PROVINCE OF BRITISH COLUMBIA

Provincial Department of Fisheries

REPORT

WITH APPENDICES

For the Year Ended December 31st

1955

VICTORIA, B.C.
Printed by DON MCDIARMID, Printer to the Queen's Most Excellent Majesty
1956

To His Honour FRANK MACKENZIE ROSS, C.M.G., M.C.,
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, 1955.

WILLIAM RALPH TALBOT CHETWYND,
Minister of Fisheries.

Department of Fisheries,
Minister's 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, 1955.

I have the honour to be,

Sir,

Your obedient servant,

GEORGE J. ALEXANDER,
Deputy Minister.

TABLE OF CONTENTS

	Page
Value of British Columbia's Fisheries in 1955 Shows a Decrease	7
Review of British Columbia's Salmon-canning Industry, 1955	7
The Canned-salmon Pack for British Columbia, 1955	8
British Columbia's Canned-salmon Pack by Districts	8
Other Canneries	16
Mild-cured Salmon	17
Dry-salt Salmon	17
Dry-salt Herring	17
Halibut-fishery	18
Fish Oil and Meal	19
Net-fishing in Non-tidal Waters	20
Condition of British Columbia's Salmon-spawning Grounds	20
Value of Canadian Fisheries and the Standing of the Provinces, 1954	20
Species and Value of Fish Caught in British Columbia	21
Contributions to the Life-history of the Sockeye Salmon (Paper No. 41) (Digest)	22
Herring Investigation	22
Report of the Biologist, 1955	24

APPENDICES

CONTRIBUTIONS TO THE LIFE-HISTORY OF THE SOCKEYE SALMON (No. 41). By D. R. Foskett, B.A., M.A., Fisheries Research Board of Canada, Biological Station, Nanaimo, B.C.	28
THE STATUS OF THE MAJOR HERRING STOCKS IN BRITISH COLUMBIA IN 1955–56. By F. H. C. Taylor, M.A.; A. S. Hourston, Ph.D.; and D. N. Outram, B.A., Fisheries Research Board of Canada, Biological Station, Nanaimo, B.C.	51
PHYTOPLANKTON AND PHYSICAL CONDITIONS IN LADYSMITH HARBOUR. By C. D. McAllister	81
THE BRITISH COLUMBIA SHIPWORM	92
REPORT OF THE INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION FOR 1955	105
INTERNATIONAL PACIFIC HALIBUT COMMISSION, 1955	109
SALMON-SPAWNING REPORT, BRITISH COLUMBIA, 1955	112
STATISTICAL TABLES	127

REPORT OF THE PROVINCIAL DEPARTMENT OF FISHERIES FOR 1955

VALUE OF BRITISH COLUMBIA'S FISHERIES IN 1955 SHOWS A DECREASE

The total marketed value of the fisheries of British Columbia for 1955 amounted to $60,668,000.* This was a decrease from the production of the year previous of $8,754,000, or approximately 15 per cent less than the marketed value of fisheries products in 1954.

The principal species, as marketed in 1955, were salmon, with a value of $42,869,000; herring, with a value of $7,323,000; and halibut, with a marketed value of $3,924,000 (livers and viscera excluded). The value of the salmon production was $7,412,000 less than in 1954. The value of herring production in 1955 was $7,323,000, almost equal to the value of the 1954 season. It should be noted that these figures are for the calendar year and, consequently, somewhat distort the picture in respect to herring, as this fishery extends from November to March. The herring values quoted are for those fish landed in the months of January and February and properly belong to the 1954–55 herring-fishing season. The value of the 1955 halibut-catch was $2,000,000 less than in 1954.

In 1955 the marketed value of shell-fish amounted to $2,133,000. The value of clam production was $436,000; oyster production, $420,000; crab production, $996,000; shrimp production, $281,000.

The total value of boats engaged in commercial fishing in 1955 was $42,500,000, and the total value of gear used in British Columbia's fisheries during 1955 was $7,840,000.

The above figures were taken from the "Preliminary Fisheries Statistics of British Columbia," published by the Canadian Department of Fisheries, Vancouver, B.C.

REVIEW OF BRITISH COLUMBIA'S SALMON-CANNING INDUSTRY, 1955

In 1955 the Provincial Department of Fisheries licensed twenty salmon-canneries to operate in the Province. This was the same number as were licensed in the year previous. The location of the canneries in 1955 was as follows: Fraser River and Lower Mainland, 12; Central Area, 2; Skeena River Area, 5; and Rivers Inlet, 1. The number of canneries operated and the distribution was the same as in 1954. No canneries have been operated on the Nass River or in the Queen Charlotte Islands for some time, and this is also true of Vancouver Island. All of these areas formerly supported salmon-canneries, but in recent past years the tendency has been to operate fewer canneries in the outlying areas and concentrate the actual canning operations in more strategically located areas. This concentration of operations has been made possible largely by the greater number of comparatively fast packers and an adequate supply of crushed ice, which makes the transportation of fresh fish in good condition over longer distances a more economical means of operation. The salmon-canners have taken advantage of this in order to cut overhead by reducing the number of canneries operating. It would seem, however, that this has been carried to what would appear to be the limit of concentration, as indicated by the number and distribution of canneries over the past few years.

In 1955 there were no significant interruptions or delays in the salmon-fishery due to disputes over prices or terms of contract.

* This figure does not include Japanese-caught tuna canned in British Columbia.

Normally the export of fresh salmon for canning is not permitted, but since 1947 fresh salmon have been permitted to be exported after September 1st in each year. This permission to export after September 1st has resulted in a large movement of chum salmon to the United States for processing in Puget Sound canneries, and in 1955 there was again a large movement of chums to Puget Sound for canning. The reader should take into consideration these quantities when an analysis is being made of the canned pack of chum salmon. The reader should also take into account, when considering the pack figures for the canneries of the Lower Mainland, the fairly large amount of chum salmon caught in Johnstone Strait and the Gulf of Georgia which find an outlet in the frozen-fish trade.

Probably the most significant single feature of the salmon-canning operations in British Columbia in 1955 was the extremely small pack of sockeye, amounting to 244,821 cases. This was the smallest pack of sockeye since 1943. Another feature of the 1955 pack was the extremely large pack of pink salmon, amounting to 831,255 cases. The 1955 pack of pinks was the largest on record in recent past years. These packs will be dealt with further in the next section of the Report.

THE CANNED-SALMON PACK FOR BRITISH COLUMBIA, 1955

The total canned-salmon pack for British Columbia in 1955 amounted to 1,410,298 cases, compared with 1,747,854 cases in the year previous, according to annual returns submitted to the Provincial Department of Fisheries by those canners licensed to operate. The 1955 total pack was 337,556 cases less than in 1954. The 1955 canned-salmon pack was 239,186 cases below the average annual pack for the previous five-year period.

In the year under review the canned-salmon pack was composed of 244,821 cases of sockeye, 17,859 cases of springs, 1,882 cases of steelheads, 186,191 cases of cohoe, 831,255 cases of pinks, and 128,289 cases of chums.

As pointed out above, the total sockeye-pack in the 1955 season was the smallest pack in British Columbia since 1943. The spring-salmon pack in 1955 was the largest pack of this species since 1949, in which year 21,184 cases were canned. The cohoe-pack, amounting to 186,191 cases, was the largest pack of this species since 1951, and in no year since 1934 has the pink-salmon pack been greater than in the year under review. Chum salmon packed in 1955 were considerably below average, and, except for the very small pack in 1952, the 1955 pack was the smallest on record in recent past years. In considering the pack of chum salmon, however, due allowance must be made for the large number of chum salmon which are exported each year to the United States.

BRITISH COLUMBIA'S CANNED-SALMON PACK BY DISTRICTS

Fraser River

The total canned-salmon pack for the Fraser River in 1955 amounted to 294,238 cases, compared with a total pack for this river system in 1954 amounting to 563,807 cases. The pack in 1953 was 496,936 cases, while in 1952 it amounted to 151,147 cases. The 1955 Fraser River pack was composed of 103,678 cases of sockeye, 6,843 cases of springs, 269 cases of steelheads, 15,910 cases of cohoe, 160,187 cases of pinks, and 7,350 cases of chums. Half-cases have been dropped in each instance.

Sockeye Salmon.—In 1955 the Canadian pack of sockeye salmon for the Fraser River amounted to 103,678 cases. This was the smallest pack of this species since 1949, when the pack amounted to 96,159 cases. The 1955 Fraser River sockeye-pack was 110,658 cases less than the average annual pack for this river system for the previous five years. The cycle-year 1951 for Fraser River sockeye produced a pack of 145,231 cases, while in the previous cycle-year the pack was 33,952 cases.

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 the fishery pass through both Canadian and United States territorial waters before reaching the Fraser River, 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. The Commission's job has been to try to rehabilitate the sockeye-salmon runs to the Fraser River. There can be little doubt, from the results of fishing in the last few years, that the efforts of the Commission are producing results. Much of the catch which produced the large sockeye-packs in recent past years was due to the remarkable comeback of the Adams River run, but there was no large run to the Adams River in 1955. Other areas of the Fraser are showing signs of improvement over previous years.

It is part of the duty of the International Pacific Salmon Fisheries Commission to regulate the Fraser River sockeye-salmon fishery in such a way that the nationals of each country will share equally in the catch as closely as is practicable. According to figures released by the Commission in 1955, the total sockeye-catch was 2,595,000 fish, the second largest in this cycle since 1903. The Canadian catch amounted to 1,108,081 fish and was 52 per cent of the total catch. The following table shows the percentage of catch by American and Canadian fishermen since 1938:—

	American (Per Cent)	Canadian (Per Cent)
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
1952	49.74	50.26
1953	50.31	49.69
1954	50.44	49.56
1955	48.00	52.00

In the Appendix to this Report there is a table showing the total sockeye-salmon packs of the Fraser River, arranged in accordance with the four-year cycle, from 1895 to 1955, inclusive, showing the catches made by British Columbia and Washington fishermen in the respective years.

For a more detailed account of the 1955 sockeye-salmon fishery on the Fraser River, the reader is referred to the report of the International Pacific Salmon Fisheries Commission for 1955, specially prepared by the Commission for inclusion in this Report and published in the Appendix.

Spring Salmon.—The canned pack of spring salmon on the Fraser River is never indicative of the size of the catch of this species or of the size of the run, 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, and, generally speaking, the canned pack is made up of fish which are caught incidental to fishing for other species or those fish caught in the early spring-salmon run. The spring-salmon catch in 1955 was 6,843 cases, compared

with 8,298 cases in 1954, 5,620 cases in 1953, 2,279 cases in 1952, and 5,719 cases in 1951.

Cohoe Salmon.—The Fraser River in 1955 produced a pack of 15,910 cases of cohoe. This is compared with the 1954 pack of 11,948 cases and the cycle-year 1953, in which the pack was 15,480 cases. The 1955 cohoe-pack on the Fraser was 3,173 cases greater than the average annual pack for this species for the previous five-year period.

In making these comparisons, due allowance should be made for large quantities of cohoes caught in the Fraser River area which are frozen. These, of course, are in addition to the catch indicated by the canned-salmon pack.

Pink Salmon.—Pink salmon run to the Fraser River every alternate year, the runs coinciding with the odd-numbered years. In 1955 the Fraser River produced a pack to Canadian fishermen amounting to 160,187 cases. This is compared with the cycle-year 1953, when 204,421 cases of pink salmon were canned. In 1951 the pack amounted to 66,673 cases, while in the corresponding cycle-year 1949, the pack was 66,626 cases. For comparison the cycle-year in 1947 produced a pack of 113,136 cases, while in 1945 the pack was 95,748 cases.

Chum Salmon.—In 1955 the chum-salmon pack on the Fraser amounted to 7,350 cases. This is compared with the 1954 pack of 45,444 cases. The 1955 pack of chum salmon on the Fraser was the smallest since 1949, when 6,763 cases were canned. The 1955 pack of chum salmon was 17,359 cases below the average annual pack on the Fraser for the past five years.

It was mentioned in a previous section of this Report that in recent past years the embargo on the exportation of salmon for canning purposes was removed after September 1st. This permits much of the chum-salmon catch to be shipped to Puget Sound canneries for canning there. This export of fall fish has resulted in a very much reduced canned-salmon pack in British Columbia. This movement of large quantities of chum salmon to the United States for canning in Puget Sound canneries is indicative of what could happen to British Columbia's salmon-canning industry if, for any reason, the Canadian embargo on the export of fresh salmon for canning were lifted. There is no doubt that the United States canners, with their very much larger home market, would be able to outbid Canadian canners for Canadian fish, with the result that Canadian fish would be canned in the United States or else the Canadian consumer would have to pay a higher price for salmon caught and canned in Canada. The extra dollars earned by the slightly higher price obtained by the fishermen for fish on the other side of the line would certainly not compensate for the loss incurred by the large number of people who find employment in British Columbia canneries, together with the higher cost to the Canadian consumer.

In view of developments which have taken place in the salmon-fisheries of British Columbia in recent past years, there would seem to be no good reason why the embargo should be lifted on chum salmon after September 1st. It would seem only prudent that the fish should be canned in Canadian canneries and the profits accrue to Canadians.

In considering the canned-salmon pack figures as an indication of the runs to the different streams in the Province, the reader is cautioned that any consideration of the canned-salmon pack as a measure of the total run of any species should take into consideration the escapement to the spawning-beds. This is contained in a report by the Chief Supervisor of Fisheries for the Federal Fisheries Department, which is included in the Appendix to this Report.

Skeena River

The total pack of all species of salmon canned on the Skeena River in 1955 was 123,507 cases. The pack was composed of 14,649 cases of sockeye, 1,430 cases of springs, 976 cases of steelheads, 14,192 cases of cohoe, 86,788 cases of pinks, and 5,471 cases of chums. Half-cases have been dropped in each instance. The 1955 pack is

compared with the pack of 1954, in which year there were canned a total of 136,500 cases. In 1953 the total pack on the Skeena River was 117,406 cases, while 221,306 cases were canned in 1952.

Mention was made under this heading in the Report for 1954 that the Federal Minister of Fisheries had announced the setting-up of a committee to recommend measures to correct the cause of the low production for the Skeena River in recent past years. This committee is still functioning.

Sockeye Salmon.—The sockeye-salmon pack on the Skeena River in 1955 amounted to 14,649 cases, which was most disappointing. The 1955 pack is compared with that of 1954, in which year there were canned 60,817 cases, while in 1953 the pack was 65,003 cases. The pack in 1955 was the lowest pack of sockeye salmon on record for the Skeena River, and while it is true the run in 1955 was partly the result of the 1951 spawning, which was badly interrupted by a rock-slide, nevertheless it does not seem that the low pack in 1955 was entirely the result of the disaster in 1951. The sockeye runs to the Skeena have been consistently averaging smaller in late years, and the industry should be prepared to accept rather drastic measures in order that the sockeye runs to this system may be rehabilitated to something like their former production.

Spring Salmon.—Spring salmon on the Skeena River, as on most of the other river systems of the Province of British Columbia, find an outlet in markets other than canning, and the springs canned are usually caught incidental to fishing for other species on this river system. The size of the pack, therefore, is not indicative of the size of the run or of the size of the catch.

In 1955 the Skeena River produced a pack of 1,430 cases of spring salmon, compared with 1,260 cases in 1954, 1,174 cases in 1953, 2,082 cases in 1952, and 2,055 cases in 1951.

Cohoe Salmon.—Cohoes are never a large factor in the Skeena River canned-salmon pack, and the total number of cases canned has varied widely from year to year. The 14,192 cases canned in 1955 are compared with 10,449 cases in 1954, 5,260 cases in 1953, 8,358 cases in 1952, and 19,977 cases in 1951.

Pink Salmon.—There were 86,788 cases of pink salmon canned on the Skeena River in 1955. The pack figures for pink salmon also vary widely from year to year. In 1954 there were canned 39,324 cases, while in 1953 the pack was 29,884 cases. In 1952 the Skeena produced a pack of 89,314 cases.

Chum Salmon.—In 1955 the chum-salmon pack on the Skeena River was 5,471 cases, which, when compared with the previous year, was most disappointing. The pack in 1954 was 23,135 cases, while in 1953, 15,114 cases were canned. In 1952 the pack was down to 4,638 cases, but in the previous year, 1951, the pack was 14,778 cases.

Nass River

The canned-salmon pack for the Nass River has fluctuated rather widely over the years, but in recent past years the pack has been remarkably steady. In 1955 the pack of 62,081 cases compares rather closely with the total pack in 1954, which was 69,358 cases, while in 1953 the pack was 66,510 cases. In 1952, 57,775 cases were canned, but in 1951 the total canned-salmon pack for the Nass River was 152,742 cases.

The Nass River pack in 1955 was composed of 13,654 cases of sockeye, 1,028 cases of springs, 99 cases of steelheads, 9,356 cases of cohoe, 29,040 cases of pinks, and 8,904 cases of chums.

Sockeye Salmon.—In 1955 the sockeye-salmon pack on the Nass River was 13,654 cases, and while this was 3,369 cases more than were packed in the year previous, the 1955 pack nevertheless was 5,545 cases below the average annual pack for the Nass River for the previous five-year period, and if Nass River fish are considered to be four-year fish, the 1955 pack is compared with the 1951 sockeye-pack, which amounted to 24,405 cases. The 1955 sockeye-pack on the Nass was most disappointing.

Spring Salmon.—Spring salmon are caught and canned on the Nass River only incidental to fishing for other species; consequently, the pack is not indicative of the size of the run and should be considered in the light of the spawning-ground reports.

In 1955 the pack of spring salmon on the Nass River amounted to 1,028 cases, compared with 398 cases in 1954, 527 cases in 1953, 641 cases in 1952, and 596 cases in 1951.

Cohoe Salmon.—On the Nass River in 1955 the pack of cohoe amounted to 9,356 cases, compared with 6,024 cases in 1954, 5,118 cases in 1953, 1,223 cases in 1952, and 18,711 cases in 1951. The records for cohoe production on the Nass River in recent past years indicate a wide fluctuation of this species.

Pink Salmon.—The pack of pink salmon on the Nass River in 1955 amounted to 29,040 cases and is compared with the previous year's pack of 36,448 cases. In 1953 the Nass produced a pack of 16,635 cases of pinks, while in the year previous 13,016 cases were canned. In 1951 the pack of pinks on the Nass amounted to 70,880 cases.

Chum Salmon.—The chum-salmon pack on the Nass River is never large, but the pack of 8,904 cases canned in 1955 was rather disappointing in view of the recent past record. In 1954 the pack of chums on the Nass was 15,965 cases, while 25,756 cases were canned in 1953. In 1952 the pack was 13,112 cases, and in 1951, 37,742 cases were produced.

In using the canned-salmon pack figures for any of the principal fishing-streams, the reader is cautioned that these do not necessarily represent the size of the runs, notwithstanding the fact that the salmon-packs are usually considered as indicative of the size of the run. The reader who is interested in the size of the runs to the different river systems should examine carefully the reports of the Chief Supervisor of Fisheries on the condition of the salmon-spawning areas of the various runs. The canned-salmon pack indicates the size of the catch and not necessarily the size of the escapement. The Chief Supervisor's report on the spawning areas will be found in the Appendix to this Report.

Rivers Inlet

In 1955 the total salmon-pack for Rivers Inlet amounted to 71,164 cases. This was almost identical to the total pack for this inlet in 1954, in which year the pack amounted to 71,023 cases. The Rivers Inlet total salmon-pack in the last two seasons has been most disappointing when compared with the previous years' packs for this system. In 1953 Rivers Inlet produced a pack of 148,885 cases, while in 1952 the pack amounted to 105,040 cases. In 1951 the pack was 148,996 cases, and in 1950 the pack was 172,107 cases. In the light of the foregoing, the 1955 pack must be considered as rather disappointing.

The 1955 pack was composed of 50,702 cases of sockeye, 813 cases of springs, 86 cases of steelheads, 5,316 cases of cohoe, 8,658 cases of pinks, and 5,588 cases of chums.

Sockeye Salmon.—The 50,702 cases of sockeye salmon canned in Rivers Inlet in 1955 was within a few cases of the pack in 1954, when 50,639 cases were canned. When considered in comparison with previous years' packs for this system, the 1955 pack must be considered as disappointing. The average annual pack for the previous five-year period on Rivers Inlet was 84,222 cases. The 1955 sockeye-pack was 34,736 cases below the average annual pack for the previous ten-year period.

Spring Salmon.—Spring salmon in Rivers Inlet are never a large factor in the total pack for this area, being caught incidental to fishing for sockeye. The pack of springs in Rivers Inlet in 1955 amounted to 813 cases, while the pack in 1954 was 649 cases. In 1953 the spring-salmon pack amounted to 865 cases, while in 1952 there were also canned 865 cases. The 1951 Rivers Inlet spring-salmon pack was 937 cases.

Cohoe Salmon.—Rivers Inlet is never a large producer of cohoe salmon, but the 1955 pack of 5,316 cases was somewhat larger than the pack in 1954, when 4,669 cases

were canned. In 1953 the pack was 1,979 cases, while in 1952, 3,415 cases were canned. The pack in 1951 amounted to 12,146 cases.

Pink Salmon.—Rivers Inlet is not a producer of pink salmon in the true sense of the word. The few which are canned each year are caught in sockeye gill-nets incidentally while fishing for sockeye salmon. The pack in 1955 amounted to 8,658 cases, which is compared with the previous years' packs of 2,581 cases in 1954, 7,304 cases in 1953, and 12,469 cases in 1952. In 1951, Rivers Inlet produced a pink-salmon pack of 20,960 cases.

Chum Salmon.—Rivers Inlet did not produce chum salmon for canning until 1935, in which year a small fall salmon-fishery was introduced for the first time. Since then there has been a pack of canned chums put up each year, the pack varying in size from year to year, more in relation to the fluctuation and demand for chum salmon than to the size of the runs.

In 1955 Rivers Inlet produced 5,588 cases of chum salmon, which are compared with 12,352 cases in the year previous. In 1953 the pack was 5,627 cases, while 3,711 cases were canned in 1952 and 11,842 cases in 1951.

Smith Inlet

Smith Inlet, like Rivers Inlet, is largely a sockeye-producing area. Other species caught in Smith Inlet are usually caught incidentally while fishing for sockeye. The total canned-salmon pack for Smith Inlet in 1955 was 34,570 cases, composed of 28,864 cases of sockeye, 326 cases of springs, 20 cases of steelheads, 1,014 cases of cohoe, 2,275 cases of pinks, and 2,070 cases of chums, half-cases having been dropped in each instance.

Sockeye Salmon.—In 1955 Smith Inlet produced a pack of 28,864 cases of sockeye, compared with 49,473 cases in 1951, the cycle-year. The 1955 pack is compared with the 1954 pack which amounted to 18,937 cases and with the 1953 pack of 29,947 cases. In 1952 the pack amounted to 34,834 cases. If Smith Inlet sockeye are considered five-year fish rather than four-year fish, then the 1955 pack should be compared with that of 1950, which produced 42,435 cases.

Spring Salmon.—Spring salmon in Smith Inlet, as in Rivers Inlet, are caught only incidentally while fishing for sockeye, and consequently the pack is never large. In 1955 Smith Inlet produced a pack of 326 cases, compared with 177 cases in 1954, 176 cases in 1953, 367 cases in 1952, and 174 cases in 1951.

Cohoe Salmon.—The same remarks hold true for the cohoe-salmon catch in Smith Inlet, and in 1955 this inlet produced a pack of 1,014 cases. The 1955 pack is compared with the 1954 pack, when 868 cases were canned. In 1953 the pack was 615 cases; in 1952, 1,466 cases and in 1951, 3259 cases of cohoe were canned in Smith Inlet.

Pink Salmon.—Smith Inlet does not support a pink-salmon run of any account. The few pink salmon caught in this area are caught incidentally while fishing for sockeye. In 1955 the inlet produced a pack of 2,275 cases of pinks. In the year previous, 523 cases of pinks were canned, while in 1953 the pack was 1,017 cases; in 1952 it was 6,496 cases; and in 1951 only 2,482 cases were packed.

Chum Salmon.—In 1955 there were 2,070 cases of chums canned from Smith Inlet caught fish. The pack in 1954 was 2,992 cases, and in 1953, 4,015 cases. In 1952 the chum-salmon pack in Smith Inlet dropped to 315 cases, while in 1951, 2,530 cases of this species were canned.

Queen Charlotte Islands

Pinks and chums are the two species of salmon fished in the Queen Charlotte Islands District exclusively for canning purposes. Chum salmon are taken every year in this district, but pink salmon are caught only every alternate year, the runs coinciding with the even-numbered years.

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 fishery is conducted by trollers and is not considered in these reports of the canned-salmon packs. The few cohoes which are caught incidentally while fishing for chum salmon are canned and included in the salmon-pack figures for the Queen Charlotte Islands. However, the canned-cohoe pack credited to the Queen Charlotte Islands is in no way indicative of the quantities of cohoes caught in this area.

In 1955 the total canned-salmon pack from Queen Charlotte Islands caught fish was 22,088 cases. This pack was composed of 433 cases of sockeye, 16 cases of springs, 5 cases of steelheads, 11,668 cases of cohoe, 548 cases of pinks, and 9,420 cases of chums. In each instance half-cases have been dropped.

Sockeye Salmon.—The 433 cases of sockeye salmon canned from Queen Charlotte Islands fish in 1955 were caught incidental to fishing for chum and apparently cohoe salmon, and are probably stragglers which were proceeding elsewhere to spawn. The 1955 pack is compared with the 107 cases caught in the preceding year.

Spring Salmon.—The above remarks also apply in the case of spring salmon. In 1955 the pack was 16 cases, while in 1954, 6 cases of spring salmon were canned from this area.

Cohoe Salmon.—The Queen Charlotte Islands District produced a pack of cohoe in 1955 amounting to 11,666 cases. This is compared with 11,289 cases in the year previous. In 1953 there were 2,437 cases of cohoe canned, while in 1952 the pack amounted to 4,168 cases. It is interesting to note that the cohoe-pack in the Queen Charlotte Islands in 1951 amounted to 22,579 cases.

Pink Salmon.—As pointed out previously, pink salmon are caught in the Queen Charlotte Islands every second year, the runs coinciding with the even-numbered years; consequently, there was no pink-fishery to speak of in 1955, although 548 cases were canned apparently from stragglers.

Chum Salmon.—The Queen Charlotte Islands have been in the past a fairly large producer of chum salmon. The 1955 pack of 9,420 cases of chums was most disappointing and must be written off as a complete failure. The pack in 1954 amounted to 83,805 cases, but in 1953 the pack dropped to 17,304 cases. In 1952 only 1,712 cases of chums were canned, but in that year there was a pink-pack of 178,959 cases, which could have had the effect of diverting considerable effort from chum salmon to pink salmon. In 1951 the chum-salmon pack in the Queen Charlotte Islands was 61,696 cases, and five years ago, in 1950, 148,669 cases were packed. It would appear that the chum-salmon runs to the Queen Charlotte Islands and the smallness of these runs in recent years should be investigated in order to try to find out the reason.

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, which is treated separately. Salmon-fishing in the Central 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 1955 the Central Area produced a total pack of 214,998 cases, compared with a pack of 327,820 cases in 1954 and 317,626 cases in 1953. The Central Area pack in 1955 was composed of 19,648 cases of sockeye, 1,864 cases of springs, 318 cases of steelheads, 24,846 cases of cohoe, 122,371 cases of pinks, and 45,950 cases of chums.

Sockeye Salmon.—The sockeye-salmon pack in the Central Area in 1955, amounting to 19,648 cases, was the smallest sockeye-pack in this area since 1949, when 16,140 cases were canned. In 1954 the pack for this area amounted to 30,858 cases of sockeye, while

in 1953, 25,845 cases were canned. In 1952 the pack was 26,583 cases, and in the cycle-year 1951 the pack was 22,312 cases. The sockeye-pack in the Central Area in 1955 was 5,401 cases below the average annual pack of sockeye in this area for the previous five-year period.

Spring Salmon.—Spring salmon caught in the Central Area find an outlet in various markets, including the fresh- and frozen-fish trade. Therefore, the canned-salmon pack figures for spring salmon are not indicative of the production of the area as a whole. In 1955 the pack of spring salmon in the Central Area amounted to 1,864 cases, compared with 1,645 cases in 1954, 1,568 cases in 1953, 1,261 cases in 1952, and 1,082 cases in 1951.

Cohoe Salmon.—The size of the cohoe-pack in the Central Area has varied widely from year to year, but in the last few years the pack has been rather consistent. In the Central Area in 1955 the cohoe-pack amounted to 24,846 cases, while in 1954 it was 26,511 cases. In 1953 there were 21,502 cases of cohoe canned in this district, and in 1952 the pack was 17,289 cases. In 1951, however, the cohoe-pack amounted to 61,423 cases.

Pink Salmon.—The Central Area is a heavy producer of pink salmon, this species producing one of the largest packs of any of the species canned in the Central Area over the years. In 1955 the Central Area produced a canned-salmon pack of 122,371 cases of pinks, compared with 118,538 cases in 1954 and 92,517 cases in 1953, while in 1952 the pack was 207,055 cases. In 1951 the pink-salmon pack in the Central Area was 237,599 cases.

Chum Salmon.—The chum-salmon pack in the Central Area in 1955 was most disappointing, the total production amounting to 45,950 cases. This small pack in 1955 is compared with the packs of previous years. In 1954 there were canned 149,672 cases of chums, and in 1953 the pack was 175,289 cases. In 1952 the pack dropped to 36,605 cases, due principally to lack of effort on the part of the fishermen, owing to market conditions. In 1951 the pack was 190,843 cases, while 164,884 cases were canned in 1950. In 1955, efforts were made to put up a large pack of chum salmon in the Central Area, but apparently the fish did not put in an appearance.

Vancouver Island

The Vancouver Island District, like the Central Area, supports numerous races of salmon running to different streams. In this Report no attempt is made to deal with the various races separately. It should be pointed out, 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. These sockeye are known to be migrating to the Fraser River.

For statistical purposes of this Report, salmon, other than sockeye, caught in Johnstone Strait between Vancouver Island and the adjacent Mainland are credited to Vancouver Island.

In 1955 the total salmon-pack from Vancouver Island caught fish amounted to 581,599 cases, compared with 349,586 cases in 1954 and 671,981 cases in 1953. The Vancouver Island pack in 1955 was composed of 13,192 cases of sockeye, 5,534 cases of springs, 63 cases of steelheads, 101,349 cases of cohoe, 421,355 cases of pinks, and 40,105 cases of chums, half-cases being dropped in each instance.

Sockeye Salmon.—The 13,192 cases of sockeye packed from Vancouver Island caught fish in 1955 was, with the exception of the small pack in the previous year, the smallest pack of this species since 1948. In 1954 the pack of sockeye for the Vancouver Island District was 12,051 cases, while in 1953 the pack was 46,895 cases. In 1952, 24,252 cases of sockeye were canned, while 22,107 cases were packed in 1951.

Spring Salmon.—Spring salmon are caught in large quantities each year by trolling off the west coast of Vancouver Island. These fish, however, find a market in the fresh- and frozen-fish trade. Troll-caught salmon on the lower west coast of Vancouver Island also find a market principally as fresh, frozen, and mild-cured. Because of these outlets, the canned-salmon pack figures for spring salmon in the Vancouver Island District are not indicative of the size of the catch of this species. In 1955 the spring-salmon pack for Vancouver Island was 5,534 cases, while in 1954 the pack amounted to 1,649 cases. In 1953, 3,115 cases of spring salmon were canned and 1,687 cases were packed in 1952.

Cohoe Salmon.—Cohoes, like spring salmon, are caught in large numbers by troll off the west coast of Vancouver Island, and these, too, find a ready market other than in cans. For this reason the canned-salmon pack of cohoe is not indicative of the size of the catch or of the run. In 1955 the cohoe-pack for Vancouver Island was 101,349 cases. This was the largest pack of cohoe since 1951, when 151,325 cases were canned. In the intervening years, 1952 produced a pack of 23,583 cases, while 57,773 cases were canned in 1953. The pack of cohoe in 1954 was 54,783 cases.

Pink Salmon.—Pink salmon canned in the Vancouver Island District in 1955 produced 421,355 cases. In the cycle-year 1953, the pack was 439,173 cases, while in the previous cycle-year, 1951, the pack was 303,102 cases.

According to the records the odd-numbered years for Vancouver Island pink runs seem to produce the largest packs. In 1954, the even cycle, the pack was 32,913 cases, while in 1952 the pack was 171,812 cases. In 1950 the pink-salmon pack was 132,016 cases.

Chum Salmon.—Chum salmon are caught in fairly large numbers in the area comprising Vancouver Island and the adjacent Mainland districts. However, in comparing the canned-salmon pack figures with other years, it must be remembered that in recent years large quantities of this species have been shipped to the United States in the fall of the year for canning there. Therefore, it must be assumed that the large drop indicated in the canned-salmon pack figures for Vancouver Island in recent past years compared with previous years is due, to some extent at least, to the export of chum salmon which, of course, are canned in the United States.

In 1955 Vancouver Island produced a pack of 40,105 cases. This is compared with 248,098 cases in 1954 and 124,840 cases in 1953, while in 1952 the pack was down to 24,039 cases.

In addition to the British Columbia canned-salmon pack discussed in detail above, there were canned in British Columbia in 1955 a total of 3,991 cases, composed of 5 cases of springs, 44 cases of steelheads, 511 cases of cohoe, and 3,430 cases of chums. These fish were packed from cold storage, some having been held over from the year previous and others caught and frozen in the off-canning periods. Half-cases have been disregarded in each instance.

Other Canneries

In 1955 we have again to report that there was no run of pilchards in British Columbia waters. This lack of pilchards has been consistent since 1949, and, as a consequence, no pilchard-cannery licences were issued. Reports from the biologists and from California indicate that we need not expect a run of pilchards off the west coast of Vancouver Island area for some considerable time in the future, and then only if the California fishery is considerably modified.

Herring-canneries.—In 1955 one herring-cannery was licensed to operate in British Columbia, producing a pack of 25,508 cases. This pack is compared with the year previous, when a total of 18,940 cases of herring were canned in various sizes, including sardines and oval snacks.

Tuna-fish Canneries.—The first commercial tuna-fish canning operation in British Columbia was licensed by the Provincial Department of Fisheries in 1948. Tuna-fish

in that year were caught off the British Columbia coast, but those which were caught previous to that time were largely frozen and shipped to United States canneries for processing there. The run of tuna to the British Columbia coast has been spasmodic since 1948. In some years the fish appear in very large numbers, while in other years they fail to put in an appearance. Since the end of the war there has been some importation of Japanese-caught tuna frozen in Japan and exported for canning in British Columbia.

In 1955 one tuna-fish cannery was operated in British Columbia under licence from the Provincial Department of Fisheries. This cannery produced 73,126 cases of 7-ounce cans and 29,675 cases of 4-ounce cans. In 1954 two canneries operated, producing 34,250 cases of canned tuna. In 1955, as in 1954, all of the tuna canned in British Columbia were imported from Japan in a frozen condition.

It might be worth while repeating here in respect to tuna-fish canneries that the tuna-fishery off the west coast of British Columbia is still in an experimental condition; consequently, the catch will vary from year to year. The canned product, however, will vary in accordance with marketing conditions.

Shell-fish Canneries.—Under this heading those plants which are concerned with the canning of various species of shell-fish are reviewed. In 1955 ten shell-fish canneries were licensed in British Columbia, all of which operated. This was the same number of canneries as operated in 1954. The ten shell-fish canneries produced the following packs in 1955:—

Crabs: 1,433 cases of 48/½'s, 15,552 cases of 24/1's, and 9,426 cases of 48/¼'s.

Clams: 1,628 cases of 48/1's, 27,930 cases of 24/1's, 3,296 cases of 48/½'s, and 2,000 cases of 6/10's (gallons).

Oysters: 341 cases of 48/1's, 4,174 cases of 48/¼'s, and 1,906 cases of 24/10-ounce oyster stew.

Abalones: 77 cases of 48/1's.

MILD-CURED SALMON

Five plants were licensed to mild-cure salmon in 1955, and all five operated. These five plants produced 553 tierces of mild-cured salmon, totalling 5,085 hundredweight. This operation is compared with the production of four plants licensed to operate in 1954 which produced a pack of 572 tierces of mild-cured calmon containing 4,519 hundredweight.

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 it 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 end of the war the business of dry-salting salmon has not been revived.

In 1947 two licences were issued, but no operation took place. No licences have been issued for salmon dry-salteries since that time.

DRY-SALT HERRING

Since the end of the war there has been a small operation in the dry-salting of herring, although this phase of the industry has never reached the proportions of the pre-war years.

In 1955 one herring dry-saltery licence was issued, and this plant produced 1,016 boxes of dry-salt herring.

HALIBUT-FISHERY

The halibut-fishery on the Pacific Coast of North America is regulated by the International Pacific Halibut Commission, which Commission is set up under a treaty between Canada and the United States for the protection and rehabilitation of the halibut-fishery. The fishery is a deep-sea fishery and is shared by the nationals of the two countries, Canada and the United States. The Commission regulates the fishery on a quota basis, and, on that account, there is little fluctuation in the amount of halibut landed from year to year, except when the quotas are changed by the Commission for any reason. There is, however, some fluctuation from year to year in the quantity landed by the nationals of each country.

For the purpose of regulations, the coast was originally divided into a number of areas, the principal ones, from the standpoint of production, being Areas 2 and 3. The Commission has found it necessary to subdivide these areas into a number of sub-areas in order to facilitate its work and to make better use of the stock of halibut on the different banks. For a more detailed breakdown of the areas and the geographical limits of each, the reader is referred to the Pacific Halibut Regulations for 1955.

In 1955 the catch-limits set by the Commission for the different areas were as follows: Area 2, 26,500,000 pounds, and Area 3, 28,000,000 pounds. These were the same quantities as were permitted in 1954.

In 1955 the total landings by all vessels in all ports amounted to 59,094,000 pounds, compared with 71,265,000 pounds in 1954. The 1955 catch was derived by areas as follows: Area 1A, 432,000 pounds; Area 1B, 217,000 pounds; Area 2, 28,730,000 pounds; Area 3A, 28,782,000 pounds; and Area 3B, 933,000 pounds.

The total halibut-landings by all vessels in Canadian ports in 1955 was 22,601,000 pounds. This is compared with 29,464,000 pounds in 1954. The total landings by all vessels in Canadian ports in 1955 were caught as follows: Area 2, 13,697,000 pounds; Area 3A, 8,796,000 pounds; and Area 3B, 108,000 pounds.

Canadian vessels landed in Canadian ports in 1955 a total of 19,850,000 pounds of halibut. This catch is compared with Canadian landings by Canadian vessels in 1954 amounting 25,240,000 pounds. The Canadian vessels took their catch by areas as follows: Area 2, 13,005,000 pounds; Area 3A, 6,737,000 pounds; and Area 3B, 108,000 pounds.

In addition to the above, Canadian vessels landed in American ports, in 1955, 2,298,000 pounds, compared with the same landings in 1954 of 2,286,000 pounds. The halibut landed by Canadian vessels in American ports in 1955 was caught as follows: Area 2, 23,000 pounds; Area 3A, 2,227,000 pounds; and Area 3B, 48,000 pounds.

American vessels landed in Canadian ports in 1955 a total of 2,751,000 pounds of halibut, compared with the same landings in 1954, amounting to 4,224,000 pounds. The American catch landed in Canadian ports was caught as follows: Area 2, 592,000 pounds; Area 3A, 2,059,000 pounds; and Area 3B, 100,000 pounds.

The average price paid for Canadian halibut in Prince Rupert in 1955 and the average price for all Canadian landings in Canadian ports in 1955 was 13 cents per pound, compared with 16.1 cents per pound in 1954. There was no average price immediately available for Prince Rupert when these figures were compiled. The average price of halibut in the Province as a whole usually reflects the Prince Rupert price.

A breakdown of the value of halibut-livers and vitamin-bearing halibut viscera, which is usually included in this Report, is not available at this time. However, it is known that halibut-livers to the value of $56,636 and Vitamin A bearing viscera to the amount of $32,492 were landed by the United States fleet. The Canadian fleet will

have, no doubt, received proportionately a similar amount for livers and Vitamin A bearing viscera landed in Canada.

The above figures relating to the halibut-catch are to the nearest thousand pounds.

The statistical information for the halibut-fishery was supplied by the International Pacific Halibut 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 reduction to meal and oil. The products of the reduction plants found a ready market, the meal being used as a supplementary food for animal-feeding and the oil being used 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. This increased demand for high vitamin oils brought into use other fish besides herring and pilchards during the war years and 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.

In addition to the production of oils from British Columbia's various fish and fish-livers in recent years, there has been considerable activity in the use of cannery-waste and viscera for the production of various pharmaceutical products. Besides 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, and large quantities are used for the feeding of poultry and live stock.

Fish-liver Oil.—In 1955 only four plants were licensed to reduce fish-livers to oil, and all four plants operated. The four plants processed 1,198,010 pounds of livers and produced Vitamin A to the extent of 4,760,668 million U.S.P. units. This production is compared with that of 1954, in which year four plants operated and produced a total of 4,310,057 million U.S.P. units of Vitamin A from 1,178,777 pounds of fish-livers.

Herring-reduction.—The winter herring-fishery has developed into British Columbia's second important fishery in dollar value. The season generally runs from late in September or early in October through until the following March, with a short break at the Christmas period. Many of the boats used in catching herring are also used in salmon-fishing, and, generally speaking, the herring-fishery does not get into full swing until the boats have been released from fishing for salmon.

In 1955 fifteen herring-reduction plants were licensed to operate. These fifteen plants produced herring-meal to the extent of 47,097 tons and 4,475,536 imperial gallons of oil. This production is compared with the year previous, when twelve herring-reduction plants were licensed, producing 28,782 tons of meal and 3,714,924 imperial gallons of oil. It is interesting to note that the herring season of 1954-55 was the largest herring-production season on record.

Whale-reduction.—In British Columbia there is only one shore-based whaling station. In 1955 operations from this station killed 630 whales, compared with the same number in the year previous. In 1953, 539 whales were killed.

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 produce meal and oil for various purposes. The oil produced from the carcasses of dogfish should not 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 1955 nine plants were licensed to operate. These nine plants produced 1,993 tons of meal and 201,690 imperial gallons of oil. This production is compared with 1954, in which year eleven plants were licensed and produced 2,361 tons of meal and 265,405 imperial gallons of oil.

NET-FISHING IN NON-TIDAL WATERS

Under section 73 of the British Columbia Fishery Regulations, 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 in question.

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 the 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 for food for 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 used exclusively for that fishery.

A detailed account of the fish taken by the licensed nets in the different waters of the Province is again carried in the table appearing in the Appendix to this Report.

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 permitting same to be published in the Appendix to this Report. The Chief Supervisor's courtesy in supplying us with this information is gratefully acknowledged.

VALUE OF CANADIAN FISHERIES AND THE STANDING OF THE PROVINCES, 1954

The value of fisheries products of Canada for the year 1954 totalled $185,435,000. During that year British Columbia produced fisheries products to the value of $69,422,000, or 26.7 per cent of Canada's total. In addition, Japanese-caught tuna-fish canned in British Columbia in 1954 totalled $1,273,000. British Columbia, in 1954, led all the Provinces of Canada in respect to the production of fisheries wealth. Her output exceeded that of Nova Scotia, second in rank, by $28,422,000.

The marketed value of the fisheries products of British Columbia in 1954 was $3,967,000 more than in the year previous. The value of salmon amounted to $50,281,000.

The following statement gives the value of fisheries products of the Provinces of Canada for the years 1950 to 1954, inclusive:—

Province	1950	1951	1952	1953	1954
British Columbia	$68,821,358	$83,812,704	$56,635,000[1]	$65,455,000[1]	$69,422,000[1]
Nova Scotia	38,164,967	40,296,367	42,435,000	40,012,200	41,000,000[2]
New Brunswick	18,053,168	21,154,877	20,503,700	17,522,700	18,158,000[2]
Quebec	5,496,282	5,511,379	6,113,000	5,804,000	5,423,000[2]
Ontario	7,033,552	7,924,530	8,343,700	7,916,100	7,890,000
Manitoba	6,791,290	7,524,392	5,959,700	4,784,500	5,435,000
Prince Edward Island	3,320,513	3,212,629	3,758,700	4,048,900	4,000,000[2]
Alberta	767,887	862,327	942,900	1,085,900	1,150,000
Saskatchewan	1,360,114	1,748,444	1,440,000	1,281,300	1,644,000
Northwest Territories	2,297,466	2,261,964	2,225,100	1,511,500	2,040,000
Newfoundland (estimated)	30,000,000	29,000,000	.....	.....	28,000,000[2]
Totals	$182,106,597	$203,309,613	$148,357,200	$149,422,100	$184,162,000

[1] This figure does not include imported Japanese-caught tuna canned in British Columbia.
[2] Estimated figures.

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 1951 to 1955, inclusive, is given in the following table:—

Species	1951	1952	1953	1954	1955
Salmon	$60,749,658	$40,495,000	$47,936,000	$50,281,000	$42,869,000
Halibut	5,603,901	5,531,000	5,552,702	5,965,000	3,924,000
Herring	10,639,653	4,235,000	6,518,000	7,340,000	7,323,000
Pilchard	.....	.....	.....	.....	.....
Grey cod	453,796	521,000	251,000	467,000	445,000
Ling cod	826,315	590,000	384,000	487,000	399,000
Clams	382,746	477,000	449,000	306,000	436,000
Black cod	501,110	310,000	313,000	257,000	265,000
Crabs	403,538	475,000	663,000	879,000	996,000
Soles	1,187,934	1,533,000	854,000	461,000	710,000
Shrimps	148,933[1]	227,000[1]	361,000[1]	290,000[1]	281,000[1]
Oysters	289,624	438,000	304,000	470,000	420,000
Abalones	2,229	3,000	6,000	4,000	.....
Flounders	47,499[3]	20,000	([3])	30,000	14,000
Red cod	109,047	75,000	29,000	41,000	35,000
Perch	([2])	.....	([2])	82,000	17,000
Smelts	30,697	15,000	7,000	4,000	1,000
Sturgeon	([2])	([2])	17,000	9,000	13,000
Octopus	([2])	.....	([2])	([2])	([2])
Skate	([3])	5,000	6,000	9,000	7,000
Eulachons	80,210	115,000	34,000	57,000	106,000
Sardines	8,386	.....	.....	.....	.....
Vitamin oil	4,864,470	349,000	355,390	427,000	.....
Whales	1,282,600	([2])	([2])	([2])	([2])
Fur-seals	5,430	([2])	([2])	([2])	([2])
Anchovies	.....	26,000	13,000	1,000	.....
Tuna	73,211	54,000	3,000	.....	.....
Liver and viscera—					
Grey-fish Vitamin A	.....	.....	.....	.....	132,000
Other vitamin oil	.....	.....	.....	.....	254,000
Other liver and oil	.....	.....	.....	.....	5,000
Miscellaneous	499,807	1,142,000	1,399,000	1,555,000	2,016,000
Totals	$83,812,704	$56,635,000	$65,455,092[4]	$69,422,000[4]	$60,668,000[4]

[1] Shrimps and prawns.
[2] Included in miscellaneous.
[3] Skate and flounders.
[4] This figure does not include imported Japanese-caught tuna canned in British Columbia.
Miscellaneous includes octopus, whales, and fish products, meal and oil, which cannot be separated into species, with a value of $500 or less.

The above figures were supplied by the Federal Department of Fisheries, Vancouver, and are hereby gratefully acknowledged.

CONTRIBUTIONS TO THE LIFE-HISTORY OF THE SOCKEYE SALMON

PAPER NO. 41 (DIGEST)

This paper is supplied this year by D. R. Foskett, B.A., M.A., of the Pacific Biological Station of the Fisheries Research Board of Canada, Nanaimo, B.C. This is the forty-first consecutive paper in this series reporting on the sockeye salmon in the commercial catch in the main runs north of the Fraser River. The data presented are, for the most part, those of the commercial fishery and do not necessarily represent the escapement. The numbers of sockeye in the catch, as shown in the tables, were obtained through the Statistical Branch of the Department of Fisheries at Vancouver.

In commenting on the individual runs, the author points out that the catch for the Nass River, which yielded a pack of 13,654 cases, was considerably below the five-year average of 19,200 cases and even below the ten-year average of 16,909 cases for this river system. The pack was derived chiefly from the run of 1950, which yielded a pack of 27,286 cases.

Commenting on the run to the Skeena River in 1955, it is pointed out that the low catch of 157,632 sockeye, which yielded a pack of 14,649 cases, indicates a drop in the runs from the ten-year average, which totalled 70,671 cases. The author attributes this drop to be directly due to the loss of spawners caused by the Babine River slide and is not a serious cause for alarm, since, with the removal of the slide and the curtailed seasons being put into effect by the Federal Department of Fisheries and the Committee on Management, Skeena River Salmon Fisheries, the situation should right itself.

In respect to the Rivers Inlet sockeye run of 1955, which yielded a catch of 584,128 sockeye, producing a pack of 50,702 cases, the writer says that this was an " extreme disappointment " in a year when it was expected that the catch would be amongst the largest recorded. According to the catch sample, the author points out that the main failure was due to the lack of adequate returns of 5-year fish from the 1950 spawning, when, according to the Chief Supervisor of Fisheries report for 1950, " a large escapement of predominantly large sockeye is reported."

In commenting on the comparative failure of the Rivers Inlet sockeye run, the author points out that " unfortunately no information on conditions in the spawning area in the winter after egg deposition is available, so that no reason for failure can be ascertained." If lake-level and temperature recorders are set up in the main Owikeno Lake spawning areas, conditions likely to cause widespread destruction of eggs in the redds would not recur without some knowledge of them being available to those interested.

Regarding the Smith Inlet sockeye run for 1955, the author remarks that " though less than the average for the past five years, the catch of 325,478 sockeye, which yielded a pack of 28,864 cases, was slightly above the Smith Inlet average of 27,926 cases for the past ten years. This is in direct contrast to the poor showing of the adjacent Rivers Inlet catch." It is pointed out that, although in general Smith Inlet runs behave similarly to Rivers Inlet runs, recording instruments in both spawning areas at times of differing conditions would materially add to the knowledge and ability to predict returns in these areas.

For a more detailed analysis of the sizes making up the different runs, the reader is referred to the paper which appears in the Appendix to this Report.

HERRING INVESTIGATION

Research on the Pacific herring (*Clupea pallasi*) in British Columbia waters was continued in 1955–56 by the Fisheries Research Board of Canada at the Biological Station, Nanaimo, B.C. Herring research is under the supervision of F. H. C. Taylor; during the winter of 1956–57, while Mr. Taylor is on educational leave, the work is being supervised by A. S. Hourston.

The purpose of herring research is to obtain the scientific basis for management policy permitting the maximum sustained yield to the fishery. Two aspects are involved, namely: (1) A general, continuing study of all the major herring populations in British Columbia to keep a running check on the status of these populations and to determine how and to what extent the results of specific studies can be applied, and (2) intensive studies of specific problems in population dynamics at various stages of the life-history to determine their effects on the fishing stocks.

General Studies on Adult Stocks of All Major Populations

The number of major populations of herring which have been identified in British Columbia waters was increased to ten with the addition of the results of the 1955–56 analysis to the data already accumulated. The existence of major populations is indicated by differences in the age composition and in average size at each age of the stocks in different regions, and by the extent of mixing between such stocks as indicated by the returns of tagged fish.

Emigration, as indicated from 2,666 returns of tagged fish, was greatest from the upper Queen Charlotte Islands (36 per cent) and northern (67 per cent) populations. This represents a sharp increase over the 1954–55 level, and both these populations suffered a reduction in abundance in 1955–56. Homing was greatest to the lower Queen Charlotte Islands and middle east coast of Vancouver Island, both of which yielded good catches. Other returns substantiated the findings of previous years.

Relative abundance in each of the major populations was determined from the catch made in the sub-district occupied by each population, plus an estimate of the escapement as indicated by the amount of spawn deposited. The 1955–56 herring-catch in British Columbia was a record 250,441 tons, up 48 per cent from the previous season. The amount of spawn deposited was 13 per cent less than in 1954–55, but was average for recent years. Thus abundance was appreciably greater in 1955–56 than in 1954–55. The increase in abundance was restricted to the lower Queen Charlotte Islands (catch up a staggering 15,450 per cent and spawn deposition down only 16 per cent), lower central (catch up 160 per cent and spawn deposition down only 39 per cent), and lower west coast of Vancouver Island (catch up 175 per cent and spawn also up 41 per cent) populations.

These increases in abundance were partially balanced by decreases in the upper Queen Charlotte Islands (catch down 70 per cent with no spawn discovered in either year), northern (catch down 43 per cent and spawn deposition down 12 per cent), upper central (catch down 81 per cent and spawn deposition down 93 per cent), upper east coast of Vancouver Island (catch down 90 per cent and spawn deposition up only 42 per cent), and lower east coast of Vancouver Island (catch down 5 per cent and spawn deposition down 52 per cent) populations. The increased catch on the middle east coast of Vancouver Island and the decreased catch on the upper west coast were balanced by a corresponding decrease and increase respectively in spawn deposition.

The large increases in abundance in the lower Queen Charlotte Islands and lower central populations result from the unusually strong contribution of the 1951 year-class as V-year fish, combined with a better than average contribution of the newly recruited 1953 year-class. The 1951 year-class was strong in most populations as III- and IV-year fish, but its failure to make up appreciable proportion of the other more northern (District No. 2) populations as V-year fish, combined with the weak contribution to most populations of the 1952 year-class, resulted in a decrease in abundance in these populations in 1955–56. Relative abundance in the more southern populations (District No. 3) in 1955–56 depended mainly on the contribution of the 1953 year-class, which was about average on the whole. The 1954 year-class, which will be recruited to the southern populations in 1956–57, appears to be comparable in strength to the 1953 year-class.

However, the considerable reduction in the contributions of the 1951 year-class as VI-year fish to the northern populations will probably result in a decrease in over-all abundance in 1956–57.

No appreciable difference in the size of fish at each age was noted in 1955–56, indicating that feeding conditions were probably normal. Females continued to slightly outnumber males, except in the lower east coast population.

Investigations of Specific Problems

An investigation of the juvenile (I-year) herring population in the Strait of Georgia region was continued for the second year in 1955–56. Estimates of abundance at this stage provide a check on adequate survival in the new year-class as well as a prediction of relative abundance at recruitment. The 1956 year-class was comparable in size to that of 1955, which was average, according to local reports.

Returns of tags inserted in juvenile herring on the lower west coast of Vancouver Island indicate that mixing between the juvenile stage and recruitment was greater than that shown by fish tagged as adults which were at large for a comparable period. Thus depletion in one spawning stock or poor survival of the brood should be buffered by the excess in immigration over emigration prior to recruitment. Tagging experiments were continued in the Gulf of Georgia region in 1956.

Experiments to improve the efficiency of tag-detectors in picking up tags in all reduction plants were continued in 1956. However, the problems arising from the modernization and increased electrification of reduction plants make the practical use of electronic-type detectors, however sensitive, increasingly difficult.

REPORT OF THE BIOLOGIST, 1955

Investigations designed to fulfil the functions of the Provincial Shell-fish Laboratory at Ladysmith have been carried forward. These functions are to provide an information service on commercial molluscs and to study the biology of these species in respect to abundance, growth, reproduction, and culture.

Since the inception of the laboratory in 1948, the main emphasis has been on oyster investigations. Work on clams has been confined to routine sampling.

Studies on the British Columbia shipworm have been carried on as time permits.

In 1955 Mr. C. McAllister, summer assistant, completed a biological-oceanographic study of Ladysmith Harbour.

Oyster Investigations

Pacific Oyster Breeding

The weather during the summer of 1955, particularly the early part, was not unsuitable for oyster-breeding, but a single prolonged period of rain at the end of July caused a drastic interruption in the normal sequence; consequently, breeding success was limited.

Ladysmith Harbour.—The first spawning in Ladysmith Harbour occurred on July 16th, when the water temperature at a level 3 feet below the surface was above 70° F., the highest level reached during the summer. This spawning produced a maximum of sixteen straight-hinged larvæ per gallon. Between July 24th and July 31st the average water temperature dropped from 70° F. to 61° F. as a result of sustained south-east winds and rain. By July 26th the larvæ from the July 16th spawning were too few in number to provide a set of consequence. A small spawning about July 23rd produced a small number of larvæ which did not survive. No further spawning occurred, and there was no significant set, only occasional spat being found. This is now the third consecutive spatfall failure in Ladysmith Harbour.

Pendrell Sound.—Water temperatures were much higher in 1955 than in 1954, particularly in July. The salinity change pattern was also much the same as in 1954. The

first spawning of significance occurred on July 17th, producing an average of one larva per gallon. From the distribution of the larvæ, this spawning apparently occurred in the middle sound.

On July 24th a spawning occurred at the head of the sound, and on July 26th samples from that area contained up to 500 straight-hinged larvæ per gallon. Samples from the middle sound contained none or relatively few larvæ.

On July 25th rain began and continued without interruption for eight days, when the water temperature at the 3-foot level dropped from 75° F. to 65° F. on August 1st. The population of larvæ from the spawning of July 17th maintained good strength until July 29th, but thereafter the numbers decreased rapidly and by August 5th only 0.25 larvæ per gallon remained from the extensive spawning of July 24th. Light spatting was forecast to begin the week of August 7th, and this resulted in an average of 13.8 spat per shell (eleven stations sampled).

Although satisfactory water-temperature conditions existed in the early part of August, no further spawning occurred until August 18th, again at the head of the sound. By August 20th the samples from the upper sound contained an average of 21.5 larvæ per gallon. By August 30th the distribution of the larvæ had not changed, but the numbers were reduced to two larvæ per gallon and by September 8th to one larva per gallon. Light spatting was again forecast, and this set resulted in an average of ten spat per shell (two stations).

The horizontal distribution of the spatfall was determined for the first set by the examination of shell strings at eleven selected stations over the sound. The average catch for the upper sound on floating cultch was 0.7 spat per shell; for the middle sound, 22.1 spat per shell; for the outer sound, 2.2 spat per shell. Floating cultch caught 18.1 spat per shell and shore cultch caught 6.8 spat per shell.

Once again Station 5 caught better than any other station, and it has now done so on four out of the five occasions when sets have been recorded quantitatively. It therefore appears that, in years of low potential setting, this is the area where cultch should be placed.

Other Investigations

A study of larval growth was made, and a growth curve has been drawn.

A study of spat growth between setting and the cessation of growth in the fall was made, and from this it is apparent that, commensurate with keeping mortality to a minimum during the movement of the cultch from the seed-ground to the growing-ground, spat should be held on the floats at least to the end of October in most years if full advantage is to be taken of the late summer and fall growth. In this instance the average diameter of the spat on November 9th was nearly 1 inch, and this provides an excellent start for growth during the next year.

No commercial cultch was exposed in 1955, since the forecasts indicated a setting intensity below the necessary commercial level.

Cultch

Further experiments were carried out with the cement-dipped veneer circles first tested in 1954. Cost of the circles was determined to be approximately 2 cents per circle, whose surface is about 1 square foot. It requires about fifty to sixty circles to provide an area equivalent to that of the shell area in a case of unbroken Japanese seed.

The circles are simply and rapidly strung on galvanized wire. A string of thirty circles weighs about 5 pounds and, although quite light, is just heavy enough to sink, and neither weights nor extensive floating power is required. The equivalent area of British Columbia shell cultch would weigh about 30 pounds.

The set on the circles in 1955 was sufficient to provide a satisfactory test, the outcome of which will be determined in 1957.

Raft Culture

Experiments further to those previously reported have been conducted with raft culture, using No. 12 gauge galvanized wire and with spat that have been held on the bottom for a year. The results indicate that the heavier wire is good insurance against loss, and that the larger spat provide a higher percentage of marketable oysters at the end of the growing season.

It has been shown that raft-culture oysters should be held on the raft for one growing season only, for in the second season there is excessive fouling and relatively little additional growth. Test raft-culture strings have been placed in various other locations to determine whether or not all areas are equally suitable for this type of culture.

High-count Japanese Oyster Seed

The normal guaranteed spat content (1956) of a case of Japanese Miyagi oyster seed is 12,000 or more for unbroken and 18,000 or more for broken seed. Recently, extra-count seed (25,000 or more spat per case) and high-count seed (40,000 or more spat per case) has been available in varying quantities.

In 1952 several cases of broken Japanese oyster seed with very high counts, varying from 50,000 to 100,000 per case, were made available to the laboratory for testing to determine the suitability of this type of seed. It was treated as commercial seed would be, on the experimental area in Ladysmith Harbour. At yearly intervals the oysters surviving in each case were counted, and the weight, volume, and average length were determined.

The experiment demonstrated again that the major part of the mortality of oyster seed with the present method of culture occurs during the first year after planting, and that the subsequent mortality is almost negligible. The average survival of five cases of high-count seed over a three-year period was 9 per cent, as compared with a 25-per-cent survival of normal commercial seed (five-year period). However, the average yield of the high-count seed in absolute numbers was 7,000 oysters per case, as compared to 4,000 oysters per case of the normal commercial-type broken seed.

Further experiments with many more cases with a wide range in spat counts will be necessary to provide a definite answer, but this experiment has indicated that the use of high-count seed has merit if the cost differential is satisfactory.

PULP-MILL

Plans to construct a pulp-mill in the Crofton area were announced in 1955. The site chosen is in an oyster-producing area, and considerable concern has been expressed by the growers, since pulp-mill effluents are known to be toxic, and in the United States considerable litigation has resulted from pulp-mills being placed contiguous to oyster-beds. Since there is provision in the "Canada Fisheries Act" relating to the discharge of deleterious substances in waters where fishing is carried on, the problem of protecting the oyster-fishery is one for the Federal Department of Fisheries, whose scientific advisers have suggested a location for the effluent discharge that is expected to prevent any harm to the oyster-beds.

However, as a precautionary measure, a programme has been developed to determine general conditions on the Crofton oyster-beds as they exist at the present time. The essentials of this programme are:—

(1) A faunistic study of the tidal flats and reefs, as many of the shore invertebrates will be more sensitive to pulp-mill waste liquor than are oysters.
(2) A collection of histological material, particularly oyster tissue.
(3) A quantitative study of the seasonal and annual variation in condition (fatness) of oysters at four stations in the area.

(4) A study of the rate of growth of oysters at four stations in the area.

(5) A study of the extent of spat survival at four stations in the area.

There are several other types of biological investigation, such as the sequence and quantity of fouling organisms under conditions of submergence and the sequence and quantity of epiphytic material in intertidal areas that might be carried on. However, the programme outlined above is additional to the normal programme of the laboratory, and with the time available more extensive investigations are impossible.

Oyster Production

Production of Pacific oysters in 1955 was less than in 1954 by 1,056 gallons.

British Columbia Pacific Oyster Production in Gallons (American)

	1951	1952	1953	1954	1955
Baynes Sound	5,117	6,830	4,815	5,169	20,552
Desolation Sound	--------	--------	976	1,651	2,893
Pender Harbour	4,183	2,347	4,614	6,603	4,176
Stuart Channel	12,442	13,613	11,620	14,897	18,974
Juan de Fuca	1,045	668	1,010	997	766
Boundary Bay	36,165	57,711	43,441	56,553	37,443
Totals	58,951	81,185	66,476	85,870	84,814

Clam Production

Butter-clam production in 1955 increased considerably over 1954 and Manila clams increased slightly, while native little-necks and razor-clams were down somewhat.

British Columbia Clam Production in Pounds

	1951	1952	1953	1954	1955
Butter-clams	3,500,500	5,492,300	3,691,000	2,896,900	4,783,500
Native little-necks	521,900	493,300	308,700	137,900	80,200
Manila	178,900	495,900	387,700	450,000	456,000
Razor	135,500	125,500	154,500	271,800	218,300

Acknowledgments

The assistance and co-operation given by the Federal Department of Fisheries, the Pacific Biological Station at Nanaimo, the Pacific Oceanographic Group at Nanaimo, and the Provincial Department of Lands and Forests are gratefully acknowledged.

APPENDICES

CONTRIBUTIONS TO THE LIFE-HISTORY OF THE SOCKEYE SALMON (No. 41)

By D. R. Foskett, B.A., M.A., Fisheries Research Board of Canada, Biological Station, Nanaimo, B.C.

INTRODUCTION

This is the forty-first report in a series reporting on the sockeye in the commercial catch in the main runs north of the Fraser River. The data presented are, for the most part, those for the commercial fishery and do not necessarily represent the escapement. Whenever the opportunity arose, escapement figures were obtained and compared with those of the catch. The numbers of sockeye in the catch, as shown in the tables, were obtained through the statistical branch of the Department of Fisheries at Vancouver.

DESIGNATION OF AGE-GROUPS AND TREATMENT OF DATA

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 fresh water. The age-groups which are met most commonly are:—

3_1, 4_1—the " sea types " or fish which migrate seaward in their first year and mature in their third and fourth year respectively.

3_2—" the grilse," almost exclusively males and frequently called " jacks," which migrate seaward in their second year and mature in their third year.

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

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

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

Fish were measured to the nearest quarter of an inch, but when averaged the average has been recorded to the nearest tenth of an inch to avoid using fractions of more than one decimal place. Weights were taken to the nearest tenth of a pound. This has resulted in an even-pound and half-pound bias when the data are grouped to the nearest quarter-pound.

1. THE NASS RIVER SOCKEYE RUN OF 1955

(1) General Characteristics

The catch of 154,904 sockeye, which yielded a pack of 13,654 cases (Table I), was considerably below the five-year average (1951 to 1955) of 19,200 cases, and even below the ten-year average (1946 to 1955) of 16,909 cases. This pack resulted chiefly from a run (1950) which yielded a pack of 27,286 cases. The escapement was reported as satisfactory that year.

(2) Age-groups

The Nass River sockeye-catch sample contained 12 per cent 4-year fish, 85 per cent 5-year fish, and 2 per cent 6-year fish (Table I). Of these fish, 27 per cent had spent one year in fresh water and had migrated seaward in the beginning of their second year; 72 per cent had spent two years in fresh water and had migrated to sea at the beginning of their third year (Table I). A few fish, which had apparently migrated to sea as fry, returned in their third or fourth year (Tables II and III).

(3) Lengths and Weights

The average lengths recorded for the main age-groups of the year's sample were less than those recorded at any time in the past ten years, except in the 6_3 males (Table IV). In this last group, only the samples of 1949 and 1950 had smaller average lengths. However, in weight, this year's samples were no lower than the lowest weights recorded during the past ten years (Table V). In no case could the sockeye samples be considered as anything but small fish for this area.

(4) Distribution of Sexes

The Nass River sockeye sample was 49 per cent males and 51 per cent females, with the percentage of males varying in the individual age-groups as follows: 4_2, 50 per cent; 5_2, 60 per cent; 5_3, 47 per cent; and 6_3, 68 per cent (Table VI).

2. THE SKEENA RIVER SOCKEYE RUN OF 1955

(1) General Characteristics

Due to the low catch of 157,632 sockeye, yielding only 14,649 cases (Table VII), the Skeena River sockeye runs have dropped from the ten-year average (1945 to 1954) of 70,671 cases to a ten-year average (1946 to 1955) of 61,708 cases. Since, however, this drop is believed to be directly due to the loss of spawners caused by the Babine River slide, it is not a serious cause for alarm, since, with the removal of the slide and the curtailed seasons being put into effect by the Federal Department of Fisheries and the Committee on Management, Skeena River Salmon Fisheries, the situation should right itself.

(2) Age-groups

Five-year-old fish formed 73 per cent of the Skeena River sockeye-catch sample, 59 per cent having spent one year in fresh water and 14 per cent two years (Table VII). There were 15 per cent 4_2 fish and 11 per cent 6_3 fish. It must be realized that these figures might have been somewhat altered if fishing had progressed evenly throughout the run. However, a total closure during the week ended July 30th and a partial closure in the week ended August 6th were imposed to permit a more adequate escapement. Test fishing above the boundary with commercial nets and with graded series of mesh sizes was carried out. While the catch from this fishing is generally considered to be from the escapement, there is a movement of as yet undetermined extent, back and forth, which undoubtedly exposes some of the fish to the fishery again after they have passed the commercial boundary. The age-class composition of the sockeye taken in the test fishing was, in round numbers, 6 per cent 3_2 fish, 25 per cent 4_2 fish, 53 per cent 5_2 fish, 7 per cent 5_3 fish, and 8 per cent 6_3 fish (Table XXV). As can be seen from a comparison of Tables XXV and XXVI, this varies from the commercial catch chiefly in having a greater percentage of jacks and 4-year-old fish and small percentage of 5- and 6-year fish. The significance of this will be discussed below when the lengths of these fish are considered.

(3) Lengths and Weights

From Tables X and XI it is noted that the Skeena River sockeye in 1955 were in the lower part of the normal size range in all the main age-classes. The lengths and weights in the main age-groups were as follows:—

The 4_2 sockeye males averaged 22.5 inches and 4.9 pounds, and the females 22.1 inches and 4.8 pounds. Averages for the 5_2 sockeye were 25.6 inches and 7.4 pounds for the males, and 24.5 inches and 6.4 pounds for the females. In the 5_3 fish, the males averaged 23.0 inches and 5.5 pounds, while the females averaged 22.6 inches and 5.0 pounds. The 6_3 sockeye averaged 25.2 inches and 7.1 pounds for the males and 24.0 inches and 6.1 pounds for the females.

When the above lengths are compared with those obtained from the test fishing, as shown below, certain features stand out. It is at once evident that the age-groups in the escapement sample have lower average lengths than those in the commercial catch sample. When comparing the abundance of each age-group in the two samples, it is readily seen that a greater proportion of the age-groups which are made up of the smaller fish, the 3_2 and 4_2 groups, is in the escapement than in the catch. Tables XXV and XXVI show more detail on the length distribution of the escapement and the catch than the following table:—

Age-group	Catch (604 Fish)		Escapement (1,094 Fish) (Test Fishing)	
	Length	Per Cent of Sample	Length	Per Cent of Sample
3_2	16.1	0.3	15.7	6.2
4_2	22.3	14.7	21.7	25.1
5_2	24.9	59.1	24.6	52.7
5_3	22.8	13.9	22.5	7.2
6_3	24.6	11.3	24.7	8.1

It is not known what effect allowing a large proportion of the escapement to come from the smaller fish from an age-group will have on the future size of that age-group. However, the fact that certain runs maintain size differences from adjacent runs indicates that hereditary factors are probably involved to a considerable extent. If so, the folly of allowing the smaller fish to form the escapement from which our future stocks must come is obvious.

(4) Distribution of Sexes

The distribution of sexes in the Skeena River sockeye-catch shows two trends which are almost invariable. These are that the catch as a whole contains over 50 per cent females and the catch of 5_2 age-group fish contains an even greater percentage of females than the total catch. This year was no exception, since 53 per cent of the sockeye sample consisted of females and 58 per cent of the 5_2 fish were females (Table XII). Only 43 per cent of the 4_2 age-group sample were females. This is the lowest percentage of 4_2 females recorded in the catch samples in over three cycles (Table XII).

3. THE RIVERS INLET SOCKEYE RUN OF 1955

(1) General Characteristics

The catch of 584,128 sockeye, yielding 50,702 cases (Table XIII), was an extreme disappointment in a year when it was expected that the catch would be amongst the largest recorded. From the catch sample, it was obvious that the main failure was in the lack of adequate returns of 5-year fish from the 1950 spawning, when, to quote from the Federal Department of Fisheries "Salmon-spawning Report, British Columbia, 1950," by Chief Supervisor A. J. Whitmore, "a large escapement of predominantly large sockeye is reported."

Unfortunately, no information on conditions in the spawning area in the winter after egg deposition is available, so that no reason for the failure can be ascertained. If lake-level and temperature recorders were set up in the main Owikeno Lake spawning areas, conditions likely to cause widespread destruction of eggs in the redds would not recur without some knowledge of them being available to those interested.

(2) Age-groups

The Rivers Inlet sockeye-catch sample in 1955 was composed of 45 per cent 4_2 fish and 54 per cent 5_2 fish, with minor numbers of 5_3 and 6_3 age-groups (Table XIII). From spawning reports of 1950 and 1951, it had been presumed that the 5_2 age-group would comprise a very much higher proportion of the run. The low catch of 1955 is largely attributable to the failure of the return from the 1950 spawning.

Through the courtesy of the Fish Culture Development Branch, the author was able to sample sockeye seined above the fishing boundary in connection with spring-salmon tagging operations. These fish would bear the same relationship to the escapement as the sockeye caught in the Skeena test fishing mentioned previously. In addition, a sample of the escapement was obtained on some of the spawning-streams. The comparison of the percentages in these two samples and the commercial catch sample is interesting in that it shows that the younger age-classes (jacks and 4_2 fish) form a larger percentage of the escapement than of the catch.

	Age-class				
	Jacks (3_2, 4_3)	4_2	5_2	5_3	6_3
	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent
Catch (685 fish)	0.0	44.8	54.2	0.4	0.6
Escapement seined (231 fish)	1.3	78.8	19.5	0.0	0.4
On redds (165 fish)	6.4	52.6	41.0	0.0	0.0

(3) Lengths and Weights

As was the case with the Nass and Skeena River runs, the Rivers Inlet sockeye were within the range of lengths and weights as recorded in previous years. The average length for the 4_2 male sockeye was 21.2 inches, and for the females, 21.0 inches; for the 5_2 age-group the lengths were 25.4 inches and 24.5 inches respectively (Table XXVI). Average weights in these classes were: 4_2 males, 4.5 pounds, and females, 4.2 pounds; and 5_2 males, 7.4 pounds, and females, 6.5 pounds (Table XXVII).

Comparison of the length of the sockeye in the catch and escapement samples is also interesting, as shown below (lengths taken to nearest quarter inch).

	Age-class				
	Jacks (3_2, 4_3)	4_2	5_2	5_3	6_3
	Inches	Inches	Inches	Inches	Inches
Catch sample (685 fish)	14¾	21¼	24¾	22	25
Escapement seined (231 fish)	14¾	19¾	25	----	----
On redds[1] (165 fish)	14¾	19½	25¼	----	----

[1] This sample was divided into age-classes on the basis of length. The 5_3 and 6_3 fish present would be indistinguishable from the larger 4_2 and 5_2 fish, and so no attempt was made to separate out these classes.

The tabulated data show clearly that the escapement comes from the smaller 4_2 fish and the larger 5_2 fish, though the tendency in this latter case is not as striking as in the former, where the average length of the catch is 1½ inches greater than in the escapement.

(4) Distribution of Sexes

The sex distribution, as related to age, again showed the invariable relationship of more males amongst the 4-year-old fish and more females in the 5-year-old fish in the catch samples (Table XVIII). Percentage of males was 67 in the 4_2 fish and 31 in the 5_2 fish. The over-all percentage of males was 48.

4. THE SMITH INLET SOCKEYE RUN OF 1955

(1) General Characteristics

Though less than the average for the past five years, the catch of 325,478 sockeye, yielding 28,864 cases, was slightly above the Smith Inlet average of 27,926 cases for the past ten years. This is in direct contrast to the poor showing of the adjacent Rivers Inlet catch. Though, in general, Smith Inlet runs behave similarly to Rivers Inlet runs, recording instruments in both spawning areas at times of differing conditions would materially add to our knowledge and our ability to predict returns in these areas.

(2) Age-groups

As is normal in this run, only two main age-groups were present; 4_2 fish formed 42 per cent of the catch sample and 5_2 fish 58 per cent (Tables XIX to XXI). One 5_3 fish was present (Tables XX and XXI).

(3) Lengths and Weights

As with the other samples, the Smith Inlet sockeye were in the lower part of the length and weight ranges of former years, but set no records. The 4_2 fish had averages of 21.8 inches and 5.0 pounds for the males and 21.6 inches and 4.7 pounds for the females, while the 5_2 fish had averages of 25.3 inches and 7.5 pounds and 24.6 inches and 6.9 pounds respectively for the males and females (Tables XXII and XXIII).

(4) Sex Distribution

The Smith Inlet sockeye catch sample showed its usual sex distribution, with 76 per cent of the 4_2 fish and 37 per cent of the 5_2 fish being males (Table XXIV). In the over-all sample, there were 54 per cent males.

Table I.—Nass River Sockeyes, Percentages of Principal Age-groups in Runs of Successive Years and Packs

Year	Pack in Cases	Number of Sockeye[1]	Percentage of Individuals			
			4_2	5_2	5_3	6_3
1912	36,037	.....	8	27	63	2
1913	23,574	.....	15	12	71	2
1914	31,327	.....	4	41	45	10
1915	39,349	.....	19	14	59	8
1916	31,411	.....	9	17	66	8
1917	22,188	.....	10	15	71	4
1918	21,816	.....	30	16	45	9
1919	28,259	.....	7	22	65	6
1920	16,740	.....	8	14	72	6
1921	9,364	.....	10	7	75	8
1922	31,277	.....	6	2	91	1
1923	17,821	.....	11	6	77	6
1924	33,590	.....	4	3	91	2
1925	18,945	.....	23	8	67	2
1926	15,929	.....	12	12	63	13
1927	12,026	.....	8	7	81	4
1928	5,540	.....	30	6	61	3
1929	16,077	.....	25	9	60	6
1930	26,405	.....	28	15	54	3
1931	16,929	.....	10	17	67	6
1932	14,154	.....	28	4	61	7
1933	9,757	.....	35	7	55	3
1934	36,242	.....	13	9	74	4
1935	12,712	.....	11	10	73	6
1936	28,562	.....	16	7	67	10
1937	17,567	.....	22	4	68	6
1938	21,462	.....	21	4	70	5
1939	24,357	.....	14	13	66	7
1940	13,809	.....	23	8	59	10
1941	24,876	.....	37	7	52	4
1942	21,085	.....	22	7	66	5
1943	13,412	.....	5	13	67	15
1944	13,083	.....	15	15	32	38
1945	9,899	.....	46	11	37	6
1946	12,511	.....	13	12	72	3
1947	10,849	.....	15	12	56	17
1948	13,181	.....	12	16	60	12
1949	9,268	.....	39	6	48	7
1950	27,286	.....	3	19	71	6
1951	24,405	.....	41	9	31	13
1952	29,492	304,500	28	19	46	4
1953	18,163	198,400	23	22	46	9
1954	10,285	101,600	35	20	40	5
1955	13,654	154,904	12	15	70	2

[1] To nearest hundred.

Table II.—Nass River Sockeyes, 1955, 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		
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
18	1	----	----	----	----	----	----	----	----	----	----	----	1
18¼	1	----	----	----	----	----	----	----	----	----	----	----	1
18½	----	----	----	----	----	----	----	----	----	----	----	----	----
18¾	----	----	----	----	----	----	----	----	----	----	----	----	----
19	----	----	----	----	----	1	----	----	----	----	----	----	1
19¼	----	----	----	----	----	----	----	----	----	----	----	----	----
19½	----	----	----	----	1	----	----	----	----	----	----	----	1
19¾	----	----	----	----	----	----	----	----	----	----	----	----	----
20	----	1	----	----	----	----	----	----	1	----	----	----	2
20¼	----	----	----	----	----	----	----	----	----	----	----	----	----
20½	----	----	----	----	1	5	----	----	1	3	----	----	10
20¾	----	----	----	----	----	3	----	----	----	3	----	----	6
21	1	1	----	----	----	4	1	----	2	4	----	----	13
21¼	----	----	----	----	1	2	1	----	1	9	----	----	14
21½	----	----	----	----	2	6	----	----	4	5	----	----	17
21¾	----	----	----	1	5	10	----	----	8	37	----	----	61
22	----	----	----	2	6	7	----	1	8	22	----	----	46
22¼	1	----	----	----	5	10	----	1	7	34	----	----	58
22½	----	----	----	----	6	7	----	2	9	21	----	----	45
22¾	----	----	----	2	13	12	----	----	24	78	----	----	129
23	----	----	1	----	2	5	1	1	10	40	----	----	61
23¼	----	----	----	----	6	1	----	1	24	40	----	1	72
23½	----	----	----	----	14	3	----	7	66	70	----	----	160
23¾	----	----	----	----	9	1	----	4	37	36	----	----	87
24	----	----	1	1	2	3	1	5	37	30	----	1	82
24¼	----	----	2	----	4	1	2	7	38	19	----	----	73
24½	----	----	----	----	4	----	2	12	51	39	----	----	108
24¾	----	----	1	----	----	----	5	7	25	13	----	----	51
25	----	----	----	----	1	----	6	9	27	12	1	----	56
25¼	----	----	----	----	----	2	8	9	22	16	1	2	60
25½	----	----	2	----	----	2	16	10	29	6	----	----	65
25¾	----	----	----	----	----	----	17	4	12	3	----	1	37
26	----	----	1	----	----	----	9	3	7	1	2	1	24
26¼	----	----	----	----	1	----	10	3	5	----	2	----	21
26½	----	----	1	----	----	----	17	1	10	1	----	1	31
26¾	----	----	----	1	----	----	10	----	3	----	2	----	16
27	----	----	----	----	----	----	5	----	----	1	----	----	6
27¼	----	----	----	----	----	----	6	1	1	----	1	----	9
27½	----	----	----	----	----	----	1	----	----	----	1	----	2
27¾	----	----	----	----	----	----	2	----	----	----	1	----	3
28	----	----	----	----	----	----	4	----	----	----	1	----	5
28¼	----	----	----	----	1	----	6	----	1	----	3	----	11
28½	----	----	----	----	----	----	----	----	----	----	----	----	----
28¾	----	----	----	----	----	----	----	----	----	----	----	----	----
29	----	----	----	----	----	----	----	----	----	----	----	----	----
29¼	----	----	----	----	----	----	----	----	2	----	----	----	2
29½	----	----	----	----	----	----	----	----	1	----	----	----	1
Totals	4	2	9	7	84	85	131	88	473	543	15	7	1,448
Average lengths	19.9	20.5	24.9	23.1	23.1	22.3	26.0	24.7	24.1	23.2	26.9	25.1	23.9

Table III.—Nass River Sockeyes, 1955, 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		
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
2½	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
2¾	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
3	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	1
3¼	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
3½	.....	.....	.....	.....	1	.....	.....	.....	.....	2	.....	.....	3
3¾	.....	.....	.....	.....	1	.....	.....	.....	2	7	.....	.....	10
4	.....	1	.....	.....	1	4	.....	.....	4	13	.....	.....	23
4¼	1	.....	.....	.....	1	8	.....	.....	6	26	.....	.....	42
4½	.....	.....	.....	2	2	17	1	.....	8	57	.....	.....	87
4¾	.....	.....	.....	.....	5	10	.....	.....	9	44	.....	.....	68
5	.....	.....	.....	2	11	15	.....	1	34	83	.....	.....	146
5¼	1	.....	1	1	6	7	1	1	21	38	.....	.....	77
5½	.....	.....	.....	1	19	13	.....	5	61	89	.....	1	189
5¾	.....	.....	.....	.....	8	2	.....	5	40	45	.....	.....	100
6	.....	.....	.....	.....	4	6	3	8	55	60	.....	.....	136
6¼	.....	.....	2	.....	9	.....	2	5	52	22	.....	1	93
6½	.....	.....	1	1	9	.....	5	13	50	24	.....	.....	103
6¾	.....	.....	1	.....	5	.....	5	13	24	14	.....	.....	62
7	.....	.....	.....	.....	1	2	11	16	38	7	2	2	79
7¼	.....	.....	1	.....	1	.....	8	4	21	5	3	1	44
7½	.....	.....	.....	.....	.....	.....	23	6	20	3	1	1	54
7¾	.....	.....	.....	.....	.....	.....	12	4	11	2	.....	1	30
8	.....	.....	2	.....	.....	.....	12	4	7	2	.....	.....	27
8¼	.....	.....	1	.....	.....	.....	10	2	5	.....	.....	.....	18
8½	.....	.....	.....	.....	.....	.....	8	.....	2	.....	1	.....	11
8¾	.....	.....	.....	.....	.....	.....	11	.....	2	.....	4	.....	17
9	.....	.....	.....	.....	.....	.....	9	.....	1	.....	2	.....	12
9¼	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	2
9½	.....	.....	.....	.....	.....	.....	4	.....	.....	.....	1	.....	5
9¾	.....	.....	.....	.....	.....	.....	4	1	.....	.....	.....	.....	5
10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1
Totals	4	2	9	7	84	85	131	88	473	543	15	7	1,448
Average weights	3.7	3.7	6.9	5.2	5.6	4.9	7.8	6.8	6.1	5.4	8.3	6.9	6.0

Table IV.—Nass River Sockeyes, Average Lengths in Inches of Principal Age-groups, 1912 to 1955

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
1952	23.9	23.1	26.8	25.3	24.8	23.9	27.6	26.3
1953	23.9	22.9	26.9	25.6	24.9	24.1	27.7	26.5
1954	24.1	23.1	26.5	25.3	25.3	24.5	27.7	26.0
1955	23.1	22.3	26.0	24.7	24.1	23.2	26.9	25.1

Table V.—Nass River Sockeyes, Average Weights in Pounds of Principal Age-groups, 1914 to 1955

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
1952	6.0	5.2	8.4	6.9	6.7	5.7	8.7	7.5
1953	6.2	5.4	8.3	7.2	6.6	5.8	9.0	7.9
1954	6.4	5.5	8.8	7.4	7.4	6.3	9.5	7.8
1955	5.6	4.9	7.8	6.8	6.1	5.4	8.3	6.9

Table VI.—Nass River Sockeyes, Percentages of Males and Females, 1915 to 1955

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
1952	49	51	56	44	49	51	59	41	50	50
1953	50	50	44	56	46	54	62	38	48	52
1954	42	58	44	56	44	56	45	55	43	57
1955	50	50	60	40	47	53	68	32	49	51

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

Year	Pack in Cases	Number of Sockeye[1]	Percentage of Individuals			
			4_2	5_2	5_3	6_3
1907	108,413	----	----	----	----	----
1908	139,846	----	----	----	----	----
1909	87,901	----	----	----	----	----
1910	187,246	----	----	----	----	----
1911	131,066	----	----	----	----	----
1912	92,498	----	57	43	----	----
1913	52,927	----	50	50	----	----
1914	130,166	----	25	75	----	----
1915	116,553	----	36	64	----	----
1916	60,923	----	34	38	13	18
1917	65,760	----	57	29	9	5
1918	123,322	----	51	34	9	6
1919	184,945	----	27	60	9	4
1920	90,869	----	15	71	6	8
1921	41,018	----	69	22	6	3
1922	96,277	----	70	16	12	2
1923	131,731	----	56	29	8	7
1924	144,747	----	23	69	7	1
1925	77,784	----	51	45	3	1
1926	82,360	----	62	26	9	3
1927	83,996	----	62	28	9	1
1928	34,559	----	51	39	7	3
1929	78,017	----	62	30	6	2
1930	132,372	----	39	52	8	1
1931	93,023	----	40	30	28	2
1932	59,916	----	44	37	7	12
1933	30,506	----	57	36	5	2
1934	54,558	----	58	34	7	1
1935	52,879	----	49	31	18	2
1936	81,973	----	67	20	11	2
1937	42,491	----	45	40	11	4
1938	47,257	----	64	15	16	5
1939	68,485	----	50	35	11	4
1940	116,507	----	80	15	4	1
1941	81,767	----	39	52	8	1
1942	34,544	----	36	54	7	3
1943	28,268	----	39	39	16	6
1944	68,197	----	37	52	7	4
1945	104,279	----	20	63	12	5
1946	52,928	----	13	70	8	9
1947	32,534	----	14	82	3	1
1948	101,267	----	80	13	6	1
1949	65,937	----	17	76	4	3
1950	47,479	----	21	72	4	3
1951	61,694	----	33	61	4	1
1952	114,775	1,294,500	66	26	3	5
1953	65,003	659,200	48	43	6	3
1954	60,817	571,900	33	54	10	2
1955	14,649	157,362	15	59	14	11

[1] To nearest hundred.

Table VIII.—Skeena River Sockeyes, 1955, 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		7_4		
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
16			1														1
16¼			1														1
16½																	
16¾																	
17																	
17¼																	
17½																	
17¾																	
18																	
18¼																	
18½											1						1
18¾																	
19																	
19¼					2												2
19½																	
19¾					1												1
20					1						1			1			3
20¼											2						2
20½											1						1
20¾					7	1						2		1			11
21					1	4					2	1					8
21¼					3	2					1	2					8
21½					2	2		1			1	3	1				10
21¾					2	9					2	7					20
22					3	3		1				2		1			10
22¼					3	2		1			1	5					12
22½					1	3		1			1	2					8
22¾		1			5	6		7			4	4					27
23					3	2		8			5	2		1			21
23¼					1	2		6			1	2					12
23½					4	2	1	20			3	3	1	6			40
23¾					1		4	13			1	1	1				21
24					2		5	17			4		1	8			37
24¼					1		6	17			1	1	1	2			29
24½					4		15	30			3	1	4	4			61
24¾	1						11	11			2	2	2	5			34
25					2		7	22			2	1	3	1			38
25¼					1		11	14					2	1		1	30
25½							22	17	1		1		11	1			53
25¾							12	6			1		2				21
26							8	6			1	1	2				18
26¼					1		13	4					1				19
26½							15	3					1	1			20
26¾							4	1					1				6
27							2	1									3
27¼							6	1									7
27½													1				1
27¾							5										5
28																	
28¼							1										1
28½																	
28¾							1										1
29																	
29¼																	
Totals	1	1	2		51	38	149	208	1		42	42	35	33		1	604
Average lengths	24.7	22.7	16.0		22.5	22.0	25.5	24.5	25.5		23.0	22.5	25.2	24.0		25.3	23.7

Table IX.—Skeena River Sockeyes, 1955, 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		7_4		
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	
2			2														2
2¼																	
2½																	
2¾																	
3					2												2
3¼					2												2
3½					1						1						2
3¾						1					2						3
4					8	3					3	4					18
4¼					4	4					2	5					15
4½					5	9		3			2	5		1			25
4¾					3	4		5				6					18
5					6	7		10			1	7	1				32
5¼		1			1	4	2	12			7	1		1			29
5½					5	4	2	19			5	7		7			49
5¾					5	1	4	18			5	3		2			38
6					3	1	12	30			2	2	1	7			58
6¼							6	18			3	1	3	4			35
6½					3		13	17			6	1	5	5		1	51
6¾					2		13	15			1		5	1			37
7							19	18			2		7	2			48
7¼							5	10					1				16
7½	1				1		15	15					7	2			41
7¾							13	2	1				1	1			18
8							11	8					1				20
8¼							10	5									15
8½							5	1					1				7
8¾							2	1					1				4
9							7	1									8
9¼							5										5
9½																	
9¾							1						1				2
10							2										2
10¼							1										1
10½																	
10¾							1										1
Totals	1	1	2		51	38	149	208	1		42	42	35	33		1	604
Average weights	7.5	5.2	2.0		4.9	4.8	7.4	6.4	7.7		5.5	5.0	7.1	6.1		6.4	6.2

Table X.—Skeena River Sockeyes, Average Lengths in Inches of Principal Age-groups, 1912 to 1955

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
1952	23.3	22.6	25.8	24.7	23.2	22.8	26.1	24.6
1953	23.2	22.8	26.2	25.0	23.6	22.9	26.0	25.5
1954	22.2	22.4	26.6	25.2	23.9	22.9	26.4	24.9
1955	22.5	22.1	25.6	24.5	23.0	22.6	25.2	24.0

Table XI.—Skeena River Sockeyes, Average Weights in Pounds of Principal Age-groups, 1914 to 1955

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
1952	5.6	5.0	7.5	6.4	5.6	5.0	7.4	6.0
1953	5.8	5.5	8.0	6.9	5.8	5.2	7.8	7.3
1954	4.9	4.9	8.8	7.2	6.2	5.2	8.6	7.2
1955	4.9	4.8	7.4	6.4	5.5	5.0	7.1	6.1

Table XII.—Skeena River Sockeyes, Percentages of Males and Females, 1915 to 1955

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
1952	52	48	34	66	48	52
1953	40	60	34	66	39	61
1954	44	56	38	62	43	57
1955	57	43	42	58	47	53

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

Year	Pack in Cases	Number of Sockeye[1]	Percentage of Individuals			
			4_2	5_2	5_3	6_3
1907	87,874	----	----	----	----	----
1908	64,652	----	----	----	----	----
1909	89,027	----	----	----	----	----
1910	126,921	----	----	----	----	----
1911	88,763	----	----	----	----	----
1912	112,884	----	21	79	----	----
1913	61,745	----	80	20	----	----
1914	89,890	----	35	65	----	----
1915	130,350	----	13	87	----	----
1916	44,936	----	26	74	----	----
1917	61,195	----	39	61	----	----
1918	53,401	----	57	43	----	----
1919	56,258	----	46	54	----	----
1920	121,254	----	5	95	----	----
1921	46,300	----	49	51	----	----
1922	60,700	----	81	18	1	----
1923	107,174	----	74	24	2	----
1924	94,891	----	43	54	2	1
1925	159,554	----	23	77	----	----
1926	65,581	----	59	38	2	1
1927	64,461	----	81	16	3	----
1928	60,044	----	55	40	4	1
1929	70,260	----	77	18	3	2
1930	119,170	----	49	48	2	1
1931	76,428	----	53	44	2	1
1932	69,732	----	67	27	5	1
1933	83,507	----	44	55	1	----
1934	76,923	----	77	20	2	1
1935	135,038	----	57	41	1	1
1936	46,351	----	53	46	1	----
1937	84,832	----	60	37	3	----
1938	87,942	----	27	70	1	2
1939	54,143	----	67	32	1	----
1940	63,469	----	69	28	3	----
1941	93,378	----	59	40	1	----
1942	79,199	----	8	91	----	1
1943	47,602	----	8	91	----	1
1944	36,852	----	76	23	1	----
1945	89,735	----	57	41	2	----
1946	73,320	----	37	63	----	----
1947	140,087	----	3	97	----	----
1948	37,665	----	55	44	1	----
1949	39,495	----	84	14	1	----
1950	142,710	----	13	87	(2)	----
1951	102,565	----	38	60	1	1
1952	84,298	938,700	41	58	1	(2)
1953	132,925	1,522,300	73	26	1	(2)
1954	50,640	575,700	60	39	1	(2)
1955	50,702	584,128	45	54	(2)	1

[1] To nearest hundred.
[2] Age-class represented but less than 0.5 per cent.

Table XIV.—Rivers Inlet Sockeyes, 1955, Grouped by Age, Sex, Length, and by Their Early History

Length in Inches	Number of Individuals								Total
	4_2		5_2		5_3		6_3		
	M.	F.	M.	F.	M.	F.	M.	F.	
16	-----	-----	-----	-----	-----	-----	-----	-----	-----
16¼	-----	-----	-----	-----	-----	-----	-----	-----	-----
16½	1	-----	-----	-----	-----	-----	-----	-----	1
16¾	-----	-----	-----	-----	-----	-----	-----	-----	-----
17	-----	-----	-----	-----	-----	-----	-----	-----	-----
17¼	-----	-----	-----	-----	-----	-----	-----	-----	-----
17½	-----	-----	-----	-----	-----	-----	-----	-----	-----
17¾	-----	1	-----	-----	-----	-----	-----	-----	1
18	1	-----	-----	-----	-----	-----	-----	-----	1
18¼	1	-----	-----	-----	-----	-----	-----	-----	1
18½	-----	1	-----	-----	-----	-----	-----	-----	1
18¾	5	2	-----	-----	-----	-----	-----	-----	7
19	8	3	-----	-----	-----	-----	-----	-----	11
19¼	8	2	-----	1	-----	-----	-----	-----	11
19½	11	3	-----	-----	-----	-----	-----	-----	14
19¾	9	4	-----	-----	-----	-----	-----	-----	13
20	11	6	-----	-----	-----	-----	-----	-----	17
20¼	13	6	1	1	-----	-----	-----	-----	21
20½	10	7	-----	-----	-----	-----	-----	-----	17
20¾	12	8	-----	-----	-----	-----	-----	-----	20
21	12	12	-----	-----	-----	1	-----	-----	25
21¼	8	7	-----	-----	-----	-----	-----	-----	15
21½	10	9	-----	-----	-----	-----	-----	-----	19
21¾	12	9	-----	-----	-----	-----	-----	-----	21
22	20	7	-----	1	-----	-----	-----	-----	28
22¼	9	4	-----	1	1	-----	1	-----	17
22½	6	5	1	4	-----	-----	-----	-----	16
22¾	7	1	-----	9	-----	1	-----	-----	18
23	9	-----	3	9	-----	-----	-----	-----	21
23¼	5	-----	-----	2	-----	-----	-----	-----	7
23½	8	1	5	18	-----	-----	-----	-----	32
23¾	2	1	3	13	-----	-----	1	-----	20
24	5	-----	6	16	-----	-----	-----	-----	27
24¼	-----	-----	2	32	-----	-----	-----	-----	34
24½	1	-----	8	30	-----	-----	-----	-----	39
24¾	1	1	7	25	-----	-----	-----	-----	34
25	-----	-----	10	27	-----	-----	-----	-----	37
25¼	1	-----	5	21	-----	-----	-----	-----	27
25½	-----	-----	7	9	-----	-----	-----	-----	16
25¾	-----	-----	9	20	-----	-----	-----	-----	29
26	-----	1	15	7	-----	-----	1	-----	24
26¼	-----	-----	7	3	-----	-----	-----	-----	10
26½	-----	-----	4	2	-----	-----	-----	-----	6
26¾	-----	-----	9	4	-----	-----	-----	-----	13
27	-----	-----	6	-----	-----	-----	-----	-----	6
27¼	-----	-----	3	-----	-----	-----	-----	-----	3
27½	-----	-----	4	-----	-----	-----	1	-----	5
Totals	206	101	116	255	1	2	4	-----	685
Average lengths	21.2	21.0	25.4	24.5	22.3	21.9	24.9	-----	23.1

Table XV.—Rivers Inlet Sockeyes, 1955, Grouped by Age, Sex, Weight, and by Their Early History

Weight in Pounds	Number of Individuals								Total
	4_2		5_2		5_3		6_3		
	M.	F.	M.	F.	M.	F.	M.	F.	
2	1	-----	-----	-----	-----	-----	-----	-----	1
2¼	-----	-----	-----	-----	-----	-----	-----	-----	-----
2½	-----	2	-----	-----	-----	-----	-----	-----	2
2¾	2	1	-----	-----	-----	-----	-----	-----	3
3	8	9	-----	1	-----	-----	-----	-----	18
3¼	13	2	-----	-----	-----	-----	-----	-----	15
3½	18	8	-----	1	-----	-----	-----	-----	27
3¾	14	11	-----	-----	-----	-----	-----	-----	25
4	32	18	1	-----	-----	1	-----	-----	52
4¼	14	13	-----	1	1	-----	-----	-----	29
4½	24	13	-----	4	-----	-----	-----	-----	41
4¾	16	8	-----	3	-----	1	-----	-----	28
5	15	8	3	8	-----	-----	-----	-----	34
5¼	14	3	3	5	-----	-----	2	-----	27
5½	9	1	2	18	-----	-----	-----	-----	30
5¾	6	1	7	15	-----	-----	-----	-----	29
6	6	-----	7	28	-----	-----	-----	-----	41
6¼	7	1	6	23	-----	-----	-----	-----	37
6½	4	-----	8	40	-----	-----	-----	-----	52
6¾	2	-----	2	18	-----	-----	-----	-----	22
7	1	1	6	30	-----	-----	-----	-----	38
7¼	-----	-----	12	12	-----	-----	-----	-----	24
7½	-----	-----	7	21	-----	-----	-----	-----	28
7¾	-----	1	9	9	-----	-----	-----	-----	19
8	-----	-----	8	9	-----	-----	1	-----	18
8¼	-----	-----	9	2	-----	-----	-----	-----	11
8½	-----	-----	10	3	-----	-----	-----	-----	13
8¾	-----	-----	3	3	-----	-----	-----	-----	6
9	-----	-----	4	-----	-----	-----	-----	-----	4
9¼	-----	-----	4	-----	-----	-----	-----	-----	4
9½	-----	-----	3	-----	-----	-----	1	-----	4
9¾	-----	-----	1	1	-----	-----	-----	-----	2
10	-----	-----	-----	-----	-----	-----	-----	-----	-----
10¼	-----	-----	-----	-----	-----	-----	-----	-----	-----
10½	-----	-----	1	-----	-----	-----	-----	-----	1
10¾	-----	-----	-----	-----	-----	-----	-----	-----	-----
Totals	206	101	116	255	1	2	4	-----	685
Average weights	4.5	4.2	7.4	6.5	4.3	4.4	7.0	-----	5.8

Table XVI.—Rivers Inlet Sockeyes, Average Lengths in Inches of the 4_2 and 5_2 Groups, 1912 to 1955

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
1952	21.5	21.5	26.0	25.0
1953	21.6	21.8	26.5	25.3
1954	22.0	21.6	26.1	25.1
1955	21.2	21.0	25.4	24.5

Table XVII.—Rivers Inlet Sockeyes, Average Weights in Pounds of the 4_2 and 5_2 Groups, 1914 to 1955

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
1952	4.9	4.7	8.7	7.4
1953	4.7	4.7	8.8	7.6
1954	5.2	4.8	8.9	7.6
1955	4.5	4.2	7.4	6.5

Table XVIII.—Rivers Inlet Sockeyes, Percentages of Males and Females, 1915 to 1955

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
1952	----	----	58	42	34	66	44	56
1953	----	----	55	45	33	67	49	51
1954	50	50	67	33	29	71	52	48
1955	----	----	67	33	31	69	48	52

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

Year	Pack in Cases	Number of Sockeye[1]	Percentage of Individuals				
			4_1	4_2	5_2	6_2	5_3
1925	33,764	----	----	----	----	----	----
1926	17,921	----	----	----	----	----	----
1927	22,682	----	----	----	----	----	----
1928	33,442	----	----	----	----	----	----
1929	9,683	----	----	----	----	----	----
1930	32,057	----	----	----	----	----	----
1931	12,867	----	----	----	----	----	----
1932	25,488	----	----	----	----	----	----
1933	37,369	----	----	----	----	----	----
1934	14,607	----	----	----	----	----	----
1935	31,648	----	----	----	----	----	----
1936	12,788	----	----	----	----	----	----
1937	25,258	----	----	----	----	----	----
1938	33,894	----	----	----	----	----	----
1939	17,833	----	----	----	----	----	----
1940	25,947	----	----	----	----	----	----
1941	21,495	----	----	----	----	----	----
1942	15,939	----	----	----	----	----	----
1943	15,010	----	----	----	----	----	----
1944	3,165	----	----	----	----	----	----
1945	15,014	----	----	50	50	----	----
1946	14,318	----	----	11	89	----	----
1947	36,800	----	----	5	95	----	----
1948	10,456	----	----	7	90	3	----
1949	13,189	----	2	92	5	----	(2)
1950	42,435	----	----	17	83	----	(2)
1951	49,473	----	----	22	77	(2)	(2)
1952	34,834	342,200	----	8	91	(2)	1
1953	29,947	367,100	----	89	10	1	(2)
1954	18,937	190,800	1	61	38	----	1
1955	28,864	325,478	----	42	58	----	(2)

[1] To nearest hundred.
[2] 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, 1955, Grouped by Age, Sex, Length, and by Their Early History

Length in Inches	Number of Individuals						Total
	4_2		5_2		5_3		
	M.	F.	M.	F.	M.	F.	
18	1	-----	-----	-----	-----	-----	1
18¼	-----	-----	-----	-----	-----	-----	-----
18½	-----	-----	-----	-----	-----	-----	-----
18¾	-----	-----	-----	-----	-----	-----	-----
19	-----	-----	-----	-----	-----	-----	-----
19¼	-----	-----	-----	-----	-----	-----	-----
19½	1	-----	-----	-----	-----	-----	1
19¾	1	-----	-----	-----	-----	-----	1
20	2	1	-----	-----	-----	-----	3
20¼	4	1	-----	-----	-----	-----	5
20½	10	7	-----	-----	-----	-----	17
20¾	14	6	-----	-----	-----	-----	20
21	27	8	-----	-----	-----	-----	35
21¼	23	5	-----	-----	-----	-----	28
21½	25	14	-----	-----	-----	-----	39
21¾	22	10	1	-----	-----	-----	33
22	32	9	-----	1	-----	-----	42
22¼	18	5	-----	1	-----	1	25
22½	26	5	-----	1	-----	-----	32
22¾	12	3	-----	2	-----	-----	17
23	11	1	-----	7	-----	-----	19
23¼	6	-----	-----	9	-----	-----	15
23½	4	1	3	9	-----	-----	17
23¾	-----	-----	3	24	-----	-----	27
24	3	-----	8	28	-----	-----	39
24¼	-----	-----	13	27	-----	-----	40
24½	-----	-----	11	35	-----	-----	46
24¾	1	-----	12	31	-----	-----	44
25	-----	-----	13	36	-----	-----	49
25¼	-----	-----	22	20	-----	-----	42
25½	-----	-----	16	23	-----	-----	39
25¾	-----	-----	20	7	-----	-----	27
26	1	-----	16	11	-----	-----	28
26¼	-----	-----	8	1	-----	-----	9
26½	-----	-----	8	2	-----	-----	10
26¾	1	-----	3	1	-----	-----	5
27	-----	-----	4	-----	-----	-----	4
27¼	-----	-----	2	-----	-----	-----	2
27½	-----	-----	1	-----	-----	-----	1
27¾	-----	-----	-----	-----	-----	-----	-----
Totals	245	76	164	276	-----	1	762
Average lengths	21.8	21.6	25.3	24.6	-----	22.3	23.5

Table XXI.—Smith Inlet Sockeyes, 1955, Grouped by Age, Sex, Weight, and by Their Early History

Weight in Pounds	Number of Individuals						Total
	4_2		5_2		5_3		
	M.	F.	M.	F.	M.	F.	
2	-----	-----	-----	-----	-----	-----	-----
2¼	-----	-----	-----	-----	-----	-----	-----
2½	1	-----	-----	-----	-----	-----	1
2¾	-----	-----	-----	-----	-----	-----	-----
3	-----	-----	-----	-----	-----	-----	-----
3¼	-----	-----	-----	-----	-----	-----	-----
3½	1	-----	-----	-----	-----	-----	1
3¾	4	1	-----	-----	-----	-----	5
4	16	9	-----	-----	-----	-----	25
4¼	23	10	-----	-----	-----	-----	33
4½	34	20	1	1	-----	-----	56
4¾	26	6	-----	1	-----	1	34
5	44	13	-----	1	-----	-----	58
5¼	30	8	-----	3	-----	-----	41
5½	33	7	-----	11	-----	-----	51
5¾	12	2	2	8	-----	-----	24
6	11	-----	4	26	-----	-----	41
6¼	5	-----	8	17	-----	-----	30
6½	4	-----	16	41	-----	-----	61
6¾	-----	-----	9	25	-----	-----	34
7	-----	-----	10	48	-----	-----	58
7¼	-----	-----	13	26	-----	-----	39
7½	-----	-----	23	33	-----	-----	56
7¾	-----	-----	11	13	-----	-----	24
8	1	-----	25	16	-----	-----	42
8¼	-----	-----	9	-----	-----	-----	9
8½	-----	-----	14	3	-----	-----	17
8¾	-----	-----	12	2	-----	-----	14
9	-----	-----	5	1	-----	-----	6
9¼	-----	-----	2	-----	-----	-----	2
9½	-----	-----	-----	-----	-----	-----	-----
9¾	-----	-----	-----	-----	-----	-----	-----
Totals	245	76	164	276	-----	1	762
Average weights	5.0	4.7	7.5	6.9	-----	4.7	6.2

Table XXII.—Smith Inlet Sockeyes, Average Lengths in Inches of Age-groups, 1945 to 1955

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	-----
1952	-----	-----	21.8	22.4	25.7	24.9	-----	25.1	22.9	23.1
1953	-----	24.3	22.9	22.3	25.9	25.2	-----	-----	22.8	23.3
1954	26.3	25.0	22.3	21.9	25.7	24.9	-----	-----	23.0	23.5
1955	-----	-----	21.8	21.6	25.3	24.6	-----	-----	-----	22.3

Table XXIII.—Smith Inlet Sockeyes, Average Weights in Pounds of Age-groups, 1945 to 1955

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	.....
1952	.....	.....	4.8	5.2	8.0	7.1	.....	7.3	5.7	5.4
1953	.....	5.9	5.9	5.3	8.2	7.6	.....	.....	5.7	5.8
1954	8.0	7.1	5.2	4.7	7.9	7.0	.....	.....	5.8	5.8
1955	.....	.....	5.0	4.7	7.5	6.9	.....	.....	.....	4.8

Table XXIV.—Smith Inlet Sockeyes, Percentages of Males and Females, 1945 to 1955

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
1952	----	----	57	43	38	62	----	100	63	37	40	60
1953	----	100	60	40	36	64	----	----	71	29	58	42
1954	25	75	70	30	25	75	----	----	25	75	52	48
1955	----	----	76	24	37	63	----	----	----	100	54	46

Table XXV.—Skeena Test-fishing Sockeyes, 1955, Grouped by Age, Length, and by Their Early History

Length in Inches	Number of Individuals						Total
	3_2	4_2	5_2	4_3	5_3	6_3	
13¾	1	-----	-----	-----	-----	-----	1
14	-----	-----	-----	-----	-----	-----	-----
14¼	1	-----	-----	-----	-----	-----	1
14½	4	-----	-----	-----	-----	-----	4
14¾	-----	-----	-----	-----	-----	-----	-----
15	13	-----	-----	1	-----	-----	14
15¼	13	-----	-----	-----	-----	-----	13
15½	-----	-----	-----	-----	-----	-----	-----
15¾	15	-----	-----	-----	-----	-----	15
16	-----	-----	-----	-----	-----	-----	-----
16¼	14	-----	-----	-----	-----	-----	14
16½	5	-----	-----	1	-----	-----	6
16¾	-----	-----	-----	-----	-----	-----	-----
17	2	-----	-----	-----	-----	-----	2
17¼	2	1	-----	-----	-----	-----	3
17½	-----	-----	-----	-----	-----	-----	-----
17¾	2	1	-----	-----	-----	-----	3
18	-----	1	-----	-----	1	-----	2
18¼	-----	-----	-----	-----	-----	-----	-----
18½	-----	5	1	-----	-----	-----	6
18¾	-----	-----	-----	-----	-----	-----	-----
19	-----	8	-----	-----	-----	1	9
19¼	-----	3	1	-----	-----	-----	4
19½	-----	-----	-----	-----	-----	-----	-----
19¾	-----	11	-----	-----	1	-----	12
20	-----	13	-----	-----	-----	-----	13
20¼	-----	-----	-----	-----	-----	-----	-----
20½	-----	18	2	-----	-----	-----	20
20¾	-----	28	1	-----	3	2	34
21	-----	-----	-----	-----	-----	-----	-----
21¼	-----	33	7	-----	12	-----	52
21½	-----	-----	-----	-----	-----	-----	-----
21¾	-----	27	2	-----	15	-----	44
22	-----	34	8	-----	8	1	51
22¼	-----	1	-----	-----	1	-----	2
22½	-----	26	16	-----	9	-----	51
22¾	-----	19	31	-----	7	1	58
23	-----	-----	-----	-----	-----	-----	-----
23¼	-----	16	35	-----	4	4	59
23½	-----	11	53	-----	5	8	77
23¾	-----	-----	1	-----	-----	-----	1
24	-----	5	44	-----	2	14	65
24¼	-----	-----	2	-----	-----	-----	2
24½	-----	2	65	-----	1	12	80
24¾	-----	2	72	-----	2	10	86
25	-----	-----	1	-----	-----	-----	1
25¼	-----	3	65	-----	3	10	81
25½	-----	3	51	-----	2	10	66
25¾	-----	-----	-----	-----	-----	-----	-----
26	-----	2	50	-----	1	5	58
26¼	-----	-----	25	-----	-----	-----	25
26½	-----	-----	1	-----	1	7	9
26¾	-----	-----	21	-----	-----	2	23
27	-----	-----	1	-----	-----	-----	1
27¼	-----	1	12	-----	1	1	15
27½	-----	-----	7	-----	-----	-----	7
27¾	-----	-----	-----	-----	-----	1	1
28	-----	1	-----	-----	-----	-----	1
28¼	-----	-----	-----	-----	-----	-----	-----
28½	-----	-----	-----	-----	-----	-----	-----
28¾	-----	-----	-----	-----	-----	-----	-----
29	-----	-----	1	-----	-----	-----	1
29¼	-----	-----	-----	-----	-----	-----	-----
29½	-----	-----	1	-----	-----	-----	1
Totals	72	275	577	2	79	89	1,094
Average lengths	15.7	21.7	24.6	15.8	22.5	24.7	23.1
Percentage	6.2	25.1	52.7	0.2	7.2	8.1	-----

Table XXVI.—Commercially Caught Skeena River Sockeyes, 1955, Grouped by Age, 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	7_4	
15	-----	-----	-----	-----	-----	-----	-----	-----	-----
15¼	-----	-----	-----	-----	-----	-----	-----	-----	-----
15½	-----	-----	-----	-----	-----	-----	-----	-----	-----
15¾	-----	-----	-----	-----	-----	-----	-----	-----	-----
16	-----	1	-----	-----	-----	-----	-----	-----	1
16¼	-----	1	-----	-----	-----	-----	-----	-----	1
16½	-----	-----	-----	-----	-----	-----	-----	-----	-----
16¾	-----	-----	-----	-----	-----	-----	-----	-----	-----
17	-----	-----	-----	-----	-----	-----	-----	-----	-----
17¼	-----	-----	-----	-----	-----	-----	-----	-----	-----
17½	-----	-----	-----	-----	-----	-----	-----	-----	-----
17¾	-----	-----	-----	-----	-----	-----	-----	-----	-----
18	-----	-----	-----	-----	-----	-----	-----	-----	-----
18¼	-----	-----	-----	-----	-----	-----	-----	-----	-----
18½	-----	-----	-----	-----	-----	1	-----	-----	1
18¾	-----	-----	-----	-----	-----	-----	-----	-----	-----
19	-----	-----	-----	-----	-----	-----	-----	-----	-----
19¼	-----	-----	2	-----	-----	-----	-----	-----	2
19½	-----	-----	-----	-----	-----	-----	-----	-----	-----
19¾	-----	-----	1	-----	-----	-----	-----	-----	1
20	-----	-----	1	-----	-----	1	1	-----	3
20¼	-----	-----	-----	-----	-----	2	-----	-----	2
20½	-----	-----	-----	-----	-----	1	-----	-----	1
20¾	-----	-----	8	-----	-----	2	1	-----	11
21	-----	-----	5	-----	-----	3	-----	-----	8
21¼	-----	-----	5	-----	-----	3	-----	-----	8
21½	-----	-----	4	1	-----	4	1	-----	10
21¾	-----	-----	11	-----	-----	9	-----	-----	20
22	-----	-----	6	1	-----	2	1	-----	10
22¼	-----	-----	5	1	-----	6	-----	-----	12
22½	-----	-----	4	1	-----	3	-----	-----	8
22¾	1	-----	11	7	-----	8	-----	-----	27
23	-----	-----	5	8	-----	7	1	-----	21
23¼	-----	-----	3	6	-----	3	-----	-----	12
23½	-----	-----	6	21	-----	6	7	-----	40
23¾	-----	-----	1	17	-----	2	1	-----	21
24	-----	-----	2	22	-----	4	9	-----	37
24¼	-----	-----	1	23	-----	2	3	-----	29
24½	-----	-----	4	45	-----	4	8	-----	61
24¾	1	-----	-----	22	-----	4	7	-----	34
25	-----	-----	2	29	-----	3	4	-----	38
25¼	-----	-----	1	25	-----	-----	3	1	30
25½	-----	-----	-----	39	1	1	12	-----	53
25¾	-----	-----	-----	18	-----	1	2	-----	21
26	-----	-----	-----	14	-----	2	2	-----	18
26¼	-----	-----	1	17	-----	-----	1	-----	19
26½	-----	-----	-----	18	-----	-----	2	-----	20
26¾	-----	-----	-----	5	-----	-----	1	-----	6
27	-----	-----	-----	3	-----	-----	-----	-----	3
27¼	-----	-----	-----	7	-----	-----	-----	-----	7
27½	-----	-----	-----	-----	-----	-----	1	-----	1
27¾	-----	-----	-----	5	-----	-----	-----	-----	5
28	-----	-----	-----	-----	-----	-----	-----	-----	-----
28¼	-----	-----	-----	1	-----	-----	-----	-----	1
28½	-----	-----	-----	-----	-----	-----	-----	-----	-----
28¾	-----	-----	-----	1	-----	-----	-----	-----	1
29	-----	-----	-----	-----	-----	-----	-----	-----	-----
29¼	-----	-----	-----	-----	-----	-----	-----	-----	-----
Totals	2	2	89	357	1	84	68	1	604
Average lengths	23.8	16.1	22.3	24.9	25.5	22.8	24.6	25.3	24.2
Percentage	0.3	0.3	14.7	59.1	0.2	13.9	11.3	0.2	-----

THE STATUS OF THE MAJOR HERRING STOCKS IN BRITISH COLUMBIA IN 1955–56

By F. H. C. Taylor, M.A.; A. S. Hourston, Ph.D.; and D. N. Outram, B.A.,
Fisheries Research Board of Canada, Biological Station, Nanaimo, B.C.

INTRODUCTION

The status of the major aspects of the herring research carried out at the Biological Station, Nanaimo, B.C., by the Fisheries Research Board of Canada is reviewed annually in these reports. During the period from 1946–47 to 1951–52 the results of a detailed study of the effects of a virtually unrestricted fishery on the herring stocks on the west coast of Vancouver Island were presented, along with such data on other stocks as were pertinent to this problem (Tester and Stevenson, 1947, 1948; Stevenson, 1950; Stevenson and Lanigan, 1950; Stevenson, Hourston, and Lanigan, 1951; Stevenson, Hourston, Jackson, and Outram, 1952). The comparative nature of this study was stressed in the next two reports, which treated the west coast and lower east coast of Vancouver Island stocks with equal detail (Stevenson and Outram, 1953; Taylor and Outram, 1954). With the termination of this experiment, attention was again focused on the coast as a whole, and the 1954–55 report (Taylor, 1955) included an analysis of all the major herring stocks on the British Columbia coast. The inclusion in this report of data from a study of the abundance and nature of the stocks of juvenile (I-year) herring provides complete coverage of the current herring research for the first time.

The results of the study to date have indicated that certain sub-districts (west coast of Vancouver Island, central, and Queen Charlotte Islands) contain more than one population, and these have been split to expand the number of sub-districts to ten (Fig. 1).

In the following report, the sections on the fishery and adult tagging and tag recovery were prepared by the senior author, who is in charge of the research programme. Outram provided the section on extent and intensity of spawning. The remaining sections were written by Hourston.

THE 1955–56 FISHERY

The phenomenally high catch in the lower Queen Charlotte Islands and good catches in the lower central and middle and lower east coast of Vancouver Island sub-districts were mainly responsible for the record catch of 250,444 tons of herring taken in 1955–56 (Morgan, MS.). Catches in the northern, upper central, upper east coast of Vancouver Island and upper west coast of Vancouver Island were poor. The table below shows for each sub-district the catch and catch per unit of effort in 1955–56 and in the previous season, and the average catch from 1951–52 to 1955–56.

Sub-district	Catch, 1955–56	Catch, 1954–55	Average Catch, 1951–52 to 1955–56[1]	Catch per Unit of Effort, 1955–56	Catch per Unit of Effort, 1954–55
Upper Queen Charlotte Islands[2] (2A (E))	6,458	21,800	13,715	58	75
Lower Queen Charlotte Islands[2] (2B (E))	85,609	550	24,827	138	76
Northern	11,429	20,050	29,632	22	51
Upper central[2]	1,869	9,700	9,218	—	22
Lower central[2]	46,391	17,850	27,620	98	32
Upper east coast of Vancouver Island	920	9,200	6,255	46	82
Middle east coast of Vancouver Island	29,652	24,650	21,062	47	40
Lower east coast of Vancouver Island	48,709	51,300	48,418	59	56
Lower west coast of Vancouver Island[2]	18,847	6,863	17,281	88	18
Upper west coast of Vancouver Island[2]	560	7,200	8,925	62	61
Totals (tons)	250,444	169,163	206,953	—	—

[1] Catches in 1952–53 were omitted. [2] Changes in terminology are discussed in section on Age Composition.

The catch in the upper Queen Charlotte Islands sub-district (Area 2B (E)) in 1955-56 was the largest ever caught in a single area. Between February 5th and March 9th a total of 85,609 tons were taken from the Burnaby Narrows-Huxley Island region. Availability declined from 251 tons per seine-day in the first week to 178 tons per seine-day in the second week, and levelled off at the relatively high level of between 112 and 126 tons per seine-day for the remaining three weeks. On the other hand, fishing in the lower Queen Charlotte Islands sub-district (Area 2A (E)) was poor in 1955–56. The catch (6,458 tons) was less than one-third of the 1954–55 catch. Availability decreased sharply during the fishery from 96 tons per seine-day in the third week in January to 9 tons per seine-day two weeks later. The fishery was closed on February 1st because of the large proportion of small fish present.

In the northern sub-district (Areas 3, 4, and 5), the quota was not taken for the second successive year. The catch, the smallest since 1946–47, was little more than one-half of the 1954–55 catch. The fishery centred in Morse Basin, with Tuck Inlet and Prince Rupert Harbour providing small catches. It would appear that the 1955–56 fishery was dependent on local resident stocks, and that the main migrating population usually fished in Edye Pass, Ogden Channel, and Kitkatlah Inlet did not become available to the fishery in 1955–56. There were reports of a large body of herring off Porcher Island during the season, which might have represented at least part of this population, but these fish were inaccessible to the fishery. This supposition receives some support from the 1956 spawn survey. Although spawning was slightly less than in 1955, it was not below the average for recent years. The decrease occurred in Area 5, while spawning in Areas 3 and 4 showed slight increases.

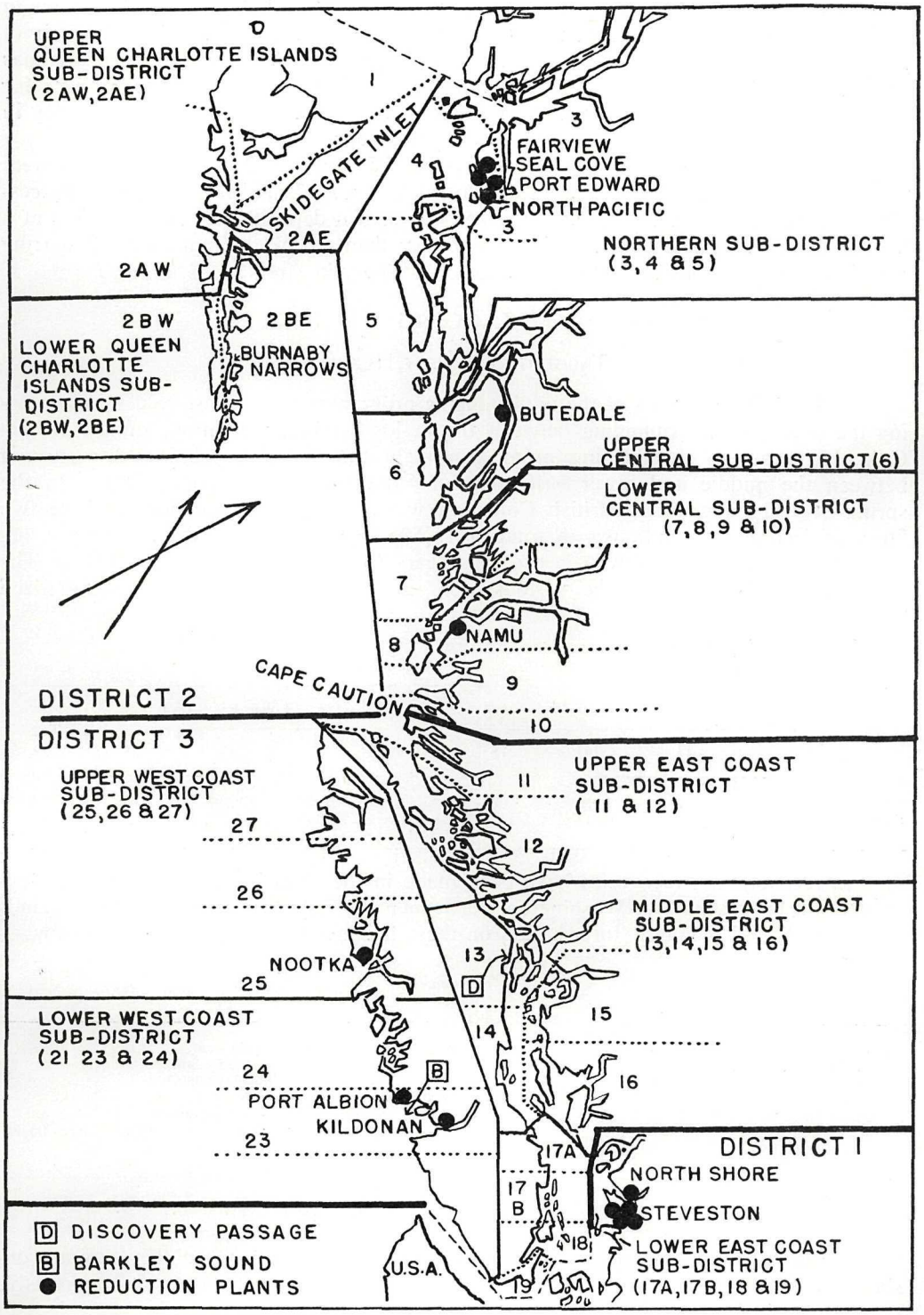
The catch in the upper central sub-district (Area 6) declined sharply from the 1954–55 level, which was average for the past five years. A small fishery developed in Thistle Passage and Laredo Passage, but poor availability, combined with good fishing in the neighbouring lower central sub-district, resulted in the poorest catch from the upper central sub-district since 1943–44.

The lower central sub-district (Areas 7, 8, 9, and 10), in contrast to the previous two seasons, supported an excellent fishery. The 1955–56 catch was exceeded only by those made in 1950–51 and 1948–49; it came almost entirely from Area 7. Availability was 98 tons per seine-day, treble that of the previous season. In the peak fishing period during the two weeks immediately prior to the pre-Christmas closure it reached 266 tons per seine-day. During this period over half the catch was taken. Insignificant catches were made in Areas 8 and 9, and there was no fishery in Area 10.

In the upper east coast sub-district (Areas 11 and 12) the catch was the lowest on record, one-tenth that of the previous season.

In the middle east coast sub-district (Areas 13, 14, 15, and 16) a record catch of 29,652 tons was made. Of this total, 17,916 tons was taken in Area 13 and 11,735 tons in Area 14. The main fishery developed after the Christmas closure. The quota of 10,000 tons was taken by January 13th, followed with a quota extension of 10,000 tons taken by January 28th, and a second extension of 10,000 tons taken by February 10th as a result of a five-day extension of the season. Availability in the sub-district as a whole was about the same as in previous years; it was somewhat greater in the post-Christmas than in the pre-Christmas period and was slightly greater in Area 14 than in Area 13.

The catch in the lower east coast sub-district (Areas 17A, 17B, 18, and 19), while high, was slightly less than in the previous two seasons. Fishing commenced approximately a month later than in 1954–55, and although the original 40,000-ton quota was again taken in three weeks, a 10,000-ton extension granted on December 6th was not filled by the time of the Christmas closure. After Christmas, only desultory fishing occurred as the fleet dispersed to other sub-districts. Availability was similar to that in 1954–55 but less than that in 1953–54.


UPPER
QUEEN CHARLOTTE ISLANDS
SUB-DISTRICT
(2AW,2AE)
SKIDEGATE INLET
FAIRVIEW
SEAL COVE
PORT EDWARD
NORTH PACIFIC
NORTHERN SUB-DISTRICT
(3,4 & 5)
2AE
2AW
2BW
2BE
LOWER QUEEN
CHARLOTTE
ISLANDS SUB-
DISTRICT
(2BW,2BE)
BURNABY
NARROWS
BUTEDALE
UPPER
CENTRAL SUB-DISTRICT(6)
LOWER
CENTRAL SUB-DISTRICT
(7,8,9 & 10)
NAMU
CAPE CAUTION
DISTRICT 2
DISTRICT 3
UPPER WEST COAST
SUB-DISTRICT
(25,26 & 27)
UPPER EAST COAST
SUB-DISTRICT
(11 & 12)
MIDDLE EAST COAST
SUB-DISTRICT
(13,14,15 & 16)
NOOTKA
LOWER WEST COAST
SUB-DISTRICT
(21 23 & 24)
PORT ALBION
KILDONAN
DISTRICT I
NORTH SHORE
STEVESTON
LOWER EAST COAST
SUB-DISTRICT
(17A,17B,18 & 19)
U.S.A.
DISCOVERY PASSAGE
BARKLEY SOUND
REDUCTION PLANTS

In the lower west coast sub-district (Areas 21, 23, and 24), the only region in which a major fishery developed was Barkley Sound (Area 23). Here a catch of 18,160 tons was made, 16,877 tons being caught in December prior to the Christmas closure. This is almost three times the catch made here in 1954–55. Availability for the season as a whole was 89 tons per seine-day, compared to 18 tons per seine-day in 1954–55. Area 24 produced a catch of only 685 tons.

In the upper west coast sub-district (Areas 25, 26, and 27) only 560 tons were taken, all from Area 26. No fishery developed in Area 27, and for the second successive year no catches were made in Area 25. As spawn deposition in Area 25 was at a high level in 1956, late inshore migration rather than a lack of abundance of herring may have been responsible for the absence of a fishery in Area 25.

TAGGING

Tagging of Adult Herring

In 1955 the emphasis of the adult tagging programme was transferred from assessing the degree of intermingling between the major herring populations on the British Columbia coast to determining more accurately the complex relationships existing between the middle and lower east coast of Vancouver Island populations. In the spring of 1956, tagging in British Columbia waters was again confined to these two Strait of Georgia populations. A total of 15,535 tags were inserted (Table I), using the same methods as employed in previous years (Tester and Stevenson, 1947). The numbers of fish tagged in the various areas in 1955 and in 1956 are summarized below:—

Year	Sub-district and Area of Tagging							Total
	Middle East Coast				Lower East Coast			
	13	14	15	16	17A	17B	18	
1955	1,500	2,953	3,020	.....	3,025	5,509	1,498	17,505
1956	1,529	6,713	.....	1,518	1,249	3,008	1,518	15,535

In recent years, recoveries have been made in the Canadian fishery from taggings carried out by the State of Washington Department of Fisheries in the San Juan Islands and Puget Sound regions. Information on these taggings is given in the table below:—

Date	Number Tagged	Location
April 8th, 1953	1,010	Quilcene Bay, Hood Canal.
November 23rd to 25th, 1953	3,650	Mitchell Bay, San Juan Island.
March 18th, 1955	1,000	Agate Pass, Bainbridge Island.
April 19th and 20th, 1955	5,000	Holmes Harbour, Whidbey Island.
November 7th, 1955	153	Small Pox Bay, San Juan Island.
November 20th, 1955	4,000	Between Upright Head and Shag Rock, Orcas Island.
November 21st, 1955	4,000	North of Shoal Bay, Lopez Island.

Tagging of Juvenile Herring

Juvenile herring remain in inshore waters until early fall, when they migrate offshore in large schools and do not reappear in inshore waters again in appreciable numbers until they mature and join the spawning stocks two years later.

In order to provide information on the relationship between the juvenile herring stocks reared in certain areas and the spawning stocks that support the fisheries in these and other areas, a juvenile-herring tagging programme was initiated in 1952. Tagging

methods (Hourston, 1956) are similar to those used for adult herring, except that the tags are considerably smaller (13 by 3 by 0.5 mm. instead of 21 by 4 by 1 mm.).

Until 1954 this programme was centred on the stocks in the Barkley Sound (Area 23) region on the lower west coast of Vancouver Island. Tagging on a limited scale was also carried out in Areas 24 and 25 in the lower and upper west coast sub-districts respectively, and in Area 17A in the lower east coast sub-district. After 1954, tagging on the lower west coast of Vancouver Island was discontinued, and emphasis was shifted in 1955 to populations in the Strait of Georgia and the adjacent San Juan Islands region. Data on the 1955 juvenile taggings (Table II) are summarized below, along with comparable data for the 1951–53 taggings. No juveniles were tagged in 1954.

Year	District or Sub-district of Tagging						Total
	Upper West Coast	Lower West Coast	Middle East Coast	Lower East Coast	District 1	San Juan Islands (U.S.A.)	
1951	.....	11,373	.....	.....	.....	.....	11,373
1952	1,940	25,993	.....	.....	.....	.....	27,933
1953	.....	18,181	.....	8,437	.....	.....	26,618
1955	.....	.....	7,291	5,650	3,149	3,553	20,055

TAG RECOVERY

As in previous seasons, tags were recovered in 1955–56 mainly from magnets in the reduction-plant meal-lines tended by plant crews. A small number of adult tags were recovered by a tag-detector operated by herring-investigation staff.

Tag-detector Operations

In the 1955–56 season, only one tag-detector was again operated, on an essentially experimental basis, in the Gulf of Georgia plant in Steveston. The modernization and increasing electrification of reduction plants has raised considerable practical problems to the continued successful operation of tag-detectors. In spite of technical improvements in the designs of the induction-type tag-detector to increase its inherent sensitivity and stability, detector efficiency again decreased. Detector efficiency was 36 per cent during the pre-Christmas period and 39 per cent during the post-Christmas period, as compared with 44 per cent during the pre-Christmas period in 1954–55, 51 per cent for the same period in 1953–54, and 80 per cent in 1951–52. The increased electrification of the reduction plants has resulted in an increase in possible sources, both of variations in line voltage and of switching transients. As was pointed out in the previous report in this series (Taylor, 1955), the amplitude of the pulse produced by a tag is little greater than that produced by such transients. Any improvements in detector sensitivity and amplification also result in an almost proportional increase in the reaction of the detector to these unwanted transients. Suitable screening of the detector may reduce or eliminate the effects of these transients, and experiments along this line are planned. On the other hand, the use of magnetic tags could be the answer to this problem. Such tags might produce a proportionately larger impulse on passing through the field of the tag-detector's magnet and hence produce sufficient increase in the signal-to-noise ratio. Magnetizing the tags could, however, reduce or eliminate the recovery by plant magnets of tags missed by the detector, as magnetic tags would tend to cling to the iron in the plant machinery whenever they came into contact with it. On the other hand, the press of the wet meal might prevent such contacts until the cooker or drier is reached, where the heat might be sufficiently great to destroy the magnetic properties of the tags. Thus an appreciable increase in the efficiency of detector recovery might be obtained by this means at the cost of a relatively small reduction in the efficiency of magnet recovery.

Operation of Magnets in Reduction Plants

Reduction plants differ in their efficiency in recovering tags from the catches processed. These differences arise from differences in the type of processing equipment used, in the location and effectiveness of the plant magnets, and in the diligence of plant crews in tending the magnets and submitting the tags found. To determine the efficiency of the various plants in recovering tags, tests were conducted in the same manner as in previous years (Stevenson, Hourston, Jackson, and Outram, 1952). A table of the average 1955–56 efficiency of each plant, along with its average efficiency for the previous season in parentheses, is given below:—

Plant	Adult Tags		Juvenile Tags	
	Number of Tests	Average Efficiency	Number of Tests	Average Efficiency
West Coast of Vancouver Island				
Port Albion	1 (1)	92 (90)	1 (1)	60 (30)
Steveston and Vicinity				
Imperial	3 (2)	84 (87)	3 (2)	53 (70)
Gulf of Georgia	3 (3)	94 (94)	3 (3)	80 (60)
Colonial	2 (2)	76 (91)	2 (2)	60 (85)
Phœnix	3 (4)	97 (98)	3 (3)	85 (93)
North Shore	2 (2)	89 (79)	2 (2)	75 (40)
Average	--------	88 (90)	--------	71 (68)
North and Central British Columbia				
Namu	2 (..)	91 (....)	2 (..)	65 (....)
Butedale	1 (2)	92 (83)	1 (..)	70 (....)
Port Edward	2 (2)	78 (87)	2 (..)	50 (....)
Seal Cove	2 (3)	79 (64)	2 (..)	35 (....)
Fairview	2 (..)	71 (....)	2 (..)	60 (....)
North Pacific	2 (..)	81 (....)	2 (..)	70 (....)
Average	--------	82 (78)	--------	58 (....)

In 1955–56, Port Albion was again the only plant operating on the west coast of Vancouver Island. The Namu reduction plant, enlarged in 1954, was modified prior to the 1955–56 season and magnets reinstalled. A new reduction plant in the Prince Rupert area, North Pacific, began operation in the 1955–56 season. Magnet tests were carried out for the first time at this plant and at the Fairview plant, which commenced operation in 1954–55 in the same locality.

In general, there was relatively little change in the efficiency of adult-tag recovery in 1955–56. North Shore, Butedale, and particularly Seal Cove showed increases in efficiency, while Port Edward and Colonial showed decreases. The drop in efficiency of Colonial may have resulted from the enlargement of the plant and installation of a cyclone-type drier.

The average efficiency of the major plants in Southern British Columbia in recovering the small juvenile-herring tags was only slightly greater in 1955–56 than in the previous season. However, individual plants showed considerable variation in efficiency between the two seasons. Port Albion, Gulf of Georgia, and North Shore showed marked increases in efficiency, while Imperial, Colonial, and, to a lesser extent, Phœnix showed marked decreases. Tests of efficiency in recovering juvenile tags were carried out in plants in Northern and Central British Columbia for the first time in 1955–56. The average efficiency was somewhat lower than for plants in Southern British Columbia. In general the plants appear to be about 80 per cent as efficient in recovering juvenile tags as in recovering adult tags. The ratio of juvenile to adult efficiency was 0.77 in 1955–56, 0.78 in 1954–55, and 0.83 in 1953–54.

Officers of the Federal Department of Fisheries carried out the magnet efficiency tests in plants in Northern and Central British Columbia, and personnel of the Biological Station, Nanaimo, B.C., those in other regions.

Recovery of Adult Tags by Plant Crews

A total of 2,666 tags, including thirty-five State of Washington tags, were recovered in 1955–56, approximately the same number as in the previous season. The distribution of adult-tag recoveries by area of tagging and probable sub-district of recovery is shown in Table III.

The varying amount of time taken for tags to pass through the plant machinery and reach the magnets in the meal-lines and the practice in most reduction plants of processing fish from several different areas in a relatively short period of time led to uncertainty as to the area of recovery of plant magnet returns. Only in cases where a plant processes fish from one area for a relatively long period of time can the area of recovery of tags found be considered certain. The same methods as employed in previous years (Tester and Stevenson, 1948) have been used to assign the most probable area of recovery to each plant magnet return. The most probable area of recovery could not be readily determined for 793 (29.7 per cent) of the tags (Table IV). Lack of precision in the determination of the exact area of recovery of plant magnet returns makes the analyses of movements within populations impossible and, as has been discussed in previous reports (Taylor and Outram, 1954, and preceding reports), limits the accuracy of the use of plant magnet returns in assessing the movement of fish between populations.

The analysis of movements between populations is based on estimates of the probable numbers of tags in the catches derived either from tag-detector recoveries or from plant magnet returns (Taylor and Outram, 1954). Because of the relatively small number of the former, obtained from one plant only in 1955–56, estimates of the probable numbers of tags in the catches derived from plant magnet returns were considered more accurate. Table IV shows by area of tagging and probable sub-district of recovery the probable numbers of tags in the catches that have been at liberty for one, two, three, and more than three years, along with the totals for each area and sub-district. Actual numbers of recoveries are shown in parentheses in all cases. As herring are tagged in March, and recoveries made in the winter fishery from November to early February or March, tagged fish are at liberty for up to four months less than the full period recorded.

The majority of recoveries from the middle and lower east coast of Vancouver Island populations were from the 1955 taggings of fish that had been at liberty for a year. (In 1955, tagging was confined to these two sub-districts.) In contrast to this, the majority of the recoveries from populations in Northern British Columbia and in the upper and lower west coast of Vancouver Island were from fish tagged in 1954 and 1953 that had been at liberty for two or more years. It will be noticed from Table IV that there is a tendency for the degree of dispersion from the sub-district of tagging to increase slightly the longer the tagged fish have been at liberty. This tendency is somewhat more marked in the Strait of Georgia populations than in those from Northern British Columbia. However, on the basis of the 1955–56 recoveries, this tendency does not seem sufficiently marked to warrant comparing the amount of dispersion from a population in different seasons on the strict basis of recoveries from fish at liberty for the same number of years. Such comparisons were therefore made, as in previous years, on the total probable number of tags recovered from each sub-district's tagging. A more important and more difficult source of error to estimate arises from differences in the degree of exploitation of the various populations in the same season and of the same population in different seasons. This effects comparisons between the same population in different seasons or different populations in the same season.

As in previous years, most of the recoveries were from the sub-district of tagging. In 1955–56 this " homing " tendency appeared to be strongest in the lower Queen Charlotte Islands and the middle east coast of Vancouver Island populations and weakest in the populations on the upper Queen Charlotte Islands and northern sub-district.

The number of recoveries of fish tagged on the lower and upper west coast of Vancouver Island was small in 1955–56, reflecting the lack of tagging there in 1955 and the light tagging in 1954. The indicated movement of herring from this region to other sub-districts was about 18 per cent (10/58). While this is somewhat less than the amount of emigration in the previous year (24 per cent), it is probably still above average for recent years. Additional recoveries were made from lower Queen Charlotte Islands, the lower central, and the middle and lower east coast of Vancouver Island sub-districts.

Movement of lower east coast herring was greatest to the middle east coast sub-district, where 13 per cent (77/586) of the recoveries were made. This compares with 20 per cent in 1954–55 and 16 per cent in 1953–54. Movements to the lower central sub-district and west coast of Vancouver Island amounted to about 1 per cent each (6/586 and 8/586 respectively). More lower east coast tags were recovered from the lower west coast sub-district (seven tags) than from the upper west coast sub-district (one tag). Considering the small number of recoveries involved and the great difference in the size of the catch in the two west coast regions, this may not represent an actual difference in movement to the two areas.

A total of thirty-five recoveries were made from tags inserted in the San Juan Islands and Puget Sound region by State of Washington Department of Fisheries. Of these tags, one was recovered from the lower central sub-district, one from the lower west coast sub-district, and the remainder from the lower east coast sub-district. Of the lower east coast recoveries, twenty-two were from herring tagged in the San Juan Islands region immediately prior to or during the lower east coast fishery, ten were from fish tagged in Holmes Harbour, Whidbey Island, in mid-April, 1955, and one from fish tagged at Agate Pass in Puget Sound in March, 1955. The large number of recoveries from the San Juan Islands region is to be expected. This locality is within 20 miles of the main centre of the lower east coast fishery, and the San Juan Islands herring are probably an adjunct to the main migrating lower east coast population. The Holmes Harbour and Agate Pass fish may represent local stocks which intermix to a more limited extent with the lower east coast fish.

Movement from the middle east coast population amounted to 6 per cent (40/647) in 1955–56. This is approximately the same as in 1954–55 (4 per cent, 6/152), but considerably less than the average of 45 per cent for the years 1936 to 1952 (Stevenson, 1955). Approximately 5 per cent of the middle east coast tags were recovered from the lower east coast sub-district, compared to 2 per cent in 1954–55, 17 per cent in 1953–54, and 6.8 per cent from magnet recoveries, or 29.9 per cent from detector recoveries in 1951–52. Although, as in 1954–55, the movement of fish tagged in Area 17A to the middle east coast (23 per cent) was greater than for those tagged in Area 17B (7 per cent) or Area 18 (6 per cent), the movement from Areas 17A and 17B in 1955–56 was somewhat less than the previous year (Area 17A, 46 per cent, and Area 17B, 14 per cent). The movement of middle east coast fish to the lower east coast sub-district was greater from Area 14 (14 per cent) than from Area 15 (4 per cent) or Area 13 (<1 per cent). Mixing between stocks in the middle and lower east coast sub-districts is thus greatest between the contiguous areas—northernmost lower east coast area and southernmost middle east coast area. This pattern of recoveries, shown by fish tagged in the middle and lower east coast sub-districts, thus tends to confirm the hypothesis that herring enter the Strait of Georgia from two directions—from the south into the lower east coast sub-district and from the north into the middle east coast sub-district.

Emigration from the lower central sub-district amounted to 16 per cent (76/472) in 1955–56, the main portion of which (9 per cent) was to the lower Queen Charlotte Islands. Limited movement of lower central fish to the upper Queen Charlotte Islands, northern, and middle and lower east coast of Vancouver Island sub-districts was also indicated.

The 1955–56 fishery in the upper central sub-district was too small (less than 2,000 tons) to provide tags certain as to area of recovery or to be able to assign recoveries to it

with any degree of certainty. About 85 per cent (194/229) of the recoveries of fish tagged in the upper central sub-district were from the upper or lower central sub-districts, 5 per cent were from the northern sub-district, 6 per cent from the lower Queen Charlotte Islands sub-district, and 2 per cent each from the upper Queen Charlotte Islands and the middle east coast sub-districts.

Of the recoveries of fish tagged in the northern sub-district, 55 per cent (143/260) were from the lower Queen Charlotte Islands sub-district and 12 per cent (31/260) from the lower central sub-district, as compared to 31 per cent (81/260) from the sub-district of tagging. This pattern of recoveries is quite different from that shown by northern fish in previous years. In 1954–55 and in 1953–54, emigration amounted to only 4 per cent (Taylor, 1955). On the basis of recoveries of fish tagged and recovered between 1936 and 1952, Stevenson (1955) found that the average emigration from the northern sub-district amounted to 23 per cent. The extent to which the greater emigration from the northern population represents an actual change in migration pattern is uncertain because:—

(1) The small northern fishery occurred concurrently with the large lower Queen Charlotte Islands and lower central fisheries. This made it difficult to decide with a reasonable degree of certainty which tags were actually recovered from the northern sub-district.

(2) The possibility exists that the herring in Tuck Inlet and Morse Basin, where the 1955–56 fishery was centred, represent a local population, not part of the main population usually fished around Porcher Island. Results in other years indicate that it was this latter population that had been tagged. A local population would probably not contain as great a proportion of tagged fish as the main population, and hence the number of recoveries from it would be expected to be proportionately low. It is interesting to note that during the season there were reports of a large body of herring off Porcher Island that remained out of reach of the fishery. This body of herring might have been at least part of the normal main migratory population which for some reason did not become available to the fishery in 1955–56. This speculation receives some support from the amount of spawn deposited in this sub-district in 1956. Spawning was only slightly less (12 per cent) than in 1955. The decrease is not as great as might have been expected in view of the very poor 1955–56 catch. Spawning was not below the average for recent years. It increased in Areas 3 and 4; the decrease occurred in Area 5, where a large spawning in Wilson Inlet, recorded in 1955, for the first time in recent years was not repeated.

The fishery in 1955–56 in the lower Queen Charlotte Islands sub-district far exceeded in size that in the upper Queen Charlotte Islands sub-district. This is in contrast to the previous two seasons, in which the upper Queen Charlotte Islands fishery had far exceeded in size that in the lower Queen Charlotte Islands. The bulk of recoveries of fish tagged in the lower Queen Charlotte Islands were from that area. Emigration amounted to only about 3 per cent (19/619), divided almost equally to the upper Queen Charlotte Islands, northern, and lower central sub-districts. On the other hand, of fish tagged in the upper Queen Charlotte Islands, 64 per cent (85/132) were recovered from the area of tagging, compared to about 96 per cent in 1954–55. Movement to the lower Queen Charlotte Islands sub-district amount to 20 per cent (27/132); to the northern sub-district, 8 per cent (11/132); and to the lower central sub-district, 5 per cent (6/132). Three recoveries were made from Southern British Columbia populations. The greater amount of emigration indicated in 1955–56 may be, in part, due to greater errors in the correct assignment of tags to area of recovery. The upper Queen Charlotte Islands fishery, like the northern fishery, occurred concurrently with

the large lower Queen Charlotte Islands and lower central fisheries, and a proportion of the tags actually recovered in the upper Queen Charlotte Islands may have been assigned in error to the lower Queen Charlotte Islands.

Recovery of Juvenile Tags by Plant Crews

Plant crews recovered twenty-two juvenile-herring tags during the 1955–56 fishing season. Only eight of these could be assigned with certainty to catches from a specific area but probable recovery areas for seven more were determined on the same basis as that employed in analysing adult-tag returns. The twenty-two returns obtained during the 1954–55 fishery and the six from the 1953–54 fishery were similarly analysed, and the resulting probable returns were corrected for magnet efficiency and the proportion of the catch searched by magnets (Hourston, 1956). The results were tabulated by sub-district (Table V), as the number of returns was too small to make analysis by area worth while. Methods employed, and consequently difficulties encountered and assumptions made, were similar to those in the analysis of adult-tag returns.

Fish tagged as juveniles showed 56 per cent homing after two years and 62 per cent after three years. This is considerably less than that shown by fish tagged as adults in the same sub-district (90 and 74 per cent respectively). Data were considered inadequate for comparison of tags at large for one year, as only three such juvenile tags were recovered. Thus the juveniles show greater wandering tendencies than do adults. A larger unit of population than the adult population may therefore be necessary for considerations relating population data on juveniles to that on adults. Most of the juveniles emigrating from the lower west coast sub-district moved to the lower east coast sub-district, and these two sub-districts may form a suitable unit for such considerations. However, it remains to be seen whether juveniles tagged on the lower east coast reciprocate this emigration. If so, it would appear that the depletion of one adult population would be compensated in part by immigration of new recruits from one or more of the others, provided, of course, they were not depleted at the same time.

AGE COMPOSITION

The age composition of the herring stocks fished was estimated from age determinations for each of 100 fish in 288 samples removed from herring-packers in the approximate proportion of one sample per 900 tons of fish caught (Isaacson, MS.). Practical difficulties precluded close adherence to this ratio, resulting in a variation of 105 to 3,722 tons per sample.

When the stocks in two sections of the Queen Charlotte Islands showed appreciable differences in age composition, the presence of two separate populations was suggested. The returns of tagged fish and the data on average length and weight supported this hypothesis. Thus Area 2A (E) is occupied by the upper Queen Charlotte Islands population and Area 2B (E) by the lower Queen Charlotte Islands population. For the sake of consistency, the north central (Area 6) and south central (Areas 7, 8, 9, and 10) populations have been redesignated upper and lower central, and the north-west coast of Vancouver Island (Areas 25, 26, and 27) and the south-west coast of Vancouver Island (Areas 21, 23, and 24) populations have been renamed upper and lower west coast of Vancouver Island. Sub-districts have been modified accordingly (Fig. 1).

For the third successive year, the 1951 year-class formed a major portion of the fishing stocks, dominating the lower Queen Charlotte Islands, lower central, and upper east coast and middle east coast of Vancouver Island populations. It shared dominance with the 1953 year-class in the upper Queen Charlotte Islands population and, to a lesser extent, in the northern population. The 1953 year-class dominated the lower east coast and lower west coast populations. The 1954 year-class formed the vast majority of the

upper central population, and appears to be at least as strong in most other populations as the 1953 year-class was as II-year fish. It would thus appear that, over the coast as a whole, both the 1953 and 1954 year-classes are above the average abundance of the last seven years, but not as large as the big 1951 year-class. The 1952 year-class was the poorest of the seven, followed by the 1949, 1948, and 1950 year-classes in that order. Thus the over-all population level of the fishing stocks will probably be lower in 1956–57 than in 1955–56. However, the recruitment of the above-average 1954 year-class should compensate somewhat for the decline in the contribution of the strong 1951 year-class.

The consistency with which the newly recruited year-class has each year dominated the heavily exploited lower east coast and lower west coast populations and the relative stability of the extent of this domination suggests that recent fluctuations in year-class strength have not been major, in these sub-districts at least. The ability of the 1951 year-class to dominate catches over a three-year period in more northerly sub-districts suggests more violent fluctuations in year-class strength in these sub-districts or that the fishery does not catch as large a proportion of a strong year-class as it enters the fishery. The latter alternative could result from relatively large portions of the year-class not being recruited until age V or age VI.

The actual contribution of these year-classes to the fishery in each population in terms of numbers of fish may be determined from the age composition, average weight at each age, and total catch. These calculations were made for each area and summed by sub-district (Table VII). The table shows the great strength of the 1951 year-class even more strikingly than the age-composition data. It experienced the strongest recruitment of any of the five most recent year-classes in the lower each coast and lower west coast sub-districts, a fact not evident from the age composition alone.

AVERAGE LENGTH AND WEIGHT

With the exception of the upper Queen Charlotte Islands, upper central, and upper east coast populations, the average length (Table VIII) and weight (Table IX) of fish from each year-class showed little variation from population to population (Isaacson, MS.). Relatively large differences in the very old and very young fish may be attributed to the small number of fish sampled in these age-groups.

For the past three fishing seasons, the upper east coast fish of all ages have been smaller, both in length and weight, than the fish in other sub-districts, whereas in 1952–53 they were larger. This supports the hypothesis that the upper east coast population is made up largely of local stocks subject to different environmental effects than the migratory populations. The upper Queen Charlotte Islands fish and the upper central fish were smaller at Ages III and IV than in other sub-districts, suggesting that these fish also are subjected to different environmental stresses than the other populations up to at least Age IV. This gives additional support to their classification as separate populations, as proposed from the age-composition analysis.

No appreciable change in the average length and weight of the various age-groups in 1955–56 is evident, except in the upper east coast where the fish were smaller than in the previous year. The lower east coast and northern fish tended to be slightly shorter than in the previous year, but this difference was not reflected in the average weights. The upper and lower central populations appear to have been a year behind in their growth from the third year on, as in 1953–54 and 1954–55. This trend is continued in 1955–56 in the upper central population. This could have occurred as a result of inclusion of a false annulus on the scales when ageing the fish, although a spot check on these scales failed to show any such possibility. A more thorough check will be made before any final decision is reached in this matter. In any event it would appear that these two populations resemble each other more closely than do any other two populations.

SEX RATIO

The sex ratio (the number of females divided by the number of males) has fluctuated between 0.96 and 1.11 over the past five years (Table X). In 1955–56 it was 1.09, slightly higher than the average for the past five years (1.05). Although, as a general rule, females tend to predominate in the older age-groups, the sex ratio bears no apparent relationship to the average age of fish in the catch or to population size as indicated by the size of the catch. Males were proportionally more abundant in samples from the lower east coast, whereas females tended to predominate elsewhere.

EXTENT AND INTENSITY OF SPAWNING

In addition to providing the initial size of the new year-class, estimates of the extent and intensity of spawn depositions give an index of the relative size of the spawning escapement. These estimates are made each spring by officers of the Federal Department of Fisheries for the entire British Columbia coast. Independent and more detailed surveys of the lower and middle east coast of Vancouver Island sub-districts were also conducted in 1955 and 1956 by staff members of the Biological Station, Nanaimo, B.C. The size of the spawning population is determined from the amount of eggs deposited, sex ratio, and fecundity of the different age-groups. The resulting calculation is taken to represent escapement from the fishery, since natural mortality during the short period between the closure of the fishery and the commencement of spawning is considered to be negligible.

The length of each spawning-ground was measured by either pacing along the beach or by reference to large-scale charts. When the width was found to be extremely small or large (that is, less than 5 yards or greater than 100 yards), the actual length was converted to an equivalent length based on a standard width of 30 yards. The intensity of spawning was estimated as one of five categories—very light, light, medium, heavy, or very heavy—depending on the number of eggs deposited per unit area of vegetation. These data were converted to the number of statutory miles of spawn at a standard intensity of medium in each statistical area (Table XI).

A summary of the results of the 1956 surveys (Outram, 1956) is presented here. The total amount of herring spawn deposited was 188.1 miles, a reduction of 13 per cent from the 1955 level. The 1956 spawning depositions were slightly below the average of the last ten years. Increases in spawn depositions over the previous year occurred in the upper east coast (73 per cent), upper west coast (200 per cent), and lower west coast (41 per cent) of Vancouver Island sub-districts. Marked decreases in the amount of spawn deposited were recorded in the upper central (96 per cent), lower central (38 per cent), lower east coast of Vancouver Island (51 per cent), and middle east coast of Vancouver Island (31 per cent) sub-districts. Smaller decreases in spawn deposition occurred in the lower Queen Charlotte Islands (14 per cent) and northern (12 per cent) sub-districts. Of the numerous reductions in spawn deposition that occurred throughout British Columbia, only the sharp decrease in the upper central sub-district appears to be of a serious nature. On the other hand, the amount of spawn deposited in the upper west coast of Vancouver Island sub-district was nearly the largest on record.

In spite of the abundance of fish in the Queen Charlotte Islands region during the fishing season, the amount of spawn recorded in the lower Queen Charlotte Islands was slightly lower than the previous year. In the upper Queen Charlotte Islands, spawning was virtually non-existent for the second successive year.

The small reduction in spawn deposition in the northern sub-district was due to the failure of the large 1955 spawning in Wilson Inlet (Area 5) to reoccur. The reduced spawning in Area 5 was partly compensated for by slight increases in Areas 3 and 4.

The amount of spawn deposited in the upper and lower central sub-districts continued to decline in 1956. A small increase in spawn deposition in Area 10 was more than offset by sharp reductions in Areas 6, 7, 8, and 9. The absence of spawnings in the usually productive Myers Pass region (Area 6) was responsible for the large decrease in spawn deposition in the upper central sub-district.

In the upper east coast of Vancouver Island sub-district, unusually large spawnings in Knight Inlet and Mackenzie Sound (Area 12) maintained spawning at an average level for the sub-district.

On the middle east coast of Vancouver Island there was less spawning in all regions, except Area 14, where a large spawning in Comox Harbour kept the spawn deposition for the sub-district at the average level. Spawnings failed to occur in Area 15 this year for the first time; spawning in this area during the past ten years has averaged about 3.4 miles.

Although there was a marked reduction in the amount of spawning on the lower east coast of Vancouver Island for the third successive year, the 1956 level remained about equal to the average of the last ten years. The lack of extensive spawnings along the shore-line on either side of Stuart Channel (Area 17B) was mainly responsible for the decreases in this sub-district. Reductions in the size of the Area 17B spawnings were partly compensated for by increases in Area 18, particularly in Saanich Inlet.

The increase in the amount of spawn deposited in the lower west coast sub-district results from greater spawning in Area 23, which more than compensated for the sharp reduction in Area 24.

The increase in the amount of spawn deposited in the upper west coast of Vancouver Island sub-district resulted primarily from a large spawning at Nuchatlitz Village (Area 25), which was responsible for about four-fifths of the total amount of spawn found in this sub-district.

On the coast as a whole, the amount of spawn deposited has been decreasing continuously for the past four years. The continuous increase in the two west coast populations has failed to compensate for decreases in Areas 6, 15, and 17B. However, the 1953 to 1955 spawnings were above average in extent, and the 1956 spawning is about average for the ten-year period immediately preceding the record spawning of 1953.

DISCUSSION

The status of the major herring populations in British Columbia may now be discussed in the light of the information presented above.

On the basis of tag returns and data on year-class strength and average length and weight of fish at each age, two populations were found in each of what were formerly known as the Queen Charlotte Islands, central, and west coast sub-districts. The latter two sub-districts were treated in two parts in the 1954–55 report (Taylor, 1955), and indications of more than one population in each have been noted for some time. Previously these divisions were known as north and south, but, for the sake of consistency and to avoid confusion, they have been redesignated upper and lower. The 1955–56 fishery in the Queen Charlotte Islands was the first in recent years to appreciably exploit both Areas 2A (E) and 2B (E), and thus it was not until this year that the presence of two populations was clearly indicated.

The populations in the lower Queen Charlotte Islands and middle east coast of Vancouver Island sub-districts showed the strongest homing tendencies, as was the case in 1954–55. However, the upper Queen Charlotte Islands and northern populations, which also showed strong homing tendencies in 1954–55, were the poorest in this respect in 1955–56. This greater wandering in 1955–56 was reflected in the catches, which were lower than anticipated that season. Emigration from the lower west coast sub-district was again relatively high in 1955–56, but was lower than in

the previous season. The increased catch in this sub-district may reflect the greater homing tendency in 1955–56.

In 1955–56, herring in British Columbia were generally more abundant than in the previous year and than the average for the past five years. The total catch was one-third greater than in 1954–55 and one-fourth greater than the five-year average, while the amount of spawn deposition decreased only slightly from the previous year and remained equal to the average of recent years. The record size of the 1955–56 catch may be attributed to large increases in abundance in the lower Queen Charlotte Islands and lower central sub-districts. With the exception of the catch on the middle east coast of Vancouver Island, which was slightly above average, and that on the lower west coast of Vancouver Island, which was average, catches in the other sub-districts were below average.

The amount of spawn deposited increased considerably in the lower and upper west coast and upper east coast sub-districts but decreased elsewhere.

In the upper Queen Charlotte Islands sub-district there was a marked reduction in catch, and no spawning was located for the second consecutive year. The decrease in abundance may be partially attributed to the decline in numbers with age of the strong 1951 year-class which was not compensated by recruitment from the weak 1952 year-class. However, it would appear that this population did not become as available to the fishery in 1955–56 as in the previous year, and this may be the major cause of the decrease in catch. In 1956–57, abundance will probably be even lower, but until this population can be related to its spawning-grounds, it will be impossible to assess its availability and predict its future strength with any confidence.

The lower Queen Charlotte Islands catch showed a tremendous increase over 1954–55, possibly also resulting from a difference in availability to the fishery. The 1951 year-class made up the major portion of the catch. The amount of spawn deposited showed a slight decrease in 1956, but not nearly enough for the decrease in escapement to account for the increase in catch. As the 1951 year-class cannot be expected to make a major contribution as VI-year fish next year, the 1956–57 population will probably be appreciably smaller, but should still be about average.

There was a sharp decline in catch in the northern sub-district, accompanied by a slight decrease in escapement, as indicated by the amount of spawn deposited. The decrease in abundance may be traced to the exceedingly poor contribution of the 1952 year-class as IV-year fish, the age-group which usually dominates this population. But for the excellent contribution of the 1953 year-class, this population would have been exceedingly small in 1955–56. Abundance should be greater in 1955–56, but not above average.

In the upper central sub-district, one of the biggest decreases in recent years was experienced in 1955–56 in both catch and spawn deposition. The good 1951 year-class was too old to make an appreciable contribution to the stock, and both the 1952 and 1953 year-classes were exceedingly poor in this population. Consequently only an unusually good contribution of the 1954 year-class as II-year fish sustained the population at a level high enough to permit a fishery. Had this year-class been equally poor as its immediate predecessors, the population might not have been large enough to provide adequate spawning. This population should be appreciably larger in 1955–56, but probably not above average.

In the lower central sub-district, spawning was down about one-third from the level of the past three years, but the catch was nearly double the average for that time. The sustained abundance of the very strong 1951 year-class as V-year fish in this sub-district, along with nearly average contributions by the 1952 and 1953 year-classes and a good recruitment of the 1954 year-class as II-year fish, resulted in a very high level of abundance. Abundance should be about average next year.

The upper east coast catch declined considerably in 1955–56, but since spawn deposition showed a marked increase, the general level of abundance was probably about the same as in the previous year. However, since the strong 1951 year-class, which dominated the catch as V-year fish this year, cannot be expected to make a major contribution to next year's population, abundance will probably decline in 1956–57.

In the middle east coast sub-district, the 1955–56 catch was slightly above average, but the extent of spawn deposition was slightly below average. The relatively weak contribution of the 1953 year-class as III-year fish was offset by the above-average contributions of the 1951 and 1952 year-classes. The 1954 year-class may be sufficiently strong to sustain the present level of abundance in 1956–57 in spite of the weakness of the 1953 year-class, but it is more likely that abundance will decrease slightly.

The catch on the lower east coast was average in size, but, for the third successive year, the extent of spawn deposited showed a sharp decline (approximately one-half that of 1955, one-third that of 1954, and one-fifth that of 1953). Since the 1954 year-class appears to be at least average in strength, the decline in spawning in 1954 was not sufficient to affect the strength of the resulting year-class. According to reports from fishermen and local residents, the juvenile herring were more abundant than usual in 1955, and surveys by Biological Station personnel of the juvenile herring in this sub-district indicate the 1955 and 1956 year-class are comparable in strength. Thus the amount of spawn deposited those years was also probably adequate. Unless the intensive fishery in the lower east coast can continue to reduce the spawning stock (quota extensions have not been fully taken during the past two seasons), there appears to be no real danger of the population not sustaining itself. No appreciable change in abundance is anticipated in 1956–57.

After a poor showing in 1954–55, both catch and spawn in the lower west coast sub-district increased in 1955–56 to the average level for the past five years. The newly recruited 1953 year-class was of average strength, whereas the 1952 year-class failed to provide the usual number of new recruits in the 1954–55 fishery. As the 1954 year-class appears to be at least as strong as that of 1953, the population level in 1956–57 should be slightly higher than in 1955–56.

In the upper west coast sub-district, no appreciable fishery materialized in 1955–56 and no samples were obtained. However, the extent of spawning was three times that of the previous year and was more than double the average for the past four years. Consequently abundance in this sub-district was probably sustained at least at the average level in 1955–56. The lateness of the inshore movement of the fish did not make them available to the fishery.

ACKNOWLEDGMENTS

The co-operation and assistance of the fishing companies, herring-fishermen, and government fisheries departments during this study is sincerely appreciated and gratefully acknowledged. Special thanks are extended to the numerous members of the staff of the Biological Station whose counsel and labours have culminated in this report.

SUMMARY

Analysis of recent data as to the status of the major herring stocks has indicated the presence of ten major populations. The Queen Charlotte Islands, central, and west coast sub-districts have been divided into lower and upper populations on the basis of differences in their age composition and average size, and from the extent of mixing indicated by the returns of tagged fish.

Emigration, as indicated by the returns of tagged fish, was greatest from the upper Queen Charlotte Islands (36 per cent) and northern (67 per cent) populations, both of which showed strong homing tendencies in 1954–55. This greater wandering was reflected in reduced catches from these sub-districts in 1955–56. Most of the emigration

was to neighbouring populations. Homing was greatest to the lower Queen Charlotte Islands (97 per cent) and middle east coast of Vancouver Island (94 per cent) sub-districts, whose populations also showed little emigration in 1954–55.

Returns of tags inserted in juvenile herring on the lower west coast of Vancouver Island indicate that mixing between that stage and recruitment is greater than that shown by fish tagged as adults and at large for a comparable period. Thus depletion in any one population should be buffered by the excess in immigration over emigration prior to recruitment.

A record catch of 250,441 tons was taken during the 1955–56 fishing season. Large increases in abundance in the lower Queen Charlotte Islands and lower central sub-districts were mainly responsible for the increase in catch. These two populations were sustained mainly by the strong 1951 year-class as V-year fish.

The total amount of spawn deposited was slightly less in 1956 than in 1955, with appreciable increases in the upper east coast and upper and lower west coasts of Vancouver Island sub-districts nearly offsetting decreases in all other sub-districts. Spawn deposition in 1956 was average for recent years. The extent of spawn deposition on the lower east coast of Vancouver Island has declined steadily since 1953 (from 102.5 miles in 1953 to 21 miles in 1956) with the increase in exploitation by the fishery. However, surveys of the juvenile (I-year) stocks in 1955 and 1956 and the contributions of the previous two year-classes to the fishery fail to show any corresponding decrease in the size of the resulting brood.

Fish were relatively more abundant in 1956 than in 1955 in the lower Queen Charlotte Islands, lower central, and lower west coast of Vancouver Island sub-districts, and less abundant in the upper Queen Charlotte Islands, northern, upper central, lower east coast of Vancouver Island, and upper west coast of Vancouver Island sub-districts. The strong 1951 year-class continued to form the major portion of most of the populations in the north, while the above-average 1953 year-class dominated in the south. The 1952 year-class was relatively small in most populations. Although the 1954 year-class appears to be above average, it is not likely to sustain the present level of abundance in 1956–57, as the 1951 year-class will cease to contribute appreciably to the population.

No appreciable difference in the size of fish of each age was noted in 1955–56. Fish from the upper east coast at ages II, III, and IV were again smaller than those in neighbouring populations. This trend probably indicates different growth conditions for this population, supporting the hypothesis that it is made up mainly of local stocks. The general trend of a decrease in size at all ages with an increase in latitude continued in 1955–56. Females continued to slightly outnumber males (except on the lower east coast) for the fifth straight year.

REFERENCES

HOURSTON, A. S. (1956): Population dynamics of juvenile herring in Barkley Sound, British Columbia, as an integral part of the life history. Ph.D. thesis, University of California at Los Angeles, 176 pp., plus tables and figures.

ISAACSON, R. S. K. (MS.): Preliminary analysis of data derived from samples of herring taken in British Columbia waters in 1955–56. 20 pp., plus tables.

MORGAN, O. (MS.): Catch statistics of the herring fishery of British Columbia for the season 1955–56. 9 pp., plus tables.

OUTRAM, D. N. (1956): Amount of herring spawn deposited in British Columbia waters during 1956. Fish. Res. Bd. Can., Pac. Biol. Stn., Circ. No. 44, pp. 1–13.

STEVENSON, J. C. (1949):* Results of the west coast of Vancouver Island herring investigation, 1948–49. Rept. British Columbia Fish. Dept., 1948, pp. 37–85.

——— (1955): The movement of herring in British Columbia waters as determined by tagging, with a description of tagging and tag recovery methods. Rapp. et Proc., Verb., Cons. Explor. Mer. 140, II, pp. 33–34.

STEVENSON, J. C.; HOURSTON, A. S.; JACKSON, K. J.; and OUTRAM, D. N. (1952):* Results of the west coast of Vancouver Island herring investigation, 1951–52. Rept. British Columbia Fish. Dept., 1951, pp. 57–87.

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.

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., and OUTRAM, D. N. (1953): Results of investigation of herring populations on the west coast and lower east coast of Vancouver Island in 1952–53, with an analysis of fluctuations in population abundance since 1946–47. Rept. British Columbia Fish. Dept., 1952, pp. 57–84.

TAYLOR, F. H. C. (1955): The status of the major herring stocks in British Columbia in 1954–55. Rept. British Columbia Fish. Dept., 1954, pp. 51–73.

TAYLOR, F. H. C., and OUTRAM, D. N. (1954):* Results of investigation of the herring populations on the west coast and lower east coast of Vancouver Island in 1953–54. Rept. British Columbia Fish. Dept., 1953, pp. 52–82.

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.

Table I.—Tags Inserted in Adult Herring during the 1956 Spawning Season

Code Letters	Tagging Code	Place	Date	Number
		Area 13		
NIN	20A	Carrington Bay	Apr. 10	508
NKN	20A	Carrington Bay	Apr. 10	507
NLN	20A	Carrington Bay	Apr. 10	514
		Area 14		
LOL	20B	French Creek	Mar. 8	231
LNL	20B	French Creek	Mar. 8	205
LPL	20B	French Creek	Mar. 8	297
JZJ	20C	Cape Lazo	Mar. 9	485
JXJ	20C	Cape Lazo	Mar. 9	483
JYJ	20C	Cape Lazo	Mar. 9	471
IJI	20D	N.W. Hornby	Mar. 11	504
IKI	20D	N.W. Hornby	Mar. 11	523
ILI	20D	N.W. Hornby	Mar. 11	505
JLJ	20E	Thames Creek	Mar. 18	510
JMJ	20E	Thames Creek	Mar. 18	500
JNJ	20E	Thames Creek	Mar. 18	507
JTJ	20F	Northwest Bay	Mar. 19	498
JUJ	20F	Northwest Bay	Mar. 19	495
JWJ	20F	Northwest Bay	Mar. 19	499
		Area 16		
NAN	20G	Porpoise Bay	Mar. 15	508
NBN	20G	Porpoise Bay	Mar. 15	507
NCN	20G	Porpoise Bay	Mar. 15	503
		Area 17A		
IEI	20H	Departure Bay	Feb. 8	503
III	20H	Departure Bay	Feb. 8	507
IHI	20H	Departure Bay	Feb. 8	239
		Area 17B		
IPI	20J	Coffin Point	Mar. 12	480
ISI	20J	Coffin Point	Mar. 12	492
ITI	20J	Coffin Point	Mar. 12	517
KSK	20K	Preedy Harbour	Mar. 30	507
KTK	20K	Preedy Harbour	Mar. 30	509
KYK	20K	Preedy Harbour	Mar. 30	503
		Area 18		
LDL	20L	Finlayson Arm	Apr. 6	506
LJL	20L	Finlayson Arm	Apr. 6	508
LKL	20L	Finlayson Arm	Apr. 6	504
		Total		15,535

Table II.—Tags Inserted in Juvenile Herring during the Summer of 1955

Code Letters	Tagging Code	Place	Date	Number
		MIDDLE EAST COAST OF VANCOUVER ISLAND		
		Area 14		
GAAG	19N	Off Union Bay, Baynes Sound	Sept. 22	482
GBBG	19N	Off Union Bay, Baynes Sound	Sept. 22	480
GCCG	19N	Off Union Bay, Baynes Sound	Sept. 22	547
GDDG	19N	Off Union Bay, Baynes Sound	Sept. 22	510
GEEG	19N	Off Union Bay, Baynes Sound	Sept. 22	492
GGGG	19N	Off Union Bay, Baynes Sound	Sept. 22	524
		Area 16		
GHHG	19O	St. Vincent Bay, Jervis Inlet	Sept. 25	519
GIIG	19O	St. Vincent Bay, Jervis Inlet	Sept. 25	529
GJJG	19O	St. Vincent Bay, Jervis Inlet	Sept. 25	526
GKKG	19O	St. Vincent Bay, Jervis Inlet	Sept. 25	552
GLLG	19O	St. Vincent Bay, Jervis Inlet	Sept. 25	547
GMMG	19O	St. Vincent Bay, Jervis Inlet	Sept. 25	521
GNNG	19O	St. Vincent Bay, Jervis Inlet	Sept. 25	524
GOOG	19O	St. Vincent Bay, Jervis Inlet	Sept. 25	538
		LOWER EAST COAST OF VANCOUVER ISLAND		
		Area 17B		
DXXD	19P	Off Grappler Rock, Kuper Island	Sept. 14	506
DYYD	19P	Off Grappler Rock, Kuper Island	Sept. 14	520
EDDE	19P	Off Grappler Rock, Kuper Island	Sept. 14	525
EXXE	19P	Off Grappler Rock, Kuper Island	Sept. 14	524
EYYE	19P	Off Grappler Rock, Kuper Island	Sept. 14	514
EZZE	19P	Off Grappler Rock, Kuper Island	Sept. 14	541
GYYG	19Q	Ruxton Passage, De Courcy Island	Sept. 26	412
		Area 18		
GXXG	19R	Village Bay, Mayne Island	Sept. 30	516
HIIH	19R	Village Bay, Mayne Island	Sept. 30	517
HTTH	19R	Village Bay, Mayne Island	Oct. 1	532
HWWH	19R	Village Bay, Mayne Island	Oct. 1	553
		DISTRICT NO. 1		
		Area 28		
GPPG	19S	Gambier Island, Howe Sound	Sept. 25	518
GRRG	19S	Gambier Island, Howe Sound	Sept. 25	519
GSSG	19S	Gambier Island, Howe Sound	Sept. 25	519
GTTG	19S	Gambier Island, Howe Sound	Sept. 25	519
GUUG	19S	Gambier Island, Howe Sound	Sept. 25	530
GWWG	19S	Gambier Island, Howe Sound	Sept. 25	544
		SAN JUAN ISLANDS		
HUUH	19T	Reid Harbour, Stuart Island	Oct. 3	498
HXXH	19T	Reid Harbour, Stuart Island	Oct. 3	536
IAAI	19T	Reid Harbour, Stuart Island	Oct. 3	476
IBBI	19T	Reid Harbour, Stuart Island	Oct. 3	496
ICCI	19T	Reid Harbour, Stuart Island	Oct. 3	472
IDDI	19T	Reid Harbour, Stuart Island	Oct. 3	503
IEEI	19T	Reid Harbour, Stuart Island	Oct. 3	486
IFFI	19T	Reid Harbour, Stuart Island	Oct. 3	486
		Total		20,053

Table III.—Number of Tags Recovered by Plant Crews, according to Area of Tagging and Probable Sub-district of Recovery, for the 1955–56 Fishing Season

Sub-district and Area of Tagging	Tagging Code	Year of Tagging	Probable Sub-district of Recovery									Total
			Upper Queen Charlotte Islands	Lower Queen Charlotte Islands	Northern	Upper and Lower Central[1]	Middle East Coast	Lower East Coast	Lower West Coast	Upper West Coast	?	
Upper Queen Charlotte Islands												
Area 2A (E)	18T	1954	5	8	.....	1	1	1	.....	.....	19	35
	18U	1954	8	6	1	3	1	.....	.....	.....	29	48
	18W	1954	5	2	.....	1	.....	.....	.....	.....	15	23
Lower Queen Charlotte Islands												
Area 2B (E)	16CC	1952	.....	64	.....	2	.....	.....	.....	.....	18	84
	17QQ	1953	.....	93	.....	.....	.....	.....	.....	.....	27	120
	17RR	1953	.....	63	.....	.....	.....	.....	.....	.....	14	77
	18S	1954	.....	270	.....	2	.....	.....	.....	.....	80	352
Northern												
Area 4	15T	1951	.....	1	.....	.....	.....	.....	.....	.....	2	3
	16Z	1952	.....	2	.....	.....	.....	.....	.....	.....	2	4
	16AA	1952	.....	2	1	1	.....	.....	.....	.....	1	5
	16BB	1952	.....	.....	.....	.....	.....	.....	.....	.....	1	1
	17MM	1953	.....	7	2	3	.....	.....	.....	.....	11	23
	17NN	1953	.....	6	.....	.....	.....	.....	.....	.....	3	9
	17PP	1953	.....	8	.....	1	.....	.....	.....	.....	5	14
	18P	1954	.....	5	1	.....	.....	.....	.....	.....	3	9
	18Q	1954	.....	11	.....	2	.....	.....	.....	.....	15	28
	18R	1954	.....	20	2	5	.....	.....	.....	.....	19	46
Area 5	14CC	1950	.....	2	.....	.....	.....	.....	.....	.....	.....	2
	18N	1954	.....	27	.....	7	.....	1	.....	.....	24	59
Upper Central												
Area 6	15V	1951	.....	1	.....	.....	.....	.....	.....	.....	2	3
	15W	1951	.....	.....	.....	1	.....	.....	.....	.....	.....	1
	17LL	1953	.....	1	.....	18	1	.....	.....	.....	11	31
	18M	1954	1	3	1	108	1	.....	.....	.....	46	160
Lower Central												
Area 7	14HH	1950	.....	.....	.....	.....	.....	.....	.....	.....	1	1
	15X	1951	.....	.....	.....	2	.....	.....	.....	.....	.....	2
	15AA	1951	.....	.....	.....	3	.....	.....	.....	.....	1	4
	15BB	1951	.....	.....	.....	1	.....	.....	.....	.....	2	3
	16U	1952	.....	.....	.....	3	.....	.....	.....	.....	.....	3
	16W	1952	.....	.....	.....	8	1	.....	.....	.....	3	12
	16X	1952	.....	1	.....	10	1	.....	.....	.....	5	17
	16Y	1952	1	1	.....	10	1	.....	.....	.....	9	22
	17EE	1953	.....	1	.....	24	.....	1	.....	.....	4	30
	17FF	1953	.....	4	.....	26	.....	2	.....	.....	10	42
	17GG	1953	.....	3	.....	17	.....	.....	.....	.....	7	27
	17HH	1953	.....	1	.....	11	.....	.....	.....	.....	2	14
	17II	1953	.....	2	.....	8	.....	.....	.....	.....	2	12
	17JJ	1953	.....	.....	.....	2	1	.....	.....	.....	.....	3
	17KK	1953	.....	3	1	19	.....	.....	.....	.....	6	29
	18K	1954	.....	5	1	44	.....	.....	.....	.....	19	69
	18L	1954	.....	4	.....	84	2	1	.....	.....	32	123
Area 10	14EE	1950	.....	.....	.....	.....	.....	.....	.....	.....	1	1
	15CC	1951	.....	.....	.....	1	1	.....	.....	.....	.....	2
Upper East Coast												
Area 12	17DD	1953	.....	.....	.....	1	1	.....	.....	.....	.....	2
Middle East Coast												
Area 13	19A	1955	.....	.....	.....	.....	116	1	.....	.....	29	146

[1] It was impossible to separate returns from the upper and lower central sub-districts as catches from these regions were mixed freely in reduction plants. However, since the catch from the upper central sub-district was quite small in comparison with that from the lower central, it is assumed that most, if not all, of these recoveries were taken in the lower central sub-district.

Table III.—Number of Tags Recovered by Plant Crews, according to Area of Tagging and Probable Sub-district of Recovery, for the 1955–56 Fishing Season—Continued

Sub-district and Area of Tagging	Tagging Code	Year of Tagging	Probable Sub-district of Recovery									Total
			Upper Queen Charlotte Islands	Lower Queen Charlotte Islands	Northern	Upper and Lower Central[1]	Middle East Coast	Lower East Coast	Lower West Coast	Upper West Coast	?	
Area 14	14A	1950	----	----	----	----	1	----	----	----	----	1
	16A	1952	----	----	----	----	5	----	----	----	1	6
	17B	1953	----	----	----	----	3	----	----	----	----	3
	17C	1953	----	----	----	----	1	----	----	----	1	2
	18B	1954	----	----	----	----	4	----	----	----	1	5
	19B	1955	----	----	----	----	55	8	1	----	27	91
	19C	1955	----	----	----	----	10	----	----	----	3	13
Area 15	13A	1949	----	----	----	----	1	----	----	----	----	1
	14C	1950	----	----	----	----	2	----	----	----	----	2
	15A	1951	----	----	----	----	2	----	----	----	1	3
	15B	1951	----	----	----	----	4	----	----	----	2	6
	17A	1953	----	----	----	----	12	2	----	----	2	16
	18A	1954	----	----	----	1	44	1	----	----	4	50
	19D	1955	----	----	----	----	87	2	----	----	25	114
	19E	1955	----	----	----	----	71	1	----	----	30	102
Lower East Coast												
Area 17A	15C	1951	----	----	----	----	1	----	----	----	1	2
	15D	1951	----	----	----	----	----	1	----	----	----	1
	16C	1952	----	----	----	----	----	1	----	----	----	1
	17E	1953	----	----	----	----	1	----	----	----	----	1
	18C	1954	----	----	----	----	14	4	----	----	8	26
	19F	1955	----	----	----	----	16	19	----	----	18	53
	19G	1955	----	----	----	----	5	56	----	1	37	99
Area 17B	15E	1951	----	----	----	----	----	2	----	----	----	2
	16F	1952	----	----	----	----	----	----	----	----	2	2
	17F	1953	----	----	----	----	----	----	----	----	2	2
	17H	1953	----	----	----	----	1	----	----	----	----	1
	17I	1953	----	----	----	----	----	1	----	----	----	1
	18D	1954	----	----	----	----	2	4	----	----	7	13
	19H	1955	----	----	----	1	1	35	1	----	29	67
	19J	1955	----	----	----	----	1	8	----	----	9	18
	19K	1955	----	----	----	1	5	35	----	----	20	61
	19L	1955	----	----	----	----	1	5	----	----	7	13
Area 18	15F	1951	----	----	----	----	----	2	----	----	----	2
	17J	1953	----	----	----	----	1	----	----	----	----	1
	18E	1954	----	----	----	----	1	7	----	----	9	17
	18F	1954	----	----	----	1	4	4	----	----	11	20
	19M	1955	----	----	----	1	1	34	3	----	19	58
Lower West Coast												
Area 23	16I	1952	----	----	----	----	----	----	1	----	----	1
	16J	1952	----	----	----	----	1	----	1	----	----	2
	17K	1953	----	----	----	----	----	----	1	----	1	2
	17M	1953	----	----	----	1	----	----	1	----	----	2
	17N	1953	----	1	----	----	----	1	----	----	1	3
	17P	1953	----	----	----	----	----	----	2	----	4	6
	17R	1953	----	----	----	----	----	----	----	----	1	1
Area 24	12L	1948	----	----	----	----	----	----	----	----	1	1
	14N	1950	----	----	----	----	----	----	----	----	1	1
	15M	1951	----	----	----	----	----	----	1	----	1	2
	15N	1951	----	----	----	----	1	----	----	----	----	1
	16M	1952	----	----	----	----	----	----	2	----	----	2
	17T	1953	----	----	----	----	----	----	2	----	2	4
	18G	1954	----	----	----	----	----	----	7	----	3	10

[1] It was impossible to separate returns from the upper and lower central sub-districts as catches from these regions were mixed freely in reduction plants. However, since the catch from the upper central sub-district was quite small in comparison with that from the lower central, it is assumed that most, if not all, of these recoveries were taken in the lower central sub-district.

Table III.—Number of Tags Recovered by Plant Crews, according to Area of Tagging and Probable Sub-district of Recovery, for the 1955–56 Fishing Season—Continued

Sub-district and Area of Tagging	Tagging Code	Year of Tagging	Probable Sub-district of Recovery									Total
			Upper Queen Charlotte Islands	Lower Queen Charlotte Islands	Northern	Upper and Lower Central[1]	Middle East Coast	Lower East Coast	Lower West Coast	Upper West Coast	?	
Upper West Coast												
Area 25	17X	1953	----	----	----	----	----	----	----	----	1	1
	18H	1954	----	----	----	----	----	2	----	----	1	3
	18J	1954	----	----	----	1	----	----	----	----	1	2
Area 26	16T	1952	----	----	----	----	----	----	----	1	----	1
	17AA	1953	----	----	----	----	----	----	----	4	2	6
	17BB	1953	----	----	----	----	----	----	----	----	1	1
Area 27	17CC	1953	----	----	----	----	----	----	----	1	----	1
United States of America												
Group 1	----	----	----	----	----	----	----	7	----	----	5	12
Group 2	----	----	----	----	----	----	----	4	----	----	5	9
Group 3	----	----	----	----	----	----	----	8	----	----	5	13
Group 4	----	----	----	----	----	----	----	1	----	----	----	1
Totals	----	----	20	628	10	436	487	262	23	7	793	2,666

[1] It was impossible to separate returns from the upper and lower central sub-districts as catches from these regions were mixed freely in reduction plants. However, since the catch from the upper central sub-district was quite small in comparison with that from the lower central, it is assumed that most, if not all, of these recoveries were taken in the lower central sub-district.

Table IV.—Probable Number of Tags in the Catches during the 1955–56 Season, Based on Magnet Recoveries, Shown by Area of Tagging and Probable Sub-district of Recovery, with Actual Number of Tags in Parentheses.

Sub-district and Area of Tagging	Probable Sub-district of Recovery								Total
	Upper Queen Charlotte Islands	Lower Queen Charlotte Islands	Northern	Central	Middle East Coast	Lower East Coast	Lower West Coast	Upper West Coast	
Upper Queen Charlotte Islands									
Area 2A (E)	85 (68)	27 (22)	11 (8)	6 (5)	2 (2)	1 (1)	-----	-----	132 (106)
Lower Queen Charlotte Islands									
Area 2B (E)	9 (7)	721 (614)	7 (5)	8 (7)	-----	-----	-----	-----	745 (633)
Northern									
Area 4	3 (2)	99 (85)	59 (38)	19 (16)	1 (1)	-----	-----	-----	181 (142)
Area 5	-----	43 (34)	22 (16)	12 (10)	-----	1 (1)	-----	-----	78 (61)
Upper Central									
Area 6	5 (4)	14 (12)	11 (8)	194 (168)	5 (3)	-----	-----	-----	229 (195)
Lower Central									
Area 7	4 (3)	43 (37)	14 (10)	393 (351)	8 (7)	6 (5)	-----	-----	468 (413)
Area 10	-----	-----	-----	2 (2)	1 (1)	-----	-----	-----	3 (3)
Upper East Coast									
Area 12	-----	-----	-----	1 (1)	1 (1)	-----	-----	-----	2 (2)
Middle East Coast									
Area 13	-----	-----	-----	1 (1)	154 (144)	1 (1)	-----	-----	156 (146)
Area 14	-----	1 (1)	-----	-----	125 (103)	21 (16)	1 (1)	-----	148 (121)
Area 15	-----	-----	-----	3 (2)	327 (282)	13 (10)	-----	-----	343 (294)
Lower East Coast									
Area 17A	-----	-----	-----	-----	51 (45)	173 (137)	-----	1 (1)	225 (183)
Area 17B	-----	-----	-----	3 (3)	17 (13)	214 (163)	1 (1)	-----	235 (180)
Area 18	-----	-----	2 (1)	2 (2)	8 (7)	106 (84)	6 (5)	-----	124 (99)
Lower West Coast									
Area 23	-----	1 (1)	-----	1 (1)	1 (1)	1 (1)	15 (13)	-----	19 (17)
Area 24	-----	-----	-----	-----	1 (1)	-----	22 (20)	-----	23 (21)
Upper West Coast									
Area 25	-----	1 (1)	-----	1 (1)	-----	3 (2)	2 (2)	-----	7 (6)
Area 26	-----	-----	-----	-----	-----	-----	-----	9 (8)	9 (8)
Area 27	-----	-----	-----	-----	-----	-----	-----	1 (1)	1 (1)
United States of America									
San Juan Islands	-----	-----	-----	-----	-----	28 (22)	-----	-----	28 (22)
Holmes Harbour	-----	-----	2 (1)	-----	-----	12 (10)	1 (1)	-----	15 (12)
Agate Pass	-----	-----	-----	-----	-----	1 (1)	-----	-----	1 (1)
Totals	106 (84)	950 (807)	128 (87)	646 (570)	702 (611)	581 (454)	48 (43)	11 (10)	3,172 (2,666)

Table V.—Probable Recoveries during the 1953–54, 1954–55, and 1955–56 Fisheries (Corrected for Plant Magnet Efficiency and Proportion of the Catch Searched by Plant Magnets) of Tags Inserted in Juvenile Herring on the Lower West Coast of Vancouver Island.

(The actual numbers of recoveries are given in parentheses.)

Year	Years at Large	Recovery Sub-district							Per Cent Homing
		Lower West Coast	Upper West Coast	Lower East Coast	Middle East Coast	Northern	Queen Charlotte Islands	All	
1953–54	1	3.4 (3)	-----	-----	-----	-----	-----	3.4 (3)	100 (100)
	2	1.4 (1)	-----	-----	-----	1.3 (1)	-----	2.7 (2)	52 (50)
1954–55	1	-----	-----	-----	-----	-----	-----	-----	-----
	2	16.9 (11)	1.1 (1)	14.2 (8)	1.1 (1)	-----	-----	33.3 (21)	50 (52)
	3	-----	-----	-----	-----	-----	-----	-----	-----
1955–56	2	2.8 (2)	-----	-----	-----	-----	-----	2.8 (2)	100 (100)
	3	14.6 (10)	-----	8.0 (5)	-----	-----	1.3 (1)	23.9 (16)	61 (62)
All years	1	3.4 (3)	-----	-----	-----	-----	-----	3.4 (3)	100 (100)
	2	21.1 (14)	1.1 (1)	14.2 (8)	1.1 (1)	1.3 (1)	-----	38.8 (25)	54 (56)
	3	14.6 (10)	-----	8.0 (5)	-----	-----	1.3 (1)	23.9 (16)	61 (62)

Table VI.—The Average Percentage Age Composition of the Herring Sampled from Each Major Population or Sub-district during the 1955–56 Fishing Season

(Comparable data are also given for the previous four seasons. Dominant year-classes are given in italics.)

Population and Fishing Season	In Year of Age									Average Age
	I	II	III	IV	V	VI	VII	VIII	IX+	
Upper Queen Charlotte Islands										
1951–52	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1952–53	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1953–54	0.05	2.42	*27.18*	21.27	*35.10*	10.66	2.33	0.68	0.29	4.35
1954–55	-----	7.81	13.77	*40.90*	18.07	14.81	4.18	0.29	0.10	4.33
1955–56	0.10	13.81	*24.71*	20.49	23.85	9.92	5.22	1.34	0.56	4.15
Lower Queen Charlotte Islands										
1951–52	1.12	15.97	21.43	*34.55*	21.52	4.23	1.09	0.09	-----	3.77
1952–53	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1953–54	-----	-----	*38.24*	*38.24*	8.82	11.76	-----	2.94	-----	4.06
1954–55	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
1955–56	-----	0.16	15.39	9.82	*62.25*	8.62	2.89	0.70	0.17	4.76
Northern										
1951–52	0.07	4.47	8.77	*33.59*	*45.62*	6.10	1.04	0.31	0.05	4.45
1952–53	-----	1.27	*34.34*	*23.58*	*25.72*	11.03	0.98	0.08	-----	4.16
1953–54	-----	1.96	*28.35*	*29.37*	*23.80*	13.33	2.54	0.58	0.06	4.28
1954–55	-----	2.78	4.90	*70.78*	15.32	5.02	1.04	0.15	-----	4.18
1955–56	-----	8.85	*56.30*	9.77	*20.84*	3.28	0.62	0.19	0.14	3.57
Upper Central										
1951–52	0.15	7.09	16.75	23.60	*45.72*	4.93	1.54	0.22	-----	4.30
1952–53	0.70	6.94	*24.74*	*24.39*	*28.49*	14.06	0.68	-----	-----	4.18

Table VI.—The Average Percentage Age Composition of the Herring Sampled from Each Major Population or Sub-district during the 1955–56 Fishing Season—Continued

(Comparable data are also given for the previous four seasons. Dominant year-classes are given in italics.)

Population and Fishing Season	In Year of Age									Average Age
	I	II	III	IV	V	VI	VII	VIII	IX+	
1953–54	0.42	5.12	*74.47*	14.11	4.93	0.94	.....	.....	.....	3.21
1954–55	0.06	12.53	18.82	*63.43*	4.08	0.87	0.21	.....	.....	3.62
1955–56	.....	*84.74*	12.72	1.26	1.14	0.15	.....	.....	.....	2.19
Lower Central										
1951–52	1.99	5.59	*25.14*	*33.53*	*27.66*	3.89	1.49	0.64	0.07	4.00
1952–53	0.40	9.14	*28.13*	*24.04*	*26.69*	9.70	1.42	0.48	.....	4.05
1953–54	0.18	5.52	*70.41*	18.00	4.39	1.32	0.13	.....	0.04	3.26
1954–55	0.39	5.74	10.20	*69.83*	10.86	2.65	0.33	.....	.....	3.94
1955–56	0.03	7.64	13.76	9.96	*64.71*	3.46	0.38	0.03	0.02	4.44
Upper East Coast										
1951–52	*43.17*	*20.22*	13.12	10.65	7.93	3.23	1.12	0.50	0.50	2.37
1952–53	.....	.....	1.14	20.45	*36.36*	28.41	9.09	2.27	2.27	5.40
1953–54	0.16	9.31	*65.87*	15.20	6.61	2.32	0.45	0.08	.....	3.28
1954–55	0.17	4.66	*34.37*	*45.23*	10.10	3.36	1.58	0.54	.....	3.80
1955–56	.....	16.84	17.15	19.45	*41.16*	5.40	.....	.....	.....	4.01
Middle East Coast										
1951–52	0.25	*32.61*	*45.82*	14.18	5.44	1.57	0.06	0.06	.....	2.97
1952–53	0.60	*30.99*	*41.18*	17.00	6.30	3.16	0.66	0.10	.....	3.10
1953–54	.....	2.48	*28.59*	*40.98*	18.82	6.77	1.91	0.39	0.05	4.06
1954–55	.....	6.02	*37.71*	*45.88*	8.25	2.01	0.12	.....	.....	3.63
1955–56	.....	9.39	13.08	*28.68*	*39.14*	7.78	1.37	0.40	0.16	4.29
Lower East Coast										
1951–52	0.04	6.62	*57.51*	27.14	6.99	1.31	0.31	0.07	0.01	3.40
1952–53	0.12	2.65	*60.53*	32.83	3.25	0.54	0.05	0.03	.....	3.38
1953–54	.....	0.79	*57.98*	34.23	6.18	0.62	0.14	0.04	0.01	3.48
1954–55	.....	2.81	*57.18*	33.37	6.05	0.50	0.10	.....	.....	3.45
1955–56	.....	4.37	*53.07*	29.86	10.70	1.71	0.24	0.05	.....	3.53
Lower West Coast										
1951–52	0.06	5.21	*65.71*	20.08	7.94	0.83	0.17	.....	.....	3.34
1952–53	0.07	8.88	*55.66*	32.86	1.95	0.54	0.04	.....	.....	3.30
1953–54	0.03	2.72	*64.29*	26.71	5.47	0.53	0.14	0.07	0.04	3.38
1954–55	0.03	16.82	*59.39*	19.81	3.32	0.59	0.03	.....	.....	3.11
1955–56	.....	11.87	*63.70*	15.86	7.04	1.29	0.14	0.04	0.05	3.23
Upper West Coast										
1951–52	.....	0.19	10.11	*27.23*	*52.54*	7.32	2.12	0.42	0.05	4.65
1952–53	0.26	22.57	*60.74*	14.60	1.35	0.40	0.07	.....	.....	2.96
1953–54	.....	.....	*46.14*	*41.85*	9.04	2.04	0.94	.....	.....	3.70
1954–55	.....	6.24	34.57	*50.40*	6.78	1.68	0.26	0.07	.....	3.64
1955–56	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Table VII.—Number of Fish (in Millions) of Each Age in the Catch from Each Population during the Past Five Fishing Seasons

(Dominant year-classes are given in italics.)

Population and Fishing Season	In Year of Age									Total
	I	II	III	IV	V	VI	VII	VIII	IX+	
Upper Queen Charlotte Islands										
1951–52[1]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1952–53[1]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1953–54	0.12	7.43	*83.61*	65.44	*107.98*	32.78	7.17	2.08	0.89	307.50
1954–55	.....	16.32	28.74	*85.36*	37.71	30.91	8.72	0.60	0.38	208.74
1955–56	0.07	9.59	*17.16*	14.23	*16.57*	6.89	3.62	0.93	0.39	69.45

[1] No catch.

Table VII.—Number of Fish (in Millions) of Each Age in the Catch from Each Population during the Past Five Fishing Seasons—Continued

(Dominant year-classes are given in italics.)

Population and Fishing Season	In Year of Age									Total
	I	II	III	IV	V	VI	VII	VIII	IX+	
Lower Queen Charlotte Islands										
1951–52	1.24	18.03	24.18	*38.99*	24.29	4.77	1.23	0.10	.....	112.83
1952–53[2]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1953–54	.....	.....	7.23	7.23	1.67	2.22	.....	0.56	.....	18.91
1954–55[3]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1955–56	.....	1.05	100.91	64.39	*408.15*	56.52	18.95	4.59	1.11	655.67
Northern										
1951–52	0.24	19.44	38.12	*145.91*	*198.17*	26.51	4.51	1.35	0.21	434.46
1952–53	.....	0.23	6.87	4.34	4.73	2.02	0.18	0.02	.....	18.39
1953–54	.....	4.87	*70.77*	*73.33*	59.42	33.28	6.34	1.45	0.14	249.60
1954–55	.....	5.09	8.98	*129.86*	28.11	9.21	1.91	0.27	.....	183.43
1955–56	.....	10.78	*68.57*	11.90	*25.38*	4.00	0.76	0.23	0.17	121.79
Upper Central										
1951–52	0.26	12.31	24.02	32.84	*63.39*	6.88	2.13	0.31	.....	142.14
1952–53	0.01	0.06	0.21	0.21	0.24	0.12	0.01	.....	.....	0.86
1953–54	0.44	5.30	*77.14*	14.14	5.11	0.97	.....	.....	.....	103.10
1954–55	0.63	14.53	21.81	*73.50*	4.73	1.01	0.24	.....	.....	116.45
1955–56	.....	*32.12*	4.82	0.48	0.43	0.06	.....	.....	.....	37.91
Lower Central										
1951–52	3.35	9.15	*41.86*	*56.09*	*46.30*	6.52	2.50	1.08	0.13	166.98
1952–53	0.04	0.99	2.66	2.14	2.17	0.78	0.09	0.03	.....	8.90
1953–54	0.41	13.94	*234.14*	66.51	15.85	3.49	0.48	.....	0.16	334.98
1954–55	0.72	14.26	25.86	*125.38*	19.85	4.63	0.48	.....	.....	191.18
1955–56	0.14	20.74	47.11	36.91	*242.67*	12.59	1.35	0.14	0.11	361.76
Upper East Coast										
1951–52	*65.59*	*30.71*	19.92	16.17	12.04	4.91	1.70	0.76	0.07	151.87
1952–53[4]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1953–54	0.13	8.60	*60.90*	14.05	6.11	2.15	0.41	0.07	.....	92.42
1954–55	0.24	9.06	*49.67*	*75.13*	18.15	3.24	0.64	0.22	.....	156.35
1955–56	.....	1.87	1.90	2.16	*4.57*	0.60	.....	.....	.....	11.10
Middle East Coast										
1951–52	0.34	*39.74*	*55.84*	17.28	6.63	1.91	0.07	0.07	.....	121.88
1952–53[5]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1953–54	.....	4.40	*50.42*	*70.08*	27.55	10.47	2.78	0.59	0.07	166.36
1954–55	.....	15.44	*95.15*	*112.83*	20.03	5.04	0.21	.....	.....	248.70
1955–56	.....	28.97	36.00	*73.94*	*96.90*	18.92	3.25	0.91	0.34	259.23
Lower East Coast										
1951–52	0.23	29.52	*201.13*	83.93	23.54	4.30	1.24	0.29	0.06	344.24
1952–53	0.12	2.00	*51.59*	30.51	2.98	0.51	0.06	0.03	.....	87.80
1953–54	.....	3.54	*283.14*	167.41	29.55	3.02	0.67	0.20	0.09	487.62
1954–55	.....	13.55	*261.95*	151.56	26.41	2.22	0.31	.....	.....	456.00
1955–56	.....	20.75	*246.47*	137.66	48.26	7.36	1.07	0.16	.....	461.73
Lower West Coast										
1951–52	0.06	5.84	*73.56*	22.44	8.89	0.91	0.20	.....	.....	111.90
1952–53[6]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1953–54	0.27	7.92	*194.15*	86.22	18.36	1.98	0.58	0.21	0.12	309.81
1954–55	0.02	11.86	*41.89*	13.97	2.34	0.42	0.02	.....	.....	70.52
1955–56	.....	25.00	*129.16*	30.65	8.36	1.47	0.27	0.07	0.03	195.01
Upper West Coast										
1951–52	.....	0.23	12.87	*34.65*	*66.85*	9.31	2.70	0.53	0.06	127.20
1952–53[1]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1953–54	.....	.....	*42.42*	*39.80*	9.03	2.19	1.02	.....	.....	94.46
1954–55	.....	3.95	21.62	*31.07*	4.32	0.92	0.17	0.04	.....	62.09
1955–56[7]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

[2] One hundred and eighty-five tons caught; no samples obtained.
[3] Five hundred and fifty tons caught; no samples obtained.
[4] One hundred and three tons caught; no samples obtained.
[5] Eighty-three tons caught; no samples obtained.
[6] Twenty-three tons caught; no samples obtained.
[7] Five hundred and sixty tons caught; no samples obtained.

Table VIII.—The Average Length in Millimetres of the Herring Sampled from Each Major Population or Sub-district during the 1955–56 Fishing Season

(Comparable data are also given for the previous four seasons.)

Population and Fishing Season	In Year of Age									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Upper Queen Charlotte Islands										
1951–52	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1952–53	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1953–54	122.00	132.53	165.58	175.69	197.14	208.13	216.68	231.09	236.33	262.00
1954–55	.....	147.28	162.59	184.32	201.68	214.50	228.87	243.67	237.00	244.00
1955–56	97.00	139.06	159.54	176.27	200.62	213.52	223.70	231.54	236.50	254.00
Lower Queen Charlotte Islands										
1951–52	101.41	150.98	180.21	194.11	202.42	212.45	218.13	213.50	.....	.....
1952–53	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1953–54	.....	.....	178.85	197.23	204.67	221.25	.....	228.00	.....	.....
1954–55	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1955–56	.....	160.50	186.19	197.74	203.16	215.06	221.92	224.50	.....	.....
Northern										
1951–52	119.67	155.65	182.48	200.15	206.92	216.09	222.84	224.76	253.50	.....
1952–53	.....	149.41	182.72	200.95	210.98	215.87	222.00	217.00	.....	.....
1953–54	.....	144.30	177.12	200.98	215.88	223.45	232.42	238.88	230.00	250.00
1954–55	.....	155.58	181.53	193.91	205.37	218.03	222.23	229.00	.....	.....
1955–56	.....	145.40	176.76	190.39	200.03	211.48	217.89	230.67	237.50	.....
Upper Central										
1951–52	108.50	156.42	187.75	203.35	210.92	218.72	221.58	226.33	.....	.....
1952–53	105.50	149.50	192.96	208.01	215.63	223.44	228.00	.....	.....	.....
1953–54	122.00	146.96	165.24	182.90	198.12	214.00	.....	.....	.....	.....
1954–55	128.00	145.76	162.18	179.17	193.65	188.23	219.33	.....	.....	.....
1955–56	.....	147.11	161.38	170.43	200.29	235.00	.....	.....	.....	.....
Lower Central										
1951–52	107.95	144.86	181.64	199.94	210.81	219.62	225.10	225.50	238.50	.....
1952–53	119.18	148.11	185.36	200.22	210.70	219.58	226.59	232.62	.....	.....
1953–54	112.22	126.59	158.15	184.06	195.62	203.75	211.67	.....	222.00	.....
1954–55	103.24	132.66	161.46	180.63	194.64	201.68	207.08	.....	.....	.....
1955–56	114.00	143.07	180.16	196.47	205.18	212.24	217.56	208.50	.....	235.00
Upper East Coast										
1951–52	99.80	143.92	180.42	195.06	207.44	215.40	222.54	226.77	.....	249.00
1952–53	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1953–54	114.25	132.35	154.67	179.24	202.62	224.82	231.91	237.50	.....	.....
1954–55	101.00	135.61	159.13	165.32	178.41	207.92	225.85	227.71	.....	.....
1955–56	.....	115.79	135.67	162.90	198.98	207.37	.....	.....	.....	.....
Middle East Coast										
1951–52	103.25	142.52	176.93	196.52	207.00	219.25	216.00	221.00	.....	.....
1952–53	107.75	138.73	177.93	199.05	215.77	224.58	228.62	229.00	.....	.....
1953–54	.....	148.32	174.03	196.28	213.68	224.26	230.88	236.33	269.00	.....
1954–55	.....	150.12	176.53	190.15	204.99	215.95	227.67	.....	.....	.....
1955–56	.....	147.03	181.72	198.00	206.06	217.56	226.83	234.36	238.20	246.00
Lower East Coast										
1951–52	96.33	150.84	185.46	198.36	208.93	216.92	225.61	226.60	222.00	.....
1952–53	106.50	155.94	183.81	195.96	208.64	214.45	222.80	233.33	.....	.....
1953–54	.....	151.97	187.22	199.49	210.70	222.89	226.70	227.33	237.00	.....
1954–55	.....	163.09	188.88	199.58	210.63	225.25	238.33	.....	.....	.....
1955–56	.....	160.16	186.44	198.36	208.26	215.85	224.08	230.50	.....	.....
Lower West Coast										
1951–52	131.00	158.41	186.16	198.38	212.19	221.14	225.67	.....	.....	.....
1952–53	97.00	162.12	184.02	197.83	209.41	219.20	211.00	.....	.....	.....
1953–54	90.50	160.53	185.34	199.81	211.16	222.52	241.38	239.50	271.00	278.00
1954–55	140.00	164.34	182.31	198.64	210.38	221.81	220.00	.....	.....	.....
1955–56	.....	165.12	185.74	197.71	204.18	216.46	227.71	233.00	221.00	.....
Upper West Coast										
1951–52	.....	167.14	191.18	207.42	217.49	225.96	231.84	236.53	240.00	.....
1952–53	99.50	145.86	187.81	199.25	207.10	228.50	233.00	.....	.....	.....
1953–54	.....	.....	181.01	198.05	210.71	222.64	231.83	.....	.....	.....
1954–55	.....	153.97	180.52	194.96	210.04	216.21	230.75	236.00	.....	.....
1955–56	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Table IX.—The Average Weight in Grams of the Herring Sampled from Each Major Population or Sub-district during the 1955–56 Fishing Season

(Comparable data are also given for the previous four seasons.)

Population and Fishing Season	In Year of Age									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Upper Queen Charlotte Islands										
1951–52	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1952–53	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1953–54	20.00	25.09	50.84	67.00	95.17	110.89	131.87	154.36	143.33	145.00
1954–55	.....	39.93	57.78	85.52	114.52	135.16	163.38	174.33	215.00	200.00
1955–56	13.00	32.03	54.12	74.38	111.42	137.12	154.60	173.46	155.00	249.00
Lower Queen Charlotte Islands										
1951–52	9.11	38.63	76.38	100.64	116.16	136.32	153.38	143.00	.....	.....
1952–53	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1953–54	.....	.....	68.00	93.08	105.33	150.75	.....	170.00	.....	.....
1954–55	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1955–56	.....	43.00	87.54	109.14	121.15	147.42	163.11	166.30	.....	.....
Northern										
1951–52	22.00	46.31	83.87	115.90	130.68	150.11	165.77	166.35	221.50	.....
1952–53	.....	38.82	80.31	110.76	130.68	143.32	157.22	.....	.....	.....
1953–54	.....	35.98	71.76	105.91	130.77	145.19	164.32	182.62	193.00	181.00
1954–55	.....	40.36	79.53	95.62	114.41	138.24	147.00	154.00	.....	.....
1955–56	.....	37.13	76.33	94.38	113.70	140.48	151.78	170.00	199.00	.....
Upper Central										
1951–52	14.75	47.50	88.57	114.91	130.23	145.29	155.92	165.00	.....	.....
1952–53	10.50	35.05	91.93	118.41	135.96	153.41	169.00	.....	.....	.....
1953–54	20.50	41.83	60.22	85.68	108.21	138.80	.....	.....	.....	.....
1954–55	28.00	41.27	64.10	84.16	105.14	97.15	156.67	.....	.....	.....
1955–56	.....	40.95	60.03	70.57	112.29	155.00	.....	.....	.....	.....
Lower Central										
1951–52	14.51	37.86	80.20	109.68	132.40	150.63	160.10	161.06	173.00	.....
1952–53	18.00	35.72	82.37	106.57	126.10	146.07	160.91	169.86	.....	.....
1953–54	17.44	26.74	53.09	84.18	101.66	115.69	125.50	.....	131.00	.....
1954–55	14.06	30.49	60.02	85.31	108.54	124.25	126.23	.....	.....	.....
1955–56	15.50	36.03	83.16	110.31	126.40	141.15	155.83	122.00	.....	180.00
Upper East Coast										
1951–52	11.05	35.79	74.36	99.12	122.71	141.50	159.36	157.50	.....	.....
1952–53	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1953–54	17.50	34.90	56.37	85.03	117.04	154.40	157.45	183.00	.....	.....
1954–55	14.00	32.84	61.17	66.78	86.25	134.53	170.05	186.29	.....	.....
1955–56	.....	17.89	32.97	62.38	116.10	127.16	.....	.....	.....	.....
Middle East Coast										
1951–52	14.00	39.51	80.81	114.82	141.00	170.79	178.00	143.00	.....	.....
1952–53	11.91	29.84	69.59	103.04	134.00	161.45	165.00	156.00	.....	.....
1953–54	.....	42.59	70.65	104.41	142.57	166.83	183.69	195.94	185.00	.....
1954–55	.....	45.24	79.54	94.34	124.42	144.78	167.00	.....	.....	.....
1955–56	.....	42.84	79.54	105.58	120.02	141.82	160.66	177.89	174.80	186.50
Lower East Coast										
1951–52	11.33	46.06	91.25	113.54	138.55	157.65	175.39	172.60	178.00	.....
1952–53	12.83	44.89	76.78	93.56	118.66	135.30	146.40	185.00	.....	.....
1953–54	.....	46.36	88.41	107.69	127.25	148.66	157.50	181.00	186.00	.....
1954–55	.....	56.64	94.08	113.45	131.96	163.44	178.33	.....	.....	.....
1955–56	.....	51.36	85.16	105.53	124.75	140.22	161.92	173.00	.....	.....
Lower West Coast										
1951–52	30.00	52.53	89.63	108.79	138.84	159.64	170.00	.....	.....	.....
1952–53	8.50	51.67	78.83	100.06	121.18	143.60	123.00	.....	.....	.....
1953–54	8.50	53.72	85.55	106.65	126.75	148.35	165.75	155.00	.....	.....
1954–55	37.00	57.83	83.06	107.68	124.91	151.40	131.00	.....	.....	.....
1955–56	.....	57.40	85.99	106.64	119.25	138.89	144.00	.....	140.00	.....
Upper West Coast										
1951–52	.....	57.00	89.49	117.11	138.46	156.48	169.66	179.50	190.00	.....
1952–53	9.75	36.23	82.27	100.25	114.70	158.50	168.00	.....	.....	.....
1953–54	.....	.....	77.41	98.51	123.85	143.25	145.00	.....	.....	.....
1954–55	.....	46.44	84.59	104.91	134.67	141.86	180.67	174.00	.....	.....
1955–56	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Table X.—Average Sex Ratio (Females/Males) in Populations of Herring on the British Columbia Coast during the Past Five Fishing Seasons

Population	Fishing Season					
	1951–52	1952–53	1953–54	1954–55	1955–56	Average
Upper Queen Charlotte Islands	.....	.....	1.05	1.05	1.18	1.09
Lower Queen Charlotte Islands	0.96	.....	0.48[1]	.....	1.00	.98
Northern	0.98	0.88	1.12	1.12	1.04	1.03
Upper Central	1.05	1.13	1.02	1.15	1.23	1.12
Lower Central	1.10	1.37	0.96	1.16	1.15	1.15
Upper East Coast	0.84	1.00	1.07	1.12	1.10	1.03
Middle East Coast	0.80	1.02	1.01	1.24	1.15	1.04
Lower East Coast	0.88	0.84	0.81	0.92	1.04	.90
Lower West Coast	1.04	1.06	1.07	1.07	0.93	1.03
Upper West Coast	1.02	1.24	1.08	1.15	.....	1.12
Average	0.96	1.06	1.02	1.11	1.09	1.05

[1] Based on only thirty-four fish and so omitted from averages.

Table XI.—Number of Statutory Miles of Herring Spawn Deposited in British Columbia Waters in 1956, Adjusted to Medium Intensity by Area and Year

(Comparable data are also given for the preceding four years. Figures in parentheses include surveys carried out by Biological Station personnel.)

Sub-district and Area	Statutory Miles of Spawn of Medium Intensity				
	1952	1953	1954	1955	1956
Upper Queen Charlotte Islands					
Area 2A (E) (Skidegate Inlet)	0.8	3.2	1.9	.....	.....
Lower Queen Charlotte Islands					
Area 2B (E) (Skincuttle Inlet)	4.6	10.2	20.2	11.3	9.7
Northern					
Area 3 (Nass)	1.6	0.9	0.5	.....	2.6
Area 4 (Skeena)	11.6	16.1	5.4	4.3	5.8
Area 5 (Grenville)	0.9	3.3	10.5	18.8	11.9
Totals	14.1	20.3	16.4	23.1	20.3
Upper Central					
Area 6 (Butedale)	4.3	6.8	4.7	4.0	0.3
Lower Central					
Area 7 (Bella Bella)	17.7	29.4	28.0	28.2	18.8
Area 8 (Bella Coola)	1.5	0.2	2.7	8.9	1.4
Area 9 (Rivers Inlet)	0.8	4.2	0.4	1.1	0.1
Area 10 (Smith Inlet)	2.8	9.2	5.8	1.6	4.1
Totals	22.8	43.0	36.9	39.8	24.4
Upper East Coast of Vancouver Island					
Area 11 (Seymour Inlet)	0.2	.....	0.4	.....	.....
Area 12 (Alert Bay)	9.7	24.7	14.0	9.2	15.9
Totals	9.9	24.7	14.4	9.2	15.9
Middle East Coast of Vancouver Island					
Area 13 (Campbell River)	6.0	5.8	3.2	12.2 (13.8)	..... (5.3)
Area 14 (Comox)	24.4	23.7	11.4	19.0 (21.0)	21.7 (22.6)
Area 15 (Powell River)	2.3	3.0	2.4	1.4 (1.6)	..... (.....)
Area 16 (Pender Harbour)	3.4	3.2	4.8	4.0 (4.0)	2.1 (.....)
Totals	36.1	35.7	21.8	36.6 (40.4)	23.8 (27.9)
Lower East Coast of Vancouver Island					
Area 17A (Nanaimo)	7.8	17.6	0.8	9.0 (9.4)	3.0 (4.2)
Area 17B (Ladysmith)	20.4	82.4	61.5	6.5 (28.8)	9.4 (7.7)
Area 18 (Ganges Harbour)	2.0	2.5	1.9	1.4 (5.2)	1.8 (9.1)
Area 19 (Victoria)	0.1	.....	.....	..... (.....)	..... (.....)
Totals	30.3	102.5	64.2	16.9 (43.4)	14.2 (21.0)
Lower West Coast of Vancouver Island					
Area 23 (Barkley Sound)	4.8 (9.8)	7.8 (13.1)	4.6 (11.0)	5.6	13.4
Area 24 (Clayoquot Sound)	4.9 (2.4)	7.0 (7.8)	4.2 (4.5)	4.7	1.1
Totals	9.7 (12.2)	14.8 (20.9)	8.8 (15.5)	10.3	14.5
Upper West Coast of Vancouver Island					
Area 25 (Esperanza Inlet)	2.8 (26.6)	11.4 (36.4)	7.1 (17.5)	6.9	53.2
Area 26 (Kyuquot Sound)	0.9 (1.6)	4.4 (8.0)	3.2 (4.8)	8.6	0.9
Area 27 (Quatsino Sound)	1.2 (1.3)	10.8 (11.5)	7.2 (7.3)	2.6	.....
Totals	4.9 (29.5)	26.6 (55.9)	17.5 (29.6)	18.1	54.1
Grand totals, all areas	137.5 (164.6)	287.8 (323.2)	206.8 (225.6)	169.3 (199.6)	177.2 (188.1)

PHYTOPLANKTON AND PHYSICAL CONDITIONS IN LADYSMITH HARBOUR

By C. D. McAllister

ABSTRACT

The general characteristics of Ladysmith Harbour and distributions of salinity, temperature, and phytoplankton there are described and factors accounting for them are suggested. The distributions of phytoplankton in the harbour are shown to be related to the physical characteristics and processes occurring in and adjacent to the harbour. Variations in the abundance of phytoplankton are suggested to be related to variations in circulation as well as to changes in abundance of zooplankton. It is calculated that advection contributes significantly to the total crop of phytoplankton in the Inner Harbour.

INTRODUCTION

Two types of agents may control the abundance, composition, and distribution of plankton in a local area. Firstly, local factors such as grazing, nutrient depletion and regeneration, mixing, and heating may act on local populations. Secondly, renewal of water through circulation and mixing may act on populations directly by adding and removing organisms and indirectly by influencing the properties of the water in the area.

In this paper, distributions of phytoplankton in Ladysmith Harbour and some of the factors and processes resulting in them are described and discussed.

COLLECTION OF DATA

Most of the data used here were collected between May, 1954, and August, 1956. A small, open, inboard-engined boat equipped with a hand-windlass and plankton pump and hose was used for the work inside the harbour. An Atlas water-sampling bottle, reversing thermometer, and bathythermograph were operated from the windlass to obtain water samples and temperatures. A 36-foot launch similarly equipped was used for more extended cruises into Stuart and Trincomali Channels.

Water for plankton samples was pumped from various depths through 1-inch hosing and filtered through No. 20 or 25 Monel netting. The volume of water filtered, usually about 3 cubic feet, was measured by a meter. This method of plankton-sampling is claimed to be inefficient for capturing the more active zooplankters, although excellent for phytoplankton (Gibbons and Fraser, 1937).

The pattern of oceanographic stations and the periods during which they were used are shown in Fig. 3.

Additional unpublished data were made available by D. B. Quayle and the Canada Department of Transport.

RESULTS AND DISCUSSION

A. Morphometry

Ladysmith Harbour is a small, narrow bay situated on latitude 49° north on the east coast of Vancouver Island. In contrast to the typical British Columbia inlet, it is short, about 4½ miles long, with extensive intertidal flats and is apparently less dominated by fresh-water inflow. A constriction, approximately at the middle, divides the harbour into a shallow inner portion and a wider, deeper outer bay (Fig. 1). The harbour opens into Stuart Channel, a typical coastal passage separated from Georgia Strait by two chains of islands (Fig. 2).

The distribution of depths in the harbour is indicated in Fig. 1. About one-third of the area of the Inner Harbour is above the zero tide-line. Most of this intertidal area lies at the head of the harbour. Two mud-flats lie on the west side of the harbour.

Along the east side of the Inner Harbour the rocky shore drops sharply. From the west the bottom slopes gradually, changing from a mixture of mud and gravel to a soft organic ooze at the zero tide-level. The deepest part of the Inner Harbour is along the eastern shore.

Mean depths in the Inner Harbour range from 3 to 35 feet in the channel, and in the Outer Bay from 35 to about 130 feet.

The constriction between the two parts of the bay is about 800 feet across. The narrow channel formed by this construction is deepest at the western side and shallows rapidly toward the east shore, forming a modified sill.

B. Fresh-water Drainage

The drainage area of the whole harbour is 39.6 square miles and that of the Inner Harbour is 20.4 square miles. The average annual rainfall is about 37 inches, giving a mean annual discharge of fresh water into the Inner Bay of about 5.5×10^6 cubic metres. This would form a layer 1.5 metres thick on the Inner Bay. No single stream dominates the drainage. Three major streams—two in the Inner Bay and one larger one in the Outer Harbour—discharge from the west shore. Small creeks, seepage, and direct run-off contribute the rest of the fresh-water drainage.

While none of the streams entering Ladysmith Harbour are metered, discharge figures are available for Haslam Creek in an adjacent watershed about 5 miles north-west of Ladysmith (Water Resources Pub. 114). The drainage area of Haslam Creek is about 27 square miles, comparable to that of the Inner Harbour. These discharge figures indicate peaks of flow in November, February, and April-May. The November and February maxima occur during periods of heavy rainfall and may be separated by a time when precipitation is being stored as snow in the watershed. The melting of this stored run-off may result in the spring peak discharge.

C. Distribution of Salinity

Surface salinities ranging from 13 o/oo to 29 o/oo have been observed at Station I over a period of years in Ladysmith Harbour (Quayle, unpublished data). Sub-surface salinities may exceed 29.5 o/oo, but are not known to reach 30 o/oo. Typically three major salinity minima occur each year. Two are associated with the autumn and winter peaks of fresh-water discharge. The third occurs in midsummer, when drainage has an almost negligible effect on salinity.

Cruises into Stuart, Trincomali, and Northumberland Channels indicate that the summer salinity minima result from intrusions of Georgia Strait water, diluted by the Fraser River spring freshet, into the Stuart-Trincomali Channels system. Several such intrusions may occur in a summer, with increases in salinity between them (Fig. 4).

In late fall and early summer, salinities above the halocline tend to increase to seaward. In midsummer, when dilution is occurring, this gradient is reversed and salinities decrease to seaward. The gradients above the halocline may be variable in late summer and early fall, when the change in salinity along the harbour may be negligible, or salinities at Station II in the Outer Harbour may be either higher or lower than at Station I or Station III.

The longitudinal gradients are typically small—less than one part per thousand. However, salinity data from Station I in the winter of 1951 reveal very strong vertical gradients of salinity in the upper 3 feet. If wind mixing in the more exposed Outer Harbour could break down this structure, then large horizontal gradients might develop in winter. Such gradients were not observed in this study, since surface salinities were

not taken during the first year. However, the winter cruises do indicate that the vertical gradients of salinity are much stronger in the Inner Harbour than just outside, indicating that wind mixing may act as suggested.

Typical longitudinal salinity sections in the harbour are shown in Figs. 5, 6, and 7.

Lateral salinity gradients in both Inner and Outer Harbours are usually of the order of 0.1–0.2 o/oo and are always less than 0.5 o/oo in the spring and summer, the only periods when lateral salinity gradients were observed. The lateral gradients are variable, but there is a tendency toward lower salinities on the west side, except when dilution from seaward is occurring. Sometimes the lateral gradients reverse below the halocline.

Observations made at six stations (ED 1.5, ED 3.5, H 4, H 1, K 1, K 4), occupied by three vessels over a period of twenty-four hours on May 18th and 19th, 1955, indicate that salinities above and below the halocline tend to vary with tidal height. Salinities in the Outer Harbour tended to increase on flood tides and decrease on ebb tides. The fact that the reverse was true at the pair of stations in the Inner Harbour could be due to the movement of relatively dilute water off the mouth of Holland Creek (Fig. 1) into the Inner Harbour on the flood tide. The halocline in the Outer Harbour showed a tendency to a steady decrease in depth rather than any marked tidal fluctuations. The range of variation of salinity with tide was about 0.1–0.6 o/oo.

The average excursion of the intersection of isohalines with the surface on ebb or flood tides was about one-half mile. Since cruises in the first two patterns of stations required a maximum of about three hours, the maximum distortion in longitudinal points of salinity due to tidal variation during the cruise should be about one-quarter of a mile. Since the maximum distortion amounts to less than one-eighth of the length of the harbour, it is neglected.

Observations made at a station occupied for twenty-four hours on May 29th and 30th, 1954, in the constriction forming the entrance to the Inner Harbour indicate that the extremes of salinity at this location occur at times of maximum tidal current rather than at the extremes of tidal height. This could result from the bottom configuration in the Gap, which may impede water-flow except at maximum current speeds. However, lateral temperature sections across the constriction indicate strong and characteristic distorting in the configuration of isotherms for both ebb and flood tides (Fig. 13). Since the twenty-four-hour station was situated to the east of the middle of the Gap, the change in salinity may be an effect of the distortion rather than a true indication of the average salinity of the water moving through the constriction.

D. Distribution of Temperature

Maximum surface temperatures of about 22° C. occur in August and minimum of about 4° C. in February. Temperature maxima and minima generally coincide with salinity minima. This may result partly from the coincidence of radiation and salinity cycles and partly from the stability at salinity minima, which usually occur with strong vertical gradients.

Inner Ladysmith Harbour has a source and sink of heat in addition to the usual ones of oceanographic and meteorological origin in the extensive area of intertidal flats. The large intertidal zone will gain or lose heat during low-tide periods, according to the conditions prevailing. When the flats are submerged during high tides, the gain or loss of heat will be passed on to the water. This phenomenon, coupled with the effect of the shore configuration in restricting water exchange and wind mixing, may be reflected in the temperature distributions. In addition, the shallow depths eliminate the possibility of modification of temperatures resulting from mixing with deep water.

In spring, summer, and early fall, temperatures above the thermocline tend to increase, sometimes irregularly, toward the mouth of the harbour. Longitudinal tempera-

ture gradients in the thermocline are sometimes strong. Below the thermocline the gradients may be similar or opposite to those above the thermocline.

Temperatures in the Inner Harbour tend to decrease from head to mouth and from west to east in spring and summer. This may result from the fact that the intertidal flats, sources of heat in spring and summer, lie at the end and side opposite the source of colder water. The distributions of temperature as indicated by extensive use of the bathythermograph may be quite irregular within the net gradient. This irregularity may result partly from the effect of the constriction mentioned on page 83. In longitudinal plots of the distribution of temperature taken by bathythermograph on the flood tide, isotherms rise sharply over the " semi-sill " in the constriction and follow the bottom down closely inside the sill. During large tidal rises relatively cold water from the greater depths of the Outer Harbour may be forced in over the sill, and be unable to move out on the following ebb tide. This effect may be enhanced by the existence of a two-layer system of circulation in which cold water tends to flow inward along the bottom. The distribution of the intertidal sources of heat and mixing resulting from a jet stream through the Gap on flood tides may also contribute to the sometimes irregular distribution of temperature.

Variations in temperatures at the six stations occupied for twenty-four hours on May 18th and 19th, 1955, were more irregular than variations in salinity. The temperature changes differed at each of the three sections and, except for Stations H 1 and H 4, the stations in each pair exhibited differences in the change of temperature with tide.

Of the six stations, only ED 3.5 and K 4, the inner and outermost on the west side of the harbour, revealed regular variation in temperature with tidal height. At Station ED 1.5, paired with ED 2, but on the east side of the inner bay, shallow layers of warm water were observed at both lower low-water periods, as might be expected. However, isotherms below a depth of 10 feet showed little change in depth, other than to appear slightly shallower at low water after the small ebb tide. This effect could be attributed to the outward movement of the upper water over the relatively immobile deeper water on this small tide.

At Stations H 1 and H 4 in the Outer Harbour, surface temperatures tended to vary directly with tidal height. Below a depth of about 20 feet, the changes in temperature at these two stations were parallel, showing an increase on the small ebb, a marked decrease on the small flood, and virtually no change on the large flood and large tides. The temperatures at intermediate depths showed a steady decrease at Station H 1, the eastern station, and paralleled the deeper temperature changes at Station H 4.

As already mentioned, temperatures at Station K 4, the western station at the mouth of the Outer Harbour, varied directly with tidal height. Temperatures below a depth of about 10 feet at Station K 1, across the harbour from K 4, varied inversely with tidal height. Above 10 feet, at Station K 1, a decrease in temperature occurred on the first flood tide and a slow increase in temperature continued from the first high-water period until occupation of the stations was terminated.

The complexity of these variations of temperature with tide could be due to simple distributions of temperature and complicated patterns of flow, to complicated distributions of temperature and simple flow patterns, or to intermediates between these two alternatives. The relative regularity of the variation in salinities suggests that the distribution of temperature rather than flow patterns may be responsible for the complex variation of temperature with tide. Some temperature sections from the Outer Harbour reveal complex distributions, indicating that this may be the case.

The station occupied for twenty-four hours in the Gap indicates that temperatures varied in much the same way as salinities. Extremes occurred at times of maximum current speed rather than at high- and low-tide periods.

On August 10th and 11th, 1955, a station was occupied for twenty-four hours at position CD 5 in the grid of stations covering the Inner Harbour (Fig. 3). Bathythermograph casts and observations of current velocities at eight depths were made at intervals of one hour for the twenty-four-hour period. At high and low tides and half-way between high and low tides, bathythermograph casts were made at four stations across Section CD.

In general, maximum temperatures occurred at low tides and minimum temperatures at high tides. The maximum change in temperature of about 4° F. took place at a depth of 12 feet on the large flood tide between lower low water and high water. The depths of the isotherms did not change smoothly, but with many small irregular fluctuations which were greatest in the lower region of the thermocline. These fluctuations may indicate turbulence or be an effect of the constriction.

Each of the eight observations on the transverse distribution of temperature indicated that temperatures above the thermocline increased toward the west side of the harbour. No distinctive variations in the lateral distributions of temperature with tide were observed other than a general increase and decrease of temperature.

Longitudinal temperature gradients in the Inner Harbour vary from 2° to about 7° F. along its length. For the whole harbour, the longitudinal gradient may exceed 10°.

Vertical temperature gradients from less than 2° to over 18° F. in 25 feet have been observed in the Inner Bay.

Transverse gradients of up to 2° F. across the width of the Inner Harbour may occur.

E. Water Exchange

1. *Circulation*

Longitudinal distributions of density suggest that a two-layer system of circulation with outflow in the upper layer and inflow in the lower layer operates in Ladysmith Harbour during most of the year. However, during periods of dilution from seaward in summer this circulation reverses and inflow in the upper layer occurs.

Direct observations of the distributions of velocity with depth over a twenty-four-hour period on two occasions support the existence of the two-layered circulation inferred from the distributions of variables. Also the movements of free drags suspended from surface floats indicate that mid-depth velocities (10 to 15 feet) are greater than those nearer the surface during the flood tide in spite of the prevailing up-harbour winds.

Observations on the movement of detritus, surface floats, and a Chesapeake Bay Institute current drag suggest that an anticlockwise lateral circulation prevails in the Inner Harbour. However, at times flood currents have been observed to be stronger on the western shore of the inner half of the Inner Harbour.

While most data indicate that less dense surface water originating toward the head of the harbour tends to move to seaward over denser water moving inward on the flood tide, a few observations suggest that mild, localized upwelling may occur there.

2. *Exchange Rates*

Where conservation of salt and volume are maintained by a two-layer circulation in a body of water receiving fresh-water drainage, the rate of water transport inward may be calculated by use of the expression—

$$Ti = \frac{Su\,D}{(Si\text{-}Su)}$$

where Ti=rate of transport of water inward, Si=salinity of the inflowing layer, Su=salinity of the outflowing layer, and D=the rate of fresh-water drainage.

On the basis of data taken in the Inner Harbour in 1955, Station I salinities were accepted as approximations to the mean salinities of the inflowing and outflowing layers.

The mean salinity above and below the depth of no net motion (taken as the inflection point of the sigma-t profile) were used as Su and Si respectively.

Fresh-water discharge rates for Haslam Creek (Canada Department of Natural Resources, 1955) in a watershed adjacent to that of Ladysmith were adjusted for the difference in drainage area and assumed to represent the fresh-water inflow into Inner Ladysmith Harbour.

The salinities in Ladysmith Harbour fluctuate continuously. However, conservation of salt may be considered satisfied at times of salinity maxima and minima.

The volume of the Inner Harbour was assessed to be constant.

The mean of the thirty-three rates calculated by this method is a transport inward of 78 cubic metres per second, or 32 per cent of the mean volume of the Inner Harbour renewed per day.

A method of calculating renewal rates analogous to the above one exists if continuity of heat and volume can be assumed.

If it can be further assumed that transport in and out are approximately equal it can be shown that—

$$Ti = \frac{(-Qv)\ A}{\rho C\ (\theta u - \theta i)}$$

where $(-Qv)$ = the amount of heat passing through a square centimetre of upper water surface per unit time, A = the area of the upper water surface, ρ = the density of the water, C = the specific heat of the water, θu = temperature of the outflowing layer, θi = the temperature of the inflowing layer, and Ti = the rate of transport of water inward.

The meteorological data necessary for the calculation of $(-Qv)$ were obtained from Cassidy airport, about 4 miles north of Ladysmith Harbour, and from tables of solar radiation prepared by Kimball (1928). The reader is referred to Sverdrup *et al.* (1942) for the method of calculating $(-Qv)$.

Water temperatures from Station I and transverse Section C (Fig. 3) were assumed to be the mean for the Inner Harbour. Data from the summer of 1955 suggest that this tends to be the case.

The mean of the fifteen rates calculated by the heat budget method, 78 cubic metres per second, agrees well with the mean of the salt budget rates.

The over-all mean of all renewal rates calculated on the assumption of a two-layer circulation is 32 per cent of the mean volume of the Inner Harbour per day with a standard deviation of 18 per cent. While values of 32 ± 18 per cent do not seem unreasonable, those near the limits of the range, about 10 and 100 per cent, appear likely to be in error.

Assumptions and sources of error in these calculations have been discussed by McAllister (1956, unpublished).

The two-layer circulation is known to exist. However, the large proportion of the mean volume of the Inner Harbour (47 per cent in an average tide) involved in tides and the effect of the constriction at the Gap in producing a jet stream suggests that horizontal mixing may also contribute significantly to water exchange in the Inner Harbour. The amount of exchange due to horizontal mixing is unknown, and in subsequent calculations it is assumed that renewal results entirely from the two-layer circulation.

F. Distribution of Phytoplankton

1. *Seasonal Occurrence*

Four phytoplankton blooms may occur in Ladysmith Harbour during the growing season. The spring bloom in Ladysmith Harbour may start early in May and last from three to six weeks. During this time, although patchiness is evident and concentrations vary with time, the gradients of concentration along the length of the harbour are gen-

erally small. A second bloom or series of blooms may occur in midsummer. Concentrations during the midsummer blooms generally increase toward the mouth of the harbour and may be low in the Inner Harbour. Observations in late August and early September of 1954 indicate that a third bloom, confined to the Inner Harbour, occurred. Concentrations of plankton from the only cruise made during the fall bloom increased toward the mouth of the Harbour.

The maintenance of the concentrations of phytoplankton in the shallow Inner Harbour during the spring blooms suggests that water exchange may be important in supplying either organisms or nutrients or both. Since concentrations of plankton and nutrients are usually higher in the lower layers, the two-layer circulation during this period would tend to advect both plankton and nutrients into the Inner Harbour.

The fact that the establishment of a gradient with concentrations of phytoplankton decreasing to seaward coincided with the reversal of circulation during the first dilution in the summer of 1954 may further indicate the importance of the spring circulation in maintaining phytoplankton populations in the Inner Harbour. The surface inflow associated with dilution would tend to replace water in the Inner Harbour with water from the plankton-poor and nutrient-depleted upper layers to seaward.

Another factor could operate if the sporadic reversal of the circulation during dilution proved to be unimportant. When depletion of nutrients to seaward of the Inner Harbour reached a certain depth, the inflow in the lower layer might fail to advect sufficient nutrients into the Inner Harbour to maintain production at the level prevailing during the spring bloom.

Two mechanisms may be responsible for the occurrence of blooms of phytoplankton in midsummer at a time when plankton concentrations have frequently been observed to be low in other geographical areas. Temperature and salinity sections for July 7th, 1954, suggest that relatively dilute water was moving into Ladysmith Harbour over the more saline deep layers. The vertical gradient of salinity was strong. Inversions of temperature suggest that strong velocity gradients existed between the two layers. Between the two layers and associated with a tongue of low temperature was a narrow band of a very high concentrations of diatoms. This may indicate that entrainment of nutrients into the upper layer gives rise to production, or that mixtures of the two layers are fertile.

This phenomenon of high standing crops in the interface between low-salinity Georgia Strait water and the deeper layers is not always evident. However, such entrainment or mixing could result in conditions suitable for production which could persist after the structures revealing the processes had deteriorated. Also plankton so produced might persist after the processes had ceased.

Some data (Fig. 11) suggest that the area in Trincomali Channel between Porlier Pass and the north end of Thetis Island is a highly productive one. This area is adjacent to a region of intense tidal mixing which could supply the nutrients necessary to maintain a large standing crop of phytoplankton. The distribution of salinity on July 2nd, 1954 (Fig. 12), suggests that the water causing the summer dilutions in Ladysmith Harbour enters the Stuart-Trincomali Channel system through Porlier Pass. If this is the case, then movement of plankton-bearing water from Trincomali Channel into the Ladysmith Harbour area is also possible. Sporadic intrusions of water from Trincomali Channel into Stuart Channel could result in small clouds or masses of water rich in phytoplankton which could occasionally pass by or enter Ladysmith Harbour.

Probably both advection of plankton originating in Trincomali Channel and entrainment are at least partly responsible for the midsummer blooms in Ladysmith Harbour.

The third bloom, confined to the Inner Harbour, follows the decomposition of large amounts of eel-grass and sessile algæ which appear floating in the late summer. Since the relative concentration of these forms is higher in the Inner Harbour than to seaward,

plankton blooms resulting from the release of nutrients through decay of sessile plants would be more intense in the Inner Harbour.

Data taken from the Inner Harbour during May, June, and July of 1955 indicate that distributions of phytoplankton there reveal both even gradients and patchiness. Patchiness in the distribution of phytoplankton may result from small areas of productivity or from localized grazing. Both factors probably operate in the Inner Harbour. Intermittent flow of fertile water in through the Gap on strong flood tides could result in small masses of water which could produce localized blooms. Lateral water movements in the Inner Harbour have been described previously as complicated and variable. If masses of water were retained in intermittent or temporary eddies in regions of the Inner Harbour where concentrations of sessile and bottom grazers were high, an otherwise even distribution of phytoplankton could become patchy through grazing. Flow patterns suggest that this may sometimes occur. The occurrence of copepods and larval decapods in swarms could also result in patchiness due to uneven grazing.

2. *Distribution of Genera of Phytoplankton*

The generic composition of phytoplankton in Ladysmith Harbour varies in both time and space. Results from 1954 and 1955 suggest that the sequence of genera from spring to autumn is as follows: *Thalassiosira, Chætoceros, Skeletonema, Chætoceros,* and in late summer a complex of dominant genera. No one type of distribution of genera along the harbour appears common. It can only be said that the generic composition of the phytoplankton in the Inner Harbour tends to differ from that to seaward.

Ketchum (1954) shows that exchange rates may be important in determining the types and distributions of plankton in estuaries. After considering known division rates of phytoplankton, he concludes that endemic phytoplankton populations should be able to maintain themselves in estuaries having exchange ratios of 0.5 or less. The exchange ratio is defined as the proportion of water moving seaward from the estuary on the ebb tide and not returning on the following flood tide. Inner Ladysmith Harbour, with a daily renewal rate of about 30 per cent of the mean volume per day (exchange ratio less than 0.15), should thus be able to maintain endemic phytoplankton populations; that is, the rates of division of phytoplankters are such that they could maintain or increase their numbers in the Inner Harbour in spite of depletion to seaward by the circulation. However, if the rate of reproduction of the plankton fell below a critical level due to grazing or nutrient depletion, the endemic population would be unable to maintain itself. In this case the composition of the plankton in the Inner Harbour would resemble that to seaward, providing the composition to seaward remained constant. If the composition to seaward varied, the time lag between the changes in the composition of the phytoplankton in the two parts of the harbour would give rise to apparent endemism.

The increase in the proportion of the total population of phytoplankton formed by *Chætoceros* between May 3rd, 1955, and May 18th–19th appears to have been a form of population succession. On May 3rd, *Thallassiosira* was the dominant genus at all depths in Ladysmith Harbour. The composition varied little longitudinally (Fig. 26). By May 10th *Chætoceros* had become dominant in the upper layers on the east side of the Inner Harbour. The proportion of the population formed by this genus decreased markedly to seaward. The observations taken at the six stations sampled over a twenty-four-hour period on May 18th and 19th indicated that *Chætoceros* had extended its distribution farther to seaward in the upper layer of the harbour by this date. At each of these stations except H_1, the proportion formed by *Chætoceros* varied inversely with tidal height, suggesting that the genus was dispersing from the Inner Harbour. In the Inner Harbour the greatest concentrations of phytoplankton during the twenty-four-hour period were associated with increases in the proportion of *Chætoceros.* This would be expected if *Chætoceros* was endemic to the Inner Harbour. During the same period the highest concentrations in the Outer Harbour were associated with high proportions of *Thalas-*

siosira. A cruise into Stuart and Trincomali Channels on May 17th indicated that *Thalassiosira* was dominant throughout these bodies of water. Thus between May 3rd and May 18th–19th *Chætoceros* had increased from a relatively minor form to a dominant one in spite of depletion to seaward by circulation in the upper layers and the advection of other forms into the harbour in the lower layer. Through population succession, *Chætoceros* had become endemic to the Inner Harbour. The change appeared to have been associated with an increase in temperature and a slight drop in salinity.

The change in the composition of the plankton between June 12th and June 22nd, 1954, may have been brought about by the circulation. On June 12th *Chætoceros* was the dominant genus in the harbour. *Skeletonema* formed less than 50 per cent of the phytoplankton, but the proportion it formed increased with depth and to seaward. By June 23rd *Skeletonema* had increased until it had formed the major constituent of the phytoplankton. The proportion of the population it formed was greatest in the Inner Harbour. This change in distribution could be interpreted to mean that the inflow of water in the deeper layers had carried *Skeletonema* into the harbour, where it largely replaced the formerly dominant *Chætoceros.* The fact that *Chætoceros* formed a higher fraction of the population in the Outer Harbour than in the Inner Harbour on June 22nd could have resulted from its advection out of the Inner Harbour or from changes beginning in the population after *Skeletonema* had attained dominance.

If *Skeletonema* had attained dominance in the Inner Harbour through advection followed by population changes in the Outer Harbour resulting from either succession or sequence, the greater proportion of this genus in the Inner Harbour is a case of apparent endemism. However, the time interval between these two cruises, ten days, is too great to allow definite conclusions to be drawn. The division rate of diatoms is such that the change in numbers and proportion of *Skeletonema* could have resulted from population succession.

The distributions of the genus *Chætoceros* cannot be related to any particular conditions of salinity and temperature. This genus contains many species adapted to a wide variety of conditions.

Only one species of the genus *Skeletonema, S. costatum,* has been observed in British Columbia coastal waters. As with *Chætoceros,* the occurrence of this species did not appear to be related to particular values of salinity or temperature. On June 12th, 1954, it was associated with the deeper and more saline layers. On August 2nd, 1954, the highest numbers and proportions of this genus were associated with low salinities. In general, *Skeletonema* was most prominent during July, 1954, the period during which dilutions were occurring.

Few generalizations concerning the distribution of genera can be drawn. The increase in the proportions of *Skeletonema* following the period when *Chætoceros* was dominant was associated with dilution. Following this, *Chætoceros* again became the most prominent genus, although *Skeletonema, Thalassiosira,* and *Nitzschia* at times formed significant proportions of the populations. The generic composition of the phytoplankton tends to vary vertically and longitudinally as do salinity and temperature. The lateral gradients of composition are usually small. Except for the first instance discussed above, no clear relationships between distributions of genera and physical-chemical factors or circulation are evident.

G. Advection of Phytoplankton in the Inner Harbour

1. *Advection of Phytoplankton*

It has been indicated that a two-layer circulation operates in Ladysmith Harbour. The net transport of phytoplankton in a body of water with such a circulation can be expressed as PT=PiTi—PuTu, where Pi=the mean concentration of phytoplankton in

the inward flowing layer, Pu=the mean concentration of phytoplankton in the seaward moving layer, Ti=the rate of transport of water in, and Tu= the rate of transport of water to seaward.

If PT is positive, a net gain of phytoplankton results from advection. If PT is negative, the reverse is true. The expression applies to phytoplankton only. For zooplankton, part of which perform diurnal vertical migrations (Sverdrup *et al.,* 1942), the amount of time spent in each layer would have to be considered.

In calculating net transports of phytoplankton for Inner Ladysmith Harbour, it is assumed that plankton concentrations at Station I represent the mean for the Inner Harbour, and that the mean transport of water inward, 78 cubic metres per second, prevailed throughout the period studied (June 6th, 1954, to August 27th, 1954). During periods of outflow in the upper layer, Pi and Pu were taken to be the mean concentrations below and above the depth of no net motion respectively. When the circulation reversed during dilution, Pi and Pu were taken from the upper and lower layers respectively.

Variations in the mean standing crop in the water column at Station I and in the net rate of transport of phytoplankton are presented in Figs. 13 and 14.

The mean rate of advection of phytoplankton into Ladysmith Harbour for the period studied is calculated to be about 140,000 cells per litre per day, suggesting that advection may contribute significantly to the total crop of phytoplankton in Inner Ladysmith Harbour.

Changes in the standing crop of phytoplankton appear to be related to variations in the rate of advection of phytoplankton as well as to changes in concentration of zooplankton.

CONCLUSIONS

1. Configuration of shore-line and distribution of depth in Ladysmith Harbour affect the distribution of phytoplankton directly by limiting the supply of nutrients in the Inner Harbour and indirectly by restricting exchange with waters to seaward.

2. Although the gradients of salinity and temperature (in part determined by freshwater drainage and morphometry) affect productivity in the harbour only indirectly, they may be important in directly determining the gradients of composition of phytoplankton.

3. The two-layer circulation transports significant amounts of phytoplankton into Inner Ladysmith Harbour.

4. Variations in the standing crop of phytoplankton appear to be associated with changes in both the rate of transport of phytoplankton and changes in the concentration of zooplankton.

5. Circulation indirectly affects the composition of the phytoplankton in the Inner Harbour by maintaining salinity and temperature conditions despite dilution and heating and also by changing them.

6. The rate of water exchange in Inner Ladysmith Harbour is such that local forms of phytoplankton may survive and increase in spite of depletion by circulation. However, if the rate of production of local forms falls below a level determined by the circulation, organisms transported in from seaward may determine the composition of populations in the Inner Harbour.

ACKNOWLEDGMENTS

The writer wishes to express his gratitude to Dr. D. B. Quayle, Dr. R. F. Scagel, Dr. W. Cameron, and Dr. G. L. Pickard for their advice, criticism, and encouragement.

LITERATURE CITED

FLEMING, R. H. (1939): The Control of Diatom Populations by Grazing. J. du Conseil Int. pour l'Exploration de la Mer. *14* (2):1–20.

GIBBONS, S. G., and FRASER, J. H. (1937): Pump and Suction Hose Sampling. J. du Conseil. *12*:163.

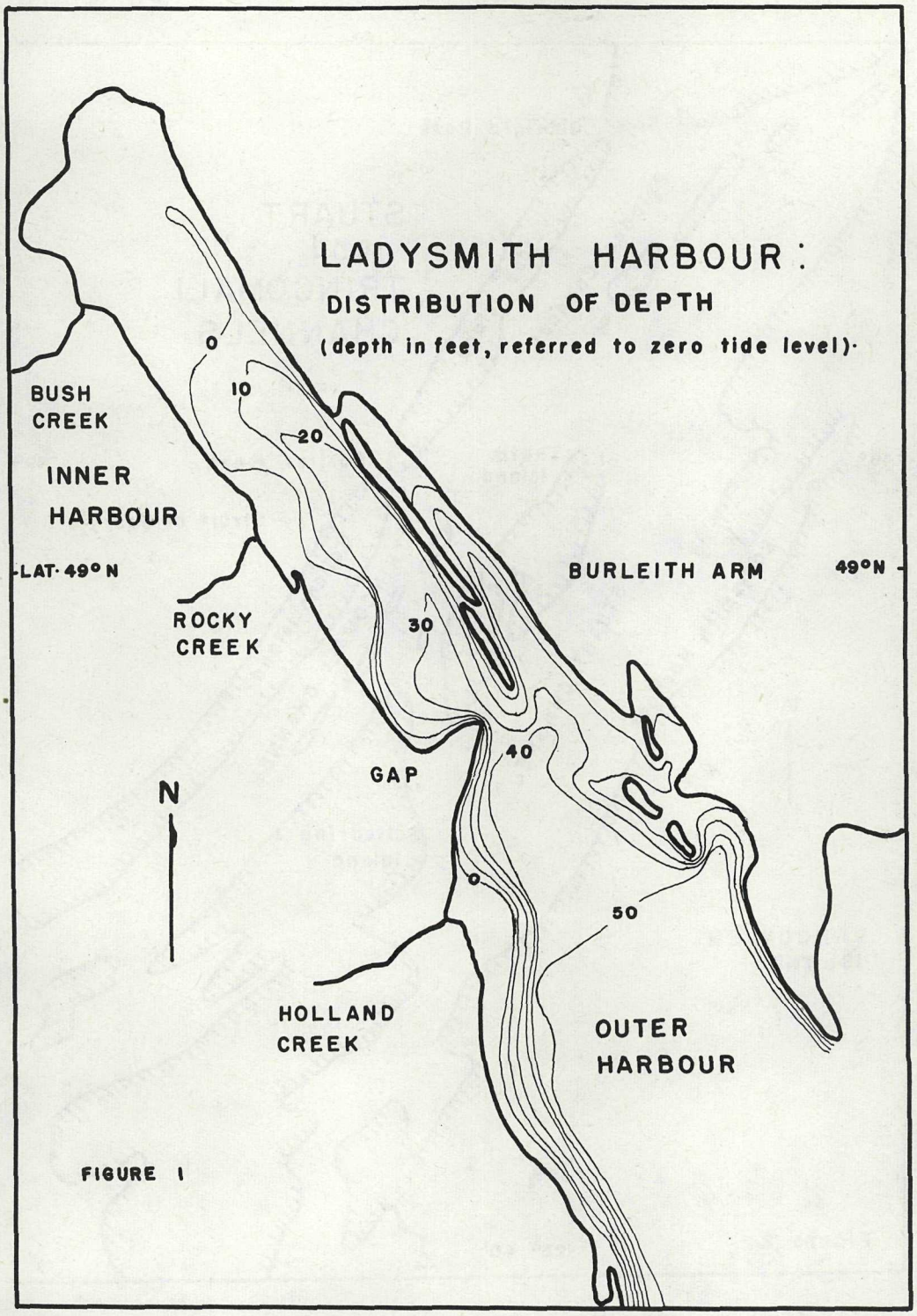

LADYSMITH HARBOUR:
DISTRIBUTION OF DEPTH
(depth in feet, referred to zero tide level).
BUSH CREEK
INNER HARBOUR
LAT. 49° N
ROCKY CREEK
BURLEITH ARM
49°N
GAP
N
HOLLAND CREEK
OUTER HARBOUR
0
10
20
30
40
50

FIGURE 1

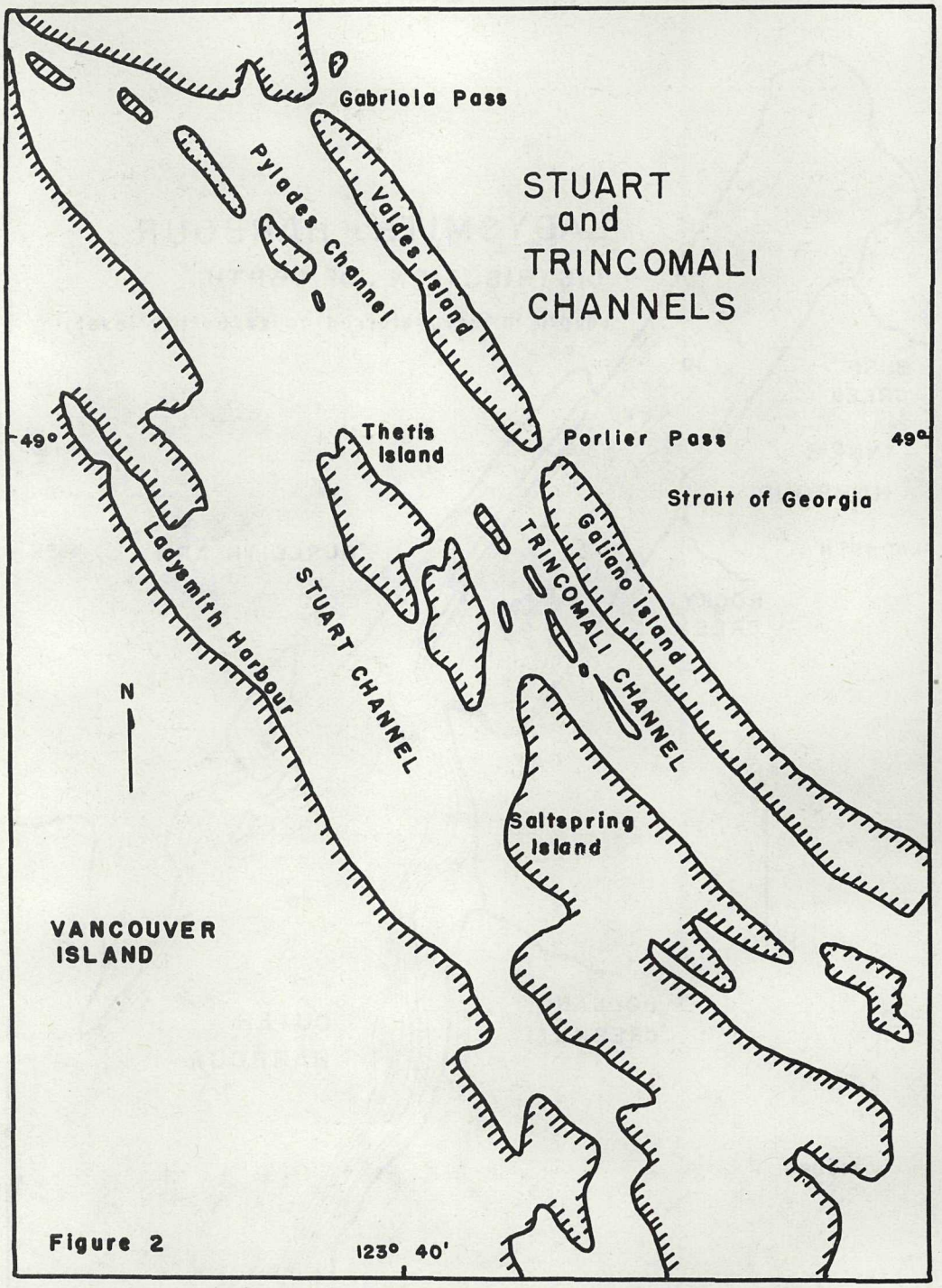

STUART
and
TRINCOMALI
CHANNELS
Gabriola Pass
Pylades Channel
Valdes Island
Thetis Island
Porlier Pass
49°
49°
Strait of Georgia
Galiano Island
TRINCOMALI CHANNEL
STUART CHANNEL
Ladysmith Harbour
N
Saltspring Island
VANCOUVER ISLAND
123° 40'

Figure 2

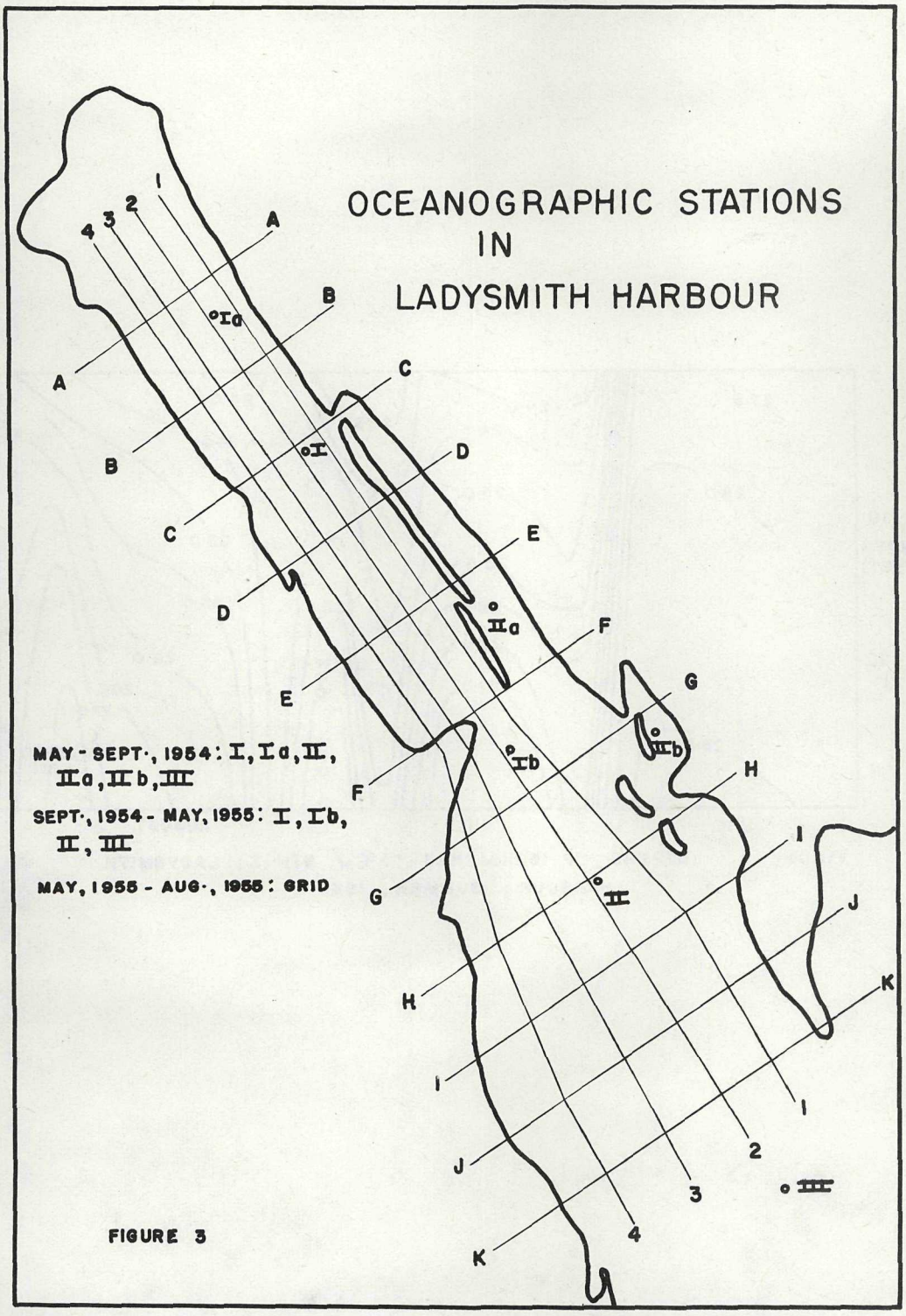

OCEANOGRAPHIC STATIONS
IN
LADYSMITH HARBOUR
MAY - SEPT., 1954: I, Ia, II, IIa, IIb, III
SEPT., 1954 - MAY, 1955: I, Ib, II, III
MAY, 1955 - AUG., 1955: GRID
A
B
C
D
E
F
G
H
I
J
K
1
2
3
4
Ia
I
IIa
Ib
IIb
II
III

FIGURE 3

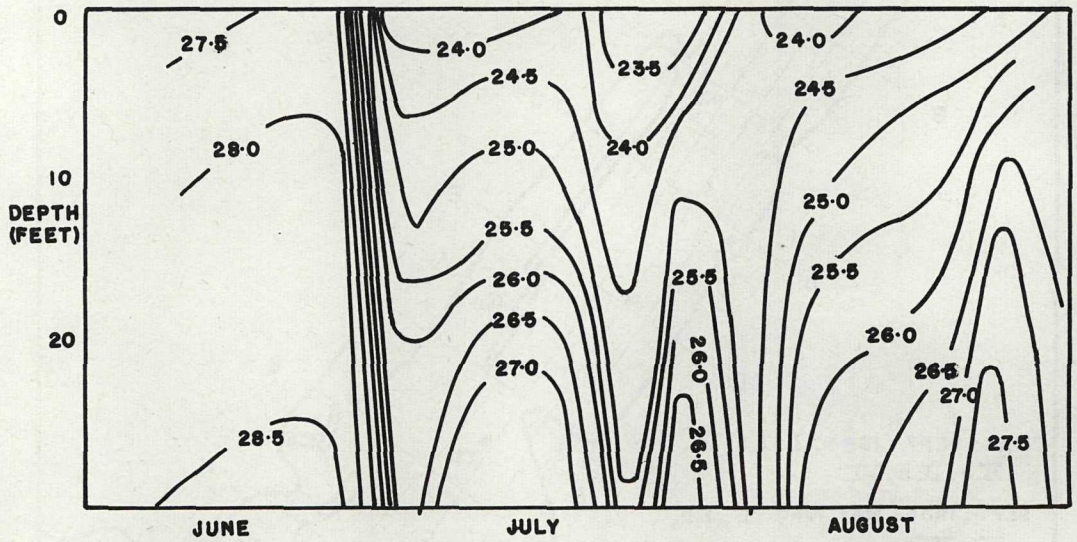
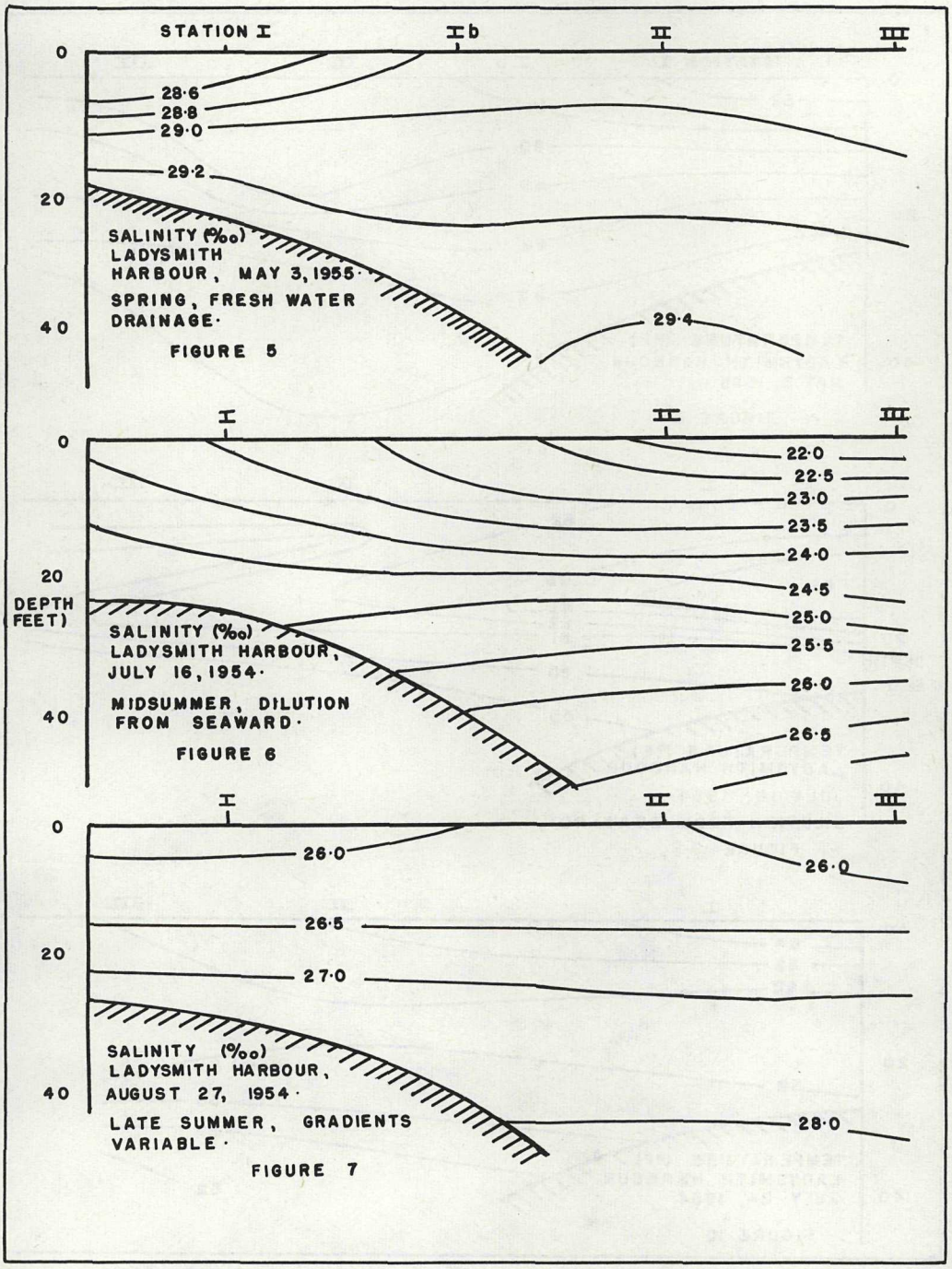
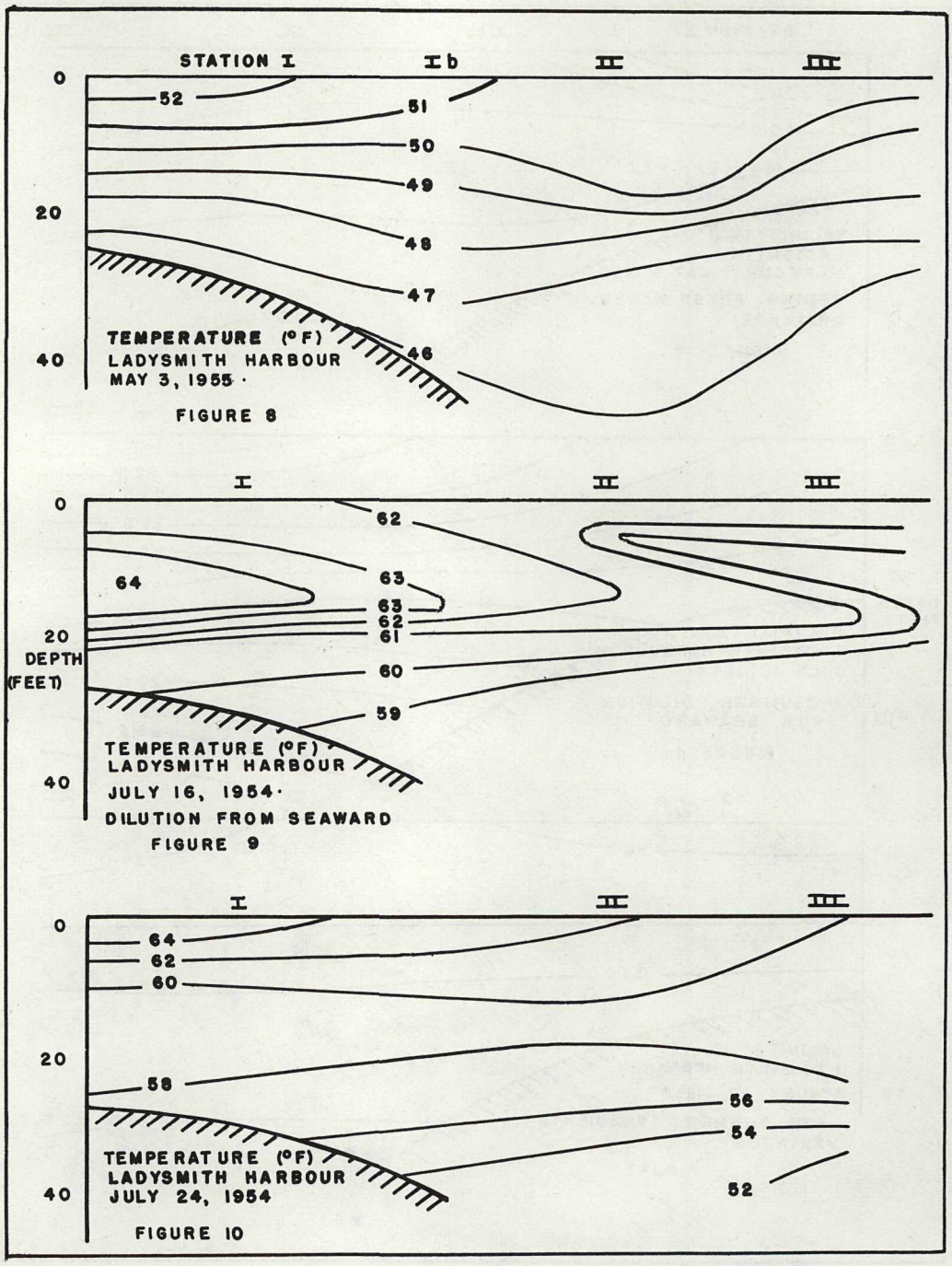


FIGURE 4 DEPTHS OF ISOHALINES (S‰), STN. I, LADYSMITH HARBOUR, SUMMER, 1954.


STATION I
Ib
II
III
0
20
40
28·6
28·8
29·0
29·2
29·4
SALINITY (‰)
LADYSMITH
HARBOUR, MAY 3, 1955·
SPRING, FRESH WATER
DRAINAGE·
FIGURE 5
I
II
III
0
20
40
DEPTH
(FEET)
22·0
22·5
23·0
23·5
24·0
24·5
25·0
25·5
26·0
26·5
SALINITY (‰)
LADYSMITH HARBOUR,
JULY 16, 1954·
MIDSUMMER, DILUTION
FROM SEAWARD·
FIGURE 6
I
II
III
0
20
40
26·0
26·0
26·5
27·0
28·0
SALINITY (‰)
LADYSMITH HARBOUR,
AUGUST 27, 1954·
LATE SUMMER, GRADIENTS
VARIABLE·
FIGURE 7


STATION I
Ib
II
III
0
20
40
52
51
50
49
48
47
46
TEMPERATURE (°F)
LADYSMITH HARBOUR
MAY 3, 1955
FIGURE 8
I
II
III
0
20
40
DEPTH
(FEET)
62
64
63
63
62
61
60
59
TEMPERATURE (°F)
LADYSMITH HARBOUR
JULY 16, 1954
DILUTION FROM SEAWARD
FIGURE 9
I
II
III
0
20
40
64
62
60
58
56
54
52
TEMPERATURE (°F)
LADYSMITH HARBOUR
JULY 24, 1954
FIGURE 10

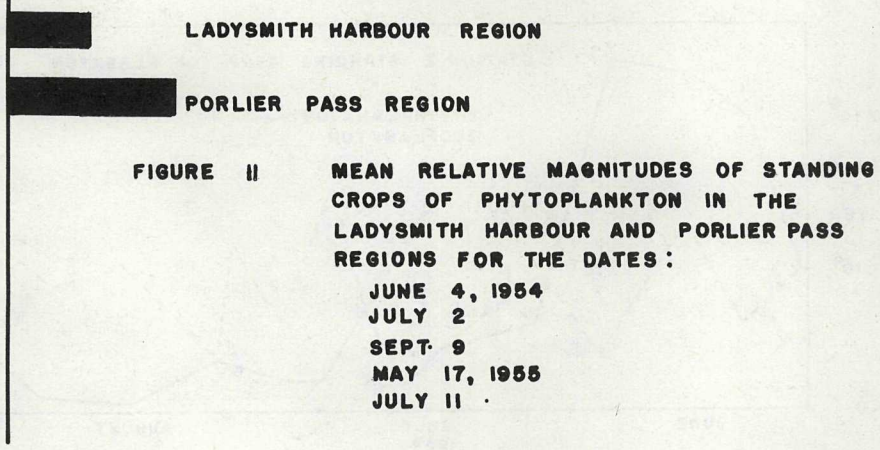


FIGURE 11 MEAN RELATIVE MAGNITUDES OF STANDING CROPS OF PHYTOPLANKTON IN THE LADYSMITH HARBOUR AND PORLIER PASS REGIONS FOR THE DATES:

JUNE 4, 1954
JULY 2
SEPT. 9
MAY 17, 1955
JULY 11.

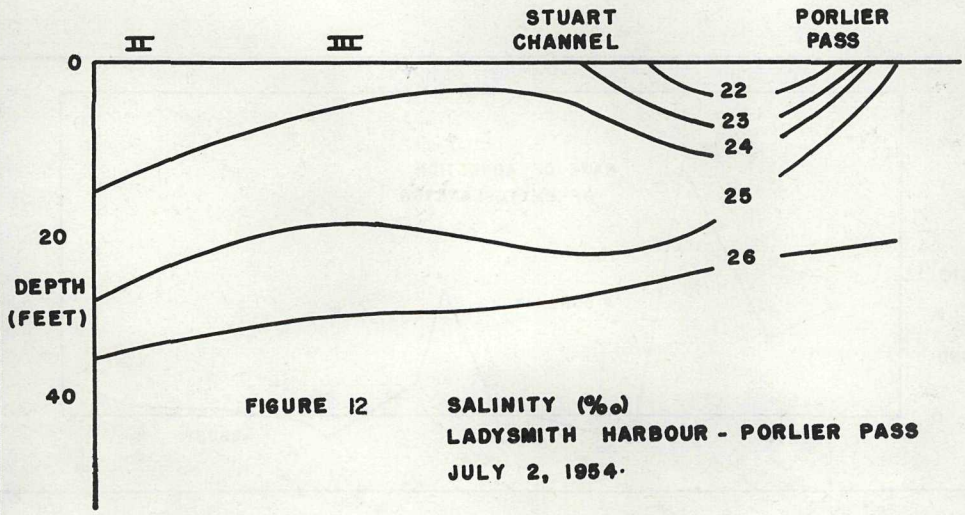
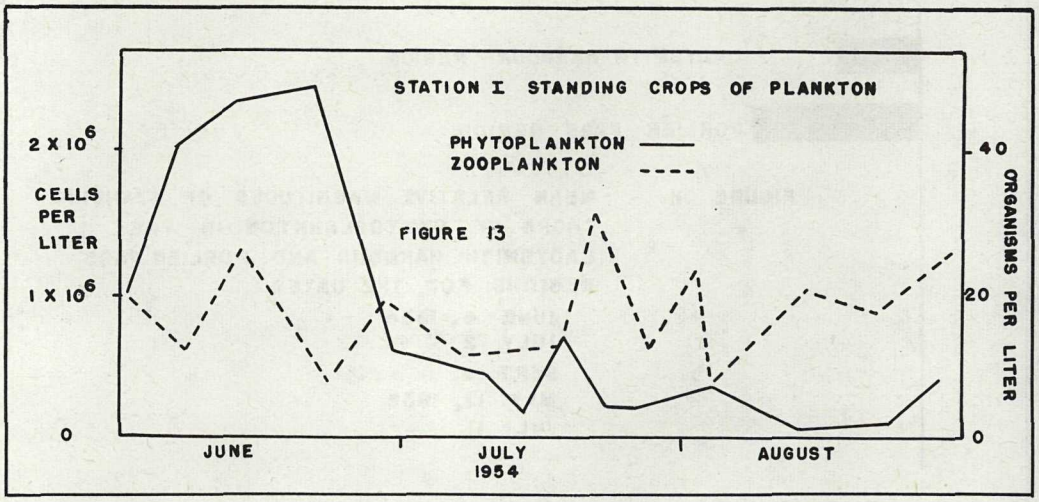
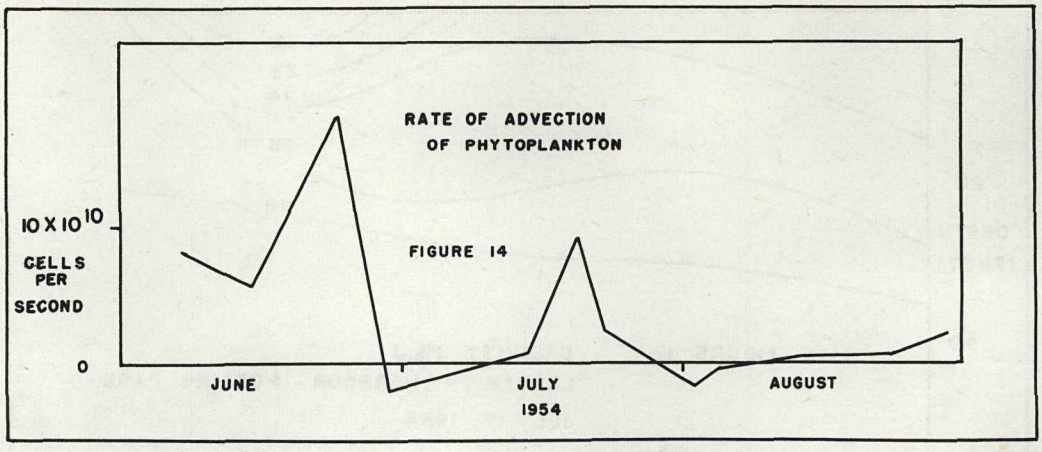


FIGURE 12 SALINITY (‰)
LADYSMITH HARBOUR - PORLIER PASS
JULY 2, 1954.


STATION I STANDING CROPS OF PLANKTON
PHYTOPLANKTON
ZOOPLANKTON
FIGURE 13
2 X 10^6
CELLS PER LITER
1 X 10^6
0
40
20
0
ORGANISMS PER LITER
JUNE
JULY
1954
AUGUST


RATE OF ADVECTION
OF PHYTOPLANKTON
FIGURE 14
10 X 10^10
CELLS PER SECOND
0
JUNE
JULY
1954
AUGUST

HARVEY, H. W. (1950): On the Production of Living Matter in the Sea off Plymouth. J. Mar. Biol. Ass., U.K. *29*:97–138.

JØRGENSEN, C. B. (1955): A Summary of Filter Feeding in Invertebrates. Cambridge Philosophical Soc. Biol. Rev. *30*.

KETCHUM, B. (1954): Relation between Circulation and Planktonic Populations in Estuaries. Ecology. *35* (2):191–200.

KIMBALL, H. (1928): The Amount of Solar Radiation that Reaches the Surface of the Earth on the Land and on the Sea, and the Methods by Which It Is Measured. Monthly Weather Review. *56*:393–399.

MARSHALL, S., and ORR, A. (1955): The Biology of a Marine Copepod (*Calanus finnarchicus* Gunnerus). Edinburgh.

SCAGEL, R. F. (1955): Saanich Inlet Cruises, 1954, 1955. Institute of Oceanography, Univ. of British Columbia, Data Report 5.

SVERDRUP, H. U.; JOHNSON, M. W.; and FLEMING, R. H. (1942): The Oceans. Prentice-Hall, New York.

ANONYMOUS (1955): Surface Water Supply of Canada. Pacific Drainage, Climatic Years 1950–51 and 1951–52. Department of Northern Affairs and National Resources. Water Resources Paper No. 114.

THE BRITISH COLUMBIA SHIPWORM

The shipworm, also known as the " teredo," has been a scourge ever since mankind began using ships and structures of wood in sea-water, for it burrows into and finally destroys submerged timber structures such as ships' hulls or wharves. Phœnicians were troubled by them and used many remedies, mostly unsuccessful, to combat the pest. From that time on a vast amount of time and effort has gone into attempts to overcome this marine " termite," but so far with no success.

British Columbia has a considerable interest in the shipworm problem, since the majority of marine structures, such as wharves and floats, are of wooden construction. The major industry in the Province is lumbering, and a large proportion of the logs are transported by water and stored in salt-water booming-grounds. When a tree has been felled and moved to tidewater, its value has been increased considerably, and to have it destroyed or partly destroyed by shipworm attack is most uneconomical. The loss due to this animal may reach as high as 10 per cent or more in transporting a single raft of logs valued at $75,000 from the Queen Charlotte Islands to the Georgia Strait area. Estimation of the total loss due to shipworm attack is difficult, for it will vary considerably from year to year.

Since much of the data on shipworms are available only in isolated scientific journals, there appears to be a need for a general account of the nature of the British Columbia shipworm and the problem it presents. Much of the information given here has been taken from publications that deal mainly with the common Atlantic species of shipworm (*Teredo navalis*), for there is relatively little information available on the British Columbia species, most of the published accounts of which are listed as references.

DESCRIPTION

The shipworm, as it is commonly called because of its shape, is a member of the family of molluscs called the Teredinidæ. There are many members of this family, only one of which, as far as we know, occurs in British Columbia waters. It has no common name, but its scientific designation is *Bankia setacea* Tryon (Fig. 7), and it is quite distinct from the common Atlantic species which occurs in California, where it was accidentally introduced in the days of the wooden sailing-ships. Biologically, shipworms have most of the characteristics and structures of other molluscs, the group to which clams and oysters belong.

As the name indicates, it is worm-like in shape, and it has a soft body enclosed in a thin skin called the mantle (Fig. 7). At the anterior or " head " end are located the two shells which are the actual boring mechanism (Figs. 8 and 14). Partly enclosed by these shells is a muscular adhesive disc called the " foot." Also at this end is the mouth, which leads into a small stomach to which is attached a rather large appendix-like organ which is used mainly as a temporary storage for wood borings. The posterior or " tail " end of the shipworm ends in two tubes of unequal length called " siphons," which correspond to the " neck " of a clam (Fig. 9). The siphons maintain outside contact, and fresh water is drawn in through the longer one and used water and excretory products are discharged through the other. In addition, two feather-like calcareous structures called " pallets " are also developed in this region, and they are used for stopping up the hole against the entry of other animals or toxic materials which are usually detected by the sensitive siphons.

DEVELOPMENT

There are male and female *Bankia,* and in breeding the eggs and sperms are discharged separately into the open water. (In most species of *Teredo,* preliminary development takes place within the body space called the " mantle cavity.") In order to ensure fertilization, many individuals must spawn simultaneously. The smaller the

number of individuals taking part in the spawning and the farther apart the individual shipworms are, the less are the chances that all of the eggs will be fertilized and developed.

After the egg is fertilized, growth and development begin, and shortly two tiny shells are formed. About the same time a digestive system is developed, along with a protrusible organ, the velum, which enables the young larva, as it is now called, to swim well enough to maintain a fairly constant depth. However, the horizontal movements are essentially determined by the water currents. The larva continues to grow, feeding on the very minute organisms found in the sea-water until it attains a length of about one-one hundredth inch. At this size it is yellow in colour and nearly spherical in shape (Figs. 1 to 6). When it reaches this length it is ready to settle, and on striking a suitable wooden object it attaches itself with a fine thread called the " byssus." Tiny calcareous teeth soon develop on the outer edges of the shell, and observations at Ladysmith indicate that within twenty-four hours the tiny shipworm is able to completely bury itself.

No information is available to show whether, when the time for settling has arrived, the young shipworm is able to prolong its free-swimming existence if it does not come into contact with wood. There are indications this may be the case, for swimming larvæ much larger than normal have been found. The length of the period between spawning and settlement is not definitely known for *B. setacea,* but from a limited amount of data it appears to be about three to four weeks. A male and a female *Bankia,* grown to a length of 4 inches in four months in the aquarium at the Shell-fish Laboratory at Ladysmith, spawned after being removed from the burrows, indicating that breeding may occur at quite an early age.

The exact time of breeding varies from place to place and from year to year, and most likely varies with depth. Studies on *Bankia setacea* in British Columbia have so far not demonstrated a close relationship between temperature or salinity and breeding. However, the time of maximum intensity of attack appears to be during the colder months in most areas. Continuous observations of this species over a considerable period of time will be necessary to obtain a clear picture of the breeding habits, with particular reference to time and intensity. It is now generally conceded that some breeding is possible in most areas at any time of the year. In Ladysmith Harbour the maximum attack occurs during March in most years.

However, a combination of relatively low salinity (5 to 22 parts per thousand) and low water temperature (40° F. to 61° F.) appear to provide optimum conditions at or near the surface. These occur in the Queen Charlotte Islands in Masset Inlet, an area which is notorious for the intensity of shipworm attack.

Recent investigations at the Shell-fish Laboratory on the vertical distribution of the larvæ of *Bankia* indicate that they occur at deeper levels during the summer than in winter. In the period August 1st to 14th, 1953, in Pendrell Sound, fir blocks at a depth of 40 feet below the surface were attacked at an intensity of twenty shipworms per square inch. Only occasional larvæ were found in samples above the 24-foot depth, and no attack occurred on the blocks above that level. The temperature at the lower level was about 52° F., where the number of larvae varied between one and three per gallon during the settlement period, while the surface temperature was 70° F. Attacks of nearly 200 per square inch have been recorded.

Recent work on other species of shipworms indicates the degree of illumination may influence the vertical distribution of larvæ and where they are likely to settle. In the Pendrell Sound studies there was no indication of a diurnal vertical movement of the larvæ of *Bankia setacea.*

Workers in the Puget Sound area have concluded that *Bankia setacea* settles most intensively during October, November, and December, with a cessation in January and February, beginning again in March and April, to continue off and on sporadically throughout the summer. They suggest that 45° F. to 54° F. constitute the temperature

limits for effective breeding in Puget Sound and that above and below these limits no attacks of destructive intensity may be expected. The presence of four or more animals in a single block 11 by 5½ by ¾ inches was considered an attack of destructive intensity.

HABITAT

Bankia setacea is found only in wood burrows, and very few species of wood are immune to attack. Certainly most of the softwoods, and many of the so-called hardwoods, are liable to infestation. Under certain conditions it will burrow into fir-bark and can pass over a narrow gap between adjoining pieces of timber.

This particular species is found only on the Pacific coast of North America. Its range there is from San Diego in the south to Kodiak Island in the north, so it is able to survive under a wide range of temperature and salinity conditions.

It occurs in varying abundance practically everywhere on the British Columbia coast, and the availability of considerable quantities of submerged wood permits the development and maintenance of large populations of this animal.

It is distributed vertically from the surface down to a depth of at least 150 feet. With the wide temperature fluctuations found in these latitudes, particularly in inshore waters, optimum breeding temperatures occur for considerable periods of the year at the surface and for a much greater time at deeper levels. In very few areas is the limiting effect of low salinity likely to occur for extended periods, so there are few localities which are free from attack at all times of the year. Studies by the British Columbia Research Council show the lower salinity limit for adult survival to be about ten parts per thousand. An extended free-swimming period assists in the widespread distribution of the species.

It has been demonstrated for other species of shipworm that the larvæ are unable to become attached at current speeds greater than about 1½ knots. However, the slack-water periods that occur in most British Columbia waters would permit settling during several hours each day.

BORING METHOD

Shipworms apparently bore by a purely mechanical rasping action of the shells. The top and bottom of each shell is provided with a round articulating knob so they are able to rock back and forth on these areas. This is unlike most clams, whose shells are held together along the top by a hinge.

Each shell of the shipworm is divided into three main parts. The most anterior section holds a series of horizontal rows of teeth, the central section holds a series of vertical rows of teeth, while the large posterior flanges hold a large muscle between them (Fig. 14). In addition, there is a small anterior muscle which draws the front edges of the shell together. While the sucker-like foot and dorsal flap of flesh, together with hydrostatic pressure in the tunnel, hold the shells against the end of the burrow, contraction of the powerful posterior muscle causes the front part of the shell to flare outward and backward, allowing the teeth to rasp and cut. As this process is repeated over and over again, the head of the shipworm is gradually turned right and left through 180 degrees, thus creating a circular burrow. The tiny particles of wood shavings are taken into mouth, passed to the digestive system, and finally discharged outside the burrow through the exhalant siphon. Often the pile of whitish-coloured pellets of wood shavings outside the burrow is the only visible evidence of shipworms.

FOOD AND DIGESTION

The raspings are passed through the digestive system, where they are partly digested and expelled through the exhalant siphon. In addition, the sea-water drawn in through the inhalant siphon also carries planktonic food.

Chemical analysis of ejected wood borings of *Teredo navalis* indicates the digestive process converts some of the wood constituents to a form that can be assimilated. This

ability is possessed by relatively few other animals, such as snails and insects. In addition, the borer uses plant and animal food (plankton), which it attains by filtering water that it draws in through the inhalant siphon. The filtering action is carried out by the gills, which are basket-like structures on which tiny vibrating hairs or cilia create water currents. The blood is aerated and the food particles are trapped in the mucus secreted by the gills. The food-laden mucus is then transported in ciliated grooves to the mouth. However, it has been shown by European workers that *Teredo navalis* is able to subsist for a period up to a year without planktonic food. When held in glass tubes and supplied with planktonic food only, the shipworms were unable to maintain life.

GROWTH

After becoming attached, the young shipworm undergoes quite drastic anatomical changes. The swimming organ is lost, and its digestive, nervous, and muscular systems become very much altered as adaptations to its new mode of life. Immediately after being completely buried, and at about the same time as the formation of the pallets, a calcareous cone is formed in the entry, with two small holes, one for each siphon (Fig. 10). After several weeks the bridge separating the two small apertures disintegrates. The entry hole at this time is about one-seventy-fifth of an inch in diameter. As the animal grows older, the size and shape of the entry hole is enlarged, mainly by disintegration of the surrounding wood. As the animal grows, it elongates as the " head " (Fig. 8), together with the two shells, grows and moves forward in the burrow. What might be called the tail (Fig. 9) remains at the entry point, where contact with the outside water must be maintained. In fact, this tail region becomes attached to the walls of the burrow by means of a muscle.

When the animal has penetrated an inch or so, it often, but not always, lines the walls of the burrow with a thin layer of shell. The shell formation begins in the region of the siphons and proceeds toward the shell valves. When a block of wood has been completely riddled and no more burrowing is possible, calcification of all the walls is completed and the animals are apparently able to subsist for a time on a diet of plankton only, but death occurs relatively soon. Shipworms only very rarely have been observed to penetrate the burrows of adjacent shipworms. They may withdraw the head from the inner end of the burrow for as much as 2 inches, abandon and seal off this part of the shell, and start off in another direction (Fig. 11). Whenever possible, shipworms follow the grain of the wood.

Since the shipworm is completely encased in wood, specimens may be obtained only by splitting open the burrows. Therefore, the rate of growth of an individual specimen is difficult to measure. It has been found, however, that X-rays in very small amounts do not appear to harm the shipworm, and in radiographs the outlines are seen quite clearly (Fig. 12). By taking a series of X-ray photographs of the same piece of infested wood over a period of time, the growth of the shipworms may be measured. Such observations were conducted in Ladysmith Harbour in 1955, where fir blocks were X-rayed at monthly intervals and the length of the burrows measured. The first X-ray, taken on December 15th, 1954, showed that altogether twenty-seven shipworms had entered through the end of six of the twelve blocks exposed. The average length at this time was 0.4 inch, with a range of 0.2 to 0.7 inch. It was not until April, 1955, that the blocks were attacked by seven more shipworms. Growth of the original group continued at a steady rate until March, when it increased slightly. The average length at this time was 5.5 inches. By May the shipworms in the more heavily infested blocks had so changed the direction of the burrows that the blocks were quite riddled, and it was quite difficult to measure accurately the individual burrows. By July only five of the original twenty-seven animals could be measured with confidence, and the average length of these was 19.9 inches, or an average growth rate of about 2.8 inches per month for the period. The largest specimen was 22.5 inches in length. The growth rate of this group is shown graphically in Fig. 13.

The shipworms attacking in April showed a higher rate of growth than those of the earlier group. From a length of 0.6 inch in mid-April, one specimen attained a length of 24 inches by mid-August, or an average of about 6 inches per month. This rapid growth may be associated with the higher water temperatures prevailing at this time, in comparison with those earlier in the year.

In more northern waters, *Bankia setacea* is said to attain a length of 48 inches, but the greatest length reached by a specimen in the Ladysmith Harbour experiment was 24 inches, although in this case the possibility for extended growth was limited, due to the fairly small blocks.

PRESENT CONTROL MEASURES

The main emphasis on the shipworm problem throughout the ages has been on protection rather than on eradication, as is the case with most pests. Protective measures are based on the application of an impenetrable or a toxic coating to the surface of the wood that is to be exposed to shipworm attack.

Copper sheathing, fibreglass, etc., are examples of material used to prevent penetration, but these are limited in the range of application. Anti-fouling paints containing copper or arsenic are the commonest protective coatings. The poisonous compounds in the paint leach out slowly and form on the paint surface a thin layer of toxic solution which inhibits the attachment of fouling and boring organisms.

For heavy wooden structures, probably the most important and widely used protective material is creosote. The wood is impregnated with creosote to a considerable depth, and the greater its penetration beneath the surface, the greater the protection, for leaching or abrasion may reduce effectiveness. For use in sea-water, plywood impregnated with creosote is becoming widely used, and pontoons of such material are being used instead of logs for floats.

There are many special anti-fouling compounds which may be suitable for special purposes if expense is not too great a consideration. Copper sulphate in solution has been used to destroy shipworms in special cases. Numerous other chemicals are toxic to shipworms, but are difficult to apply.

The British Columbia Research Council has made extensive studies on toxic substances that could be used to protect sawlogs against marine borers. Sodium arsenite was found to be very toxic, and twenty-five parts per million of this substance will completely kill shipworms in eighteen hours of exposure. The important feature of this chemical is that it does not cause the borers to close off their burrows.

Flat rafts of sawlogs containing shipworms are treated by ponding them in a tidal basin to which sodium arsenite is added. Deep-sea rafts (usually called Davis rafts), where the piles of logs are bundled together with steel cables, are treated by spraying with sodium arsenite solution as the raft is built up. The main use of this method is to kill shipworms already in the logs, although the protective action does appear to persist for some time. Care must be taken in the use of this chemical, since it is also toxic to fish and other marine life.

To destroy shipworms in untreated piling and in permanent rafts, underwater dynamite blasting has been used with apparent success by some logging companies. Investigations by the British Columbia Research Council indicate that blasting is only partially effective in killing adult shipworms.

CONTROL OF SHIPWORM POPULATIONS

It has already been pointed out that the shipworm menace has been met almost entirely by protective methods. Little or no effort has been made to combat the animal by eradicating it from an area. Since any true control involves a reduction of the population of the pest, some consideration should be given to whether or not this is feasible in

the case of the shipworm. The larvæ of the shipworm of the *Bankia* group are dispersed by water currents during the comparatively long free-swimming period. During this time they feed on the small aquatic organisms. Food-supply, predators, and unsuitable hydrographic conditions, such as extremes of temperature and salinity, all may limit survival. At the same time, however, the long larval period affords opportunity for wide distribution. At the end of the free-swimming period, the larva must find a suitable place to settle within what is believed to be a relatively short time or it dies.

Because of these factors, especially predation, mortality is very great, but is compensated for by the production of large numbers of eggs. While no measure of egg production is available for *Bankia setacea,* in many molluscs it is known to be great, but with a relatively low survival. In a related species a specimen 4 feet long was estimated to have spawned 100,000,000 eggs. In favourable years, only one larva per million of the Danish oyster is able to survive and develop into an adult. It is evident that, as a general rule, the number of adults reflects the production of young. Thus oyster-growers maintain heavy stocks of oysters to ensure an abundance of larvæ which will settle as seed. In the case of the shipworm, however, it is desirable to eliminate or reduce the number of larvæ in order to minimize infestation, and efforts toward this end may be made by reducing the number of adults.

The only habitat of the shipworm is in submerged wooden structures. If these are removed, the contained population of the shipworms will be eliminated and there will be no place for the larvæ from other sites to settle and develop into adults. In British Columbia, for various reasons, there is a great deal of timber in sea-water. One deliberate concentration is the result of a procedure known as " graveyarding " in log-booming operations. Graveyards are areas where " deadheads," which are partly sunken logs, are gathered and stored. In time most of these sink completely (called " sinkers ") and lie on the bottom. These are excellent breeding centres for shipworms. It is obvious that a reduction in the number of deadheads would affect a reduction in the number of adult shipworms, the number of larvæ produced, and, therefore, the risk of heavy infestation of other timber in the general area. Therefore, the elimination of graveyards, the removal of old, unused wharf piling and booming-ground pylons would be essential steps in a thorough shipworm-control programme.

It is realized that all deadheads, sinkers, and submerged wooden structures cannot be immediately or completely removed, but if no further deliberate accumulation occurred, the shipworms themselves would quickly destroy all old timber (Fig. 15) and there would be no new homes for them.

Adventitious floating and sunken timber will always present a problem in British Columbia, but the quantity might not be great enough in most areas to have a significant effect (log wharf floats also harbour considerable populations of shipworms, but there is a trend toward replacing them with creosoted wooden pontoons, and if this trend is continued it will constitute an important advance).

Another way in which adult populations of shipworms may be reduced is in controlling the infestation of log-booms in storage-grounds by the orderly utilization of these booms so each unit is allowed to remain in an infested area only as long as is absolutely necessary. This is already a fairly general practice. A knowledge of the time and extent of local breeding cycles would be of considerable assistance here, as well as in the selection of new booming and storage grounds.

The destructive ability of the shipworm needs no elaboration. It may be that some inexpensive protective measure may be developed in the future or some technique to wipe out existing adult populations may be developed. In the meantime, the possibility of reducing loss by common-sense low-cost measures appears possible and would be well worth investigating. This could be done on an experimental basis in a selected area.

REFERENCES

BLACK, E. C. (1934): The Shipworm. Pac. Biol. Sta. and Pac. Exp. Sta. Prog. Rep. *21,* 7–9, 1934.

ELSEY, C. R., and BLACK, E. C. (1948): Incidence of wood-borers in British Columbia waters. Bull. Fish. Res. Bd. Can., *LXXX.* 1948.

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

——— (1925): Marine wood borers in British Columbia waters. Trans. Roy. Soc. Can., *19,* Sect. V, 159–167.

——— (1926): Marine wood borers on the Pacific Coast of North America. Proc. Third Pan-Pacific Sci. Congr., Tokyo, 2270–2275, 1926.

HILL, C. E., and KOFOID, C. A. (1927): Marine borers and their relation to marine construction on the Pacific Coast. Final Report of the San Francisco Bay Marine Piling Committee, San Francisco, 1927.

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

KOFOID, C. A. (1921): The marine borers of the San Francisco Bay region. Report on the San Francisco Bay Marine Piling Survey, *1,* 23–61, 1921.

MILLER, R. C. (1926): Ecological relations of marine wood-boring organisms in San Francisco Bay. Ecology, *7,* 247–254. 1926.

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

QUAYLE, D. B. (1942): The use of dynamite in teredo control. Fish. Res. Bd. Can. Prog. Rep. Pac., *51,* 20, 1942.

——— (1953): The larva of *Bankia setacea* Tryon. Rep. B.C. Dept. Fish. for 1951.

——— (1955): Growth of the British Columbia shipworm. Fish. Res. Bd. Can. Prog. Rep. Pac., *105,* 3–5, 1956.

TRUSSELL, P. C.; FULTON, C. O.; CAMERON, C. J.; and GREER, B. A. (1955): Marine borer studies: evaluation of toxicants. Canadian Journal of Zoology, *33.* 327–338. 1955.

TRUSSELL, P. C.; ANASTASIOU, C. J.; and FULTON, C. O. (1956): Protection of saw-logs against marine borers. I, Treatment of flat rafts by ponding. Pulp and Paper Magazine of Canada. February, 1956.

TRUSSELL, P. C.; FULTON, C. O.; ANASTASIOU, C. J.; and GILLESPIE, R. E. (1956): Protection of saw-lags against borers. II, Treatment of deep-sea rafts. Pulp and Paper Magazine of Canada. February, 1956.

TRUSSELL, P. C.; GREER, B. A.; and LE BRASSEUR, R. J.: Protection of saw-logs against marine borers. III, Storage ground study. Pulp and Paper Magazine of Canada. February, 1956.

WHITE, F. D. (1929): Studies on marine borers. III. A note on the breeding season of *Bankia* (*Xylotrya*) *setacea* in Departure Bay, B.C. Contrib. Can. Biol. N.S. IV, No. 3.

——— (1930): The pile-borer or " teredo." Pac. Biol. Sta. and Pac. Exp. Sta. Prog. Rep. *5,* 3–6. 1930.

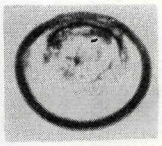


Fig. 1.

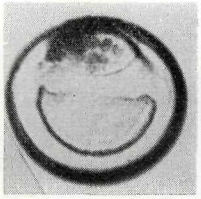


Fig. 2.

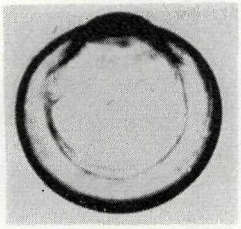


Fig. 3.

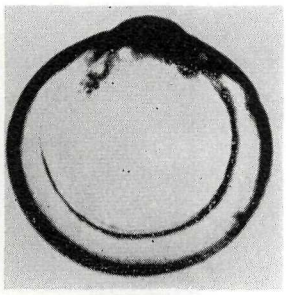


Fig. 4.

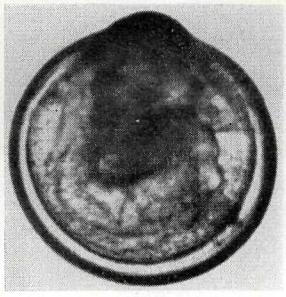


Fig. 5.

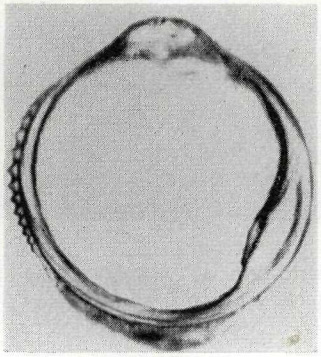


Fig. 6.

BRITISH COLUMBIA SHIPWORM (*Bankia setacea*)

Fig. 1. Photograph of very young larva, 100 μ in length. (1 $\mu = \frac{1}{25000}$ inch.)
Fig. 2. Photograph of larger larva, 145 μ in length.
Fig. 3. Photograph of single shell of larva, external view, 175 μ in length.
Fig. 4. Photograph of single shell of larva, external view, 220 μ in length.
Fig. 5. Photograph of whole larva, 220 μ in length.
Fig. 6. Photograph of newly settled *Bankia,* showing the cutting-teeth, 245 μ in length.

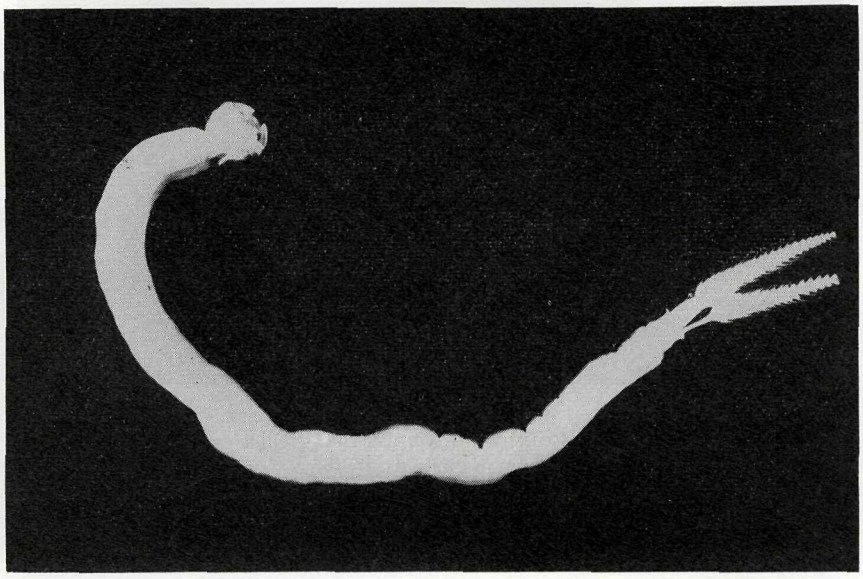


Fig. 7. British Columbia shipworm (*Bankia setacea*). Whole animal removed from burrow. The feather-like structures at the right are the pallets. The two shells are at the left end. Magnification $\times \frac{2}{3}$.

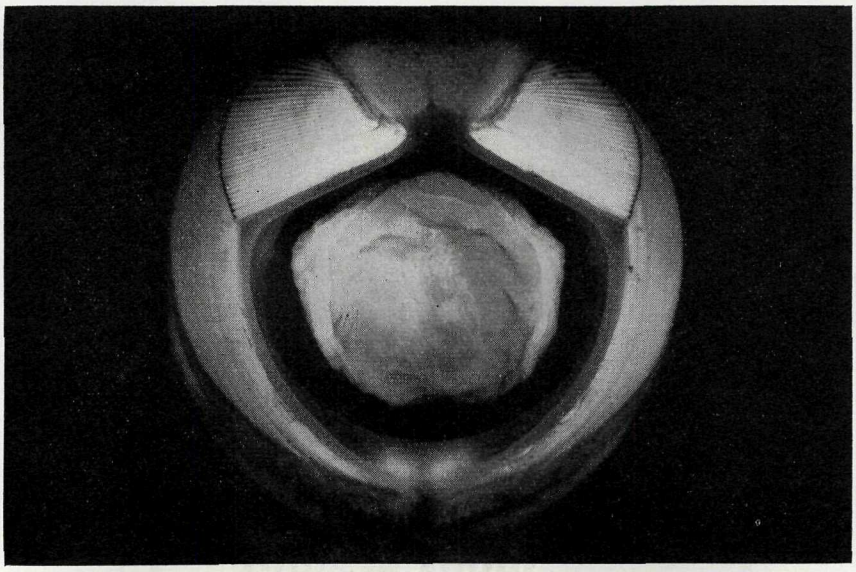


Fig. 8. Front view of head of the British Columbia shipworm showing foot with shells on each side. Magnification ×7. Showing the foot (centre) with shells on each side.

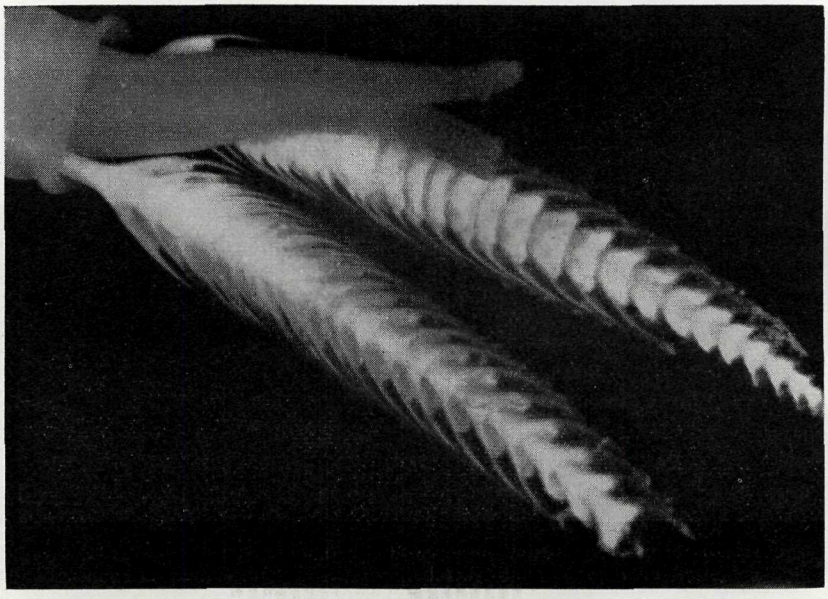


Fig. 9. Tail end of British Columbia shipworm showing the calcareous feather-like pallets, the two siphons, and the collar (upper left hand) which surrounds these organs. The siphons are in the retracted position. Magnification ×3.

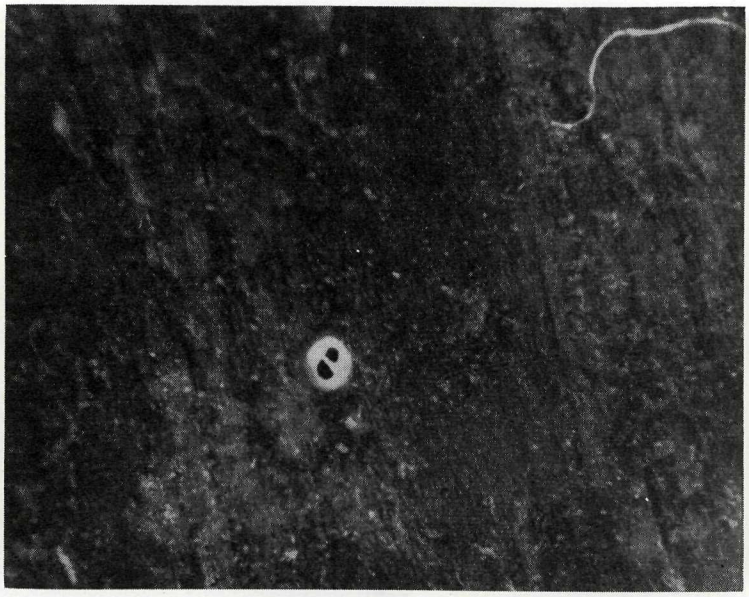


Fig. 10. Calcareous cone of the British Columbia shipworm formed in the entry hole in the early stages after settling. Magnification ×15.

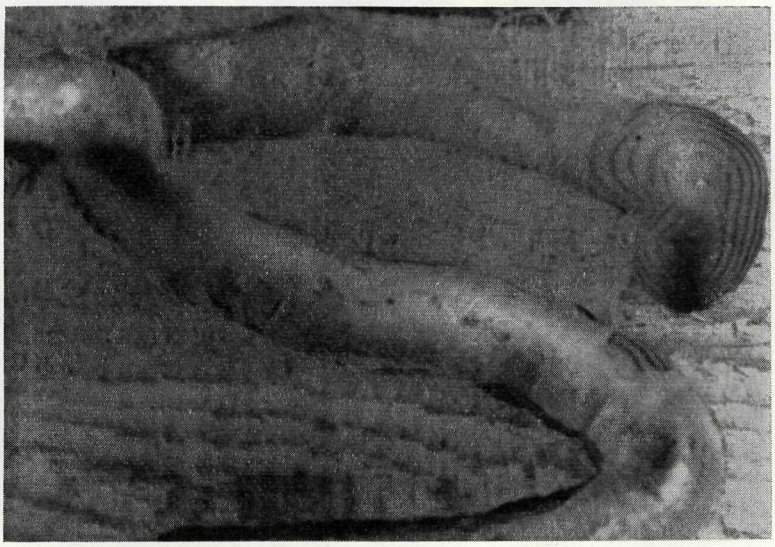


Fig. 11. Burrow of the British Columbia shipworm (*Bankia setacea*) showing the abandoned burrow (upper right) and the calcareous seal (upper left). The main burrow has been lined with lime while the grain of the wood shows in the abandoned burrow. Magnification ×2.

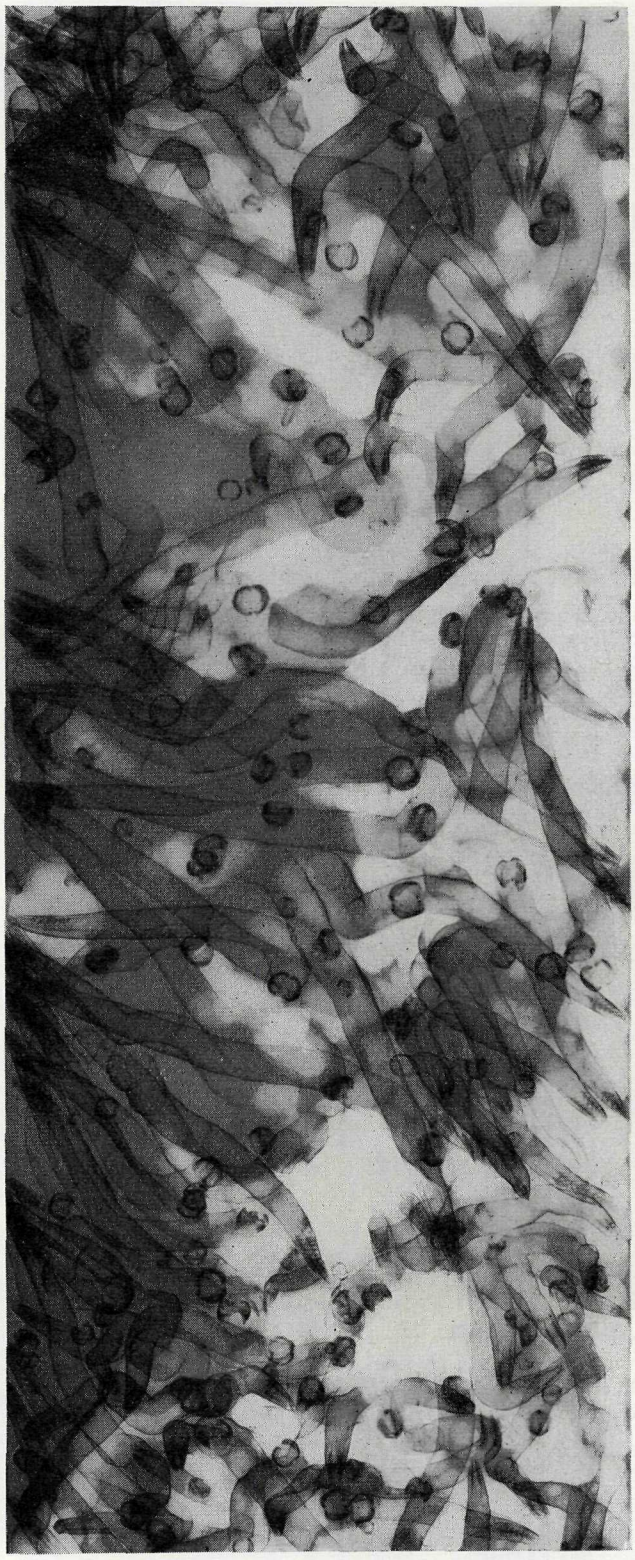


Fig. 12. X-ray of a piece of fir, 1 by 4 by 9 inches, exposed at the 4-foot tide-level in Ladysmith Harbour from August to December, 1952.

(Radiograph by H. Duncan.)

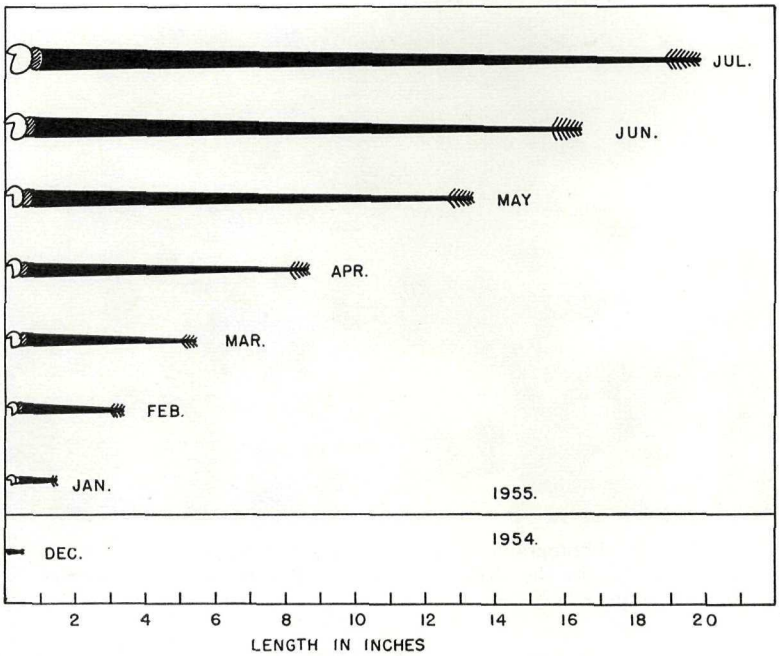


Fig. 13. Growth rate of the shipworm (*Bankia setacea*) in Ladysmith Harbour.

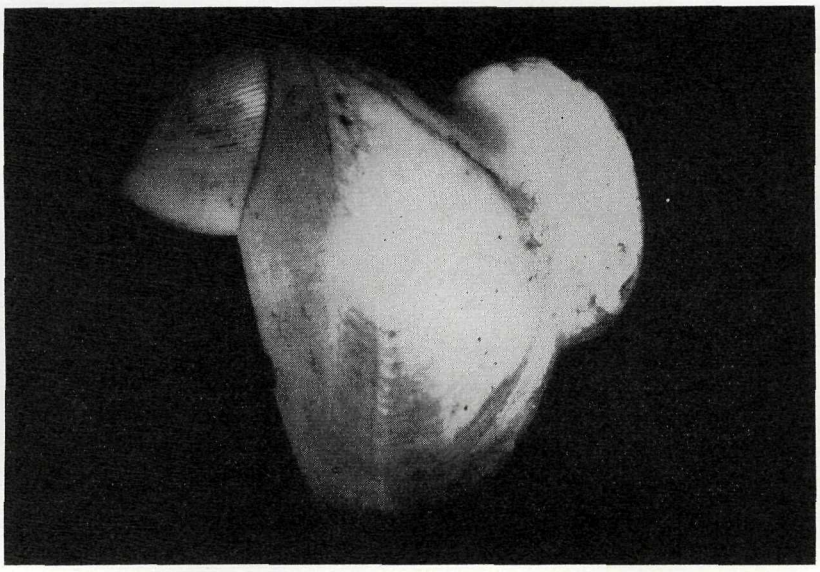


Fig. 14. External view of left shell of the British Columbia shipworm (*Bankia setacea*). The large flange for the insertion of the powerful posterior adductor muscle is shown on the right. The two groups of cutting-teeth are shown on the left. Magnification ×6.

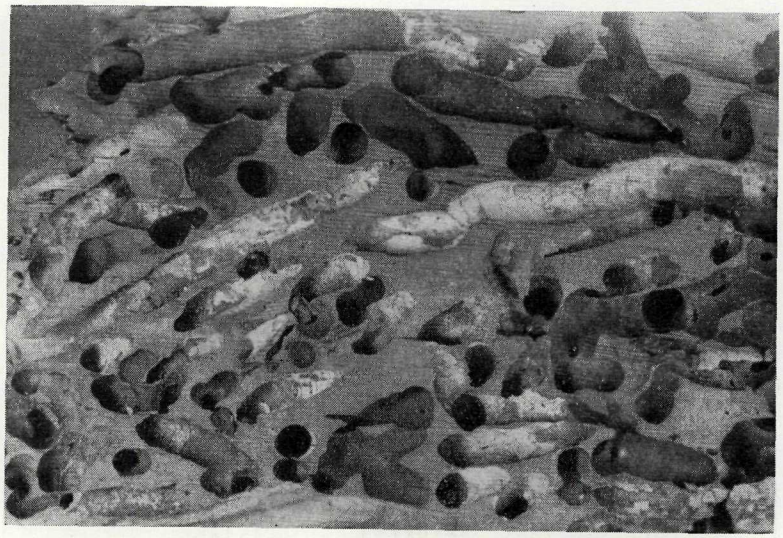


Fig. 15. Photograph of piece of fir to show the complete destruction of timber by the British Columbia shipworm (*Bankia setacea*). Magnification ×½.

REPORT OF THE INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION FOR 1955

For the eighteenth consecutive year the Governments of Canada and the United States continued the work of restoration of the sockeye salmon of the Fraser River watershed, acting through the International Pacific Salmon Fisheries Commission. Since its establishment by a convention between the two countries in 1937, the Commission has sought to fulfil its designated purpose of protection, preservation, and extension of the sockeye-salmon fisheries in the Fraser River system.

The total 1955 run of 2,595,000 fish was the second largest on this cycle since 1903, but represented a 17-per-cent decline over that of the previous cycle-year, 1951. The Canadian catch of 1,108,081 fish was 52.40 per cent of the total catch. The table which follows shows the sockeye-catch by gear in convention waters of Canada and the United States for the cycle-years 1943, 1947, 1951, and 1955.

1955 SOCKEYE-CATCH BY GEAR

Canadian Convention Waters

Year	Traps		Purse-seines		Gill-nets		Total Catch
	Units	Catch	Units	Catch	Units	Catch	
1943	4	18,023	.....	.....	854	330,988	349,011
1947	5	3,617	97	44,011	1,072	307,407	355,035
1951	5	42,012	50	214,187	1,148	1,031,963	1,288,162
1955	5	18,548	104	462,934	1,348	625,207	1,108,081[1]

United States Convention Waters

Year	Purse-seines		Gill-nets		Reef-nets		Total Catch
	Units	Catch	Units	Catch	Units	Catch	
1943	139	202,927	22	5,688	57	33,161	241,776
1947	174	76,691	29	1,770	60	9,758	88,219
1951	242	875,607	177	152,372	105	108,497	1,136,791[2]
1955	286	621,527	584	282,995	88	102,088	1,006,610

[1] Includes 1,392 troll-caught sockeye.
[2] Includes 315 drag-seine caught sockeye.
NOTE.—Gear counts represent the maximum number of units delivering on any single day.

In addition to the commercial fishery catches, Indians in various parts of the Fraser River watershed captured 65,630 sockeye for subsistence purposes, according to data received from the Inspectors of the Department of Fisheries of Canada.

The 1955 escapement to the spawning-grounds was 379,185 sockeye, representing a decline of 38.6 per cent compared with that of the previous cycle-year, 1951. This is considered to be the first unsatisfactory seasonal escapement since the Commission started controlling the fishery in 1946. Although the decline in escapement was caused in part by the unexpected decline in the run, it was also due to overfishing engendered by a larger and individually more efficient Canadian Sooke-San Juan fishing fleet and a marked increase in the United States fishing fleet. The catch, in per cent of the total run, increased over that of the brood-year (1951) in spite of greatly increased protective closures. In order to assure that such overfishing will not be repeated in the future, it is necessary to have a relatively stable fishery that is reasonably controlled in size, efficiency, and fishing area.

A natural factor of lower than average ocean survival, apparently affecting all North Pacific Coast sockeye populations, also adversely influenced the numerical escapement in 1955. The closely estimated return of adults in the Chilco run from a known number of down-stream migrants indicated a sea survival of only 5 per cent. A second natural factor which reduced the numbers of spawners resulted from late high water in the Fraser River. A six-day block to the up-stream migration of the early runs of sockeye occurred near Yale, B.C. The early Stuart run was almost annihilated, with only 2,170 sockeye reaching the spawning-grounds out of an estimated escapement from the fishery of between 30,000 and 35,000.

Recommended regulations for the 1955 Fraser River sockeye-fishery were adopted by the Commission after consultation with the Advisory Committee in Vancouver, B.C., on January 8th, 1955. The recommendations for regulations, as approved by the Commission, were transmitted to the Departments of Fisheries of Canada and the State of Washington, and to the Secretary of the Interior at Washington, D.C. The recommendations were accepted in substance for Canadian waters by an Order in Council adopted on June 2nd, 1955, and for United States waters by an Order of the Director of the Washington State Department of Fisheries promulgated April 1st, 1955.

For Canadian convention waters the Commission recommended that fishing for sockeye commence on June 30th, 1955, and that the following weekly closures be in effect: For Areas 19, 20, 21, and 23, seventy-two hours from June 30th to August 1st, and forty-eight hours from August 1st to August 22nd. For Areas 17 and 18 and District No. 1 below Pattullo Bridge, seventy-eight hours from June 30th to August 8th, ninety-six hours from August 8th to August 30th, seventy-two hours from August 30th to September 15th, and a complete closure from 8 a.m. on September 15th to 8 a.m. on September 20th. For District No. 1 above Pattullo Bridge the closures were the same as for Areas 17 and 18 and District No. 1 below Pattullo Bridge, except that the closed periods extended four hours longer. During the course of the fishing season, certain modifications of these regulations were recommended by the Commission. In Areas 19, 20, 21, and 23 the weekly close time was increased by forty-eight hours during the period August 3rd to August 10th. In Areas 17 and 18 the weekly close time was increased by eighteen hours during the period July 27th to August 10th. In District No. 1 below Pattullo Bridge the weekly close time was increased to ninety-six hours for the period July 27th to August 10th; above Pattullo Bridge the weekly close time ceased four hours later than this. Additional closures effected by the Canada Department of Fisheries for the protection of pink salmon extended the close time to include all except two days of sockeye-fishing between September 9th and October 11th, which was virtually the end of the sockeye season.

With respect to United States convention waters, the Commission recommended the following regulations: Seventy-two hours weekly closure from June 30th to August 1st, forty-eight hours weekly from August 1st to August 8th, and thirty-six hours weekly from August 8th to August 29th. The following modifications of these regulations were recommented by the Commission: Extension by twenty-four hours of the weekly close period for the first week-end in August, and extension by twelve hours of the weekly close time for the period August 10th to August 17th. As conservation measures for pink salmon the Washington State Department of Fisheries extended by twelve hours the weekly closures recommended by the Commission from August 17th to the end of the salmon net-fishing season and closed the waters west of a line projected from Point Roberts Light to Patos Island Light from September 15th to the end of the fishing season.

In high seas convention waters the weekly close period was seventy-two hours from June 30th to August 1st, and forty-eight hours from August 1st to August 15th.

During 1955, as in previous years, the Commission continued to expend the greater part of its effort on scientific research. Biological and technological research for the purpose of developing and supporting the fisheries management policies of the Commis-

sion and for rehabilitation and extension of the runs is a continual part of the staff's programme. Technical studies by the Commission staff of various current and proposed industrial water-use projects are expanding more each year.

Part of the biological research in 1955 included enumeration of both catch and escapement on a racial basis. This allowed calculation of the catch of each major race by date, fishing area, and relative fishing intensity, as well as yielding close estimates of the true racial catch-escapement ratios. These studies were conducted on a daily basis during the fishing season. In conjunction with these studies the progress of the runs was closely followed through the fishing areas and up to the spawning-grounds by means of statistical analysis of the daily catches, week-end test fishing, and observations along the migration routes. In continuation of previous practices, the individual populations were carefully enumerated and observed through spawning while environmental conditions were simultaneously recorded. The relative success of reproduction of each of these spawning populations will subsequently be studied in relation to the reproductive environment.

Studies of the possible long-term effect of selective fishing-gear were continued, and additional experiments were conducted on the relative efficiency of spawning with various sex ratios. Studies of relative survival during the different stages of life-history of a major population were continued through field enumeration of the newly hatched fry as they entered their lake-residence period and yearlings as they migrated seaward. Investigation of possible relationships between young sockeye and predators or competitors or food availability was continued as a part of the programme to determine the cause, or causes, and functioning of cyclic dominance. Determination of age-composition relationships in the mixed-age populations shows promise as an alternative means of determining the way in which cyclic dominance functions, although the exact physical cause may not be revealed by such analysis.

At the Commission's field station on Horsefly Lake a second and technologically improved experimental artificial spawning area was constructed. The experimental area was divided into sections; one half was stocked with 100 adult sockeye of mixed sexes and the other half planted with 340,000 newly fertilized eggs. The fish and eggs were transported by air from Stellako River.

Attempts to rehabilitate barren areas by the introduction of new stocks are continuing. Transplanting of eyed eggs was shown by 1954 adult returns to be an effective method. The 1955 transplanting of 780,700 eyed eggs from Seymour River to Upper Adams River is expected to produce adult returns in 1959. Eyed-egg transplantations will be rapidly expanded to meet the requirements of replacing exterminated populations.

The Commission, in liaison with the Canadian Department of Fisheries, the British Columbia Fisheries Department, and the British Columbia Game Commission, analysed the expected effects on the Fraser River sockeye-fishery of the proposed diversion of the Columbia River and the associated power development in the Thompson and Fraser Rivers. A joint report was prepared on this subject, which stated that preservation and extension of the Fraser River sockeye runs, assessed at an average annual wholesale value of $23,850,000, would be precluded by the proposed ten dams.

As a continuance of research in the methods of protecting down-stream migrants at dams, the first prototype guiding experiment attempted on young Pacific salmon was conducted in 1955 by the Commission in co-operation with the Department of Fisheries of Canada and the Washington State Department of Fisheries. During 1955, its first season of operation, the fishway recently constructed at the Seton Dam successfully passed 129 sockeye destined for Gates and Portage Creeks and 8,800 pink salmon to Seton Lake tributaries. Technical meetings were held between personnel of the Department of Fisheries of Canada, British Columbia Fisheries Department, British Columbia Game Commission, International Pacific Salmon Fisheries Commission, and Moran Power Development Limited in connection with the salmon problems associated with the pro-

posed dam on the Fraser River at Moran. These meetings will be continued in 1956. Recommendations for handling and disposal of waste products and screening of water intakes for the proposed brewery on the Nechako River at Prince George were detailed in a preliminary report. The delay and subsequent loss of a large portion of the early Stuart, Bowron, and Nadina River sockeye escapements in 1955 at a point below Hells Gate near Yale, B.C., prompted surveys of the area to determine the extent of the blockade and the remedial measures which might be indicated. Laboratory experiments investigating the effect of silt on incubating sockeye eggs buried in gravel were concluded.

Commission meetings in 1955 were held in Vancouver, New Westminster, Ottawa, Washington, D.C., and Seattle. The Canadian Government was represented on the Commission by Senator Thomas Reid (Chairman of the Commission for 1955), A. J. Whitmore (Chief Supervisor of Fisheries, Vancouver), and H. R. MacMillan. Robert J. Schoettler (Director of Washington State Department of Fisheries), Elton B. Jones (Commission Secretary, 1955), and A. J. Suomela (Assistant Director of the U.S. Fish and Wildlife Service) were the United States Commissioners.

INTERNATIONAL PACIFIC HALIBUT COMMISSION, 1955

During 1955 the Commission continued the regulation of the halibut-fishery and broadened its programme of statistical and biological investigations as required by the Halibut Convention of 1953.

The members of the Commission for Canada in 1955 were Richard Nelson (elected Chairman), Harold Helland, George R. Clark, and S. V. Ozere, appointed in January to succeed Mr. Clark, who resigned after seven years of service. The United States members were Seton H. Thompson (elected Vice-Chairman), J. W. Mendenhall, Edward W. Allen, and Mattias Madsen, appointed in June to succeed Mr. Allen, who resigned after twenty-three years of service on the Commission.

The Commission held its annual meeting at its research headquarters in Seattle, Wash., from January 24th to 27th, inclusive. It reviewed the results of investigations and regulations in 1954 in conferences with representatives of halibut-fishermen's, vessel-owners', and wholesale dealers' organizations and discussed with them proposals regarding regulations in 1955. Thereafter it approved a research programme and adopted regulations for the ensuing year.

At the close of the annual meeting the Commission announced that because of the inauguration of multiple fishing seasons in 1954 and the resultant great increase in catch, it was recommending few regulatory changes to the two Governments for 1955. It felt that the multiple fishing seasons should be repeated under virtually the same conditions as in 1954 to make sure of their effectiveness, and that no changes which might materially increase the removals from the stocks should be made until the effect of the 1954 increase was determined. For practical reasons it was recommending a relocation of the boundary-line between Areas 3A and 3B and some minor changes in the fishing seasons.

The halibut regulations recommended for 1955 were approved by the Governor-General in Council on March 8th and by the President of the United States on March 18th and became effective on the latter date.

The regulations in 1955 divided convention waters in five regulatory areas: Area 1A, the waters off the Northern California and Southern Oregon coasts, south of Heceta Head, Oregon; Area 1B, the waters off the Oregon and Washington coasts between Heceta Head and Willapa Bay, Washington; Area 2, the waters between Willapa Bay and Cape Spencer, Alaska; Area 3A, from Cape Spencer to a line running south-east one-half east from Kupreanof Point near Shumagin Islands; Area 3B, all convention waters west of Area 3A, including those of the Bering Sea.

Catch-limits of 26,500,000 pounds for the first season in Area 2 and of 28,000,000 pounds for the first season in Area 3A were continued in the regulations. Control of fishing in other areas and for other seasons, in which the total catch of halibut is comparatively small, was again accomplished by limiting the lengths of the fishing seasons. Closed nursery areas, minimum size-limits, prohibition of the use of nets for the capture of halibut, and provision for the landing of a limited amount of halibut caught incidentally by set-line vessels in areas closed to halibut-fishing were also continued without significant change.

Fishing began in all areas on May 12th. The first season in Areas 1B and 2 was closed on June 5th, and the first season in Areas 3A and 3B closed on August 4th, at which dates it was deemed that the catch-limits set for Areas 2 and 3A respectively would be attained. Second seasons of seven days in Areas 1B and 2 and of nine days in Areas 3A and 3B commenced on August 14th. A third season of twenty-three days in Area 3B commenced on August 29th. Area 1A was closed to halibut-fishing on September 21st, with the termination of the third season in Area 3B.

Landings from Areas 1A and 1B together totalled about two-thirds of a million pounds, as in 1954.

The catch from Area 2 in 1955 totalled 28,700,000 pounds, approximately 8,000,000 pounds less than during 1954, when the catch reached a forty-year high. Bad weather during the last five days of the twenty-four-day first fishing season, when it was too late to change the date of closure, reduced the catch to about 22,500,000 pounds, 4,000,000 pounds less than the catch-limit. Bad weather, unfavourable tides, and a reduction in the number of vessels fishing reduced the catch during the seven-day second season to 5,300,000 pounds, almost 4,000,000 pounds below the catch during the corresponding season in 1954. Halibut caught incidentally during the fishing for other species under permit after the area was closed to halibut-fishing accounted for more than 1,000,000 pounds of the 1955 total.

The catch from Areas 3A and 3B combined amounted to 29,800,000 pounds, compared to 33,800,000 pounds in 1954. In the first season of eighty-four days the catch was 27,500,000 pounds, one-half million pounds below the catch-limit and more than 2,000,000 pounds less than the corresponding catch in 1954. In the second season of nine days the catch was 1,500,000 pounds, almost 2,000,000 pounds below the catch during the corresponding season in 1954. Bad weather and a reduction in the number of vessels fishing during the second season contributed to the deficits.

Little fishing was done in Area 3B during the first and second seasons in 1955, but the catch during the third season of twenty-three days was almost 1,000,000 pounds, approximately one-third million more than in the preceding year. Some of the 1955 catch was taken in Bering Sea.

Landings of halibut from all areas and all seasons in 1955 amounted to 59,100,000 pounds, a sharp drop from the 71,200,000 pounds of 1954. The reduction resulted mainly from bad weather and from conditions which caused many vessels to leave the fishery for other seasonal activities.

Investigation of the fishery and of life and habits of the halibut were continued to provide information required for regulation. After July, when United States funds were increased to match those made available by Canada, a beginning was made upon a broader and more intense, long-range research programme designed to ascertain the conditions necessary for attainment of maximum sustainable yield.

New tagging experiments were begun on some grounds to determine what changes in availability and utilization had taken place there as a result of the adoption of multiple fishing seasons.

The United States halibut vessel "Eclipse" was chartered for approximately three months in late summer and early autumn. A total of six trips were made between the northern end of Vancouver Island off British Columbia and Coronation Island off South-eastern Alaska. A total of 8,526 halibut, weighing approximately 162,000 pounds, were tagged. Fish unsuitable for tagging provided materials for age, length, sex, and maturity studies.

The Canadian halibut vessel "Aleutian Queen" was chartered for about two months in November and December for tagging on the spawning-grounds in the eastern part of the Gulf of Alaska. Although the operation was seriously handicapped by bad weather, 1,242 fish, weighing 51,300 pounds, were tagged.

Recoveries of tagged halibut by fishermen in 1955 numbered 783, compared to 1,584 in 1954. Those from Area 2 decreased from 1,379 in 1954 to 559, which was not unexpected in view of the normal year-to-year decline which results from removals by the fishery and natural mortality and in view of the decrease in the total Area 2 catch mentioned earlier. Recoveries from Area 3A increased from 205 to 224 in spite of a decrease in the total catch due to extensive tagging in the area during 1954.

The availability of halibut, as measured by tag recoveries per unit of fishing effort, was somewhat lower in 1955 than in 1954 on the productive grounds between the north end of Vancouver Island and Dixon Entrance. This was particularly noticeable on Goose Island ground and in southern Hecate Strait. In middle Hecate Strait, on the other hand,

availability was higher. These differences occurred in both the May-June and August seasons.

In Area 2 during the May-June season the catch per unit of effort was generally lower than in 1954, particularly on the Cape Scott, Goose Island, and Icy Straits grounds. On the grounds in Hecate Strait, and notably in the middle portion, the catch per unit of effort showed some increase over 1954.

In the May-August season in Area 3A the over-all catch per unit of effort was somewhat lower than in 1954, particularly in the heavily fished section between Cape St. Elias and Trinity Islands. On the grounds between Cape Spencer and Cape St. Elias the catch per unit of effort was about the same as in 1954, and on the grounds between Trinity Islands and the Shumagin Islands there was some increase over 1954.

During the second fishing seasons in Areas 2 and 3A the catch per unit of effort was also generally lower than in 1954, and the variation from one section of the coast to another was similar to what prevailed during the first season.

In Area 3B, west of Shumagin Islands, the catch per unit of effort during the August-September season of twenty-three days was higher than during the 1952 to 1954 seasons in spite of unfavourable weather during most of the period.

Studies of changes in the length and age composition of important Area 2 stocks both in the first and second seasons showed a generally lower abundance of the important age-groups, reflecting the lower availability of fish in 1955. There was, however, a pronounced increase in the showing of fish 7 years old and younger, which augured well for the future supply of fish.

In Area 3A the fishery continued to be dependent upon the 11- to 16-year-olds, as it had since 1952. The abundant 1944 brood class was the strongest group numerically, as in 1954. In 1955 it became also the largest contributor to the catch by weight.

Studies of the growth of the halibut under different stock and environmental conditions were begun late in the year to fill gaps in present knowledge of this factor, which plays an important role in the productivity of each stock.

To increase knowledge of the factors that determine recruitment of young into the commercial stock, investigations of the life and habits of young halibut were also initiated. These will cover the period between the time the young begin life on the ocean bottom and the time when they appear in the commercial catch five to seven years later.

The latter studies will cover the distribution of the sub-commercial sizes, the nature and probable extent of their habitat, their food and the species which compete with them, the species that prey upon them, and their growth rate. It is hoped that they will show whether limitations are placed upon recruitment by the space available for young halibut, by any unusual abundance of other species, or by great abundance of commercial-sized halibut.

As a first step in these investigations planned for the next several years, the Canadian otter trawler "Phyllis Carlyle" was chartered for a twenty-day exploratory operation in British Columbia waters late in 1955. Immediate objectives were to secure information regarding the types of gear to be used and the operational problems involved, and to acquire as much information as possible on the geographical and depth distribution of the small halibut.

This preliminary investigation showed that small halibut of the 0-year and 1-year groups can be caught on trawlable bottom and gave some indication of their depth distribution in the autumn and of their location in the area sampled. It also indicated a need for modification of the trawl gear used, the desirability of developing gear that can be used on rough bottom, and ways of improving operational procedures.

A summary report upon the regulation of the fishery and upon investigations during 1954 was published and distributed.

SALMON-SPAWNING REPORT, BRITISH COLUMBIA, 1955

GENERAL

Foreword.—Developments or trends of special interest associated with the 1955 salmon migration and spawning escapement include:—

1. Outstanding feature was the failure of the chum run to almost every section of the coast. Immediately evidence of this condition could be perceived, drastic conservation measures by special and early close-down of net-fishing operations were applied. The run proved to be not more than one-third of normal and definitely was the lightest return in the history of the fishery. Despite the drastic regulatory restrictions, the escapement for reproduction purposes was, with few exceptions, exceedingly light, and with present information the situation definitely will require special conservation measures four years hence in an effort to rehabilitate this particular cycle. The spawning escapement of the cycle-year 1951 was such that a normal run was to be expected, and because of its coastwide character it can only be assumed that the failure was the result of very unfavourable survival conditions either in the fresh water or later during existence in the ocean of the progeny of the 1951 brood-year.

2. On the favourable side of the ledger was the excellent return of pinks to the Skeena area and to the Fraser system. These runs yielded the predominant portion of the near-record pack of pinks.

3. A serious reverse in the past ten-year Fraser sockeye rehabilitation programme by the International Pacific Salmon Fisheries Commission was the "block" of early-run sockeye, destined primarily for the Stuart Lake spawning-grounds, at Lower Fraser Canyon just above Yale. Unusually late high-water conditions stemming from the late spring run-off seemingly brought about a "block" condition at this point, not dissimilar to that experienced at Hells Gate prior to the construction of the fishways in 1945, and it is estimated that 95 per cent of the early run, which under the rehabilitation measures of recent years had reached a substantial volume, was delayed and subsequently lost for reproduction.

4. Another occurrence which will likely have serious effect was the heavy destruction of pink and early-run chum spawn in the lower reaches of the Fraser as well as in streams of the Lower Mainland and Vancouver Island opposite. As much as 6 inches of rain fell in twenty-four hours in some areas, and a number of heavily seeded spawning-grounds suffered almost entire destruction, and losses up to 90 per cent in the spawn deposition are estimated. Other spawning areas suffered lesser loss, but there is every reason to believe that the over-all result cannot be other than a much-reduced return from these particular spawning stocks.

5. There was general expectation that the sockeye return to the Skeena would be of reduced proportions, reflecting the destruction caused to the spawning stocks of 1951 by the Babine rock-slide. Actually the run proved to be even smaller; it amounted to slightly more than 300,000 fish, the smallest on record. Special regulatory measures enabled slightly more than one-half of this quantity to reach the spawning-grounds, two-thirds of which passed through the Babine counting-fence en route to the Babine spawning areas. The Babine spawning stock reached its destination in good condition, indicating no difficulty or delay at the point of the 1951 slide or elsewhere.

6. Further advances in effectiveness and efficiency in fishing effort and techniques were again recorded. They necessarily must be taken into consideration in our future administration requirements. These included fairly general installation of power block gear for handling salmon-seines, a tremendous addition in seining efficiency; further trend in use of drum seines; further trend to improve the size and capability of gill-net fishing units, bringing about wider range of operations and further tending to displacement of

small inside-type gill-net units; doubling the production of gill-net units on the Skeena in river pink-fishing by the use of fine-thread gill-nets (spider web).

7. Important aids to salmon-spawning migration were brought into effect at several points during the year. Concrete and steel fishways were built at Stamp Falls to assure passage of important spawning runs of the Somass system. At Skutz Falls in Cowichan River, construction of a new ladder had progressed sufficiently to enable passage of excellent runs of cohoe and spring salmon, and since then the structures have been fully completed. Chum salmon were successful in passing Skutz Falls for the first time. At Kajusdis Creek in Bella Bella area, fishway facilities commenced late last year were completed early this summer in time to permit passage of good runs of sockeye and cohoe. A point of difficult passage is now entirely eliminated.

8. The problem of protection and preservation of our salmon-fisheries in association with the Province's current great industrial expansion and multiple water-use demands is becoming increasingly acute. More and more attention by the Department's forces generally and its technical personnel in particular—fishery engineers and biologists—in collaboration with technical staffs of Fisheries Research Board and the International Pacific Salmon Fisheries Commission is being required and is being given to this phase of the Department's responsibilities.

Sockeye.—It is noteworthy that the runs of sockeye to all the principal spawning areas were composed of fish of smaller size than usual; also aggregate volume was below normal in all sections with the exception of Smith Inlet area and the Chilco River, tributary to the Fraser system.

An unforeseen seasonal condition which contributed to reducing the number of spawners was a late high-water "block" in the Lower Fraser Canyon near Yale, which extended into the migration period of the early-run Fraser sockeye. It is estimated that 95 per cent of the early Stuart run and 50 per cent of the run to the Bowron system failed to effectively reproduce on account of the extended hold-up at this point. With the exception of the Chilco, Cultus Lake, and Weaver Creek systems, supplies in all other sections of the Fraser were below brood-year levels.

Mainly as a result of the rock-slide in the Babine River in 1951, which resulted in the destruction of two-thirds of the escapement to the Babine system or the equivalent of 50 per cent of the entire Skeena supply, the return to the Skeena, as expected, was much below normal.

The run of sockeye to the Rivers Inlet area did not equal expectations, notwithstanding substantial spawnings in this sub-district in 1950 and 1951. The returns from these brood-years were disappointing, and the escapement, although very good in some individual streams, was generally light to medium. In the Smith Inlet area, spawning was heavy, while at Bella Coola, although the escapement in numbers was about normal, 65 per cent of the spawners were jacks.

On Vancouver Island the escapement to the Nimpkish system was below average, while in the Somass system the supplies were light.

Springs.—Spawning stocks of this species over the Province were well maintained. The escapement to the Fraser watershed was up to average in the Quesnel, Kamloops, Chilliwack, and Harrison areas, but somewhat below normal at Tête Jaune in the Fraser, as well as in the Nechako. Spawning in District No. 2 was also satisfactory, moderate to heavy in all spawning areas, including the Owekano system at Rivers Inlet. Along the east coast of Vancouver Island and the Mainland opposite, all spring-salmon streams were generally well supplied, with the exception of Salmon River flowing into Johnstone Strait, where spawning was light, and in Cowichan River, where stocks were fair. On the west coast of Vancouver Island, the Barkley Sound and Quatsino area streams were lightly supplied, while stocks in the Nootka area were fairly satisfactory.

Cohoe.—Supplies of this species were generally satisfactory in all sections north of the Seymour Narrows, with the exception of the Butedale area, which showed marked

decline. In the other coastal areas south of Seymour Narrows and along the west coast of Vancouver Island, supplies were generally fairly light, exceptions being Cowichan and Kyuquot areas, which were well supplied, and Pender Harbour sub-district, where stocks were satisfactory.

In District No. 2, spawning in the Bella Coola area was heavy; in the Queen Charlotte Islands areas, moderate to heavy; and in all other areas, with the exception of the Butedale area, moderately good. In the Butedale area there was generally marked decline, exceptions being the Laredo and Aristazabal sections. In District No. 3, spawning in the Seymour Inlet area was excellent; supplies to the Alert Bay area were above average; the best for some years in the Cowichan River; satisfactory in the Pender Harbour area; and heavy in the Kyuquot sub-district. Stocks in the Quathiaski and Comox sub-districts were fairly good, and very light in the Nanaimo-Ladysmith, Nootka, and Quatsino areas. Barkley Sound streams were lightly supplied, with the exception of Toquart and Maggie Rivers.

In the Fraser River system, marked increases over the brood-year were noted in the Kamloops, Yale-Merritt, Mission-Harrison, and Chilliwack areas. In the Lower Fraser area, although the escapement was fairly good, flood damage to early spawning as a result of the storm at the beginning of November was heavy. Supplies in the Squamish area, estimated at 16,000, were about 25 per cent of the heavy escapement in 1952, and it is estimated that 30 per cent of spawn deposited was lost in the November floods.

Pinks.—With the exception of the Fraser and Skeena systems as well as Mainland portions of the Bella Bella, Alert Bay, and Quathiaski sub-districts, spawning supplies were comparatively light and very similar to the escapement in the brood-year 1953.

The combined catch of pink salmon bound for the Fraser system by Canadian and American fishermen was some 1,000,000 pinks less than the 10,500,000 pink-catch of 1953. A feature was a further increase in supplies passing through Hells Gate fishways to upper spawning-grounds. These included stocks estimated between 150,000 and 200,000 observed spawning in the Thompson River between Thompson Rapids and Kamloops Lake, also larger stocks noted in the Nicola system. Stocks in the Seton system were estimated to be in excess of 75,000. Supplies escaping to the Lower Fraser area compared favourably with the brood-year spawning, exception being the Harrison River, where the seeding was down by 50 per cent. The pink-salmon spawning in Lower Fraser and Lower Mainland sections was drastically reduced as a result of floods and erosion on November 2nd and 3rd following record rainfall. Saving factor is that a larger percentage than usual of this year's Fraser spawning escapement reached points above Hells Gate Canyon outside the range of the storm effects.

There was an excellent escapement to the Skeena watershed. Noteworthy is the continuing expansion of the aggregate number of pinks passing through the fishway at Moricetown Falls into the Bulkley system. Spawning in the Bella Bella area was moderately heavy and in the Nass area generally light, with the exception of Ikginik, Tseax, and Dogfish Creeks, where supplies were good. In all other principal pink-spawning areas supplies were light, comparable to the brood-year.

In District No. 3 the escapement to the Mainland streams of the Alert Bay and Quathiaski sub-district was good. This was the off-year for pink salmon in the Vancouver Island section of these areas. In the Comox area, supplies, although fairly substantial, were below brood-year levels. Spawning in the Pender Harbour sub-district, which was 30 per cent lighter than the moderate to heavy spawning in 1953, was drastically reduced as a result of the November flash flood.

Chums.—With minor exceptions, the spawning of chums was the lightest on record, notwithstanding special conservation measures in the way of much earlier seasonal closing dates. In District No. 2, Naden Harbour supplies were satisfactory, while the stocks in the Bella Bella area were light to medium. In all other sections the supplies

were very light and much below brood-year levels. In District No. 3, spawning in the Alert Bay sub-district was light, somewhat less than in 1951. Supplies to the Nimpkish were satisfactory. In the Cowichan sub-district, spawning was fairly good, but below brood-year levels. Elsewhere supplies were generally light to very light and much below those of the brood-year. In the Fraser area the escapement from the early runs was good in practically all sections. The late run, however, was light and disappointing. Here again flood damage resulting from the storm of November 2nd and 3rd caused extensive damage to the early spawning. Some damage also resulted to the moderately good supplies in the Squamish system.

IN DETAIL

Masset Inlet and North Coast of Graham Island Area

The usual small run of creek sockeye was somewhat lighter than for several seasons. The escapement of cohoe generally was mediocre, with the exception of Naden River, which had an excellent seeding. This was the off-year for pinks in Masset Inlet and Naden Harbour. Hiellen River, flowing into Dixon Entrance, however, was moderately seeded. Chum-supplies were generally light in Masset Inlet, with the exception of Awun River, which had approximately 10,000 spawners. Stocks of this species in Naden Harbour were very satisfactory. Fishway construction at the falls in Naden River to assist salmon in reaching available spawning-grounds located above this obstacle was commenced, and it is expected that this project will be completed before the 1956 migration commences.

Skidegate Inlet and West Coast of Graham-Moresby Islands Area

Medium to heavy runs of cohoe spawned in Copper and Tlell Rivers as well as in all Skidegate Inlet spawning areas. Streams on the west coast of Graham and Moresby Islands received only a light seeding. The off-year runs of pinks to the Copper and Tlell systems were exceptionally good, but very light to Skidegate Inlet and Rennell Sound streams. Returns of chums throughout the area were disappointing. Deena, Slatechuck, Long Arm, and North Arm Creeks in the Skidegate Inlet area had the best showing. On the west coasts of Graham and Moresby Islands the escapement was light to negligible in all streams.

East Coast of Moresby Island and South Queen Charlotte Islands Area

Cohoe-supplies were very light, comparing unfavourably with the moderate to heavy brood-year spawning. This was an off-year for pinks. Mathers and Pallant Creeks, Salmon River, and Atli Inlet streams, however, received vey light seedings. The escapement of chum salmon was negligible in Selwyn Inlet and very light for the remainder of the area, many streams having only 50 to 100 spawners, where up to ten times this number appeared in previous years.

Nass Area

Notwithstanding the satisfactory escapements of sockeye to the Nass area in brood-years 1950 and 1951, supplies to the Meziadin system, the principal producer of this species, were again light for the third consecutive year, and spawnings in all other sockeye areas were also light, with the exception of Gingit River, which had a near-adequate seeding. Generally a light to medium spawning of spring salmon occurred, with moderately satisfactory stocks being found on the Meziadin grounds. There was a good medium escapement of cohoe over the entire area, showing satisfactory improvement over the brood-year 1952. Stocks of pinks were generally light and somewhat less than the inadequate supplies in brood-year 1953. The Ikginik, Tseax, and Dogfish Bay Creeks, however, experienced good seedings and appeared to supply most of the season's commer-

cial catch. A completely inadequate escapement of chums occurred over the entire area, with even the ever-prolific Toon River having few spawners. This very light escapement contrasted sharply with the heavy seedings of this species in 1951 and 1952.

Skeena Area

Babine-Morice Area.—The anticipated below-normal run of sockeye to the Skeena River from the light seeding in 1951 in the Babine system, the principal producer, resulting from the "block" in the Babine River that fall caused by the large rock-slide, materialized. The escapement to this watershed was correspondingly light, being about 20 per cent of that in normal years. Fifteen Mile, Pierre, Twin, and Sockeye Creeks, which receive early runs, had light to medium seedings, but in all other streams of the system the numbers of sockeye were small. Total unrevised figures of salmon passing through the counting-fence established just below the outlet of Babine Lake for 1955 were as follows: Sockeye, 101,976; springs, 3,528; pinks, 2,151; cohoe, 8,947; chums, 3.

Spring-salmon supplies were generally larger than in 1951. Babine River received a fair seeding. The cohoe run was very good, and all spawning areas received good seedings.

Numbers of sockeye in the Bear Lake area were small and much the same as the the cycle-year. The spring-salmon spawning in Bear River was good and compared favourably with the cycle-year, with an estimated 15,000 to 20,000 of this species noted on the grounds. The pink escapement to the Bear River was light but showed some improvement over the brood-year. Cohoe were seen at the mouths of streams flowing into Bear Lake, but while not on the spawning-grounds at the time of inspection, it was considered that sufficient numbers were present to assure a good spawning of this species. The sockeye escapement to the Nanika River, estimated at 3,500, is one of the lightest on record. This very light escapement contrasts sharply with the 1951 brood-year escapement, which was estimated at 55,000. Spring-salmon supplies in the Morice and Upper Bulkley Rivers, estimated at 8,000, although showing improvement over the brood-year, was considered light. The escapement of cohoe was about average. Noteworthy is the expansion in volume of pinks passing through the fishway at Moricetown Falls to spawning-grounds in the Upper Bulkley watershed. Dead pinks were recovered at many points along the Bulkley River and Morice River from Moricetown Falls to Owen Creek, located some 16 miles up Morice River.

Skeena-Lakelse Area

Sockeye stocks were generally light, all spawning areas showing a decrease from the 1951 brood-year. Supplies in Allistair Lake were slightly less than those of brood-year 1951, while the Kispiox, Kitsumgallum, and Lakelse Rivers showed definite decreases. The over-all spring-salmon escapement was good. There was a better than average showing in Kitsumgallum and Copper Rivers, while a run of about 10,000 spawned in the Kispiox River. The run of cohoe was average over the area. About 10,000 of this species spawned in the Kispiox River. Good numbers were present in all other streams. Pink-supplies were heavy compared to brood-year 1953. Lakelse and Kitwanga Rivers and smaller streams accounted for about 380,000 spawners, while roughly three-quarters of a million were scattered over the lower 70 miles of the Kispiox River. The chum run was light in all areas. Supplies were estimated at less than 25 per cent of those of the brood-year.

Lower Skeena Area

The sockeye-seeding in Diana, Shawatlans, and Ecstall Rivers in the Lower Skeena area was fair, but not as good as that of the cycle-year, 1951. The spring-salmon spawning was good and equal to the seeding of cycle-years. The escapement of cohoe to all streams was satisfactory and showed improvement over brood-year 1952. Pink-supplies

were good and somewhat greater than those of 1953. The run of chum salmon to the spawning-grounds in this area was light, considerably lighter than that in the parent year, 1951.

Grenville-Principe Area

The seeding of sockeye in the majority of the streams and lake systems was light and about on a par with that of the cycle-year, 1951. Numbers in the major producers, such as the Mink Trap, Mikado, Bonilla, and Lowe Inlet systems, were particularly light and disappointing, while the supplies in the Endhill, Quinstonsta, Curtis, and Lewis systems were moderate. The cohoe escapement to the majority of the streams was medium and generally better than in 1952. Good runs occurred in Quinstonsta Creek and Endhill Creek on Banks Island, as well as in the Lowe Lake system. Supplies of pinks were generally light and similar to that of brood-year 1953. As in the parent year, the seeding in the northern portion of the area, including Kitkatla Inlet, Ogden Channel, and West Principe Channel, was better than the spawning in the southern part of the area, such as streams on Gil Island and in East Principe Channel and East Grenville Channel. The chum run was almost a complete failure. Of forty-two chum-producing streams, twenty-five had seedings less than those of the parent year, four had spawnings similar to those of 1951, while four streams showed some increase. The commercial catch of 18,180 chums was the smallest for the area since 1931, and only 22 per cent of that taken in the cycle-year, 1951.

Butedale Area

Sockeye-supplies were light, considerably less than those of the brood-year. Runs to Douglas Channel, Kitimat Arm, and Gardner Canal all showed a decline, especially the run to Kitlope River, the main sockeye-producer. Laredo Channel and Aristazabal Island received similar or improved escapements compared with 1951. The over-all escapement of cohoe was light to medium in the Mainland rivers, although the runs were not excessively fished due to special conservation measures. Spawnings did not exceed those of the brood-year, and in many rivers showed a marked decline. The only streams in the area which had increased spawning stocks were those on Aristazabal Island and in Laredo Channel. The pink-spawning was again very light and unsatisfactory in spite of early closures to the northern portion of the area. The escapements to Douglas Channel, Kitimat Arm, Kildala Arm, Devastation Channel, and Gardner Canal were extremely light and similar to those of the brood-year. Even in other portions of the area from which the major portion of the pink-catch was taken, the escapement was below that of the parent year and showed some increase only in several Aristazabal Island streams. The escapement of chums was extremely light, considered to be one of the lightest the area has ever experienced, notwithstanding early closures of fishing taken in an effort to conserve spawning supplies. An indication of the size of the run is obtained from the fact that the catch was only 10 per cent of that in the cycle-year, 1951. The seeding of spring salmon in the area was average.

Bella Bella Area

Sockeye-supplies were moderate and somewhat better than that in 1951. Good supplies were observed in the Tinkey River system, while in Kajusdis River the largest spawning of this species ever reported occurred. There was a medium spawning of cohoe, which compared favourably with the parent year. Kajusdis River, the main producer, had an excellent spawning. The new fishway completed at the falls near the mouth of this stream eliminated any hold-up of spawners at that previously difficult point. The smaller streams realized fair to good escapements. The seeding of pinks was medium heavy and showed an increase over the cycle-year, 1953. The run to the area in 1955 was good and the catch twice that of 1953. Kainet River, the largest pro-

ducer, had some 110,000 spawners, while other streams in the district had fair to good seedings. Chum-supplies were light to medium but showed an increase over 1951. Kainet River had some 60,000 spawners, twice as many as in the brood-year, while Neekas River had medium to heavy supplies. Good supplies were noted in Howyet, Kwakusdis, Noota, and Gullchuck streams, and other smaller streams in the district had good seedings.

Namu-Bella Coola Area

The sockeye-spawning in the Bella Coola-Atnarko system, the principal producer, was heavy in numbers, but some 65 per cent of the spawners were runts. Supplies in Kimsquit River were medium, and light to moderate in the smaller sockeye-streams. Generally the cohoe-spawning was heavy. Supplies to the Bella Coola-Atnarko system and the larger streams were much better than those of the brood-year. Pink-spawning was light and less than that of the parent year, notwithstanding special conservation measures at the peak of the run. The escapement to Bella Coola system, the main producer, was poor, while Kwatna and Koeye Rivers had fair spawnings. Stocks in the smaller streams were mostly light. The over-all seeding of chums was light. The runs to the area were light and far below those of the brood-year 1951, in spite of the fact that an early closure was applied on salmon net-fishing. The spring-salmon run to the Bella Coola-Atnarko system was heavy.

Rivers Inlet Area

The over-all sockeye-spawning in the Owekano system was light to medium. Supplies in the Dallac showed an increase over the 1950 and 1951 brood-years, while good signs were noted on Whonock Flats at the outlet of Owekano Lake. Stocks in the Quap and Waukwash Rivers were similar to those of the 1950 parent year but below those of 1951. In the Indian and Gennesse Rivers, the supplies were less than those of the parent years, as was the case in the Nookins and Asklum Rivers. There were signs of a fair escapement to the Shumahalt and Markwell Rivers, but the run to Cheo River was light. In the Rivers Inlet area, where a special effort was made to evaluate the important spring escapement, sufficient spawned-out springs were seen to indicate that the ratio of spawning springs to the known catch could be considered satisfactory, compared with the same ratio existing for other varieties on other spawning-grounds. Supplies of cohoe were light, similar to the brood-year. Pink-supplies were light and down slightly from 1953. The escapement of chums from both the early and late runs was light and down markedly in all streams from that of the cycle-year, 1951.

Smith Inlet Area

The sockeye escapement to the Long Lake system was heavy. The Delebah and Geluck Rivers, which comprise the principal spawning-grounds, were both heavily supplied. Stocks of springs to Docee River were heavy. Cohoe-supplies were medium. Heaviest spawning was in the Wyclees Lagoon streams. There was a medium heavy escapement of pinks. Nekite River was heavily seeded. The chum run was light and below that of the brood-year in all streams.

Alert Bay Area

Stocks of sockeye were again generally below average throughout the sub-district and were comparable to the below average seedings in 1954. This was the case in the Nahwitti, Shushartie, Quatse, Adam, Fulmore, and Kakweiken Rivers. In Mackenzie River the numbers on the spawning-grounds were very satisfactory. There was also a satisfactory abundance of this species in the Klinaklini River. Stocks throughout the Nimpkish system were practically negligible, except in Woss Lake, where they were comparable to previous years. The run of spring salmon to Nimpkish River was very

satisfactory, and Klinaklini and Kingcome Rivers were again well stocked. Cohoe returned to the sub-district in above average numbers considerably greater than those of the parent year, 1952. A good run appeared in Nimpkish River, while seedings in Quatse and Keogh Rivers were very satisfactory. Salmon River in Seymour Inlet and Tsulton River in Beaver Cove supported excellent returns. In spite of generally poor pink-seedings in the cycle-year 1953, the return this year was very good. In the Mainland streams, returns were satisfactory, and in Glendale River pinks were present in outstanding abundance. Kakweiken, Waterfall, and Wakeman Rivers also supported heavy runs, while the return to Embley River, in spite of having been good for the past several years, was very poor this season. In Vancouver Island streams, where the off-year applied, seedings were generally light, with the exceptions of Keogh, Tsitika, and Adam Rivers, where medium returns occurred. The seeding of chums was light and somewhat less than that of 1951; however, medium returns were recorded in Quatse and Keogh Rivers of Vancouver Island and Kakweiken and Wakeman Rivers on the Mainland. With the exception of Salmon River, returns to Seymour and Belize Inlets were well below average. The Nimpkish River spawning was satisfactory.

Quathiaski Area

The sockeye escapement to Phillips River was considerably less than that of the brood-year, and in Hayden Bay Creek a very sharp decline occurred, though some increase over the past few years has been realized. The return of spring salmon to Campbell River was very good and slightly greater than that of the parent year. Salmon River, on the other hand, had a very light seeding. In Orford River the escapement was only fair, substantially less than that of 1950, but equalled that of 1951. In Phillips River the spawning was also only fair, better than that of 1950 but below that of 1951. The escapements of cohoe to the spawning-grounds were all below comparatively heavy supplies of the brood-year, with the exceptions of Apple River and Eva Creek, where slight increases were recorded. While a decrease was evident in Campbell River, it did compare favourably to the past two years. This was an off-year for pinks in Vancouver Island streams. However, on the Mainland the seedings in Phillips and Quatum Rivers were very good, with tremendous increases over the brood-year. Seedings in Cumsack Creek, Stafford River, and Homathko River were very light and less than those of 1953. Numbers of spawners in Apple River and Eva Creek were generally good, and fair in Orford River. Without exception, every stream in the sub-district showed a substantial decrease in the numbers of chums reaching the spawning-grounds compared to those of the brood-year, and the seeding in every stream was exceptionally light.

Comox Area

The run of springs to Little Qualicum River was five times that of 1951, when only 300 of this species spawned in that stream. The escapement to Big Qualicum River was also good and triple that of 1951. The run to Puntledge River was about equal to that of the parent year, with 6,000 springs on the spawning-grounds. Construction of the power project of the British Columbia Power Commission on Puntledge River continues, and close liaison is being maintained with Commission representatives to assure that the fisheries aspects are fully protected. The run of cohoe to all streams in the area, with the exception of four, was well below that of the brood-year, and in many cases was only 25 per cent of that experienced in 1952. The escapement to Oyster River was estimated at 13,000, compared to 25,000 in 1952, while the run to Big Qualicum River was 3,500, compared to 5,000 in 1952. This year's run of pinks to Tsolum River was about equal to that of 1953, when 40,000 spawned in this stream. There were about 16,000 spawners in the Puntledge, compared to 10,000 in the cycle-year. The run to Oyster River was about one-third that of 1953, when 12,000 of this species were found on the spawning-

grounds. Light runs to Englishman, Little Qualicum, and Tsable Rivers were slightly greater than those of the parent year. The run to other pink-streams in the sub-district was poor. Generally the escapement of chums was below that of 1951, with supplies in the two main producers, the Big and Little Qualicum Rivers, being very short. The seeding in the Puntledge River was just short of that of the brood-year. A heavy late run entered this stream. Baynes Sound streams, Englishman River, and Oyster River were lightly stocked, while Nile Creek showed some slight improvement over the brood-year.

Pender Harbour Area

A favourable sockeye-salmon run to Sakinaw Lake developed, with 5,079 spawners tallied through the Sakinaw Dam fishway, compared to 3,451 in 1951. Toba River and tributaries received normal quantities of spring salmon, while a medium seeding of this species occurred in Tzoonie River, Sechelt Inlet. Generally the cohoe escapement was satisfactory, with Toba Inlet streams and Theodosia River receiving good medium seedings. Medium supplies were also observed in Deserted Bay, Tzoonie River, and Sakinaw Lake, with light to medium stocks observed elsewhere in the sub-district. The pink-salmon spawning in Toba Inlet streams was approximately one-third lighter than the satisfactory pink-seeding in the parent year, 1953. A very light early seeding in Jervis Inlet streams showed some improvement following a boundary movement there and a closure in the Johnstone Strait area, and a medium spawning subsequently occurred in the Squawawka River, with a light to medium seeding observed in Deserted Bay River, while the escapement to Vancouver Bay River was very favourable. Jervis Inlet pink-salmon streams received a drastic set-back as a result of the phenomenal floods of early November, which scoured the stream-beds and did heavy damage to spawn deposition. The chum escapement was the lightest of the past decade, with the early seedings receiving a serious set-back due to the early November flash flood referred to previously. Seedings in later streams, such as Saltery Bay, Sliammon River, and Tzoonie River, escaped the worst effects of the floods.

Nanaimo-Ladysmith Area

The run of spring salmon to Nanaimo River compared favourably to that of the brood-year and was slightly better than average. The escapement of cohoe was very disappointing, with virtually no early-season migrants and late runs not arriving in any good quantity. Seeding of the main streams was only fair, and escapements to the smaller creeks poor. The small pink run to Nanaimo River failed to equal that of the brood-year. The chum-spawning was less than one-third that of the brood-year. There was little or no early escapement, and subsequent runs did not occur in any appreciable volume. Fair numbers appearing in the principal rivers early in November were practically decimated by extreme flood conditions, which also had severe effects on the previous light seedings in all streams.

Cowichan Area

The cohoe run to the Cowichan and Koksilah systems was the best for some years, and it is estimated that approximately 70,000 spawned in these systems this year. The spring-salmon escapement was below average; it is estimated that 6,000 to 8,000 of this species entered the Cowichan system. The escapement of chums to Cowichan River was fairly good, though not up to that of the brood-year. A fair escapement of this species was also noted in the Koksilah River.

Victoria Area

Generally the seeding of cohoe was light. The chum-salmon escapement was very good to Sooke River, Stoney Creek, and De Mamiel Creek; it is estimated, however, that 75 per cent of the spawn deposition in these streams was destroyed by the November flash

flood. Supplies were light in Coal and Tugwell Creeks. The early run to Goldstream was light and disappointing, though some improvement resulted from later runs.

Alberni-Nitinat Area

The sockeye escapement to the Somass system this year was light and much below that of the brood-year. The Great Central Lake run was estimated at 8,000 to 10,000, while that into Sproat Lake was 10,000 to 15,000 fish. Stocks at Anderson Lake were again very good and slightly larger than those of the parent year. Spawners in Hobarton Lake were light in number, despite an early closure and an almost negligible commercial catch. The seeding of spring salmon was, on the whole, light, with runs of this species to the San Juan, Gordon, Sarita, Toquart, and Effingham Rivers not too satisfactory. The escapement to Nahmint River was fairly good. Good supplies reached the Somass River. The cohoe escapement was light to all streams, with the exception of Toquart and Maggie Rivers, which again had a good supply of this species. The chum escapement was in general very light, although there was a fair seeding in a few of the smaller streams. Grappler Creek and Hobarton River were the only two streams in the sub-district with good escapements of this species.

Clayoquot Area

The escapement of sockeye to the Kennedy Lake system was very fair, much better than anticipated. Runs of creek sockeye to Megin and Cecilia Lakes were light. The light spawning of spring salmon throughout the area was about average. The seeding of cohoe was generally fair. This was an apparent reflection of the good escapement in 1952. It was noted that the average size of these fish was smaller than usual, with a large number of jacks being present. A few pinks spawned in the Megin River. The spawning of chums over the area was generally very light. Atleo and Tranquil Rivers had satisfactory escapements of this species. Supplies to Sidney Inlet were very light.

Nootka Area

The escapement of creek sockeye to the few streams frequented by small runs of this species was comparable to that of the cycle-year, with a fairly good showing in Muchalat Lake and the streams feeding and draining that body of water. The spring-salmon spawning was considered fairly satisfactory and considerably heavier than that for 1954. No pink salmon were observed on spawning-grounds in the area, 1955 being an off-year for this species. There was generally an extremely light escapement of cohoe. Stocks of chums were light and well below the brood-year totals. A number of streams in widely separated localities received a fair seeding from very late runs. The early portion of the chum run, which generally appears in September and October and which is a major contributor to the commercial fishery, failed to appear in quantity.

Kyuquot Area

Power River and Lake had normal small runs of creek sockeye similar to those of 1951, while supplies in Jansen Lake were lighter than those of the brood-year. Stocks of spring salmon to local rivers were lighter than usual and slightly less than those of the brood-year. A very heavy run of cohoe arrived in the sub-district, and in most cases a fair increase over the parent year was noted, and in some rivers the run was phenomenal. These fish were smaller than last year's, and the number of jacks was greater than usual. The seeding in Malksope, Kaoowinch, Jansen, and Amai Rivers was particularly heavy, and runs to Power Lake, Clanninick River, and Artlich River were very good. The only failures occurred in two very small streams and in Chamiss River, where the cohoe-run has never been particularly heavy. The escapement of chum salmon to local spawning-grounds was very light. In Tahsish, Chamiss, Malksope, Kaoowinch, and Amai Rivers,

the seedings were similar to those of the poor years 1951 and 1954. In the streams where regular spawning of this species is 2,000 to 5,000, the average 1955 spawning was 400 to 800 fish.

Quatsino Area

Generally sockeye-salmon escapement was light, with the exception of Mahatta River, where fair supplies were present. The run is of little commercial importance. Spring-salmon stocks were light this year and below those of previous years. The cohoe-salmon escapement was extremely light, with some streams experiencing no spawning of this species at all. Notable in the lack of cohoe were Koprino and Ingersoll Rivers and Dominick Creek. The only known exception was Spruce River, which had approximately 2,500 cohoe salmon on the spawning-grounds. Supplies of chum salmon were extremely poor, and in some streams a failure. Small escapements occurred in San Josef, Klaskish, Marble, Rupert, and Koprino Rivers. Spruce River had a fair seeding of this species. This was an off-year for pinks, and only in the San Josef River were a few observed.

Fraser River-Prince George Area

The number of sockeye reaching the Stuart Lake system was extremely light. This run was held up by high turbulent water in the lower reaches of the Fraser Canyon near Yale, caused by the unusual late spring run-off, and the first sockeye did not arrive at Stuart Lake until August 3rd, about eighteen days later than normal. Thousands died along the migration route, and it is estimated that only about 5 per cent of the spawning supply of salmon got through to their spawning-grounds. The late Stuart Lake run arrived at the lake on September 3rd, almost two weeks later than the arrival time in 1951, but this late run showed increase over the parent year. The total number of sockeye observed spawning in the Stuart Lake system was some 9,780 fish. Of this, 2,160 were early-run fish and 7,620 were late-run salmon. In 1951, the brood-year, the early run numbered some 61,300 fish and the late run 1,800 sockeye.

Stocks in the Fraser-Francois system totalled some 52,896 sockeye, a decrease from 96,800 in 1951. The run to Stellako River commenced to arrive in Fraser Lake August 29th, the peak period being September 14th to 18th. The spring-salmon run to the Tête Jaune area of the Fraser River was about 50 per cent of last year's run and estimated to be from 4,000 to 5,000 fish. Water from the Cheslatta reservoir was again released in August and September to assist spring salmon in the residual Nechako River above Fort Fraser. Numbers on the spawning-grounds amounted to somewhat more than 500, which is less than the brood-years. The run to Stuart River was about equal to that of the parent year, 1951. Spawning conditions were generally fairly good, although some streams were below average in water-level.

Fraser River

Quesnel-Chilko Area.—The sockeye runs to the Chilko system, estimated at 128,000, showed an increase of about 15 per cent over the brood-year of 1951. There was a 20-per-cent predomination of females, and 8 per cent of the total were jacks. There was an unusual variation in distribution on the Chilko spawning-grounds this year, with a lighter concentration in the fast water and a much heavier density of spawners in the more quiet waters. Returns to Taseko River and Lake showed some increase over the brood-year. As the Horsefly River was almost barren in 1951, few sockeye were expected this year, and thirty-five to forty fish were counted on the spawning-grounds. No sockeye were observed in the Mitchell River this season, the brood-year also being barren. Returns to the Bowron system, numbering 9,364, were less than half those of the parent year. This run was also partially blocked in the lower reaches of the Fraser Canyon, and losses were serious. The peak of the run, however, reached the grounds only several days later than in 1951. It was expected, in view of the delayed arrival, that considerable mortality

would occur before spawning, but only the usual few unspawned dead fish were found. Conditions for spawning in this system were very good, with normal water-levels and favourable temperatures. While there is no known history of sockeye runs to San Jose River, a small run arrived there about August 7th. Spawning eventually occurred in this stream, with a total of 130 fish being counted. The spring-salmon run to the Chilko River was slightly heavier than that of the brood-year, slightly below average in the Quesnel system, and normal in the Bowron system.

Kamloops Area.—In general, sockeye-spawning in all areas of the Kamloops sub-district showed a marked decrease when compared with the cycle-year. Migrations of sockeye to the Shuswap Lake area were, for the most part, somewhat lighter than the brood-year. The Adams River run totalled some 55,000 spawners, of which a very marked percentage were jacks. Approximately twice this number seeded Adams River during the brood-year. The Raft River sockeye population, totalling slightly over 5,000, was considerably lighter than in the brood-year. The Seymour River migration of almost 10,000 fish was also considerably lighter than that of the brood-year. The spawning in these last-mentioned streams occurred in water conditions which were slightly below normal. Spring-salmon supplies in the North Thompson River watershed were comparable to those of the brood-year, and inspections indicate that approximately 10,000 spawned in this stream. The run to Upper Shuswap River showed an increase of 100 per cent over the parent year and numbered approximately 2,000 spawners, and the supplies to Adams and Little Rivers totalled 1,500 fish, which was about double that of the cycle-year. The seeding of cohoe was good, showing a sharp increase over that of the brood-year, particularly to tributaries of the North Thompson River, where an increase of approximately 50 per cent was recorded. The greatest increase was apparent in Louis Creek, where over 7,000 cohoe spawned successfully, compared with less than 1,000 in 1952. Runs to the South Thompson and Shuswap Lake area were very similar to the North Thompson runs in numbers, and in most instances there was a decided increase over the parent year. The total of all cohoe runs to the area represents an increase of approximately 40 per cent over 1952. Expansion of the volume of pink salmon passing through the fishways at Hells Gate to upper spawning areas was again evident. Although there is no adequate basis for comparison of this year's migration of pinks, a run of considerable proportion spawned in the main channel of the Thompson River from Thompson Rapids to Kamloops Lake, and it is estimated that this run totalled between 150,000 and 200,000 fish. Bonaparte River and Deadman Creek, which were seeded by pinks in 1953, were, with the exception of a few spawners, virtually barren this year due to low-water conditions.

Lillooet Area.—The sockeye run in the Birkenhead River this year was small and is estimated to be approximately one-half of the brood-year. Jack sockeye composed about 15 per cent of this run. In the Seton-Anderson system, runs were small and similar to those of the brood-year. Some early Stuart Lake sockeye, held up by high water in the Lower Fraser Canyon, were observed using Seton Creek. These fish were in an advanced condition. Stocks of spring salmon in Birkenhead were about average, the same as the parent year. A small number of this species, estimated at fifty, were observed in Seton Creek, with the same number on the spawning-grounds in Portage Creek. A few springs were observed in the Yalakom River during the year. The cohoe run to Birkenhead was light this year, estimated at 2,000, as compared with 20,000 in the brood-year. Pinks again spawned in large numbers in Seton Creek, the run there being estimated in excess of 75,000. Only 500 were observed in Portage Lake, while in 1953 approximately 10,000 of this species spawned in that stream.

Yale-Merritt Area.—The spring-salmon spawning in the Nicola River and tributaries was on a par with that of the brood-year, with a slight increase apparent in Coldwater River. It is estimated that 10,000 adults spawned in the system, with 80 per cent of this number seeding the Nicola River. Stocks in the Nahatlatch River were light. The

escapement of cohoe salmon showed a marked increase, with numbers in many instances double and triple those of the parent year. The increase in Coldwater River and Spius Creek was marked, and in Nicola River, where the spawning has previously taken place in the section just below the lake, distribution of spawners extended for a distance of some 30 miles down-stream. The escapement of pink salmon to the sub-district showed an increase over the brood-year, with approximately 5,000 of this variety in Nicola River. The distribution of pinks was heavier in sections of the river removed from the unsuitable area at the river-mouth.

Chilliwack Area.—The sockeye escapement to Cultus Lake was excellent this year, with 25,500 counted through the fence, in comparison with 13,000 in 1951. Small numbers were also observed in Chilliwack River and Kawkawa Lake. It is estimated that 700 springs spawned in Chilliwack River, as well as a few near the mouth of Slesse Creek. This year's cohoe run to the Chilliwack-Vedder system compared favourably with that of the brood-year, when an estimated 18,000 to 20,000 spawned in the Chilliwack River. All smaller streams in the area supported their customary light runs. An estimated 100,000 pinks spawned in the Chilliwack River and 15,000 in the Vedder River this year. The run to Sweltzer Creek dropped off sharply, with 6,500 on the spawning-grounds, compared to 30,000 in 1953 and 60,000 in 1951. There was also a noticeable decrease in the spawning of this species in Coquihalla River, Silver Creek, and Succer Creek. This same condition applied in Jones Creek, where only 450 pinks entered the stream, compared with 3,000 in 1953 and 10,000 in 1951. A severe flash flood in early November completely changed the course of the Lower Chilliwack and Vedder Rivers in many sections, destroying much of the spawning-beds. However, pinks that entered the Vedder after the floods provided a fair seeding in many of the newly formed side channels, and the estimated over-all loss of pink spawn in the Chilliwack-Vedder system now stands at 30 per cent. Chum-spawning was disappointing throughout the area. Fifteen thousand of this species entered the Chilliwack-Vedder system, and this run suffered heavy losses during the November flood but, unlike the pink run, did not benefit by late seeding in the newly formed channels as the customary late run of chums was almost non-existent. Four thousand one hundred chums entered Sweltzer Creek this year, while in 1951 this stream supported 15,000 of this species. The runs to Succer and Luckakuck Creeks were also below normal.

Mission-Harrison Area.—The most important sockeye run to the area in 1955 was the very fine run to Weaver Creek, where an estimated 25,000 sockeye spawned, compared with 10,000 in the parent year. However, due to flood damage it is estimated that half of the spawn depositions were lost. The run of this species to Harrison River was double that of 1951, which was estimated at 10,000, while in Big Silver River the escapement was very light again this year. Runs to Hatchery and Douglas Creeks were light, and in other tributaries of Harrison Lake which have supported runs in past years, no sockeye were observed during the season. The cohoe escapement to the major streams was similar to or better than the satisfactory supplies of the parent year, while runs to the smaller streams were very light. It is estimated that 5,000 cohoe entered the Chehalis this year, which compares favourably with that of 1952. Stocks in Weaver Creek were good, but down to about 2,000 spawners from a brood-year escapement of over 3,000. The pink run to Harrison River was estimated at 50,000 spawners, compared with over 100,000 in 1953. Stocks in the Chehalis River were heavy and comparable to those of the parent year, but it is likely that up to 90 per cent of the redds were destroyed during the disastrous November floods. An excellent spawning of this species, considerably larger than that of the brood-year, took place in the Stave River. The runs to Weaver and Whonock Creeks showed some slight improvement, as did the escapement to Suicide Creek. The chum run to Chehalis River was good and exceeded that of the brood-year, but the loss of spawn due to November freshets was probably about 75 per cent. The escapement to Harrison River was little better than half that of the parent year, with

the early run being light and the late run poor. Stocks in the Stave River were good and showed a big improvement over preceding years. Other streams in the area had fair supplies, except Nicomen Slough, where stocks were very light.

Lower Fraser Area.—The escapement of sockeye to the Upper Pitt system and Boise Creek arrived toward the end of August and totalled 17,500 fish, down somewhat from the brood-year escapements of 1950 and 1951, of 42,000 and 38,000, respectively. The flash flood in early November destroyed an estimated 50 per cent of the Upper Pitt run and 25 to 30 per cent of the Boise Creek run. The only important spawning of springs in the area occurs in the Upper Pitt system, where it was estimated that up to 1,500 spawners were observed. Cohoe escapements to the Coquitlam and North and South Alouette Rivers were fair, but down from the brood-year. The spawning in Upper Pitt River was fairly good. The runs to the Nicomekel, Serpentine, and Campbell Rivers were good and compared favourably with those of the parent year. The cohoe-spawning areas of the Upper Coquitlam were badly scoured during the flood conditions of early November, and damage to the spawn probably was fairly heavy, while flood damage in the North and South Alouette Rivers was more moderate. Returns of pinks to the Upper Pitt River showed a marked drop from the brood-year. From 2,500 to 3,000 pinks spawned in the North Alouette River and 3,000 to 3,500 in the South Alouette River. Some 4,500 of this species were found in Kanaka Creek and 1,500 to 2,000 in the Coquitlam River. However, heavy damage to these spawning-grounds resulted during the flood of early November, and in the Coquitlam River it is estimated that as high as a 90 per cent loss of the pink spawn occurred. The early runs of chums which occurred in late September and early October appeared to be the best in some years, but the later runs which normally appear in mid-November and during December were very disappointing and in some cases almost non-existent. From 3,000 to 3,500 of this species were noted in Kanaka Creek and 1,500 to 2,000 in Coquitlam River. Early runs to the North Alouette and South Alouette Rivers were good, with 2,000 to 2,500 spawners in each stream. Silver and Nelson Creeks had poor runs, and escapement to the Upper Pitt was negligible and down considerably from the brood-year. Flood losses through flood damage were heavy, and the early run to the Coquitlam was all but wiped out.

Squamish Area

The spring-salmon run to the Squamish system was about the same as that of the cycle-year, when 16,000 were present. The cohoe run was much smaller, and in the Squamish River was only about one-quarter of the heavy escapement in 1952, and 30 per cent of that run was affected by the flood in early November. Supplies of pinks to the Squamish River system, estimated at 120,000, were considerably less than those of 1953, which were estimated at 200,000. The run to Howe Sound and Gulf of Georgia streams was abnormally small and much below that of the cycle-year. Stocks of chums were smaller than the moderately good supplies of the brood-year, and while some of the early runs to the Upper Squamish may have been affected by the November floods, the lower portions of the system were seeded later in the month and were therefore unaffected. In the Squamish and Cheakamus Rivers, numbers on the spawning-grounds were one-third to one-half those of the parent year.

North Vancouver Area

Escapement of cohoe to the Capilano, Seymour, and Indian Rivers was somewhat less than the satisfactory supplies present in the brood-year, 1952. The fish-trap facilities provided by the Greater Vancouver Water Board in the Capilano River below Cleveland Dam were in operation, and during the season 4,988 cohoe were trapped and trucked to a point on the river several miles above the dam, where they were released to migrate to their spawning-grounds. Stocks of pinks in these streams were for less than in 1953,

although Indian River was well supplied. Flood damage during November was high in the Capilano and Seymour Rivers. The return of chums to the area was far below that of 1951. In Indian River it is estimated up to 5,000 of this species were present, a considerable decline compared with the parent year. Considerable flood damage also resulted to the spawn deposits of this species in the Capilano and Seymour Rivers and Nelson Creek.

STATISTICAL TABLES

LICENCES ISSUED BY THE DEPARTMENT OF FISHERIES FOR THE 1955 SEASON

Kind of Licence	Number of Licences	Revenue
Salmon-cannery	20	$4,000.00
Herring-cannery	1	100.00
Pilchard-cannery	----	----------
Herring-reduction	15	1,500.00
Pilchard-reduction	----	----------
Tierced salmon	5	500.00
Fish cold storage	14	1,400.00
Fish-processing	17	17.00
Shell-fish cannery	9	9.00
Tuna-fish cannery	1	1.00
Fish-offal reduction	9	9.00
Fish-liver reduction	4	4.00
Whale-reduction	1	100.00
Pickled herring	----	----------
Herring dry-saltery	1	100.00
Processing aquatic plants	----	----------
Harvesting aquatic plants	----	----------
Fish-buyers'	511	12,775.00
Non-tidal fishing	239	243.50
Dogfish-reduction	1	1.00
General receipts	6	25.05
Total		$20,784.55

PACK OF BRITISH COLUMBIA SALMON, 1955 SEASON

(Showing the Origin of Salmon Caught in Each District (48-pound Cases))

District	Sockeyes	Springs	Steelheads	Cohoes	Pinks	Chums	Total
Fraser River	103,678¼	6,843½	269	15,910	160,187½	7,350½	294,238¾
Queen Charlotte Islands	433	16	5	11,666	548	9,420	22,088
Nass River	13,654½	1,028	99	9,356	29,040	8,904	62,081½
Skeena River	14,649	1,430	976½	14,192	86,788	5,471½	123,507
Rivers Inlet	50,702½	813	86	5,316½	8,658	5,588	71,164
Smith Inlet	28,864	326	20½	1,014½	2,275½	2,070	34,570½
Vancouver Island and adjacent Mainland	13,192½	5,534	63	101,349	421,355½	40,105	581,599
Central Area	19,648	1,864	318½	24,846	122,371½	45,950	214,998
Alaska	----------	----------	----------	2,030	31	----------	2,061
Cold-storage (1954) catch	----------	5	44½	511½	----------	3,430	3,991
Totals	244,821¾	17,859½	1,882	186,191½	831,255	128,289	1,410,298¾

NOTE.—10,544½ cases of bluebacks are included with cohoes (Vancouver Island); also included are 177 cases of sockeyes (minced), 277 cases of sockeyes (flakes), 50½ cases of cohoes (flakes), and 247½ cases of steelheads (smoked).

STATEMENT SHOWING THE TOTAL SALMON-PACK BY SPECIES FROM 1947 TO 1955, INCLUSIVE

	1955	1954	1953	1952	1951	1950	1949	1948	1947
Sockeyes	244,821¾	680,789	510,148	449,494½	428,299	408,026½	259,821	261,230½	286,497
Springs	17,859½	14,357	13,048½	9,279	13,698	9,233½	21,184	16,445½	10,025
Chums	128,289	582,124½	394,867	96,005	462,101	507,611	230,556½	511,404	486,615½
Pinks	831,255	337,062½	795,330	679,182	736,093	446,456½	709,987	321,721½	600,787½
Cohoes	186,191½	129,624	110,164½	67,438	313,674	123,629½	215,944	221,804	146,293
Steelheads	1,882	3,897½	3,030½	3,762	3,655½	3,227½	2,373	5,663½	3,260½
Totals	1,410,298¾	1,747,854½	1,826,588½	1,305,160½	1,957,520½	1,498,184½	1,439,866	1,338,271	1,533,478½

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

Total Packed by Districts in 1947 to 1955, Inclusive

	1955	1954	1953	1952	1951	1950	1949	1948	1947
Fraser River	294,238¾	563,807½	496,936½	151,147	268,233	139,721½	189,938	104,485	171,302½
Skeena River	123,507	136,500	117,406	221,306½	130,681	97,889	129,027	193,435½	79,718
Rivers Inlet	71,164	71,023	148,885½	105,040	148,996	172,107½	70,210½	72,117	168,935½
Smith Inlet	34,570½	23,548½	35,870½	43,562½	58,022	52,750	19,083	14,675	46,172
Nass River	62,081½	69,358½	66,510½	57,775	152,742½	57,961	58,336½	38,538½	29,450
Vancouver Island and adjacent Mainland	581,599	349,586½	671,981½	245,437	585,240	347,996½	538,370½	317,572	552,940½
Other districts	239,147	529,972½	338,432	475,066	612,482	623,609	431,498½	567,314	456,639
Cold storage	3,991	4,058	566	5,826½	1,124	6,150	3,402	30,134	28,321
Grand totals	1,410,298¾	1,747,854½	1,826,588½	1,305,160½	1,957,520½	1,498,184½	1,439,866	1,338,271	1,533,478½

TABLE SHOWING THE TOTAL SOCKEYE-PACK OF THE FRASER RIVER, ARRANGED IN ACCORDANCE WITH THE FOUR-YEAR CYCLE, 1895–1955

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	550,702	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	1952— 134,625	1953— 191,123	1954— 497,023
Washington	118,151	114,638	178,323	501,496
Total	263,472	249,263	369,446	998,519
British Columbia	1955— 103,678			
Washington	85,136			
Total	188,814			

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

Fraser River, 1947 to 1955, Inclusive

	1955	1954	1953	1952	1951	1950	1949	1948	1947
Sockeyes	103,678¼	497,023	191,123	134,625	145,231½	108,223	96,159½	64,823½	33,952½
Springs	6,843½	8,298	5,620	2,279	5,719	1,818½	9,889	2,955½	1,455
Chums	7,350½	45,444	26,921	8,480	35,530½	23,343½	6,763	20,209	16,475½
Pinks	160,187½	17½	204,421½	60	66,673	72	66,626	31	113,136½
Cohoes	15,910	11,948	15,480	5,500½	14,848½	6,025½	10,286	16,102	6,105
Steelheads	269	1,077	371	202½	230½	240	214½	364	178
Totals	294,238¾	563,807½	496,396½	151,147	268,233	139,721½	189,938	104,485	171,302½

Skeena River, 1947 to 1955, Inclusive

	1955	1954	1953	1952	1951	1950	1949	1948	1947
Sockeyes	14,649	60,817	65,003	114,775	61,694½	47,479½	65,937	101,267½	32,534
Springs	1,430	1,260½	1,174½	2,082	2,055½	1,758½	2,507½	4,018½	2,113
Chums	5,471½	23,135½	15,114½	4,638	14,778	10,969	4,896	11,863	8,236
Pinks	86,788	39,324½	29,884	89,314	30,356½	26,256	33,069½	50,656	13,190½
Cohoes	14,192	10,449	5,260	8,358	19,977½	9,781	21,333½	22,086½	21,600½
Steelheads	976½	1,513½	970	2,139½	1,819	.....	2,507½	3,544	2,044
Totals	123,507	136,500	117,406	221,306½	130,681	97,889	129,027	193,435½	79,718

Rivers Inlet, 1947 to 1955, Inclusive

	1955	1954	1953	1952	1951	1950	1949	1948	1947
Sockeyes	50,702½	50,639½	132,925½	84,297½	102,565½	142,710½	39,494½	37,665½	140,087
Springs	813	649	865½	865½	937½	619½	743	899½	475
Chums	5,588	12,352½	5,627	3,711½	11,842½	10,014½	11,819	11,486½	13,873
Pinks	8,658	2,581½	7,304½	12,469½	20,960	12,864	11,937	13,491	9,025
Cohoes	5,316½	4,669½	1,979	3,415½	12,146	5,736	5,978	8,143	5,182
Steelheads	86	131	184	280½	274½	163	239	431½	293½
Totals	71,164	71,023	148,855½	105,040	148,996	172,107½	70,210½	72,117	168,935½

Smith Inlet, 1947 to 1955, Inclusive

	1955	1954	1953	1952	1951	1950	1949	1948	1947
Sockeyes	28,864	18,937	29,947	34,834	49,473	42,435	13,189	10,456½	36,800
Springs	326	177½	176	367	174½	71½	159	186½	43
Cohoes	1,014½	868	615	1,466	3,259	397	785	929½	348
Pinks	2,275½	523	1,017	6,496	2,482	5,308	2,533	1,481½	1,054
Chums	2,070	2,992	4,015	315½	2,530	4,499½	2,361	1,521½	7,910
Steelheads	20½	51	100½	84	103½	39	56	99½	21
Totals	34,570½	23,548½	35,870½	43,562½	58,022	52,750	19,083	14,675	46,172

Nass River, 1947 to 1955, Inclusive

	1955	1954	1953	1952	1951	1950	1949	1948	1947
Sockeyes	13,654½	10,285	18,162½	29,429	24,405½	27,286½	9,268	13,181½	10,849
Springs	1,028	398½	527½	641	596½	798½	174½	416	398
Chums	8,904	15,965½	25,756½	13,112½	37,742	14,321	7,854	7,272½	8,925
Pinks	29,040	36,448	16,635½	13,016	70,880	12,582	34,324	8,565	5,047
Cohoes	9,356	6,024½	5,118	1,223	18,711	2,737	6,665	8,954½	4,075
Steelheads	99	237	310½	290½	407½	236	51	149	156
Totals	62,081½	69,358½	66,510½	57,775	152,742½	57,961	58,336½	38,538½	29,450

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

VANCOUVER ISLAND DISTRICT AND ADJACENT MAINLAND, 1947 TO 1955, INCLUSIVE

	1955	1954	1953	1952	1951	1950	1949	1948	1947
Sockeyes	13,192½	12,051	46,895½	24,252½	22,107	13,806	19,486½	9,981½	14,543
Springs	5,534	1,649½	3,115½	1,687	3,133	3,343	6,361½	6,622	4,942½
Chums	40,105	248,098½	124,840	24,039	105,458	125,833	51,629	147,227½	99,679½
Pinks	421,355½	32,913	439,173½	171,812	303,102½	132,016	361,783½	43,574½	355,992
Cohoes[1]	101,349	54,783	57,773	23,583	151,325½	72,871	98,958½	109,939½	77,684½
Steelheads	63	91½	184	63½	114	127½	151½	227	99
Totals	581,599	349,586½	671,981½	245,437	585,240	347,996½	538,370½	317,572	552,940½

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

QUEEN CHARLOTTE ISLANDS, 1947 TO 1955, INCLUSIVE

	1955	1954	1953	1952	1951	1950	1949	1948	1947
Sockeyes	433	107½	246	635	510	89	.....	20	.....
Springs	16	6½	1½	96	.....	48	.....	145	.....
Chums	9,420	83,805½	17,304	1,712	61,696½	148,669	24,852½	71,287	14,096
Pinks	548	105,123	811	178,959½	3,455	92,986	1,550	51,722	1,200
Cohoes	11,666	11,289	2,437½	4,168	22,579	9,021	8,141½	4,145	392
Steelheads	5	37½	6	19½	.....	15	.....	.....	.....
Totals	22,088	200,369	20,806	185,590	88,240½	250,828	34,544	127,319	15,688

CENTRAL AREA, 1947 TO 1955, INCLUSIVE

	1955	1954	1953	1952	1951	1950	1949	1948	1947
Sockeyes	19,648	30,858½	25,845½	26,583½	22,312	25,997	16,140½	23,246½	17,343½
Springs	1,864	1,645	1,568	1,261½	1,082	776	1,007	1,195½	514½
Chums	45,950	149,672	175,289	36,605	190,843½	164,884	116,292½	225,686	292,604½
Pinks	122,371½	118,538½	92,517	207,055	237,559	163,301	173,456	152,200½	101,241½
Cohoes	24,846	26,511	21,502	17,289	61,423½	17,061	44,169	36,816	28,778
Steelheads	318½	595½	904½	682	706½	762	355	850½	469
Totals	214,998	327,820½	317,626	289,476	513,926½	372,781	351,420	439,995	440,951

STATEMENT SHOWING THE QUANTITY OF PILCHARD PRODUCTS PRODUCED IN BRITISH COLUMBIA, 1930 TO 1955

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	.....	.....	.....
1952–53	.....	.....	.....
1953–54	.....	.....	.....
1954–55	.....	.....	.....
1955–56	.....	.....	.....

STATEMENT SHOWING THE QUANTITY OF HERRING PRODUCTS PRODUCED IN BRITISH COLUMBIA, 1935 TO 1955

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]	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
1952–53	5,132	5,871	.....	218	7,203
1953–54	66,231	3,910	.....	31,740	3,516,106
1954–55	.....	2,397	.....	28,782	3,714,924
1955–56	25,508	249	.....	47,097	4,475,536

[1] 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, VITAMIN A, AND FERTILIZER PRODUCED FROM SOURCES OTHER THAN HERRING AND PILCHARD, 1947 TO 1955.

Season	From Whales			From Fish-livers	From Other Sources	
	Whalebone and Meal	Fertilizer	Oil	Oil	Meal and Fertilizer	Oil
	Tons	Tons	Gal.	Units[1]	Tons	Gal.
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
1952–53	2,349	.....	668,408	5,409,264	2,011	192,315
1953–54	1,786	.....	5,707,968	5,339,768	2,059	243,819
1954–55	2,502	.....	872,060	4,310,057	2,361	265,405
1955–56	3,411	.....	759,785	4,760,668	1,993	201,690

[1] Million U.S.P. units Vitamin A.

CATCH OF FISH TAKEN FROM NON-TIDAL WATERS, 1955–56 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	—	4	—					6	30	75	60											81	90
Bednesti Lake	—	1	—																				
Cameron Lake	—	2	—					10	100	365	1,155			60	360					141	396	576	2,011
Christina Lake	—	16	—			2,460	815			15	10			38	76							2,513	901
Cluculz Lake	—	1	—													1,200	1,150	950	2,800	950	950	3,100	4,900
Cobb Lake	—	1	—																				
Chief Lake[1]	1	—	—																				
Duck Creek	—	1	—									4,475	16,750			300	600	16,775	16,775			21,550	34,125
Eaglet Lake	1	—	—			700	171							74	120	55	27	35	21			864	339
Francois Lake	—	5	—					42	302	15	56			10	39			11	35			78	432
Fraser River	1	—	1											12	24	12	28	130	230	1[2]	60	155	342
Inzana Lake	—	1	—																				
Klua Lake	—	3	—																				
Moberley Lake	—	5	—					163	1,140	3,799	10,695			60	360					141	396	4,163	12,591
Murch Lake[1]	1	—	—																				
Naltesby Lake	1	—	—							240	344					300	216			340	170	880	730
Nechako River	—	—	3																	2[2]	290[2]	2	290
Okanagan Lake	—	195	—			3,676	3,556															3,676	3,556
Otter Lake[1]	1	—	—																				
Pinchi Lake	—	1	—																				
Premier Lake	—	1	—			1,040	130															1,040	130
Swan Lake	—	2	—															2	6	1	3	3	9
Tchesinkut Lake	—	1	—							7	25											7	25
Tezzeron Lake	—	1	—																				
Woods Lake	—	1	—									4,475	16,750			300	600	16,775	16,775			21,550	34,125
Whitefish Lake	—	1	—																				
Swamp Lake[1]	1	—	—																				
Totals	—	—	—			7,876	4,672	221	1,572	4,516	12,345	8,950	33,500	254	979	2,167	2,621	34,678	36,642	1,576	2,265	60,238	94,596

[1] No returns submitted. [2] Sturgeon.

Licences Issued during the 1955–56 Season

Fur-farm	5
Ordinary	231
Sturgeon	3
Total	239

VICTORIA, B.C.
Printed by Don McDiarmid, Printer to the Queen's Most Excellent Majesty
1956

1,060-956-5110