INDEX TO SUMMARY REPORTS FOR 1948

FISHERIES RESEARCH BOARD OF CANADA

Report of the

Pacific Biological Station

Nanaimo, B. C.

for 1948

by R. E. Foerster, Director

The research activities of the Station during 1948 continued essentially along the same lines as in previous years, the objective being to elicit those biological facts concerning our commercially important Pacific coast fishes which have a significant bearing on their production and which are basic to proper and effective regulation and management. The total value of the British Columbia fisheries in 1947 amounted to $58,764,950 (according to the Advance Report on the Fisheries of British Columbia, 1947, issued by the Dominion Bureau of Statistics, November, 1948). Maintenance of this natural resource at a high level of exploitation is most desirable. The wider and more intimate our understanding of the factors governing sustained optimum natural production of our fish and of the effect of present fishing operations upon the stocks the more efficient the management regulations or policies can become in endeavoring to provide maximum catches consistent with adequate perpetuation of the species.

The major investigations included (1) a study of the sockeye salmon fishing of the Skeena river to determine whether the relatively low catches in recent years indicated a true decline and, if so, what were the contributing factors and how could they be overcome, and, further, what measures might be adopted to increase production of salmon for the commercial fishery, (2) a study of the runs of Pacific salmon, especially pink and chum, to all sections of the British Columbia coast and the factors affecting production, particularly those which might be contributing to the great variability in the extent of the runs from year to year, (3) a comprehensive study of the populations of herring frequenting the various coastal areas and contributing heavily to an important fishery and (4) a study of those species of fish which enter into the otter trawl fishery. This last is a somewhat more complicated problem than the others since there are three species of flat fish involved (brill, lemon sole, rock sole) as well as several species of round fish (ling cod, gray cod, black cod, dogfish and rockfishes). For the round fish the problem of competition with other types of gear also enters into the study.

During the year very satisfactory progress has been made in all investigations, as will be noted in the more detailed statements that follow. More essential information has been obtained and the significance of previous data more clearly determined. Gradually our findings are becoming of greater and greater value to the Department and to industry. For example, reference may be made to the fact that this year the salmon and herring researchers felt they had acquired a sufficient understanding of the factors governing the variations in production and in return of fish to the fishing areas that they might offer tentative predictions to the industry as a guide to possible extent of catch.

The reliability of these predictions rested solely on the reliability of the information available and the predictions were therefore subject to certain modifications if abnormal circumstances prevailed but, as it turned out, they were reasonably correct and of much significance. We are informed that such predictions are very valuable to the fishing industry, especially for those fisheries which fluctuate appreciably from year to year. As our understanding of the factors influencing variability in abundance develops the significance of our predictions should increase. It might here be mentioned, in passing, that pilchard studies a few years ago had reached a stage where reliable predictions of abundance each year could be made. Unfortunately the last prediction was for a severe decline in abundance due largely to no influx of new age-classes entering the fishery. This prediction was so well borne out that there has been no pilchard fishery for three years and our pilchard research has become temporarily very much reduced.

In addition to the four major investigations referred to above, the Station has been conducting a number of minor studies - those relating to crab, shrimp, oyster, anchovy and eulachon - in which only certain pertinent features have been investigated as funds, facilities and availability of material permitted. In many of our minor fisheries, at least presently minor, it does not seem advisable to devote too comprehensive attention to them at the moment. Consequently only certain phases, such as migration, catch statistics, reproduction, etc., are being considered with a view to answering immediate questions and eventually rounding out the studies as conditions permit.

Two new studies were commenced this year. These were whale and albacore. The first season's operations were largely exploratory and preliminary, but nevertheless very interesting and profitable. They serve to represent somewhat of a phenomenon, namely, the initiation of scientific study of a fishery before the fishery has shown a ruinous decline with all features very much abnormal. What the future of either of these fisheries will be remains to be seen, but for the albacore, the fishing for which was very profitable for many trollers this season, there will certainly be much interest aroused in 1949. The question as to whether albacore have always been present in off-shore waters cannot be answered with available data. Observations another season should be exceedingly revealing. If albacore do appear again in 1949 it may be very desirable to undertake a well-designed survey of the coastal region to compare the oceanographic conditions in the waters in which the tuna are present with those in which they are not found, thereby perhaps revealing those factors which govern their distribution and their appearance or disappearance in our waters. At the same time a comprehensive morphological study should be made to determine whether these albacore are racially the same as those taken in more southern waters or off the coast of Japan.

It has been emphasized by the Pacific Sub-Executive Committee, unanimously supported by the industry, that greater attention should be given to our Pacific salmon problems, particularly pink and chum salmon in those coastal areas where the runs have greatly declined. Such an agitation has much justification. It is particularly justified since studies to date have revealed that conditions in the streams affecting spawning and hatch of fry govern the production of fish to a much greater extent than any limitation of fishing is likely to do. In three out of four tests of chum salmon fry survival in recent years, the survival percentages have been so low that even with total closure of the com-

mercial fishery it is questionable whether the decline in the production of fry would have been arrested. If the decline in the fishery has been due to changing conditions in the streams which have reduced the level of fry production to too low a figure for maintenance of the species even with complete elimination of fishing, vigorous measures of stream improvement, water control or artificial propagation may be required. An appreciable expansion in the General Salmon Investigation programme would permit operation of a larger number of test streams in more areas and provide the necessary data on conditions governing fry production in quicker time.

It seems desirable to refer again to the growing need for a comprehensive oceanographic investigation of our Pacific waters, both coastal and offshore. For a number of years a valuable and illuminating series of data has been built up respecting temperature and salinity conditions in coastal areas - these data obtained from observations and water samples taken daily by certain lighthouse attendants along the coast. With the very promising possibility that it will soon be possible to get accurate statistics of fish catches according to the area of capture, it may soon be feasible to attempt correlations of fish catches (an approximate measure of abundance) with these coastal-water physical factors, but this would represent only one part of the picture. The conditions in offshore waters are perhaps of greater significance, certainly as related to movements or migrations of pilchard, albacore tuna and some species of salmon. Particularly for prediction purposes the knowledge of what the conditions are in the ocean, what variations are taking place, is essential.

It is our opinion that such an oceanographical investigation should embrace all the essential physical and chemical factors (temperature, salinity, oxygen, nitrates, phosphates, carbonates, etc.) likely to be of significance and all the biological factors (phytoplankton, zooplankton, larger marine fauna and fish) in order to establish their relationships and select, eventually, those "key" indicators which may be found to represent the changing conditions generally and which may be useful as guides for prediction of availability or abundance of fish from year to year.

Actually very little is known about the annual and seasonal changes in oceanographic conditions taking place naturally in any marine habitat and the time seems ripe for a fundamental study of a more or less enclosed salt-water lagoon or bay in order to determine what happens therein from season to season and from year to year and how the natural changes affect fish populations. Such a study might well be instituted to parallel the more general coastal and offshore oceanographic investigations.

One investigation which the Station has continued for many years, firstly under Dr. C. R. Elsey, then under Mr. D. B. Quayle and latterly under Mr. Neave, has come to an end, namely that dealing with shellfish, chiefly clams and oysters. This work has for some years had financial assistance from the Provincial Fisheries Department. During 1948 that Department has set up its own biological division under Dr. Quayle and is now in aposition to take over this work which comes directly under its jurisdiction and which it proposes to expand by giving scientific advice on proper culture procedures, etc., to growers. The Station has long enjoyed the very excellent association with the Provincial Fisheries Department and its Deputy Minister, Mr. G. J. Alexander. It looks forward to its continuance, wishes the Department and Dr. Quayle every success in the shellfish work and offers its facilities at any time.

REVIEW OF INVESTIGATIONS

Skeena River Salmon. According to the terms of reference this investigation, commenced in 1944 with the objective of determining (1) whether the sockeye fishery had suffered a decline, (2) if so, what factors had been responsible and (3) what measures might be used to increase the populations, was required to assess its results at the end of five years and submit a report of its findings and recommendations regarding further research to be done. This being the final year and with the report to prepare, the field operations were largely restricted to only those required to complete pertinent series of data. During the season Dr. Pritchard, who was in charge of the investigation, left the service of the Board and it fell to Mr. Milne, assisted by Messrs. Withler, McMahon, McConnell and Foskett to continue the field operations as originally planned.

The season's programme included, as in past years, (a) the marking of seaward migrating sockeye smolts from Lakelse and Babine lakes in order to trace the return of these races from the sea, through the fishery and to the natal breeding grounds, (b) the total count of migrants from Lakelse lake in order to determine percentage efficiency of natural propagation to this stage, (c) certain limnological studies at Lakelse, Babine, Morrison and Bear lakes, (d) tagging of salmon in the estuary of the Skeena to determine degree of exploitation by commercial and Indian fisheries and distribution to the spawning areas, and (e) spawning stream surveys to estimate the spawning escapement.

Due to abnormal flood conditions at Lakelse lake, the counting fence was rendered inoperative during the early part of the migration and a count of the outgoing sockeye smolts was impossible. Furthermore, only a few (4,709) of yearlings were marked. (Appendix 1 and 2). At Babine, capture of migrants by trap was again successful and a marking of 103,906 smolts resulted. These fish will return in 1950 and 1951. (Appendix 3).

Anticipating the return of marked adult sockeye from marking experiments at Lakelse and Babine lakes in 1945 and 1946, observers were stationed at all Skeena canneries during most of the fishing season to recover the marked individuals from catches landed. For the Lakelse group a very small percentage was obtained (0.07%), confirming information from tagging experiments that much of the Lakelse run of sockeye had passed the fishing areas before the season opened. For the Babine group a greater recovery was made (0.37%). Recovery of marked fish at Lakelse and Babine lakes was difficult since inoperation of the counting fences made it impossible to examine all fish readily and reliance had to be placed on observing marked individuals in the streams. It is hoped that better success will attend this work next season when a much larger number of marked adults should be available. (Appendix 4).

Tagging of salmon, chiefly sockeye, at the mouth of the Skeena resulted in 2,329 tags being affixed during the season. Subsequent recoveries were as follows: commercial fishery - 21.8%; Indian fishery - 11.1% and spawning grounds - 3.3%. The percentage recovery from the commercial fishery is relatively low as compared with other seasons (1944 - 40.1%; 1945 - 25.5%; 1946 - 30.1% and 1947 - 18.6%) and may have been due to inclement weather coupled with high water conditions. As in other years the Indian fishery exploited the

early run most heavily. Recoveries from the spawning grounds indicate that the Lakelse lake run occurs early and the greatest concentration of Babine sockeye enters the fishery in mid-season. (Appendix 5).

Lake surveys (Appendices 6 - 9) were confined to routine physical, chemical, meteorological and plankton studies at specified stations which have been maintained since 1945. A certain amount of gill netting was undertaken, except at Babine, in order to compare catches in 1948 with those of previous seasons. A series of net sets at Lakelse during February provided interesting data in comparison with summer sets.

Spawning stream surveys indicated a probably very limited seeding at Lakelse, (Appendix 10), a surprisingly heavy escapement to the Kispiox area (Appendix 11), excellent seeding in the many streams of Babine lake (Appendix 12) and a relatively poor escapement to Bear lake (Appendix 13). It was decidedly unfortunate that a washout occurred at one end of the Babine counting fence early in the season (Appendix 14), thus making the structure quite useless. Floods and abnormally high water occurred in all Pacific coast areas this year. Much of the repair work has been completed; the remainder will be done during low water next spring.

Predictions on the extent of the sockeye run in 1948 were that the low catch of 1947 would not be repeated and that as high as 60,000 cases might be obtained. The pack of approximately 90,000 cases was unexpected and was due in large part to an influx of four-year fish (Appendix 16), heralded, we now realize, by the large number of three-year-old grilse or "jacks" which were observed last year. It will be of interest to see whether a heavy run of five-year fish occurs next season, 1949. Analysis of the age composition of Skeena river sockeye (Appendix 18) reveals that in most years the five-year-old fish predominate, though in some seasons four year olds are more abundant.

General Salmon. This investigation, directed by Mr. Neave with Messrs. Hunter, Wickett and Robertson assisting and supervising some of the field operations, has as objectives an understanding of the present conditions of salmon fisheries along the coast, particularly pink and chum, an estimation of future runs and trends, a study of the factors governing the natural production of fry and seaward migrants and the development of methods for increasing such production. (Appendix 19).

In order to determine what takes place under natural conditions during spawning, during incubation and hatch of eggs and during seaward migration, two field stations have been established, one at Nile creek on the east coast of Vancouver island and the other at Port John creek, in the central coastal area between Namu and Ocean Falls. Here counting fences for both adult salmon and fry seaward migrants have been constructed (Appendix 21, 23) and records of percentage efficiency of natural propagation under varying climatic and stream flow conditions can be obtained over a period of years. For Nile creek, which is essentially a chum salmon stream (Appendix 20), a very low production of fry resulted from natural spawning in 1947-48, namely 0.38% of eggs deposited; at Port John creek, which not only chum salmon but also pinks, cohos and sockeye frequent, a record of 0.990% was obtained. For pinks in Port John creek a fry production of 0.866% occurred (Appendix 24).

Operations at both Nile and Port John creeks are being continued during 1948-49. The run of chum salmon to Nile is presently (November 23) in progress; that to Port John creek is over. Pinks, chums, sockeye and coho occurred, the two former in very low abundance. (Appendix 25). A good opportunity for testing the propagation of so-called "creek" sockeye is presented.

At Nile creek experiments are also being made to determine the value of adopting certain fish cultural methods to increase fry production. In 1947-48 it was found that by stripping the eggs from females, fertilizing them and planting them in a section of the creek where water flow could be controlled, a production of 3.40% of eggs available resulted, nine times the number obtained under natural propagation (Appendix 20), whereas if the eggs are placed in a hatchery and reared to the "eyed" stage before planting, a production of 10.62% was obtained, 28 times that from natural propagation. Studies of this kind are very important and records over a series of years must be obtained before conclusions can be drawn. Comprehensive records of weather conditions, stream flow, etc. are being taken and the relation of these factors to salmon fry production are being studied (Appendix 19). It is believed that if more field stations such as Nile and Port John creeks could be established in various parts of the coast much pertinent information could be obtained on the variation in efficiency of natural propagation as determined by varying stream conditions. Useful prediction data could be obtained concerning the probable size of runs of adult fish each year. Methods of overcoming hazardous stream conditions, either by stream control measures or by introducing some fish cultural procedures could be more widely and effectively tested.

Acclimation of salmon fry to salt water and the physiological processes concerned therewith have been the subject of study. (Appendix 22). Pink and chum salmon leave their freshwater environment and migrate to the sea as fry. Coho salmon, on the other hand, normally spend their first year in the streams where they are subject to heavy mortality. If this period of freshwater residence could be successfully reduced survival rates might be appreciably increased.

In an initial study of young pink and chum salmon in Departure Bay relative growth rates were determined, stomach contents examined, distribution and movement studied (Appendix 26). Diurnal changes are associated with available food supply. Group movement varies with the size of the fry.

Tagging of pinks and chums was again undertaken, this year in the Whale channel area, to determine migration routes and to obtain some estimate of fishing intensity. Recoveries of tags represented 30 percent of tags used for pinks and 16 percent for chums. In general most of the recoveries of each species were made in the tagging area. The fish appeared to be approaching their destination when tagged, with comparatively few showing long subsequent journeys north or south along the coast. (Appendix 27).

Age determinations of salmon are of value in indicating the normally dominant year groups for the various species in the many more or less distinct coastal areas and in enabling predictions to be made on the basis of the extent of previous cycle spawning escapements. Analyses of chum salmon scale samples collected in 1947 in several areas of the central coast showed

a dominance of four-year-old fish (70 to 90 percent) with a fair proportion of three year individuals. Samples taken at Sooke, at the south end of Vancouver island, revealed a different situation, however, with three-year fish representing 27 percent, four-year-olds 55 percent and five-year-olds 18 percent. (Appendix 28). For sockeye salmon in the Smith inlet area, the dominant age group was the five-year one (90 percent), substantiating previous years' findings.

For many years records of spring and coho salmon landings by the angling fishery at Cowichan bay, Vancouver island, have been collected. These data reveal the variations occurring, presumably naturally, in a salmon run over a period of years. In 1947 with 2,295 boats operating and 18,508 line-hours expended in the fishing, during the main period of fishing (six weeks) 3,751 coho salmon were taken, representing 4.9 line-hours per fish. This represents a marked improvement in both total catch and catch per unit of effort, as compared with the poor season of 1946 (6.3 line-hours per fish). A study of the correlation between availability of cohos to anglers (line-hours per fish) and the minimum summer flow of the Cowichan river two years previously reveals a very close relationship. It suggests that low water levels result in increased mortality among coho fingerlings through stranding in pools, increased predation and restriction of feeding areas, thus directly influencing the abundance of returning adults two years later. (Appendix 29).

Trawl Fishery. This investigation commenced a number of years ago as a study of the stocks of commercially-important flatfish in order to determine how these stocks were reacting to the then relatively heavy exploitation. It was felt that if intensive fishing pressure were maintained a decline in the populations might result. Suitable methods of regulating or control were desired. It was further felt that an attack on the problem should be made before any decline set in rather than afterward, thus enabling the investigators to know what might be considered normal and for what goal to strive if conditions deteriorated quickly.

Other species of fish besides flatfish are taken by trawl. Dragging for dogfish and lingcod is important and profitable, also for gray cod, black cod and various species of rock-fish. Some of these species, particularly lingcod and dogfish, were being taken by other types of gear as well, e.g., by sunken gill net, long line and by "jigging" for live lingcod which were kept alive until marketed. It was necessary, therefore, to expand the investigation and to include in its objective the rather complicated problem of competition between types of gear in order that where possible or feasible no important method of fishing would be destroyed.

The investigation, directed by Dr. Hart with Messrs. Barraclough, Ketchen, Manzer and Miss Bethune as assistants and with the M/V "Investigator No. I" as research ship, has endeavored to collect as much information as possible of significance to the conservation of the most important species, but has also very wisely maintained an interest in other fishes because of possible inter-relationships which may be intimately involved (Appendix 30). One very complicating feature is that certain of the species change in commercial importance rather suddenly. A year ago the rock sole was the most keenly sought species, now the brill is most popular. In certain areas one species will prove to be dominant, in others, other forms are most abundant. It becomes extremely difficult, consequently, to confine the research too narrowly.

abundance and availability. Correlations between seawater and air temperatures and percentage annual catch of pilchards were attempted but until other pertinent meteorological data can be included no definite relationships can be established. (Appendix 53).

Eulachon. Since 1941 catch statistics for the Fraser river eulachon fishery have been collected by Department of Fisheries officers and submitted to this Station for analysis, particularly as to the trend from year to year as influenced by the fishery. Records were again available for 1948 and show (Appendix 54) a very heavy fishing effort, a heavy catch, but a relatively low catch per unit effort.

Anchovy. Fishing for anchovy in 1948 was relatively poor. In many cases no fish were seen; in others the populations seemed very meagre. This may possibly be attributable to a small recruitment of two-year-old fish to the commercially acceptable three-year-old class. There is evidence that populations of anchovy in some of the bays and inlets of the coast are capable of successful reproduction and may persist for several generations if not fished too intensively. No indication of separate populations in various areas along the coast has been found. The range appears to be from the strait of Georgia, throughout the bays and inlets of the east and west coasts of Vancouver island and northward along the mainland coast to Ogden channel. (Appendix 55).

Albacore. Due to the generous cooperation of the Department of Fisheries the Station was able to place a biologist aboard the Fisheries Protection Cruiser assigned to explore the off-shore waters of the west coast of Vancouver island in search for albacore tuna this summer. There being nothing to indicate whether or not albacore would be encountered, in what abundance or where, it was impossible to envisage what information the biologist might obtain or what useful material he could collect. All that could be done was equip him with all possibly useful experimental fishing equipment, bathythermograph, thermometers, plankton nets, bottles for water samples, etc. and direct that he make all the observations he could as conditions permitted. It was suggested that he obtain specimens of albacore for measuring, sexing, obtaining scales and stomach contents and, if possible, release some alive bearing a tag. In short, it was felt that it would be largely exploratory work and perhaps lead to a more adequately designed experiment another season. Dr. Hart directed the programme, the field work being carried out by Mr. Scagel.

While, due to the nature of the duties of the vessel, no definite and connected survey could be accomplished and due to the size and speed of the ship, some of the collecting proved to be difficult, e.g., plankton collecting, much useful information and material were obtained. It was found that fish were taken in water temperatures ranging from 57° F. to 63° F. with most fish captured in temperatures of from 58° to 60°. (Appendix 59). Salinity seemed to show no significant variation throughout the area traversed. The colour of the water exhibited a gradual transition from intense green in the coastal region to blue-green above the continental shelf and thence to an intense blue. The temperature of the water increased to seaward, the green coastal being around 52° F., the blue-green approaching 57° F. and the deep blue ranging from 59° F. in northern latitudes to 64° F. and higher further south.

It is suggested that albacore distribution may be correlated more closely with temperature than with colour of water. Samples of water were collected to determine whether predominance of any organisms might contribute to the colour differences, but no analysis has yet been made (Appendix 60). Plankton samples were taken over a wide area, but have not yet been examined. It was noted, however, that microscopic forms and larger plankton, tunicates, worms, ctenophores, coelenerates and crustacea were abundant. Stomach contents of tuna were taken, but have yet to be examined. It was noted, however, that saury, squid, small rockfish and "red-feed" - probably euphausiids - bulked largely in the diet. Various types and colours of lures were tested to establish any preference. Both feather baits and fast-towing plugs seemed effective and any preference seemed to favour amber-headed feather baits with red and white feathers and green-headed feather baits with white and green feathers (Appendix 61). A total of 140 albacore were tagged but no recoveries have been reported (Appendix 63). Long-line fishing with baited hooks at different levels and gill-netting were tested, but without success, though the Japanese practice the former quite effectively (Appendix 64).

In addition to operations at sea, certain shore work was also accomplished. Port observers at Prince Rupert and Victoria measured a large number of albacore landed and it was found that while the length range ran from 53 cm. (21 inches) to 82 cm. (32¼ inches), there were two modes apparent, one at 63 cm. (25 inches) and the other at 75 cm. (29½ inches). These modes probably represent age groups but the exact ages cannot be assigned. (Appendix 57). Since 1946 tuna log-books have been issued to tuna fishermen in order to collect information on catches made, water temperature, position, etc. In 1946 only one book was returned; in 1947 six were received; in 1948 a goodly number came to hand. While the data submitted were complete and representative for the respective season, no useful compilation can be made since circumstances in the three years were so different. For example, in 1947 no fish were caught north of 50° N. latitude, whereas in 1948 over 62% were taken north of this parallel. In 1946 the optimum temperature appeared to be 61° F. In 1947 it was found to be 65° F. In 1948, as mentioned above, it was within the range of 58° F. to 60° F.

Herring. After many years of intensive biological study of our Pacific herring populations along the coast, during which much pertinent information has been collected relative to the life history and habits of the fish and the effect of the commercial fishery on the stocks of fish, it has become possible to attack the problem of how best to regulate the fishery so that the greatest maximum sustained catch can be achiefed.

Some years ago it was considered that perhaps a quota system of regulation would be most effective. This would permit a fishery to take what was considered a sufficient quantity of fish and leave an adequate supply for spawning purposes. It would, also, tend to stabilize the fishery and prevent years of "feast and famine". To test out the method, quotas were arbitrarily set for all of the important coastal areas where separate populations of herring existed (i.e. little intermingling occurred between them). The results were closely followed. In only one area, the lower east coast of Vancouver island, were the quotas selected found to be effective and they have thus continued to be used as an experiment in this type of management.

It was subsequently found that great variations take place from year to year in the success of spawning, hatch, survival of young and eventual recruitment of young fish to the herring stock. This was particularly the case in the west coast of Vancouver island area. It was observed that after years of heavy spawning heavy recruitment of young fish to the fishery did not always occur; conversely, light spawnings were frequently particularly successful in producing extensive additions to the stock. The question arose, therefore, as to whether, in view of such great natural variations in survival and production of young fish, quota regulations were really effective. Attempts to ensure large spawnings might only result in great wastage of fish which might have gone to the commercial fishery.

The importance of settling this problem which is basic to effective management of the fishery was realized. An experiment was therefore commenced in the 1946-47 season in the west coast of Vancouver island area whereby there would be no restriction to the commercial fishery except an annual closing date when the fish approached maturity and moved into shallow water to spawn. There are thus two experiments now under way, one involving quota regulation, the other permitting wide-open fishing.

The research activities on herring have therefore been largely confined to these two experiments, but a certain amount of work is also being carried on with regard to the herring stocks and the fishery in other coastal areas. where quota limits to fishing still apply. The work has for a number of years been directed by Dr. Tester but, with his departure on September first to the University of Hawaii on a year's leave of absence, the supervision has fallen to Mr. Stevenson, assisted by Messrs. McMynn, Lanigan, Glover (to September 30) and Outram (from November 1) and a competent staff of field technicians. (Appendix 66).

Three very essential phases of the work have been carried on over the years. These are collection of catch statistics, sampling and tagging. Accurate records of catch statistics are required (Appendix 67) in order to reveal the place and date of all catches, the number of active fishing days (fishing effort), the availability of fish (catch divided by fishing effort) and general abundance. These records are obtained chiefly from Pilot House Record books compiled by each seine vessel captain. Daily landing forms submitted by processing plants give the data on total catch from each area and method of disposal. During the 1947-48 season, 171,700 tons of herring were taken, the largest annual catch on record. In spite of increased fishing effort the west coast of Vancouver island fishery was 23 percent less than in the previous year. New runs came inshore during the spawning season, however, and resulted in a good seeding. A spectacular fishery developed in Ogden channel in the northern sub-district in late January and early February and resulted in a catch of 30,000 tons for this area.

Tagging experiments fulfil the dual purpose of revealing the extent of intermingling populations of herring between major districts and among the various areas of each district and of indicating the fishing intensity. Results of tagging in 1947-48 showed, as in previous years, that the west coast population is essentially discrete. Little intermingling between west and east coast populations occurred. Considerable mixing was again noted between individual west coast areas and the tendency for fish to wander in a south-

easterly direction along the coast was again indicated. For the west coast of Vancouver island the rate of exploitation in 1947-48 was approximately 2.7 times that in 1946-47. Data are not yet available for other districts (Appendix 68, 69, 70, 71). During tagging operations in the spring of 1948, a total of 45,577 herring were tagged in the strait of Georgia and along the west coast of Vancouver island (Appendix 72). Since tagging operations must have some detrimental effect on the fish tagged, observations were made on the condition of tagged individuals recovered at the shore plants (Appendix 73). All specimens showed completely healed wounds, with a scar on the inside of the body wall being the only visible evidence of the tagging incision. Usually the tags were found lying loosely in the body cavity or attached to the mesenteries of stomach, intestines or gonads by scar tissue. In a few cases tags were found imbedded in the gonads. More tagged males were recovered than tagged females, suggesting that the males survive the tagging operation more successfully. Tests conducted in Station retaining tanks showed a mortality from tagging of between 50 and 60 percent. (Appendix 74).

Sampling of herring catches throughout the season for each fishing area is a long, laborious task. It must be undertaken, however, if pertinent information is to be available on the fluctuations in abundance and size of the successive year-classes and their influence on the catch. During the 1947-48 season a total of 383 samples comprising 37,631 fish was examined (Appendix 75). The results thereof (Appendix 76, 77, 78, 79, 80, 81, 82) reveal the extent to which the various age classes (chiefly III, IV, and V, but occasionally also II and VI) contribute to the populations and result in a good, medium or poor fishery. An abundant age or year class normally boosts the population and hence the fishery for three years and therefore age-composition data are of great significance in preparing predictions (Appendix 86) which for the past few years have been of much interest and value to the industry.

Herring ground spawning surveys are made each spring by members of the staff of the Herring division and also by Department of Fisheries officers. They are useful in indicating the potential extent of spawning or seeding. In 1948 spawning was much more extensive than in the previous year and appeared to be quite satisfactory. (Appendix 83). The subsequent survival of eggs and young is of even greater significance in arriving at an estimate of the probable recruitment of young fish to the herring stocks and progress is being made in this phase of the work (Appendix 84, 85) by carrying out surveys along the west coast of Vancouver island during the spring and early summer months when herring larvae are present and are developing, through metamorphosis, into young herring. Studies are being conducted on movements of the larvae, abundance of food, predators, etc. Different types of collecting gear are being tested.

In 1947 and again in 1948 some enterprising fishermen attempted to try out a method of catching herring by trawl. Bottom trawls were used but have not proven particularly effective. It is conceivable that trawls designed to operate at intermediate depths may be more effective when used in conjunction with echo sounders which indicate the positions of the schools of herring. Very little experimentation was attempted this fall. (Appendix 87).

Oyster. Research in this field, under Mr. Neave's supervision, embraced only further experiments in rearing oyster larvae to the spatting stage in retaining tanks, a continuation of tests initiated two years ago. Unfortunately the large tank developed leaks which allowed too great an escape of water to be replaced by water preheated to keep the tank temperatures at a minimum of 20° C. The temperatures of Departure bay were too low this summer to permit pumping water direct. For most of July oysters were quite immature. Though by stimulation and subjecting them to rise in temperature spawning would occur, the larvae were very poor and short-lived. Salinities were low during early summer and until they reached 27.00 it was impossible to keep them more than 7 to 8 days. A temperature of at least 22° C. for the first 10 days gives best survival and development. After 10 to 12 days the larvae appear to tolerate temperatures as low as 18° C. for short periods. Control of flagellate protozoa in the tanks and elimination of larger forms appear necessary. (Appendix 89).

Whale. With the resumption of whaling off the northern west coast of Vancouver island this season by a new company, Western Whaling Corporation, it was agreed that a biologist should be stationed at the Coal Harbour shore plant to collect pertinent information required by the International Whaling Convention and to make such observations and obtain such material as might be of interest scientifically. (Appendix 90). This was done, the biologist working under the supervision of Dr. Hart.

A total of 182 whales were landed of which 113 were humpback, 39 finback, 2 sei and 28 sperm. Humpbacks therefore predominated, a characteristic apparently common in many areas when whaling is commenced, and which disappears as further whaling operations proceed. A large number of the 64 humpback females taken were pregnant; 38 were carrying young. Of the finbacks, only 13 percent of the females were pregnant. A large proportion were immature. All of the sperm whales were males. Sizes of whales varied according to species, the average lengths taken being as follows: humpback - 40 feet; finback - 58 feet; sei - 46 to 47 feet; sperm - 45 feet. (Appendix 91).

Much material has been collected for subsequent examination, such as ovaries, foetuses, parasites, stomach contents, glands, organs, etc.

Shrimp. During the summer season certain observations were made on species of fish and other crustaceans taken by shrimp trawlers operating out of Vancouver. (Appendix 92). Small specimens of rockfish, midshipmen, eelpouts, hake and whiting were abundant, flatfish and ling cod much less so. Stomach content analysis indicated that many of these fish were feeding on shrimps. While fishing in the strait of Georgia off Lasqueti island one shrimper landed a quantity of shrimp not commonly utilized commercially, **Pandalus montagui tridens** Rathbun. (Appendix 93).

Crab. Further tagging experiments were undertaken during the summer to determine for the populations of crabs along the north coast of Graham island the migratory habits of the crabs and the effect of present fishing intensity. The conditions in Naden Harbour, where a sizeable fishery has again been established, are being followed with interest. A quota regulation has been suggested to ensure no over-fishing. (Appendix 94).

Lobster. In June, 1946, the British Columbia Packers Limited purchased and brought to the Pacific coast a shipment of around 2,000 "canner" size Atlantic coast lobsters with a view to determining whether these crustaceans, commercially-valuable on the east coast, would survive and develop normally in Pacific waters and whether they would reproduce. The Fisheries Research Board consented to give scientific advice and supervision to this experiment.

The lobsters were duly delivered to and liberated in a well-enclosed salt-water lagoon on Lasqueti island. While it was originally intended to block off the lagoon and thus prevent outward migration of lobsters, the cost was considered prohibitive and no barrier was erected, it being thought that perhaps the shallowness of the lagoon outlet would discourage any large escapement.

For two years efforts to recapture lobsters in the lagoon have been made with indifferent success. Very occasionally an individual would be trapped. A small number of lobsters were kept in a retaining cage for observation purposes. These have done well and have moulted and mated satisfactorily. Growth rates have been comparable with those reported for lobsters on the east coast. (Appendix 95). One lobster has been trapped outside the lagoon.

During the summer of 1948 an attempt was made to hatch the eggs and rear the larvae from two berried lobsters. A small hatchery unit, similar to those used on the east coast, was provided. Larvae were hatched but all appeared to be premature and abnormal, attributable probably to very reduced salinities of the seawater as a result of Fraser river floods. A repetition of this work is proposed for next season. (Appendix 96).

Oceanography. Conditions of salinity and temperature in coastal waters of the Pacific coast were again investigated through the daily collection of surface seawater samples and temperature reading at eleven lighthouse stations along the coast. Previous years' data are being tabulated and mimeographed and to date all records from 1914 to 1943 have been compiled into six volumes and distributed to interested scientists, scientific institutions and government departments. (Appendix 97).

During the summer of 1948 an investigation of the approaches to the Skeena river was undertaken. (Appendix 99). The purpose was to describe the behaviour of the water discharged from the Skeena river in Chatham sound during maximum and normal runoff and to relate that behaviour to daily observation of river discharge, weather, and surface seawater observations taken at the Triple island lighthouse. From the records obtained it is anticipated that the movement of salmon from the ocean to the Skeena and Nass rivers may be more clearly delineated. This work formed a part of the programme of the Pacific Oceanographic Group under Dr. J. P. Tully, with Mr. W. M. Cameron as Associate Oceanographer.

Polychaete Studies. Mr. and Mrs. Berkeley continued, on a voluntoer basis, their taxonomic studies of Polychaete worms. A portion of their recent work is now in press, the remainder being prepared for publication. (Appendix 100).

Fish Parasites. Collections of marine fish parasites and of endo parasites from fish in the Skeena river system were made during the summer. Identifications are being undertaken by Dr. Adams. A survey of available published records and of manuscripts on parasites of marine fish in this area was made and a host-parasite list has been compiled. (Appendix 101).

ACKNOWLEDGMENTS

It is a pleasure to acknowledge the continued generous cooperation of the following agencies and the officers thereof whose kindly interest, assistance, advice and encouragement have made the season's work so pleasant and so effective: the Federal Department of Fisheries, the Provincial Fisheries Department, various Departments of the University of British Columbia, especially Zoology, the Water & Power Bureau of the Department of Mines and Resources, the Provincial Game Commission and other federal and provincial departments. The Provincial Fisheries Department again contributed financially to the herring and pilchard investigations and the personal interest and support of the Deputy Minister, Mr. George J. Alexander, have been most appreciated.

We are again deeply indebted to those fishing companies who, through Mr. R. E. Walker, Chairman of the Pacific Sub-Executive Committee, have so graciously loaned the Station fishing vessels when required. They are the British Columbia Packers Limited who made available vessels for both spring and fall herring operations, the Canadian Fishing Company Limited, Nelson Bros. Fisheries Limited and Francis Millerd and Company Limited. Without this assistance much of our herring field work would have been severely handicapped. In all cases the salaries of crew and operating expenses of the vessels were met by the Station.

The members of the Skeena river salmon consulting committee, Messrs. I. Urseth, Supervisor of Fisheries for District No. 2 (subsequently forced to retire due to ill-health and replaced by Mr. G. S. Reade), T. Wallace, C. E. Salter, W. Johnson and B. Kristmanson, continued to give valuable assistance and support to the Skeena river salmon investigation. Their sincere interest, suggestions and criticism have been most encouraging and keenly appreciated.

The visit of members of the Executive Committee and other Board members to the Station in June and to certain field stations was a happy event, very much appreciated by the staff of the Station. Such contacts as are thus made are of incalculable value, especially to the scientists, and it is regretted that they can not be more frequent. The interest and encouragement displayed by the Chairman and Vice Chairman have been most stimulating.

STAFF

During the year the Station suffered the loss of two of its senior scientists, Dr. Pritchard and Dr. Tester, members of staff who have been associated with the institution for many years. Such separations in order to enter fields of greater responsibility or to take up work of a different nature must be expected and accepted. It is a tribute in many respects to

training which results from service with the Board. Two of the Station's junior workers also left the staff, Mr. J. H. Glover, Junior Scientist, and Miss Winona Bethune, Senior Research Assistant, the former to enter commercial fishing, the latter to join the faculty of Victoria College. To each of our departing colleagues the staff extends sincerest wishes for every success.

Only two additions to the scientific staff have been made, Mr. R. G. McLynn, B.A. and Mr. D. N. Outram, B.A., both graduates of the University of British Columbia. Both have been assigned to the herring investigation. Mr. McLynn has had one season's field experience with the crab study on Graham Island, Q.C.I., while Mr. Outram has had two summers with the Skeena river salmon investigation.

Granted leave of absence to commence or continue post graduate studies are the following:

Mr. J. R. Brett, M.A., University of Toronto, for Ph. D.
Mr. K. S. Ketchen, M.A., University of Toronto, for Ph. D.
Mr. F. H. C. Taylor, B.A., Scripps Institution of Oceanography, for Ph. D.
Mr. W. M. Cameron, M.A., returned from Scripps Institution of Oceanography July 1st and has taken up his work as Associate Oceanographer with the Pacific Oceanographic Group.

PACIFIC OCEANOGRAPHIC GROUP

This unit of the Joint Committee on Oceanography which conducts cooperative research for the Royal Canadian Navy, the National Research Council and the Fisheries Research Board has proven to be a most useful and effective adjunct to the Station. The staff members are also members of the staff of the Station, though in some cases salaries are paid by one or other of the cooperating institutions.

P. O. G. has assumed responsibility for the lighthouse sampling work, has compiled five volumes of data related thereto and is now working on the remaining records (from 1944) to bring them up to date and continue with annual mimeographed compilations. It has undertaken a comprehensive survey of the waters off the Skeena and Nass rivers, reported elsewhere. Dr. Tully has completed his report and bulletin on the Alberni inlet survey and is endeavoring to put together the data collected several years ago in a study of the strait of Georgia.

At all times the members of P. O. G., when at the Station, are available for consultation on limnological or oceanographic problems and their interest and cooperation are most helpful. In turn the Station endeavors to provide suitable accommodation, facilities and advice on biological matters. It is hoped that the present cooperative effort, the pooling of interests and facilities, will enable the early initiation of the much-needed coastal and offshore oceanographic investigations referred to elsewhere.

BUILDINGS AND GROUNDS

New Biological Laboratory. Construction of the new, fully-fireproof building appears to be proceeding satisfactorily. Excavation commenced early in September and by November 30th the walls and columns of the second floor should be completed and the third floor slab ready to pour. According to a "Progress Schedule" prepared by the contractors, Dominion Construction Company Limited, the building is to be completed by mid-February. This may prove to be slightly over-optimistic. Already inclement weather has delayed operations several days. Considerable attention will have to be given to grading and appropriate landscaping and beautification of grounds once construction is completed. This will presumably be done next spring.

Warehouse. Utilizing sections of the old laboratory building a reasonably commodious warehouse has been built behind the Garage. Supplies and miscellaneous equipment are now conveniently stored, in charge of a competent store-keeper.

Boathouse-workshop. During the summer our boathouse-workshop, situated on the waterfront below the Chemistry Building and in course of being enlarged and renovated, was totally destroyed by fire. Wholely of frame construction the structure burned fiercely and all that could be done was to save the nearby Chemistry Laboratory and Director's residence. This was successfully accomplished due to the fact that the day was calm with no wind. The loss of a workshop has been keenly felt and it is hoped that a new building may soon be authorized. It is recommended that it be of cement or cinder block construction, hence partially fire-proof. Power tools and other equipment were also lost and must be duly replaced.

Fire Protection System. Plans have been prepared for a complete remodelling of the fire protection system in order to provide more water to a greater number of hydrants strategically placed about the buildings and grounds. A new fire pump has been installed to supply salt water to the existing system and is housed in a concrete-block pump house erected behind the retaining tanks. Delay has occurred in obtaining adequate supplies of pipe, but this matter is now well in hand. Walsh Construction Company Limited of Vancouver has given valuable advice and has submitted a tender to install the new piping, etc.

Grounds. Following completion of the new Laboratory Building relocation of existing roads and parking areas may be necessary. A new fence around the Station property will be required and steps will be taken to clear out underbrush and level off the terrain. The Station being a working institution, it is desirable to have the grounds reasonably attractive without being too artificial and too great an attraction for tourists and picnickers and requiring a disproportionate amount of Station appropriations for maintenance and upkeep.

VESSELS

At the present time the Station possesses only one vessel, the "Investigator No. 1", which is attached to the trawl fishery investigation. There is an urgent need for a competent ship for the herring investigation, one adequate to operate in west coast of Vancouver island areas for tagging work, larval herring studies, etc. A 70-75 foot vessel with adequate power is desired. In addition a replacement for the M/V "A.P. Knight" is required for general Station use. A vessel of a similar size and similarly equipped but with accommodation altered somewhat to make more effective use of space would suffice. A smaller vessel, 35 to 40 feet in length, will be required by the General Salmon investigation as the work expands.

PUBLICATIONS

The appearance of only one paper from this Station in the Board's publications (other than Progress Reports) during the year and the submission to the Editor of only three manuscripts - one for the Journal and two for the Bulletin series - deserves explanation. In some respects it may tend to signify a lack of attention to this phase of the Station's work, admittedly an important phase since proper dissemination of results of researches is highly desirable, but this is not quite the case. Reference to the list of manuscripts already submitted for publication will show that a goodly number (five) were presented before Section V of the Royal Society of Canada at the June meeting in Vancouver. With most of the investigations presently in a stage when voluminous data are being collected it is yet too early to draw significant conclusions and present results. Consequently there is a definite limitation to the number of papers which can be prepared. The Station is at the moment passing through a period when there are not enough small researches or problems in progress whose results can be quickly obtained and reported and the major investigations have not proceeded sufficiently far enough to report any particular phases.

Ten Progress Report articles have been prepared and published and a further issue is planned before the end of the year. Some of these articles might be considered suitable for the Journal, but distribution to the industry and interested scientists is much wider and quicker when issued as Progress Reports.

PUBLICATIONS DURING 1948

Barraclough, W.E. The Hag-fish (Polistotrema stoutii) in British Columbia. Prog. Rep. Pac. No. 75, pp. 57-58.

Brett, J.R. The design and operation of a trap for the capture of migrating young sockeye salmon. Trans. Amer. Fish. Soc. Vol. 75, pp. 97-104.

Cameron, W.M. Fresh water in Chatham sound. Progress Rep. Pac. No. 76, pp. 72-75.

Foerster, R.E. Fisheries Research in British Columbia. The Victoria Naturalist. Vol. 4, No. 8, pp. 87-91.

Prospects for Managing our Fisheries. Bull. Bingham Oceanographic Collection, Vol. XI, Art. 4, pp. 213-227.

Gibson, J.S.T. Lobsters and allied crustacea: Distinguishing points. Prog. Rep. Pac. No. 74, pp. 13-17.

Milne, D.J. and A.L. Pritchard. The true picture of the 1947 Skeena river sockeye run. Prog. Rep. No. 75, pp. 46-47.

McMahon, V.H. Lakes of the Skeena river drainage. VII. Morrison lake. Prog. Rep. Pac. No. 74, pp. 6-9.

McMynn, R.G. Crab fishing off the Queen Charlotte islands. Prog. Rep. Pac. No. 76, pp. 81-84.

Pritchard, A.L. Efficiency of natural propagation of the pink salmon (Oncorhynchus gorbuscha) in McClinton creek, Masset inlet, B. C. J. Fish. Res. Bd. Can. 7 (5), pp. 224-236.

Sockeye salmon tagging off the Skeena river in 1947. Prog. Rep. Pac. No. 75, pp. 40-42.

Ricker, William E. and R.E. Foerster. Computation of Fish Production. Bull. Bingham Oceanographic Collection, Vol. XI, Art. 4, pp. 173-211.

Robertson, J.G. Smith inlet sockeye. Prog. Rep. Pac. No. 75, pp. 31-34.

Tully, J.P. Pollution research in Alberni inlet. Prog. Rep. Pac. No. 76, pp. 66-71.

Withler, F.C. Lakes of the Skeena river drainage. VIII. Lakes of the Lac-da-dah basin. Prog. Rep. Pac. No. 74, pp. 9-12.

Observations of Sea Water Temperature, Salinity, and Density on the Pacific Coast of Canada. (Mimeographed compilations of daily records).

Volume I, including data from 1914 to 1934. Distributed - May, 1947.
Volume II, " " " 1935 to 1937. Distributed - September, 1947.
Volume III, " " " 1938 to 1939. Distributed - January, 1948.
Volume IV, " " " 1940 to 1941. Distributed - March, 1948.
Volume V, " " " 1942 to 1943. Distributed - July, 1948.

The distribution list of these volumes of raw data includes 23 agencies in Canada (46 copies), 21 agencies in the United States (26 copies) and 13 in Great Britain and western Europe (15 copies). In all cases the recipients have expressed keen appreciation of the records and many references to the great value of long-term continuous series of such data have been received.

Volumes VI and VII, bringing the records up to the end of 1947 are in preparation. Thereafter annual volumes will be issued for 1948 and succeeding years.

MANUSCRIPTS SUBMITTED FOR PUBLICATION

Barraclough, W.E. Measures of abundance in dogfish (Squalus suckleyi) and soup-fin shark (Galeorhinus galeus). Trans. Roy. Soc. Can., Section V, Submitted June, 1948.

Berkeley, E. and C. Annulata. Polychaeta errantia. Can. Pac. Fauna. Fish. Res. Bd. Can.

Black, Edgar C. and C.R. Elsey. The incidence of marine wood-borers in the coastal waters of British Columbia. Bull. Fish. Res. Bd. Can.

Hart, J.L. Increased abundance of an unusual British Columbia fish, the California pompano. Canadian Field Naturalist. Submitted April 4/48.

Age and growth rate in the Butter sole, Isopsetta isolepis (Lockington). Trans. Roy. Soc. Can., Section V. Submitted June, 1948.

Neave, Ferris. Fecundity and Mortality in Pacific Salmon. Trans. Roy. Soc. Can., Section V. Submitted June, 1948.

Pritchard, A.L. A discussion of the mortality in Pink salmon (Oncorhynchus gorbuscha) during their period of marine life. Trans. Roy. Soc. Can., Section V. Submitted June, 1948.

Tester, A.L. The efficiency of catch limitations in regulating the British Columbia herring fishery. Trans. Roy. Soc. Can., Section V. Submitted June, 1948.

Populations of Herring along the west coast of Vancouver island on the basis of mean vertebral number, with a critique of the method. J. Fish. Res. Bd. Can. Submitted July, 1948.

Tully, J.P. Oceanography of Alberni inlet. Bull. Fish. Res. Bd. Can.

Prediction of pulp mill pollution in Alberni inlet. Bull. Fish. Res. Bd. Can.

(with H.J. Hollister, R.L. Fjarlie and W. Anderson). A hydraulic model of Alberni harbour. Bull. Fish. Res. Bd. Can.

CIRCULAR SERIES (Mimeographed)

Hart, J.L. The Pilchard Situation. No. 11, 2 pp. January 24.

Hart, J.L. with W.E. Barraclough, G.C. Pike, Winona Bethune. Accumulated data on Albacore (Thunnus alalunga). No. 12, 12 pp. May 10.

Neave, Ferris and W.P. Tickett. Prediction of Salmon Runs. No. 13, 2 pp. May 11.

Milne, D.J. and A.L. Pritchard. Prospects for the 1948 salmon catch on the Skeena river. No. 14. May.

Stevenson, J.C. Prospects for the 1948-49 Herring Fishing Season. No. 15. September.

STAFF

PACIFIC BIOLOGICAL STATION

1948*

R.E. Foerster, M.A., Ph.D., F.R.S.C.	Director
J.L. Hart, M.A., Ph.D., F.R.S.C.	Senior Biologist
A.L. Pritchard, M.A., Ph.D.	Senior Biologist (to July 12)
Ferris Neave, M.Sc.	Senior Biologist
A.L. Tester, M.A., Ph.D.	Senior Biologist (to September 4)
J.P. Tully, M.B.E., D.Sc., A.I.C., F.C.I.C.	Senior Oceanographer
W.M. Cameron, M.A.	Associate Oceanographer (returned from leave July 1)
J.R. Brett, M.A.	Assistant Biologist (on leave from Nov. 1)
J.G. Hunter, M.A.	Assistant Biologist
K.S. Ketchen, M.A.	Assistant Biologist (on leave from Oct. 1)
D.J. Milne, M.A.	(Assistant Biologist (to March 31) (Associate Biologist (from April 1)
V.H. McMahon, B.A.	Assistant Biologist
J.C. Stevenson, M.A.	Assistant Biologist
F.C. Withler, M.A.	Assistant Biologist
W.E. Barraclough, M.A.	(Junior Biologist (to March 31) (Assistant Biologist (from April 1)
D.R. Foskett, B.A.	(Junior Biologist (to March 31) (Assistant Biologist (from April 1)
J.I. Manzer, B.Sc.	(Junior Biologist (to March 31) (Assistant Biologist (from April 1)
W.P. Wickett, B.A.	(Junior Biologist (to March 31) (Assistant Biologist (from April 1)
J.S.T. Gibson, M.A.	Junior Biologist
J.H. Glover, B.Sc.	Junior Biologist (to October 2)
J.A. Lanigan,	Junior Biologist
J.A. McConnell, B.A.	Junior Biologist
R.G. McMynn, B.A.	Junior Biologist (from May 10)
D.N. Outram, B.A.	Junior Biologist (from November 1)
J.G. Robertson, B.Sc.	Junior Biologist
F.H.C. Taylor, M.A.	Junior Biologist (on leave)
Winona Bethune, B.A.	Senior Research Assistant (to October 7)

Seasonal:

J.R. Adams, M.A., Ph.D.	Assistant Biologist (May 17 to Aug. 31)
Alice M. Hirsch, B.A.	Junior Biologist (June 22 to Sept. 4)

*As of December 1st, total staff numbered 62, consisting of scientists - 23, administration and clerical - 16, technicians - 17, boat crews - 6.

R.F. Scagel, B.A.	Junior Biologist (May 13 to Sept. 10)
D.F. Alderdice, M.A.	Senior Research Assistant (May 18 to Sept. 2)
W.R. Hourston, B.A.	Senior Research Assistant (May 1 to Sept. 11)
E.W. Burridge, B.A.	Assistant Technician (May 11 to Sept. 17)
B.M. Chatwin	Assistant Technician (May 11 to Sept. 2)
A.C. Johnson	Assistant Technician (May 11 to Aug. 31)
Dorothy M. Furk	Senior Research Assistant (May 3 to Sept. 17)
H. Godfrey, B.A.	Senior Research Assistant (May 13 to Sept.14)
D.N. Outram, B.A.	Assistant Technician (May 11 to Oct. 31)
G.C. Pike, B.A.	Assistant Technician (May 17 to Sept. 24)
H.W. Spencer	Senior Research Assistant (May 6 to Sept. 4)
J.W. Stokes, B.A.	Assistant Technician (May 7 to Sept. 12)
R.D. Harris	Assistant Technician (May 1 to Sept. 13)
M.D. Wheeler	Assistant Technician (May 1 to Sept. 11)
K.V. Aro	Assistant Technician (May 8 to Sept. 2)
S.B. Smith	Assistant Technician (May 1 to Sept. 2)
G.H. Towers	Assistant Technician (May 14 to Sept. 15)
T.H. Butler	Assistant Technician (May 17 to Sept. 18)
R.O. Palmer	Assistant Technician (May 25 to Sept. 15)
C. Berkeley, F.C.I.C.	Volunteer Investigator
E. Berkeley	Volunteer Investigator

Technical and Clerical:

G.B. Starr, B.Sc., M.E.I.C.	Civil Engineer (to May 31)
G.F. Hart	(Executive Assistant Grade 1 (to March 31)
	(Supervising Clerk (from April 1)
Ethel E. Robinson	Clerk, Grade 3
Irma J. Hilton, B.A.	Clerk, Grade 3
Evelyn M. Keighley	Clerk, Grade 2
E.K. Inch	Clerk, Grade 2 (from September 9)
Anne Brewer	Clerk, Grade 1 (to November 30)
Fay V. Collins	Clerk, Grade 1
Hazel J. Cox	Clerk, Grade 1 (from September 1)
Marjorie E. Elliott	Clerk, Grade 1
Enid M. Marsh	Clerk, Grade 1
Margaret K. Philp	Clerk, Grade 1
J. Martell	(Mainten. Super. Gr. 3 (to March 31)
	(Mainten. Super. Gr. 4 (from April 1)
T. Russell	Caretaker, Grade 4
A. Rigby	Caretaker, Grade 2
C.J. Morley	Storekeeper, Grade 1 (from November 1)
H.K. Pinchin	Ship's Captain
R.E. Hirst	Ship's Captain
R.A. Zanelli	Ship's Engineer (from July 28)
K.R. Sutherland	Ship's Engineer
R.T. Hearns	Ship's Mate (from July 1)
W.R. Brandon	Cook-Deckhand (from September 20)
R.H. Eaton	Technician Grade 1
E.V. Epps	(Assistant Technician Grade 2 (to March 31)
	(Technician Grade 1 (from April 1)
H.J. Hollister	Technician Grade 1

A.G. Paul	(Assistant Technician Grade 3 (to March 31) (Technician Grade 1 (from April 1)
W.G. Calderwood	Assistant Technician Grade 3 (to October 7)
W. Caulfield	Assistant Technician Grade 3 (from Nov. 1)
C.R. Forrester	Assistant Technician Grade 3 (from Nov. 1)
J.H. Larkman	Assistant Technician Grade 3
A.I.R. McLeod	Assistant Technician Grade 3, (from Aug. 30)
R.C. Wilson	Assistant Technician Grade 3
R.A. Wilson	(Assistant Technician Grade 2 (to March 31) (Assistant Technician Grade 3 (from April 1)
A.J. Dodimead	Assistant Technician Grade 2 (from May 3)
R.C. Issacson	Assistant Technician Grade 2
D.G. Odlum	Assistant Technician Grade 2 (from May 1)
W.L. Tait	Assistant Technician Grade 2
E.A.R. Ball	Assistant Technician Grade 1 (from July 15)
R.H. Herlinveaux	Assistant Technician Grade 1 (from Feb. 23)
K.J. Ross	Assistant Technician Grade 1 (from Aug. 1)
E. Baldwin	Watchman (from October 1)
L. Baldwin	Watchman (from Aug. 9 to Sept. 30)
B. Wildman	Watchman (from Aug. 25)

INDEX TO SUMMARY REPORTS FOR 1948

SKEENA RIVER INVESTIGATION

1. PROPAGATION STUDIES

J.A. McConnell and J.R. Brett — Appendix No. 1

Propagation Studies at Lakelse Lake

In 1946 and 1947, a netting type fence was installed in the lakelse river through which were enumerated the migrating yearling sockeye salmon. The temporary structure was replaced this year with a sturdier, more permanent one involving part of the adult sockeye fence built in 1947. Work on the new project began on March 21 so that the fence was operating on May 18, in spite of considerable delay occasioned by a late spring break-up. The screened panels, (8' x 10'), covered with small mesh seine notting, were inserted in slotted piling and arranged in a V leading to a central trap. This trap, a modification of the previous one, had a 4" x 4" timber framework and strong wire netting surrounding the four pens. The system of doors, leads and double bottoms which were installed, made the device more efficient in that virtually all the fish entering the trap were captured and held. Handling of the fish was reduced by use of a pair of large graduated tanks in which the volumes of all the migrants were taken and a sample of approximately 25% of the run counted to obtain the volume-number ratio.

The fence was only in operation for a few days before the effects of the unusually high water began to tell. The level reached a peak on May 29 which was 16 inches higher than the peak in 1946 and 21 inches higher than that in 1947. In spite of all efforts to brace and strengthen the panels, five were washed out on the night of May 29 and efforts to obtain a yearling count had to be abandoned. It is felt that the fence as designed but with additional strong permanent braces will be quite satisfactory in the future, the loss of the count this year being due to very exceptional flood conditions.

During the period of operation, May 18 to May 29, a total of 349,000 yearling sockeye were passed through the fence. A statistical treatment of the daily runs up to May 29 in relation to those of the previous years indicates that the sockeye migration would probably have totalled 1,500,000. This total would be approximately 3 times the 1946 run and 4 times that for 1947. It would indicate a percent survival to yearling stage of 1.93 from the 1946 seeding by an estimated 40,000 adults.

2. MIGRATION STUDIES

J.A. McConnell and J.R. Brett — Appendix No. 2

Marking of Sockeye Salmon Yearlingsat Lakelse Lake

It was planned to continue as in 1946 and 1947 the marking of 100,000 yearling sockeye migrating down the Lakelse river. However, the unexpected loss of the yearling fence early in the season prevented completing this, and in the three days prior to May 29 only 4,709 yearlings were marked by removal of both pelvic fins.

Appendix No. 3

V.H. McMahon

Marking of Sockeye Salmon Yearlings at Babine Lake in 1948

The marking of 103,906 yearling sockeye salmon by removal of the adipose and both ventral fins was carried out in the spring of 1948 from May 23 to June 9.

The method of capture was identical to that employed in 1947. Some difficulty was experienced this year when high waters threatened to wash out the lead, but this was overcome by the addition of supporting piles on the downstream side. As a last challenge to the fast rising water, the lead was extended in height and stilts were installed on the bottom of the trap.

A total of 468 was preserved for later analysis, this being approximately equal to 1/50 of one man's marking total. It was estimated that less than 1% of the fish caught died as a result of manipulation during the marking process.

Factors which might affect the yearling migration were again observed and recorded. These included water level and temperature, climatic conditions, the time range of the daily migrations, etc. In addition water temperature series were collected from seven points along the axis of the lake as far south as 10 miles from Fort Babine. The first 5 points were approximately 1 mile apart while the last 2 points were at 2-mile intervals. Temperatures were taken at the bottom, at the 20, 10 and 5 metre levels and at the surface. Most positions were sampled every 5 days throughout the marking period.

Another feature of this year's marking program was the observation from a high vantage point of the migration "routes" over the entire width of the lake. This was carried out about 5 miles south of Fort Babine. In general it was discovered that schools close to shore move faster and apparently with more directed movement than the offshore schools.

Appendix No. 4

D.J. Milne

Return of Marked Salmon in 1948

During 1948 a considerable number of recoveries of four-year-old individuals were expected from 100,967 young sockeye marked at Lakelse lake in 1946 by removing both ventral fins and from 88,972 marked at Babine the same year by removing the adipose and both ventral fins. In addition there might also be encountered a few five-year-old fish from smaller markings of 1945 (ca. 10,000) and a small number of three-year-olds from the 1947 experiments involving approximately 200,000. In order to assure adequate collection, an observer was stationed at each of the six operating canneries to examine all the sockeye taken in the Skeena gill net area during July. During August approximately one quarter of the catch was examined. Close observation was also maintained of the spawning adults on the streams tributary to Lakelse and Babine lakes.

From approximately 800,000 sockeye examined in the Skeena river, the following legitimate and undoubted marks were obtained: Babine - 327, Lakelse - 72. From cannery to cannery, the concentration of the Babine recoveries varied from 1 in 1900 to 1 in 5000 and the Lakelse marks from 1 in 7700 to 1 in 14,000. Since equal application was given to inspection throughout, the difference is attributed to the disposition of the various fleets, in relation to the migration routes. Fish from both lakes were apparently widely distributed through-

D.J. Milne Appendix No. 4

out the area to Stephens, Finlayson and Tugwell islands and at the mouth of the river. The Lakelse sockeye were obtained generally in the early part of the season with 70% of the returns being made by mid-July at which time only 40% of the Babine recoveries had been recorded. The greatest concentration of Babine recaptures was during the last three weeks in July. While the Lakelse run must still be considered early, the marking returns have certainly indicated a later effect than was previously shown by tagging.

A large number of fish (159) were discovered which had damaged fins or lacked one or more of the specified appendages. There is no doubt that the majority of these have been rightly ignored as natural deformities but it cannot be denied that some were the result of poor marking procedure. It is difficult to determine just how many should be considered as legitimate but as a result of observations on the spawning grounds it appears that approximately 10% might be so assigned.

The concentration of Skeena marked fish as determined by examining samples in areas definitely outside the Skeena influence, was low, e.g. Smiths inlet - 1 possible Lakelse in 1,000, Rivers inlet - 2 doubtful in 500, Butedale - 1 doubtful in 100, Lowe inlet - 0 in 7,000 and Nass river - 0 in 30,000. Off Banks island where Skeena fish are known to run, the numbers were 2 Lakelse, 1 Babine and 1 doubtful in 4,000.

The examination of 58,600 spawning adults at Babine produced 63 legitimate marks and 7 doubtful. The percentage of marked individuals with fins not cleanly cut was lower than the proportion on the coast but still amounted to over 10%. From 6,000 fish at Lakelse, 9 legitimate marks were recovered.

In general the total returns may be considered small when compared with other experiments but they have been valuable in demonstrating the distribution of the sockeye from these areas in point of time and place.

A.L. Pritchard Appendix No. 5

Salmon Tagging off the Skeena River in 1948

From June 10 to July 18, 1948, Captain Leask as in four previous years, seined for the salmon tagging in the northern areas. Two trips were made to the Nass area including Steamer passage and Finlayson island from June 10 to 13 inclusive and July 13 to 15 inclusive. The remainder of the time was spent at the mouth of the Skeena off Smith and Lelu islands. In all the following fish were tagged - Nass area - Sockeye - 121, Springs - 77, Coho - 6, Pinks - 123, Chums - 138, and Steelhead - 1; Skeena River Mouth Area - Sockeye - 2,342, Springs - 159, Coho - 9, Pinks - 19, Chums - 6, and Steelhead - 9. Since returns from the Nass tagging and from that for spring, coho, pink and chum off the mouth of the Skeena have been relatively limited and add little to the indications of migration recorded in previous years, the recoveries from the Skeena River Mouth area for sockeye only are treated herein.

Sockeye Salmon Recoveries. Of the 2,329 tags affixed to sockeye salmon, the following returns have been recorded to date: Commercial fishery - 510 (21.8%), Indian fishery - 261 (11.1% and spawning grounds - 77 (3,3%).

The percentage recovery from the commercial fishery (21.8%) is relatively low, cf. 1944 - 40.1%, 1945 - 25.5%, 1946 - 30.1% and 1947 - 18.6%. It is possible that the generally inclement weather early in the season coupled with high water may have had some effect in this connection.

A.L. Pritchard Appendix No. 5

Following the usual outline of the last four years, the percentage recoveries from each day's fishing varied greatly (13.3% to 61.9%). They were relatively low for fish off the Skeena river mouth up to June 27, high for salmon in early July dropping off on July 17 and 18.

As in other years, the Indian fishery exploited most heavily the early run, those present off the mouth of the river up to June 26. The drop-off toward the end of the run was, however, not so great as usual. This early fishing has been attributed to a desire to get fresh food as soon as possible after the winter. The total percentage recovery was 11.1 which is normal by comparison with 6.9 in 1944, 9.0 in 1945, 10.2 in 1946 and 12.2 in 1947.

The times taken for the sockeye to move upriver from the point of tagging as calculated from dates of tagging and return, show the same general progression as previously. They are as follows (1947 figures in brackets): to the eastern end of de Horsey island - 4.5 (5.6) days, Point Lambert - 6.4 (5.9), Terrace and Kitselas - 10.6 (14.3), Cedarvale, Kitwanga and Skeena Crossing - 20.3 (19.0), Hazelton, Hagwilget and Kispiox - 19.0 (16.7), Babine Lake streams - 37.0 (46.7) and Moricetown - 22.3 (25.4). Even though the fish remained in the lower river up to Point Lambert for a slightly shorter time in 1948 (4.5 as compared with 5.6 days), the limited value of the weekly closed season of forty-eight hours is again indicated.

Returns from the spawning grounds, though few, still show that the run to Lakelse is early. No tags were recovered there which were affixed after June 23. The greatest concentration of Babine sockeye was moving through the fishery just after the middle of July. On the whole, however, the runs were mixed.

3. LAKE SURVEYS

J.R. Brett and J.A. McConnell Appendix No. 6

Lakelse Lake

The regular physical, chemical, meteorological and plankton studies of Lakelse lake have been continued as in past years and amplified with monthly temperature series and plankton hauls taken during the winter months. Mr. V.H.B. Giraud, the fisheries inspector at Terrace, has been most helpful with this winter work.

Standard netting was reduced to 4 sets made during a winter trip in February and 5 sets in the latter part of June. The catch and catch per net-night are tabulated below:

	Winter - 1948		Summer - 1948	
Species	Catch	Catch per net-night	Catch	Catch per net-night
Peamouth	-	0.00	156	6.24
Squawfish	-	0.00	41	1.64
Cutthroat	14	0.70	13	0.52
Rocky mountain whitefish	3	0.15	13	0.52
Sculpin	-	0.00	2	0.08
Columbia large-scaled sucker	-	0.00	2	0.08
Dolly varden	2	0.10	-	0.00

J.R. Brett and J.A. McConnell

Appendix No. 6

It will be noted that the winter catches were very different from the typical summer catch in that no peamouth or squawfish were caught. The stomachs of the cutthroat trout contained 98% fish whereas in the summer they take only about 60% fish. The predation upon young sockeye, though, was much the same, the extra fish taken by the winter samples being sticklebacks.

Virtually all the available fish stomachs from Lakelse lake have now been analysed and these data applied to our knowledge of predation and competition.

V.H. McMahon

Appendix No. 7

Babine Lake Area

With the majority of the summer workers at the canneries from June 22 to August 3, relatively little lake work was carried out at Babine this year.

Water temperatures were taken and plankton samples collected at approximately two-week intervals throughout the summer at Stations I and III. Meteorological records were kept for Division I during periods of camp operation.

There was no attempt to catch fish by netting in the lake, but a series of trolling experiments were carried out in Division I. A weighted main line on which leaders and baited hooks were fastened at 5-metre intervals was let down and towed at slow speed. No fish were caught after several trial runs and the experiment was discontinued.

The sounding of Babine lake was completed in 1948 with a more comprehensive coverage of Morrison and Hagan Arms.

V.H. McMahon

Appendix No. 8

Morrison Lake

The work on Morrison lake in 1948 was confined to a one-day trip in July and a five day visit in August. Water temperatures and plankton samples were taken at Station III in both months, and a short netting program was carried out in August.

On the later visit a fourth netting position was set up near the north end of the lake, and was netted in a standard manner, i.e. a standard series of nets was set perpendicular to the shoreline with the large meshes inshore for the first set and the series reversed each succeeding set. This effort yielded a total catch of 10 Eastern Whitefish, 10 squawfish, 9 kokanees, 6 peamouth chubs, 2 lake trout, 1 burbot and 1 sucker. In addition, 3 experimental bottom sets were made using one or two nets at depths of 5, 12 and 25 metres in the hope of capturing predator fish. No such fish were taken.

D.R. Foskett Appendix No. 9

Bear Lake Area

This year a party was in the Bear lake area from July 21 to October 5. Temperature records were obtained, plankton collections made and a netting program carried out.

Temperature records show that the lake warms up until the second week in August and then commences to cool again. As was noted in 1947, layers of warm water sometimes occur in the cold water at various depths in the lake. The theory that these are caused by mineral springs seems to be the only reasonable explanation.

Plankton samples and transparency readings appeared to be normal, though a small algal developed in August instead of September as in other years.

The netting programme was extended to include sampling of the Bear river fish and additional areas in the lake especially over the sockeye redds. In 18 sets, a total of 73 net nights, 536 fish were caught of which 152 were sockeye, 27 were predators and 357 were other species. Netting in lake spawning areas to assess predation on the eggs in the redds accounted for the high catch of sockeye, a large proportion of which were returned to the water. Further netting in these areas in the spring when the fry are emerging from the gravel is essential for a complete understanding of the extent of predation in this type of spawning. That it may be considerable was evident from information gathered from the Indians regarding the catches of predators in the spawning areas in the spring.

4. STREAM SURVEYS

J.R. Brett and D.F. Alderdice Appendix No. 10

Lakelse Lake Area

In 1947 an apparently feasible and inexpensive type of fence was constructed in the Lakelse river to provide a count of the numbers of adult sockeye salmon entering Lakelse lake. It did not function properly due to the lack of a strong current to bring the fish into the pens. The fence was reconstructed this year in May and June with the short shear or funnel, built last year to increase flow through the pens, being extended almost to the banks. In addition, new pens were installed, designed to hold up water as little as possible. Although this did increase the current through the pens to approximately 5 miles per hour the fish still would not enter in satisfactory numbers. Considerable difficulty was also experienced in maintaining a seal in the clay bottom and it was felt that the shear would increase scouring in spite of sandbagging, etc. to the point where labour to maintain the fence would be prohibitive. Thus, after every possible effort had been made to ensure success, the project had to be abandoned.

If a propagation study is to be carried on at Lakelse it would appear that a more expensive platform and picket type fish fence will have to be constructed farther down the Lakelse river in swift flowing water.

The fence, operating at low efficiency, did capture 3,796 sockeye between June 19 and August 19. These were examined for marks, 2 being observed

J.R. Brett and D.F. Alderdice — Appendix No. 10

as were 6 ocean tags. A total of 298 sockeye was tagged at the fence. Lacking a fence count, a good estimate of the total run was formed by recording recaptures of these tags in samples of the population taken by seining in Blackwater bay. Four seine hauls were made on July 26, 27, 28 and 29 in this bay where the Lakelse sockeye congregate before moving into the spawning streams. Some 19 fence tagged fish and 986 untagged fish were recorded, giving by statistical analysis a total run of 15,000.

In the past, an estimate of the total run has been made by using a tagged to untagged ratio from counts made on the spawning streams. That method was not feasible this year even though the routine 8-day stream counts were made. Heavy rains caused unusually high and murky water in the main spawning stream, Williams creek, resulting in relatively small and inaccurate counts. Eliza and Scully creeks were less murky and on the basis of counts in them the distribution to the creeks was probably:

Williams creek	13,000
Eliza creek	800
Scully creek	1,200
Granite creek	0
Total	15,000

Granite creek, which in recent years has become increasingly jammed with logs and spread out, was inaccessible to salmon this year.

J.A. McConnell — Appendix No. 11

Kispiox System - Lac-da-dah District

In order to add another area to the year's stream observations it was arranged to accompany Fisheries Inspectors V.H.B. Giraud and W.K. Elliott on an airplane inspection trip to sockeye spawning streams in the Lac-da-dah basin. In the one-day trip on September 22, a landing was made first on Swan lake and surveys made of Falls creek and the upper end of Club creek. An amazing heavy run was spawning in Falls creek with approximately 10,000 fish jammed into the short spawning area. Also a school of several hundred were observed off the mouth in Swan lake. Spawning was at its peak at the time and large numbers of whitened eggs in all the pools and eddies gave evidence of egg wastage. Upper Club creek, the outlet of Swan lake, was well seeded, there being 550 live and 16 dead sockeye on this short spawning area.

A second landing on Stephenslake gave access to Lower Club creek, the main spawning stream of the area. Here 3,000 live and 550 dead sockeye were observed in the creek and in addition, a large school of between 500 and 700 coho salmon was present off the mouth in Stephens lake. A few coho and spring salmon were observed at the upper end of Stephens creek, which drains the chain of lakes into the Kispiox river.

The total sockeye escapement for the area was probably 15,000 but it is felt that because of the egg wastage in Falls creek, the effective escapement would have to be considered somewhat less.

F.C. Withler Appendix No. 12

Babine Lake Area

With the loss of an absolute count at the Babine fence in 1948 as a result of the washout, enumeration of the runs to the streams in the Babine area became essential. As in previous years, surveys were carried out at 8 to 10 day intervals, and in addition to the counts of live and dead fish, sex ratios, mark recoveries, water levels and obstructions were recorded. Comparison of the runs to various streams is given in the following table:

Sockeye Runs - Babine Area

	1946	1947	1948
Lower Babine river	9,000	10,000	15,000
Upper " "	9,000	10,000	12,500
Trail creek	100	75	0
Unnamed creek	0	0	0
Five Mile creek	50	200	1,300
Nine Mile "	1,000	600	3,900
Fulton river	100,000	115,000	115,000
Tachek creek	6,500	12,000	5,700
Sockeye creek	320	1,400	600
Pierre creek	16,000	19,000	19,600
Twin Creek	9,500	9,700	5,100
Pendleton creek	2,000	1,800	1,300
Fifteen Mile creek	28,000	25,000	25,500
Four Mile creek	1,100	1,800	3,300
Six Mile creek	340	800	2,700
Grizzly creek	3,500	4,900	8,800
Morrison river	20,000	28,000	30,000
Salmon creek	5,000	5,000	7,000
Total	211,410	245,275	257,300

Since the estimates of runs to streams in 1946 and 1947 totalled approximately one-half of the run through the Babine fence in those years, it becomes possible to estimate the probable run through the Babine fence in 1948. On the basis of the ratio in the past, the fence count this year would have been in the neighbourhood of 560,000, or approximately 40,000 greater than in 1947.

In terms of effective spawning population, the run to Babine lake in 1948 is much greater than in 1947. Precocious male or "jack" sockeye were much fewer than in 1947, when they formed 48% of the run through the fence. Thus, the effective escapement to the Babine area in 1948 could well be 200,000 larger than in 1947.

D.R. Foskett Appendix No. 13

Bear Lake Area Spawning

The count at the Bear lake fence and the subsequent recovery of tags on the lake shore indicated that the sockeye run to the area this year was the

D.R. Foskett Appendix No. 13

lowest recorded during the investigation. The stream counts, however, indicate that these runs were normal for the area and therefore the decrease must have been in the lake spawning population. The small number of sockeye recovered on the lake shore, 260, as compared to the 1,244 of 1947 supports this assumption. Adding to the sockeye tagged, those put over the fence which had tags, and eliminating recoveries from gill netting and stream recoveries, the net total of tags on the lake population was 132. The number of tags recovered from fish on the lake shore was two and four fish having unmistakable tag scars were found. That is a total of six tags for 260 sockeye, indicating a population of 5,720. While several factors tend to reduce the value of this estimate, it is directly comparable to that of 1947 which indicated a population of 40,000 sockeye for the area. As no tagging program was carried out in 1945 and 1946, estimates for those years cannot be compared with those of 1947 and 1948. From observation, however, it is known that the 1945 population exceeded the 1947 run by a very large amount and the 1946 run was equal to and probably better than the 1947 run.

The spring salmon run in the Beer river was as large as in 1945 when an estimated 9,000 spawned there. The run was at least two weeks later this year. Coho were present in approximately the same numbers as in previous years though spawning was just commencing towards the end of September. Pink salmon were absent as is normal in even-numbered years in this area.

In view of the very great fluctuations in the size of sockeye runs to this area and the desirability of knowing more about the conditions affecting the fry, it is recommended that the area should be examined during the spring months, especially with regard to water conditions under the ice and predation on the redds when the fry are emerging.

5. SALMON COUNTING FENCES

J.A. McConnell Appendix No. 14

Babine Fence

In the spring of 1948 work was started to put the Babine fence in condition for a third year of operation. A sixth trap was added, the panels drilled, and the pickets spaced with steel rods. It became apparent late in May that exceptionally high water levels were to be expected in June and the half of the panels which had been installed earlier were removed to eliminate strain on the fence. At this time additional filling was done with boulders around the cribbings on each bank. With receding water levels late in June, the panels were replaced and the fence sealed on July 2 for the expected beginning of the sockeye run.

A cautious watch was maintained on the structure for the next week and there was no indication of weakness. On the morning of July 9, however, a washout occurred which in a very short time cut a hole 15 feet into and under the east cribbing and 32 feet out and under the fence floor, removing the sheet piling and the new trap and reaching a depth of some 4 to 6 feet. The panels were removed immediately and attempts were made to block the hole. However, the strong force of the water made the efforts ineffective and the fence had to be declared inoperative for the season. It became necessary

J.A. McConnell Appendix No. 14

then to switch the manpower over to stream surveys and to preparations for repair of the fence during the fall low water.

It was decided to extend the fence at each end into the present abutment cribbings and rock fill them prior to filling the hole and re-driving the washed out sheet piling. Mr. O.A. Ragsdale, the original builder, agreed to do the repair work in the fall and in the meantime all possible preparations were made, viz. collecting rock for the fill, logs for piling and cribbing, transporting the lumber and piledriver to the fence site. The repair work commenced on October 2 and continued until November 2. Completion of the work will be carried out in the low water period of early spring.

D.R. Foskett Appendix No. 15

Bear Lake Fence

Construction of the Bear lake fence this year was accelerated by the use of one-inch mesh stucco wire and the fact that, despite high water, the framework of the 1947 fence was for the most part intact. However, the ability of the sockeye to break through the wire resulted, in the end, in a fence which was almost as heavily picketted as that of 1947.

The fence was in operation from July 27 to September 23, during which period it is estimated that 90% of the sockeye run entered Bear lake. The count of 3,021 sockeye represents a large proportion of the salmon entering the lake as it was very seldom that any hole was not patched within 24 hours. Of the sockeye counted through the fence 139 (4.6%) were tagged. The sex ratio was relatively even, 1,395 being females and 1,626 being males of which 45 were jacks. The two peaks recorded for the run, about August 10 and August 30 are believed to represent the peak of the stream and lake spawning runs respectively.

The count of coho this year, 191, was very similar to that of 1947 and as was the case then, large numbers were just below the fence at the time it was removed. Only 5 spring salmon entered the pens at the fence which is above the spawning grounds of this species.

Of the local fish populations, 76 rocky mountain whitefish, 23 eastern whitefish, 38 long-nose suckers were caught as well as one dolly varden char and one rainbow trout. Of these, the dolly varden char, 4 rocky mountain whitefish, 9 eastern whitefish and 16 northern suckers were tagged. One northern sucker tagged in 1947 was again captured at the fence and released.

6. STATISTICS

D.J. Milne Appendix No. 16

Commercial Fishery - 1948 season

As previous summary reports have reviewed the commercial fisheries in past years the present report will be confined to the 1948 season. In general it has been an exceptional year, especially for the sockeye fishery.

The weather, which was particularly fine for most of the spring and summer months may have been an associated factor. The spring flood of the Skeena river was the most extreme since 1936. It had been predicted that the 1948 sockeye catch would not repeat the low catch of 1947 (32,000 cases) but might be as much as twice as large. The catch recorded of three times this size could not be anticipated in the light of past data.

In detail, the sockeye fishing started off slowly, with daily averages of 30 fish per boat reported for the first two weeks in July. The average for the third week rose to 60, and dropped to 55 during the fourth week. Up until this time the catch had followed the upper range of expectancy. However the last week of July and the first two weeks of August produced catches which were the largest for the season with the result that the total catch was about 98,000 cases. This large catch late in the season gave a date for the 50% point at July 25, which is two days later than any season since 1935, the period for which detailed records are available. Thus the catch for this season could not be reliably predicted either in total or at the end of the first four weeks of fishing.

This season's large catch attracted and sustained the fishing efforts of 827 boats. With the exception of 1946 this is the largest number of boats licensed since 1941. These boats averaged over 50 fish per day and 1,500 fish for the season. As it is only three years since the last large catch in 1945 the regularity of the five-year cycle has been broken for the second time in the last twenty years. The fish comprising the catch were smaller (5.6 lbs or 13.4 fish per case). This small size and the lateness of the run may indicate that the large run of jacks in 1947 was probably followed by a large run of four-year-old fish. It remains to be seen if the age determinations will substantiate such a supposition. As the estimated escapement has not been wholly in keeping with the large catch, it would appear that the commercial catch may have taken more than the usual proportion (approximately 50% of the run).

The pink salmon catch this season of over 50,000 cases has followed the two lowest catches on record in 1946 and 1947. This indicates that the run for the even year cycle has probably reverted to an average condition and it will be interesting to see if the odd year cycle will do the same in 1949. The pink run appeared earlier in July from which a random sampling of 100 fish yielded 57% males. In August, 68% of the 156 fish sampled were males which is considerably lower than the percentages obtained for 1946 or 1947. The chum catch was again exceptionally high and the spring and steelhead catches were good. The coho catch was only fair so that for this species the catches have dropped each year since the peak catch in 1941.

In contrast to the Skeena salmon catches, it has been reported for southeastern Alaska that the sockeye catch has been the lowest on record and that the pink catch is lower than in 1947 or has been the lowest since 1927. The chum catches were good in both regions.

The general results from the oceanographic study of the dispersal of fresh water from the Skeena river indicate that during the sockeye fishing period the fresh water passes northwards along the shore to meet the fresh water from the Nass river in the northern portion of the Skeena gillnet area. This picture is in general agreement with the ocean migration routes of sockeye bound for the Skeena river as deduced from tagging experiments and fishing experience.

D.J. Milne Appendix No. 17

Indian Fishery on the Skeena River

As in previous years all the Indian fishing sites were visited during the summer. The final estimate of the number of fish taken in 1947 by the 2,200 Indians (650 families) on the Skeena was 41,000 sockeye, 5,700 coho, 6,700 spring, 1,800 pink, 13 chum and 1,900 steelhead. The estimates for 1948 are not yet available.

In the case of sockeye it was pointed out last year that these estimates may be low by as much as 50% and that the number of ocean tags returned by the Indian fishery appears much higher than would be expected. This is particularly true for 1947 and 1948 for in both years the Indian fishery returned approximately one-half as many tags as were returned by the commercial fishery. This year evidence was found of some tags which had been caught at the coast in the commercial fishery and were brought up river to be sold at such places as Kitwanga, Hazelton and Kispiox. Due to the flood conditions in 1948 the river was high and muddy throughout most of the summer. Associated with this the fish arrived from one to two weeks later at most of the fishing sites. In contrast to 1947 few jacks were caught in 1948.

The gillnet fishery in Nilkitkwa lake attained its normal requirement in both 1947 and 1948 despite the fact that there were fewer sockeye present in 1947, especially when the small jacks are not considered, than in 1948. This was accomplished by a greater effort in 1947 when 21 of the 23 smokehouses operated compared to only 13 in 1948. The 35 nets used in 1947 averaged 30 to 50 sockeye per night while the 25 nets in 1948 averaged 50 to 100 sockeye per night. In each year the deeper and longer nets brought up from the coast caught about twice as many fish as the nets issued free by the Indian Department.

At Moricetown falls the gaff fishery took 3,300 sockeye in 1947 and 8,800 in 1948, which is in keeping with the commercial catches. This year, as in previous years when a large catch is made, there was more evidence of wastage and of peddling fish to the whites in the district.

To complete the study of Moricetown falls as an obstruction to the salmon on their spawning migration, water levels were again recorded. The water was highest around June 5, dropping rapidly up to July 5 and more gradually during the rest of the summer. However, it remained at a higher level throughout than during any of the previous three seasons of observation. It appears that during this year's flood the Bulkley river was higher than in 1936 while the Skeena river north of Hazelton was lower. Probably this high water accounts for the fact that all species of salmon were about two weeks later in arriving at the falls and that less obstruction was presented by the falls than in other years.

7. AGE DETERMINATIONS

D.R. Foskett — Appendix No. 18

Age Composition of the Skeena River Sockeye Salmon Runs

During 1948 the reading was completed of sockeye scales taken in 1946 and 1947 incidental to tagging off the mouth of the Skeena river. A summary of the age composition for 1944, 1945, 1946 and 1947 follows.

Table I. Age Composition of Sockeye Salmon off the Skeena River Mouth

Year:		1944	1945	1946	1947
No. of samples		872	2,129	2,105	2,317
Age Class:	3_1	%	0.05%	%	0.04%
	4_1		0.09	0.10	0.12
	5_1		0.05		0.09
	3_2	0,34		0.19	11.18
	4_2	47.25	18.60	26.65	25.98
	5_2	41.40	58.90	58.34	53.04
	6_2	3.21	0.42	0.38	0.17
	4_3			0.10	0.86
	5_3	5.50	11.65	3.90	4.83
	6_3	2.29	10.15	10.31	3.58
	7_3			0.05	
	5_4		0.05		
	6_4		0.05		

The 1946 run of sockeye to the Skeena river consisted largely (58.3%) of the 5_2 year class. The other two year classes prominently represented were the 4_2 class (26.6%) and the 6_3 class (10.3%). In 1947 the 5_2 class represented 53.0% of the population and the 4_2 class represented 26.0%. The main divergence from the 1946 figures was in the 3_2 class which formed 11.2% of the fish sampled. This age class, composed almost entirely of males, formed the bulk of the "jacks" present in the 1947 run.

L.R. Foskett Appendix No. 18

Analysis of age of the tagged fish returned throws some light on the distribution of different age classes.

Table II. Age Composition of Tag Returns from Skeena River

Area:	Commercial fishery		Lower Skeena		Upper Skeena		Babine		Bulkley	
Year:	1946	1947	1946	1947	1946	1947	1946	1947	1946	1947
No. of Returns:	622	429	50	65	404	656	310	572	72	40
Age Class:										
4_1	. %	0.2%	%	%	%	%	%	%	%	%
5_1						0.2				
3_2		3.0		4.6	0.2	9.1	0.3	8.6		
4_2	23.6	17.0	18.0	26.2	23.3	33.4	21.0	35.3	27.8	12.5
5_2	60.8	69.2	66.0	58.5	68.1	53.7	77.4	54.0	34.7	57.5
6_2	0.2	0.2								
5_3	4.2	6.1	2.0	4.6	1.0	1.8	0.3	1.2	2.8	12.5
6_3	11.3	4.2	14.0	6.2	7.2	1.8	1.0	0.9	33.3	17.5
7_3					0.2				1.4	

Percentages of age classes taken in the commercial fishery in 1946 (Table II) do not vary to any great extent from percentages caught by the seiner for tagging purposes (Table I). Upriver recoveries (Table II) are shown with recoveries for the area from the commercial fishing boundary to Hazelton designated "Lower Skeena" and above Hazelton on the Skeena proper designated "Upper Skeena". The figures for the Babine and Bulkley river runs are also shown separately. From these it is readily seen that the age composition of runs to specific areas with different ecological conditions may show a great deal of variance both from each other and from the population as a whole.

In 1947 return of tags from the commercial fishery showed that the 5_2 class accounted for the bulk of the catch. Seine catches indicated that the 5_2 age class formed 53% of the population while gill net catches had 69% of the fish from this class. The jacks which formed only 3% of the gill net catches according to tag returns formed 11% of the tagged fish.

Upriver returns, which are chiefly Babine figures, in Table II show the main change from 1946 seems to have been an increase in the percentage catch of the 4_2 group and a decrease in the 5_2 year class. The Bulkley river returns, however, show increases in the percentage of the 5_2 and 5_3

groups with decreases in the 4_2 and 6_3 classes.

On the whole, the 1947 tagged fish showed a greater diversity of age classes with a more even distribution of fish in the age groups than was shown by the 1946 population.