ANNUAL REPORT
OF THE
PACIFIC BIOLOGICAL STATION,
NANAIMO, B.C.
FOR 1939
BY W. A. CLEMENS, DIRECTOR.

INTRODUCTION

During the year 1939, the program of investigation has been carried forward steadily along the lines described in the report of a year ago. Such temporary interruptions as were occasioned through changes in staff personnel have been largely overcome and the variety of investigation and the extent of accomplishment have at least equalled those of any previous year. The outlook throughout all the endeavours has been one of application but at the same time the fundamental aspects have not been neglected. This will be evident in the reviews of investigations that follow.

Reference to the situation created by the war may not be out of place. During the past years of intensive research there has been assembled a large body of information concerning the fishes and fisheries of the coast. This should be of particular value during the war period. At the same time there will undoubtedly be need for intensification in certain investigations and initiation of new ones. In any case the Station is in a position to render service in solving various problems which may arise in the emergency.

Again it is a pleasure to acknowledge the assistance and co-operation of many organizations and grateful thanks are extended to the following: the Royal Canadian Naval Service, the Lighthouse Division and the Meteorological Bureau of the Department of Transport, the Water Power and Hydrometric Bureau of the Department of the Interior, the Department of Health, the Department of Fisheries, the Provincial Fisheries Department, the Provincial Game Commission, the University of British Columbia and the Oceanographic Laboratories of the University of Washington. The fishing companies and many individual fishermen have continued to give much appreciated help in various ways.

INVESTIGATIONS

Salmon

Sockeye Salmon.

The annual collection of sockeye salmon scales and data from Rivers inlet and the Skeena and Nass rivers as made by the Provincial Fisheries Department have been handled as usual by Dr. Clemens. These "Contributions" published in the annual report of the Provincial Fisheries Department now cover a period of twenty-seven years and constitute a most useful record.

A study of the sockeye salmon run to the Lakelse lake area on the Skeena river was carried out by Dr. A.L. Pritchard and Mr. W.M. Cameron. Counting fences were installed in the three mouths of the largest tributary, Williams creek, for the

purpose of accurately determining the numbers of fish entering this stream. The run extended from July 23 to September 16 and the number of migrants consisted of 12,350 males and 11,735 females, a total of 24,085. Estimations of the spawning populations in the other tributaries to the lake were placed between 9,000 and 16,000 making a total for the Lakelse area between 33,000 and 40,000. This is considered a very good spawning run. Observations at Williams creek showed the sexes were in approximately equal numbers and that the fish were fully mature. Spawning was completed 10 to 16 days after the fish passed the fence.

The average lengths and weights of 1,000 individuals of each sex were as follows: male - 25½ in., 6¼ lbs.; female - 23½ in., 5¼ lbs. The average number of eggs per female based on a random sample of 24 individuals was 3,888.

During the last two weeks of the spawning run an examination was made of ten scattered redds in order to determine the extent of fertilization. It was found that of 14,627 eggs obtained 98.6% were fertile. It is concluded that fertilization in the case of sockeye salmon spawning in Williams creek under average natural conditions is most efficient and comparable to the figure of 98.2% obtained for pink salmon in McClinton creek, Queen Charlotte islands in 1938.

By the application of combinations of colored disc tags to approximately ten per cent of the fish at the weirs it was possible to make observations on individual fish upstream and to test tagging as a means of estimating the fish in the stream. As to the first point, no significant correlation was discovered between the time of migration or the size of the fish and the spawning location. As to the second point, the method as applied at Williams creek was found to be subject to a wide range of error and no more reliable than an estimate made by an experienced observer.

Pink Salmon.

The investigation of the natural propagation of pink salmon in McClinton creek, Queen Charlotte islands has been continued by Dr. Pritchard and Mr. Cameron. The fry migration from the stream to the inlet extended from February 19 to June 2, and consisted of 2,020,000 individuals. These were the product of the spawning of 5,549 males and 5,028 females in the autumn of 1938. On the calculated deposition of 8,500,000 eggs, the migrants represented a percentage of 23.8 which is the highest percentage of production so far to be recorded. The figures for previous cycles have been 6.9, 9.1, 16.7 and 10.6. Climatic conditions undoubtedly constitute the most important factor in successful production on the spawning grounds and where these are particularly favourable a high percentage of fry may result from the deposition of a relatively small number of eggs.

As stated previously the percentage production of fry from the 1938 spawning was 23.8. An attempt has been made to allocate the 76.2 per cent loss. Examination of redds soon after spawning showed a loss of 1.8 per cent from non-fertilization. Extended examination of redds in February and early March gave the following losses: pre-eyed eggs 6.8; eyed eggs 23.9; unclassified eggs 10.7; larvae 9.5 per cent and a production of live larvae of 49.1 per cent. The remaining loss must be distributed among such headings as death of adults, destruction of adults by bears and eagles, unspawned eggs, eggs not covered by gravel, death of fry after emergence from gravel, destruction of fry by predators such as yearling coho, trout, char, birds, etc. An exploratory investigation was made to determine the effect of the predators on the fry by marking groups of fry of approximately 100

each and liberating them about one-third of a mile above the counting weir. Since each fry reaching the weir could be examined, it was possible to determine the numbers surviving. Liberations were made at dusk and it was found that practically all survivors appeared at the fence during the first night. None was recovered after the second night. The losses averaged approximately fifty per cent. Attempts will be made in 1940 and 1941 to obtain further and more extensive data. It is fully realized that this is a very preliminary experiment as there are very many factors involved. However, it is of interest to calculate on the basis of the present findings. Assuming a loss of 3 per cent of the potential egg deposition due to predation on adults and non-deposition, for each 100 eggs, 97 would remain. Of these 49 per cent develop to fry or 48. A loss of 50 per cent during migration leaves 24 fry to reach the sea. That this figure agrees exactly with the actual fry production is undoubtedly mere coincidence.

The percentages of adult fish returning to McClinton creek from the sea in relation to the number of seaward migrants have been very variable. The causes may lie in 1) the variation in survival during sea life 2) the variation in the commercial catch 3) wandering. The first mentioned possibility does not lend itself to easy investigation at the present time. The other two causes would appear to offer opportunities for study by means of marking seaward migrants. The initial step in this phase of the investigation was taken when 178,629 fry were marked at McClinton during the spring of 1939 by the removal of both ventral fins. It is planned to place observers in the canneries throughout the northern area during the summer and autumn of 1940 to watch for scarred adult fish. It is hoped to have the co-operation of the United States Bureau of Fisheries in making observations in the canneries of south-eastern Alaska.

Spring Salmon.

In order to obtain some information as to the extent to which herring enter into the food of spring salmon, Drs. Pritchard and Tester commenced a study of the contents of a collection of spring salmon stomachs. Equipment was supplied to fishermen in areas extending from the Queen Charlotte islands to off Barkley sound. A total of 333 stomachs was so obtained. Considering the material as a whole, it was found that herring (Clupea pallasii) and sand lance (Ammodytes personatus) occurred in almost equal amounts by volume and together constituted about eighty-seven per cent of the food. The remaining percentage was made up of whiting (Theragra chalcogramma), tomcod (Microgadus proximus), gray cod (Gadus macrocephalus) surf smelt (Hypomesus pretiosus), eulachon (Thaleichthys pacificus), capelin (Mallotus catervarius), sand fish (Trichodon trichodon), rockfish (Sebastodes sp.), stickleback (Gasterosteus aculeatus), squid (Loligo opalescens) and red feed (Thysanoessa spinifera). In the northern area herring predominated while on the west coast of Vancouver island sand lance was the chief item. Since the percentages of food materials will undoubtedly vary from year to year it is planned to obtain another and perhaps more extensive lot of stomachs in 1940.

Mortalities Among Salmon.

During the summer, two reports were received of salmon dying in the sea. The first concerned spring salmon in the traps at Sooke in mid-July. Examination of the situation by Dr. Pritchard and Mr. Tully revealed a high production of algae and supersaturation of the water with oxygen. It was apparent that the oxygen-carbon dioxide relationship was exceptional and respiratory activities of the salmon seriously disturbed. The condition was a temporary one and disappeared in a few days. The second instance was a report of sockeye salmon dying in English bay in late August. A survey of the situation by Mr. McHugh and Mr. Tully showed conditions very similar to those at Sooke. About this time salmon gill net fishermen experienced trouble with accumulations of "silt" on their nets causing them to sink. Investigation by Mr. Tully and Mr. McHugh led to the conclusion that the "silt" consisted of dead jellyfish on which algae and silt were deposited. These unfortunate conditions were relieved shortly upon a change in weather conditions.

Ocean Fisheries

Pilchard.

Pilchards failed entirely to reach the British Columbia coast in 1939. A catch of 5,220 tons was made off the coast of Washington by Canadian boats and processed in Canadian reduction plants. The average total catch per boat was approximately 210 tons or about one-tenth that of the 1938 season in the same area. All the evidence points to a serious decline in abundance of fish and unless the stock is restored to something like its former condition, the future of the British Columbia fishery would appear rather uncertain. The immediate hope of the fishery depends upon the ability of the small sardines at present rather abundant in California waters to survive the intense fall fishery long enough and in sufficient numbers to replenish the stock of large fish. Although the future may appear unfavourable, it is probable that good seasons may be experienced from time to time.

The pilchard investigation has been continued by Dr. Hart and limited to sampling and insertion and recovery of tags. The average lengths of both males and females show a marked decline in 1939 and continue the downward trend demonstrated since 1937. The data are as follows: 1939, M. 241.0, F. 243.3; 1938, M. 246.4, F. 251.0; 1937, M. 248.0, F. 252.9. An analysis of the length data leads to the conclusion that during the last three years successively younger fish have been exploited by the fishery. The average vertebral number was again low, namely, 50.69. It would seem that the dominating group which entered the fishery in 1931 is still forming an appreciable portion of the population.

Tagging was restricted to the use of 2,400 tags all of which were inserted off the American coast, some of them as far south as northern Oregon.

Sixty-two tags have been recovered since the report of last year. They were as follows:

1) Recoveries of Canadian tags used off Washington-Oregon coast in 1939:
   By Canadian plants, from fish taken off Washington-Oregon coast 6
   By Washington plants, from fish taken off Washington-Oregon coast 14
   By Oregon plants, from fish taken off Washington-Oregon coast 8

2) Recoveries of Canadian tags used off Canadian coast in 1938:
   By Canadian plants, from fish taken off Washington-Oregon coast 2
   By Washington plants, from fish taken off Washington-Oregon coast 4
   By California plants, from fish taken off California coast 17

3) Recoveries of Canadian tags used off the Washington coast in 1938:
   By California plants, from fish taken off California coast 2

4) Recoveries of Canadian tags used off the Washington coast in 1937:
   By Washington plants, from fish taken off Washington-Oregon coast 2
   By California plants, from fish taken off California coast 2

5) Recoveries of California tags used off the California coast:
   By Canadian plants, from fish taken off Washington-Oregon coast 5

Total 62

Attention may be called to two points, first, the absence of any return from tags used off the Washington coast in 1938 and second, the mixture of tags present among the fish on the grounds off the Washington-Oregon coast in 1939.

Herring.

With the steady expansion of the herring fishery, every effort is being made to extend the herring investigation in order to obtain adequate data for determining the abundance of the stock, the main population groups, the extent of movement and intermingling among populations, the characteristics of the population groups, and the effects of fishing on the various populations. In addition an attempt is being made to fill gaps in the knowledge of the early life-history of the species. The investigations are being made by Drs. Hart, Tester, Boughton and Mr. McHugh.

The total catch of herring during the 1938-39 season was 107,267 tons, which is the largest on record. Pilot House Record Books were distributed to all the seine boat captains and while unfortunately the return of records from some areas was meagre, it has been possible to calculate the availability in terms of tons per seine per day for many areas. On the south-east coast of Vancouver island the availability was 98.2 tons/seine/day. This is somewhat less than that of last year but close to the average over a six year period. It is apparent that the abundance of fish in the area has remained reasonably constant and supports a steady and reliable fishery. The west coast of Vancouver island, exclusive of Quatsino sound, showed an availability of 12.7 tons /seine/day. The records for the previous three years were: 1935-36, 67.9; 1936-37, 50.2; 1937-38, 31.6. The conclusion that there has been a steady decline in abundance seems evident and is strongly supported by the spawning bed reports which indicate a steady decrease in the annual deposition of eggs. Quatsino sound appears to be distinct from the

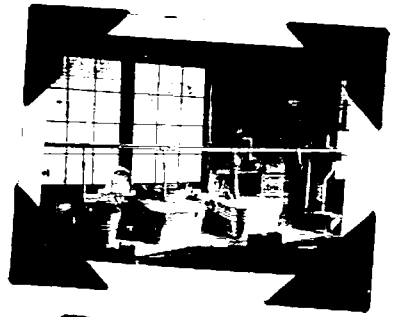
Counting weir - Lakelse lake

STANLEY PAR

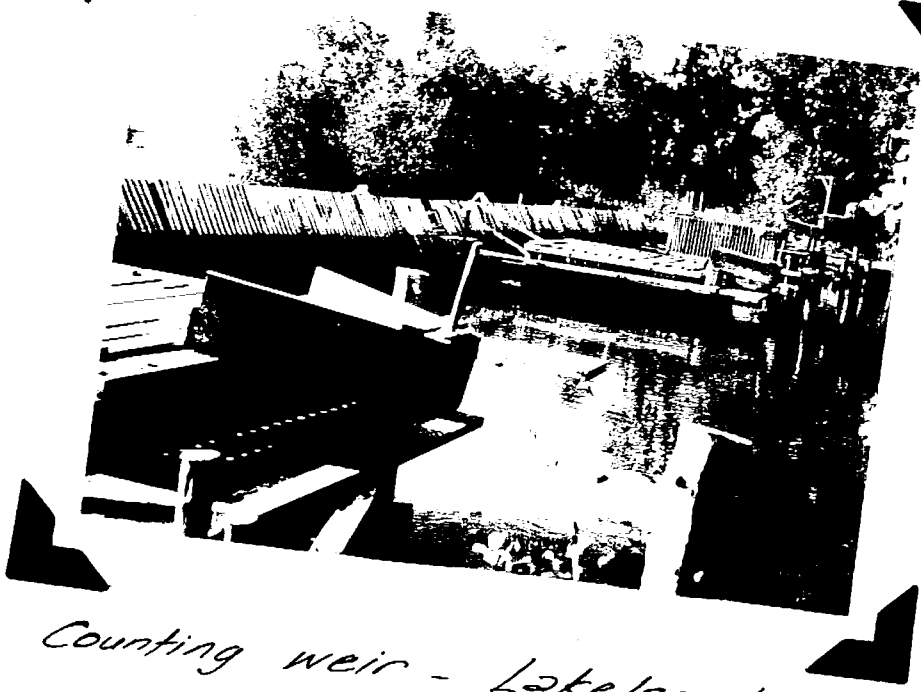
Hatchery

Filter - Cowichan hatchery

Laboratory holding tanks



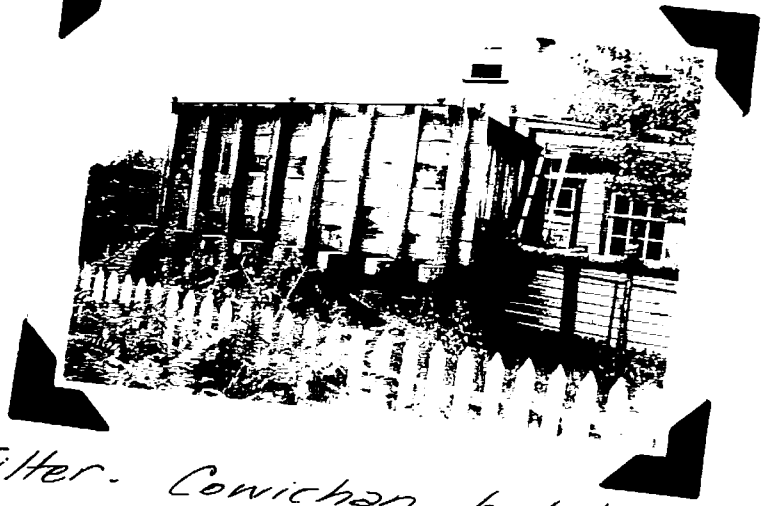
Experimental



Counting weir - Lakelse lake

STANLEY PAR

Hatchery



Filter. Cowichan hatchery

Laboratory holding tanks

Experiment-