY-SALT SALMON

Previous to the outbreak of the war in 1939, large quantities of chum salmon were dry-salted in British Columbia each season for shipment to the Orient. In some years the production of dry-salt salmon reached quite large proportions and was a very definite factor in the market for fall fish.

During the war years the Provincial Government declined to issue licences for salmon dry-salteries in order to divert as much of the salmon-catch as possible to the salmon canners and freezers. This was done as a war measure. Since the war the business of dry-salting salmon has not revived. In 1947 two licences were issued but no operation took place, and no licences have been issued for salmon dry-salteries since that time. No doubt this cessation of business in the dry-salt salmon trade is in some measure due to unsettled conditions in the Orient.

As most of the dry-salt salmon found a market in Japan, there is a possibility of this market reviving now that the Japanese people have obtained their sovereignty. Whether or not economic conditions will permit of the import of chum salmon into Japan from Canada, of course, is an economic problem which, at the present time, requires clarification.

DRY-SALT HERRING

In British Columbia, previous to World War II, the dry-salting of herring was quite a factor in the winter fishery, the dry-salted product being shipped to China. Since the outbreak of the war in 1939, the bulk of British Columbia's herring-catch has been either canned or reduced to meal and oil. During the war years the British Columbia Government declined to issue licences for herring dry-salteries in order to divert as much as possible of the herring-catch to the canneries, the product from which being used as food for the allied nations. Since the war some activity has taken place each season in the dry-salting of herring, although the business has never attained anything like the proportions of pre-war years.

In 1951 there were five plants licensed to operate as herring dry-salteries, all of which operated. The five plants in 1951 produced a total of 4,331 cured tons of salt herring. This figure is compared with 4,418 tons produced in the year previous. All of the 1951 production was shipped to the Orient.

PICKLED HERRING

There has been no activity under this heading since 1947.

HALIBUT-FISHERY

The halibut-fishery on the Pacific Coast of North America is regulated by the International Fisheries Commission, which Commission is set up under a treaty between

Canada and the United States for the protection and rehabilitation of the halibut. The fishery is a deep-sea fishery and is shared in by the nationals of the two countries. The Commission regulates the fishery on a quota basis, and, on that account, there is little fluctuation in the total amount of halibut landed from year to year, except where the quotas are changed for any reason.

For the purpose of regulation, the coast was originally divided into a number of areas, the principal ones, from the standpoint of production, being Areas 2 and 3. Former Area 2 comprised the waters off the coasts of Washington and British Columbia, from the approximate vicinity of Willapa Harbour in the south to Cape Spencer in the north, while Area 3 comprised the waters from the northern boundary of Area 2 to the Aleutian Islands. In order to make better use of the stocks of halibut on the different banks, it was found necessary to further divide some of the areas, and Area 2, particularly, was subdivided. The new areas now comprise Areas 1A and 1B; Areas 2A, 2B, and 2C; Area 3; and Area 4. Areas 1A and 1B comprise what was formerly Area 1, while Areas 2A, 2B, and 2C were formerly Area 2. For a more detailed breakdown of the areas and the geographical limits of each, the reader is referred to the Pacific Halibut Regulations for 1951.

In 1951 the catch-limits set by the Commission for the different areas were as follows: Area 2A, 25,500,000 pounds; Area 3, 28,000,000 pounds; Area 4, 500,000 pounds. In Areas 2B and 2C there was no limit set, but fishing was limited to a ten-day period only. In Areas 1A and 1B there was no catch-limit, but Area 1A closed with Area 3, and Area 1B closed with Area 2A. In 1951 the total quota placed on Areas 2A, 3, and 4 amounted to 54,000,000 pounds. This was the same as in the year previous.

In 1951 the total landings by all vessels in all ports from the different areas amounted to 56,906,000 pounds, compared with 57,287,133 pounds in 1950. A breakdown of halibut production in 1951 by areas is as follows: Area 1A, 147,000 pounds; Area 1B, 325,000 pounds; Area 2A, 26,666,000 pounds; Area 2B, 2,468,000 pounds; Area 2C, 1,213,000 pounds; and Area 3, 26,087,000 pounds. There were no landings from Area 4 in 1951. The total production of halibut in 1951 was 381,113 pounds less than in the year previous. These figures are contrasted with the total landings by areas in 1950 as follows: Area 1, 359,000 pounds; Area 2, which comprises Areas 2A, 2B, and 2C, 26,742,000 pounds; and Area 3, 30,185,000 pounds.

In 1950 total landings by all vessels in Canadian ports amounted to 25,275,000 pounds, compared with total landings in 1950 of 22,498,000 pounds. Of this amount, former Area 2 produced 17,002,000 pounds, compared with 14,376,000 pounds in the year previous. In 1951 Area 3 produced 8,273,000 pounds, compared with 8,121,610 pounds landed in Canadian ports by all vessels in 1950.

The total landings of halibut in Canadian ports by Canadian vessels only in 1951 amounted to 20,884,000 pounds, compared with 18,814,000 pounds in the year previous. Former Area 2 was the big producer for Canadian vessels again in 1951, producing 16,346,000 pounds of the total landings by Canadian vessels in Canadian ports. Canadian vessels also landed some halibut in American ports, and in 1951 Canadian vessels landed 582,000 pounds of halibut in American ports, all of which were taken in Area 3.

In 1951 United States vessels landed in Canadian ports a total of 4,391,000 pounds of halibut. This is compared with 3,683,000 pounds in 1950.

It will be noted that while the quotas for 1951, as set by the International Fisheries Commission, were unchanged from the year previous, the total landings in 1951 were slightly less.

The average price paid for Canadian halibut in all Canadian ports in 1951 amounted to 15.5 cents per pound. The price paid for halibut landed at Prince Rupert in 1951 was slightly higher and averaged 17.4 cents per pound. In addition to the halibut landed in the various ports, the halibut-fishermen have, for a number of years, sold the halibut-livers to the pharmaceutical trade because of the high vitamin content of the livers. This

has been an important source of revenue to the halibut-fishermen on the Pacific Coast for a number of years. In 1951 Canadian halibut-fishermen received a total of $258,000 (estimated) for livers and viscera derived from the halibut-catch.

The statistical information for the above review in connection with the Pacific halibut-fishery was supplied by the International Fisheries Commission and is hereby gratefully acknowledged.

FISH OIL AND MEAL

The production of fish-oil and edible fish-meal has been an important branch of British Columbia's fisheries for a number of years. Previous to World War II, pilchards and herring were the principal species used for the production of oil and meal. Products of the reduction plants found a ready market, the meal being used as a supplementary food for animal-feeding and the oil found a ready market for use in manufacturing processes of many kinds. The demand for natural sources of vitamins stimulated the production of vitamin oils from fish products, and at the outbreak of World War II the demand for natural sources of vitamins greatly increased the production of fish-oils of high vitamin content in British Columbia. This increased demand for high vitamin oils brought into use other fish besides herring and pilchards during the war years and the years immediately after the war. Dogfish and shark livers were in high demand in those years. Recently, however, the increased production of synthetic Vitamin A has lessened the demand for fish-liver oil as a natural source of this vitamin, and if the price of synthetic Vitamin A falls much lower, the market for livers containing this vitamin may very soon disappear.

Fish-livers, cannery waste, and viscera are all utilized for the production of fish-oil in British Columbia. In addition to the production of oils from British Columbia's various fish and fish-livers, in recent years there has been developed considerable activity in the use of cannery waste and viscera for the production of various pharmaceutical products. In addition to the high vitamin-content oils used in the medicinal field, British Columbia's fish-oils of lower vitamin potency find an outlet in many manufacturing processes, while some of the vitamin-bearing oils of lesser quantity produced in British Columbia are sold in quite large quantities for feeding poultry and live stock.

Fish-liver Oil.—In 1951 there were four plants licensed to reduce fish-livers into oil, all of which operated. In 1950 the number of plants licensed was five, but only four plants actually got into production. In 1951 the four plants which operated processed 1,346,040 pounds of livers, producing 5,250,441 million U.S.P. units of Vitamin A with a value of $553,404. This production is compared with the 1950 production, in which four operating plants processed 834,376 pounds of livers, producing 3,578,905 million U.S.P. units of Vitamin A.

Pilchard-reduction.—The year 1951, like the preceding six consecutive years, did not produce a pilchard run. The year in question was the seventh consecutive year in which the pilchard run to British Columbia waters has been a complete failure from a commercial standpoint, and biologists charged with the investigation of this fishery are still not optimistic that this condition will materially improve in the near future. Pilchards are not native to British Columbia waters but migrate off our coast from California, where they are spawned in the ocean. There is a large pilchard-fishery in California conducted on the same body of fish that formerly migrated to British Columbia. This fishery is fished very heavily in California, and it is thought that the heavy fishing there has had some bearing on the migration habits of this species.

Herring-reduction.—The winter herring-fishery in British Columbia has developed into a very important branch of British Columbia's fishing industry. This branch of the industry ranks second in point of dollar value in British Columbia's fisheries. The season runs through from late in September or early in October until March in the following year, and although a few herring are caught previous to October, the season actually

gets into full swing by the middle of November. Many of the boats used in catching herring are also used in the salmon-fishery and, generally speaking, the herring-fishery does not get into full swing until the boats have been released from fishing for salmon. During the war most of the herring-catch was utilized in the herring-canneries, but since the war the catch is principally reduced to meal and oil. This fact should be kept in mind when figures are being compared with similar figures during the war years in connection with the herring-fishery and the production of herring-reduction plants.

In 1951 there were fifteen plants licensed, all of which operated. This was one more than the number which actually operated in 1950. The fifteen operating plants in 1951 produced 32,777 tons of meal and 3,832,301 imperial gallons of oil. This production had a total value of $8,233,965. The 1951 production of meal and oil from the herring-fishery is compared with 1950, when the total production of meal amounted to 31,913 tons and 3,385,685 imperial gallons of oil.

Whale-reduction.—In 1948 the hunting of whales off the British Columbia coast, for reduction purposes, was again resumed after a short period of inactivity. Whale-reduction continued in 1951. In that year there were 437 whales captured, compared with 314 whales in the year previous. The 437 whales captured in 1951 were reduced to meal, oil, whale-liver oil, and whale-solubles.

Miscellaneous Reduction.—Dogfish and fish-offal reduction plants are licensed by the Provincial Department of Fisheries under miscellaneous reduction licences. These plants operate on cannery waste and the carcasses of dogfish and produced meal and oil for various purposes. The oil produced from the carcasses of dogfish is not to be confused with the oil produced from dogfish-livers, the latter being a high-potency oil which is reported in another section of this Report.

In 1951 there were fifteen plants licensed, fourteen of which operated. The number is compared with twelve plants operated in the year previous. The fourteen plants operated in 1951 produced 3,217 tons of meal and 227,517 imperial gallons of oil. These figures are contrasted with the previous year's production when the twelve operating plants produced 1,717 tons of meal and 166,989 imperial gallons of oil.

NET-FISHING IN NON-TIDAL WATERS

Under section 24 of the Special Fishery Regulations for British Columbia, fishing with nets in certain specified non-tidal waters within the Province is permissible under licence from the Provincial Minister of Fisheries. This fishery is confined almost exclusively to the residents living within reasonable distance of the lakes mentioned.

In the Appendix to this Report there again appears a table showing the name and number of lakes in which net-fishing has been permitted, together with the number and approximate weight of the various species of fish taken from each lake.

It will be noted that there are three different kinds of fishing licences issued for net-fishing in non-tidal waters of the Province; namely, fur-farm, ordinary, and sturgeon. The fur-farm licences are issued to licensed fur-farmers, and the coarse fish taken under these licences are used as food for feeding fur-bearing animals held in captivity. Ordinary fishing licences are issued for the capture of fish other than trout, salmon, or sturgeon, while licences issued for sturgeon-fishing are exclusively for that fishery.

For a detailed account of the fish taken by licensed nets in the different waters of the Province, the reader is referred to the table appearing in the Appendix to this Report.

VALUE OF CANADIAN FISHERIES AND THE STANDING OF THE PROVINCES, 1950

The value of the fisheries products of Canada for the year 1950 totalled $182,106,597. During that year British Columbia produced fisheries products to the value of $68,821,358, or 37.8 per cent of Canada's total. British Columbia in 1950 led all of the Provinces of

Canada in respect to the production of fisheries wealth. Her output exceeded that of Nova Scotia, second in rank, by $30,656,391.

The market value of the fisheries products of British Columbia in 1950 was $12,701,204 more than in the year previous. There was an increase in the value of salmon amounting to $12,048,075.

The capital employed in 1950 in the primary fishing industry was $80,118,100.

The following statement gives the value of fishery products of the Provinces of Canada for the years 1946 to 1950, inclusive:—

Province	1946	1947	1948	1949	1950
British Columbia	$43,817,147	$58,764,950	$58,703,803	$56,120,154	$68,821,358
Nova Scotia	34,270,761	26,658,915	36,090,820	35,039,804	38,164,967
New Brunswick	16,419,983	17,131,690	20,122,378	17,428,127	18,053,168
Quebec	7,927,022	5,316,999	6,393,635	5,111,878	5,496,282
Ontario	6,296,658	5,403,662	5,942,723	5,728,389	7,033,552
Manitoba	4,871,037	5,329,448	5,414,583	4,800,387	6,791,290
Prince Edward Island	4,470,877	2,897,284	3,634,376	2,704,444	3,320,513
Alberta	1,399,083	856,609	1,527,834	652,545	767,887
Saskatchewan	1,148,886	1,170,930	1,282,437	1,025,896	1,360,114
Northwest Territories	558,264	530,948	636,352	2,334,009	2,297,466
Yukon	5,014	7,474	(1)	(1)	(1)
Newfoundland (estimated)	----------	----------	----------	----------	30,000,000
Totals	$121,124,732	$124,068,909	$139,748,941	$130,945,633	$182,106,597

[1] Not available.

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 1946 to 1950, inclusive, is given in the following table:—

Species	1946	1947	1948	1949	1950
Salmon	$24,346,483	$35,692,625	$36,671,140	$35,897,732	$48,701,583
Halibut	3,708,819	5,296,942	4,120,003	4,023,110	5,430,374
Halibut livers and viscera oil	300,303	647,002	527,868	333,200	121,165
Herring	9,574,643	12,094,582	10,485,090	9,412,786	9,313,447
Pilchard	213,753	41,750	----------	----------	----------
Mackerel	----------	----------	----------	----------	----------
Grey cod	----------	108,130	134,494	204,855	444,317
Ling cod	1,319,501	596,886	878,972	870,513	523,435
Clams	349,804	369,788	107,546	209,379	262,983
Black cod	446,008	268,165	564,888	631,850	263,892
Crabs	217,792	297,533	326,263	443,339	399,396
Soles	848,004	515,148	1,170,890	580,238	913,689
Prawns	----------	55	----------	----------	----------
Shrimps	40,431	48,538	84,910	89,447	122,345
Oysters	258,964	239,099	214,495	282,616	353,429
Abalones	150	7,101	4,838	2,811	1,732
Flounders	25,765	10,629	15,661	17,112	43,500
Red cod	214,882	78,435	131,910	140,830	54,362
Perch	15,970	8,070	5,731	4,636	7,681
Smelts	10,326	11,328	10,053	18,421	20,785
Sturgeon	6,070	10,142	5,502	13,418	11,909
Octopus	3,705	514	2,199	6,172	2,722
Skate	4,486	3,861	5,208	4,683	7,284
Eulachons	11,337	36,732	30,224	29,609	25,861
Whiting	180	----------	----------	----------	----------
Sardines	----------	----------	----------	----------	30,324
Trout	----------	----------	----------	----------	----------
Grayfish, etc.—					
Fresh	----------	----------	----------	----------	----------
Livers	12,258	43,121	11,057	6,659	----------
Liver-oil	1,098,569	1,439,861	1,634,388	1,539,951	169,724
Body-oil	----------	----------	----------	----------	----------
Meal	----------	----------	----------	2,822	----------
Whales	----------	----------	----------	450,405	639,643
Fur-seals	620	987	296	720	2,336
Hair-seals	----------	----------	----------	----------	----------
Anchovies	615,106	537,787	88,305	37,283	688
Tuna	122,892	233,096	990,424	708,004	767,767
Shark-livers	4,375	21,147	2,822	195	----------
Shark-liver oil	37,625	23,160	23,435	8,464	----------
Ratfish-livers	1,199	2,657	242	678	----------
Miscellaneous	7,127	80,079	454,949	148,216	184,985
Totals	$43,817,147	$58,764,950	$58,703,803	$56,120,154[1]	$68,821,358

[1] Corrected to date.

The above figures were supplied by the Dominion Bureau of Statistics, Ottawa, and are hereby gratefully acknowledged.

CONDITION OF BRITISH COLUMBIA'S SALMON-SPAWNING GROUNDS

We are again indebted to the Chief Supervisor of Fisheries for the Federal Government and the officers of his Department who conducted the investigations for furnishing us with a copy of the Department's report on the salmon-spawning grounds of British Columbia and in permitting the same to be published in the Appendix to this Report. The Chief Supervisor's courtesy in supplying us with this information is gratefully acknowledged.

CONTRIBUTIONS TO THE LIFE-HISTORY OF THE SOCKEYE SALMON (PAPER No. 37)

(Digest)

Paper No. 37 in this series is again contributed by D. R. Foskett, M.A., of the staff of the Pacific Biological Station at Nanaimo. It has been pointed out previously in the pages of this Department's Annual Report that the work of analysing the commercial salmon-catch in British Columbia's principal sockeye-fishing rivers has heretofore been done with funds supplied by the Provincial Department of Fisheries. Latterly, the extended salmon work being conducted by the Fisheries Research Board of Canada has made it possible to have the material for the catch analyses collected simultaneously while other field work was in progress, and arrangements have now been made to have this investigation continued, but in future the work will be financed and carried forward by the Fisheries Research Board of Canada. The Provincial Department of Fisheries will continue to contribute to this work by publishing the papers relating to this investigation. These papers will appear in the Appendix to the Annual Report of the Provincial Department of Fisheries as heretofore.

In the introduction to this year's contribution the author refers to the excellent packs of sockeye in both Rivers Inlet and Smith Inlet areas and draws attention to one of the problems in connection with the utilization of the sockeye runs presented by the numbers of jacks or 3-year-old males which are so prominent in certain areas in different years. The author points out that because of their small size they are taken by the commercial gear in small numbers only, in spite of the fact that they may be numerous in the run and exceedingly numerous on the spawning-grounds, which is true for Rivers Inlet and the Skeena River run in 1951. No experiments known to the author on the inheritance of the tendency toward early maturity have been carried past the first generation and, therefore, they cannot be considered conclusive. The suggestion is made that some work should be done with a view to carrying this investigation further in order that we might better assess the value of large numbers of jacks on the spawning-beds.

Speaking of the runs to the specific areas in question, the author points out that the sockeye-pack of 24,405 cases in 1951 was very good for the Nass River, where the average for the past ten years has been in the neighbourhood of 15,500 cases. The escapement to the Meziadin area, which reportedly constitutes the main spawning area for sockeye in the Nass River system, was reported to be adequate.

In connection with the Nass River age-groups, the author points out that there is still some doubt existing as to the particular point at which a check in the scale is sufficiently distinct to warrant recognition as marking the completion of the year and refers to research which is now being carried out by the Fisheries Research Board of Canada in two other areas—namely, Lakelse Lake and Port John Lake—and, as a result of this work, it is hoped that information will be obtained in these areas which will help in a clearer understanding of the situation in other areas.

Regarding the Skeena River sockeye run of 1951, the author points out that the pack of 61,694 cases was equal to the average pack of 61,720 cases for the past ten years. However, the author draws attention to the fact that the escapement in 1951 was reported to be light. The Babine area spawning population suffered tremendous losses due to a slide in the canyon about 40 miles below Babine Lake. This slide is referred to in another section of this Report.

Referring to the Rivers Inlet sockeye run of 1951, the author points out that this inlet produced a very satisfactory pack, amounting to 102,565 cases. The escapement was classed as moderate to heavy and, in the opinion of the writer, adequate in most of the streams in the area.

The author, in this paper, refers to the situation with regard to predators in the Rivers Inlet region by both seals and bears. After discussing predation, the author

suggests that an investigation might be undertaken, preferably as a joint enterprise with the British Columbia Game Commission, in order to settle the very controversial question as to the damage caused by bears to the spawning runs.

The Smith Inlet run of 1951, according to the author, amounting to 49,473 cases, was the highest pack yet recorded for this inlet and more than double the twenty-six-year average of 22,100 cases. In addition to this large pack, there was a heavy escapement to the spawning-grounds. It will be interesting to learn whether or not this heavy escapement in 1951 produces a run in 1955 commensurate with its size.

For more details in connection with the sockeye-salmon runs to the above-mentioned areas, the reader is referred to Mr. Foskett's paper, published in full, with supporting statistics, in the Appendix to this Report.

HERRING INVESTIGATION

Research on the various British Columbia herring populations was continued by the Fisheries Research Board of Canada at the Pacific Biological Station, Nanaimo, during the 1951–52 season. The studies are supervised by J. C. Stevenson.

The main purpose of the investigation is to gain sufficient information on the herring populations to enable more effective administration of the resource. The research involves three interrelated lines of approach:—

(1) Comparative study of two populations which are subjected to different methods of management. The catch of one population (that of the west coast of Vancouver Island) is not restricted by quota, whereas the catch of the other (the lower east coast of Vancouver Island) is limited to 40,000 tons annually. A fishing-closure date of February 5th applies to both populations.

(2) Collection of data on the adult stocks of all other major herring populations. One of the purposes of these studies is to enable wide application of results of the comparative study.

(3) Study of the factors that affect year-class recruitment. The present investigation seeks to determine whether either annual variations in survival of spawn or annual variation in abundance of juveniles is indicative of the abundance of the year-class when it is recruited to the fishery. The main purpose of these studies is to obtain information that will enable more precise prediction of adult abundance.

The Comparative Study

The west coast fishery in 1951–52 produced the second smallest catch of the six-year period (30,000 tons). Average catch per unit of effort was almost as high as in the years of greatest catch, a result considered to be due to exceptionally efficient fleet deployment rather than great population abundance. Extent of spawn deposition on the west coast in 1952 suggested that the amount of fish that escaped the fishery was less than in any year since 1947. Thus it appeared that population abundance was considerably reduced from that of 1950–51. Spawning data indicated that the main southern west coast stocks (Area 23) suffered relatively greater reduction than the more northerly west coast runs (Area 25). More intensive exploitation of the Area 25 runs occurred in 1951–52 than in the two previous years, principally because of the ten-day extension of fishing past the regular closure date of February 5th.

The decrease in population abundance on the west coast was considered to be largely a result of the recent entrance of two year-classes of generally low recruitment (1948 and 1949 year-classes). These year-classes (as III- and IV-year fish) were the main contributors to the Area 23 fishery. The 1947 year-class, which supplied the main bulk of the 1949–50 and 1950–51 west coast fisheries, was still abundant in the Area 25 stocks

as V-year fish in 1951–52 and, as a result, prevented a decrease in population abundance as large as that which occurred in Area 23.

In contrast to the decrease in west coast abundance, population abundance on the lower east coast of Vancouver Island showed a substantial increase in 1951–52. The spawning population, as shown by extent of spawn records, showed a phenomenal increase over that of the previous year (56 per cent). The 1947 year-class was of negligible importance on the lower east coast in 1951–52, but the 1949 year-class (as III's) was recruited in large numbers and the 1948 year-class (IV's) made an appreciable contribution to the stocks.

The present difference in the abundance of the two populations under investigation is not considered to be a result of the effect of quota restrictions on the lower east coast fishery. The difference is more likely a direct consequence of dissimilarity in the recruitment of the individual year-classes to the two populations. In recent years the year-classes entering the lower east coast stocks have been generally more uniformly productive than those recruited to the west coast population. Early life-history studies suggest that year-class strength on the west coast may be more affected by oceanographic conditions than it is on the lower east coast of Vancouver Island. This indication of a fundamental difference between the two populations is strengthened by data which show a major difference in survival from spawning to recruitment. Year-classes on the lower east coast have been derived from smaller spawn depositions than year-classes on the west coast, but average recruitment from lower east coast year-classes has exceeded average west coast recruitment. In view of this apparently fundamental difference, the present comparative study may be considerably complicated, so much so that it may be impossible to make direct comparisons. It appears possible that quota restrictions may serve a useful purpose when applied to the lower east coast population, but not when applied to the west coast fishery. Further investigation is required before results can be conclusive.

Tag-recovery data indicated that emigration of west coast fish to other sub-districts (about 3 per cent) was less than in previous years. The negligible movement of west coast herring to the lower east coast was considered to be a possible result of the present low abundance of the west coast population, and particularly of the greatly reduced abundance of the Barkley Sound stocks, with which the lower east coast runs usually show greatest intermixture. Similarly, recovery of lower east coast tags in west coast catches was less than usual (3.6 per cent), presumably a consequence of the exceptionally small west coast catch. Intermixture of these two Southern British Columbia stocks with those of northern waters of British Columbia was relatively small. The greatest movement was from the northern sub-district to the lower east coast and west coast, which comprised a combined emigration of between 5 and 6 per cent. There is a strong possibility that the heavy exploitation of the northern population in 1951–52 led to an abnormally high recovery of tags which originated in other sub-districts.

The large degree of discreteness of west coast herring was indicated by the calculation that only about 1,000 tons of west coast fish were caught in other sub-districts in 1951–52, and that not more than 2,000 tons of fish from other sub-districts were taken in west coast catches.

Detailed data from the 1951–52 study on the west coast fishable population, along with a discussion of the implications of the results of the comparative management study after six years of investigation, are presented in the Appendix of this Report.

General Studies on the Adult Stocks of All Major Herring Populations

A record herring-catch of 198,000 tons was taken in 1951–52 in British Columbia waters, about 10,000 tons greater than in the previous season. The non-quota fishery in the Queen Charlotte Islands sub-district was over three times as great as in the previous

year. In sub-districts where catch quotas are applied, all quotas were taken or approximated. After the 30,000-ton quota was completed in the northern sub-district, the fishing-grounds were thoroughly scouted, using a Federal Department of Fisheries vessel equipped with an echo-sounder. Because of the large amount of fish present, the Department authorized two separate quota extensions (totalling 27,300 tons), which were taken in remarkably short periods of fishing.

In addition to the regular scouting surveys undertaken in most sub-districts, an intensive survey of herring in inshore waters of the northern sub-district was carried out with a vessel loaned by the industry. The quantity of herring estimated in the course of the survey was related to the spawning in the region.

Spawning surveys were again undertaken through the assistance of Federal Department of Fisheries officers. All herring populations except those of the middle east coast and lower east coast sub-districts showed decreased amounts of spawning. The generally poor recruitment of the 1948 and 1949 year-classes and the heavy exploitation of the stocks in the 1951–52 fishing season were probably the most important factors in the decreased spawnings. Reduction in spawn deposition was most pronounced in the west coast and central sub-districts. There is no evidence, however, that the amount of spawn in any of the populations has reached so low a level that future maintenance of the stocks is threatened.

The 1947 year-class, which made heavy contributions to all major populations in 1949–50 and 1950–51, was unusually abundant in the 1951–52 fisheries as V-year fish. It was especially productive in the three populations of Northern British Columbia and in the more northerly stocks of the west coast of Vancouver Island. This year-class did much to sustain population abundance in 1951–52 in the face of the relatively low recruitment from the 1948 and 1949 year-classes. Population abundance in the 1952–53 season will be largely dependent on the amount of herring that will be contributed to the adult stocks by the 1949 and 1950 year-classes. There is little likelihood that either will be as abundant in any of the major populations as the 1947 year-class.

The importance of age determination in the study of year-class abundance has led to the initiation of special scale studies designed to improve the accuracy of scale-reading.

The 1951–52 tag-recovery was the largest since the beginning of the tagging programme—a total of 4,758 tags were recovered by magnets in sixteen reduction plants and through the operation of three tag-detectors. Tag-detector returns were less than in the previous year, forming 5 per cent of the total, as compared to 11 per cent in the previous season. Attention will be given to improving the efficiency of tag-detection during the summer of 1952.

Analysis of tag returns showed limited intermixture between herring of the northern and central sub-districts. The 1951–52 data provided the first opportunity to assess the amount of the movement between these two populations. The data also strongly suggested that north central and south central runs comprise two fairly distinct stocks. In addition, tagging results in 1951–52 confirmed previous tagging work in indicating that the main inshore migration of lower east coast herring is through the Strait of Juan de Fuca.

Predictions of fishing success were again made in the fall of 1951. These predictions, based on various data from adult-herring studies, proved to be reasonably accurate.

Studies on Survival of Herring Spawn and Juvenile Herring

Data obtained from various spawnings on the west coast of Vancouver Island in the spring of 1952 showed that bird predation varied greatly (from 17 to 56 per cent), but comparison of these results with those of previous years suggested that the over-all loss through bird predation probably does not vary greatly from year to year. Loss of spawn by factors other than bird predation appeared to be relatively small. Study of

the " natural " spawn mortality on eelgrass, which forms about 70 per cent of the substrate for west coast spawn, was found to be less than 5 per cent.

An extensive juvenile-herring survey was undertaken in Barkley Sound on the west coast of Vancouver Island and in Departure Bay on the lower east coast during the summer and fall of 1951. Estimates of juvenile abundance based on series of scouting surveys were compared with estimates made in the preliminary survey of 1950. Analysis of the data suggested that juvenile herring of the 1951 year-class were less abundant in Barkley Sound than those of the 1950 year-class, while in Departure Bay the 1951 supply of juveniles was equal to or slightly greater than the 1950 juvenile population. Marking and tagging experiments were also conducted to estimate juvenile abundance. The value of these estimates in predicting year-class strength will not be known until the particular year-classes have been fully recruited to the fishing stocks.

Several groups of juveniles were found in Barkley Sound, each of which showed relatively complete mingling within its own locality. Mixing between these groups was limited. No evidence was obtained to indicate intermixture between the major west coast sounds.

The 1952 juvenile study was restricted to the west coast of Vancouver Island. The data from this study have not yet been analysed.

REPORT OF THE BIOLOGIST, 1951

The purpose of the Provincial Shell-fish Laboratory at Ladysmith is to provide an information service on commercial molluscs and their culture and to investigate the biology of those species as it affects their reproduction, growth, abundance, and culture. The main effort continues to be placed on various phases of the oyster investigation. Studies of imported Japanese oyster-seed and the provision of an independent British Columbia supply is of importance. Examination is being made of the various phases of oyster-culture to determine quantitatively their efficiency and possible modification, if necessary. The biology of the oyster, especially in relation to the condition (fatness) cycle, is being studied. Consequently, the activities in regard to clams are being confined to the maintenance of contact with the clam-fishery and the carrying-on of routine observations to preserve continuity of records.

A series of bulletins covering the activities of the laboratory and reports of published work of interest to the industry were issued to growers and other interested individuals. During the summer oyster-breeding season these bulletins are mainly concerned with spawning reports and spatfall forecasts.

Again, the oyster-seed imported from Japan was inspected for pests and quality at Anacortes, Wash., the port of landing. The 1951 seed proved to be pest-free, so far as could be determined from random sampling. Due to weather conditions in Japan in the previous summer, the oyster-seed was somewhat larger in size and lower in count than usual. By the end of the year, however, indications were that most of the seed turned out to be satisfactory.

Lectures, both of a technical and general nature, were given throughout the year.

Oyster-growers were visited whenever possible, or when they asked for assistance.

Co-operation was maintained with the Provincial Department of Lands and Forests and the Department of Health and Welfare in connection with the issue of shell-fish leases.

Some time has been devoted to the subject of paralytic shell-fish poisoning, although this is largely a public health matter. This year has concluded a period of active participation in the study of this problem.

A small amount of time was devoted to the shipworm problem, chiefly in the direction of early life-history studies. The laboratory is in receipt of numerous inquiries relating to this destructive organism.

Biological Investigations

Native Oysters

Each year small amounts of Native-oyster seed are being caught, and a concentrated population is being built up on the experimental area in Ladysmith Harbour.

Pacific Oysters

Collection of material for a histological study of the seasonal reproduction changes in the Pacific oyster has been completed, and some of the tissue has been sectioned.

The culture of Pacific-oyster seed from Japan has been continued, and the experiment should be concluded during the 1952–53 oyster season. Cluster-breaking studies were included, and the production from individual cases of seed is being obtained.

Pacific-oyster breeding in various areas throughout the Province was closely followed. Although a long, almost rainless summer was experienced, water temperatures were not any higher than normal, apparently due to almost continuous westerly winds, which caused vertical mixing in most of the breeding areas. Commercial sets occurred in only three areas.

Ladysmith Harbour

A spawning which occurred on July 14th and 15th resulted in a set of approximately 1 spat per Pacific-oyster shell. A second smaller spawning on July 24th and 25th resulted in a set on August 12th and 13th which gave 3 spat per shell. A further series of small spawnings produced scattered settings throughout the latter part of August, which assisted in increasing slightly the cumulative set for the summer. The average final set for the harbour was 5 spat per shell. Cultch nearest the head of the harbour caught considerably more than that farther out.

Pendrell Sound

Water temperatures here remained consistently high during the breeding period and were apparently adequate for good larval survival. Three separate spawnings occurred between July 9th and 18th. A further extensive spawning occurred on July 25th. Shell exposed during the period July 27th to August 4th caught an average of 33 spat per inner Pacific-oyster shell-face. Shell-strings exposed during the period August 4th to 13th caught a heavy set and counts on the inner faces of Pacific-oyster shells averaged 406 spat per shell with a range of 125 to 1,091. This spatfall, originating from the spawning of July 25th, began on August 12th and continued until about August 15th. On August 27th a gale of near-hurricane force swept the area and caused the surface water temperature in Pendrell Sound to drop from 20° C. to 10° C. in twenty-six hours. Eight hours later it had risen to 15° C. This sharp change in temperature coincided with a spat mortality which approached 90 per cent. Shell-strings kept in Pendrell Sound until January, 1952, at that time held an average of 60.7 spat per whole (both sides) Pacific-oyster shell, 3 by 5 inches, with a range of 7 to 176 spat per shell.

Sets of commercial proportions have now been observed for two successive years in Pendrell Sound, and at least two, and probably three, sets occurred before observations were begun. It appears, then, that there is justification in recommending this area to the oyster industry of British Columbia for the collection of Pacific-oyster seed. Observations indicate that the amount of seed that may be taken from the area will be limited only by the amount of cultch material exposed.

Hotham Sound

A spatfall of commercial proportions occurred in Hotham Sound in 1951, but since observations indicate that setting has been light and irregular in the past, further investigation is necessary before its value as a seed-producing area can be assessed.

Other Areas

Regular plankton samples were examined from Pender Harbour, Boundary Bay, and Baynes Sound, but larval production in each case was at a low level, and no sets of consequence occurred.

Observations and operations at the Carrington Bay lagoon were necessarily reduced to a minimum. No evidence of successful breeding was found.

Work in the development of a more suitable oyster-cultch material has gone forward with emphasis on the use of cement-coated Keyes-type moulded-paper egg-trays. In 1951, 2,500 trays, with flat cardboard separators, were dipped in cement and arranged in bundles of twenty-five trays and twenty-five separators. These bundles were placed in crates 6 by 4 by 2 feet, each holding eight bundles. Forty bundles were used in Pendrell Sound and the remainder in Ladysmith Harbour. The set in the latter area was too light to provide a satisfactory assessment of the efficiency of the trays. In Pendrell Sound, however, counts indicated that the survived catch was 2 spat per square inch, which gives 15,000 spat per bundle of twenty-five trays and twenty-five separators, roughly equivalent to the number of spat in a case of Japanese-oyster seed.

The general results of the egg-tray work to the present time are as follows:—

(*a*) A wide variety of mixes (cement, lime, and sand) give satisfactory results, both in ability to catch spat and durability in sea-water. Only the obviously inadequate mixes proved unsatisfactory.

(*b*) Based on original costs, shell-strings are cheaper cultch. However, this difference may be partly cancelled out by less costly flotation and cluster separation in the case of the trays.

(*c*) The best method of handling seed caught on egg-trays is under investigation.

(*d*) Water circulation to the centre of the trays requires to be improved.

(*e*) The incorporation of cement or other material along with the paper pulp in the manufacturing process is most necessary. An alternative is a coating more easily applied than cement.

The Behaviour of Pacific-oyster Larvæ

Knowledge of the behaviour of oyster larvæ is necessary for the most efficient use of cultch material. The vertical distribution of spatting on floating cultch was studied and found to occur down to at least 19 feet below the surface. A maximum spatfall occurred fairly evenly between the surface and 9 feet. The normal vertical distribution of spatfall on the shore in Pendrell Sound is between the 1-foot and 10-foot tide-levels.

Vertical Distribution of Oyster Larvæ

The vertical distribution of oyster larvæ in Pendrell Sound in relation to tidal height and daylight and darkness was studied. The data indicate there are no definite vertical movements of larvæ, and no tidal or light effects were demonstrated. The greatest proportion of the umboned larvæ appear to remain above the 10-foot level and the straight-hinged larvæ to remain above the 3-foot level.

Oyster Production

The oyster production in British Columbia for 1951 for the various fisheries statistical areas are tabulated below according to the number of gallons and the weight of oysters produced. The data are supplied by the Dominion Department of Fisheries.

	Weight in Cwt.	Gal. (American)
Area 29E (Boundary Bay)	25,744	36,165
Area 20 (Sooke)	836	1,045
Area 17 (Ladysmith-Crofton)	11,226	12,442
Area 16 (Pender Harbour)	3,289	4,182
Area 14 (Baynes Sound)	3,410	5,117
Totals	44,505	58,951

This production was derived from twenty-eight producers.

At the present time there are seventy-nine oyster-lease holders, in which are included those leasing from the Esquimalt and Nanaimo Railway in the Baynes Sound area. A number are quite new leases that have not yet come into production, while others have not produced since the leases were taken out. As of December, 1950, 3,270 acres of foreshore, the main part of which is in the Strait of Georgia region, were being held under lease for oyster-culture purposes.

In 1951 thirty leaseholders imported 1,985 cases of unbroken and 3,375 cases of broken oyster-seed from Japan through the facilities of the Pacific Coast Oyster Growers' Association. Four growers caught seed locally.

Oyster-ground

Since practically all of the suitable oyster-ground in the Strait of Georgia region has been taken up, any further expansion of the industry is possible only by:—

(*a*) The utilization of ground presently under lease but not producing.
(*b*) More efficient use of the ground presently in use.
(*c*) The improvement of marginal ground by mechanical means.
(*d*) The utilization of ground below the zero tide-mark.
(*e*) The utilization of ground outside the Strait of Georgia region.

As time allows, some attention is being paid to each of the above methods, but it is particularly important that knowledge of the extent of suitable oyster-ground (as well as clam-bearing areas) outside the Strait of Georgia area should be available. A part of the time available each spring is devoted to this end. In addition to the examination of the areas, small test plantings of seed-oysters are made in the most promising areas.

In 1951 a small section of the southern Johnstone Strait area was covered. All areas showing any promise in Masset Inlet in the Queen Charlotte Islands were also examined in some detail. While test plantings have shown that the rate of growth is considerably slower than in the Strait of Georgia region, it appears that there is a limited area that would be suitable for oyster-culture.

One of the most important problems of the oyster industry is that of the marked fluctuations which occur in condition, or fatness, of oysters. There exists a general seasonal trend in condition in which the spawning process is involved, but there are variations within this seasonal trend. An investigation to define these fluctuations quantitatively has been undertaken in Ladysmith Harbour. Since changes in conditions are no doubt due to fluctuations in food-supply and temperature, the possible sources of food, such as phytoplankton, the smaller zooplankton, and the nanno-plankton are being measured quantitatively weekly throughout the year. In addition, certain physical and chemical measurements are being made. Preliminary information should be available by the end of 1952.

Oyster-drills

In the summer of 1951 a survey was made of the Japanese-oyster drill (*Tritonalia japonica*) situation in Ladysmith Harbour. Certain conclusions were drawn regarding the distribution and abundance of drills there which will serve as a reference point regarding future fluctuations. A small population of a new Japanese drill (*Purpura clavigera*) (*Thais tumulosa clavigera*) was discovered and every effort has been made to destroy it, with apparent success. Only a single specimen of the eastern drill *Urosalpinx cinerea* was found in the survey. Drills occur in Boundary Bay, Comox, and Ladysmith Harbour, and with care there should be no spread beyond these areas. The inspection and selection of seed in Japan by the Pacific Coast Oyster Growers' Association and subsequent inspection of the seed on arrival in this country is apparently serving to control the infestation of new ground by Japanese imports.

Because of the high potential value of Pendrell Sound as a seed-producing area, it will be most important to guard against the introduction of pests, such as oyster-drills, in that area. Drills may be introduced by using cultch of fresh oyster-shell, which may carry either the living drills or the living egg cases. Another possible method of introducing pests into Pendrell Sound would be by scows that are used to transport the seed or cultch to and from areas infested by pests, if the scows are allowed to rest on the beds at low tide.

Eel-grass

As time permits, an investigation into the chemical control of eelgrass (*Zostera marina*) is being carried on. If eelgrass can be eradicated and controlled, additional acreages will be made available for oyster-culture.

Clam Investigations

Razor Clams

The razor-clam beach on the north end of Graham Island, near Massett, was examined in September, 1951. Adult clams showed quite well on all beaches. The best showing of razor-clams of the year—that is, the 1951 brood-year—between one-quarter and one-half inch in length, occurred on the north beach, where numbers between twenty-five and fifty per square yard were found. Smaller numbers were found on Horseshoe Beach and the north end of South Beach. None were found in the central area of South Beach.

According to statistics received from the Federal Department of Fisheries, the 1951 razor-clam production totalled 135,300 pounds from 1,300 man-tides, giving a return of 104.1 pounds per man-tide. This is a marked increase over 1950, when the return was 56.8 pounds per man-tide. The digging intensity, however, showed a marked drop from 6,204 man-tides in 1950, as did the total production, which dropped from 352,358 pounds in 1951.

Hard-shell Clams

The production of butter-clams in 1951 was 3,500,500 pounds; Manila clams, 178,900 pounds; and Native little-neck clams, 521,900 pounds, with 127,000 pounds of the three species mixed, giving a total poundage of 4,329,100 pounds. Further analysis of the hard-shell clam production will be delayed until the new method of collecting is functioning properly.

Seal Island

The history of the clam population on Seal Island was followed, and again there was no evidence of major breeding activity. Samples of clams are being collected at monthly intervals to check whether breeding has occurred and to follow the seasonal gonad change in the butter-clams.

Seal Island was closed completely during the year 1951 to commercial digging.

Paralytic Shell-fish Poisoning

The co-operative programme of investigation of shell-fish toxicity in relation to salinity, stratification, and dinoflagellate abundance with the Pacific Oceanographic Group at the Pacific Biological Station at Nanaimo, the Federal Department of Fisheries, and the Department of National Health and Welfare was completed in Barkley Sound and reported to the Pacific Coast Shellfish Committee. The results of the investigation to demonstrate the possible use of water stratification (salinity) as an indicator of water type, and so of the occurrence of shell-fish toxicity, were inconclusive. The plankton sampling showed no dinoflagellates that could be definitely identified as *Gonyaulax catenella,* the presumed causative organism on the Pacific Coast. In none of the samples did any of the species of this genus occur in large numbers. While the plankton samples

were not strictly quantitative, at no time did the total dinoflagellate count reach numbers large enough to result in toxicity values of any magnitude, although the plankton samples may have missed periods of high dinoflagellate production.

Acknowledgments

A sincere appreciation is expressed for the assistance and co-operation given by the Federal Department of Fisheries, the Pacific Biological Station at Nanaimo, the Pacific Oceanographic Group at Nanaimo, the Provincial Department of Lands and Forests, the Provincial Department of Health and Welfare, and the shell-fish industry of British Columbia.

APPENDICES

CONTRIBUTIONS TO THE LIFE-HISTORY OF THE SOCKEYE SALMON (No. 37)

By D. R. Foskett, M.A., Pacific Biological Station, Nanaimo, B.C.

INTRODUCTION

The excellent packs of sockeye in the Rivers Inlet and Smith Inlet areas, 102,565 cases and 49,473 cases, following last year's high packs were indeed encouraging. The Skeena River pack of 61,694 cases was equal to the average for the last ten years. The Nass River pack of 24,405 cases was considerably above the average for the past thirty-nine years of 20,200 cases.

One of the problems in connection with the utilization of the sockeye runs is that of the jacks or 3-year-old males. Because of their small size these are taken by the commercial gear in small numbers only, and yet may be exceedingly numerous on the spawning-grounds, as is shown below for both the Rivers Inlet run and the Skeena River run in 1951. Unfortunately, no experiments known to the author on the inheritance of the tendency toward early maturity have been carried past the first generation, and thus they cannot be considered conclusive. Also, it cannot be said at the present time whether the number of jacks on the spawning-grounds is increasing, since accurate numerical records over a fair number of years, such as are obtained by counting-fences, are not available at present. It is known that certain streams will tend to have large percentages of jacks while other streams will seldom have any jacks present.

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 in their third and fourth year respectively.

3_2, 4_3—the " grilse " or " jacks," usually males, which migrate in their second year and mature in their third year, or migrate in the third year and mature in their fourth year.

4_2, 5_2—fish which migrate in their second year and mature in their fourth and fifth year respectively.

5_3, 6_3—fish which migrate in their third year and mature in their fifth and sixth year respectively.

6_4, 7_4—fish which migrate in their fourth year and mature in their sixth and seventh year respectively.

As is indicated in the discussion of the Nass River age-groups, some doubt still exists as to the particular point at which a check is sufficiently distinct to warrant recognition as marking the completion of a year. This is particularly the case when the analysis of the fresh-water residence of sockeye is considered because of the small number of circuli involved and the variability of their numbers in different areas of a large water-

shed. Research is now being carried on by the Fisheries Research Board of Canada in two areas where doubt exists as to the length of fresh-water residence—Lakelse Lake and Port John Lake—and it is hoped that the results obtained in these areas will help in obtaining a clearer understanding of the situation in other areas, such as the Nass watershed, where the absence of field surveys and stations makes it difficult to determine the correct interpretation of doubtful scales.

The Nass River run is the most northerly of the sockeye-salmon populations in British Columbia which is fished by our fishermen. This population has therefore been placed first in the analyses this year, and the other populations have been placed in order as one proceeds south along the coast. This arrangement would be upset less by the subsequent addition of new areas. Extra tables which may be introduced, as in the Rivers Inlet report this year, will, however, be placed at the end of the regular tables to preserve the numbering for comparative purposes.

1. THE NASS RIVER SOCKEYE RUN OF 1951

(1) General Characteristics

The sockeye-pack of 24,405 cases was very good for the Nass River, where the average for the past ten years has been 15,545 cases. The escapement was reported to be adequate to the Meziadin area, which reportedly constitutes the main spawning area for sockeye in this system.

(2) Age-groups

The three age-classes 4_2, 5_3, and 6_3, forming 41, 31, and 13 per cent respectively of the 1951 sample of 2,901 fish (Tables I to VI), made up the bulk of the Nass River sockeye-catch. The 5_2 age-class was represented by 239 fish or 8.6 per cent of the sample (Tables II and III). The 3_1 and 4_1 age-classes, comprising 10 and 151 individuals respectively, formed 5.8 per cent of the sample (Tables II and III). There is some doubt as to the legitimacy of these age-classes, since there is in many cases a very slight check which could be interpreted as a year's growth in fresh water. The samples of this type, coming chiefly in the early part of the sampling, have been interpreted as " sea-run " fish in some years, for example, Paper 28, 1942, of this series, and probably as 4_2 and 5_2 age-classes in other years when the checks were more distinct. Research has already been instigated to determine more exactly what may be interpreted as a year check in the fresh-water growth, and it is hoped that this will also aid in the interpretation of salt-water checks, especially in the first year of salt-water growth when changing physiological as well as environmental factors could be expected to have an effect on the configuration of the scale circuli.

(3) Lengths and Weights

Though the Nass sockeye were quite large (Tables II and III), there was nothing outstanding in the samples, the season's averages falling within the upper range of the average lengths and weights recorded in the past ten years (Tables IV and V).

(4) Distribution of the Sexes

The over-all sex ratio of 49.4 to 50.6 is as near equality as one could expect. Only in the 6_3 age-class is there any really significant deviation from an even sex ratio, the group being 70 per cent males and thirty per cent females.

2. THE SKEENA RIVER SOCKEYE RUN OF 1951

(1) General Characteristics

The Skeena pack of 61,694 cases was equal to the average pack of 61,720 cases for the past ten years. The escapement was reported to be light. The Babine area spawning

population suffered tremendous losses due to a slide in a canyon about 40 miles below Babine Lake.

(2) Age-groups

The Skeena River sockeye sample of 1951 was composed chiefly of 5_2 fish (61.5 per cent), and the bulk of the remainder (32.5 per cent) was of 4_2 fish (Table VII). The 5_3 age-class was represented by 130 sockeye and the 6_3 age-class by 38 sockeye, giving percentages of 4.4 and 1.3 respectively (Tables VIII and IX). Jacks were of minor importance in the catch, though figures from up-river investigations* indicate that they were more numerous in the run than was shown by the catch.

The presence of one or two individuals in several additional age-classes is to be expected in a large sample and does not of necessity indicate anything unusual in the population.

(3) Lengths and Weights

The Skeena River sockeye were large in 1951 (Tables VIII and IX). The 4_2 age-class males at 22.7 inches were not unusual, though the females at 22.6 inches were the largest since 1941 (Table X). Both the 5_2 males at 25.9 inches and the females at 24.8 inches were the largest in the past ten years (Table X). Neither the 5_3 nor 6_3 fish were unusual in either length or weight. The 4_2 males, in weight as in length, were within the limits of variation of the past ten years (Tables X and XI). However, the 4_2 females and both sexes of the 5_2 age-class had the highest average weight recorded since 1940 (Table XI).

(4) Distribution of Sexes

The over-all sex ratio of 39 males to 61 females reflects the condition in the two most prevalent age-classes, the 4_2 group having 41 per cent males and the 5_2 group 37 per cent males (Table XII). In the 5_3 and 6_3 groups the ratio was 53 males to 47 females.

3. THE RIVERS INLET SOCKEYE RUN OF 1951

(1) General Characteristics

The Rivers Inlet sockeye run of 1951 produced a very satisfactory pack of 102,565 cases (Table XIII). The escapement, classed as moderate to heavy, was, in the opinion of the writer, adequate in most of the streams in the area.

(2) Age-groups

The catch was largely 5_2 fish (59.7 per cent), of large size, the average weight of the age-class being 7.8 pounds (Tables XV and XVII). The 4_2 age-class fish, which comprised 38.0 per cent of the run, were also of large size, the average weight being 5.2 pounds (Table XV). The 5_3 class was represented by 17 fish (1.2 per cent). The 6_3 age-class was represented by 9 fish (0.6 per cent), and the 3_2 age-class or jacks were represented by 4 fish (0.3 per cent). As will be shown later, the percentage of jacks in the commercial catch does not represent the percentage of jacks in the run. One fish was present in each of the following age-classes: 4_1, 6_2, and 5_4.

(3) Lengths and Weights

The average length and weight of the Rivers Inlet sockeye in 1951 was high. In the 4_2 age-class the average length of 21.9 inches for both males and females (Table XVI) has not been exceeded since 1938. The 5_2 age-class averages of 25.8 inches for males and 24.8 inches for females are high, the former having been exceeded only in 1950 and the latter equalled only in 1940 (Table XVI).

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* *See* Aro, "The Babine River Salmon Escapement in 1951," and Foskett, "The Effect of the Babine Slide on the 1951 Sockeye Run," in No. 90, Progress Reports of the Pacific Coast Stations of the Fisheries Research Board of Canada, March, 1952.

Though high, the 5.2-pound average for 4_2 age-class males and the 5.0-pound average for females of this group have been exceeded several times in the past. The average weight of the 5_2 age-class males, 8.6 pounds (Table XVII), has never been exceeded in this area, though the average for the females in the same group, 7.4 pounds (Table XVI), is the second highest, having been exceeded in 1927, when an average of 7.6 pounds was recorded.

(4) Distribution of Sexes

The over-all sex ratio of 43.9 per cent males and 56.1 per cent females (Table XVIII) in the 1,420 samples does not reveal the peculiarities of the sex distribution. The 4_2 age-class is largely males (65.7 per cent), while the 5_2 age-class is predominantly females (69.8 per cent). The 5_3 and 6_3 age-classes are also largely female.

(5) Spawning-ground Samples

Through the courtesy of the Dominion Fisheries Department and especially Inspector M. P. Houghton, the author was able to examine the Rivers Inlet spawning-grounds and obtain samples of the spawned sockeye. Due to the advanced state of absorption of the scales of these fish, age determinations were not possible by this means. However, comparison of the lengths of these fish with those sampled at Goose Bay is enlightening.

As may be seen from Table XXV, the male sockeye were present in the sample in three main length-groups. Those between 13 and 16½ inches may be presumed to be the 3_2 age-group, the jacks, which were so sparsely represented in the commercial catch. The next group, between 18½ and 20½ inches, may be presumed to represent the 4_2 fish. The third group, from 24 to 29 inches, presumably would be predominantly 5_2 age-class fish.

The female fish do not separate as readily into groups as the male fish. There is a range from 20½ to 24½ inches which has a few samples throughout its length with no main concentration. Then there is a concentration of fish in the range from 25 to 26 inches. In comparing these figures with Table II, it is seen that these lengths coincide with the range of the 4_2 fish and the smaller 5_2 fish in the first case and with the larger 5_2 fish in the second case.

Thus we see that the spawning-ground samples do not reflect the catch samples but rather complement them. This is not only so in the length frequencies, but also may show up in the sex ratios, as evidenced by the following excerpt from Inspector Houghton's report on the Asclum River: "The sex ratio of the 4 and 5 year-classes favoured females in the younger fish and males in the older class." Similar remarks were made with regard to the four other streams in the area in which sex ratios were given separately for the larger and smaller fish. This is opposite to the situation in the commercial catch, as shown previously.

(6) Predation

The situation with regard to predators in this region warrants a few words. Both seals and bears are numerous. The former enter the lake and hang about off the mouths of the streams. Here they have a very high potential for damaging the sockeye which frequent these areas in large schools while ripening preparatory to entering the stream and spawning. It is possible that some type of weir could be placed in the lower part of Owikeno Lake to exclude seals from the spawning areas of the system.

Grizzly bears are found on the redds, and until it is known whether they take spawned or unspawned salmon, their effect is not known. Their habit at times of entering the river in huge bounds might be presumed to frighten off fresh fish and leave the more nearly spent fish to be captured. The effect of their fishing when wading in the stream may be quite different. However, an investigation might well be undertaken, preferably as a joint enterprise with the British Columbia Game Commission, in order to settle this controversial question.

Nothing is known at present with regard to the indigenous fish population of Owikeno Lake, either as predators on, or competitors with, the sockeye.

(7) Discussion

From an examination of Tables XIV and XXV it is evident that either the sampling on the spawning-grounds was not adequate or the gill-net fishery selects the catch from the medium-size fish or probably both. Unfortunately, samples were obtained at only one period during the run, and though the distribution covered most of the spawning areas, it did not cover the early runs nor the latest runs.

However, it is felt that the results do show that the escapement is predominantly of the smaller and larger sockeye and that this situation is especially true of the males. Unfortunately, the author knows of no experiments upon the inheritance of various characters in the sockeye which have been taken beyond the first generation. Thus it is impossible to say what effect such a continued selection is apt to have on the stock. Many factors could have an influence on size at maturity. Prediction can never be completely satisfactory until we know the factors controlling growth and maturity.

(8) Summary

The Rivers Inlet sockeye run of 1951 was very satisfactory both from the catch and escapement angles. The bulk of the escapement appears to come from the extreme ends of the size range, though relatively more females than males in the middle sizes are found on the spawning-grounds. While predators are numerous in the Owikeno Lake area, the greatest amount of damage is probably done by seals off the mouths of the creeks. That gill-net selection takes place is evident from the catch and escapement samples, but at present no definite statements can be made regarding long-term effects on the population.

4. THE SMITH INLET SOCKEYE RUN OF 1951

(1) General Characteristics

The Smith Inlet pack of 49,473 cases, the highest recorded, was more than double the twenty-six-year average of 22,100 cases. The excellent condition of the fish was shown in their average weight. There was a heavy escapement to the spawning-grounds.

(2) Age-groups

Of the 673 sockeye in the sample, 521 (77.4 per cent) were in the 5_2 age-class and 147 (21.8 per cent) were in the 4_2 age-class (Table XIX). Both the 6_2 and 5_3 age-classes were represented by 2 fish and the 3_2 or jack class was represented by 1 fish.

(3) Lengths and Weights

The 4_2 age-class had average lengths of 22.8 inches for the males and 22.0 inches for the females (Table XX). The 5_2 age-class had average lengths of 25.6 inches and 24.8 inches respectively for the males and females. The 5_2 lengths are greater than the averages recorded since 1945, when length records commence in this area. The average weights of the fish in the two main age-classes were 6.0 and 5.2 pounds respectively for the males and females in the 4_2 age-class and 8.2 and 7.3 pounds in the 5_2 group (Table XXI). Records in the other age-classes are too sparse to justify comparisons.

(4) Distribution of Sexes

The peculiar sex ratios shown in the Smith Inlet sockeye records point to some connection between sex and age of maturity, in this population at least. As has been normal in the past, the 4_2 age-class again showed an excess of males (72 per cent), while the 5_2 age-class showed more females (58.5 per cent) (Table XXIV).

Table I.—Nass River Sockeyes, Percentages of Principal Age-groups in Runs of Successive Years 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
1941 (24,876 cases)	37	7	52	4
1942 (21,085 cases)	22	7	66	5
1943 (13,412 cases)	5	13	67	15
1944 (13,083 cases)	15	15	32	38
1945 (9,899 cases)	46	11	37	6
1946 (12,511 cases)	13	12	72	3
1947 (10,849 cases)	15	12	56	17
1948 (13,181 cases)	12	16	60	12
1949 (9,268 cases)	39	6	48	7
1950 (27,286 cases)	3	19	71	6
1951 (24,405 cases)	41	9	31	13

Table II.—Nass River Sockeyes, 1951, Grouped by Age, Sex, Length, and by Their Early History

Length in Inches	Number of Individuals																		Total
	3_1		4_1		4_2		5_2		5_3		6_3		7_3		6_4		7_4		
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
14¼	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
14½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
14¾	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
15	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
15¼	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
15½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
15¾	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16¼	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16¾	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
17¼	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
17½	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
17¾	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18¼	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18¾	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
19	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
19¼	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
19½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
19¾	—	—	—	—	2	1	—	—	—	—	—	—	—	—	—	—	—	—	3
20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20¼	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	1
20½	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	2
20¾	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
21	—	—	—	—	1	2	—	—	—	—	—	—	—	—	—	—	—	—	3
21¼	—	—	1	1	1	3	—	—	—	—	—	—	—	—	—	—	—	—	6
21½	—	1	—	—	—	10	—	—	—	—	—	—	—	—	—	—	—	—	11
21¾	1	—	—	1	3	7	—	—	—	2	—	—	—	—	—	—	—	—	14
22	—	—	—	2	3	29	—	—	—	3	—	—	—	—	—	—	—	—	37
22¼	—	—	—	3	5	50	—	—	1	8	—	—	—	—	—	—	—	—	67
22½	2	—	—	4	14	77	1	2	1	18	—	—	—	—	—	—	—	—	119
22¾	—	—	—	3	26	60	—	1	—	13	—	—	—	—	—	—	—	—	103
23	—	—	1	9	25	94	—	2	7	28	—	1	—	—	—	—	—	—	167
23¼	1	1	—	10	29	70	—	4	3	30	—	—	—	—	—	—	—	—	148
23½	—	1	—	14	60	80	—	5	15	40	—	—	—	—	—	—	—	—	215
23¾	—	—	2	13	49	50	—	5	18	31	—	1	—	—	—	—	—	—	169
24	—	—	4	6	67	37	1	10	21	41	—	1	—	—	—	—	—	—	188
24¼	—	—	1	6	65	13	3	9	22	59	1	3	—	—	—	2	—	—	184
24½	—	—	2	2	62	13	6	5	26	53	—	4	—	—	—	1	—	—	174
24¾	—	—	3	—	32	8	3	19	29	33	3	2	—	—	—	3	—	—	135
25	—	—	12	2	35	6	6	20	52	36	1	4	—	—	2	1	—	—	177
25¼	—	—	5	2	28	1	4	13	39	27	1	4	—	—	—	3	—	1	128
25½	1	—	9	—	8	—	9	9	39	18	1	8	—	—	2	2	—	—	106
25¾	—	—	3	—	5	—	8	8	26	12	3	6	—	—	2	2	—	—	75
26	—	—	7	1	2	—	18	7	34	9	10	4	—	—	—	1	—	—	93
26¼	—	—	8	—	2	—	4	2	27	1	14	9	—	—	1	—	—	—	68
26½	—	—	4	—	1	1	10	—	14	1	20	10	—	—	—	—	1	—	62
26¾	—	—	1	1	—	—	7	1	9	—	15	9	—	—	—	—	—	—	43
27	—	—	1	—	—	1	11	4	5	—	27	11	—	—	—	—	—	—	60
27¼	—	—	2	—	—	—	6	—	1	—	22	6	—	—	—	—	—	—	37
27½	—	—	2	—	—	—	4	—	1	—	26	14	—	—	1	—	—	—	48
27¾	—	—	—	—	—	—	5	—	—	—	20	4	—	—	—	—	—	—	29
28	—	—	1	—	—	—	5	—	1	—	29	6	—	—	—	—	—	—	42
28¼	—	—	—	—	—	—	2	—	—	—	19	1	—	—	—	—	—	—	22
28½	—	—	2	—	—	—	—	—	—	—	20	3	—	—	—	—	—	—	25
28¾	—	—	—	—	—	—	—	—	—	—	6	—	—	—	—	—	—	—	6
29	—	—	—	—	—	—	—	—	—	—	14	—	1	—	—	—	—	—	15
29¼	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	3
29½	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	3
29¾	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	2
30	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
Totals	7	3	71	80	527	613	113	126	391	464	261	111	1	—	8	15	1	1	2,793
Average lengths	22.0	22.8	25.6	23.5	24.0	23.1	26.2	24.8	25.1	24.1	27.4	26.4	29.0	—	25.8	25.1	26.5	25.3	24.5

Table III.—Nass River Sockeyes, 1951, Grouped by Age, Sex, Weight, and by Their Early History

Weight in Pounds	Number of Individuals																		Total
	3_1		4_1		4_2		5_2		5_3		6_3		7_3		6_4		7_4		
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1¼	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1¾	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2¼	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
2½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2¾	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1
3¼	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3½	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	2
3¾	1	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	2
4	1	—	—	—	3	11	—	—	—	2	—	—	—	—	—	—	—	—	17
4¼	—	—	1	2	1	18	—	—	—	5	—	—	—	—	—	—	—	—	27
4½	—	1	—	4	13	67	—	2	1	19	—	—	—	—	—	—	—	—	107
4¾	1	—	—	3	11	100	—	—	4	27	—	—	—	—	—	—	—	—	146
5	2	—	1	7	29	122	1	2	7	41	—	—	—	—	—	—	—	—	212
5¼	—	—	—	11	34	86	—	4	5	49	—	1	—	—	—	—	—	—	190
5½	—	—	2	14	65	99	1	9	21	73	—	2	—	—	1	1	—	—	288
5¾	—	1	2	12	70	55	—	13	29	59	—	2	—	—	—	2	—	—	245
6	—	—	—	14	84	30	4	10	35	61	1	3	—	—	—	2	—	—	244
6¼	1	1	1	3	46	16	3	11	37	39	1	3	—	—	1	1	—	1	165
6½	—	—	8	5	70	3	5	14	47	36	3	7	—	—	2	3	—	—	203
6¾	—	—	8	2	39	3	4	12	44	22	3	10	—	—	1	2	—	—	150
7	—	—	5	—	23	1	8	10	43	14	5	8	—	—	1	1	—	—	119
7¼	—	—	6	—	22	—	10	10	26	13	9	8	—	—	—	2	—	—	106
7½	—	—	8	2	10	1	8	11	40	4	13	11	—	—	1	—	—	—	109
7¾	—	—	6	—	2	—	9	10	17	—	19	7	—	—	—	1	—	—	71
8	—	—	4	1	2	—	11	4	20	—	13	14	—	—	—	—	1	—	70
8¼	—	—	5	—	—	—	10	—	5	—	18	5	—	—	—	—	—	—	43
8½	—	—	6	—	—	—	13	1	7	—	30	11	—	—	—	—	—	—	68
8¾	—	—	5	—	—	—	5	3	1	—	27	7	—	—	—	—	—	—	48
9	—	—	2	—	—	—	6	—	1	—	22	4	—	—	1	—	—	—	36
9¼	—	—	—	—	—	—	5	—	1	—	24	3	—	—	—	—	—	—	33
9½	—	—	—	—	—	—	5	—	—	—	20	4	—	—	—	—	—	—	29
9¾	—	—	1	—	—	—	2	—	—	—	16	1	—	—	—	—	—	—	20
10	—	—	—	—	—	—	3	—	—	—	10	—	—	—	—	—	—	—	13
10¼	—	—	—	—	—	—	—	—	—	—	15	—	1	—	—	—	—	—	16
10½	—	—	—	—	—	—	—	—	—	—	7	—	—	—	—	—	—	—	7
10¾	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—	—	3
11¼	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
11½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11¾	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	1
12	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
12¼	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
12½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
12¾	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
13¼	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
13½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
13¾	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Totals	7	3	71	80	527	613	113	126	391	464	261	111	1	—	8	15	1	1	2,793
Average weights	4.5	5.5	7.4	5.6	6.0	5.2	7.9	6.6	6.7	5.7	8.8	7.6	10.3	—	6.9	6.5	7.9	6.3	6.3

Table IV.—Nass River Sockeyes, Average Lengths in Inches of Principal Age-groups, 1912 to 1951

Year	4_2		5_2		5_3		6_3	
	M.	F.	M.	F.	M.	F.	M.	F.
1912–41	24.5	23.7	26.3	25.2	26.1	25.3	27.7	26.4
1912–41 (conversion)	23.8	23.0	25.6	24.5	25.4	24.6	27.0	25.7
1942	23.9	23.2	26.1	24.9	24.9	24.3	26.9	26.0
1943	22.8	22.2	26.1	24.8	24.1	23.5	27.1	25.8
1944	23.5	22.7	25.7	24.6	24.8	23.8	26.8	25.8
1945	23.4	22.8	25.0	24.4	24.7	24.0	25.1	25.5
1946	23.4	22.4	26.3	24.9	24.9	23.9	28.1	26.0
1947	23.4	22.9	25.9	24.1	24.5	23.6	27.0	25.6
1948	23.3	22.6	26.2	25.3	25.0	24.1	27.7	26.7
1949	23.8	22.8	26.2	23.8	24.7	23.7	26.1	25.5
1950	23.6	23.1	26.0	24.7	24.5	23.7	26.7	25.6
1951	24.0	23.1	26.2	24.8	25.1	24.1	27.4	26.4

Table V.—Nass River Sockeyes, Average Weights in Pounds of Principal Age-groups, 1914 to 1951

Year	4_2		5_2		5_3		6_3	
	M.	F.	M.	F.	M.	F.	M.	F.
1914–41	6.0	5.4	7.3	6.4	6.9	6.2	8.0	7.0
1942	5.8	5.1	7.1	6.3	6.2	5.6	7.5	6.7
1943	5.2	4.7	7.6	6.4	5.9	5.3	7.9	6.9
1944	5.7	5.0	7.7	6.5	6.7	5.7	8.2	7.1
1945	5.7	5.3	7.0	6.4	6.5	5.9	7.2	7.1
1946	5.6	4.9	8.1	6.7	6.5	5.4	8.9	7.0
1947	5.8	5.3	7.7	6.2	6.3	5.6	8.1	6.9
1948	5.8	5.3	8.1	7.1	7.0	6.0	9.1	7.9
1949	5.9	5.1	7.9	5.8	6.5	5.4	7.7	6.8
1950	5.9	5.2	7.9	6.6	6.4	5.5	8.2	7.1
1951	6.0	5.2	7.9	6.6	6.7	5.7	8.8	7.6

Table VI.—Nass River Sockeyes, Percentages of Males and Females, 1915 to 1951

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.		
1915–41 (average)	49	51	47	53	45	55	63	37	47	53
1942	42	58	48	52	44	56	70	30	45	55
1943	51	49	67	33	47	53	74	26	54	46
1944	53	47	45	55	39	61	60	40	50	50
1945	37	63	37	63	38	62	53	47	38	62
1946	62	38	59	41	45	55	75	25	50	50
1947	50	50	52	48	51	49	81	19	56	44
1948	45	55	54	46	52	48	66	34	53	47
1949	57	43	56	44	51	49	50	50	53	47
1950	41	59	42	58	43	57	58	42	44	56
1951	46	54	47	53	46	54	70	30	49	51

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
1941 (81,767 cases)	39	52	8	1
1942 (34,544 cases)	36	54	7	3
1943 (28,268 cases)	39	39	16	6
1944 (68,197 cases)	37	52	7	4
1945 (104,279 cases)	20	63	12	5
1946 (52,928 cases)	13	70	8	9
1947 (32,534 cases)	14	82	3	1
1948 (101,267 cases)	80	13	6	1
1949 (65,937 cases)	17	76	4	3
1950 (47,479 cases)	21	72	4	3
1951 (61,694 cases)	33	61	4	1

Table VIII.—Skeena River Sockeyes, 1951, Grouped by Age, Sex, Length, and by Their Early History

Length in Inches	Number of Individuals																				Total
	3_1		4_1		3_2		4_2		5_2		6_2		4_3		5_3		6_3		6_4		
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
14																					
14¼																					
14½																					
14¾																					
15																					
15¼																					
15½																					
15¾																					
16					1								1								2
16¼																					
16½																					
16¾																					
17					1																1
17¼					1																1
17½					1																1
17¾																					
18																					
18¼																					
18½																					
18¾																					
19																					
19¼																					
19½							1														1
19¾																					
20	1						3														4
20¼							3														3
20½							4														4
20¾							9	2													11
21							19	6													25
21¼							23	12							1	1					37
21½							20	23		1					1	1					46
21¾							20	29		1					1	1					52
22							20	65		1					1	3					90
22¼							27	67	2	2				1		6					105
22½							23	102	3	5					5	11					149
22¾							29	83	3	7					2	11					135
23				1			49	69		10					5	7					141
23¼							23	43	2	24					11	6		1			110
23½							34	39	4	43					14	5		1	1		141
23¾							12	18	4	60					7	3					104
24							29	10	11	85					6	2	1	4			148
24¼							20	1	12	130					5	2		3			173
24½							11	4	27	121					4		3	3			173
24¾							4		20	120					1						145
25							3	1	41	165					1		2	1			214
25¼							4		56	100		1			1	1	2	2		1	168
25½							2		62	94					2	1		1			162
25¾							1		54	60							1	1			117
26								1	96	65							1				163
26¼									65	30											95
26½									64	13							5	1			83
26¾									42	11							3				56
27									49	4											53
27¼									28	2											30
27½									15												15
27¾									9						1						10
28									1	1							1				3
28¼									6												6
28½																					
28¾																	1				1
29																					
29¼																					
Totals	1			1	4		393	575	676	1,155		1	1	1	69	61	20	18	1	1	2,978
Average lengths	20.0			23.0	16.9		22.7	22.6	25.9	24.8		25.3	16.0	22.3	23.6	22.9	26.0	24.6	23.5	25.3	24.3

Table IX.—Skeena River Sockeyes, 1951, Grouped by Age, Sex, Weight, and by Their Early History

Weight in Pounds	Number of Individuals																				Total
	3_1		4_1		3_2		4_2		5_2		6_2		4_3		5_3		6_3		6_4		
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
1																					
1¼																					
1½																					
1¾					1								1								2
2					1																1
2¼					1																1
2½					1																1
2¾																					
3																					
3¼							2	1													3
3½							4														4
3¾							17	2													19
4	1						30	14		1					2	2					50
4¼							32	42		2					1	5					82
4½							51	127	1	10					5	15					209
4¾							44	105	2	16					4	8		1			180
5							32	102	7	29					6	12					188
5¼				1			36	64	4	37				1	8	4			1		156
5½							48	65	14	87					16	9	1	2			242
5¾							31	25	11	124					9	2		2			204
6							15	14	26	116		1			10		2	3		1	188
6¼							16	7	18	114					3	2	1				161
6½							12	3	38	165					1	2	1	5			227
6¾							9	2	40	99					1		3				154
7							4		61	92								1			158
7¼							3		50	67								1			121
7½							3	1	84	77					1		1	1			168
7¾							3		70	39					1		4	1			118
8								1	49	22							3	1			76
8¼									38	25											63
8½							1		55	25							2				83
8¾									40	3											43
9									25	3											28
9¼									10						1						11
9½									15												15
9¾									8	1											9
10									4								1				5
10¼									1												1
10½									2												2
10¾									2	1											3
11																					
11¼																					
11½									1								1				2
11¾																					
12																					
12¼																					
12½																					
12¾																					
13																					
13¼																					
13½																					
13¾																					
Totals	1			1	4		393	575	676	1,155		1	1	1	69	61	20	18	1	1	2,978
Average weights	4.0			5.2	2.1		5.1	5.0	7.6	6.5			1.7	5.2	5.6	5.0	7.6	6.4	5.3	6.0	6.2

Table X.—Skeena River Sockeyes, Average Lengths in Inches of Principal Age-groups, 1912 to 1951

Year	4_2		5_2		5_3		6_3	
	M.	F.	M.	F.	M.	F.	M.	F.
1912–41	23.7	23.1	25.8	24.9	24.2	23.4	25.8	24.8
1912–41 (conversion)	23.0	22.4	25.1	24.2	23.5	22.7	25.1	24.1
1942	22.6	22.3	25.2	24.3	24.1	23.7	26.3	24.9
1943	21.9	21.9	25.1	23.9	23.3	22.6	25.8	24.7
1944	22.4	21.7	24.8	23.9	22.5	21.7	25.0	23.7
1945	22.6	22.3	24.9	24.1	23.3	22.6	25.0	24.3
1946	22.7	22.0	25.4	24.3	23.9	23.2	25.5	24.4
1947	22.3	22.0	25.1	23.8	23.0	22.4	26.3	25.8
1948	23.0	22.3	25.3	24.1	23.0	22.1	26.0	24.5
1949	22.5	22.2	25.3	24.5	23.2	22.3	24.8	23.9
1950	22.8	22.3	25.7	24.4	23.9	23.4	25.5	24.3
1951	22.7	22.6	25.9	24.8	23.6	22.9	26.0	24.6

Table XI.—Skeena River Sockeyes, Average Weights in Pounds of Principal Age-groups, 1914 to 1951

Year	4_2		5_2		5_3		6_3	
	M.	F.	M.	F.	M.	F.	M.	F.
1914–41	5.4	5.0	6.8	6.1	5.7	5.1	6.8	6.0
1942	4.9	4.7	6.7	6.0	5.8	5.4	7.2	6.6
1943	4.7	4.6	6.8	5.9	5.5	4.9	7.3	6.1
1944	5.1	4.6	7.0	6.1	5.3	4.6	7.1	5.8
1945	5.2	4.9	6.7	6.1	5.6	5.0	6.7	6.2
1946	4.7	4.2	6.9	5.8	5.8	5.1	7.0	6.1
1947	4.9	4.7	6.9	5.9	5.3	5.0	7.7	6.8
1948	5.5	4.9	7.3	6.1	5.4	4.7	7.7	6.4
1949	5.0	4.7	7.1	6.3	5.3	4.8	6.6	5.7
1950	4.8	4.3	7.2	5.9	5.8	5.1	6.8	5.6
1951	5.1	5.0	7.6	6.5	5.6	5.0	7.6	6.4

Table XII.—Skeena River Sockeyes, Percentages of Males and Females, 1915 to 1951

Year	4_2		5_2		Per Cent Total Males	Per Cent Total Females
	M.	F.	M.	F.		
1915–41 (average)	48	52	43	57	46	54
1942	42	58	25	75	33	67
1943	50	50	31	69	43	57
1944	54	46	34	66	43	57
1945	41	59	35	65	38	62
1946	50	50	32	68	38	62
1947	50	50	29	71	33	67
1948	50	50	29	71	47	53
1949	54	46	30	70	36	64
1950	56	44	40	60	44	56
1951	41	59	37	63	39	61

Table XIII.—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	3	—
1938 (87,942 cases)	27	70	1	2
1939 (54,143 cases)	67	32	1	—
1940 (63,469 cases)	69	28	3	—
1941 (93,378 cases)	59	40	1	—
1942 (79,199 cases)	8	91	—	1
1943 (47,602 cases)	8	91	—	1
1944 (36,852 cases)	76	23	1	—
1945 (89,735 cases)	57	41	2	—
1946 (73,320 cases)	37	63	—	—
1947 (140,087 cases)	3	97	—	—
1948 (37,665 cases)	55	44	1	—
1949 (39,495 cases)	84	14	1	—
1950 (142,710 cases)	13	87	(1)	—
1951 (102,565 cases)	38	60	1	1

[1] Age-class represented but less than 0.5 per cent.

Table XIV.—Rivers Inlet Sockeyes, 1951, Grouped by Age, Sex, Length, and by Their Early History

Length in Inches	Number of Individuals																Total
	4_1		3_2		4_2		5_2		6_2		5_3		6_3		5_4		
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
14¼	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
14½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
14¾	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
15	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
15¼	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
15½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
15¾	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
16¼	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16¾	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
17¼	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
17½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
17¾	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18¼	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18¾	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
19	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
19¼	—	—	—	—	6	—	—	—	—	—	—	—	—	—	—	—	6
19½	—	—	—	—	7	1	—	—	—	—	—	—	—	—	—	—	8
19¾	—	—	—	—	13	3	—	—	—	—	—	—	—	—	—	—	16
20	—	—	—	—	11	2	—	—	—	—	—	—	—	—	—	—	13
20¼	—	—	—	—	17	9	—	—	—	—	—	—	—	—	—	—	26
20½	—	—	—	—	16	6	—	—	—	—	2	—	—	—	—	—	24
20¾	—	—	—	—	23	9	—	—	—	—	—	—	—	—	—	—	32
21	—	—	—	—	29	22	—	—	—	—	—	—	—	—	—	—	51
21¼	—	—	—	—	22	13	1	1	—	—	—	1	—	—	—	—	38
21½	—	—	—	—	33	17	—	1	—	—	—	—	—	—	—	—	51
21¾	—	—	—	—	21	16	1	—	—	—	—	1	—	—	—	—	39
22	—	—	—	—	17	14	—	1	—	—	—	—	—	—	—	—	32
22¼	—	—	—	—	11	11	—	3	—	—	—	—	—	—	—	—	25
22½	—	—	—	—	22	11	1	9	—	—	—	—	—	—	—	—	43
22¾	—	—	—	—	10	19	2	6	—	—	1	1	—	—	—	—	39
23	—	—	—	—	18	10	9	16	—	—	—	1	—	—	—	—	54
23¼	—	—	—	—	15	6	8	24	—	—	—	—	—	—	—	—	53
23½	—	—	—	—	16	5	6	19	—	—	—	1	—	—	—	—	47
23¾	—	1	—	—	9	7	5	28	—	—	—	2	—	—	—	—	52
24	—	—	—	—	7	2	7	20	—	—	—	1	—	—	1	—	38
24¼	—	—	—	—	12	1	7	36	—	—	1	—	—	—	—	—	57
24½	—	—	—	—	7	1	7	58	—	—	—	—	—	1	—	—	74
24¾	—	—	—	—	3	—	6	61	—	—	1	—	—	—	—	—	71
25	—	—	—	—	3	—	9	67	—	—	1	1	—	—	—	—	81
25¼	—	—	—	—	—	—	12	58	—	—	1	1	—	—	—	—	72
25½	—	—	—	—	2	—	12	54	—	—	—	—	—	1	—	—	69
25¾	—	—	—	—	3	—	18	42	—	—	—	—	1	2	—	—	66
26	—	—	—	—	—	—	26	27	—	—	—	—	—	2	—	—	55
26¼	—	—	—	—	—	—	17	30	—	—	—	—	—	1	—	—	48
26½	—	—	—	—	—	—	20	19	—	—	—	—	—	—	—	—	39
26¾	—	—	—	—	—	—	19	6	—	1	—	—	—	—	—	—	26
27	—	—	—	—	—	—	19	3	—	—	—	—	—	—	—	—	22
27¼	—	—	—	—	—	—	13	1	—	—	—	—	—	—	—	—	14
27½	—	—	—	—	—	—	10	1	—	—	—	—	1	—	—	—	12
27¾	—	—	—	—	—	—	7	1	—	—	—	—	—	—	—	—	8
28	—	—	—	—	—	—	8	—	—	—	—	—	—	—	—	—	8
28¼	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
28½	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	2
28¾	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
29¼	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
29½		—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	2
Totals	—	1	4	—	354	185	256	592	—	1	7	10	2	7	1	—	1,420
Average lengths	—	23.8	15.9	—	21.9	21.9	25.8	24.8	—	26.8	23.3	23.4	26.6	25.7	24.0	—	23.9

Table XV.—Rivers Inlet Sockeyes, 1951, Grouped by Age, Sex, Weight, and by Their Early History

Weight in Pounds	Number of Individuals																Total
	4_1		3_2		4_2		5_2		6_2		5_3		6_3		5_4		
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1¼	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1¾	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	2
2	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
2¼	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1
2½	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1
2¾	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
3	—	—	—	—	3	2	—	—	—	—	—	—	—	—	—	—	5
3¼	—	—	—	—	5	—	—	—	—	—	—	—	—	—	—	—	5
3½	—	—	—	—	5	2	—	—	—	—	—	—	—	—	—	—	7
3¾	—	—	—	—	12	3	—	3	—	—	—	—	—	—	—	—	18
4	—	—	—	—	30	11	1	1	—	—	1	1	—	—	—	—	45
4¼	—	—	—	—	34	13	1	—	—	—	—	—	—	—	—	—	48
4½	—	—	—	—	43	31	—	3	—	—	2	1	—	—	—	—	80
4¾	—	—	—	—	28	21	2	4	—	—	—	1	—	—	—	—	56
5	—	—	—	—	37	24	1	5	—	—	—	—	—	—	—	—	67
5¼	—	—	—	—	17	15	2	5	—	—	—	1	—	—	—	—	40
5½	—	—	—	—	20	23	3	19	—	—	—	2	—	—	—	—	67
5¾	—	—	—	—	16	17	1	12	—	—	—	—	—	—	—	—	46
6	—	1	—	—	22	9	11	28	—	—	1	—	—	—	1	—	73
6¼	—	—	—	—	15	4	9	24	—	—	—	1	—	—	—	—	53
6½	—	—	—	—	20	5	6	32	—	—	—	1	—	—	—	—	64
6¾	—	—	—	—	9	3	9	33	—	—	—	—	—	—	—	—	54
7	—	—	—	—	15	2	4	58	—	—	—	—	—	—	—	—	79
7¼	—	—	—	—	6	—	8	41	—	—	2	—	—	1	—	—	58
7½	—	—	—	—	6	—	9	67	—	—	1	2	1	—	—	—	86
7¾	—	—	—	—	1	—	13	42	—	—	—	—	—	—	—	—	56
8	—	—	—	—	8	—	12	57	—	—	—	—	—	1	—	—	78
8¼	—	—	—	—	1	—	12	31	—	—	—	—	—	—	—	—	44
8½	—	—	—	—	—	—	23	43	—	—	—	—	—	1	—	—	67
8¾	—	—	—	—	—	—	13	28	—	—	—	—	—	2	—	—	43
9	—	—	—	—	—	—	19	24	—	—	—	—	1	2	—	—	46
9¼	—	—	—	—	—	—	15	10	—	—	—	—	—	—	—	—	25
9½	—	—	—	—	—	—	20	17	—	—	—	—	—	—	—	—	37
9¾	—	—	—	—	—	—	12	1	—	1	—	—	—	—	—	—	14
10	—	—	—	—	—	—	8	—	—	—	—	—	—	—	—	—	8
10¼	—	—	—	—	—	—	8	1	—	—	—	—	—	—	—	—	9
10½	—	—	—	—	—	—	11	1	—	—	—	—	—	—	—	—	12
10¾	—	—	—	—	—	—	6	1	—	—	—	—	—	—	—	—	7
11	—	—	—	—	—	—	5	1	—	—	—	—	—	—	—	—	6
11¼	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
11½	—	—	—	—	—	—	5	—	—	—	—	—	—	—	—	—	5
11¾	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	2
12	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
12¼	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
12½	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
12¾	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
13¼	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	1
13½	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
13¾	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Totals	—	1	4	—	354	185	256	592	—	1	7	10	2	7	1	—	1,420
Average weights	—	6.0	2.0	—	5.2	5.0	8.6	7.4	—	9.7	5.8	5.7	8.3	8.5	6.0	—	6.7

Table XVI.—Rivers Inlet Sockeyes, Average Lengths in Inches of the 4_2 and 5_2 Groups, 1912 to 1951

Year	4_2		5_2	
	M.	F.	M.	F.
1912–41	22.4	22.4	25.4	24.7
1912–41 (conversion)	21.6	21.6	24.6	23.9
1942	21.9	21.3	25.0	23.8
1943	20.5	21.1	24.3	23.7
1944	21.1	21.0	23.5	23.3
1945	20.9	21.2	24.2	23.9
1946	20.6	21.1	25.1	24.1
1947	20.6	20.7	24.0	23.5
1948	21.4	21.3	25.2	24.2
1949	20.9	21.4	23.8	22.8
1950	21.1	20.8	25.2	24.2
1951	21.9	21.9	25.8	24.8

Table XVII.—Rivers Inlet Sockeyes, Average Weights in Pounds of the 4_2 and 5_2 Groups, 1914 to 1951

Year	4_2		5_2	
	M.	F.	M.	F.
1914–41	4.9	4.8	7.0	6.5
1942	5.1	4.6	7.2	6.4
1943	4.1	4.4	6.8	6.3
1944	4.6	4.4	6.2	6.0
1945	4.3	4.4	6.6	6.4
1946	3.9	3.9	7.2	6.2
1947	4.1	3.9	6.4	5.9
1948	4.7	4.6	7.9	7.0
1949	4.4	4.3	5.9	5.9
1950	4.2	3.9	7.5	6.4
1951	5.2	5.0	8.6	7.4

Table XVIII.—Rivers Inlet Sockeyes, Percentages of Males and Females, 1915 to 1951

Year	4_1		4_2		5_2		Per Cent Total Males	Per Cent Total Females
	M.	F.	M.	F.	M.	F.		
1915–41 (average)	----	----	63	37	34	66	50	50
1942	----	----	61	39	35	65	38	62
1943	----	----	62	38	34	66	36	64
1944	----	----	67	33	33	67	59	41
1945	----	----	70	30	39	61	57	43
1946	----	----	79	21	37	63	53	47
1947	----	----	72	28	35	65	36	64
1948	----	----	50	50	38	62	45	55
1949	36	64	70	30	22	78	63	37
1950	50	50	75	25	36	64	41	59
1951	----	----	66	34	30	70	44	56

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

Year	Percentage of Individuals				
	4_1	4_2	5_2	6_2	5_3
1925 (33,764 cases)	—	—	—	—	—
1926 (17,921 cases)	—	—	—	—	—
1927 (22,682 cases)	—	—	—	—	—
1928 (33,442 cases)	—	—	—	—	—
1929 (9,683 cases)	—	—	—	—	—
1930 (32,057 cases)	—	—	—	—	—
1931 (12,867 cases)	—	—	—	—	—
1932 (25,488 cases)	—	—	—	—	—
1933 (37,369 cases)	—	—	—	—	—
1934 (14,607 cases)	—	—	—	—	—
1935 (31,648 cases)	—	—	—	—	—
1936 (12,788 cases)	—	—	—	—	—
1937 (25,258 cases)	—	—	—	—	—
1938 (33,894 cases)	—	—	—	—	—
1939 (17,833 cases)	—	—	—	—	—
1940 (25,947 cases)	—	—	—	—	—
1941 (21,495 cases)	—	—	—	—	—
1942 (15,939 cases)	—	—	—	—	—
1943 (15,010 cases)	—	—	—	—	—
1944 (3,165 cases)	—	—	—	—	—
1945 (15,014 cases)	—	50	50	—	—
1946 (14,318 cases)	—	11	89	—	—
1947 (36,800 cases)	—	5	95	—	—
1948 (10,456 cases)	—	7	90	3	—
1949 (13,189 cases)	2	92	5	—	(1)
1950 (42,435 cases)	—	17	83	—	(1)
1951 (49,473 cases)	—	22	77	(1)	(1)

[1] This age-class was represented by less than 0.5 per cent of the number of fish in the sample.

Table XX.—Smith Inlet Sockeyes, 1951, Grouped by Age, Sex, Length, and by Their Early History

Length in Inches	Number of Individuals										Total
	3_2		4_2		5_2		6_2		5_3		
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
14	---	---	---	---	---	---	---	---	---	---	---
14¼	---	---	---	---	---	---	---	---	---	---	---
14½	---	---	---	---	---	---	---	---	---	---	---
14¾	---	---	---	---	---	---	---	---	---	---	---
15	---	---	---	---	---	---	---	---	---	---	---
15¼	---	---	---	---	---	---	---	---	---	---	---
15½	---	---	---	---	---	---	---	---	---	---	---
15¾	---	---	---	---	---	---	---	---	---	---	---
16	---	---	---	---	---	---	---	---	---	---	---
16¼	---	---	---	---	---	---	---	---	---	---	---
16½	---	---	---	---	---	---	---	---	---	---	---
16¾	---	---	---	---	---	---	---	---	---	---	---
17	---	---	---	---	---	---	---	---	---	---	---
17¼	---	---	---	---	---	---	---	---	---	---	---
17½	---	---	---	---	---	---	---	---	---	---	---
17¾	---	---	---	---	---	---	---	---	---	---	---
18	---	---	---	---	---	---	---	---	---	---	---
18¼	---	---	---	---	---	---	---	---	---	---	---
18½	---	---	---	---	---	---	---	---	---	---	---
18¾	---	---	---	---	---	---	---	---	---	---	---
19	---	---	---	---	---	---	---	---	---	---	---
19¼	---	---	---	---	---	---	---	---	---	---	---
19½	1	---	---	---	---	---	---	---	---	---	1
19¾	---	---	---	---	1	---	---	---	---	---	1
20	---	---	---	---	---	---	---	---	---	---	---
20¼	---	---	---	---	---	---	---	---	---	---	---
20½	---	---	---	1	---	---	---	---	---	---	1
20¾	---	---	---	1	---	---	---	---	---	---	1
21	---	---	3	2	---	---	---	---	---	---	5
21¼	---	---	2	1	---	---	---	---	---	---	3
21½	---	---	6	12	---	---	---	---	---	---	18
21¾	---	---	6	5	1	---	---	---	---	---	12
22	---	---	7	5	---	---	---	---	---	---	12
22¼	---	---	8	2	---	1	---	---	---	---	11
22½	---	---	12	2	1	---	---	---	---	---	15
22¾	---	---	7	2	---	1	---	---	1	---	11
23	---	---	20	6	4	2	---	---	---	---	32
23¼	---	---	8	1	---	3	---	---	---	---	12
23½	---	---	12	---	1	19	---	---	---	---	32
23¾	---	---	7	1	5	9	---	---	---	---	22
24	---	---	2	---	3	24	---	---	1	---	30
24¼	---	---	3	---	4	16	---	---	---	---	23
24½	---	---	2	---	11	55	---	---	---	---	68
24¾	---	---	1	---	7	28	---	---	---	---	36
25	---	---	---	---	22	46	---	2	---	---	70
25¼	---	---	---	---	16	36	---	---	---	---	52
25½	---	---	---	---	29	34	---	---	---	---	63
25¾	---	---	---	---	16	13	---	---	---	---	29
26	---	---	---	---	32	11	---	---	---	---	43
26¼	---	---	---	---	14	1	---	---	---	---	15
26½	---	---	---	---	22	6	---	---	---	---	28
26¾	---	---	---	---	9	---	---	---	---	---	9
27	---	---	---	---	9	---	---	---	---	---	9
27¼	---	---	---	---	5	---	---	---	---	---	5
27½	---	---	---	---	2	---	---	---	---	---	2
27¾	---	---	---	---	1	---	---	---	---	---	1
28	---	---	---	---	---	---	---	---	---	---	---
28¼	---	---	---	---	1	---	---	---	---	---	1
28½	---	---	---	---	---	---	---	---	---	---	---
28¾	---	---	---	---	---	---	---	---	---	---	---
29	---	---	---	---	---	---	---	---	---	---	---
29¼	---	---	---	---	---	---	---	---	---	---	---
Totals	1	---	106	41	216	305	---	2	2	---	673
Average lengths	19.5	---	22.8	22.0	25.6	24.8	---	25.1	23.4	---	24.5

Table XXI.—Smith Inlet Sockeyes, 1951, Grouped by Age, Sex, Weight, and by Their Early History

Weight in Pounds	Number of Individuals										Total
	3_2		4_2		5_2		6_2		5_3		
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
1	----	----	----	----	----	----	----	----	----	----	-----
1¼	----	----	----	----	----	----	----	----	----	----	-----
1½	----	----	----	----	----	----	----	----	----	----	-----
1¾	----	----	----	----	----	----	----	----	----	----	-----
2	----	----	----	----	----	----	----	----	----	----	-----
2¼	----	----	----	----	----	----	----	----	----	----	-----
2½	----	----	----	----	----	----	----	----	----	----	-----
2¾	----	----	----	----	----	----	----	----	----	----	-----
3	----	----	----	----	----	----	----	----	----	----	-----
3¼	----	----	----	----	----	----	----	----	----	----	-----
3½	1	----	----	----	----	----	----	----	----	----	1
3¾	----	----	----	----	----	----	----	----	----	----	-----
4	----	----	----	----	----	----	----	----	----	----	-----
4¼	----	----	----	----	----	----	----	----	----	----	-----
4½	----	----	3	8	----	----	----	----	----	----	11
4¾	----	----	3	5	2	----	----	----	----	----	10
5	----	----	11	10	1	1	----	----	----	----	23
5¼	----	----	6	2	----	2	----	----	----	----	10
5½	----	----	17	7	2	2	----	----	1	----	29
5¾	----	----	13	5	1	6	----	----	----	----	25
6	----	----	15	3	3	14	----	----	----	----	35
6¼	----	----	11	1	4	10	----	----	----	----	26
6½	----	----	10	----	6	36	----	----	----	----	52
6¾	----	----	8	----	5	17	----	----	----	----	30
7	----	----	2	----	8	43	----	1	----	----	54
7¼	----	----	2	----	8	30	----	----	1	----	41
7½	----	----	2	----	28	45	----	1	----	----	76
7¾	----	----	1	----	11	28	----	----	----	----	40
8	----	----	1	----	29	31	----	----	----	----	61
8¼	----	----	----	----	14	11	----	----	----	----	25
8½	----	----	----	----	19	18	----	----	----	----	37
8¾	----	----	1	----	10	6	----	----	----	----	17
9	----	----	----	----	24	3	----	----	----	----	27
9¼	----	----	----	----	10	2	----	----	----	----	12
9½	----	----	----	----	9	----	----	----	----	----	9
9¾	----	----	----	----	5	----	----	----	----	----	5
10	----	----	----	----	7	----	----	----	----	----	7
10¼	----	----	----	----	4	----	----	----	----	----	4
10½	----	----	----	----	3	----	----	----	----	----	3
10¾	----	----	----	----	----	----	----	----	----	----	-----
11	----	----	----	----	1	----	----	----	----	----	1
11¼	----	----	----	----	----	----	----	----	----	----	-----
11½	----	----	----	----	2	----	----	----	----	----	2
11¾	----	----	----	----	----	----	----	----	----	----	-----
12	----	----	----	----	----	----	----	----	----	----	-----
12¼	----	----	----	----	----	----	----	----	----	----	-----
12½	----	----	----	----	----	----	----	----	----	----	-----
12¾	----	----	----	----	----	----	----	----	----	----	-----
13	----	----	----	----	----	----	----	----	----	----	-----
13¼	----	----	----	----	----	----	----	----	----	----	-----
13½	----	----	----	----	----	----	----	----	----	----	-----
13¾	----	----	----	----	----	----	----	----	----	----	-----
Totals	1	----	106	41	216	305	----	2	2	----	673
Average weights	3.6	----	6.0	5.2	8.2	7.3	----	7.2	6.4	----	7.2

Table XXII.—Smith Inlet Sockeyes, Average Lengths in Inches of Age-groups, 1945 to 1951

Year	4_1		4_2		5_2		6_2		5_3	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1945	.....	.....	22.2	22.0	25.1	24.4	.....	.....	.....	.....
1946	.....	.....	21.3	22.7	24.7	24.0	.....	.....	.....	.....
1947	.....	.....	23.2	23.4	25.2	24.3	.....	.....	.....	.....
1948	.....	.....	21.9	21.7	25.0	24.3	26.7	25.0	.....	.....
1949	25.4	23.5	21.4	21.7	24.6	24.3	.....	25.5	.....	.....
1950	.....	.....	21.6	21.7	24.8	24.0	.....	.....	20.5	.....
1951	.....	.....	22.8	22.0	25.6	24.8	.....	25.1	23.4	.....

Table XXIII.—Smith Inlet Sockeyes, Average Weights in Pounds of Age-groups, 1945 to 1951

Year	4_1		4_2		5_2		6_2		5_3	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1945	.....	.....	4.9	4.7	7.1	6.5	.....	.....	.....	.....
1946	.....	.....	4.6	5.8	7.3	6.6	.....	.....	.....	.....
1947	.....	.....	5.7	5.5	6.9	6.0	.....	.....	.....	.....
1948	.....	.....	5.1	5.4	7.6	6.9	10.3	7.5	.....	.....
1949	7.9	6.1	5.0	5.1	7.2	6.7	.....	7.3	.....	.....
1950	.....	.....	4.9	5.0	7.4	6.6	.....	.....	4.0	.....
1951	.....	.....	6.0	5.2	8.2	7.3	.....	7.2	6.4	.....

Table XXIV.—Smith Inlet Sockeyes, Percentages of Males and Females, 1945 to 1951

Year	4_1		4_2		5_2		6_2		5_3		Per Cent Total Males	Per Cent Total Females
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.		
1945	—	—	73	27	49	51	—	—	—	—	61	39
1946	—	—	76	24	37	63	—	—	—	—	41	59
1947	—	—	38	62	47	53	—	—	—	—	46	54
1948	—	—	79	21	42	58	11	89	—	—	43	57
1949	36	64	80	20	40	60	—	100	—	—	77	23
1950	—	—	86	14	42	58	—	—	100	—	49	51
1951	—	—	72	28	41	59	—	100	100	—	48	52

Table XXV.—Length Distribution of Spawning-ground Samples, Rivers Inlet Sockeye

Length in Inches	Males	Females	Total	Length in Inches	Males	Females	Total
13	1	----	1	21¼	----	----	----
13¼	----	----	----	21½	----	1	1
13½	1	----	1	21¾	----	----	----
13¾	----	----	----	22	----	3	3
14	7	----	7	22¼	1	----	1
14¼	1	----	1	22½	----	3	3
14½	7	----	7	22¾	----	----	----
14¾	----	----	----	23	1	1	2
15	1	----	1	23¼	----	1	1
15¼	1	----	1	23½	----	3	3
15½	2	----	2	23¾	----	----	----
15¾	----	----	----	24	2	3	5
16	----	----	----	24¼	----	----	----
16¼	----	----	----	24½	1	5	6
16½	1	----	1	24¾	1	----	1
16¾	----	----	----	25	----	17	17
17	----	----	----	25¼	----	1	1
17¼	----	----	----	25½	4	18	22
17½	----	----	----	25¾	----	----	----
17¾	----	----	----	26	1	10	11
18	----	----	----	26¼	----	----	----
18¼	----	----	----	26½	3	2	5
18½	3	----	3	26¾	----	----	----
18¾	1	----	1	27	2	----	2
19	2	----	2	27¼	1	----	1
19¼	----	----	----	27½	9	1	10
19½	3	----	3	27¾	----	----	----
19¾	----	----	----	28	7	----	7
20	4	----	4	28¼	----	----	----
20¼	----	----	----	28½	5	----	5
20½	1	1	2	28¾	----	----	----
20¾	----	----	----	29	2	----	2
21	----	3	3	Totals	76	73	149

RESULTS OF THE WEST COAST OF VANCOUVER ISLAND HERRING INVESTIGATION, 1951–52

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INTRODUCTION

Since 1946–47 the herring population of the west coast of Vancouver Island has been fished without any limitations to catch except for a closure date prior to spawning. During the same period the herring-catch on the lower east coast of Vancouver Island has been limited to 40,000 tons annually, and a similar closure date has been applied to fishing. The scientific investigation of these two herring populations over a number of years aims to determine the comparative merits of these two methods of fisheries management. More specifically, it seeks to find out whether catch quotas are effective in stabilizing herring populations in view of the great natural fluctuations which occur in abundance.

This report, the sixth in an annual series,* outlines the results of studies carried out on the adult stocks of the west coast of Vancouver Island population during the 1951–52 season, and in it these results are compared with those of previous seasons. As in previous reports, detailed consideration is given to changes in catch and fishing effort, to the year-classes which comprise the fishing and spawning runs, and to the relative amount of fish which escape the fishery. Also, the extent of movement between

* Previous publications in this series are Tester and Stevenson, 1947, 1948; Stevenson, 1950; Stevenson and Lanigan, 1950; and Stevenson, Hourston, and Lanigan, 1951.

all major herring populations, as determined by tag-recovery, is discussed. Finally, the results of the 1951–52 study are discussed from the point of view of their implications upon the comparative study of two populations subjected to different management methods.

Herring research on Pacific herring (*Clupea pallasi*) is undertaken by the Fisheries Research Board of Canada at the Pacific Biological Station, Nanaimo, B.C. It includes, besides the comparative study of two herring populations which forms the basis of this series of publications, various phases of research applied to all major fishable stocks. Also, investigation is continuing on certain aspects of the early life-history of the herring in an effort to understand more completely the principles involved in the supply of fish to the fishery, and thereby to acquire a sound basis for prediction of population abundance.

Districts, sub-districts, and areas in which British Columbia coastal waters are divided for purposes of fisheries statistics are shown in Fig. 1. Place-names along the coast of Vancouver Island and adjacent Mainland, which are mentioned in the text, are shown in Fig. 2.

THE 1951–52 FISHERY

The British Columbia herring-fishing season opened on November 15th, most boats seining in the middle east coast and lower east coast sub-districts. No fishing took place in the west coast of Vancouver Island sub-district until December 1st, when a fairly large body of herring was located in Effingham Inlet (Area 23). Fair fishing was experienced during the ensuing days, with from seven to eighteen boats participating, and almost 7,300 tons were caught. By December 8th seining proved unproductive, and most of the seiners, which had originally come around from the lower east coast, returned there or moved to the northern sub-district, where excellent catches were being made. From December 8th until fishing was closed for the Christmas recess on December 17th, fishing in the west coast sub-district was generally poor, partly because of the smaller fishing effort, but mainly because of the lack of sizable schools of fish to set on. The few boats which remained in the sub-district thoroughly scouted the fishing-grounds, and small bodies of fish were located in Effingham Inlet, in Barkley Sound (Area 23), in Clayoquot and Sydney Inlets (Area 24), and in Nootka, Tahsis, and Esperanza Inlets (Area 25). The total pre-Christmas catch on the west coast amounted to 8,900 tons. Barkley Sound accounted for the entire catch, except for about 300 tons from Nootka Sound taken during the last week of the fishery and 200 tons from Clayoquot Sound caught on December 17th.

Fishing recommenced on January 6th, when eleven boats seined in Barkley Sound. During the first four days approximately 2,200 tons were brailed from this area and 540 tons were taken from Sydney Inlet and Refuge Cove (Area 24). By January 10th the fish had scattered, and from then until the middle of the month small catches amounting to approximately 900 tons were made in all west coast areas except Area 27. The west coast fishery was non-existent after January 15th, when all boats left for the northern and central sub-districts, but a few of the boats returned after the completion of the quota extension in the northern sub-district on January 18th. All areas were scouted again, but without success. A time extension for fishing the more northerly west coast areas was sought and granted, the closure date being moved from February 5th to February 15th. On February 4th the herring started to move inshore to Esperanza Inlet (Area 25), and by the time the boats from the central sub-district arrived on February 8th, a vigorous fishery was in progress, reaching its peak on February 12th, when thirty-two boats seined over 4,000 tons on that day. Heavy fishing with high catch per unit of effort (101 tons per seine per day) continued until the closure on February 15th. The total west coast catch in 1951–52 was 30,000 tons (Table I), over one-half of which was taken during the time extension.

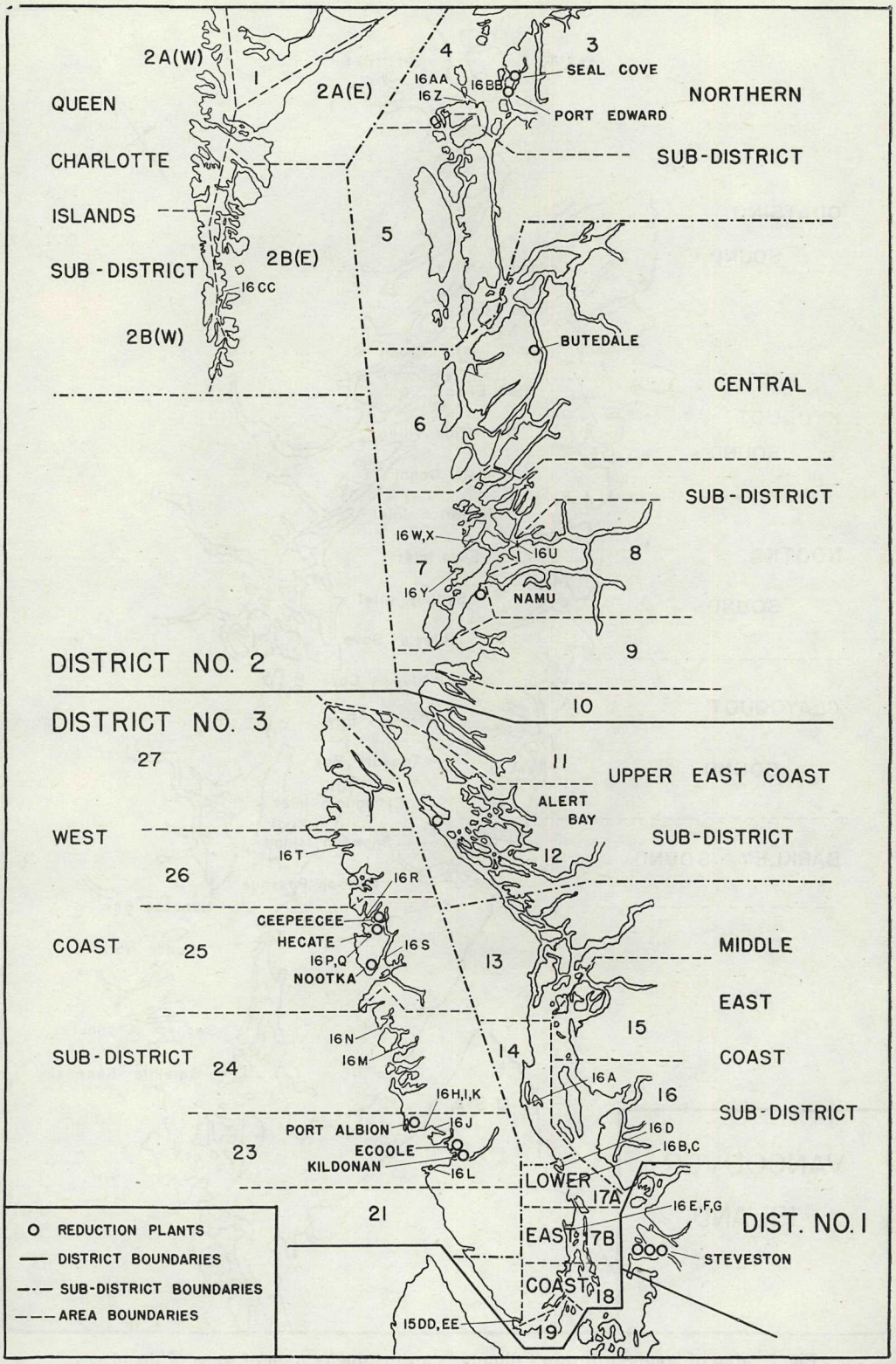

Fig. 1. Map showing the division of the British Columbia coast into districts, sub-districts, and areas, and including the locations and codes of taggings made during the fall of 1951 and the spring of 1952.

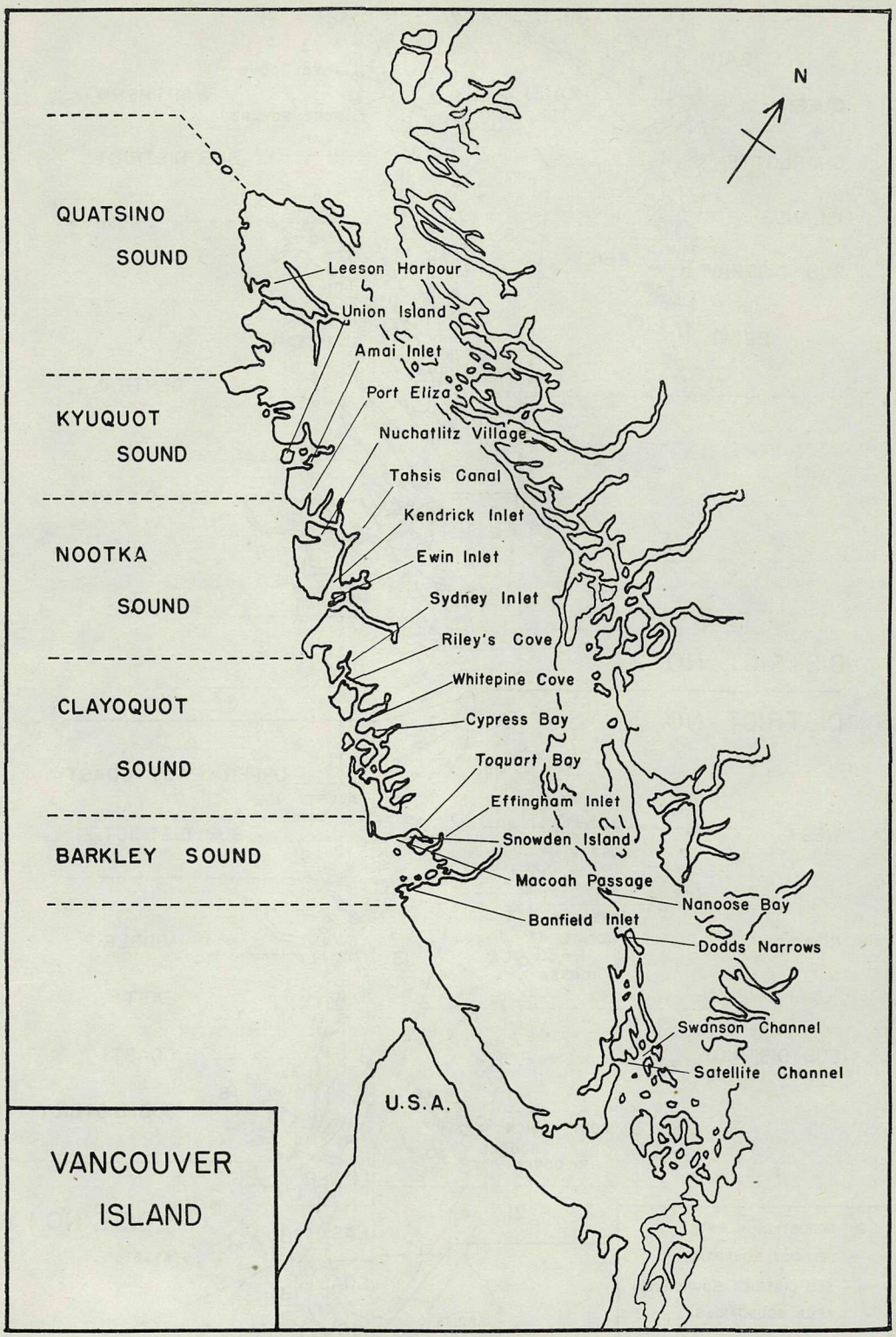

Fig. 2. Map of Southern British Columbia showing the location of some of the places mentioned in the text.

Details of catches, fishing effort, and catch per unit of effort are given for each area and the whole sub-district in Table I. Captains of seine-boats submitted data on the number of fishing or scouting days, and from these the catch per unit of effort was obtained. These records represented 75 per cent of the total catch for the sub-district, and the total fishing effort was gained by adjusting the number of recorded fishing-days to account for the whole catch.

Catch, fishing effort, and catch per unit of effort on the west coast of Vancouver Island are tabulated below for the 1951–52 and previous seasons:—

	1946–47	1947–48	1948–49	1949–50	1950–51	1951–52
Catch (tons)	59,000	45,200	55,000	37,300	25,200	30,000
Effort (seine-days)	777	948	686	790	528	395
Catch per unit of effort (tons per seine per day)	76	48	80	47	48	76

The 1951–52 west coast fishery produced the second smallest catch of the six-year period. The high average catch per unit of effort appears to be not comparable with availability figures of previous seasons, and is principally a result of the high catch per unit of effort in the Area 23 fishery—70.9 tons per seine per day (Table I), the highest availability for Area 23 in the six years of the study. Unusually great efficiency in fleet deployment during the period of fishing in Area 23 was undoubtedly a major factor in producing the artificially high availability. When fish were scarce on the fishing-grounds, the bulk of the fleet was moved promptly to fishing areas where fish were more plentiful. Spawning and age-composition data have strongly indicated that Area 23 stocks were smaller than at any time since the removal of quota restrictions.

The high availability of fish in Area 25 (Table I) was partly the result of the exploitation of dense herring schools moving toward the spawning-grounds during a ten-day time extension beyond the usual date of fishing closure. However, it no doubt also reflected the relatively high abundance of Area 25 herring stocks which in the two previous years had been largely unfished because of their late inshore movement (Stevenson, Hourston, and Lanigan, 1951).

TAGGING AND TAG-RECOVERY

The aims of tagging are twofold. Analysis of tag-recovery data permits (1) a description of the extent of movement between and within populations, and (2) a rough calculation of the rate of exploitation of the fishery.

In 1952, tagging operations were continued in the middle east coast, lower east coast, and west coast of Vancouver Island sub-districts, as they have been since 1946–47, and, as in 1951, fish in the central and northern sub-districts were tagged extensively. Methods used in tagging herring and in recovering tags were the same as those employed in previous years.

Tags were recovered during the 1951–52 fishing season* by (1) tag-detectors operated by herring-investigation personnel and (2) magnets tended by plant crews at reduction plants. Recovered tags were derived from the 1951 tagging (15-series) and from taggings of previous years.

Those fishing-grounds which yielded or might have yielded tags during the 1951–52 fishing season were: Area 2B (E)—Burnaby Narrows and Bigsby Inlet; Area 5—Gasboat Pass and Kitkatlah Inlet; Area 6—Laredo Inlet and Myers Pass; Area 7—Kildidt Sound; Area 8—Cousins Inlet and Reid Pass; Area 9—Moses Inlet and Douglas Channel; Area 12—Sargeaunt Pass, Simoom Sound, Greenway Sound, Thompson Sound,

* A list of the places and dates of individual taggings which produced recoveries during 1951–52 will be supplied on request (Supplementary Table I).

and Bones Bay; Area 13—Deepwater Bay; Area 17A—Nanoose Bay; Area 17B—Dodd Narrows; Area 18—Swanson Channel and Satellite Channel; Area 23—Effingham Inlet; Area 24—Sydney Inlet; Area 25—Tahsis Canal, Espinosa Inlet, and Port Eliza Inlet.

During the 1951–52 herring season, tag-detectors recovered tags at three plants. Two were located in Steveston, B.C., at the Imperial and Gulf of Georgia reduction plants. The other detector was located at Seal Cove in Prince Rupert. A tabulation follows, showing the type of detector used at each plant, the percentage efficiency of each detector during the pre-Christmas and post-Christmas periods, and in parentheses are shown the comparable efficiencies at which they operated during the 1950–51 season:—

Detector Installation	Type of Detector	Efficiency while Operating	
		Pre-Christmas	Post-Christmas
Imperial	Wheatstone bridge	59 (90)	87 (71)
Gulf of Georgia	Induction	80 (25)	80 (94)
Seal Cove	Both types	0 (—)	5 (—)

The Imperial detector operated during the pre-Christmas period at an efficiency which was considerably lower than that of the previous year over the same period. While its efficiency was greater in the post-Christmas than in the pre-Christmas period, it developed serious troubles after two days of post-Christmas operation and could not be operated for the rest of the season. The induction-type set, operating at the Gulf of Georgia plant, performed well during the whole pre-Christmas period and the principal part of the post-Christmas period. Its average mechanical efficiency increased from 60 per cent in 1950–51 to 80 per cent in 1951–52. Tag-detection of the new installation at Seal Cove was very unsatisfactory. Generally, many problems arise in the first year's operation of a new detector installation. The speed of the conveyor-belt was insufficient to permit satisfactory operation of the induction-type set. A Wheatstone bridge set which was operated at Seal Cove late in the season performed unsatisfactorily because of a faulty coil mechanism.

The efficiency of recovery of tags taken from the magnets by plant crews depends upon both the mechanical efficiency of the magnet and the diligence of those individuals in returning the tags with pertinent information on recovery to the Pacific Biological Station. To test efficiency, sets of fifty tags differentiable from those taken by the fishery are inserted from time to time during the season in landed fish. The percentage recovered by the magnets and returned to the Biological Station is the index of plant or " magnet " efficiency of recovery. A table of the average 1951–52 efficiency of each plant, with its average 1950–51 efficiency in parentheses, follows in the table below:—

West Coast

Plant	Number of Tests	Average Efficiency of Tests
Kildonan	0 (2)	— (88)
Ecoole	0 (1)	— (90)
Port Albion	0 (2)	— (91)
Nootka	1 (3)	82 (88)
Ceepeecee	2 (1)	69 (68)
Hecate	1 (0)	54 (—)
Average	—	68 (85)

Steveston and Vicinity

Plant	Number of Tests	Average Efficiency of Tests
Imperial	7 (3)	86 (82)
Colonial	3 (3)	83 (74)
Gulf of Georgia	8 (3)	83 (50)
Phoenix	5 (1)	94 (86)
North Shore	3 (1)	97 (54)
Average		89 (69)

Other Localities

Alert Bay	1 (0)	78 (...)
Namu	2 (1)	91 (78)
Butedale	1 (0)	86 (...)
Port Edward	3 (1)	94 (78)
Seal Cove	1 (0)	63 (...)
Average		82 (78)
Grand average		80 (77)

The efficiency of recovery for those west coast plants which were tested was about the same in 1951–52 as in 1950–51. Unfortunately, because of the sporadic nature of the fishery in this sub-district, it was impossible to test Kildonan, Ecoole, or Port Albion plants. Plants at Steveston, and those listed under " other localities," were tested more frequently this year (thirty-four tests in 1951–52 as compared with thirteen in 1950–51). All of them showed increases in efficiency. The principal reason for the increase was apparently related to the fact that plant personnel this year were paid directly for tag-recoveries by a herring-investigation contact-man. They were thus saved the inconvenience of sending tags to the Pacific Biological Station for payment. Also, the increased number of magnet tests in 1951–52 increased the likelihood of reward to the men. Increased incentive might have prompted greater diligence on the part of plant crews and tended toward an increase in efficiency of recovery.

Recoveries by Tag-detectors

The number of detector recoveries in 1951–52 showed a decrease compared with the 1950–51 recovery. A total of 226 tags was recovered from regular spring taggings, and 20 tags were taken from taggings carried out at Sooke in the fall of 1951 just prior to the opening of the fishery. The number of tags taken at each detector installation was as follows: Imperial, 59; Gulf of Georgia, 178; and Seal Cove, 9. Detector recovery in 1950–51 amounted to 259 tags, all from spring taggings. A comparison of the number of tags (from spring taggings) obtained from the various sub-district fisheries in the past two seasons is given in the following tabulation:—

Sub-district Fishery	Number of Detector Returns 1950–51	1951–52
Northern	2	50
Central	111	42
Upper east coast	2	1
Middle east coast	26	34
Lower east coast	30	83
West coast	88	16
Totals	259	226

Increased intensity of tagging in the northern sub-district in 1951 and a heavy 1951–52 fishery accounted for the higher number of returns from northern catches, while the decrease in the number of tags from the central sub-district was largely due to decreased catch. The increase in the number of tags from lower east coast catches was at least partly a result of increased intensity of tagging. Recovery of tags from the west coast of Vancouver Island sub-district showed a sharp decrease in 1951–52. The decrease was largely due to the fact that while heavy west coast fishing was taking place at the end of the fishing season, only one tag-detector, operating erratically, searched the catches for tags. Furthermore, concentration of tags in the west coast catch was somewhat less in 1951–52 (0.0358 tags per ton) than in the previous year (0.0531 tags per ton).

Because of the small number of tags recovered from west coast catches by tag-detectors in 1951–52, no attempt will be made to calculate various population statistics on the west coast stocks, as has been done in previous years. Detector recoveries from some of the other herring populations, however, appear sufficiently numerous to warrant calculation of certain population statistics, and discussion of these statistics will be published later.

Movement between Populations

To study movement between populations, the "probable" number of tags in the various catches is calculated. Since (1) detectors are never 100 per cent efficient in operation and (2) only part of each sub-district catch is searched by the detector, corrections must be applied to the actual number of recoveries to provide the probable number of tags in the catches. The actual numbers of tags recovered by detectors in 1951–52 and the calculated probable numbers of tags in the catches are given in Table II, according to area of tagging, tagging code, and area of recovery. This table is summarized below, according to sub-districts, to provide data pertinent to the analysis of herring movements; the probable number of tags in the various catches are given, and actual numbers of tags on which the calculations were based appear in parentheses:—

Sub-district of Tagging	Sub-district of Recovery						Total
	Northern	Central	Upper East Coast	Middle East Coast	Lower East Coast	West Coast	
Northern	619 (43)	.....	.....	.....	7 (2)	32 (1)	658 (46)
Central	98 (7)	2,631 (32)	.....	13 (3)	.....	.....	2,742 (42)
Upper east coast	.....	.....	3 (1)	.....	.....	.....	3 (1)
Middle east coast	.....	.....	.....	108 (24)	46 (5)	.....	154 (29)
Lower east coast	.....	.....	.....	27 (6)	322 (73)	.....	349 (79)
West coast	.....	70 (1)	.....	4 (1)	14 (3)	1,042 (15)	1,130 (20)
Totals	717 (50)	2,701 (33)	3 (1)	152 (34)	389 (83)	1,074 (16)	5,036 (217)[1]
Catch (in tons)	57,300	39,900	8,250	10,350	41,000	30,000	.....
Probable number tags per ton	0.0125	0.0677	0.0004	0.0147	0.0095	0.0358	.....

[1] The difference between these totals and the corresponding totals in Table II is due to the fact that returns from Sooke taggings are not included.

As in previous years, most of the recoveries were taken from the sub-districts in which they were originally used. This "homing" tendency was most pronounced in the central sub-district—96.0 per cent ($^{2631}/_{2742}$)—but it was also great in the northern, lower east coast, and west coast sub-districts—94.1 per cent ($^{619}/_{658}$), 92.3 per cent ($^{322}/_{349}$), and 92.2 per cent ($^{1042}/_{1130}$) respectively. On the other hand, only 70.1 per cent ($^{108}/_{154}$) of the middle east coast tags were derived from middle east coast catches. Only one upper east coast tag was recovered in 1951–52, a result of complete lack of tagging on the upper east coast since 1946. It will be noted in the above tabulation that the present concentration of tags in the upper east coast population is very low in relation

to tag concentrations in other sub-districts. The heavy concentration of tags in the central and west coast sub-districts reflects recent intensive tagging programmes in those areas.

Movement of herring from the west coast of Vancouver Island to other sub-districts was calculated to be about 8 per cent in 1951–52, somewhat lower than the corresponding emigration noted in 1949–50 (12 per cent) and in 1950–51 (15 per cent). The data suggest that most of the west coast emigration was to the central sub-district—6.2 per cent ($^{7}/_{1130}$)—but since the calculation was based upon only one tag return, little confidence can be placed on the calculated extent of this migration. A movement of 1.2 per cent ($^{14}/_{1130}$) was noted to the lower east coast, the smallest such movement calculated since this type of data has been collected. This extremely small migration is probably related to the present reduced size of the Area 23 stocks, which generally provide most of the west coast herring to lower east coast runs. The reverse movement, that of emigration of lower east coast herring to the west coast, was entirely lacking in the 1951–52 detector returns.

A single northern tag was taken from west coast catches by tag-detectors, but no central tags were recovered on the west coast. Considering the relatively small proportion of the west coast catch that was searched for tags by tag-detectors, these results are not likely to be representative of the extent of herring movement. Plant returns, which are discussed later, suggest that migration of central fish to the west coast is greater than the migration of northern fish to the west coast.

The main movement of central tags was to the northern sub-district—3.6 per cent ($^{98}/_{2742}$); no reciprocal movement of herring from the northern to the central sub-district was shown by detector returns. In 1950–51 detector recovery data indicated no movement in either direction.

Lower east coast herring moved only to the middle east coast, a movement amounting to 7.7 per cent ($^{27}/_{349}$). Middle east coast herring, however, showed a large migration to the lower east coast—29.9 per cent ($^{46}/_{154}$). A generally great interchange of fish between these two sub-districts has been noted in all years of the present tagging programme, except for 1950–51 when a movement of only 2 to 3 per cent occurred in each direction (Stevenson, Hourston, and Lanigan, 1951).

No lower east coast tags were taken in the northern catches, but a 1.1 per cent movement ($^{7}/_{658}$) was noted in the opposite direction.

Detector returns in 1951–52 show a tendency for a southerly movement of herring along the British Columbia coast. The major exception to this general condition was the northward movement of central fish to the northern sub-district, which was not accompanied by a corresponding southward movement from the northern to the central sub-district. The heavy exploitation of the northern stocks in 1951–52 might have accentuated this northerly movement which appeared to be contrary to the general migration pattern.

Movement within Populations

Because of the small number of detector recoveries from the west coast catches in 1951–52, only a general analysis of herring movement within the sub-district is possible. Three Area 23 tags of the 15-series (tagged in 1951) were recovered in Area 23, and none were recovered in other west coast areas. One Area 25 tag of the same series was recovered in Area 25, and one was taken from Area 23 catches. One Area 24 tag was returned in Area 23 catches. Thus, even with the limited number of the returns, the tendency for herring to move in a south-easterly direction along the west coast of Vancouver Island was shown.

The probable numbers of 14-series (1950 taggings) and 15-series (1951 taggings) tags in the central sub-district catches are summarized from Table II in the following

tabulation (actual numbers of tags, on which probable numbers are based, are given in parentheses):—

Area of Tagging	Area of Recovery—14-series		Area of Recovery—15-series	
	6	7	6	7
6	377 (3)	.....	880 (7)	.....
7	.....	140 (2)	.....	1,094 (18)
10	.....	.....	.....	140 (2)

Returns from neither the 14-series tagging nor the 15-series tagging showed intermixture of herring between Areas 6 and 7. No Area 6 tags were taken in Area 7, and no Area 7 tags were taken in Area 6 catches. In the previous year, Area 7 tags were not recovered from Area 6, and only two Area 6 tags were returned from the Area 7 fishery (Stevenson, Hourston, and Lanigan, 1951). These data strongly suggest that the two main central sub-district stocks should be considered as separate populations. However, it seems desirable to collect additional data pertaining to this problem before arriving at a conclusion.

As in the previous year, movement of Area 10 herring to Area 7 was noted. Since Area 10 tags were also taken in the middle east coast of Vancouver Island sub-district, it appears that the relatively small Area 10 herring population is subject to wide dispersal.

Movement of herring within the lower east coast sub-district appears to be a different problem than movement of herring within other sub-districts. In the case of most other sub-districts, the inshore migration routes of the various runs to the different fishing areas are relatively discrete, whereas herring of the lower east coast population move from offshore summer feeding-grounds through the Strait of Juan de Fuca to the southern entrance of the Strait of Georgia, from where they follow along the general contour of the Vancouver Island coast through each of the three main fishing areas (Areas 18, 17B, and 17A). Thus movement within populations, as considered with respect to most herring populations, is not applicable to the lower east coast runs, since whether tags are caught in their area of tagging or in another area depends almost wholly on the particular area in which the fishing fleet contacts the main bodies of fish along the migration route within the sub-district. In 1951–52 Area 18 contributed about two-thirds of the sub-district catch, and although the 1951 taggings were fairly evenly distributed between all areas of the sub-district, a preponderance of the tag returns (about 80 per cent, in terms of probable numbers of tags in the catches) was taken from the Area 18 fishery.

In the fall of 1951, 991 herring were tagged at Sooke in the Strait of Juan de Fuca with a view to obtaining further evidence of the inshore migration of lower east coast stocks through the Strait of Juan de Fuca. A total of twenty of these tags was recovered by tag-detectors (Table II), and all of them were from the lower east coast fishery, which took place about two months after tagging. Plant returns accounted for thirty-six recoveries (Table III); thirty of these were considered to have come from lower east coast catches, two from west coast catches, and too much doubt surrounded the exact sub-district of recovery of the other four tags to permit assignment. A similar tagging was conducted in the fall of 1944, when 1,409 fish were tagged at Sooke. In the 1944–45 fishery, seventy-four tags were recovered by tag-detectors, all of which were from lower east coast catches (Tester, 1945); in 1945–46 only one tag was returned, and it came from the lower east coast (Tester, 1946), while in 1946–47 three tags were recovered—two from lower east coast catches and one from Area 23 on the west coast of Vancouver Island (Tester and Stevenson, 1947).

Both Sooke taggings strongly indicated that the main inshore migration route of the lower east coast population is through the Strait of Juan de Fuca. The single west coast

recovery obtained more than two years after the 1944 tagging could have resulted from the limited intermingling known to exist between west coast and lower east coast fish. The two plant returns from the 1951 tagging which were considered to have come from the west coast fishery suggest that a small proportion (about 6 per cent) of the fish at Sooke went back offshore and then moved inshore to west coast fishing-grounds.

Recovery of Tags by Plant Crews

In 1951–52, 4,512 decipherable tags were recovered by plant crews from magnets and plant machinery of sixteen reduction plants. This record recovery constitutes an increase of 119 per cent over that of the previous year. The increase was due primarily to (1) the record large 1950 and 1951 taggings, (2) heavy exploitation of all herring populations, and (3) a system of direct payment of tag rewards to plant crews:—

Plant Name	Number of Tags Recovered	Plant Name	Number of Tags Recovered
Imperial	497	Port Edward	525
Colonial	449	Seal Cove	94
Gulf of Georgia	235	Kildonan	43
Phoenix	370	Port Albion	42
North Shore	317	Nootka	131
Alert Bay	56	Ceepeecee	239
Namu	683	Hecate	33
Butedale	756	Shingle Bay	42

The distribution of tags according to area of tagging and probable sub-district of recovery is given in Table III. While the area of recovery of detector returns is always specific, it is often difficult to determine specifically the area or even the sub-district from which a plant recovery originated. Certain methods (Tester and Stevenson, 1948) are employed to assign as accurately as possible the most probable area of recovery to each tag. It is seen from Table III that 592 tags, or 13.1 per cent, were unclassifiable as to location of recovery. In general, less trouble was occasioned in assigning plant recoveries in 1951–52 than in previous years, since, for the most part, landings from only one fishery entered each plant during any particular part of the season. In the following tabulation, data from Table III have been summarized to show numbers of recoveries according to the sub-district of tagging and the most likely sub-district of recovery:—

Sub-district of Tagging	Probable Sub-district of Recovery							Total
	Northern	Central	Upper East Coast	Middle East Coast	Lower East Coast	West Coast	Indeterminate	
Northern	382	24	.....	.....	.....	1	44	451
Central	112	2,143	3	5	.....	8	425	2,696
Upper East Coast	.....	.....	4	.....	.....	1	1	6
Middle East Coast	1	2	2	77	6	.....	25	113
Lower East Coast	.....	1	.....	7	132	11	31	182
West Coast	5	9	.....	.....	.....	948	66	1,028
Totals	500	2,179	9	89	138	969	592	4,476[1]

[1] The difference between this total and the total number of plant recoveries obtained previously is due to the fact that returns from Sooke taggings are not included in this tabulation.

The great tendency for tags to be recovered in the sub-district of tagging, noted previously in the analysis of detector returns, was also shown by the plant returns. In both sources of recovery, central herring showed greatest "homing," while middle east coast herring showed the smallest "homing" tendency.

On the basis of plant returns, emigration of west coast fish was unusually small—1.5 per cent ($^{14}/_{962}$). All west coast emigration was to the central and northern sub-districts.

In 1950–51 considerably larger movement of west coast fish to the central and northern populations was calculated (7.5 per cent). Most of this movement in 1950–51 was found to be tags used in the most northerly west coast areas (Areas 26 and 27), and the complete lack of tagging in those areas in 1951 is part of the reason for the apparently reduced west coast emigration in the past season.

Plant returns showed that eight central tags were taken on the west coast, while only one northern tag was recovered from west coast catches, suggesting movements of 0.4 per cent ($^{8}/_{2271}$) and 0.2 per cent ($^{1}/_{407}$) respectively. Thus both plant returns and detector recoveries indicated an almost negligible quantity of northern and central tags in west coast runs. In view of the intensive tagging in the northern and central sub-districts in 1950 and 1951, the results appear to indicate strongly that west coast stocks are not appreciably supplemented by northern and central herring.

There was no indication of movement of west coast fish to the lower east coast from plant returns for the first time since the beginning of the present tagging programme; the movement in the reverse direction was 7.3 per cent ($^{11}/_{151}$), which is large in view of the lack of evidence of such a movement from detector returns, but about average when compared with data from past years.

The main movement of central fish was to the northern sub-district (4.9 per cent ($^{112}/_{2271}$)), closely resembling the 3.6-per-cent movement determined from detector returns. An appreciable emigration of northern fish to the central sub-district (5.9 per cent ($^{24}/_{407}$)) was shown. The lack of such a movement, on the basis of detector returns, was probably largely a result of the relatively small tonnage of central fish examined for tags by tag-detectors.

The movement of lower east coast fish to the middle east coast amounted to 4.6 per cent ($^{7}/_{151}$) on the basis of plant returns. The corresponding movement, calculated from detector recoveries, was 7.7 per cent. The reverse movement, from the middle east coast to the lower east coast—6.8 per cent ($^{6}/_{88}$)—was much smaller than that computed from detector returns (29.9 per cent). Considering the small numbers of tags indicating emigration of middle east coast fish to the central and northern sub-districts and the complete absence of supporting data from detector returns, there is much doubt concerning the extent of the northward movement of middle east coast fish.

Tag returns from both main sources of recovery give no support to the contention frequently expressed by fishermen and others that the changes in the west coast stocks are appreciably affected by emigration of fish away from the west coast or by immigration to the west coast. It was calculated that in 1951–52 about 1,000 tons of west coast fish were caught in other sub-districts, and about 2,000 tons of fish from other sub-districts were taken in west coast catches.

Tagging during the 1952 Spawning Season

The 1952 tagging programme was carried out with the assistance of three seine-boats loaned by fishing companies. Two vessels began tagging operations on February 25th, one operating in the lower and middle east coast sub-districts until March 24th, the other being used on the west coast until March 21st and in the central sub-district from then until April 7th. The third vessel commenced tagging about March 6th on the west coast, moved to the central sub-district by March 24th, and carried out tagging operations in central, northern, and Queen Charlotte Islands waters until April 10th.

The numbers of herring tagged in the various areas in 1951 and 1952 are given in the following tabulation:—

Year	Sub-district and Area of Tagging														
	Queen Charlotte Islands	Northern	Central			Middle East Coast		Lower East Coast				West Coast			
	2B (E)	4	6	7	10	14	15	17A	17B	18	20	23	24	25	26
1951	.....	5,091	5,092	7,507	3,027	.....	4,087	5,129	2,058	4,074	991[1]	8,583	4,077	8,109	.....
1952	4,114	8,089	.....	8,837	.....	3,013	.....	5,034	5,540	.....	.....	10,058	5,071	8,058	3,073

[1] Tagged in the fall of 1951 after the previous report in this series had been presented for publication.

A total of 60,887 fish* was tagged in 1952, as compared to 57,825 in 1951. More herring were tagged in the west coast sub-district than in the previous year (26,260 as compared to 20,769). Taggings were carried out in all west coast areas except Area 27.

Herring were tagged on the east coast of the Queen Charlotte Islands in 1952—the first tagging made in that sub-district since 400 fish were tagged in the spring of 1940 (Hart and Tester, 1940). Tagging in the northern sub-district was also more intensive than in 1951, but fewer fish were tagged in the central, middle east coast, and lower east coast sub-districts. The 1952 herring-tagging programme was the largest ever carried out in British Columbia.

SAMPLING OF THE CATCHES AND THE SPAWNING RUNS

Knowledge of the relative strength of the various year-classes is basic to a comprehensive understanding of a fish population. Information on relative year-class strength is provided by the determination of the ages of fish taken in random samples from the fishery and spawning runs. In addition, these samples provide data on growth rates, which may reflect changes in feeding conditions. Furthermore, data obtained on sex ratio and development tie together certain aspects of the adult and spawn studies.

A total of sixty-three samples† was taken from the west coast of Vancouver Island sub-district during the 1951–52 season. The distribution of this sampling according to area is given below (comparable numbers for 1950–51 are given in parentheses):—

Area	Number of Samples: Fishery	Number of Samples: Spawning Runs
23	16 (38)	5 (4)
24	1 (2)	2 (2)
25	37 (2)	1 (4)
26	0 (0)	1 (0)

No samples have been obtained from Area 27 since the 1949–50 season.

* A list of all taggings made in 1952, including information on the date and place of each tagging, will be supplied on request (Supplementary Table II).

† A list of all fishing and spawning samples taken in 1951–52, including places and dates of sampling, numbers of fish of each age, numbers of fish of each sex, and data on maturity, will be supplied on request (Supplementary Table III).

Age Composition

The average percentage age composition (weighted to numbers of fish caught in each area) of the west coast fishing samples is given below for each season since the removal of the quota restrictions in that sub-district:—

Fishing Season	In Year of Age								
	I	II	III	IV	V	VI	VII	VIII	IX–XI
1946–47	+[1]	5.0	53.0	32.1	6.0	2.5	0.9	0.5	0.1
1947–48	+	2.4	58.2	27.8	8.5	2.1	0.5	0.3	0.1
1948–49	+	7.4	45.2	32.9	9.6	3.4	1.0	0.3	0.1
1949–50	+	4.4	68.8	20.5	5.3	0.8	0.2	0.1	0.0
1950–51	+	9.8	35.3	44.5	8.0	1.9	0.5	+	+
1951–52	+	2.6	36.2	23.9	31.6	4.3	1.2	0.2	+

[1] The plus signs indicate percentages of less than 0.05.

The striking feature of the age composition in 1951–52 is the large proportion of the V-year fish (1947 year-class), forming nearly a third of the catch. This is the largest contribution of V-year fish to the fishing stock since detailed age-composition data were first recorded (1929–30), and is four times the average percentage contribution of V-year fish during the last five years. Since it entered the fishery in 1949–50, this year-class has made a higher contribution to the percentage age composition of the herring stocks than any other year-class in the last nine years.

The great strength of the 1947 year-class has been evident since its first summer, when large numbers of I-year fish were seen in inshore waters (Tester and Stevenson, 1948). In the spring of 1949 it entered the spawning runs in tremendous numbers as II-year fish (Stevenson, 1950); as III- and IV-year fish, it dominated the catch (Stevenson and Lanigan, 1950; Stevenson, Hourston, and Lanigan, 1951). During the 1951–52 season it formed about the same proportion of the catch as the newly recruited 1949 year-class (III's). Since negligible recruitment occurs after the fifth year, it is unlikely that the 1947 year-class will form an important part of the fishing stocks in future fishing seasons.

The relative weakness of the 1948 year-class was again evident in the 1951–52 stocks. Its contribution to the catch as IV-year fish was one of the smallest in recent years. The newly recruited 1949 year-class also showed indications of relatively low abundance. It failed to form a significantly higher proportion of the population than did the weak 1948 year-class in the previous year.

On the basis of the number of fish contributed by each year-class to the fishery (tabulated below as millions of fish), the relative weakness of both the 1948 and 1949 year-classes is particularly striking (Fig. 3 (A)). As III-year fish, each supplied only a little over one-third of the contribution made by the immediately preceding year-classes.

Fishing Season	Age									
	I	II	III	IV	V	VI	VII	VIII	IX+	Total
1946–47	0.13	27.02	288.72	174.70	32.53	13.65	4.88	2.49	0.47	544.79
1947–48	0.13	10.03	240.18	114.60	35.16	8.76	2.24	1.10	0.56	412.76
1948–49	0.30	36.83	224.02	163.00	47.52	16.84	5.05	1.66	0.45	495.67
1949–50	0.13	14.89	233.67	69.68	17.86	2.69	0.65	0.20	0.00	339.77
1950–51	0.08	22.27	80.17	100.93	18.05	4.36	1.04	0.04	0.04	226.98
1951–52[1]	0.06	6.08	86.39	56.99	75.55	10.20	2.89	0.53	0.06	238.76

[1] The number of fish of each age in the catches of each individual west coast area will be supplied on request (Supplementary Table IV).

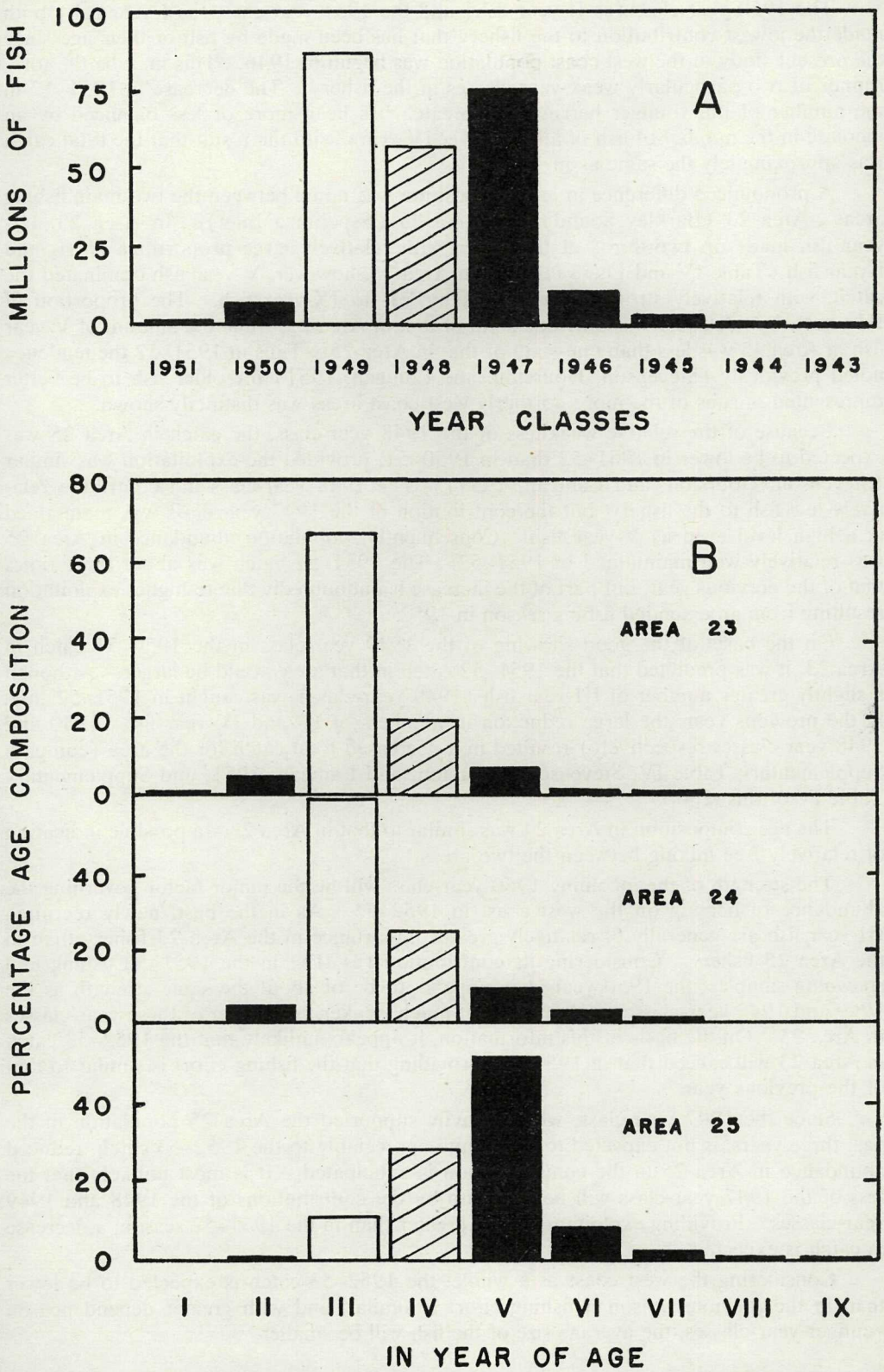

Fig. 3. Diagrams showing (A) the total number of herring in each year-class caught by the commercial fishery in 1951–52, and (B) the average age composition of samples from the commercial catches in Areas 23, 24, and 25.

The 1950 year-class (as II-year fish) and the 1951 year-class (as I-year fish) both made the lowest contribution to the fishery that has been made by fish of their age since the present study of the west coast population was begun in 1946. This may be the forerunner of two particularly weak year-classes in the fishery. The decrease in 1951–52 in the number of the younger herring in the catch has been more or less balanced by an increase in the number of fish of all ages over IV years, with the result that the total catch was approximately the same as in 1950–51.

A pronounced difference in age composition was noted between the two main fishing areas—Area 23 (Barkley Sound) and Area 25 (Esperanza Inlet). In Area 23, III-year fish made up two-thirds of the catch, with relatively large proportions of II- and I-year fish (Table IV and Fig. 3 (B)). In Area 25, however, V-year fish dominated the catch, with relatively strong contributions by VI- to IX-year fish. The proportion of III-year fish in Area 25 was only one-sixth of that in Area 23, while the amount of V-year fish in Area 23 was less than one-sixth of that in Area 25. Thus in 1951–52 the tendency noted previously (Stevenson, Hourston, and Lanigan, 1951) for older fish to be better represented in runs of the more northerly west coast areas was distinctly shown.

Because of the relative weakness of the 1948 year-class, the catch in Area 25 was expected to be lower in 1951–52 than in 1950–51, provided the exploitation was similar (Stevenson, Hourston, and Lanigan, 1951). The 1948 year-class did contribute relatively few fish to the fishery, but the contribution of the 1947 year-class was maintained at a high level even as V-year fish. Consequently, population abundance in Area 25 was relatively well maintained in 1951–52. The 1951–52 catch was about three times that of the previous year, but part of the increase is undoubtedly due to higher exploitation resulting from an extended fishing season in 1952.

On the basis of the good showing of the 1949 year-class in the 1950–51 catch in Area 23, it was predicted that the 1951–52 catch in that area would be larger. Although a slightly greater number of III-year fish (1949 year-class) was caught in 1951–52 than in the previous year, the large reduction in numbers of II- and IV-year fish (1950 and 1948 year-classes respectively) resulted in a decreased total catch for the area (compare Supplementary Table IV, Stevenson, Hourston, and Lanigan, 1951, and Supplementary Table IV of this report).

The age composition in Area 24 was similar to that in Area 23—a possible indication of relatively free mixing between the two areas.

The strength of the incoming 1950 year-class will be the major factor governing the abundance of herring on the west coast in 1952–53. As in the past, newly recruited III-year fish are generally of relatively greater importance in the Area 23 fishery than in the Area 25 fishery. Considering its contribution (as II's) in the 1951–52 fishing and spawning samples, the 1950 year-class appears to be of about the same strength as the 1949 and 1948 year-classes in Area 23, but much weaker than either of these year-classes in Area 25. On the basis of this information, it appears unlikely that the 1952–53 catch in Area 23 will exceed that in 1951–52, providing that the fishing effort is similar to that of the previous year.

Since the 1947 year-class, which heavily supported the Area 25 population in the past three years, is not expected to contribute appreciably to the 1952–53 catch, reduced abundance in Area 25 in the coming season is anticipated. It is most unlikely that the loss of the 1947 year-class will be made up by the contributions of the 1948 and 1949 year-classes. Providing exploitation is no greater than in the 1951–52 season, a decrease in catch is expected.

Considering the west coast as a whole, the 1952–53 catch is expected to be lower than in the previous season if fishing effort is similar, and with greater dependence on younger year-classes, the average size of the fish will be smaller.

Sex Ratio and Stage of Development

The sex ratio (number of females divided by number of males) and sexual development of the herring in samples taken from the 1951–52 commercial fishery and the 1952 spawning runs are given in Table V. The sex ratio for the sub-district was typical of the general trend noted in most recent years; namely, that males and females were about equally abundant in the commercial catch (with a slight tendency for the females to predominate), whereas the males were more numerous than females in the spawning runs. The difference in sex ratio between samples from the fishery and those from the spawning runs was attributed to the fact that the average age of fish in the spawning runs was less than that of the fishing schools (Table IV). It has been previously noted that the proportion of males to females is generally greater in samples of younger fish (Stevenson and Lanigan, 1950). In Area 25, where the spawning population was made up of relatively old fish, the females dominated, as they did in the commercial catch. The average age of the spawning fish decreased from Area 25 to Area 24 to Area 23 to Area 26, and with this decrease, the sex ratio diminished from 1.17 to 0.80 to 0.64 to 0.47. This phenomenon could be produced by generally slower maturity of females or higher mortality in males.

Immature fish were found in spawning runs for the second successive year. In 1951–52 they were found only in Area 23, where they made up 1.4 per cent of the catch. On the other hand, the percentage of immature fish in the commercial runs was the lowest (2.5 per cent) during the six years of the study. This situation could result from a later-than-usual inshore movement of the immature fish.

Spent fish were taken in the commercial catch in 1951–52 for the first time since 1946–47, but in very small numbers (less than 1 per cent). They were taken in Esperanza Inlet, where the date of closure for the fishery was extended for ten days after February 5th. Early spawnings were beginning when the fishery was closed, and consequently some of the fish could have either spawned before they were caught, or on the seine while being caught.

Average Length and Weight

Differences in average length and weight between two comparable populations are probably mainly due to differences in the environmental conditions (food-supply, temperature, etc.) which influence growth. Consequently, annual variations in the average size of fish from a given region may be used as indicators of changes in these environmental conditions. Average weights of the various age-groups are also used, in conjunction with percentage age composition, to calculate the number of fish of each age in the annual catch. The average lengths and weights of herring from the commercial catch in 1951–52 are given in Table VI for each age-group; comparable lengths for fish from the spawning runs are given in Table VII. Weights are not taken for the spawning fish mainly because of the variation in weight involved in spent and unspent fish.

The average lengths and weights of herring from the major age-groups in the fishery are given below:—

Year	In Year of Age				
	II	III	IV	V	VI
Length in millimetres—					
1946–47	166	187	203	213	222
1947–48	161	188	201	210	220
1948–49	159	188	201	213	222
1949–50	164	190	202	212	220
1950–51	158	188	204	215	220
1951–52	159	187	205	217	226
Weight in grams—					
1946–47	57	86	113	133	151
1947–48	53	90	110	129	150
1948–49	50	87	111	138	158
1949–50	56	94	117	137	152
1950–51	50	88	114	135	149
1951–52	53	90	114	139	157

Fish of IV years and over were longer in 1951–52 than in any other season during the current study and tended to be heavier. The younger fish were about average size. Since, as a whole, the west coast fish were larger than average in 1951–52, better than average feeding conditions during the 1951 growth season might be indicated. Variations in preceding seasons have been discussed previously (Stevenson, Hourston, and Lanigan, 1951).

There was no difference in the average weights of the two major west coast populations (Area 23 and Area 25), so their 1951 feeding conditions were presumed to be similar. However, the Area 25 fish might have had better environmental conditions during their earlier years, for they were consistently longer than those from Area 23. Area 24 fish resembled the herring from Area 23 both in size and weight.

The length differential between fish sampled from the fishery and those from the spawning runs, which was noted in 1950–51 (Stevenson, Hourston, and Lanigan, 1951), was not evident in the 1951–52 samples. Only relatively small differences were noted in the data for Area 23 and Area 25. Differences shown in Area 24 were greater than those in either Area 23 or Area 25, but since only one sample was taken from the Area 24 fishery and two from spawning runs, they may not represent any real dissimilarity between the growth of the spawning and fishing stocks.

EXTENT AND INTENSITY OF SPAWNING

For the sixth consecutive year, members of the herring-investigation staff surveyed the west coast of Vancouver Island spawning-grounds. The main purpose of this phase of the research is to estimate the amount of spawn (in statutory miles) deposited in this sub-district during successive years. This information is used to assess from year to year the relative abundance of the spawning stock, that portion of the population which escapes the preceding winter fishery. This information also provides basic data for early life-history studies. Methods used in this survey were similar to those of previous years (Tester and Stevenson, 1948). As in the past, the spawning-grounds in each area were independently surveyed by fisheries officers.

West coast spawnings in 1952* resembled the general spawning pattern of previous years (Stevenson and Lanigan, 1950; Stevenson, 1950; and Tester and Stevenson, 1947, 1948). The main spawning-grounds were:—

Area 23: Toquart Bay and Macoah Passage.

*A list of the individual spawning localities, with dates, intensity, and extent of spawn depositions, will be supplied on request (Supplementary Table V).

Area 24: Cypress Bay, Mosquito Harbour, Big Whitepine Cove, and Riley's Cove.

Area 25: Port Langford and Nuchatlitz Village vicinity.

Area 26: Gay Passage and Union Island.

Area 27: Leeson Harbour and Greenwood Point.

Early spawnings, in February, took place at Port Langford (Area 25), Macoah Passage and Useless Inlet (Area 23), Mosquito Harbour (Area 24), and Winter Harbour (Area 27). These were followed by general spawnings on customary grounds during March. Late spawnings, in April, occurred at Toquart Bay (Area 23), Kendrick Inlet (Area 25), and Leeson Harbour (Area 27).

The most striking features of the 1952 spawnings were:—

(1) The lack of spawning at Mayne Bay, Stopper Islands, and the Sunshine Bay region (Area 23).

(2) The small, deep, and very heavy spawn deposition recorded at Riley's Cove and in Millar Channel (Area 24) for the first time in the six-year period of the investigation.

(3) A large spawning at Nuchatlitz Village for the second consecutive year (Area 25).

(4) The complete lack of spawning in the Port Eliza-Queen Cove (Area 25) vicinity for the third successive year.

(5) A general decrease in the number of spawnings in Area 25.

(6) The absence of spawnings in Nasparti and Malksope Inlets (Area 26) for the first time, and the lack of spawnings in Ououkinsh Inlet (Area 26) for the second successive year.

The extent of spawn deposition on the west coast of Vancouver Island was less in 1952 than in any year since 1947, and about 35 per cent less than in 1951. The data for the 1951 and 1952 spawnings are tabulated below (in statutory miles) according to area:—

Area	Extent in Miles 1951	1952
23	8.8	6.2
24	11.4	5.6
25	28.3	21.4
26	1.5	1.4
27	4.9	1.1[1]
All areas	54.9	35.7

The decrease in spawning extent was reflected in all areas of the sub-district, except in Area 26, where the total extent was similar in each of the past two years. The reduction in the extent of spawn deposition in Area 24 was the greatest of any west coast area, the 1952 total amounting to only about half that of 1951. Small spawnings at Mosquito Harbour and Cypress Bay were responsible for the reduced spawn deposition in Area 24. The extent of spawning in Area 23 was the lowest in the past six years. This decrease resulted mainly from the absence of a spawning in Mayne Bay and from reduced spawnings in Useless Inlet and Toquart Bay. Spawnings in Area 25 were reduced in extent by about 25 per cent, but the recurrence of a large spawning (17.5 miles of spawn) in the vicinity of Nuchatlitz kept the spawning at a generally high level; for the second consecutive year this area comprised more than half of the total west coast spawning.

[1] Adverse weather conditions prevented surveys of spawnings in Klaskish and Klaskino Inlets. It is doubtful, therefore, that the actual decrease in Area 27 spawning was as great as that recorded.

The average spawning intensity on the west coast this year was slightly greater than that of the 1951 spawnings. A comparison of the average spawning intensity in 1951 and 1952 is summarized below:—

Area	Average Spawning Intensity 1951	1952
23	2.9	2.6
24	1.3	2.3
25	3.4	3.7
26	3.4	2.8
27	3.1	3.2
All areas	2.9	3.3

Average intensities of spawn deposition are calculated by weighting the various intensities of the individual spawnings—very light, light, medium, heavy, and very heavy—in the ratio of 1, 2, 3, 4, and 5 respectively, and by correcting for extent of the individual depositions.

The increase in average spawning intensity compensated in some measure for the great decrease in spawning extent, but, in spite of this, an actual decrease in the amount of spawn deposited on the west coast was considered to have occurred. The pronounced reduction in extent of spawning in Area 24 was largely balanced by a tremendous increase in spawning intensity. Also, the reduction in spawning extent in Area 25 was apparently offset, in part, by increased intensity of deposition. In Areas 23 and 26, however, the decrease in extent of spawn was accompanied by a decrease in intensity.

The decreased west coast spawning in 1952 appears to be a direct result of reduced population abundance, caused by entrance of the relatively weak 1948 and 1949 year-classes into the fishing stocks. There is no evidence that the 1952 spawn deposition is below that necessary to maintain the population. A spawning even smaller than that of 1952 produced the extremely abundant 1947 year-class (Tester and Stevenson, 1948).

Data on spawn deposition have shown that Area 23 stocks have decreased in the past three years, while the Area 25 fishing population has maintained a generally high level during this period, despite the decrease noted in 1952. The reduced Area 23 population is a consequence of the poorly recruited 1948 and 1949 year-classes, while the Area 25 stocks from the 1949–50 to the 1951–52 season were sustained by the abundant 1947 year-class. Light exploitation in Area 25 in 1949–50 and 1950–51 resulting from late inshore migration of the fish apparently assisted in maintaining the stocks of that area at a high level (Stevenson, Hourston, and Lanigan, 1951). Increased exploitation in the past season, resulting from a time extension of the fishery-closure date (from February 5th to February 15th), probably accounted for part of the spawn reduction in 1952, but low recruitment from the 1948 and 1949 year-classes undoubtedly had some effect on abundance of the Area 25 spawning stocks.

DISCUSSION

An analysis of the data accumulated in 1951–52 on catch statistics, age composition, and spawning deposition of the west coast of Vancouver Island population has been given in the foregoing sections of this report, as well as an analysis of the movement of herring between all major herring populations. The purpose of the present section is to assemble these results and discuss them in terms of the comparative management study being carried out on the west coast and lower east coast herring stocks.

For the first time since the present study began, there was a definite indication of a decrease in population abundance on the west coast. The slight increase in the west coast catch in 1951–52 over that of the previous year occurred in spite of a pronounced reduction in the abundance of the southerly west coast stocks (Area 23), and only because of a greater exploitation of the runs in the more northerly section of the sub-

district (Area 25). The increased exploitation in Area 25 was effected through a time extension of the fishery.

The extent of spawn deposition, an index of the size of the escapement from the fishery, reached the lowest level since 1947 for the west coast as a whole. In Area 23 the spawning extent was the smallest of the entire period of the present study. The extent of spawning in Area 25 in 1952 showed the first downward trend since before the present study was initiated. Although the decrease in the Area 25 spawning was probably largely a result of the high catch (which was double that of the two preceding seasons combined), it is known that larger catches (as, for instance, that of 1948–49) were followed by greatly increased extent of spawn deposition (Stevenson, 1950). This suggests that the Area 25 stocks, as well as those of Area 23, were not maintained at their former high level by recruitment in the past year.

Analysis of the relative contribution of various year-classes in the fishery provides a logical explanation of the reduced population abundance on the west coast. The 1951–52 catch contained an unusually high proportion of V-year fish (1947 year-class). This is the third consecutive season that the 1947 year-class comprised a considerable portion of the west coast catches (Stevenson, Hourston, and Lanigan, 1951), a fact that indicates not only the great strength of the year-class, but also the relatively poor recruitment of the 1948 and 1949 year-classes. The recruitment of the 1947 year-class in 1951–52, as V-year fish, would be expected to be considerably less than the recruitment of this year-class in either of the two previous seasons (at ages III and IV). Even so, the contribution of this year-class to the 1951–52 stocks was large in comparison to that of either the 1948 or 1949 year-class (IV- and III-year fish respectively), which were in their first and second years of major recruitment—striking evidence of the weakness of the latter two year-classes. Unfortunately, an estimate of the relative size of the west coast population in 1951–52 as compared to that in the previous season is not available because of the small number of tag-detector recoveries obtained from the 1951–52 west coast fishery.

When the age composition of the individual area fisheries on the west coast is considered, it is seen that the Area 23 fishery was mainly dependent upon the relatively poor 1949 year-class (III's), thereby resulting in greatly reduced population abundance. In Area 25, population abundance was maintained near to the level of the previous year, principally due to the large contribution of the 1947 year-class.

In contrast to the decrease in population abundance on the west coast, the lower east coast herring population showed an increase in abundance in 1951–52. Following the taking of the fixed catch quota of 40,000 tons, a record high spawn deposition occurred, exceeding by 56 per cent the spawning extent of the previous year. Heavy recruitment of the 1949 year-class (III-year fish) and an appreciable contribution from the 1948 year-class (IV-year fish) appear to have been largely responsible for the increased abundance. The 1947 year-class, which was prominent in the more northerly west coast fishery, was of only minor importance in the lower east coast stocks. In view of the evidence indicating increased abundance of lower east coast stocks, the significant reduction in catch per unit of effort (110.7 tons per seine per day in 1950–51 against 66.9 tons per seine per day in 1951–52) is difficult to explain. Possibly the availability of the fish to the fishing fleet was influenced by the extremely late commencement of the fishery (November 15th), the interruption of the fishery by transference of seining-vessels to more productive fishing-grounds, or by a later-than-usual inshore movement of the fishing runs.

By the end of the fifth year of the comparative study of these two populations, it was noted that abundance had remained generally high during the five-year period, both in the population with quota restrictions on catch and in the population on which no catch restriction by quota was imposed (Stevenson, Hourston, and Lanigan, 1951). Although it appeared that natural limitations on catch in Area 25 had assisted in main-

taining population abundance on the west coast, the results of the study could be interpreted as indicating that the fixed quota on the lower east coast had not aided in stabilizing population abundance. In the light of results of the sixth year's investigation, what conclusions can be drawn? Is the decrease in west coast abundance directly attributable to fishing without quota limitation or is the decrease a result of reduced recruitment occurring through the operation of factors other than fishing?

In the following tabulation, catch and extent of spawn deposition in the two sub-districts are shown for the first three years of the present study:—

Sub-district	Catch, 1946–47	Spawn Deposition, 1947	Catch, 1947–48	Spawn Deposition, 1948	Catch, 1948–49	Spawn Deposition, 1949
	Tons	Miles	Tons	Miles	Tons	Miles
West coast of Vancouver Island	59,000	32.5	45,200	44.0	55,900	41.1
Lower east coast of Vancouver Island	36,500[1]	9.9	39,900	17.4	40,100	20.9

[1] Because of a change in sub-district boundary, the entire quota allotment was not taken within the present lower east coast boundaries in 1946–47.

The 1947, 1948, and 1949 year-classes on the lower east coast have proven to be above the average strength of year-classes of the past fifteen years. The amounts of spawn deposition from which they were derived was indicative of their order of strength (the 1949 year-class being the strongest and the 1947 year-class the weakest), but not of the absolute amount of their recruitment.

On the other hand, the amount of spawn deposited on the west coast has given no indication of the resultant year-class strength. The 1947 year-class, derived from the smallest spawning, has been one of the most productive year-classes of recent years, whereas the 1948 and 1949 year-classes, originating from somewhat greater spawnings, were amongst the least productive. Restriction of the record west coast catches of the 1946–47 to 1948–49 period by fixed quota would have tended to increase the unusually large spawnings of that period. Because of the lack of direct connection between spawn deposition and year-class strength, it appears unlikely that still greater spawnings than those which occurred from 1947 to 1949 would have given rise to more productive year-classes and to increased west coast population abundance in 1951–52.

From spawning and catch data a rough indication of the survival from spawn to maturity can be obtained in each of the two populations. The average west coast spawn deposition of 39.2 miles for the 1947 to 1949 period was followed by an average catch of 30,800 tons from 1949–50 to 1951–52, the seasons in which the catch was largely comprised of fish originating from the 1947 to 1949 spawnings. Comparable figures for the lower east coast show that an average of 16.1 miles of spawn preceded an average catch of 40,800 tons. The striking difference in spawn survival in the two populations suggests a basic difference in the conditions which influence survival in the two stocks. Recently, data were obtained which indicated that poor year-classes on the west coast were formed when certain current conditions off the west coast of Vancouver Island existed during the presumably critical period of larval life in the herring life-history (Stevenson, 1950). If such conditions are not present, at least to the same extent, in the waters of the Gulf of Georgia, higher survival of lower east coast spawn would be expected, and large fluctuations in year-class strength and population abundance, such as are found on the west coast, would not occur.

If it is assumed that such a fundamental difference exists in the two populations under investigation, a comparative study may not be strictly possible. The rough correlation that was previously suggested between spawn deposition and year-class strength on the lower east coast may signify that the spawning stock is being kept close to the critical minimum, below which a close relationship between spawning and resultant year-class strength would be anticipated (Tester and Stevenson, 1947). If this is so,

removal of catch restrictions on the lower east coast may endanger the spawning population. On the other hand, in view of the great fluctuation in survival of west coast spawn, and the natural limitations on catch imposed by late inshore migration, as noted in 1949–50 and 1950–51 (Stevenson, Hourston, and Lanigan, 1951), restriction of catch by fixed quota may serve no useful purpose in maintaining west coast abundance. Investigations being carried out on early life-history phases should shed light on these possibilities.

Continuance of the study is expected to provide results on the effect of non-quota fishing on the diminished west coast population. In previous reports, the necessity of carrying out the present investigation during a period of generally low recruitment was pointed out. Little is known at present on the role that natural limitations to catch will play on the exploitation of the stocks under such condition of abundance. Present indications of the west coast recruitment which will take place in the coming year suggest that population abundance will remain relatively low on the west coast in 1952–53.

SUMMARY

This is the sixth in a series of annual reports on the comparative study of changes occurring in two major herring populations, one of which (that of the west coast of Vancouver Island) is not subjected to quota restrictions on catch, while the other (that of the lower east coast of Vancouver Island) is held to an annual fixed quota of 40,000 tons.

The west coast fishery in 1951–52 (30,000 tons) produced the second smallest catch of the six-year period. Average catch per unit of effort was almost as high as in the years of greatest catch, a result considered to be due to exceptionally efficient fleet deployment rather than great population abundance. Extent of spawn deposition on the west coast in 1952 suggested that the amount of fish that escaped the fishery was less than in any year since 1947. Thus it appeared that population abundance was considerably reduced from that of 1950–51. Spawning data indicated that the main southern west coast stocks (Area 23) suffered relatively greater reduction than the more northerly west coast runs (Area 25). More intensive exploitation of the Area 25 runs occurred in 1951–52 than in the two previous years, principally because of the ten-day extension of fishing past the regular closure date of February 5th.

The decrease in population abundance on the west coast was considered to be largely a result of the recent entrance of two year-classes of generally low production (1948 and 1949 year-classes). These year-classes (as III- and IV-year fish) were the main contributors to the Area 23 fishery. The 1947 year-class, which supplied the main bulk of the 1949–50 and 1950–51 west coast fisheries, was still abundant in the Area 25 stocks as V-year fish in 1951–52 and, as a result, prevented a decrease in population abundance of the magnitude of that which occurred in Area 23.

In contrast to the decrease in west coast abundance, population abundance on the lower coast of Vancouver Island showed a substantial increase in 1951–52. The spawning population, as evidenced from extent of spawn records, showed a phenomenal increase over that of the previous year (56 per cent). The 1947 year-class was of negligible importance on the lower east coast in 1951–52, but the 1949 year-class (as III's) was recruited in large numbers and the 1948 year-class (IV's) made an appreciable contribution to the stocks.

The present difference in the abundance of the two populations under investigation is not considered to be a result of the effect of quota restrictions on the lower east coast fishery. The difference is obviously a direct consequence of dissimilarity in the recruitment of the individual year-classes to the two populations. In recent years the year-classes entering the lower east coast stocks have been generally more uniformly productive than those recruited to the west coast population. There is a strong suggestion from

early life-history studies that oceanographic conditions on the west coast may tend to cause greater variation in year-class strength than conditions on the lower east coast of Vancouver Island. This indication of a fundamental difference between the two populations is strengthened by data which show a major difference in the rates of survival between spawning and recruitment. In view of this apparently fundamental difference, the present comparative study may be considerably complicated. It appears possible that quota restrictions may serve a useful purpose when applied to the lower east coast population but not when applied to the west coast fishery. Further investigation is required before results can be conclusive.

Analysis of tag returns showed a pronounced " homing " in all major populations, as noted in previous years. Tag-recovery data suggested that smaller than usual quantities of fish emigrated from and immigrated to the west coast in 1951–52. Tag-detector returns showed a general southerly migration pattern over the British Columbia coast.

ACKNOWLEDGMENTS

The herring investigation is sincerely appreciative of the various types of assistance provided during the 1951–52 season by fishing companies, herring fishermen, and government fisheries departments.

Special thanks are extended to the fishing companies for the continuance of their support to herring research, without which the present intensive investigation of the herring-fisheries could not be maintained. British Columbia Packers Limited loaned the *Bessie Mac* for general contact work during the fishing season and for tagging in the spring of 1952, permitted installation of tag-detectors at their Steveston (Imperial) and Prince Rupert (Seal Cove) plants, and provided facilities for sampling the catches. The Canadian Fishing Company, Limited, loaned the *Pacific Queen* for tagging work, and made space available at their Steveston (Gulf of Georgia) plant for tag-detection and sampling. A third tagging-vessel (the *B.C. Pride*) was loaned by Nelson Brothers Fisheries, Limited. Anglo-British Columbia Packing Company provided scout-boats and other equipment which were used in connection with the tagging survey. Acknowledgment must also be given to the staff members of various plants for their valuable work in collecting herring samples from the plant landings. In addition to the foregoing assistance, the interest shown by the companies and their plant managers and staffs in herring research was greatly appreciated.

The captains of most seiners of the fishing fleet again provided various statistics on catch through filling out and submitting pilot-house records. The sincere efforts and goodwill of the captains and crews of the tagging vessels constituted an important factor in the successful completion of the large 1952 tagging programme. For this assistance and for the general concern of all herring fishermen in herring research, the herring investigation is truly thankful.

The herring investigation is also grateful for the considerable assistance rendered by the Federal Department of Fisheries through the Chief Supervisor, A. J. Whitmore, and the regional supervisors in Nanaimo and Prince Rupert. Final catch records of all fishing areas were provided, and tentative catch totals were made available during the progress of each fishery. In addition, surveys of the extent and intensity of herring-spawning in all coastal areas were again undertaken. In consideration of the tremendous amount of effort required to carry out these surveys, special thanks are extended to the fisheries officers who participated.

The interest of the Provincial Department of Fisheries and its Deputy Minister, G. J. Alexander, in continuing the publication of this series of reports is gratefully acknowledged. The present annual report is the sixteenth of the series.

The conscientious endeavours of the staff members of the herring investigation were sincerely appreciated during the past year. A. S. Hourston, assistant scientist, undertook

the analysis of the sampling data included in this report, and, in addition, he was responsible for the studies carried out on juvenile herring and for a special study of the herring of the northern sub-district. The compilation and analysis of the tagging data were the chief responsibility of K. J. Jackson, junior scientist. D. N. Outram, junior scientist, undertook the supervision of the spawning studies, which included those reported here and others concerned with spawn mortality.

The administrative assistant of the investigation, G. T. Taylor, assumed chief responsibility for the compilation and analysis of the catch statistics of all herring-fisheries, and gave considerable assistance in the assembling of the various sections of this report.

R. S. Isaacson and M. Bakich, laboratory technicians, were responsible for making age determinations on all fish sampled in the various fisheries and spawning runs, and for making preliminary analysis of sampling data from all populations except that of the west coast. The former staff member also supervised the compilation of the age and growth data, and the latter undertook studies on structure and types of scales.

Most staff members at one time or another assisted in the field work connected with sampling, tag-recovery, spawn studies, and juvenile studies. A. G. Paul, senior field technician, undertook major responsibilities in the tagging and tag-recovery programmes and in the maintenance of non-electrical equipment. J. H. Larkman, field technician, serviced and overhauled tag-detectors and other electrical equipment, and also carried out various other duties connected with tag-recovery and tagging. Other members of the technical staff, B. Wildman, K. A. Herlinveaux, J. A. Saker, R. D. Thicke, J. A. Bond, J. S. Rees, and E. W. Stolzenberg, assisted in field programmes and in preliminary analysis of field data. Stenographic and clerical duties were efficiently carried out by Miss Alice Nyquist and Miss Mary Cairns.

The senior author assumes responsibility for the general interpretation of the results of the 1951–52 studies which are presented in this report.

The counsel and encouragement offered by Dr. J. L. Hart, Director of the Pacific Biological Station, during the past year is acknowledged with sincere thanks.

REFERENCES

HART, J. L., and TESTER, A. L. (1940): The tagging of herring (*Clupea pallasii*) in British Columbia: insertions and recoveries during 1939–40. Rept. British Columbia Fish. Dept., 1939, pp. 42–66.

STEVENSON, J. C. (1950): Results of the west coast of Vancouver Island herring investigation, 1948–49. Rept. British Columbia Fish. Dept., 1948, pp. 37–85.

STEVENSON, J. C., and LANIGAN, J. A. (1950):* Results of the west coast of Vancouver Island herring investigation, 1949–50. Rept. British Columbia Fish. Dept., 1949, pp. 41–80.

STEVENSON, J. C.; HOURSTON, A. S.; and LANIGAN, J. A. (1951):* Results of the west coast of Vancouver Island herring investigation, 1950–51. Rept. British Columbia Fish. Dept., 1950, pp. 51–84.

TESTER, A. L. (1945): Tagging of herring (*Clupea pallasii*) in British Columbia: insertions and recoveries during 1944–45. Rept. British Columbia Fish. Dept., 1944, pp. 45–63.

——— (1946): Tagging of herring (*Clupea pallasii*) in British Columbia: insertions and recoveries during 1945–46. Rept. British Columbia Fish. Dept., 1945, pp. 43–66.

TESTER, A. L., and STEVENSON, J. C. (1947): Results of the west coast of Vancouver Island herring investigation, 1946–47. Rept. British Columbia Fish. Dept., 1946, pp. 42–71.

——— ——— (1948):* Results of the west coast of Vancouver Island herring investigation, 1947–48. Rept. British Columbia Fish. Dept., 1947, pp. 41–86.

* Reprints were published in year following the date of publication of report.

TABLES

Table I.—Catch (Tons), Fishing Effort (Total Number of Active Fishing-days Expended by All Seine-boats), and Catch per Unit of Effort (Average Catch per Seine per Day's Active Fishing) for West Coast Areas during the 1951–52 Fishing Season.

Area	Estimated Catch	Fishing Effort[1]	Catch per Unit of Effort
23	11,200	158.0	70.9
24	660	18.0	35.6
25	18,100	211.0	85.9
26	40	0.5	80.0
27	-------	3.0	-----
Totals	30,000	395.5	75.8

[1] The total number of active fishing-days is calculated to the nearest whole number from catch per unit of effort based on incomplete data and from estimated catch.

Table II.—Probable Number of Tags in the Catches during the 1951–52 Season, Based on Detector Returns, with Actual Number of Recoveries Shown in Parentheses[1]

Tagging Area	Tagging Code and Year	Area of Recovery										Total
		5	6	7	12	13	17A	17B	18	23	25	
4	15T (1951)	323 (23)										323 (23)
	15U (1951)	208 (14)							7 (2)	32 (1)		247 (17)
5	14CC (1950)	88 (6)										88 (6)
6	14AA (1950)		126 (1)									126 (1)
	14BB (1950)	14 (1)	251 (2)									265 (3)
	15V (1951)	28 (2)	754 (6)									782 (8)
	15W (1951)	56 (4)	126 (1)									182 (5)
7	14HH (1950)			140 (2)								140 (2)
	15X (1951)			155 (3)								155 (3)
	15AA (1951)			538 (9)								538 (9)
	15BB (1951)			401 (6)								401 (6)
10	15CC (1951)			140 (2)		13 (3)						153 (5)
12	10H (1946)				3 (1)							3 (1)
14	14A (1950)					13 (3)						13 (3)
15	13A (1949)					4 (1)						4 (1)
	14B (1950)						5 (1)					5 (1)
	14C (1950)					20 (4)		26 (1)				46 (5)
	15A (1951)					23 (5)	5 (1)					28 (6)
	15B (1951)					48 (11)	6 (1)		4 (1)			58 (13)
17A	11D (1947)					4 (1)						4 (1)
	14D (1950)					5 (1)			4 (1)			9 (2)
	14E (1950)								10 (2)			10 (2)
	15C (1951)					18 (4)	6 (1)		22 (6)			46 (11)
	15D (1951)						5 (1)	26 (1)	17 (4)			48 (6)
17B	14G (1950)								8 (2)			8 (2)
	14H (1950)								12 (3)			12 (3)
	15E (1951)								22 (6)			22 (6)
18	10A (1946)								4 (1)			4 (1)
	13F (1949)						5 (1)		4 (1)			9 (2)
	15F (1951)						13 (2)		129 (32)			142 (34)
	15G (1951)						6 (1)		29 (8)			35 (9)
20	15DD (1951)						24 (4)		39 (9)			63 (13)
	15EE (1951)						19 (3)	26 (1)	11 (3)			56 (7)
23	13H (1949)									32 (1)		32 (1)
	14L (1950)					4 (1)						4 (1)
	14M (1950)									32 (1)		32 (1)
	15H (1951)									96 (3)		96 (3)
24	15M (1951)								5 (1)			5 (1)
	15N (1951)									32 (1)		32 (1)
25	13M (1949)			70 (1)								70 (1)
	15Q (1951)								4 (1)	32 (1)		36 (2)
	15R (1951)								5 (1)			5 (1)
	15S (1951)										102 (1)	102 (1)
26	14V (1950)										307 (3)	307 (3)
	14W (1950)										307 (3)	307 (3)
27	14X (1950)										102 (1)	102 (1)
	Totals	717 (50)	1,257 (10)	1,444 (23)	3 (1)	152 (34)	94 (16)	78 (3)	336 (84)	256 (8)	818 (8)	5,155 (237)

[1] Nine tags recovered at Seal Cove are not included in table. Seven Area 6 tags (one 14AA, one 14BB, and five 15V) and one Area 7 tag (15AA) were recovered from Area 6; one Area 10 tag (14EE) was recovered from Area 7.

Table III.—Number of Tags Recovered by Plant Crews, According to Area of Tagging and Probable Sub-district of Recovery, for the 1951–52 Fishing Season

Tagging Area	Tagging Code	Probable Sub-district of Recovery							Total
		Northern	Central	Upper East Coast	Middle East Coast	Lower East Coast	West Coast	?	
4	15T (1951)	219	16	.....	.....	.....	1	19	255
	15U (1951)	136	4	.....	.....	.....	.....	21	161
5	9P (1945)	1	.....	.....	.....	.....	.....	.....	1
	9Q (1945)	.....	1	.....	.....	.....	.....	.....	1
	14CC (1950)	26	3	.....	.....	.....	.....	4	33
6	9N (1945)	1	.....	.....	.....	.....	.....	.....	1
	14AA (1950)	8	94	.....	.....	.....	1	2	105
	14BB (1950)	19	180	.....	.....	.....	.....	11	210
	14DD (1950)	7	50	.....	.....	.....	.....	7	64
	15V (1951)	28	572	.....	.....	.....	1	207	808
	15W (1951)	38	209	.....	.....	.....	2	13	262
7	8M (1944)	.....	.....	.....	.....	.....	.....	1	1
	9M (1945)	.....	1	.....	.....	.....	.....	1	2
	14HH (1950)	2	51	.....	.....	.....	.....	1	54
	14KK (1950)	2	91	.....	1	.....	.....	10	104
	15X (1951)	3	220	.....	1	.....	.....	32	256
	15AA (1951)	3	346	1	.....	.....	2	121	473
	15BB (1951)	.....	272	.....	.....	.....	.....	9	281
10	9K (1945)	.....	2	.....	.....	.....	.....	.....	2
	14EE (1950)	.....	11	.....	.....	.....	.....	1	12
	15CC (1951)	1	44	2	3	.....	2	9	61
12	9G (1945)	.....	.....	.....	.....	.....	1	.....	1
	9H (1945)	.....	.....	.....	.....	.....	.....	1	1
	9J (1945)	.....	.....	1	.....	.....	.....	.....	1
	10H (1946)	.....	.....	3	.....	.....	.....	.....	3
15	13A (1949)	.....	.....	.....	5	1	.....	.....	6
	14B (1950)	.....	.....	.....	9	.....	.....	4	13
	14C (1950)	1	1	1	9	.....	.....	5	17
	15A (1951)	.....	.....	1	15	2	.....	4	22
	15B (1951)	.....	1	.....	39	3	.....	12	55
17A	9C (1945)	.....	.....	.....	.....	.....	1	.....	1
	13C (1949)	.....	.....	.....	.....	1	1	.....	2
	14A (1950)	.....	1	.....	3	.....	.....	1	5
	14D (1950)	.....	.....	.....	.....	1	.....	.....	1
	14E (1950)	.....	.....	.....	.....	4	1	.....	5
	14F (1950)	.....	.....	.....	.....	1	.....	.....	1
	15C (1951)	.....	.....	.....	1	27	.....	7	35
	15D (1951)	.....	.....	.....	.....	11	.....	3	14
	15L (1951)	.....	.....	.....	.....	.....	.....	1	1
17B	9B (1945)	.....	.....	.....	.....	.....	1	.....	1
	14G (1950)	.....	.....	.....	.....	5	1	.....	6
	14H (1950)	.....	.....	.....	.....	8	.....	6	14
	15E (1951)	.....	.....	.....	.....	7	2	1	10
18	13E (1949)	.....	.....	.....	.....	3	1	1	5
	13F (1949)	.....	.....	.....	.....	5	1	1	7
	15F (1951)	.....	.....	.....	2	42	1	9	54
	15G (1951)	.....	.....	.....	1	17	1	1	20
20	15DD (1951)	.....	.....	.....	.....	20	.....	4	24
	15EE (1951)	.....	.....	.....	.....	10	2	.....	12
23	11F (1947)	.....	.....	.....	.....	.....	.....	1	1
	11H (1947)	.....	.....	.....	.....	.....	2	.....	2
	11J (1947)	.....	.....	.....	.....	.....	1	.....	1
	11K (1947)	.....	.....	.....	.....	.....	3	.....	3
	11M (1947)	.....	.....	.....	.....	.....	2	.....	2
	12G (1948)	.....	.....	.....	.....	.....	1	.....	1
	12H (1948)	.....	.....	.....	.....	.....	1	.....	1
	12I (1948)	.....	.....	.....	.....	.....	2	.....	2
	12J (1948)	.....	.....	.....	.....	.....	3	.....	3

Table III.—Number of Tags Recovered by Plant Crews, According to Area of Tagging and Probable Sub-district of Recovery, for the 1951–52 Fishing Season—Continued

Tagging Area	Tagging Code	Probable Sub-district of Recovery							Total
		Northern	Central	Upper East Coast	Middle East Coast	Lower East Coast	West Coast	?	
23	12K (1948)	------	------	------	------	------	3	------	3
	13G (1949)	------	------	------	------	------	3	------	3
	13H (1949)	------	------	------	------	------	11	1	12
	13I (1949)	------	------	------	------	------	9	------	9
	14I (1950)	------	------	------	------	------	9	2	11
	14K (1950)	------	------	------	------	------	4	------	4
	14L (1950)	------	------	------	------	------	14	------	14
	14M (1950)	------	------	------	------	------	6	2	8
	15H (1951)	------	------	------	------	------	59	1	60
	15K (1951)	------	------	------	------	------	5	------	5
	15L (1951)	------	------	------	------	------	------	1	1
24	11P (1947)	------	------	------	------	------	1	------	1
	12L (1948)	------	------	------	------	------	2	------	2
	12M (1948)	------	------	------	------	------	8	1	9
	13K (1949)	------	------	------	------	------	4	------	4
	13L (1949)	------	1	------	------	------	16	------	17
	14N (1950)	------	------	------	------	------	10	1	11
	15M (1951)	------	------	------	------	------	10	1	11
	15N (1951)	------	------	------	------	------	45	2	47
25	10P (1946)	------	------	------	------	------	1	------	1
	11F (1947)	------	------	------	------	------	1	------	1
	11R (1947)	------	------	------	------	------	1	1	2
	11W (1947)	------	------	------	------	------	6	------	6
	11X (1947)	------	------	------	------	------	1	------	1
	12N (1948)	------	------	------	------	------	5	------	5
	12Q (1948)	------	------	------	------	------	6	------	6
	12R (1948)	------	------	------	------	------	2	------	2
	12S (1948)	------	------	------	------	------	6	1	7
	13M (1949)	------	------	------	------	------	21	------	21
	13P (1949)	------	------	------	------	------	5	------	5
	13Q (1949)	------	------	------	------	------	8	------	8
	13R (1949)	------	------	------	------	------	7	1	8
	13S (1949)	1	------	------	------	------	39	------	40
	14P (1950)	------	------	------	------	------	1	------	1
	14Q (1950)	------	------	------	------	------	23	------	23
	14R (1950)	1	------	------	------	------	7	1	9
	14S (1950)	1	------	------	------	------	7	1	9
	14T (1950)	------	------	------	------	------	45	1	46
	14U (1950)	------	------	------	------	------	22	2	24
	15P (1951)	------	------	------	------	------	43	6	49
	15Q (1951)	------	------	------	------	------	89	5	94
	15R (1951)	------	------	------	------	------	52	2	54
	15S (1951)	------	------	------	------	------	77	3	80
26	10Q (1946)	------	------	------	------	------	1	------	1
	12T (1948)	------	------	------	------	------	11	1	12
	12U (1948)	------	1	------	------	------	1	1	3
	14V (1950)	1	------	------	------	------	101	9	111
	14W (1950)	1	------	------	------	------	86	10	97
27	12W (1948)	------	------	------	------	------	2	------	2
	12X (1948)	------	------	------	------	------	9	1	10
	14X (1950)	------	7	------	------	------	28	7	42
	Totals	500	2,179	9	89	168	971	596	4,512

Table IV.—Average Percentage Age Composition of Samples from Commercial Catches and from Spawning Runs during the 1951–52 Season

COMMERCIAL CATCHES

Area	Number of Samples	In Year of Age								
		I	II	III	IV	V	VI	VII	VIII	IX
23	16	0.06	5.29	66.06	19.83	7.88	0.75	0.13	.....	.....
24	1	.....	4.00	60.00	24.00	9.00	2.00	1.00	.....	.....
25	37	.....	0.19	10.11	27.23	52.54	7.32	2.12	0.42	0.05
All	54	0.03	2.55	36.18	23.87	31.64	4.27	1.21	0.22	0.03
SPAWNING RUNS										
23	5	.....	16.48	70.20	9.60	2.27	1.02	0.42	.....	.....
24	2	.....	9.91	63.97	18.27	5.74	1.58	0.52	.....	.....
25	1	.....	2.06	27.84	21.65	39.18	4.12	5.15	.....	.....
26	1	.....	28.42	57.89	9.47	4.21	.....	.....	.....	.....
All	9	.....	14.74	62.74	12.85	7.36	1.38	0.92	.....	.....

Table V.—Average Sex Ratio (Females—Males) and Stage of Development for Samples of Commercial Catches and Spawning Runs during the 1951–52 Season

COMMERCIAL CATCHES

Area	Sex Ratio	Percentage		
		Immature	Mature, Unspent	Mature, Spent
23	1.10	7.6	92.4	.....
24	0.47	4.0	96.0	.....
25	1.02	.....	99.3	0.7
All	1.03	2.5	97.0	0.5
SPAWNING RUNS				
23	0.64	1.4	44.8	53.8
24	0.80	.....	85.5	14.5
25	1.17	.....	72.0	28.0
26	0.47	.....	100.0	.....
All	0.70	0.8	51.9	47.3

Table VI.—Average Length (Millimetres) and Average Weight (Grams) for Each Age in Samples from Commercial Catches, with Numbers of Fish on Which Averages Are Based in Parentheses.

AVERAGE LENGTH

In Year of Age	Area 23	Area 24	Area 25	All Areas
I	(1) 131.0	.....	.....	(1) 131.0
II	(84) 158.5	(4) 156.8	(7) 167.1	(95) 159.1
III	(1,047) 186.3	(60) 184.2	(329) 191.2	(1,436) 187.3
IV	(315) 198.4	(24) 198.5	(891) 207.4	(1,230) 204.9
V	(125) 212.7	(9) 205.6	(1,693) 217.5	(1,827) 217.1
VI	(12) 221.1	(2) 221.5	(230) 226.0	(244) 225.7
VII	(2) 220.0	(1) 237.0	(70) 231.8	(73) 231.6
VIII	.....	.....	(15) 236.5	(15) 236.5
IX	.....	.....	(2) 240.0	(2) 240.0
?	(14) 192.5	.....	(76) 216.4	(90) 212.7

AVERAGE WEIGHT

I	(1) 30.0	.....	.....	(1) 30.0
II	(84) 52.6	(4) 51.2	(7) 57.0	(95) 52.9
III	(1,047) 89.6	(60) 89.5	(255) 89.5	(1,362) 89.6
IV	(315) 108.7	(24) 109.3	(683) 117.1	(1,022) 114.4
V	(125) 139.3	(9) 132.0	(1,251) 138.5	(1,385) 138.5
VI	(12) 161.3	(2) 150.0	(168) 156.5	(182) 156.7
VII	(2) 161.0	(1) 188.0	(50) 169.7	(53) 169.7
VIII	.....	.....	(14) 179.5	(14) 179.5
IX	.....	.....	(2) 190.0	(2) 190.0
?	(14) 94.1	.....	(60) 131.7	(74) 124.6

Table VII.—Average Length (Millimetres) in Samples from Spawning Runs, with Numbers of Fish on Which Averages Are Based Indicated in Parentheses

In Year of Age	Area 23	Area 24	Area 25	Area 26	All Areas
II	(77) 166.1	(19) 161.4	(2) 171.5	(27) 166.6	(125) 165.6
III	(332) 186.0	(123) 187.8	(27) 187.8	(55) 190.8	(537) 187.0
IV	(46) 201.4	(35) 202.9	(21) 207.7	(9) 204.2	(111) 203.3
V	(11) 215.4	(11) 216.3	(38) 220.0	(4) 218.7	(64) 218.5
VI	(5) 222.2	(3) 214.7	(4) 228.3	.....	(12) 222.3
VII	(2) 229.5	(1) 230.0	(5) 231.4	.....	(8) 230.8
?	(27) 181.0	(8) 194.1	(3) 210.3	(5) 193.0	(43) 186.9

THE LARVA OF *BANKIA SETACEA* TRYON

By D. B. Quayle, Provincial Shell-fish Laboratory, Ladysmith, B.C.

The larvæ of several species of Teredinidæ have been described by various authors who are listed by Jørgensen (1946). Later Sullivan (1948) described the larva of *Teredo navalis* L. The larva of *Bankia setacea,* although well known to a number of workers, has not been figured, and because of the present interest in this species in British Columbia, the description is given here.

Details of the methods of identification of lamellibranch larvæ are given by Werner (1939) and by Rees (1950).

As far as is known, *Bankia setacea* is the only species of the Teredinidæ found in British Columbia waters. Its range on the Pacific Coast, as given by Keen (1937), is between 23° and 61° north latitude.

Bankia setacea has a planktotrophic larva with a long pelagic life, and while the length of the free-swimming period is not definitely known, limited data on the occurrence of the size-groups in successive plankton samples indicates a duration of about four weeks at the temperature of 12° to 15° C. in Ladysmith Harbour. The extent to which the normal pelagic life may be prolonged, if at all, by the lack of suitable settlement area is also not known, but a number of larger than normal larvæ have been found in plankton samples, although none of these had developed dissoconch.

As with most lamellibranch species, the straight hinge or veliger stage of the larva of *Bankia setacea* is distinguished only with difficulty. Very early, however, the characteristic dark rim forms around the outer edge of the shell (Fig. 1). The length of Prod. I (the first prodissoconch of Werner, 1939) varies between 100 μ and 130 μ. Soon after the umbones begin to protrude and at the same time a clearly defined line appears inside of and parallel to the edge of each of the valves (Fig. 2). This line persists throughout the larval life, and although it occurs in other larvæ, it is very pronounced in *Bankia setacea.* The significance of the line is not known, but it appears to mark the inner edge of the mantle musculature. At a length of about 200 μ the larva is spherical in shape and the internal organs have become more readily visible, although at no time are the anatomical details clear because of the thickness of the valves, which by now have acquired a definite yellow colour. The foot is well developed and the otocyst and two gill filaments are present. The digestive gland appears as a compact mass of globules.

The well-developed provinculum conforms to Rees's (1950) Type *b* for the Adesmacea, with two strong teeth on the left valve and three on the right (Figs. 7 and 8). The ligament has not been observed.

At setting size the veliconcha is broader than long, yellowish-green in colour, and nearly opaque with highly vaulted valves. The small nipple-like umbones are centrally placed, and the larva has become so thick through it can no longer lie flat on its side. The surface of the larva is sculptured with strongly but not sharply delineated concentric markings. Measurements of the prodissoconch (Prod. II) of newly settled spat averaged 245 μ long, 256 μ broad, and 200 μ thick.

Fig. 6 shows the first cutting-teth on the anterior edge of the left valve of a spat taken from a test-block exposed for forty-eight hours. The teeth are fourteen in number, and the largest are 14 μ in length. The development of the apophyses has proceeded rapidly, and the growth of the ventral articular connection has caused the valves to gape markedly at both ends.

The only larvæ that might be confused with *Bankia setacea* are those of the Pholadidæ. However, both the hinge-teeth and the valve outlines differ slightly.

VERTICAL DISTRIBUTION OF THE LARVÆ

In 1951 a regular weekly series of pumped plankton samples was taken from three levels at a single station in Ladysmith Harbour where the depth at mean low water is 20 feet (6.1 m.). The larvæ of *Bankia setacea* were counted, and 4 per cent of the total number taken during the year were found in the samples from the 3-foot (0.91-m.) level, 32 per cent were found in the 10-foot (3.05-m.) samples, and 64 per cent in the 20-foot (6.1-m.) samples. Johnson and Miller (1935), Black and Elsey (1948), and Neave (unpublished), using test-blocks, found the heaviest attack on the blocks at the lowest levels.

Fig. 1.

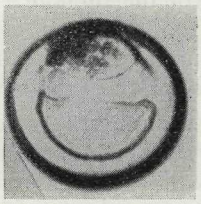

Fig. 2.

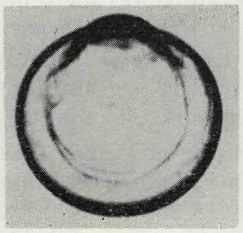

Fig. 3.

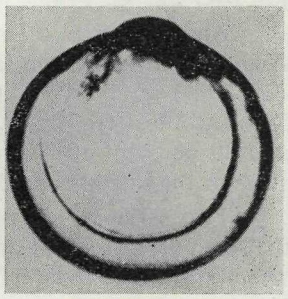

Fig. 4.

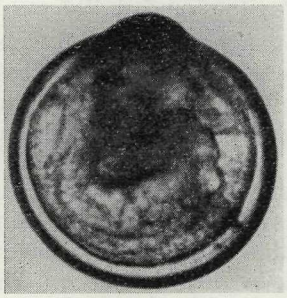

Fig. 5.

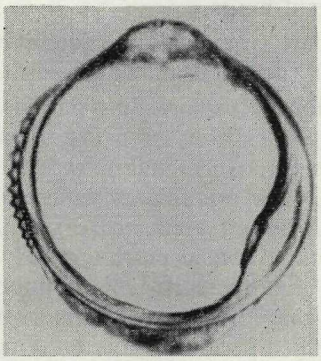

Fig. 6.

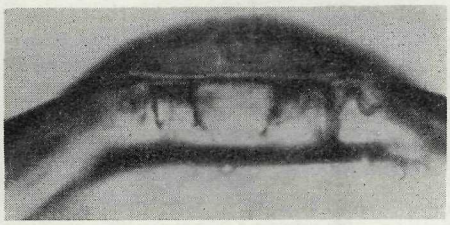

Fig. 7.

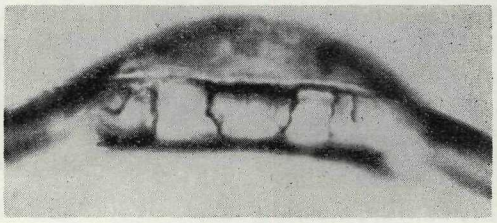

Fig. 8.

Fig. 1. *Bankia setacea.* Photograph of early veliger; length, 100 μ.
Fig. 2. Photograph of larva showing development of inner line; length, 145 μ.
Fig. 3. Photograph of single valve, external view; length, 175 μ.
Fig. 4. Photograph of single valve, external view; length, 220 μ.
Fig. 5. Photograph of larva; length, 220 μ.
Fig. 6. Photograph of left valve, external view, of newly settled spat with cutting-teeth on the anterior edge and articular area on the ventral edge; length, 245 μ.
Fig. 7. Photograph of provinculum of left valve ($\times$150).
Fig. 8. Photograph of provinculum of right valve ($\times$150).

During an investigation of the vertical distribution of oyster larvæ in Pendrell Sound in 1952, *Bankia setacea* larvæ were found to occur in some numbers. Samples of 3 cubic feet (85 litres) were taken by means of a pump from depths of 3 feet (0.91 m.), 10 feet (3.05 m.), 20 feet (6.10 m.), and 40 feet (12.2 m.). The depth at mean low water was 80 feet (24.4 m.). Samples were taken at consecutive slack-water periods.

In a group of twelve samples taken on August 14th and 15th, 1952, no *Bankia setacea* larvæ were found in the samples from 3 feet (0.91 m.) and 10 feet (3.05 m.). Of the larvæ taken, 75 per cent were in the 40-foot (12.2-m.) samples, where the temperature remained near the 14° C. level. The temperature at the 3-foot level (0.91 m.) was just over 22° C.

Another series of fifty-four samples was taken during the period August 23rd to August 26th, when the temperature was quite uniform between the surface and 40 feet (12.2 m.) at about 17° C. At this time 15 per cent of the *Bankia setacea* larvæ were found at 3 feet (0.91 m.), 21 per cent at 10 feet (3.05 m.), 25 per cent at 20 feet (6.10 m.), and 39 per cent at 40 feet (12.2 m.). No diurnal movements were observed, and the stage of the tide appeared to have no effect on the distribution of the larvæ.

Two series of samples, using the Clarke-Bumpus plankton sampler, were taken in the same area at about the same time. These samples showed a concentration of *Bankia setacea* larvæ at the 50-foot (15.25-m.) level, where the temperature at the time was about 15° C. Larvæ were found in reduced numbers down to 90 feet (27.43 m.). Test-blocks placed at the 50-foot (15.25-m.) level caught a number of *Bankia setacea* spat within forty-eight hours.

Salinity data from Pendrell Sound for 1952 are not yet available, but the normal range is from 19 per thousand at the surface to 28 per thousand at 40 feet (12.2 m.).

Information on the breeding periods of *Bankia setacea* in British Columbia waters has been derived entirely from test-block experiments. In all cases the blocks were exposed in comparatively shallow water. It is also possible for spawning to occur without settlement. The preliminary data presented here on vertical distribution, particularly in the Pendrell Sound area where summer water temperatures are high, suggest that *Bankia setacea* may breed more regularly throughout the year than has been previously supposed and that the larval distribution may be influenced by temperature. Neave (1943) stated that for the coastal waters of the south-east part of Vancouver Island there are no well-defined periods of immunity from attack by *Bankia setacea*. This contention is further supported by the results of the 1951 series of plankton samples from Ladysmith Harbour, where larvæ were found in each month of the year. Adult *Bankia setacea* are known to occur down to a depth of 25 fathoms (Fraser, 1923), and it may be that populations at different depths spawn at different times. A study of the occurrence of larvæ may assist in defining more accurately the breeding season.

Thanks are due to Dr. F. Neave for his comments on these observations.

REFERENCES

BLACK, E. C., and ELSEY, C. R. (1948): Incidence of wood-borers in British Columbia waters. Fish. Res. Bd. Can., Bull. No. LXXX.

FRASER, C. M. (1923): Marine wood-borers in British Columbia waters. Trans. Roy. Soc. Can., *17*, Sect. 5, 21–28.

JOHNSON, M. W., and MILLER, R. C. (1935): Seasonal settlement of shipworms, barnacles and other wharf-pile organisms at Friday Harbour, Wash. Univ. Wash. Pub. Oceanog., *2*, 1–18.

JØRGENSEN, C. B. (1946): Reproduction and larval development of Danish marine bottom invertebrates. 9. Lamellibranchia. Medd. Komm. Danmarks Fisk. Havunders., Ser. Plankton, IV (1), 277–311.

KEEN, A. M. (1937): An abridged check list and bibliography of West American marine Mollusca. Stanford University Press, Stanford.

NEAVE, F. (1943): Fish. Res. Bd. Can. Prog. Rep. Pac., *54,* 12–14.

REES, C. B. (1950): The identification and classification of lamellibranch larvæ. Hull Bull. Mar. Ecol. 111, 73–104.

SULLIVAN, C. M. (1948): Bivalve larvæ of Malpeque Bay, P.E.I. Fish. Res. Bd. Can. Bull. LXXVII, 1–36.

WERNER, B. (1939): Über die Entwicklung und Artunterscheidung von Muschellarven des Nordseeplanktons, unter besonderer Berücksichtigung der Schalentwicklung. Zool. Jahr., Abt. Anat., LXVI, Heft 1, 1–54.

REPORT OF THE INTERNATIONAL FISHERIES COMMISSION, 1951

In 1951 the International Fisheries Commission completed its twentieth year of regulation of the Pacific halibut-fishery, under authority of the Halibut Treaty of 1937 between Canada and the United States. It also carried forward the statistical and biological observations which guide regulation.

The members of the Commission during the year were George R. Clark, Ottawa; Edward W. Allen, Seattle; George W. Nickerson, Prince Rupert; and Milton C. James, Washington, D.C. Mr. Allen and Mr. Clark completed the second year of their terms of office as chairman and secretary respectively.

The annual meetings of the Commission were held at Seattle, Wash., on January 25th, 26th, and 27th. During this period, conferences were held with representative wholesale halibut-dealers from Canada and the United States, with the Conference Board composed of delegates from the fishermen's and vessel-owners' organizations in the major halibut ports, and with a delegate of the Alaska salmon-trollers.

At a meeting with the above-mentioned representatives of the halibut industry, the Commission reviewed the results of investigations and accumulated evidence which indicated that fishing in Area 2 during the single month of May was resulting in the underutilization of some sections of the stocks and probably in the overutilization of other sections. It informed the meeting that, in view of the delay of the conclusion of a new treaty, with more flexible powers such as it had recommended in 1946, it was considering modification of the regulations under the present treaty to secure better utilization of the stocks.

The terms of the 1937 treaty allowed only one fishing period in each regulatory area during each year. This made only two types of measures available for spreading fishing over more of the year; namely, a gradual rotation of the fishing season during a period of years and (or) a subdivision of the present large areas into smaller ones which might each be opened at the most appropriate time of year.

It appeared probable that a moderate rotation of fishing seasons applied to the present large areas over a period of years would bring about a more even exploitation of the stocks appearing on the grounds at different times of year. The division of the present large areas into smaller areas, and the opening of the latter at their most productive season, seemed less generally applicable. However, two recently underfished sections of Area 2 suggested themselves as suitable for separation from the remainder of Area 2 and for opening about August 1st. One of these sections lies in southern Hecate Strait off British Columbia; the other in the Forrester Island region off Southeastern Alaska.

The merits, limitations, and disadvantages of the above two methods were subsequently discussed at separate meetings with the wholesale halibut-dealers and with the representatives of the vessel-owners and fishermen. During the latter meeting, the vessel-owners and fishermen presented recommendations dealing with regulation and other matters.

At its final session the Commission considered the regulatory proposals of the industry, adopted regulations for the 1951 fishing season, and agreed upon a programme of investigations for the ensuing year.

The halibut-fishing regulations for 1951, which became effective upon approval of the Governor-General of Canada and of the President of the United States, were substantially the same as those for 1950, but contained a few major changes.

Convention waters were divided into seven regulatory areas, two more than in 1950, by subdividing former Area 2 into Areas 2A, 2B, and 2C. The seven areas were as follows: Area 1A, south of Cape Blanco, Oregon; Area 1B, between Cape Blanco and

Willapa Bay, Washington; Area 2A, between Willapa Bay and Cape Spencer, Alaska, exclusive of Areas 2B and 2C; Area 2B, off the east coast of Moresby Island in lower Hecate Strait, British Columbia; Area 2C, off the west coast of Dall Island in the Forrester Island region of South-eastern Alaska; Area 3, between Cape Spencer and Cape Sarichef, in Unimak Pass; and Area 4, the portion of Bering Sea north of Cape Sarichef.

Catch-limits of 25,500,000 pounds, 28,000,000 pounds, and 500,000 pounds were assigned to Areas 2A, 3, and 4 respectively, involving no changes except that Area 2A was given the entire previous catch-limit of former Area 2. Areas 1A and 1B were continued without catch-limits. New Areas 2B and 2C also had no catch-limits assigned to them.

The opening of the fishing season was again set for May 1st in all areas, except 2B and 2C, which were given a ten-day open period between July 26th and August 4th, inclusive.

Areas 2A and 1B were closed to halibut-fishing at midnight of May 28th when the Area 2 catch-limit was attained, and Areas 3, 4, and 1A were closed at midnight, June 25th, when the Area 3 catch-limit was taken. Small landings of halibut continued until midnight, November 15th, under the long-standing regulatory provision which allowed set-line vessels to retain and land under permit a small proportion of halibut caught incidentally in closed areas.

Landings of halibut on the Pacific Coast in 1951 amounted to 56,904,000 pounds, slightly less than in 1950. The landings from the different areas were 472,000 pounds from Areas 1A and 1B combined, 26,664,000 pounds from Area 2A, 2,468,000 pounds from Area 2B, 1,213,000 pounds from Area 2C, and 26,087,000 pounds from Area 3. No halibut-catches were reported from Area 4. Landings of incidentally caught halibut, amounting to 951,000 pounds and taken mostly in Area 2A, are included in the above figures.

The catch of 3,681,000 pounds from Areas 2B and 2C during the ten-day season at the end of July and the beginning of August was approximately 2,500,000 pounds greater than the catch on the same grounds during the May fishing season of 1950. This gain was offset by a loss of approximately 2,000,000 pounds in Area 3, due to the occurrence of very bad weather during the last week of the season, too late for change of the date of closure. This deficit balanced a corresponding excess over the catch-limit in 1950, when unusually favourable weather occurred after the date of closure was announced.

Landings of halibut by Canadian vessels in 1951 amounted to 21,466,000 pounds, of which 16,346,000 pounds were from Areas 2A, 2B, and 2C, and 5,120,000 pounds from Area 3. Canadian landings constituted 54 per cent of the landings from Areas 2A, 2B, and 2C and 20 per cent of the landings from Area 3. Landings of the United States vessels in Canadian ports amounted to 4,391,000 pounds.

The observations and investigations which guide the regulation of the fishery were continued by the Commission's staff. Statistical and biological data were collected and analysed to ascertain the current condition of the stocks. The marking programme, undertaken to ascertain the extent to which the stocks and banks were being utilized, was carried forward by the initiation of new tagging experiments.

Preliminary analysis of fishing records for the 1951 fishing season in Area 2A indicated that the catch per unit of effort for the area as a whole was unchanged from 1950. However, as had been noted in immediately earlier years, different sections of Area 2A showed variations in the trend of catch per unit of effort. The most heavily fished sections failed to show improvement and in some instances showed some decline. The less heavily fished sections, on the other hand, showed some improvement.

Preliminary analysis of similar data from Area 3 indicated that the catch per unit of effort was approximately 8 per cent above the level of 1950. For the second consecutive year the downward trend of abundance of the late 1940's in this area was reversed.

The catch per unit of effort in Area 2B during the ten-day fishing period in late July and early August was much higher than during the May fishing season of other recent years. No reliable comparative data were available for Area 2C, due to the limited amount of fishing there in the relatively unproductive May season in recent previous years. The catch per unit of effort declined sharply in these areas during the ten-day season and raised the question as to whether or not the stocks in such small areas could withstand, year after year, an extremely intense fishery during such a short season. It was apparent that this question could be answered only by further trial of the method.

Studies of the changes occurring in the size and age composition of the stocks were continued. More than 46,000 halibut were measured at Prince Rupert, Vancouver, and Seattle from grounds in Areas 2A, 2B, 2C, and 3. Materials for the determination of age composition were taken from 8,500 of the fish measured.

The size and age samples from Area 2A showed, for the fourth consecutive year, that the numbers of young halibut entering the fishery were below average. The July-August samples from Area 2B contained a much higher proportion of large fish than did the May samples of recent earlier years and supported previous statements of the fishermen and of the Commission that the stock in this region could not be fully exploited by a fishery in May alone. Since most of the fishing in Area 2C was conducted in the northern portion of the area, adjacent to the Timbered Islet nursery grounds, where there was a concentration of smaller-size fish, no conclusion could be reached as to differences in the size composition of the May stock and the July-August stock.

Comparison of 1951 size-composition data from Area 3 with similar data for 1949 and 1950 demonstrated clearly for the first time the existence of consistent differences in the nature of these stocks in four major sections of the area. It provided bases for the comparison of past, present, and future data, which should make the changes in those stocks understandable.

Age-composition studies of the stocks in Area 3 were begun, using the materials available from 1935 to 1951. Scattered results from this time-consuming work demonstrated clearly the existence of natural fluctuations in the production of young fish from one year to another, similar to those previously found in Area 2. They suggested that the decline in abundance in Area 3 during the late 1940's was caused by successful spawning in the late 1920's, which made the abundance of adults abnormally high in the early 1940's, and by unsuccessful spawnings in the early 1930's, which made the resultant adult stocks abnormally low in the late 1940's.

The marking programme, begun in 1949 to ascertain the extent to which different sections of the stocks were being utilized, received special attention. During five months of vessel operations, a total of 11,130 halibut was tagged and released on seven important fishing-grounds between Kodiak Island and the north end of Vancouver Island. The year's operations virtually completed the summer phase of the marking programme and will permit a beginning on the spring phase of the programme during the fishing season in 1952. Comparison of tag-recoveries from the summer experiments with recoveries from spring experiments will show to what degree the sections of the stocks on important banks in summer are available to the spring fishery and what changes in the fishing season will be required to reach underfished sections of the summer stocks.

Some 340 tagged halibut were recovered in 1951 from experiments of previous years. These corroborated and strengthened earlier evidence of the unequal exploitation of the stocks on the different banks during the short fishing season and of unequal availability of halibut on the same bank at different times of the year to the fishery during the short season. They made more evident the need for the distribution of fishing throughout a greater part of the year to permit the fishery to exploit the stocks and their different sections more uniformly.

Two reports, " Regulation and Investigation of the Pacific Halibut Fishery in 1949 " and " Regulation and Investigation of the Pacific Halibut Fishery in 1950," were published during the year. Three other reports were in advanced stages of preparation as the year ended.

REPORT ON THE INVESTIGATIONS OF THE INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION FOR 1951

The Sockeye Salmon Fisheries Convention, ratified by Canada and the United States in 1937, established the International Pacific Salmon Fisheries Commission to protect, preserve, and extend the greatly reduced sockeye-salmon fisheries of the Fraser River system. The Commission is now engaged in the direct management of the Fraser River sockeye-salmon resources in order to restore them to their former productiveness.

The Commission held four meetings in 1951. At a meeting in Vancouver, B.C., on February 2nd tentative recommendations for regulatory control over the 1951 fishing season were presented and were discussed with the Advisory Committee. Agreement on the regulatory recommendations was reached by the Commissioners, with the exception of that pertaining to weekly closed periods in Convention waters. A regulation was unanimously approved by the Commission with the majority approval of the Advisory Committee providing a weekly closed period of forty-eight hours duration for the taking of sockeye on the high seas between July 2nd and August 26th. At a meeting in New Westminster, B.C., on April 7th the recommendations with respect to weekly closed periods for the taking of sockeye in Convention waters were presented to the Advisory Committee for discussion and were thereafter approved by the Commission. Recommendations for regulations in Canadian waters were transmitted to Ottawa and accepted by an Order in Council adopted on June 7th, 1951. Those for the United States were sent to the Director of the Washington State Department of Fisheries, who accepted them in an order promulgated May 7th, 1951.

The 1951 sockeye-fishing season commenced in the territorial waters of Canada at 8 a.m. and the United States at 4 a.m. on July 2nd, 1951. Canadian waters of District 1 and Areas 17 and 18 were subject to a seventy-two-hour weekly closed period. Canadian waters of Areas 19 and 20 of District 3 were subject to a weekly closed period of forty-eight hours' duration until and including August 26th, 1951. Other Canadian waters embraced in the Convention were subject to a weekly forty-eight-hour closure until August 26th, 1951. Territorial waters of the United States embraced in the Convention were subject to the same forty-eight-hour weekly closures.

Certain adjustments to these regulations were agreed upon, recommended, and became effective during the fishing season. In United States waters an adjustment was made in the Puget Sound fishing season on the week-end of August 11th and 12th, when an additional twenty-four-hour closure was applied by commencing the weekly closure at 6 p.m. on August 9th for gill-nets and at 12.01 a.m. on August 10th for other gear. In the high-seas area the weekly closed season was abrogated August 13th and became effective August 18th instead of August 26th, the terminal date originally specified. In District 1 of Canadian waters the seventy-two-hour week-end closure was terminated at a Commission meeting held on September 26th at Horsefly, B.C. This action was taken by a resolution relinquishing control of sockeye-fishing on September 27th, 1951. Fishing had been further restricted by the Department of Fisheries by extending the regular weekly closure beginning September 21st in District 1 by twenty-four hours to commence on September 20th. This ninety-six-hour weekly closure was applied also the following week-end, beginning on September 27th. Further Departmental orders set up five-day closures commencing on October 3rd and 10th. Weekly closed periods following October 15th to the end of the fishing season were of seventy-two hours' duration.

The 1951 catch and escapement showed a tremendous increase over the cycle-year 1947. The 1951 cycle has tended to be the lowest producer of the four quadrennial runs since the early days of the fishery. In 1947 severe restrictions were placed on the commercial fishery in order to allow certain runs spawning above Hells Gate to receive the full benefits offered by the Hells Gate fishways. As a result, in 1951 not only were

substantial increases noted in the escapements to these areas, but also a total catch of sockeye was taken which exceeded that of any other cyclic catch since the year 1903, a period of forty-eight years.

The United States fishery in Puget Sound commenced on July 2nd, with all types of gear operating in large numbers. Production was at an efficient level on the first day of the season and was maintained thereafter until the last half of August. In Canadian waters, sockeye appeared in large numbers during the last week of June and the first week of July. Gill-nets having a minimum mesh size of 6½ inches and traps caught an important number of sockeye in June, 1951, prior to the official opening of the sockeye-control season on July 2nd. This successful fishery continued through July and August. When purse-seines began to operate in Area 20 on July 19th, they, too, produced good catches. Production of sockeye in each part of the 1951 season in Canadian waters was superior to recent years of the cycle, except for the late season fishing in September and October.

Both countries combined to produce a total catch of 2,424,953 sockeyes, of which 1,136,791 were taken by United States fishermen and 1,288,162 by Canadian fishermen.

The Indian catch on the Fraser River and its tributaries in 1951 totalled 78,000 sockeyes, as compared with 42,000 in 1947 and 27,000 in 1943. The Indian catch has increased continuously since the fishways were completed.

The escapement of sockeyes to most of the up-river spawning-grounds increased greatly in spite of a forty-eight-year record catch on this particular cycle. The combined escapement to the Seymour River, Raft River, Chilko River, Nechako River, Stuart River, and Bowron River was 334,300 sockeyes, as compared with 166,847 in 1947, 36,149 in 1943, and 8,447 in 1939. Also, three once barren or practically barren areas now appear to have native spawners on this cycle; namely, the Barriere River with 108 sockeyes, Taseko Lake with 500 sockeyes, and the Horsefly River with 51 sockeyes originating mainly from marked fingerlings transplanted from Bowron to Horsefly. A 25-per-cent decline in the Adams River run, which was composed to a large extent of 5-year-old sockeye produced from the preceding and dominant cycle, can be related to the Adams River failure of 1950.

Escapements to the lower-river spawning areas were normal or above normal for this cycle, with the exception of the Birkenhead River, which showed a substantial decline from the unfished escapement of 1947.

The programme of rehabilitation of barren spawning-grounds by transplantation was intensified in 1951. Operational experiments consisted of (1) planting 193,000 sockeye fingerlings, which were raised at the Quesnel station from eggs of Lower Adams River origin, into Anderson Lake near its Portage Creek outlet; (2) planting 15,000 sockeye fingerlings in Lac la Hache from the same lot as in item (1); (3) planting 120,000 kokanee fingerlings (non-migratory sockeye), which were taken as eggs from the Little Horsefly River and raised at the Quesnel station, into Horsefly Lake near its outlet to determine whether increased growth will stimulate the urge to migrate to sea and return as normal adults; (4) planting 72,000 sockeye fingerlings of Stellako River origin in Horsefly Lake near its outlet; (5) taking 625,000 sockeye eggs from the Lower Adams River for raising at the Quesnel station and eventual planting as fingerlings in Anderson Lake; and (6) taking 325,000 eggs from the Seymour River to be raised at the Quesnel station and ultimately to be planted in Gates Creek at the head of Anderson Lake.

Historical records on the origin and size of individual runs of sockeye in the Fraser River system over the past 140 years are being obtained from the Hudson's Bay Company in London, England. In addition, detailed historical information has been acquired from the files of the Departments of Fisheries of British Columbia and Canada. These voluminous data are proving of great aid in the study of cyclic dominance, which was evidently present long before the days of commercial fishing.

An analysis of the early commercial-catch records kept by various government agencies and fishing companies is enabling the Commission to determine which races of sockeye contributed most to the annual catches of past years. The identification of certain races in the present-day fishery through extensive research on characteristic scale patterns aided by the development of new techniques is showing promise of success.

Studies of the day-by-day intensity and effectiveness of the fishery when combined with data on the availability by time of particular races progressing through the fishery gave promise of estimating the population abundance and its division into catch and escapement for these races. Studies of the fishing intensity and its related catch in United States waters have given a close approximation of the escapement to date. An analysis of the gill-net catch for specific areas before and after the weekly closed periods may provide another method of estimating current escapements.

Other projects being studied by the Commission include the evaluation of fry production from a given number of spawners; fishing-gear selectivity with respect to timing of the escapement, sex ratio, and average size of the sockeyes of various races; the physical requirements necessary for reproduction of sockeyes on various spawning areas; the relationship of the abundance of 3-year-old jack sockeyes to the abundance of 4-year-old sockeyes; the effect of a high power-dam on the survival rate of down-stream migrants; and the effect of proposed water-use projects of many types and sizes on the maintenance of sockeye populations.

Extensive field and office studies on the possible effects of the Aluminum Company of Canada's Nechako project were carried out in collaboration with the Department of Fisheries of Canada. This project will divert the flow of the Nechako watershed above the Grand Canyon from its present course and carry it directly to tide-water via a tunnel through the Coast Range from Tahtsa Lake. The greatly reduced flow of the residual Nechako will pose major access problems for the large sockeye runs which pass through that river en route to the spawning-grounds of the Stellako and Stuart basins. A report was prepared on the complex temperature problem expected in the residual river and the anticipated need for cold-tempering water to prevent a serious mortality in the migrating sockeye populations.

In December, 1951, the Commission completed the construction of a high-level fishway on the left bank of Hells Gate for extending the operating range to a river-level of 70 feet on the Hells Gate gauge. Delays in the early runs of sockeyes passing Hells Gate in July when gauge heights above 54 feet have persisted will now be eliminated. Routine maintenance was carried on at the Hells Gate, Bridge River Rapids, and Farwell Canyon fishways by the Commission's field crew. There was no extensive damage at any of the fishways.

Members of the Commission during 1951 were as follows:—

Canadian Commissioners: Senator Thomas Reid, chairman; A. J. Whitmore, member; Olof Hanson, member.

United States Commissioners: Robert J. Schoettler, secretary; Albert M. Day, member; Edward W. Allen, member (January to December); Elton B. Jones, member (December).

SALMON-SPAWNING REPORT, BRITISH COLUMBIA, 1951

By A. J. Whitmore, Chief Supervisor of Fisheries

GENERAL SUMMARY

Sockeyes.—Sockeye-salmon spawning reports for 1951 show with one exception that satisfactory numbers of sockeyes reached their spawning-grounds for maintenance of the resource.

The exception, the Skeena, is a misfortune of serious proportion. A large rock-slide in a remote canyon of the Babine River, some 40 miles north of Hazelton, occurred just prior to the commencement of the 1951 sockeye migration. Preliminary estimates show that at least two-thirds of the important Babine run, the equivalent of 50 per cent of the entire Skeena run, perished at the block formed by this slide. Further loss may be expected; that is, ineffective spawning by the fish which eventually succeeded in passing the obstruction through damage to spawn by physical injury or resulting from the long delay at the block. Steps immediately authorized for relieving the block give assurance that before next year's run occurs adequate passage-way will have been created, but it is inevitable that the return from the 1951 spawning will be substantially below that which would be normally expected.

Rivers Inlet spawning-grounds received good sockeye-seeding, judged as medium to heavy. The Smith Inlet sockeye-spawning escapement was very good. Bella Coola, Nimpkish, Somass, and Anderson spawning-grounds received heavy seedings, while the Nass sockeye escapement is classed as satisfactory.

Further definite progress in the rehabilitation programme for the Fraser sockeyes under the International Pacific Salmon Fisheries Commission is again indicated. Resulting from drastic regulatory controls applied to commercial fishing in the cycle-year 1947, it is highly gratifying that not only was a substantial catch realized from the returning progeny this year, but the spawning escapement was doubled to the upper spawning-grounds. Hells Gate fishways assured ready passage through the difficult canyon stretch, and the fish reached these distant areas in good shape. These upper areas include Seymour River, Raft River, Chilko Lake system, Nechako River system, Stuart River and Lake system, and Bowron River; they received some 335,000 spawners, compared with 166,000 in 1947.

Springs.—Spring-salmon supplies to the Fraser River watershed were again satisfactory; escapement to the Skeena spawning-grounds was reduced by the Babine slide, but otherwise spring-salmon seeding of District 2 spawning-grounds was reasonably good. This also applies to Vancouver Island and the streams of the Mainland opposite, the exception being lesser returns to Campbell River and Cowichan River.

Cohoes.—Supplies of cohoes reaching the spawning-grounds generally are judged to be adequate; indeed, several areas experienced substantially greater supplies than in recent years. The coast-wide cohoe run, in which there was extensive participation by both commercial and sport fishermen, was the largest for many years. It is gratifying that spawning reports indicate that with assistance of conservation measures the spawning-grounds shared correspondingly in this year's larger run.

Pinks.—The over-all coast-wide return of pinks showed improvement over the brood-year. Despite a large commercial operation, excellent spawning escapements were realized at Fitzhugh-Bella Coola, Alert Bay, Comox, and Nass areas. Good returns were experienced in Butedate, Quathiaski, and Lower Skeena sections.

For the third cycle-year in succession a further deterioration in the volume of the over-all pink run to the Fraser system seems to be indicated. The combined catch of the United States and Canadian fishermen again shows a drop for 1951. Because of dual participation by the two countries, this run is not subject to the undivided control for

conservation purposes that otherwise would exist. The difficulty in this respect has been referred to in spawning-report summaries for 1947 and 1949. Notwithstanding that the 1951 return was definitely less than in 1949, by special conservation measures applied on the Fraser, requiring a four-day fishing closure each week for two weeks and a five-day fishing closure in each of the next two weeks at the height of the run, an escapement for spawning purposes about equal to that of the brood-year was secured.

Of significant importance is the fact that several thousands of pinks succeeded in passing through Hells Gate Canyon, beyond which there had been no appreciable migration by this species for many years. This development no doubt stems from the existence of the newly constructed fishways. The fish successfully spawned at such points as Nicola River, South Thompson River, and Seton Creek.

Chums.—Supplies of chums on the spawning-grounds of northern areas generally are classed as light to moderate. There was heavy seeding of the Nass area, and fairly good at Butedale and Fitzhugh-Bella Coola. The escapement to the South Queen Charlotte Island streams was only fair, with a medium to heavy spawning indicated in the north and central section of the Queen Charlottes. Satisfactory seeding occurred in the streams along the east coast of Vancouver Island and the Mainland opposite. On the west coast of Vancouver Island this cycle continues to be light, and with the exception of Quatsino Sound, despite a sharply restricted fishing season, the escapements are classed not better than in the light-medium category. Chum-seeding of the Quatsino area was excellent.

SALMON-SPAWNING PROTECTION AND AIDS

1. This compilation is derived from detailed spawning reports of 1,681 salmon-streams covered by experienced fishery officers to determine the volume of spawning stocks, spawning-ground conditions, obstructions, et cetera.

2. Resulting from periodic stream inspections, fishery-officer personnel is continuously engaged in stream-improvement work. During 1951, log-jams and accumulations of forest debris, or other conditions detrimental to salmon runs, were cleared away or received attention by or under supervision of Departmental personnel in 125 streams. This class of work is a continuing part of fishery-officer duties.

3. All new industrial projects located on or near salmon-streams are investigated, and action taken to assure the interest of the salmon-fisheries is properly safeguarded.

4. The following major aids to salmon in their spawning migration were completed or extended in 1951:—

(*a*) High-level fish-ladder at Hells Gate on Fraser River, by the International Pacific Salmon Fisheries Commission.

(*b*) Steel and concrete fish-ladder at Moricetown Falls on the Bulkley River (Skeena watershed) by Fish Culture Branch, Department of Fisheries.

(*c*) Steel and concrete fish-ladder at Sproat Falls on the Sproat River by Fish Culture Branch, Department of Fisheries.

(*d*) Concrete fish-ladder and mechanical screen at Kloiya River dam by the Columbia Cellulose Company.

(*e*) Special extended closure of commercial net-fishing was required in a large section of the coast last fall for protection of spawning stocks temporarily hampered in their spawning migrations due to prolonged drought.

IN DETAIL

Masset Inlet and North Coast of Graham Island Area

Cohoe-supplies were light to moderate, showing some increase over the brood-year in most streams. Being the off-year for this species, no pinks were observed in any of the streams of Masset Inlet or Naden Harbour. There was a moderately heavy escapement

of chums to the spawning-grounds over the area, particularly so in Masset Inlet, where it was better than in any recent year.

Skidegate Inlet and West Coast of Graham-Moresby Island Area

There was a medium spawning of cohoes over the entire area, with noteworthy increase in Tlell River. This was the off-year for pinks; fair supplies, however, were present in Reilly Creek, Tlell River, and Copper River. Generally, there was a moderate seeding of chums—heavy in Port Chanal, Peel Inlet, and South Kootenay; light but showing some improvement in the Rennell Sound streams. The spawning-grounds in Skidegate Inlet were well stocked with chums.

East Coast of Moresby Island and South Queen Charlotte Islands Area

The escapement of cohoes to the streams frequented by this species was light to medium, the exceptions being Mathers Creek and Pallant Creek, which were fairly well supplied. This was the off-year for pinks. Chum-supplies were only fair, somewhat lighter than the brood-year, particularly so in Juan Perez Sound area. Due to lack of rainfall, levels in all the streams were extremely low from June until the latter part of September. Mass migration commenced in all streams on October 18th, following heavy rainfalls. The spawning period was short and intense. Substantial numbers of chums were present in Cumshewa Inlet streams, Lagoon and Sewell Inlets, Powrico Inlet streams, Salmon River, Tangle Cove, Oyster Cove, Harriett Harbour, and Ikeda Cove streams.

Nass Area

Although somewhat less than the spawning of the brood-years, the number of sockeyes reaching Meziaden Lake area, the principal spawning-grounds for this variety in the Nass system, appears to be adequate. There was a light to moderate escapement of spring salmon over the area, the exception being the Meziaden Lake area, where moderately heavy seeding occurred. Supplies of cohoes were fairly satisfactory in all streams in the area. The escapement of pink salmon to the Nass River system was heavy, while stocks in other creeks and rivers were generally moderately heavy. Chum-supplies were strong over the area, showing improvement over the brood-year, and the escapement to Wark Channel streams was exceptionally good.

Skeena Area

Babine-Morice Area.—A large rock-slide occurred in a narrow canyon of the Babine River at a point some 12 miles above its confluence with the Skeena. It created a block to the main run of sockeye going to the Babine watershed, where at least 60 per cent of the important Skeena River sockeye run normally spawns. At least two-thirds of the sockeye run to the Babine area, or about 50 per cent of the Skeena River run, was affected, as also, in varying proportion, were runs of other salmon species to this system. Due to the inaccessible character of the terrain and distance from existing roads, nothing could be done to assist or salvage this year's run at the obstruction. Steps were taken at once looking to earliest feasible action. Work on an access road was commenced and has progressed favourably. It is hoped that before spring high water of 1952 it will have been possible to have essential heavy equipment on the ground to undertake remedial action to assure passage of the 1952 run. In all, some 152,457 sockeyes passed the obstruction and through the counting-fence maintained in the Babine River by the Fisheries Research Board. Of these, 27.4 per cent were damaged and 7.2 per cent were jacks. It is estimated that 20,000 of this number died before spawning. There is some doubt as to the productive efficiency of spawn deposited by the remainder. Supplies of sockeye to the early streams flowing into Babine Lake were comparable to other years.

The larger tributaries of the lake, such as Grizzley Creek, Fifteen Mile Creek, Hatchery Creek, and Fulton River, showed diminished supplies, largely composed of damaged and poorer-class fish and many jacks. The number of spring salmon passing the block was very small, while the escapement of pinks was practically *nil*. Cohoe-supplies were just fair. These arrived during the fall high water. Unrevised final figures of salmon passed and counted through the Fisheries Research Board fence are as follows: Sockeyes, 152,457; pinks, 50; springs, 2,778; and cohoes, 2,122.

On the Bulkley River, the other principal branch of the Skeena system, the fishways constructed at Moricetown Falls during the winter and spring months of 1950–51 were in operation when the migration commenced, and eliminated difficulty previously experienced at certain water-levels there. There was a moderately good escapement of medium- and large-sized sockeye to the Bulkley system. Very few jacks were in evidence. Spring-salmon stocks were medium to light; the exception was the Bulkley River above Houston, where numbers observed were much greater than usual. Small numbers of pinks succeeded, with the help of fishways, in passing above Moricetown Falls. This is the first time in the memory of Departmental officers that this species, other than the odd fish, has been noted in any numbers above this obstacle. The cohoe-seeding is the best in many years.

The run of spring salmon to Bear Lake system was light and disappointing, as were the supplies of sockeyes and pinks. Cohoe stocks were just appearing on the grounds at the time of inspection.

Lakelse Area.—Good supplies of sockeyes were observed in the Allistair Lake, Kitsumgallum River, and Kispiox River systems. The Lakelse spawning-grounds were lightly seeded in comparison with the cycle-year. The spring-salmon run was somewhat below normal. Cohoe-supplies were satisfactory and compared favourably with the cycle-year. The pink escapement is the best for an odd-year for a long time. The escapement of this species on the odd-year cycle has been improving since 1947, and this year it was nearly as good as the heavy escapement in 1950, particularly so in the Lakelse River, Kitwanga River, and Kispiox River. Light supplies of chums were present in the few streams frequented by this variety, the exception being Kitwanga and Lakelse Rivers, where stocks were fairly good.

Lower Skeena Area

The escapement of sockeyes to Shawatlans Creek and Johnson Creek was satisfactory and showed improvement over the runs of cycle-years. Diana Creek in the Kloyia River system was well seeded with 6,000 sockeye spawners. The fishway incorporated in the dam of the Columbia Cellulose Company, completed last spring in Kloyia River, was in operation, and the several varieties of salmon frequenting the system negotiated the fishway without difficulty. The controlled spill during the long dry spell permitted continuous escapement; this would not have been the case under natural flow conditions this season. Spring-salmon stocks were heavy in Johnson Creek, but light in the Kloyia River. The escapement of pink salmon, although somewhat less than the exceptionally heavy escapement of 1949, is considered satisfactory. The chum-salmon seeding of the limited spawning areas of this species in this area, although somewhat less than the escapement of 1947, is considered adequate. Cohoe stocks were fairly good.

Grenville-Principe Area

Generally, the escapement of sockeyes to this area was light, heaviest seedings occurring in early-run streams such as Minktrap Bay, Curtis Inlet, and Bare Bay lake systems. The cohoe-spawning was moderate in all streams. Notwithstanding, the pink escapement generally was below brood-year proportions, adequate seedings occurred in Mainland streams of Kumealon Inlet and Seven Mile Creek, also End Hill Bay, Bare Bay,

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and Gale Bay in the Principe Channel area. Streams in Kitkatla Inlet were adequately seeded, with the exception of Billy Creek and Kitkatla Creek, where supplies were light. Other streams in the North Grenville Channel area, as well as Ogden Channel, Petrel Channel, Beaver Pass, and the southern portion of the area embracing Turtle and Turn Creeks, were lightly seeded. Chum-supplies were generally light throughout the area, with the exception of Rawlinson Anchorage, Skull Creek, and Bonilla Arm, where good seedings occurred.

Butedale Area

There was a moderate escapement of sockeyes slightly below brood-year level to the various sockeye-streams. The Kitlope River, chief producer, was fairly well supplied. There was a medium seeding of cohoes with slight increase over the brood-year, most streams being fairly well stocked. The pink escapement in the area was generally satisfactory, but not quite up to brood-year strength. The Douglas Channel streams were well seeded. Escapement to Kitimat River and streams in Devastation Channel was somewhat less than in 1949. Gardner Canal streams experienced pink-spawning generally greater than in 1949, including Kemano River, where pink spawners numbered 30,000 fish. Generally, in other streams in the area the seeding was fairly good, the outstanding exception being Laredo Inlet, which showed slight increase over the brood-year, but was still disappointingly light. There was a fairly good seeding of chums over the area, best seedings occurring in the northern part of the area, where returns exceeded expectations. Spring-salmon supplies were above normal.

Bella Bella Area

There was a normal escapement of sockeyes to the limited spawning-grounds frequented by this species. Cohoe-supplies were fair and above the level of previous years at time inspection was made. The moderate seeding of pinks was in line with that of 1950, but somewhat less than that of 1949. Supplies in Klatse River, Kainet River, and Kynoch River were heavy, although spawners were not present at the two latter points in the same abundance as in 1949. Chum-supplies were light and below brood-year proportion.

Bella Coola Area

The Bella Coola-Atnarko system, which produces about 90 per cent of the sockeyes in the area, received heavy seeding, some 30 per cent of the run being jacks. Moderate supplies reached the Kimsquit system, Kisemete and Port John Rivers. The escapement to Dean and Koeye Rivers was light. The cohoe run to the Bella Coola-Atnarko system was one of the best on record. Moderate supplies reached the Kimsquit, Koeye, and Dean Rivers, while the smaller rivers received from light to medium seedings. The quantity of pinks to this area was heavy. Pink stocks in the Bella Coola-Atnarko system were heavy, although not as abundant as last year. Koeye River was also heavily seeded. Kwatna River received the best seeding in some time. In the smaller streams, supplies ranged from moderate to light. In the main pink-salmon streams the fish strove far up-stream. The chum escapement was generally moderate. The seeding of the Bella Coola-Atnarko system, Kwatna and Nootum Rivers was heavy. Moderate supplies were noted in Kimsquit River, Dean River, and rivers in South Bentinck Arm. Cascade River was lightly seeded, as were some of the smaller streams. Generally, there was a considerable increase in chum spawners in comparison with the brood-year. There was a heavy run of spring salmon to the Bella Coola-Atnarko system, medium to Kimsquit, and light to the Dean River.

Rivers Inlet Area

Inspections of the Owekano Lake spawning areas were again carried out during the months of September, October, and November. There was a medium to heavy escape-

ment of sockeyes to this system. Heavy seedings occurred in the Waukwash River, Dalleck River, Nookins River, and Asklum River. Moderately strong supplies were present in Indian River, Shumahault River, and Quap River, while moderate numbers were noted in the Cheo River and Wannock River flats near the outlet. The seeding of spring salmon was light. Pink stocks in the streams frequented by this variety were heavy, showing an increase over the brood-year. The escapement of chums to the rivers at the head of Rivers Inlet was on a par with the brood-year, but the supplies to Moses Inlet and Drainey Inlet showed sharp decline. Cohoe stocks, although on the light side, show improvement over the brood-year.

Smith Inlet Area

The heavy supplies of sockeyes reaching the spawning-grounds of this area compares with the escapement in 1950 and 1947, and shows some improvement over 1946. A notable feature was that the majority of spawners were a very large size, averaging well over 7 pounds. The principal sockeye spawning-streams, the Geluck and Delabah Rivers, were inspected twice in 1951—once in September and again in October. Supplies in the Geluck River, the more important stream, were heavy, all spawning areas being well covered. The more limited spawning-grounds in the Delabah were also well seeded. The number of jacks present was negligible. Cohoe-supplies were light. Pink stocks in the streams frequented by this variety were also light, showing a decrease from the brood-year. The chum-supplies, although not intensively fished, were also light.

Alert Bay Area

Generally, the escapement of sockeyes to all streams frequented by this variety was satisfactory. The return to the Nimpkish River, the principal producer, was heavy, in line with the excellent seeding in the cycle-year. Fish en route to upper spawning areas met with serious obstruction at Karmutsen Falls, due to unfavourable seasonal water-levels. The escapement of spring salmon was satisfactory. Noteworthy were the above-average runs to the Klinaklini and Franklin Rivers. Indications are that the spring-salmon run to Nimpkish River is continuing to build up. There was an unexpectedly abundant return of cohoes to the various spawning-grounds of this sub-district, outstanding runs occurring to the Nimpkish, Glendale, Koegh, and Quatse Rivers. Supplies of pink salmon were again remarkably good, not quite as extensive as the exceptional run of 1950, but still in unusual abundance. As was expected, Mainland streams received the larger seedings, but those on Vancouver Island were very well seeded also. The runs to Glendale, Ahnuhatti, and Kakweiken Rivers were particularly good. Noteworthy also was the showing in Tsitika River on Vancouver Island. The fish individually were generally large in size. Chum stocks are considered adequate, although slightly less than 1947. The run to Viner River, while satisfactory, did not reach the proportions expected. In Glendale River an outstanding heavy return materialized. The Nimpkish River showed a slight decline from the past three years. There was no improvement in the light returns of recent years to the Johnstone Strait streams. There was a very satisfactory seeding of the Kakweiken River. In the Seymour and Belize Inlets there were satisfactory numbers on the spawning-grounds; Quashela and Village Bay Creeks and Salmon River were also well seeded.

Quathiaska Area

Sockeye-supplies in the Phillips River were fairly good—better than the past few years—and in Heydon Bay fair, showing slight increase over the brood-year. The escapement of spring salmon to Campbell River showed a decrease over the past several years. The Homathko and Southgate Rivers had their usual good supplies; the seeding of Orford River was very light; Phillips River spawning by spring salmon was about equal to the brood-year, with slight improvement as compared to last year; and Salmon River

supplies were heavier than the last three years. Cohoes were present in moderate abundance. Several streams showed an increase over last year and compared favourably with the brood-year. In the larger streams, escapement was generally light. This was an off-year for pink salmon in the Vancouver Island streams. The Apple River and Fraser Creek were well stocked. Phillips River had a very good seeding, as had Quatum River and Ramsay Arm. In Bute Inlet, the Homathko, Southgate, and Orford Rivers were all well stocked. The escapement to the smaller streams on Quadra-Senora Islands was moderately light. Chum-streams on the Vancouver Island shore were moderately seeded. Topaz Harbour, Forward Harbour, and Loughborough Inlet streams were well stocked. The Phillips and Quatum Rivers were also well supplied, as were those on the east side of Quadra Island. Bute Inlet streams were moderately seeded.

Comox Area

The run of spring salmon to the Puntledge River was very good. It is estimated that a total of 6,000 spring salmon spawned in this system. There were also runs to various streams which, although light, were good in comparison with previous years, such as the Big Qualicum, the Little Qualicum, and Oyster Rivers. There was a good escapement of cohoes to practically all streams frequented by this variety. Stocks were particularly good to the Tsolum River, Big Qualicum River, Oyster River, French Creek, Cougar Creek, and Millard Creek, and average to the remainder of the streams, with the exception of Kitty Coleman and Royston Creeks, which were below average. There was an exceptionally heavy run of pink salmon to the Courtenay-Puntledge system. Due to prolonged summer drought, the Tsolum River was dry over several stretches, and to prevent heavy mortality of fish becoming trapped in pools left by the receding tides, a barrier was placed below the mouth of the stream in order to divert the fish to Puntledge branch. As a result, most of the early run ascended the Puntledge River. The barrier fence was removed on September 29th, following rise in the stream-levels. The run to Oyster River was lighter than the brood-year. Tsable River was moderately stocked, and light runs were present in Big Qualicum River, Little Qualicum River, Millard Creek, Cougar Creek, and Nile Creek. Chum-supplies were also very satisfactory. There was strong escapement to Puntledge River, Little Qualicum River, Tsable River, Cook Creek, McNaughton Creek, Cougar Creek, and Waterloo Creek. Average or better runs occurred to all other streams, with the exception of Nile Creek, where supplies were light. The run as a whole was above average and an improvement over the brood-year.

Pender Harbour Area

Some 3,451 sockeyes spawned in Sauch-en-auch Lake, which is comparable to the escapement of the past five years. Spring-salmon supplies in the Toba River system were normal; in Jervis Inlet the escapement was below average. The early run of cohoes to Jervis Inlet and Toba Inlet was below normal. The late cohoe run to Toba Inlet and Brem River was much heavier than the brood-year, while the late run to Jervis Inlet was somewhat below average. The run of pinks in Toba River and Brem River was below brood-year proportions. In some of the smaller creeks the run was far heavier than that which occurred in the brood-year; in Jervis Inlet, the Deserted River run was normal; in the Skwawaka River the run was double that of the brood-year. The over-all chum-spawning was satisfactory. The streams in Toba Inlet area all had average runs; the Jervis Inlet run to Skwawaka River was light, and in the remaining streams, normal. The run to Tzoonie River was very satisfactory.

Nanaimo-Ladysmith Area

Spring-salmon supplies in the Nanaimo River were better than usual. The early cohoe escapement to the larger rivers was average. Early runs to the small creeks, how-

ever, were definitely off. Late runs to all streams were good, and, as a result, escapement this year is better than average in numbers. The usual light run of pinks occurred in the Nanaimo River and Englishman River, the only streams frequented by this species. Although late in arriving, the escapement of chums will compare favourably with average seedings of the past four years.

Cowichan Area

The spring-salmon run to the Cowichan system was below average. It is estimated this season that approximately 7,000 spawned in the system this year, compared with 5,000 in 1947 and 12,000 to 15,000 in 1946. The escapement of cohoe to this area was about the same as in the brood-year. An estimated 47,000 spawners were present in the system, compared to an estimated 45,000 in 1948. The seeding of the area below Skutz Falls was, however, lighter than in the brood-year. Chum-supplies were heavy.

Victoria Area

Stocks of cohoes and chums in Demaniel, Sooke, and Goldstream Rivers, the three principal producers of these varieties, were satisfactory. Escapement to the other streams was only fair.

Alberni-Nitinat Area

Supplies of sockeyes in the Somass River system were highly satisfactory and equal to those of the brood-year. An excellent escapement also occurred to Anderson Lake spawning-grounds, the best in recent years. Supplies in the Hobarton Lake grounds showed slight decrease from the average runs of the past few years. An excellent seeding of spring salmon occurred, particularly in the Somass, Nahmint, Sarita, Toquart, and Nitinat systems. The escapement of cohoes to practically all streams was better than the past three years, although the count at Stamp Falls ladder was slightly less than the brood-year. Particularly good spawning of cohoes occurred in Toquart, Nitinat, and Sarita Rivers. Although the early run of chum salmon to this area was very light, the escapement from the late run was fairly good for this cycle. Special fishing controls assisted in making this possible. The escapement to Toquart, Sarita, and Nahmint Rivers was quite good; Nitinat and Effingham Rivers were lightly seeded. A concrete fish-ladder of vertical-baffle type was constructed at the falls in Sproat River, tributary to the Somass River, last fall. Needs for improving conditions for the passage of salmon at this point had been under study for some years. The falls, particularly during the lower-water stages, prevented salmon from ascending, resulting at times in serious loss or damage to the run. The new fishway is designed to eliminate entirely any such block at this point in future.

Clayoquot Area

There was a good escapement of sockeyes to Kennedy Lake area. Supplies in the Megin River system were fair. Spring-salmon stocks were average. Escapement of cohoes was particularly satisfactory, all streams being well seeded by this species. The chum-salmon seeding was light over the area, with the exception of Tranquil River and Kennedy Lake river systems, which were well stocked.

Nootka Area

The small early runs of sockeyes to the various streams in this area were again in evidence; they are not of sufficient strength to warrant commercial exploitation. There was an increase in the supplies of spring salmon. Cohoe stocks were light and late in arriving. Although the early run of chum salmon did not materialize in strength, a fairly good seeding of the late run of this species occurred in most of the streams.

Kyuquot Area

A medium escapement of spring salmon took place at the Tahsis, Artlish, and Kaouk Rivers, the main spawning-streams for this species. Cohoe-supplies were good; heavy in Jansen-Power Lakes, and Tahsis, Artlish, Malksope, Kaouk, and Kaooinch Rivers; medium heavy in the numerous other streams in the area. The chum-seeding was generally light to medium, with heavy showings in Malksope River, Chamiss River, and McKay Cove Creek. As in the case of other areas on the west coast, south of Kyuquot, the early run of this species was weak.

Quatsino Area

There was improvement in the numbers of small " creek " sockeyes frequenting streams in this area. Spring-salmon supplies were particularly good in the Marble Creek system, which is the main producer of this species; elsewhere the seeding was average. All streams in this area received more cohoes than for some years. This was an off-year for pinks in this area; a few were observed in the Johnstone, Ingersoll, and Koprino Rivers. Chum-supplies were excellent in practically all streams flowing into Quatsino Sound waters. The upper portion of the coast from Winter Harbour to Cape Scott does not produce chums in any numbers. Lower down, in the Brooks Bay area, there was marked improvement, excellent escapement occurring to East Creek, Klashish River, and Buck Creek.

Fraser River

Prince George Area.—A total of 63,500 sockeyes is estimated to have spawned in the Stuart Lake system, an increase of approximately 55,000 over the brood-year of 1947. The early run, estimated at 61,000, spawned in streams tributary to Takla River and Middle River, while the late run spawned chiefly in the Middle and Tachie Rivers. The early run commenced to arrive at the outlet of Stuart Lake on July 16th and continued until September 10th. Approximately 97,000 sockeyes were observed in the Fraser-Francois watershed, an increase of some 40,000 over 1947. The early run, estimated at between 700 and 800 sockeyes, spawned in the streams tributary to the Fraser and Francois Lake, while the late run, estimated at 96,200 sockeyes, spawned in the Stellako River. There was some decrease in the supplies of spring salmon in the Upper Nechako system, where between 2,000 and 3,000 spawners were present. The main bars of the Fraser River at Tête Jaune carried an exceptionally good run, estimated at between 5,000 and 10,000. Elsewhere, supplies of springs were average.

Quesnel-Chilko Area.—Sockeye-supplies in the Chilko River exceeded by far the brood-year returns; an estimated 125,000, 16.9 per cent of which were jacks, were observed in this area, compared with 50,000 estimated by the local guardian in 1947, 25 per cent of which were jacks. Approximately 750 sockeyes were observed spawning on the beaches of Taseko Lake. In the Quesnel system this was a barren year for the Horsefly area, but a total of 30 sockeyes returned from plantings made in 1948 by the International Pacific Salmon Fisheries Commission. The grounds in Mitchell River were barren of sockeyes, as in the brood-year. An estimated 23,000 sockeyes ascended the Bowron system, the bulk of the run arriving in the middle of August in good shape. This is about the same number as appeared on the grounds in the brood-year 1947. Spring-salmon supplies were average in the Chilcotin and Bowron systems. There was an increase of about 100 per cent in the return of spring salmon, estimated at 1,200 fish, to the Quesnel River system, and spawning occurred in areas not previously seeded by this variety. The Narrows area had a larger concentration than has been seen for many years. About 100 springs ascended the North Fork of Quesnel River, some of these entering Spanish Creek, a small tributary.

Kamloops Area.—Early-run sockeye, estimated at 30,000 by the local Fishery Inspector, compared with 15,000 in 1947, spawned in Seymour and Raft Rivers. Late-

run sockeye, estimated at 160,000, spawned in Adams River, and 20,000 were estimated at Little River. Sockeye-supplies in the South Thompson River were estimated at 2,000. Spring-salmon stocks were fair, showing improvement generally over the brood-year. Cohoe-supplies were considered satisfactory. Pink salmon were reported in the Thompson River at Walhachin during late September. This is the first time pink salmon have been observed in this area for many years.

Lillooet Area.—The return of sockeyes to the Birkenhead River was somewhat less than in 1947. As in the past several years, jacks again composed about 15 per cent of the run. The channel of the river at Creekside, in which important spawning-grounds are located, is more stable this season, although some shift of gravel occurred, which possibly had some effect on spawn there. Supplies of sockeye in the Seton-Anderson system were small and similar in numbers to the brood-year. The spring-salmon run to the Birkenhead River was about average, estimated to be about 700; about 50 springs were present in Seton Creek. No spring salmon were observed in the Yalakom River this season. Cohoe-supplies were normal over the area, with the exception of the Birkenhead-Upper Lillooet River system, where spawning, although below the brood-year levels, was still substantial, estimated at 27,000 fish. Salvage of the spring-salmon run to Bridge River at a point below the diversion-dam was continued by the Fish Culture Branch, and a total of 278,300 spring-salmon eggs were secured; 4,000 were planted in Portage Creek and the remainder in Gates Creek.

Yale-Merritt Area.—This area, formerly listed as the Yale-Lytton area, was extended to include that portion of the Thompson River between Lytton and Spences Bridge, as well as Nicola River watershed. Spring-salmon supplies in the Nicola system were very good, estimated at 9,000 fish, 8,000 of which spawned in the Nicola River, and the remainder in tributaries; that is, Spius Creek and Coldwater River. Several thousand pink salmon were observed spawning in the Nicola River, and large numbers of pink salmon were observed in the Thompson River in the vicinity of Shaw Springs and the Big Horn. This is the first time this species has been observed in these localities in any volume for many years. Small stocks of approximately 500 pinks migrated up the Nahatlatch River. This cycle of cohoes is building up and again shows an increase over the brood-year, particularly so in Spius Creek and Coldwater River, tributaries of the Nicola River.

Chilliwack Area.—A total of 13,000 sockeyes spawned in the Cultus Lake system, compared with 8,500 in 1947. Usual numbers of this species were observed in the Chilliwack Lake area. Approximately 600 spring salmon were present in the Chilliwack-Vedder River. There was marked improvement in the cohoe run to the Chilliwack-Vedder River where some 20,000 of this species spawned, as compared with up to 5,000 in the brood-year of 1948. Local anglers report better fishing than they have experienced in the past fifteen years. Other streams in this area received good average seedings of cohoes. The main pink spawning-streams supported heavy runs of this species; 100,000 to 120,000 pinks were present in the Chilliwack-Vedder River, compared with 60,000 in 1949. Supplies in Sweltzer Creek, estimated at between 60,000 and 70,000, were triple the numbers of the brood-year. In Jones Creek, stocks of 10,000 were comparable with the brood-year. Succer Creek was well seeded. Spawning of this species was below brood-year levels in the Coquihalla River and in the smaller streams, such as Silver, Lorenzetti, and Popcum Creeks. Chum-supplies were satisfactory, although perhaps smaller than those of the brood-year, exceptions being the Chilliwack-Vedder River and Sweltzer Creek, which were heavily stocked.

Mission-Harrison Area.—Satisfactory supplies of sockeyes, estimated at 10,000, spawned in Weaver Creek. Harrison Rapids received only a light seeding by this species, estimated at not more than 3,000; elsewhere, stocks were light. The escapement of spring salmon to the Harrison River, amounting to 10,000, was the best in some years. The pink-salmon run was very good and above brood-year levels, being estimated at

110,000, compared with 85,000 to 100,000 in 1949. The main run occurred to Harrison Rapids, where some 85,000 spawners were present. Chehalis River pink-spawning, on the other hand, was considerably less than two years ago. Chum stocks were satisfactory; approximately 80,000 spawned in the various streams in the area. The early run to the Chehalis, estimated at 5,000, was the largest in many years. Total stocks in this stream were placed at between 25,000 to 50,000 chums. Approximately 20,000 chums were noted in the Harrison River area and sloughs adjacent, while 5,000 were noted in Nicomen Slough.

Lower Fraser Area

Approximately 38,000 sockeyes spawned in the Upper Pitt River system, or more than double the number in the brood-year. Supplies of spring salmon in the Upper Pitt River, the only area frequented by this species, amounted to between 500 and 1,000. Better than average numbers of cohoes were observed in most of the streams at time of inspection, but the spawning run extends well into January and February. The run of pinks was disappointing, amounting to approximately one-half to two-thirds of the brood-year escapement. Supplies were late reaching the Coquitlam River, Alouette River, Kanaka Creek, and other small streams in the area, compared to other years. There was a fair showing in Stave River. The early run of chums to the small streams on the north bank of the Fraser River was above average and commenced to arrive on the grounds early in October. No early-run chums reached the lower streams on the south bank of the Fraser, but there was a plentiful supply of the late run of this species.

North Vancouver Area

The escapement of cohoes to the Capilano and Seymour Rivers was satisfactory, about equal to the brood-year. There was a considerable increase in the number of this species observed in Indian River. The escapement of pinks to the Capilano and Seymour Rivers was light and far below brood-year levels. This was more or less expected owing to the severe damage by flash floods in the fall of 1949. Indian River received adequate pink-seeding. The escapement of chum salmon was very good in all streams frequented by this species, Indian River in particular.

Squamish Area

The spring-salmon seeding, much in line with that of the brood-year, was considered fairly adequate, there being some 16,000 spawners throughout the system. An excellent escapement of cohoes occurred, showing increase on all spawning areas, particularly those located in the Mamquam River. Pink-supplies were heavy, although somewhat less than the brood-year of 1949. Chum-supplies over the watershed were moderately good.

STATISTICAL TABLES

LICENCES ISSUED BY THE DEPARTMENT OF FISHERIES FOR THE 1951 SEASON

Kind of Licence	Number of Licences	Revenue
Salmon-cannery	23	$4,600.00
Herring-cannery	3	300.00
Pilchard-cannery	-----	----------
Herring-reduction	15	1,500.00
Pilchard-reduction	-----	----------
Tierced salmon	3	300.00
Fish cold-storage	22	2,200.00
Fish-processing	21	21.00
Shell-fish cannery	10	10.00
Tuna-fish cannery	5	5.00
Fish-offal reduction	15	15.00
Fish-liver reduction	4	4.00
Whale-reduction	1	100.00
Pickled herring	1	100.00
Herring dry-saltery	5	500.00
Processing aquatic plants	-----	----------
Harvesting aquatic plants	-----	----------
Fish-buyers'	574	14,350.00
Non-tidal fishing	382	385.00
Dogfish-reduction	-----	----------
General receipts	6	45.25
Total		$24,435.25

PACK OF BRITISH COLUMBIA SALMON, SEASON 1951, SHOWING THE ORIGIN OF SALMON CAUGHT IN EACH DISTRICT

(48-pound cases.)

District	Sockeyes	Springs	Steelheads	Cohoes	Pinks	Chums	Total
Fraser River	145,231½	5,719	230½	14,848½	66,673	35,530½	268,233
Queen Charlotte Islands	510	----------	----------	22,579	3,455	61,696½	88,240½
Nass River	24,405½	596½	407½	18,711	70,880	37,742	152,742½
Skeena River	61,694½	2,055½	1,819	19,977½	30,356½	14,778	130,681
Rivers Inlet	102,565½	937½	274½	12,146	20,960	11,842½	148,996
Smith Inlet	49,473	174½	103½	3,259	2,482	2,530	58,022
Central Area	22,312	1,082	706½	61,423½	237,559	190,843½	513,926½
Vancouver Island and adjacent Mainland	22,107	3,133	114	151,325½	303,102½	105,458	585,240
Alaska	----------	----------	----------	8,305	625	1,385	10,315
Cold storage, 1950 catch	----------	----------	----------	829	----------	295	1,124
Totals	428,299	13,698	3,655½	313,674	736,093	462,101	1,957,520½

NOTE.—13,237 cases of bluebacks are combined with cohoes in this table for Vancouver Island.

STATEMENT SHOWING THE TOTAL SALMON-PACK BY SPECIES FROM 1943 TO 1951, INCLUSIVE

	1951	1950	1949	1948	1947	1946	1945	1944	1943
Sockeyes	428,299	408,026 1/2	259,821	261,230 1/2	286,497	543,027	329,001 1/2	247,714	164,889
Springs	13,698	9,233 1/2	21,184	16,445 1/2	10,025	8,100 1/2	12,801	19,362	10,658
Chums	462,101	507,611	230,556 1/2	511,404	486,615 1/2	576,133 1/2	350,188 1/2	255,316 1/2	363,347 1/2
Pinks	736,093	446,456 1/2	709,987	321,721 1/2	600,787 1/2	116,607 1/2	825,513	389,692	530,189
Cohoes	313,674	123,629 1/2	215,944	221,804	146,293	100,154 1/2	218,886 1/2	181,546 1/2	186,043
Steelheads	3,655 1/2	3,227 1/2	2,373	5,663 1/2	3,260 1/2	4,115 1/2	2,922	3,926 1/2	3,095
Totals	1,957,520 1/2	1,498,184 1/2	1,439,866	1,338,271	1,533,478 1/2	1,348,138 1/2	1,739,312 1/2	1,097,557 1/2	1,258,221 1/2

STATEMENT SHOWING THE TOTAL SALMON-PACK OF BRITISH COLUMBIA BY DISTRICTS

Total Packed by Districts in 1943 to 1951, Inclusive

	1951	1950	1949	1948	1947	1946	1945	1944	1943
Fraser River	268,233	139,721 1/2	189,938	104,485	171,302 1/2	413,542	221,351 1/2	130,883 1/2	126,541 1/2
Skeena River	130,681	97,889	129,027	193,435 1/2	79,718	105,912 1/2	221,471 1/2	149,948 1/2	133,589
Rivers Inlet	148,996	172,107 1/2	70,210 1/2	72,117	168,935 1/2	123,304	135,412	59,391	79,697 1/2
Smith Inlet	58,022	52,750	19,083	14,675	46,172	23,177	21,682	6,194 1/2	21,942
Nass River	152,742 1/2	57,961	58,336 1/2	38,538 1/2	29,450	38,313	54,980 1/2	61,096	52,333 1/2
Vancouver Island and adjacent Mainland	585,240	347,996 1/2	538,370 1/2	317,572	552,940 1/2	264,922	492,281 1/2	193,459	347,710 1/2
Other districts	612,482	623,609	431,498 1/2	567,314	456,639	378,968	592,133 1/2	496,587	496,407
Cold storage	1,124	6,150	3,402	30,134	28,321	----------	----------	----------	----------
Grand totals	1,957,520 1/2	1,498,184 1/2	1,439,866	1,338,271	1,533,478 1/2	1,348,138 1/2	1,739,312 1/2	1,097,557 1/2	1,258,221

TABLE SHOWING THE TOTAL SOCKEYE-PACK OF THE FRASER RIVER, ARRANGED IN ACCORDANCE WITH THE FOUR-YEAR CYCLE, 1895–1951

British Columbia	1895— 395,984	1896— 356,984	1897— 860,459	1898— 256,101
Washington	65,143	72,979	312,048	252,000
Total	461,127	429,963	1,172,507	508,101
British Columbia	1899— 480,485	1900— 229,800	1901— 928,669	1902— 293,477
Washington	499,646	228,704	1,105,096	339,556
Total	980,131	458,504	2,033,765	633,033
British Columbia	1903— 204,809	1904— 72,688	1905— 837,489	1906— 183,007
Washington	167,211	123,419	837,122	182,241
Total	372,020	196,107	1,674,611	365,248
British Columbia	1907— 59,815	1908— 74,574	1909— 585,435	1910— 150,432
Washington	96,974	170,951	1,097,904	248,014
Total	156,789	245,525	1,683,339	398,446
British Columbia	1911— 58,487	1912— 123,879	1913— 719,796	1914— 198,183
Washington	127,761	184,680	1,673,099	335,230
Total	186,248	308,559	2,392,895	533,413
British Columbia	1915— 91,130	1916— 32,146	1917— 148,164	1918— 19,697
Washington	64,584	84,637	411,538	50,723
Total	155,714	116,783	559,702	70,420
British Columbia	1919— 38,854	1920— 48,399	1921— 39,631	1922— 51,832
Washington	64,346	62,654	102,967	48,566
Total	103,200	111,053	142,598	100,398
British Columbia	1923— 31,655	1924— 39,743	1925— 35,385	1926— 85,689
Washington	47,402	69,369	112,023	44,673
Total	79,057	109,112	147,408	130,362
British Columbia	1927— 61,393	1928— 29,299	1929— 61,569	1930— 103,692
Washington	97,594	61,044	111,898	352,194
Total	158,987	90,343	173,467	455,886
British Columbia	1931— 40,947	1932— 65,769	1933— 52,465	1934— 139,238
Washington	87,211	81,188	128,518	352,579
Total	128,158	146,957	180,983	491,817
British Columbia	1935— 62,822	1936— 184,854	1937— 100,272	1938— 186,794
Washington	54,677	59,505	60,259	135,550
Total	117,499	244,359	160,531	322,344
British Columbia	1939— 54,296	1940— 99,009	1941— 171,290	1942—446,371
Washington	43,512	63,890	110,605	263,458
Total	97,808	162,899	281,895	709,829
British Columbia	1943— 31,974	1944— 88,515	1945— 79,977	1946— 341,957
Washington	19,117	37,509	53,055	268,561
Total	51,091	126,024	133,032	610,518
British Columbia	1947— 33,952	1948— 64,823½	1949— 96,159	1950— 108,223
Washington	6,760	90,441	80,547	116,458
Total	40,712	155,264½	176,706	224,681
British Columbia	1951— 145,321			
Washington	118,151			
Total	263,472			

STATEMENT SHOWING THE SALMON-PACK OF BRITISH COLUMBIA, BY DISTRICTS AND SPECIES

Fraser River, 1943 to 1951, Inclusive

	1951	1950	1949	1948	1947	1946	1945	1944	1943
Sockeyes	145,231½	108,223	96,159½	64,823½	33,952½	341,957	79,977	88,515	31,973½
Springs	5,719	1,818½	9,889	2,955½	1,455	1,096½	6,130½	12,577½	3,505½
Chums	35,530½	23,343½	6,763	20,209	16,475½	60,713	27,610	13,803½	52,149
Pinks	66,673	72	66,626	31	113,136½	429	95,748½	130	29,860½
Cohoes	14,848½	6,025½	10,286	16,102	6,105	9,168½	11,615	15,564½	8,809
Steelheads	230½	240	214½	364	178	178	270½	293	244
Totals	268,233	139,721½	189,938	104,485	171,302½	413,542	221,351½	130,883½	126,541½

Skeena River, 1943 to 1951, Inclusive

	1951	1950	1949	1948	1947	1946	1945	1944	1943
Sockeyes	61,694½	47,479½	65,937	101,267½	32,534	52,928	104,279½	68,197	28,268½
Springs	2,055½	1,758½	2,507½	4,018½	2,113	2,439	2,382	1,500½	1,783
Chums	14,778	10,969	4,896	11,863	8,236	11,161	9,264	8,741½	6,597
Pinks	30,356½	26,256	33,069½	50,656	13,190½	10,737	69,783½	48,837	54,509
Cohoes	19,977½	9,781	21,333½	22,086½	21,600½	26,281½	34,201½	20,191½	40,479½
Steelheads	1,819	.....	2,507½	3,544	2,044	2,366	1,561	2,481	1,952
Totals	130,681	97,889	129,027	193,435½	79,718	105,912½	221,471½	149,948½	133,589

Rivers Inlet, 1943 to 1951, Inclusive

	1951	1950	1949	1948	1947	1946	1945	1944	1943
Sockeyes	102,565½	142,710½	39,494½	37,665½	140,087	73,320	89,735	36,582½	47,602½
Springs	937½	619½	743	899½	475	1,108½	1,191½	805	765
Chums	11,842½	10,014½	11,819	11,486½	13,873	37,395½	16,793	2,705	11,448
Pinks	20,960	12,864	11,937	13,491	9,025	1,641½	9,916	5,289½	8,347
Cohoes	12,146	5,736	5,978	8,143	5,182	9,524½	17,516½	13,921	11,466
Steelheads	274½	163	239	431½	293½	314	260	88	69
Totals	148,996	172,107½	70,210½	72,117	168,935½	123,304	135,412	59,391	79,697½

Smith Inlet, 1943 to 1951, Inclusive

	1951	1950	1949	1948	1947	1946	1945	1944	1943
Sockeyes	49,473	42,435	13,189	10,456½	36,800	14,318	15,014	3,165	15,010
Springs	174½	71½	159	186½	43	45	26	66	118
Cohoes	3,259	397	785	929½	348	177	560	343	541
Pinks	2,482	5,308	2,533	1,481½	1,054	235	2,362	498½	556
Chums	2,530	4,499½	2,361	1,521½	7,910	8,369	3,692	2,122	5,693
Steelheads	103½	39	56	99½	21	33	28	666	24
Totals	58,022	52,750	19,083	14,675	46,172	23,177	21,682	6,194½	21,942

STATEMENT SHOWING THE SALMON-PACK OF BRITISH COLUMBIA, BY DISTRICTS AND SPECIES—*Continued*

Nass River, 1943 to 1951, Inclusive

	1951	1950	1949	1948	1947	1946	1945	1944	1943
Sockeyes	24,405½	27,286½	9,268	13,181½	10,849	12,511	9,899	13,083	13,412½
Springs	596½	798½	174½	416	398	472	202	681½	1,002½
Chums	37,742	14,321	7,854	7,272½	8,925	13,810	4,981½	9,143	10,146½
Pinks	70,880	12,582	34,324	8,565	5,047	7,147	35,918½	31,854	17,669
Cohoes	18,711	2,737	6,665	8,954½	4,075	4,239	3,895	6,102	9,768
Steelheads	407½	236	51	149	156	134	84½	232½	335
Totals	152,742½	57,961	58,336½	38,538½	29,450	38,313	54,980½	61,096	52,333½

Vancouver Island District and Adjacent Mainland, 1943 to 1951, Inclusive

	1951	1950	1949	1948	1947	1946	1945	1944	1943
Sockeyes	22,107	13,806	19,486½	9,981½	14,543	35,381½	5,988	5,288½	7,185
Springs	3,133	3,343	6,361½	6,622	4,942½	2,283½	2,323	3,068½	2,937
Chums	105,458	125,833	51,629	147,227½	99,679½	190,313	136,724	56,029½	132,843
Pinks	303,102½	132,016	361,783½	43,574½	355,992	6,809½	242,590½	49,092	130,825
Cohoes*	151,325½	72,871	98,958½	109,939½	77,684½	29,983	104,528	79,813½	73,846½
Steelheads	114	127½	151½	227	99	151½	128	165	74
Totals	585,240	347,996½	538,370½	317,572	552,940½	264,922	492,281½	193,459	347,710½

* Since 1940, bluebacks have been included with the cohoe-pack for Vancouver Island.

Queen Charlotte Islands, 1943 to 1951, Inclusive

	1951	1950	1949	1948	1947	1946	1945	1944	1943
Sockeyes	510	89	----------	20	----------	----------	----------	157	53
Springs	----------	48	----------	145	----------	----------	4	20	----------
Chums	61,696½	148,669	24,852½	71,287	14,096	32,414	12,132	81,916	35,370
Pinks	3,455	92,986	1,550	51,722	1,200	8,024	4,809	90,993	313
Cohoes	22,579	9,021	8,141½	4,145	392	1,192	1,108	19,615	14,488
Steelheads	----------	15	----------	----------	----------	5	----------	1	----------
Totals	88,240½	250,828	34,544	127,319	15,688	41,635	18,053	192,702	50,224

Central Area, 1943 to 1951, Inclusive

	1951	1950	1949	1948	1947	1946	1945	1944	1943
Sockeyes	22,312	25,997	16,140½	23,246½	17,343½	12,611½	24,109	32,715	21,101
Springs	1,082	776	1,007	1,195½	514½	656	542	643	547
Chums	190,843½	164,884	116,292½	225,686	292,604½	221,958	138,992	80,793	109,101
Pinks	237,559	163,301	173,456	152,200½	101,241½	81,584½	364,385	162,986	288,109½
Cohoes	61,423½	17,061	44,169	36,816	28,778	19,589	45,462½	25,823	26,645
Steelheads	706½	762	355	850½	469	934	590	666	397
Totals	513,926½	372,781	351,420	439,995	440,951	337,333	574,080½	303,626	445,900½

STATEMENT SHOWING THE QUANTITY OF PILCHARD PRODUCTS PRODUCED IN BRITISH COLUMBIA, 1930 TO 1951

Season	Canned	Meal	Oil
	Cases	Tons	Gal.
1930–31	55,166	13,934	3,204,058
1931–32	17,336	14,200	2,551,914
1932–33	4,622	8,842	1,315,864
1933–34	2,946	1,108	275,879
1934–35	35,437	7,628	1,635,123
1935–36	27,184	8,666	1,634,592
1936–37	35,007	8,715	1,217,087
1937–38	40,975	8,483	1,707,276
1938–39	69,473	8,891	2,195,850
1939–40	7,300	906	178,305
1940–41	59,166	4,853	890,296
1941–42	72,498	11,437	1,916,191
1942–43	42,008	11,003	1,560,269
1943–44	94,512	15,209	2,238,987
1944–45	78,772	8,435	1,675,090
1945–46	79,536	5,812	1,273,329
1946–47	4,359	699	81,831
1947–48	2,656	67	12,833
1948–49	------	------	------
1949–50	------	------	------
1950–51	------	------	------
1951–52	------	------	------

STATEMENT SHOWING THE QUANTITY OF HERRING PRODUCTS PRODUCED IN BRITISH COLUMBIA, 1935 TO 1951

Season	Canned	Dry-salted	Pickled	Meal	Oil
	Cases	Tons	Tons	Tons	Gal.
1935–36	26,143	14,983	-----	5,313	328,639
1936–37	20,914	16,454	-----	10,340	786,742
1937–38	27,365	10,230	-----	14,643	1,333,245
1938–39	23,353	7,600	-----	18,028	1,526,117
1939–40	418,021	7,596	-----	22,870	1,677,736
1940–41	640,252	5,039	892	10,886	923,137
1941–42	1,527,350	------	779	8,780	594,684
1942–43	1,253,978	------	502	4,633	323,379
1943–44	1,198,632	------	591	7,662	512,516
1944–45	1,190,762	------	26	9,539	717,655
1945–46	1,307,514	302	100	5,525	521,649
1946–47	1,634,286	5,807	129½	7,223	484,937
1947–48	1,283,670	3,084*	1	18,948	1,526,826
1948–49	92,719	412	-----	31,340	2,614,925
1949–50	77,913	3,858	-----	30,081	3,823,464
1950–51	56,798	4,418	-----	31,913	3,385,685
1951–52	103,928	4,331	-----	32,777	3,832,301

* Previously reported as 2,988 tons.

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

STATEMENT SHOWING THE QUANTITY OF MEAL, OIL, AND FERTILIZER PRODUCED FROM SOURCES OTHER THAN HERRING AND PILCHARD, 1941 TO 1951.

Season	From Whales			From Fish-livers	From Other Sources	
	Whalebone and Meal	Fertilizer	Oil	Oil	Meal and Fertilizer	Oil
	Tons	Tons	Gal.	Gal.	Tons	Gal.
1941–42	270	561	619,025	.....	5,410	405,340
1942–43	130	205	255,555	916,723	4,768	338,502
1943–44	62	90	134,553	822,250	4,332	60,000
1944–45	.....	.....	.....	545,736	2,721	301,048
1945–46	.....	.....	.....	445,858	4,560	513,442
1946–47	.....	.....	.....	211,914	4,208	453,008
1947–48	.....	.....	.....	11,109,063*	3,929	519,802
1948–49	119	324	186,424	10,121,374*	1,172	141,098
1949–50	921	21	312,055	12,079,015*	1,635	175,202
1950–51	1,098	.....	393,176†	3,578,905‡	1,717	166,898
1951–52	1,981	.....	680,129	5,250,441‡	3,593	250,777

* Fish-liver oil, formerly reported in gallons, is now reported in million U.S.P. units Vitamin A.
† Includes oil from whales.
‡ Includes Vitamin A production from whales.

CATCH OF FISH TAKEN FROM NON-TIDAL WATERS, 1951–52 SEASON

Lakes and Rivers	Kind of Licence			Trout		Kokanee		Lake-trout		Whitefish		Carp		Ling		Squawfish		Suckers		Other Fish		Number of Fish Taken	Approximate Weight (Lb.)
	Fur-farm	Ordinary	Sturgeon	No.	Lb.	No.	Lb.	No.	Lb.	No.	Lb.	No.	Lb.	No.	Lb.	No.	Lb.	No.	Lb.	No.	Lb.		
Atlin Lake	—	2	—					17	75	329	372											346	447
Arrow Lake	2	—	—																				
Bennett Lake	1	—	—																				
Bednesti Lake	1	—	—											33	96	409	409	556	1,665	166	86	1,164	2,256
Chief Lake	1	—	—																				
Cluculz Lake	1	1	—											33	96	411	411	557	1,673	166	87	1,167	2,267
Cobb Lake	—	1	—											33	96	410	410	557	1,672	166	87	1,166	2,265
Cameron Lake	—	3	—							140	560											140	560
Christina Lake	1	7	—																				
Columbia River	—	3	—																				
Duck Lake	—	1	—																				
Dixie Lake	—	1	—					14	43									123	150			137	193
Eaglet Lake	1	—	—																				
Eulatazella Lake	1	—	—																				
Francois Lake	—	5	—					98	573	50	210			62	307			33	142			243	1,232
Fish Lake	—	3	—							280	1,600											280	1,600
Fraser River	—	—	1																				
Hogsback Lake	1	—	—									244	245	275	114			37	15			556	374
Kootenay River	2	—	—							775	360			1	2			620	1,125			1,396	1,487
Moberly Lake	—	3	—							860	3,440									835	10,000	1,695	13,440
Nechako River	—	—	2																	*1	90	1	90
Otter Lake	—	1	—																				
Okanagan Lake	—	342	—			31,120	18,323															31,120	18,323
Stuart Lake	1	—	—																				
Sinkut Lake	-1	—	—									244	246	276	114			37	15			557	375
Swan Lake	—	3	—																				
Windermere River	—	2	—																				
Totals	—	—	—			31,120	18,323	129	691	2,434	6,542	488	491	713	825	1,230	1,230	2,520	6.457	1,334	10,350	39,968	44,909

* Sturgeon.

Licences Issued during the 1951–52 Season

Ordinary	371
Fur-farm	9
Sturgeon	2
Total	382

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