

ANNUAL REPORT
OF THE
PACIFIC BIOLOGICAL STATION,
NANAIMO, B.C.
FOR 1938
BY W. A. CLEMENS, DIRECTOR.

INTRODUCTION

The year 1938 marks the thirtieth anniversary of the establishment of the Pacific Biological Station and it accordingly seems appropriate to refer briefly to some features of its development. The Station was opened in 1908 under the curatorship of the Rev. George W. Taylor who had been very active in the organization work and who evidently chose the location with foresight as there has been no considered suggestion of another as better. Unfortunately Mr. Taylor was able only to initiate the work of the Station and was soon forced to retire on account of ill health. He was succeeded by Dr. C. McLean Fraser who remained as Director until 1923 when he resigned in order to give undivided attention to his duties at the University of British Columbia. The present Director was appointed as from June 1, 1924.

During the first sixteen years all investigations, except those by the Director, were carried out by what have been called voluntary investigators, that is, persons chiefly from the universities of Canada who undertook approved researches during the summer months and who received no direct remuneration but were reimbursed for travelling expenses to and from the Station and provided with living and laboratory accommodation. In 1924 the Board entered upon a program of gradually building up a resident scientific staff. The first appointment was that of Dr. R.E. Foerster who was assigned to the study of the propagation of sockeye salmon at Cultus lake. Additional appointments followed until a staff numbering about ten was attained. During this period the number of voluntary investigators increased very considerably. Then the economic depression with its consequent limitation of funds brought about not only a halt in expansion but a decided restriction in the program of investigation. Fortunately it was possible to maintain the permanent staff for the most part and thereby the continuity of the major investigations. Under the altered conditions of recent years only very limited numbers of voluntary workers have been provided with accommodation and a few temporary assistants have been employed for special investigations.

In the early years chief attention was given to systematic studies of the fauna and flora and life history studies of certain fishes, particularly salmon and herring. Then followed researches in biochemistry, general oceanography and to a limited extent in morphology. In recent years the major effort of the Station has been directed into the fields of fishery biology, the life histories of commercially important shellfish, fish diseases and dynamic oceanography. That the thirty years of research activity at the Station have been productive is indicated by the publication of over three hundred papers in recognized scientific journals.

While much fundamental and directly applicable work has been accomplished, there remains an urgent need for a very great deal to be done. The fauna and flora of the northern waters is largely unexplored; the life histories of many important economic species have not been adequately worked out; the fields of biochemistry and physiology are almost untouched; innumerable problems in fishery biology await investigation and information concerning ocean conditions, particularly in relation to the fisheries, is very meagre.

Future progress and development in research at the Station will depend upon the maintenance of an adequate staff for intensive and long-term investigations and the judicious employment of voluntary investigators and temporary assistants for more or less isolated phases of major problems and for certain general but necessary researches.

Early in the year two resignations from the staff were received, namely, those of Drs. R.E. Foerster and W.E. Ricker, who accepted positions with the International Pacific Salmon Fisheries Commission. In order to fill the vacancies caused by the above and previous resignations a number of appointments have been made during the year. These have been as follows: Professor Ferris Neave, Dr. R.V. Boughton, Mr. D.B. Quayle, Mr. J.L. McHugh and Mr. W.M. Cameron. With the acquisition of these men the program of investigation has been carried forward along the lines as reviewed in the following section on investigations.

The program of investigation has been greatly facilitated by the generous co-operation of various 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 Royal Canadian Mounted Police, 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 assistance of all the fishing companies, the men connected with the industry and many individual fishermen is most sincerely appreciated.

In order to provide much-needed space for office and laboratory work, ten rooms in the wing of the Station dormitory building have been fitted up with desks and shelving and will be occupied by a portion of the staff. The vacated old house will be used for storing collections of scientific materials, particularly fishes and plankton. A combined work-shop and storehouse has been erected. This will free the basement of the chemistry building which it is planned to have converted into a draughting and chart room for the hydrographic investigations. These arrangements will serve as a temporary relief from congestion but it should be pointed out that the need still exists for proper office and laboratory facilities. Furthermore, a Station so favourably located should be provided with adequate facilities for investigations in biochemistry, physiology and behaviour of marine animals.

Attention must again be called to two other very important requirements. The one is that of a fire-proof library building. The library is valued at approximately \$16,000.00 and is increasing in value at the rate of at least \$1,000.00 a year. It is without doubt the second most extensive fisheries library in Canada and contains many publications which would be difficult of replacement.

The other pressing requirement is that of boats, particularly one for open ocean operation. The sixty-foot motor vessel, the "A.P. Knight", is scarcely large enough and her engine not reliable for work off the west coast of Vancouver island or around the Queen Charlotte islands. Arrangements on the part of the Naval Service and the fishing industry for the use of vessels have been much appreciated, but there have frequently been times when carefully arranged schedules and programs have had to be abandoned because vessels could not be made available. It should be pointed out, however, that when the Board does obtain a boat, the co-operation of the Naval Service should be maintained as far as possible. In respect to smaller boats, the "Ptarmigan" obtained from the Department of Fisheries two years ago has had to be scrapped and the "Ron-a-Vic" has reached the end of its usefulness. Two small boats such as these are required, one for the herring work and the other for the clam investigation because the field work in these cases coincides.

INVESTIGATIONS

Salmon Investigations

Sockeye Salmon.

In co-operation with the International Pacific Salmon Commission the count of seaward sockeye salmon migrants was made at Cultus lake under the supervision of Dr. R.E. Foerster. This count was the survival of 12,000,000 fry liberated in the lake in the spring of 1937 and constitutes the third and last test of the effect of the removal of predator fishes upon the survival of young sockeye during their year's residence in the lake. The following table presents the results of the complete investigations:

	1935-36	1936-37	1937-38
Predators removed:			
Squawfish	2,695	4,805	2,573
Char	231	263	230
Trout	229	790	893
Coho	43	252	335
Method of propagation	Egg planting	Natural spawning	Fry liberation
Extent of seeding	5,600,000	40,000,000	12,000,000
Number of seaward migrants	302,000	3,125,000	1,627,000
Percentage efficiency	9.0	7.8	13.6
Average per cent efficiency in previous tests with predators present	3.6	1.8	4.2
Probable increase in number of seaward migrants	301,000	2,400,000	1,131,000
Probable increase in number of adult sockeye	30,100	240,000	113,100

A test carried out under the auspices of the International Pacific Salmon Commission by Drs. Foerster and Ricker to determine the possible reduction in numbers of predatory fishes from 1935 to 1938 appears to show that the squawfish population in Cultus lake has been reduced by about 85 per cent, the trout by 40 per cent and the char by 60 per cent. As far as can be determined there has been little change in the populations of these species from 1937 so that the program of removal must be continued if the present reduced levels of abundance are to be maintained.

The analysis of the annual collection of scales and data on the sockeye salmon runs to the Skeena and Nass rivers and to Rivers inlet as made by the Provincial Fisheries Department was carried out by Dr. Clemens.

Pink Salmon.

The investigation of the pink salmon has been continued on McClinton creek, Massett inlet, Queen Charlotte islands, by Dr. A.L. Pritchard, assisted by Mr. W.M. Cameron. A count of the adult fish ascending the creek was made this autumn. The number was 10,577, of which 5,549 were males and 5,028 females and the egg deposition was calculated as 8,500,000. This body of fish is presumably the return from the seaward migration of 3,675,000 fry in the spring of 1937 and represents a percentage of 0.3. In previous cycles the percentage returns have been 0.3, 7.0 and 0.4. In all cases the number of McClinton creek fish taken in the commercial fishery has not been taken into account because of the very great difficulty in obtaining such a record. Although the number of pink salmon appearing in McClinton creek was relatively small in 1938, the percentage return on the basis of seaward migrants was practically equal to those of 1932 and 1936. It would seem that the spawning escapement of 155,183 adults in 1934, representing a percentage return of seven, was the exception.

While considerable numbers of seaward migrants have been marked during the past four production years, it has been impossible to check all the commercial catches and so obtain information as to the relation of catch to escapement or as to the extent of wandering. The marking did establish the fact of a fairly high percentage return to the natal stream. The pink salmon investigation is now to be directed toward determining these relations, that is, of catch to escapement and of the extent of wandering to return to the natal stream. During the spring of 1939 as many as possible of the seaward migrating fry are to be marked and in 1940 arrangements are to be made on an extensive scale for the examination of the commercial catches for the occurrence of marked individuals. It is hoped to have the co-operation of the United States Bureau of Fisheries in the checking of catches in Alaskan waters. In association with this investigation it is planned to obtain a comprehensive record of the ocean conditions in Dixon entrance with the seasonal and annual variations and determine, if possible, any correlations between the physico-chemical conditions and the salmon migrations.

Another phase of the study of pink salmon production was begun this autumn. It has been found that in McClinton creek the production of pink salmon fry migrants has averaged about 10 per cent of the number of eggs deposited by natural spawning. The 90 per cent loss has been puzzling in view of the fact that the fry proceed to sea almost immediately after emergence from the gravel. It has seemed of value to attempt to determine the distribution of mortalities during the portion of the life history from the deposition of the eggs to the entrance of the fry into the sea. It is conceivable that a knowledge of the extent and causes of the mortalities may lead to the development of procedures which may reduce the losses. The first examination was carried out after the eggs had been in the redds for about two weeks. Five representative redds were examined from which 2,353 eggs were taken. Of these about two per cent were unfertilized. Further examinations will be made, if possible, in December, early in the new year, at hatching time, at the time of emergence from the gravel and during downstream migration.

Detailed observations are being made on the behaviour of the spawning fish and investigations made of various physico-chemical factors which may influence the upstream spawning migration. Dr. Pritchard has already shown that rainfall is significantly correlated with the number of upstream migrants. Studies this autumn by Mr. Cameron indicate that under normal conditions there is a daily rhythm in the dissolved oxygen content of the creek water and that with rainfall there is a break in the rhythm with a sharp rise in oxygen content.

Skeena River Investigation.

The survey of the Skeena river as a salmon-producing stream has been continued by Dr. Pritchard. All the records of spawning escapements to the various streams on file in the office of the Department of Fisheries in Vancouver have been examined and pertinent information concerning the runs, their time and extent to the various streams and lakes has been catalogued. In addition, the annual pack records for the five species have been examined and certain cannery records of catches have been copied and analyzed for the purpose of determining whether trends in the fishery throughout the past years could be observed. For various reasons the data for the sockeye salmon are the most reliable and show a definite and serious downward trend in the abundance of this species.

Early in August Dr. Pritchard, Dr. Clemens and Mr. J. McHugh, accompanied by Fisheries Inspector A.R. McDonnell and Fishery Guardian Beecher, visited all the more or less readily accessible areas of the river system. In particular the outlets of Lakelse and Babine lakes were carefully examined as to the feasibility of installing counting weirs. A detailed report of the Skeena river problem was submitted to the Executive Committee in August. Among other things this report points out that if the regulation of the salmon fishery on the Skeena river is to be ultimately placed upon a scientific basis it will be necessary to set up as accurate a system as possible: (1) for the enumeration of the escapement to the spawning beds, and (2) for the record of the catch. The former may involve the installation of one or more weirs and an extension of the inspection system; the latter the carrying out of a tagging and marking program in order to determine the extent of the fishing drain on Skeena fish in areas far from the mouth of the river, and the collection of detailed catch records at the canneries.

In October Dr. Pritchard made a further inspection trip to Babine lake and to the upper reaches of the Kispiox river.

Ocean Fisheries.

Pilchard.

The investigations of the pilchard and herring fisheries have been continued by Dr. J.L. Hart and Dr. A.L. Tester, assisted by Dr. R.V. Boughton and Mr. J.L. McHugh. The Provincial Fisheries Department has contributed financially to the investigation.

The occurrence of pilchards was of interest this year in that the fish appeared off the Washington coast from late July until mid-August and then appeared off the northerly portion of the west coast of Vancouver island from early September well into October. The total landings at the Canadian reduction plants up to October 8 was 48,521 tons which is the highest catch since 1931.

The results of the sampling of the catches showed that the average lengths of the fish taken off the Canadian coast were slightly greater than those taken off the Washington coast. It would seem also that the influence of the dominant year class which entered the Canadian fishery in 1931 has disappeared.

During the season, 2,500 pilchards were tagged off the coast of Washington and another 2,500 off the Canadian coast. Magnets were again operated in the reduction plants and the following recoveries obtained:

(1) Recoveries of Canadian tags used off the Washington coast in 1938:	
By Canadian plants from fish from Washington coast	20
" " " " " " Canadian "	4
" Washington plants and floaters off Washington	23
" Oregon plants	6
(2) Recoveries of Canadian tags used off Canadian coast:	
By Canadian plants only	188
(3) Recoveries of Canadian tags used in 1937 and 1936:	
By Washington and Oregon plants off Washington coast	3
" Canadian plants off Washington coast	3
" " " " Vancouver island	7
" Californian " (winter 1937-38) off Californian coast	5
(4) Recoveries of Oregon tags:	
By Canadian plants off Vancouver island	3
(5) Recoveries of California tags:	
By Canadian plants off Washington coast	15
" " " " Vancouver island	23
	<hr/>
Total for year	300

These returns clearly confirm the interchange of pilchards between the California and British Columbia fishing grounds as already shown by the work of previous years. In respect to the movements of the pilchards this season, Dr. Hart suggests the following interpretation:

"In July and early August there was a very substantial body of fish off the Washington coast. This was a well-mixed group bearing tags from many different taggings and very possibly was the main body of adult pilchards. Around the middle of August a small section of this body of fish became detached from the rest, moving to the northwest and finally arriving off the west coast of Vancouver island. The movement evidently took place well offshore as the Canadian fishing fleet failed entirely to intercept it. Part at least of the remaining and larger body of fish moved slowly southward. This is indicated by the fishing localities of Canadian and American pilchard fishermen in August and September".

The returns from the west coast of Vancouver island apparently demonstrate a great and presumably continuous mixing of the pilchards during September and October.

In connection with the tagging work, two experiments were carried out to test efficiencies of methods. One to determine the comparative efficiencies of tagging by the use of a knife and a tagging gun showed no significant differences in results. The other to test the efficiencies of the magnets in the various plants showed variations from 34 to 87 per cent in recoveries. Fifty-eight per cent of all the tags used and 90 per cent of all the tags recovered were obtained by the end of the second day. In a few instances considerable time elapsed before the tags finally appeared on the magnets. This information is very important when calculations of abundance of fish and of fishing intensity are made.

Herring.

The study of the herring populations along the coast of British Columbia has been continued by the sampling of commercial catches and by tagging. On the basis chiefly of age composition and vertebral counts, it was concluded that there exist a number of local populations. To test this conclusion, there has been instituted an extensive tagging program in which internal tags are employed and recovery made by electro-magnets and electronic tag detectors.

The results of the tagging to date seem to show that the great majority of the herring supporting the commercial fishery along the southeast coast of Vancouver island have a summer feeding area in the open sea off the entrance to the strait of Juan de Fuca. In late summer or early autumn they move into this strait and then along the east coast of Vancouver island and eventually spawn in this area at least as far north as Nanaimo. There is evidence of a very limited movement of fish tagged on the west coast of Vancouver island to the east coast but on the whole the results of the investigation to date demonstrate that the herring frequenting the southeast coast of Vancouver island constitute a self-contained group.

Owing to the delay in the passage of tags through the reduction plant machinery the interpretation of recoveries on the west coast of Vancouver island has had to be made with extreme care. There would seem to be some evidence of a very slight amount of intermingling of populations. With the installation of tag detectors at Ucluelet and Nootka to supplement the magnets it is hoped to obtain more definite information concerning the movements of west coast fish.

Sampling of the commercial catches in various areas has been continued and the results confirm the previous conclusions as to the essential distinctness of populations.

Studies of young herring indicate that the commercial herring fishery of the east coast of Vancouver island is supplied by a number of groups of young each with its own characteristics and each of which contributes its share to the supply of maturing fish. There is not at present, however, any evidence for believing that these groups maintain their individualities after joining the maturing schools.