NANAIMO, B.C.,

DECEMBER, 1944

FISHERIES RESEARCH BOARD OF CANADA

REPORT OF THE

PACIFIC BIOLOGICAL STATION

NANAIMO, B.C.

for 1944

By R.E. Foerster, Director

One of the primary functions of the Station is to conduct such investigations of the commercial fish and fisheries of the British Columbia coast as will make available to the Federal Department of Fisheries pertinent information necessary for adequate regulation or "management" of the fisheries in order to provide optimum sustained yields. Such investigations involve careful biological studies of the life histories of the species of fish and shellfish concerned, analysis of the existing state or trend of each fishery and recommendations as to future conduct or "management".

Life history studies may be fairly readily undertaken and completed, particularly if adequate samples of fish are easily obtainable. In fact the general life-history features of many of the species concerned in the present-day fisheries are already known. However when it becomes necessary to determine the variations in natural production of the species, as caused by varying favourable or unfavourable environmental conditions during egg-laying, development of young, etc., which in turn produce appreciable differences in the volumes of fish available to the fishery, the problem becomes not only complex but also requires many years' observation before reliable conclusions can be reached.

The influence of the fishing drain upon the stock of fish and upon the perpetuation of the population at a reasonably high level of abundance is as yet not fully understood. It has to be carefully studied over a period of years in order to segregate and evaluate the various factors concerned. When the varying fishing drain, as affected by number of boats fishing, weather conditions during the fishing season, the economic situation and the price of fish, is added to the natural variations occurring from year to year in the abundance of the fish, painstaking analysis of all factors must be made in order to determine how serious the condition is and what effect it will have upon future maintenance of the fishery.

It is of paramount importance, therefore, that there be obtained a reasonably accurate and clear understanding of the normal variations occurring in production of the species of fish and shellfish concerned and, where possible, a knowledge of the factors responsible. Remedial action may then become practicable. The fishing industry, and presumably the Fisheries Department also, is primarily concerned in having a relatively stable fishery each year rather than a highly variable one which produces a rich harvest one year and a struggle for survival the next. Until the basic facts of natural production are known, sta-

bility of the fishery within reasonable limits seems hardly feasible.

With respect to the various existing fisheries the methods of arriving at an understanding of what might be termed normal production and the natural variations therefrom differ widely between marine species and those anadromous species which proceed into fresh water for spawning.

In the case of the marine species (herring, pilchard, ling cod, flatfish, etc.) natural variations in normal production are likely to be less extreme and serious. Moreover since the fish usually reproduce more than once, any decrease in production occurring in any particular year class is partially compensated for by the contributions of older or younger year classes. One difficulty is that calculations of total abundance of marine species are extremely complicated and frequently impossible. Nevertheless it is possible, by stabilizing the commercial catches at a suitable level, to keep this factor, fishing mortality, a constant and study the normal variations in abundance of the population in relation to it. In this way, by a method involving a degree of trial and error, normal fluctuations may be evaluated and a comparatively stable fishery developed.

For anadromous fishes (salmon), however, the conditions are quite different. Here natural variations in normal production are very susceptible to wide fluctuation as the result of environmental conditions. There is relatively little overlapping of spawning age classes and unfavourable conditions during spawning and development of the young fish may have catastrophic effect, especially for those salmon which spawn chiefly in coastal streams. While it may be possible to calculate the total abundance of fish each year in any stream or coastal area the susceptibility of the species to sudden and wide fluctuation in reproduction makes it extremely difficult to predict, with any degree of accuracy, the size of future populations unless there are available reliable records of conditions existing in each area during the periods of spawning, incubation and migration of the young fish to salt water.

Such records can only be obtained properly by selecting typical streams in the different areas and, by accurate counts of ingoing adults and outgoing progeny, correlating the amount of production with the climatic and environmental conditions prevailing. The findings derived from the "index" stream may then be used to indicate the situation over the whole area and regulation of fishing accordingly planned, as is now done for pink salmon in south-east Alaska by the U.S. Fish and Wildlife Service.

Basically, therefore, to provide data on which to establish stable fisheries long-term programmes of research are necessary. Whether it be a study of a marine fishery fluctuating about an artificially-derived catch limit (quota) or of a salmon fishery regulated on a predicted "propagation estimate", many years' observations of the relation of the production of species of fish to the environmental factors occurring under natural conditions are required. A back-log of information is needed before any conclusions or predictions can be derived.

The acquiring of this fundamental background of scientific information for each important commercial fishery has been one of the objectives of the Station. Much progress has been made as far as the sockeye, coho and pink salmon, herring, pilchard and clam fisheries are concerned. In others a beginning has been made.

While one of the main functions of the Station is to investigate the status of existing fisheries, principally the major fisheries, one should not lose sight of the importance and potential value of extending and increasing the present minor fisheries and perhaps encouraging the development of new enterprises. There are at present exploited on the B.C. coast a number of minor fisheries, e.g., crab, shrimp, oyster, smelt, eulachon, which are limited largely to certain well-known fishing areas. It is quite conceivable that extensive populations of these species exist elsewhere along the coast and that their discovery may lead to wider exploitation, increase in employment and greater provision of marine food products. When personnel become available a comprehensive survey of coastal waters, the many inlets and channels, may reveal a wealth of products as yet untapped and make it possible for the Department to encourage fishermen, now interested in such minor fisheries as a means of livelihood, to settle in the more promising areas and develop the fisheries. Judging from requests which have come to the Station, interest in these minor fisheries to provide part-time employment and subsistence is growing. In order to assist in extending these minor fisheries we require a fuller knowledge of the general distribution and abundance of the species concerned. Consideration should be given to the possibility of anticipating fishery developments and initiating research before conditions become critical and investigation is demanded.

A third function of the Station may, perhaps, be the development of oceanographic studies of the more accessible and more highly exploited areas of the coast to reveal the factors affecting distribution and abundance of our food fishes. This matter was touched upon in last year's report.

One decidedly delaying factor in our research work has been the lack of adequate biological statistics of the various fisheries. In practically every case it has been necessary, in commencing a study of a fishery, to devise some system of collecting the necessary statistics which will give not only the total catch of the species concerned but also the catch per unit of gear per area. This means that the statistics commence only with the investigation and there is not available any back-log or accumulation of statistical records which might be turned to and used for early analysis of the trend of the fishery in question. Several years may elapse before the statistics are comprehensive enough to be of use.

For some years we have attempted to persuade the Department to institute a modern system of adequate biological statistics collection in order that pertinent information concerning the fisheries may become available. It appears that some such system is going to be eventually necessary, as the experiences of the U S. Fish and Wildlife Service, and the States of California and Washington, have shown, if proper management of the fisheries is to be assured. Hence, the longer put off the more serious the delay in putting the administration of the fisheries on a firm foundation.

If, as has sometimes been stated, it is the responsibility of the Station to collect its own biological statistics, action should be taken to set up the proper machinery, obtain the necessary authority to guarantee submission of fishing data and seek to avoid any duplication and unnecessary overlapping of present Departmental statistics of fish landings. It would be desirable to anticipate, as far as possible, the need for statistics in fisheries not now under investigation and make available an adequate back-log of information whenever closer study is requested.

For example, it has recently been reported that a serious decline has occurred in the sablefish (black cod) fishery of Alaska. Drastic restriction of the fishing is expected. What is the situation in the B.C. fishery? Is it experiencing decline? Is it even getting optimum exploitation? With no prior statistics capable of statistical analysis the questions remain unanswerable until the statistics are made available.

During 1944, not only were the regular investigations of coho and pink salmon, herring, pilchard, ling cod, oyster and clam continued (reports appear below and also in the appendices), but two new studies were commenced, concerned with the Skeena river sockeye and the coastal trawl fishery, respectively.

The former arises because of an indicated decline in the sockeye fishery on the Skeena river. It is desired to ascertain whether a decline has occurred and if so whether it is a natural cyclic phenomenon or is correctable. Is it due to overfishing, i.e., to too severe a fishing drain and too small a spawning escapement which it is beyond the capabilities of the natural regenerative powers of species to surmount or is it the result of increased mortality of eggs, fry or young fish in the streams and lakes?

The study, therefore, covers the whole of the life-history from the time that the adult fish approach the coast and enter the fishery until the young one or two year old sockeye leave the lakes for the sea. It embraces the coastal migration of the adult fish into and through the commercial fishery, the degree of fishing mortality or drain, the up-river movement, the possible identification of separate "races" or populations going to the various spawning grounds, the effect of the Indian fisheries upon the spawning stock, the extent of the spawning escapement in each area, the character of the spawning grounds in the many rivers and streams, the degree of successful spawning or egg deposition, the degree of success of hatch and migration of fry into the lake and the degree of survival of fry, fingerlings and yearlings during the one or two years' lake residence. During the whole of the period from the time the adult fish reach the spawning grounds to that when the fry move down to the lakes the state of weather and water conditions will be watched, the effect of unfavourable conditions analyzed and remedial possibilities sought. During the period from the hatch of fry and their movement into the lakes to the time of seaward migration of the smolts the influence of the populations of predator and competitor species of fish will be examined and, again, remedial steps sought.

In order to have the active co-operation of fishermen and canners and to assure that the practical aspects of the fishery are not overlooked a consulting committee consisting of representatives from the industry (selected by Mr. Walker), from the fishermen (selected by Mr. Deane) and from the Department of Fisheries was set up during 1944. One meeting was held at Prince Rupert in late September when the summer's activities were reviewed and plans for 1945 discussed. The members of the Committee are taking an active interest in the work and should be most helpful.

The trawl fishery study, on the contrary, represents the investigation of a fishery which has been carried out by a limited number of boats in B.C. waters and in a few areas only. A few bottom trawlers have operated in the strait of Georgia for a number of years with flatfish, gray cod and ling cod the main species sought. Perhaps the ling cod was the main profitable species. Now,

however, the flatfish are of special interest and attention is being given to the Hecate strait region where trawling has been relatively light, yet where abundant stocks of flatfish are believed, by fishermen, to exist. Unfortunately the Hecate strait waters are considered extra-territoral and it has been intimated that a large fleet of U.S. trawlers proposes to drag these areas next season. In this case exploitation may be very intensive.

In view of the apparent potential importance of the flatfish fishery and the likelihood of intensive fishing in the near future, the Department desired to have information on the abundance of the stocks of fish on the known trawling grounds, the species involved, pertinent life-history features such as spawning times, rates of growth, age at maturity, migration habits and, if possible, some idea of what fishing drains the populations in the various areas could withstand. In addition information is needed of the effect of trawling on other species of fish and of the effect of trawl fishing upon other fisheries (competition between gear). A certain amount of exploring in new areas may be undertaken to discover new stocks of commercially-exploitable species, preferably within Canadian waters.

Other species of fish besides flatfish will also be taken by trawling gear, such as black cod (sablefish), gray cod, dogfish (grayfish), and these will be given attention, also, in the investigation.

The efforts of the first year or two will be largely exploratory and fact-finding. A system of collecting adequate statistics must be devised and put into operation. The findings should point the way to proper regulation and management in maintaining, perhaps building up, this new branch of the fishing industry.

STAFF

During 1944 several additions to the staff were made. In April and May, respectively, Mr. Dudley R. Foskett, B.A. (Saskatchewan) and Mr. J. Roland Brett, M.A. (Toronto) joined the staff as Scientific Assistants in Biology to assist in the Skeena river sockeye salmon investigations. In November Mr. James I. Manzer, B.A. (Manitoba) and Mr. John D. Campbell, B.A. (McMaster) were engaged for the trawl fishery study. No separations from the staff took place although Mr. Tully and Mrs. Kelley continued to be largely "with us but not of us" due to the loan of their services to the Department of Naval Services "for the duration".

The addition of the two new major investigations, the Skeena river sockeye and the trawl fishery, has but accentuated the urgent need for more trained and experienced scientists on the staff. The senior scientists in charge of the various researches are responsible for direction and progress of the work and must, as well, carry out some of the actual field work until the plans and techniques are adequately conceived and so formulated and laid down that a junior scientist or field assistant can expertly follow them. Actually from one to two years must elapse before the new junior assistants are able to assume any appreciable degree of responsibility and meanwhile the burden of keeping close track of the progress of field work, ensuring that all pertinent phases

of the study are being adequately advanced and that the research has been properly designed to achieve the objectives falls on the senior scientist in charge. It has been a heavy load and too frequently it has meant that the senior men have had to spend long periods in the field at the expense of having opportunity to study the results being gathered and to assess their significance in relation to the objectives.

Consideration should be given to the appointment to the staff of an engineer, sufficiently qualified in civil and hydraulic engineering to take responsibility for construction and maintenance of counting weirs, also for designing and constructing whatever structures may be found desirable for improving existing water conditions in pink and chum salmon streams in order to assure greater production of young fish. Such structures as retaining walls, low dams, artificial pools, artificial raceways, prepared gravel beds, etc., may have to be tested. In order to acquire knowledge of fish movements and habits, the engineer should work closely with the field biologists for some time.

The complete list of the scientific staff is given at the end of the report. I should here like to express my deep gratitude for and sincere appreciation of the fine manner in which the staff members have assumed the extra burdens of the War period, have readily given of extra time and effort in furthering the researches assigned and have assiduously supported me in making the researches and the influence of the Station and of the Board of greater significance to the Department and the industry.

BUILDINGS

The time has arrived when the Board should seriously consider the necessity of providing a new, modern fire-proof administration and laboratory building for this Station. At the present time the staff is scattered throughout the old Station Building (built in 1908) and portions of the Residence Building. The facilities available have now become fully taxed.

With the increase presently taking place in the scope of the Station's work and having regard to the probable expansion if any appreciable part of the Post-War programme is undertaken, not only does added accommodation become necessary but it should be arranged so as to provide advantageous working conditions and high efficiency of operation. Reasonably sound-proof offices and well equipped laboratories are needed.

In addition, a separate building should provide accommodation for carpenter and machine shops, net loft, storage for field equipment, laboratory supplies and collections of biological material.

PUBLICATIONS

Four issues of Pacific Progress Reports appeared during 1944. One issue, No. 60, was given over to providing an author-subject index of all previous Pacific Progress Reports. The other three carried nine contributions from this Station. Three scientific papers appeared during the year in the Journal

of the Fisheries Research Board of Canada and eight in outside journals, including four to the Annual Report of the British Columbia Fisheries Department. Three bulletins were prepared and published in the Board's Bulletin series. A list of the Station's publications is appended hereto.

During the year a series of mimeographed Circulars was introduced, being intended to place quickly and less officially before the industry certain information and findings of particular interest or significance. Two such circulars have been issued, one by Dr. Tester on "Herring Catch Statistics. Lower East Coast Sub-District", the other by Dr. Hart, entitled "Commercial Utilization of the Slime Flounder". From acknowledgements received it appears that the Circulars have been well received by the industry. It is intended that they will appear at irregular intervals, whenever the occasion demands.

ACKNOWLEDGEMENTS

During 1944 the Station again enjoyed the active co-operation of both the Federal and Provincial Departments of Fisheries. The latter continued to contribute financially to the herring, pilchard and shellfish investigations. To Major J.A. Motherwell, Chief Supervisor of Fisheries for British Columbia and Mr. G.J. Alexander, Assistant Commissioner of the Provincial Fisheries Department, our grateful thanks are tendered for advice, suggestions and help freely given. We wish also to acknowledge the excellent assistance given in so many different ways by the field officers of the Department in their respective districts.

During the herring spawning season the Nootka-Banfield Company, Ltd., and Nelson Bros. Fisheries again provided seine boats for tagging work and spawning ground surveys. The British Columbia Packers Ltd., again allotted space in their Imperial Cannery, Steveston, for the installation of an induction tag detector and offered similar facilities at their Alert Bay plant. This co-operation has been deeply appreciated and has helped materially in furthering the herring field operations. All companies readily assisted, through members of their staffs, in the collection and submission of statistics, tags and tag records and many individual fishermen aided the various investigations by sending in marks, tags and pertinent particulars. To all concerned we extend sincere thanks.

Finally, it seems but fitting that the ever-ready help and advice extended so graciously and patiently by the Honorary Secretary and Honorary Treasurer should be gratefully acknowledged. Many have been the appeals and requests to these officers; responses have always been forthcoming.

INVESTIGATIONS

Brief references only to the various scientific investigations conducted by the Station are here given. Fuller reports are contained in the investigators' summaries which appear as appendices hereto.

SALMON. A knowledge of what variations normally may be expected to occur in natural spawning and the development of the young fish under naturally varying environmental conditions is fundamental to any attempt at management of our salmon fisheries. An understanding of the affecting factors and their possible control or correction is basic to any attempt at either stabilizing or increasing present production. The fact-finding studies, under Dr. A.L. Pritchard, of the natural propagation of pink and coho salmon in typical streams have therefore been continued during 1944. Migration studies of both species have also been carried forward to reveal not only the routes of travel but also where and to what extent the populations from certain rivers or coastal areas are tapped by the commercial or sport fisheries. A new investigation, the study of the sockeye salmon of the Skeena river, was commenced, the main objective being to determine what factor or factors may be limiting production of fish. A thorough analysis of the fishery and of the various phases of the fresh-water life history are involved.

Natural propagation of pink salmon. Six tests conducted at McClinton creek, Masset inlet, 1930-1940, had shown that from 6.9 to 23.8% of the eggs deposited on the spawning grounds had produced seaward migrating fry. Similar experiments were begun in 1943 at Morrison creek, east coast of Vancouver island, and resulted in a fry migration in the spring of 1944, which represented only 4.7% of the eggs deposited in the fall of 1943. The cause of the reduced production in Morrison creek has not been clearly established but heavy silting of the spawning beds is considered a likely detrimental factor (App. 1).

Natural propagation of coho salmon. Continuing the studies in two adjacent small streams - Oliver and Beadnell creeks - tributary to the upper Cowichan river, it was found that, of the eggs deposited, 15.2 and 19.5% respectively produced seaward migrating fry. Previous tests had given the following percentages: Oliver creek - 14.4, 11.8, 30.4, 26.0 and 25.6; Beadnell creek - 40.0, 30.1, and 16.3. Variations in climatic conditions are being studied to determine their possible influence on production or survival of eggs and alevins (App. 6).

Migration of pink salmon, strait of Georgia and Puget sound. During the summer of 1943 the Station and the Washington State Fisheries Department cooperated in an extensive pink salmon tagging experiment to determine the general distribution of pinks entering the inside waters of the strait of Georgia and Puget sound by way of Johnstone strait on the north and Juan de Fuca strait on the south. Individuals tagged in the former (34.5% retaken) found their way into almost every inlet from Alert bay to Puget sound, only 8.7% being recovered in the latter, while from the south (41.7% retaken) distribution from cape Flattery, through Puget sound and the strait of Georgia, to as far north as Knight inlet occurred. Returns from American waters amounted to 61.9%. A difference was noted in the periods when pink salmon, eventually recovered in the various larger rivers, Fraser, Nooksack and Skagit, entered and passed through the fishing areas. (App. 2).

Migration of coho salmon from the Cowichan river. In the spring months of 1942 and 1943 all the seaward migrating young cohos - fry and yearlings, respectively - from the spawning of 1941 were marked by removal of certain fins. During the summer and fall of 1944 adult coho bearing this distinctive mark were recovered in the commercial and sport fisheries and in Cowichan river.

A total of 21 marked adults was retaken over the whole of the open ocean troll fishing grounds from Langara island, off the north end of the Queen Charlotte islands, to Port Renfrew, at the south end of Vancouver island. In the gulf of Georgia area 15 were recovered by commercial gear and in Cowichan bay 8 were taken by anglers.

These recoveries when added to similar data of earlier years clearly show the wide distribution range and the extent to which the Cowichan cohos contribute to the commercial fishery in the various coastal areas. Undoubtedly the findings apply generally to other coastal streams. It is quite apparent that the commercial fishing drain occurs far from the parent river, also that any wide variations in production of young cohos in the Cowichan river area may have far-reaching consequences. (App. 3).

Variation in size of the Cowichan river coho run from year to year. In an effort to reveal the natural variations that may occur in the numbers of coho salmon running to an important coastal stream, observations have been made in the Cowichan river for a number of years. The size of the run is assessed by conducting tagging experiments at Skutz falls and checking the numbers of tagged individuals observed against the untagged fish seen on the spawning grounds of the various tributary streams. Only that portion of the river system above Skutz Falls is included in the surveys but this takes in by far the major portion of the population.

The estimates for the past three years are as follows: 1941 - 65,000, 1942 - 67,000, 1943 - 56,000. The 1943 run therefore showed a decline, though not a serious one (App. 4). This is further borne out by a statistical study of the angling fishery in Cowichan bay in 1943 when the line-hours per fish amounted to 6.5 as compared with 5.4 for both 1941 and 1942. For 1944 the spawning ground estimates have not yet been obtained but the angling statistics, showing 6.9 line-hours per fish, substantiate general observations made during the tagging operations at Skutz Falls that the spawning run was appreciably lower in 1944 than in previous years. In spite of an increased angling effort the total catch was appreciably lower both for coho and spring salmon (App. 8).

The behaviour of coho salmon ascending to the spawning grounds. A study of the distribution and movements of cohos tagged at Skutz Falls revealed that they distributed themselves generally among the many streams tributary to the upper Cowichan river and Cowichan lake. No reports were received of individuals dropping back to streams below the falls. Climatic conditions influencing the water flow and temperature characteristics of the river definitely affect the rate of up-river movement of the fish but from the past three years' observations it is found that the coho reach the spawning grounds from Skutz Falls, in from 15 to 30 days and have completed spawning in from 30 to 60 days (App. 5).

The Skeena river sockeye salmon survey. Migration studies involving both marking and tagging have been undertaken. In marking, i.e., the removal of certain fins from young, seaward-migrating smolts, the area of origin is known and subsequent recovery of marked adults in the ocean and during up-river ascent reveals the distribution of the population. At Babine lake, an important sockeye producing area, approximately 25,000 smolts were marked (App. 13) but at Lakelse the party arrived too late to intercept the run (App. 12). Recoveries of adults will not be made until 2 to 3 years hence, depending upon the age of the fish.

Tagging operations were conducted on the fishing grounds off the Skeena and in the river estuary throughout the fishing season. (App. 14). The greater part of the tagging took place in the river mouth and while most of the recoveries from this area were made in the gill net fishery (41.0 per cent.), some were obtained from the various up-river Indian fishing sites (6.9 per cent.) and others were collected on the spawning grounds (Babine lake only). Information was obtained as to the speed of migration up-river and the effect of the weekly 48 hour closed period. The operations in 1944 were in part exploratory and indicate clearly what extensions in the study should be inaugurated in 1945. Adequate taggings of fish in areas above the fishing limits and more complete coverage of known spawning grounds are evident needs.

The Babine and Lakelse lakes areas being the best known productive regions, field parties were assigned to each to carry out limnological studies and determine the populations of competitor and predator fish present. (App. 15, 16). The lake conditions may have a significant bearing upon the number and quality of young sockeye produced. Satisfactory progress was made in both districts. The Lakelse party was able to make observations on another nearby lake, Kitsumgallum (App. 15), while a third party penetrated into the remote Morice lake area (App. 17).

During the summer and fall the Director and Dr. Pritchard covered a large part of the lower Skeena area and the Bulkley and Babine watersheds, inspecting Indian fisheries, checking conditions in canyons through which ascending sockeye must pass, observing the character of spawning streams and generally obtaining an intimate picture of the whole situation. In the Babine and Bulkley areas surveys they were frequently accompanied by Fisheries Inspector A.R. McDonell whose advice and generous co-operation were most keenly appreciated. Departmental boats and guardians' services were placed freely at their service for which sincere thanks are tendered.

During mid-September an aerial tour of the more remote northern headwater regions of the river system was made (App. 22). On this trip the Director and Dr. Pritchard were accompanied by Fisheries Inspector McDonell, Mr. Geo. J. Alexander, Assistant Commissioner of the Provincial Fisheries Department and, for the first six days, Major D.H. Sutherland, Honorary Secretary of the Board. In all areas spawning sockeye were found and it was obvious that any real study of the river's sockeye production would have to include these areas and their sockeye populations. Many are readily accessible only by air and careful consideration is being given to the most feasible and effective methods of carrying forward such work.

The final season's activities of the field parties consisted of visiting all streams in their districts and counting or estimating the numbers of spawning sockeye (App. 16-21). By this means an estimate of the total spawning escapement to each area can be derived and some idea of the probable production of young fish reached. The spawning ground capacities of all streams are being calculated and the presence of obstructions or other features affecting full utilization of the gravel beds are being noted. It will be necessary to know as accurately as possible the total spawning escapement to all parts of the river system in order to calculate the relation of this escapement to the original size of the population, i.e., commercial catch plus Indian fishery catch plus spawning escapement, and to determine whether that escapement is sufficient for adequate perpetuation of the population at optimum level. Wherever improvements in spawning ground conditions are possible these will be given attention and wherever conditions for spawning and incubation of eggs can be improved, these too will be considered.

As an example of the general objective it may be pointed out that the 1944 commercial fishery caught approximately 800,000 sockeyes while the Indian fishery absorbed some 60,000 sockeye, according to Departmental reports. The tag returns showed that 41 per cent. of the fish tagged in the Skeena estuary were retaken in the commercial fishery and 6.9 per cent. by the Indians. This would suggest that not more than one-half of the total population had been taken by the two fisheries and that therefore a somewhat similar quantity of fish had passed to the spawning grounds. Yet in those areas where spawning escapement estimates were made only around 185,000 sockeye were found. Other sockeye populations seen could hardly account for more than another 65,000 fish, making a total of 250,000 on the spawning grounds. The discrepancy therefore is great and to produce a useful and reliable figure of the relationship between catch and escapement and the extent of the seeding upon which production of the next cycle's crop depends much greater refinement and extension of field observations is required.

The Skeena sockeye investigation is in charge of Dr. Pritchard, assisted by Mr. D.R. Foskett and Mr. J.R. Brett.

TROUT. The studies conducted by Mr. Neave in the Cowichan river system were confined, during 1944, to recovery of previously marked steelhead, Kamloops and cutthroats. The recoveries, 17 in all, confirmed previous findings that steelhead return to the river from the sea in their fourth year to spawn and that cutthroats spawn for the first time at three or four years of age, the males tending to mature at an earlier age than the females. (App. 24)

HERRING. The herring investigation, conducted by Dr. A.L. Tester and Mr. J.C. Stevenson, represents a definite attempt to take an entire fishery, arrive at an understanding of pertinent features such as abundance and availability, migration, inter-relationships of populations, age-classes, rates of growth, extent of spawning, etc., and set up a management programme which will tend to maintain a stable fishery at a high level of exploitation. There are four major populations along the British Columbia coast, each definitely distinct from the others in the matter of fishing and spawning grounds inhabited. In each the fishery has at present quite differing characteristics which make possible interesting comparisons in devising management policies.

The commercial fishery in 1943-44. The total catch amounted to 98,000 tons. Fishing in the northern area was again practically a failure, presumably due to the failure of the fish to move into inshore waters during the fishing season. In the central area the catch was unusually heavy (37,900 tons), and in the lower east coast of Vancouver island district, which is of particular importance because most of the catch is canned to fill British Ministry requirements, the quota of 30,000 tons was extended to 43,400 tons. The west coast of Vancouver island area contributed slightly less than 10% of the total. (App. 25).

Migration studies. Recovery of tagged fish again demonstrated the lack of extensive mixing between fish of major areas. An interchange of around 16% occurred. Tag returns from the unusual run to the Central area indicated that approximately 83.8% were local Central area tagged fish, 4.5% had been tagged along the north-west coast of Vancouver island, and the remainder had come from taggings along the upper east coast of Vancouver island. Two years of tagging of the strait of Georgia populations has shown two migration routes from the ocean, one at the northern end, Johnstone strait, the other in the south, strait of Juan de Fuca. Herring returning to spawn in the southern regions enter through Juan de Fuca strait while the northern populations pass in through Johnstone strait. Enroute to their spawning grounds they contribute to the fishery in intervening fishing areas but the degree of overlap on the fishing grounds, probably varying from year to year, has not been clearly established. (App. 26).

During the spring of 1944, some 46,000 herring were tagged on the spawning grounds. Approximately 30,000 of these were in the lower east coast of Vancouver island and Discovery passage areas, 6,000 in the Central area, 4,000 on the west coast of Vancouver island and 6,000 in the Queen Charlotte strait district. Individuals from these taggings are now being recovered in the 1944-45 fishery. (App. 27).

Herring Spawning Surveys. During the fishing season availability records are obtained which indicate the general abundance of herring on the fishing grounds but are not necessarily an index of total abundance of the population. This latter is actually the sum of the commercial catch and the residual spawning escapement. The commercial catch is known but calculation of the spawners is quite difficult. A system has been devised for examining the spawning grounds and estimating the "spawning intensity", i.e., multiplying the acreage of spawn by factors ranging from 1 to 5 to denote the relative heaviness of egg deposition. Knowing the egg content per female herring, some quantitative estimate of the number of spawners can be derived.

In 1944 spawnings in the lower east coast area were the lightest on record, perhaps signifying that the high catches of recent years have caused too heavy a drain on the population. On the west coast of Vancouver island the spawning was relatively light but essentially similar to that in 1943, whereas for the central area intensity was approximately one-half that of 1943. In the northern district spawning was somewhat heavier. These spawning ground estimates are largely made by Department of Fisheries officers and submitted to the Station for analysis. (App. 30).

R.E. Foerster and A.L. Pritchard

Appendix No. 11

The Skeena River Investigation - General Introduction

In 1943, the Department of Fisheries, alarmed at the apparent decline in the sockeye salmon catches on the Skeena river, which in 1942 and 1943 had dropped to the very low packs of 34,544 and 28,268 cases respectively, requested that a thorough investigation be initiated. The problem actually may be stated as: "What are the causes for the decline in the Skeena river sockeye salmon catches and what remedies can be implemented to overcome them?"

Several possibilities suggest themselves, namely:-

(1) Sufficient salmon may not reach the spawning grounds to produce the number of young necessary to maintain the runs. This may be due to overfishing, but it may also be due to removal of too many fish above the fishing boundaries illegally by irresponsible persons or legally by the Indians for food, or to the fact that the salmon cannot reach the good spawning grounds because of obstructions.

(2) If the spawning escapement is sufficient, the conditions for deposition, incubation and hatching of the eggs may be unfavourable. Many of these factors, such as adverse climate, perhaps cannot be remedied, but others such as maintenance of constant stream flow over the spawning beds, can be helped to some extent.

(3) Heavy mortality may occur in the nursery lakes where it is usual for the young sockeye salmon to spend at least one to two years before migrating to the sea. Physical, chemical and biological relationships in these areas may be entirely disadvantageous.

(4) Heavy mortality may occur in the ocean due to factors other than fishing.

For 1944 a broad programme of reconnaisance was laid out which could be handled by the personnel and funds available. Its main purpose was to give a general survey of the existing situation and to indicate on what phases of the life history future work should be concentrated to produce beneficial results in as quick a time as possible. The work may roughly be divided into four parts, viz.- migration studies, lake surveys, stream surveys, and investigation of the fishery drain. Brief comments on each of these sections are made in this report. The details of the findings are included in the appendices to follow.

Migration Studies

No knowledge of the factors affecting a run of fish can be gained if one does not know where the fish are to be found throughout their complete life history. No sound measures can be implemented to improve a run to any river unless it is known what factors operate and where they function to cause either an increase or decrease in numbers. It would be almost useless to restrict fishing at one time or place if the chief damage was being caused by overfishing at another period and in another area. It thus is essential to know the times and routes of migration of the various populations and the extent to which each of these is exploited in the different localities on the route.

Two methods are employed to gain such information. The first of these, marking, involving the removal of designated combinations of fins from groups of young salmon, provides data on the movements of the group throughout almost the whole life cycle. The second method, tagging or the affixing of

serially-numbered discs to the larger adult fish, provides facts on the behaviour of the individual during the later part of its life.

Marking experiments were begun in the spring of 1944 since it was deemed desirable to make a start even though no specific problem demanded the investigation of a definite run. Results will not be available for at least two years. To begin the series yearling sockeye migrants from the Lakelse and Babine areas, two important sockeye nurseries, were selected. In addition to the actual marking accomplished, much information has been gained as to the methods which should be employed in the capture of the fish for such programmes.

The tagging experiment of 1944 was designed to be exploratory and thus covered a wide range of areas in the northern district off the mouths of the Nass and Skeena rivers throughout the fishing season.

Lake Surveys

As has already been indicated, the young of the sockeye salmon spend at least one and possibly more years in the fresh water lakes or streams before migrating to sea. Conditions in these nursery areas will thus be of vital importance in dictating the number of young fish which can survive from a given seeding and eventually migrate to the ocean. Perhaps the physiography of the lake is such, i.e. deep with little shallow shore area, that food is limited and thus only a small population can be supported. Perhaps, due to the physical characteristics of the body of water, fauna and flora are plentiful, but the predators and competitors which also flourish under these good conditions, serve to keep down the young sockeye. The lake surveys were thus designed to include mapping of the general features, e.g. depth, drainage, etc., examination of the chemical conditions, e.g. oxygen content of the water, pH., etc., and netting to learn the other fish present as well as to indicate their abundance.

One field party under Mr. J.R. Brett operated at Lakelse and Kitsumgallum lakes. Another under Mr. D.R. Foskett worked throughout the summer in the Babine area. A third consisting of Messrs. D.F. Alderdice and D.K. Foerster made a short visit of about three weeks' duration to the Morice lake district.

Stream Survey

As an indication of whether the populations of salmon are being maintained, it is important to have a fairly accurate estimate of the escapement to the spawning grounds each year. All the spawning grounds must be known and inspected. During the examination records of accessibility and condition can be made as a guide to future recommendations for improvement or as a basis for prediction of abundance in later runs.

During the autumn of 1944 while the sockeye salmon run was in progress, periodic visits were carried out on the streams in the Lakelse, Kitsumgallum and Babine areas. A short trip was completed to the rivers at Morice lake. In addition, the writers in company with Inspector McDonell of Smithers covered many other areas in their travels over the watershed. Finally an aeroplane survey of the more remote localities produced data on spawning beds which had not previously been examined by officers of the Department. The summarized findings presented in the appendices to follow give a general idea of the extent of the watershed and a very rough conception of the distribution of the escapement.

R.E. Foerster and A.L. Pritchard — Appendix No. 11

Investigation of the Fishery Drain

Undoubtedly the greatest drain on the runs to the Skeena river is exerted by the commercial fishery. It may be that the exploitation is too great. Perhaps the exploitation on the Skeena proper is not too severe but damage is being caused in outside areas through which the salmon are migrating. For this reason certain general inquiries were initiated regarding the availability and reliability of statistics and much thought has been given as to how these could be worked over to advantage.

After the salmon pass the commercial fishery, they are subject to exploitation by the Indians who are allowed to take them for food. Limited general information and catch records for certain areas are available at present but it was considered desirable to examine the matter more thoroughly to determine whether a truer picture could be obtained. Accordingly the writers visited all possible Indian fishing locations, inspecting the local conditions and the methods of capture used, and endeavouring to work out an efficient plan for keeping a record of the operations.

During the first season's work many persons have contributed in help and advice. Particular thanks are due to Inspector Strachan of Prince Rupert for aid in collecting tags and for the use of his boat in getting to the various canneries, to Head Fishery Guardian Brynildsen of the Lowe inlet area for the collection of tags, and to Inspector McDonell of Smithers who guided us through many of the areas in the upper Skeena and provided much valuable information. Mr. J. Boyd, Mr. T. Wallace, Mr. C. Salter and Mr. J.H. Deane, all members of the newly-formed Skeena river advisory committee, gave invaluable active help.

Brett, J.R. — Appendix No. 12

Attempted Marking of Yearling Sockeye Migrants at Lakelse Lake

At Lakelse lake the initial effort at marking, commenced on May 25th, proved fruitless as no yearling sockeye were obtained at any period, either on this date or subsequent to it up to July 2. Many seine hauls were made on the Lakelse river at all times of day and night, particularly in one suitable locality across a large gravel bar at the mouth of Herman creek. Being unsuccessful at this point, other areas were tried, both in the river and along the shore of the lake. Although many fish were found in these hauls, including spring and coho yearlings, no sockeye were obtained.

In addition to the seining program a fyke net was set in the Lakelse river covering at least one third of its width. Here, too, other species of fish were obtained but no sockeye yearlings.

It thus seemed apparent that the run of yearling sockeye, at least for the year 1944, was virtually over by the end of May. It is proposed next year to be ready for the marking of yearling sockeye in Lakelse lake within a relatively short period after the ice break-up, probably about the middle of April.

D.R. Foskett

Appendix No. 13

Marking Experiment with Yearling Sockeye Migrants at Babine Lake

Fish for the marking experiment were captured by means of a beach seine. The first attempts involved dragging the net along over the beach in shallow water, bringing it in to shore, and removing the catch. Later it was found that greater efficiency was obtained by setting the seine in certain locations and closing it as soon as a school of sockeye entered. This was possible because the schools travelled in straight lines and their presence was usually indicated by some of the fish breaking water. When the surface of the water was broken by wind one of the party was placed in front of the seine pocket to act as a spotter. The sockeye when captured, were placed in a live box until the next day. They were then marked by removal of the adipose and both ventral fins and released.

The sockeye were found to run only in the evening; seining before 4 P.M. resulted in from none to three or four individuals. Schools were seen migrating down the lake before this time on only two or three occasions. Similarly schools were very seldom seen or captured after 11 P.M. though light conditions were very often adequate for spotting them. The catch for the evening could be approximately forecast by observing the weather conditions during that day. Clear calm days produced the largest catches. This may have been due to the ideal conditions for catching the yearlings but it is believed that it was the result mainly of the larger numbers moving. The runs on dull calm days when conditions for observation were equally as good as on clear calm days appeared to be only a fraction as large. This was borne out by the catches.

Seining for sockeye was commenced at the lower end of Babine lake just above the outlet on May 28. It was continued until July 7. During this period 25,347 yearlings were caught and 24,890 were marked and released. The mortality due to seining and marking was 1.24%. Two hundred and forty-three fish were retained as samples. One hundred and sixty-four fish previously marked were recaptured and released. The largest catch made in one evening was 3,613 fish. No definite period could be designated as the peak of the run due to the wide daily fluctuations. It is probable that the run had been in progress for some time before the experiment commenced.

Certain modifications of method were indicated through this year's experience. By reducing the length of the seine to 75 feet, greater ease of manipulation would be obtained with little change in efficiency. Catches could be improved by the general use of waist or armpit height waders.

The value of a trap in catching yearlings should be tested at Fort Babine as well as the value of various types of leads for concentrating yearlings in areas where seining conditions are ideal. Much information might be gained by having one party observe, capture and mark yearling sockeye throughout the Babine lake area, in Morrisch lake and in Nilkitkwa lake.

A.L. Pritchard Appendix No. 14

Sockeye Salmon Tagging off the Skeena River in 1944

In an effort to discover the time and routes of travel of the sockeye salmon migrating up the Skeena river to spawn and to assess the extent to which the run was exploited, 1,384 individuals were tagged in northern British Columbia in 1944.

Since the farther from the river mouth the fish are tagged, the greater is the area from which information can be collected, it was planned to seine in all available locations from the northern end of Dundas island to the northern end of Banks. It soon became apparent that in these outside districts schooling was not general and thus the numbers which might be captured by purse-seining were definitely limited and small. Toward the end of the season, therefore, tagging was undertaken closer to the mouth of the Skeena off Ridley and Smith islands where more sockeye could be obtained. Grouped according to more or less limited geographical districts, the numbers handled throughout the experiment were as follows: Ness area including Wales island, Steamer pass and Finlayson island - 13, Edye passage - 15, Principe channel area including End Hill and Mink Trap bay - 455, and Skeena river mouth area including the waters around Ridley and Smith islands - 901.

Total returns from the fishery - commercial and Indian food - have amounted to 569 or 41.1 per cent. If used as an indication of exploitation, this must be considered a minimum figure since many factors might serve to reduce the number of tag recoveries. According to districts the total recovery from the fishery varied from area to area, 23.1 per cent. for the Ness, 27.3 for Principe channel, 47.9 for the Skeena river mouth and 60.0 for Edye passage. While perhaps the small number of sockeye tagged in the Edye passage district did not constitute a sufficient sample, the high recovery of 60.0 per cent. is at least a warning that exploitation is heavy and should be carefully controlled. The low percentage return for the Principe channel area was undoubtedly due to the fact that most of the fish, 402 out of 455, were tagged at or inside the fishing boundary in Mink Trap bay. Many never came out where the fishery could reach them. The returns from the Skeena river mouth area are sufficient to allow comparison of the effect of the Indian-food as compared with the commercial fishery. In this year, of the total captured, the Indians took 14.4 per cent.

The data available indicate that exploitation as indicated by percentage return is low in the beginning of the season, higher in the middle, and low again at the end. Friday especially and Saturday to some extent, show lower percentage recaptures than other days of the week. This condition is attributed mainly to the fact that no commercial gill net fishery is allowed between 6.00 P.M. Friday and 6.00 P.M. Sunday, thus permitting some individuals to migrate above the fishing boundary.

The time taken for individual sockeye to move from the point of tagging to the point of recapture, as calculated from the recovery dates submitted, may be only roughly accurate. The averages submitted below do show a general progression: mouth of Skeena to eastern end of De Horsey island - 2.4 days, Point Lambert - 2.8, Terrace - 10.5, Kitwanga - 14.0, Hazelton - 12.7 Babine - 28.5 and Moricetown - 27.3.

Appendix No. 14

A.L. Pritchard

The fact that 21 out of 25 recoveries from the Principe channel area were local in distribution, viz. in Mink Trap bay and vicinity, is striking. The fish from Edye passage, on the other hand, were mainly discovered on their way to the Skeena. Of the sockeye tagged in the Skeena river mouth area, 419 out of 431 returns were from the river itself. The 12 remaining recoveries came from localities from the Nass river on the north to Whale channel on the south.

Location of tagged fish on the spawning grounds has proved a difficult task mainly because of the size of the drainage area, the water conditions and the limited help available. Tagged sockeye were taken, however, in several streams tributary to Babine lake but not in the Lakelse area although the search was equally efficient in both districts. This situation together with other facts on the time of occurrence of the runs has lead to the conclusion that the Lakelse sockeye had migrated mainly early in the season before tagging commenced.

The tagging programme herein recorded, while embodying only a small number of fish, has indicated the important general results which might be obtained. It would seem highly desirable to expand the tagging off the river mouth and to tag above the fishing boundary. With this increase in tagging effort should come an increase in the effort put into stream examination. There is little doubt that the data accruing, while perhaps confirmatory of certain general ideas now existing, will produce sound information on which to base regulatory measures.

Appendix No. 15

J.R. Brett

Survey of Lakes in the Terrace Area - Lakelse and Kitsumgallum Lakes

Of the various lakes and tributary waters that constitute the headwaters of the Skeena river there are two, Lake Lakelse and Lake Kitsumgallum, situated relatively close to Terrace, approximately 70 miles directly east of Prince Rupert. These two lakes lie in a basin between two mountain ridges extending roughly north and south from the Kitsumgallum area down to the Kitimat arm of the Pacific. Lake Kitsumgallum, or more commonly, Kalum lake, is 16 miles north of the Skeena river while Lakelse lake, somewhat smaller than the former is 8 miles south of the Skeena. At this point in the area drained by the Skeena river it is only about 50 miles from the southern extreme of drainage, (5 miles south of Lake Lakelse) to the northern extreme (10 miles north of Kalum Lake), thus forming a narrow neck of drainage which extends westward to the Pacific. To the north the drainage is via the Nass river while to the south of this area it is mainly to the Kitimat Arm, the latter being only about 20 miles from the southern tip of Lake Lakelse. These two lakes, although both small, being each about 5 to 6 miles long and averaging 1 to 1 1/2 miles in width, are the largest between Terrace and Prince Rupert and constitute important spawning grounds for sockeye salmon as they migrate up the Skeena river. A thorough investigation from the point of view of topography, lake limnology, fish population and sockeye salmon spawning intensity was consequently carried out on Lakelse lake with a less concentrated effort of the same nature on Kalum lake for comparative purposes

J.R. Brett Appendix No. 15

Lakelse Lake

Lakelse lake was discovered to be very shallow, particularly in the southern third which was at most only 25 feet deep, the greater part of this area being less than 15 feet. The deepest hole was found in the centre of the northern third, a maximum of 90 feet. Being so shallow and open to strong winds from the north and south the whole water volume rose quite rapidly in temperature as summer approached.

For the purpose of taking plankton hauls, temperature readings, oxygen concentrations and pH values at different levels in the lake, two stations were established and marked by buoys. The first was located at the deep hole, the second at the narrow opening of the mouth of the Lakelse river where the maximum depth was 24 feet. Because of the shallow nature of the lake and the strong wind effect the oxygen saturations remained very high at all levels, the thermocline being relatively low early in the season and the bottom temperatures almost 12°C. (53.6°F.) by the end of June.

The larger fish in most abundance were squawfish (Ptychocheilus oregonensis), common sucker (Catostomus commersonnii), peamouths (Mylocheilus caurinus), and cut-throat trout (Salmo clarkii), with whitefish (Prosopium williamsoni) and dolly varden trout (Salvelinus malma) less abundant.

From the gill net catches and seine hauls in the Lakelse river it was discovered that in late May and June a large proportion of the mature suckers, squawfish and peamouths migrated out of the lake into the Lakelse river to spawn, returning again to the lake. In any future study of the fish population in the lake great advantage could be taken of this migration and a program of tagging and marking of the adults carried out in the early part of the season with subsequent recoveries by gill netting in the lake.

All the fish caught by gill nets were measured, sexed, scales taken and stomachs preserved for later analysis. In all, 799 individuals were netted (531 by gill net, 268 by seine) during the months of June, July and early August, seventy-five per cent. of which were suckers, squawfish and peamouths.

Eleven gill nets, each fifty yards in length, were arranged in two gangs, one of six nets (meshes 1 1/2", 2 1/4", 3", 4", 5", 6") and the other of five nets (meshes 1 3/4", 2 3/4", 3 1/2", 4 1/2", 5 1/2"). These gangs were set in various recorded localities throughout the lake, usually from shore out to deep water. From the thirteen sets made, the catch per night-net (for fifty yards of netting) in order of abundance for the different species obtained was as follows:

Species	Catch per night-net
Squawfish	2.46
Peamouth	1.73
Cut-throat	.91
Sockeye	.84
Sucker	.64
Sculpin	.56
Whitefish	.05

Appendix No. 15

J.R. Brett

Kitsumgallum lake.

Kitsumgallum, or Kalum lake, although not much larger than Lakelse lake in area was found to be very different in many respects. The whole lake is one large basin of 300 to 400 feet in depth and, unlike Lakelse lake, very opaque by virtue of a fine glacial silt in suspension. The water temperatures at all times were found to be low, rarely exceeding 13°C. (55.4°F.) at the surface and constantly at 4°C. (39.2°F.) in the regions below 350 feet. The thermocline was relatively close to the surface in mid-summer, and the temperature of all the inflowing rivers between 7° and 10°C. (44.6°F. and 50°F.).

No squawfish or common suckers were obtained whereas the whitefish, peamouths, cut-throat and dolly varden trout were found in an abundance exceeding that for Lakelse lake.

To facilitate the work at Kalum lake only six nets were used (meshes 1 1/2", 1 3/4", 2 1/4", 2 3/4", 3", 3 1/2") and these were either arranged in one complete gang or set separately. In particular the peamouths were predominant in numbers, constituting over fifty per cent. of the total catch. Four sets were made with the following catch per night-net:

Species	Catch per night-net
Peamouth	10.68
Whitefish	1.88
Cut-throat	1.79
Dolly-varden	1.50
Sculpin	1.04
Spring	.88

Although these figures, when compared with those for Lakelse lake, indicate a more prolific population of fish, it cannot be concluded that in either case the abundance of fish is particularly great.

Appendix No. 16

D.R. Foskett

Survey of Babine Lake Area

The watershed of the Babine river is one of the major sockeye spawning areas of the Skeena river. Most of the sockeye spawned in this area spend their fresh water life in either Babine, Nilkitkwa or Morrison lake. A study of these lakes is thus essential to an understanding of the factors affecting these sockeye during their fresh water life.

The Babine lake system lies in a long valley with a general S.E.-N.W. direction. The shores and the country immediately surrounding these lakes is rolling and hilly rising to mountains several miles distant on either side. The highest of these mountains are situated at the northern end. The watershed on the eastern side is short throughout most of the length of the lake.

Babine lake is 110 miles long and about 10 miles wide at its widest point. It has, in addition, two arms approximately 8 and 10 miles long. While there are many small tributary streams, the main ones are Sutherland (Beaver)

river, Pinkut (Fifteen Mile) creek, Fulton river and Morrison river. Nilkitkwa lake is a widening of the Babine river a mile downstream from Babine lake. It is approximately six miles long. Morrison lake, tributary to Babine lake via Morrison river (Hatchery creek) is about nine miles long. As no boat was available on this last lake no work was completed on it this year.

Recording stations for physical and chemical data were set up in deep water off Topley landing (Sta. 1 - 350 ft.), Donalds landing (Sta. 2 - 520 ft.) and Fort Babine (Sta. 3 - 150 ft.). Soundings and plankton samples were taken mainly in the vicinity of these stations during the present year. In Nilkitkwa lake all data were gathered at one station where the water was 60 feet in depth.

The dissolved oxygen in the water was at all times sufficient to support a fish population. On only one occasion was the dissolved O_2 below 80 per cent. of saturation value in Babine lake. This was from 35 metres depth at Station 3 on August 26 and was 65.7 per cent. of saturation. The highest values obtained were towards the end of July and the beginning of August. During this period supersaturation values were found at all stations on Babine lake down to depths of 7.5 metres at Station 3 and 50 metres at Stations 1 and 2. This was probably due to the warming of the water at this period as in each case the temperatures at this time were the highest recorded during the summer at their respective stations. These temperatures however were not excessively high in absolute values, the maximum being 18.5°C. (65.3°F.) at Station 1 on July 25.

The thermocline at Station 3 was located between 5 and 10 metres during the period in which readings were taken. It was considerably deeper, 10 to 20 metres, though less marked, at the other two stations. This was undoubtedly due to the greater wind action at these points mixing the surface waters to these depths. Below these depths the waters are very cold with temperatures ranging between 4 and 7°C. (39 and 44.6 °F.). The water at all stations and at all depths was slightly basic. Nilkitkwa lake presented much the same conditions as the surface waters of Babine lake.

Plankton hauls were taken at the stations established in Babine and Nilkitkwa lakes but plankton forms were not abundant in any location.

Gill netting was carried out during July and August. Twelve settings were made of a 550 yard gang constituted of 50 yards each of 1 1/2, 1 5/8, 2 1/4, 2 3/4, 3, 3 1/2, 4, 4 1/2, 5, 5 1/2, and 6 inch mesh. Two sets were made with a 200 yard gang made up of 50 yards each of 1 5/8, 3, 4 1/2 and 5 1/2 inch mesh. A total of 276 fish was caught. Of these 204 were retained as specimens and the rest were released. Of those released 27 were tagged and 22 were marked by clipping off their ventral fins.

The following species which are listed in order of abundance were taken: northern sucker - Catostomus catostomus; sockeye salmon - Oncorhynchus nerka; rocky mountain whitefish - Prosopium williamsonii; eastern whitefish - Coregonus clupeaformis; lake trout - Cristivomer namaycush; chub - Mylocheilus caurinus; kokanee - Oncorhynchus nerka kennerlyi; squawfish - Ptychocheilus oregonensis; ling - Lota maculosa; rainbow trout (steelhead) - Salmo gairdneri; common sucker - Catostomus commersonii.

D.R. Foskett

Appendix No. 16

The catch per 50 yard net per night was:

Northern sucker	.51
Rocky mountain whitefish	- .37
Eastern whitefish	- .19
Lake trout	- .12
Chub	- .11
Squawfish	- .04
Ling	- .04
Rainbow trout	- .02
Common sucker	- .01

In addition the following kinds were captured in seine hauls along shore: coho salmon - Oncorhynchus kisutch; shiner - Richardsonius balteatus; bullhead - Cottus asper. Certain fish are known to be present but were not caught at any time during the season. Spring salmon - Oncorhynchus tschawytscha; cutthroat trout - Salmo clarkii; dolly vardon char - Salvelinus malma. It is believed that there is also a species of cisco present in the lake.

In addition to the marking and tagging mentioned above a collection of the stomach contents of fish of all species was made. These will be analysed in order to learn their food habits and their role in the ecology of the lake. Scale samples were kept for age determinations.

The gill net catches indicate that the fish are not numerous and are inclined to spottiness in distribution. Most of the individuals taken were small. Though the lake was not adequately sampled in all areas, from the results of the netting it is not believed that the lake would support a commercial fishery.

A more intensive netting program next year would be necessary to finally check these assumptions.

Due to the large size of Babine lake, it is recommended that two parties be assigned it. One of these should have a boat capable of speeds in excess of 20 miles per hour in order to minimize the constant waste of time in travelling. Also a portable boat and motor of some type should be provided so that information can be obtained on tributary lakes such as Morrison and Salmon (Tahla) lakes.

D.F. Alderdice and D.K. Foerster

Appendix No. 17

Survey of Morice Lake Area

The survey of the lakes in the Morice area was limited in scope due to the fact that the main purpose of the party visiting the district was to survey the salmon spawning streams and attempt to estimate the escapement. Certain pertinent data have, however, been discovered and are submitted herein.

Morice lake lies in a basin between two mountain ridges which almost completely encircle it, only the north-east shore, in the region of McBride lake and the entrance of the Nanika river, being comparatively flat. From the north-east extremity where it is drained by a single large river, the Morice, it extends south-west for a distance of nearly thirty miles. With the exception of a large bay, atna bay, which stretches westward for about four miles near the

D.F. Alderdice and D.K. Foerster — Appendix No. 17

centre of the lake, it is only from one to two miles in width. The lake is approximately thirty-five miles directly south-west of Houston, not far from which the Morice river enters the Bulkley.

Morice lake is a cold-water glacial-fed lake with numerous fast flowing glacial streams draining the nearby high mountain areas. Most of these streams are very precipitous, carrying large quantities of silt part of which is deposited at the outlets forming extensive deltas. Despite this glacial silt the lake is comparatively clear, visibility being possible to a depth of fifteen feet in most places.

In the centre there is a large basin over 500 feet in depth, while the majority of the lake is at least 200 feet deep with steep rocky shores. The surface temperature was approximately 13°C. (55.4°F.) in early September and approached 4°C. (39.2°F.) at a depth of 200 feet, the thermocline occurring in the region of 60 feet.

Extending in a line almost parallel to Morice lake and eight miles distant from it to the southwest are McBride lake, Stepp lake, Kidprice lake and Nanika lake, all draining either directly or indirectly into Morice lake. With the exception of McBride lake these latter lakes may be dismissed from the point of view of sockeye spawning since all migration into these waters is blocked by a falls at the upper end of the Nanika river.

With the exception of air travel, the only means of getting to the lake is by way of Morice river or by pack horse. The Morice river is close to fifty miles in length and quite treacherous in many places. Only skilled boatmen can manoeuvre up it and then only with the aid of a powerful out-board motor. Despite these hazards a boat was piloted up the river by Indians into the lake and a boat-house built by the research party near the base camp, located on the extreme north-east shore.

The second means, by pack horse, is difficult and long, requiring the aid of an experienced guide, considerable equipment and about four days travel. In view of the experiences in this respect it would seem advisable to enter the lake by air, thus overcoming the hazards of the trail, reducing the time of the journey and also reducing the expense involved.

J.R. Brett — Appendix No. 18

Spawning Ground Survey - Lakelse Lake Area

In 1937 and 1938 short investigations were made of the Terrace area by the Fisheries Research Board while in 1939 a thorough examination of the sockeye run in Lakelse lake was made by Dr. A.L. Pritchard and Mr. Wm. Cameron. A fence was erected at the mouth of Williams creek, the main spawning area of sockeye salmon for that lake, and a complete count with an additional tagging program made. These figures are the most accurate ones available for comparison with later studies, although some estimates are to be found in the records of the Dominion hatchery maintained at Lakelse from 1922 to 1936. A brief description of the Lakelse area and some of the creeks entering that lake is contained in earlier reports. Further investigation and mapping of the creeks was carried on with particular reference to available spawning areas and stream blockage.

J.R. Brett

Appendix No. 18

As previously stated Williams creek was of major importance in this survey. It was found that after three miles of the river have been traversed the gradient changes fairly rapidly from about one foot rise for over 150 feet of stream bed to a one to twenty-five foot ratio. This steeper gradient only extends for a little over one half a mile and then falls back to a ratio of about one foot rise to over 110 feet of river.

The character of the river bed changes distinctly with this increased gradient to one of large rocks and boulders with little area possible for spawning purposes. The flow is obviously much more rapid and the turbulence of the river is greater. In addition to this the river is jammed with trees and logs at this point and has been forced to follow a varied course around and among these obstacles. However, the flow is good and the jam is not sufficiently tight to prevent salmon from passing up-stream, nevertheless just about at the three mile level the sockeye cease to occur and are not found at any point above this region.

The first adult sockeye to enter Lakelse lake were taken on June 22nd. By early July they were observed in schools off the mouths of Williams creek and Scully creek and by August 7th had started to migrate up these streams. The complete run of adult sockeye was virtually over by September 17th.

On July 27th and 28th 600 sockeye were tagged off the mouth of Williams creek. Although these fish were congregated in large schools right at the mouth of Williams creek it is interesting to note that tagged fish were obtained in nets at the extreme opposite end of the lake, and that in each of the creeks where more than 100 salmon were counted, tagged fish were also observed.

The total number of tagged dead and untagged dead sockeye counted for the Lakelse area was 30 and 1245 respectively. The calculated total number of sockeye entering the lake from the tagging ratios equalled 24,900 or approximately 25,000. With the exception of Williams creek all the creeks entering the lake are of such a nature as to afford relative ease in making total counts of the live and dead salmon present. From these records and the tag returns the following estimates have been made of the distribution of sockeye to the different creeks:

Williams creek	-	20,000
Eliza creek (tributary of Williams)	-	2,000
Scully creek		2,300
Granite creek		500
Others		200
Total		25,000

The figures quoted here are an indication of the relative importance of the various creeks entering Lakelse lake with respect to abundance of spawning sockeye. Eighty per cent. of the fish ran up Williams creek. Although it is true Williams creek has always been by far the most important of the spawning streams at Lakelse it has become relatively more important through the decrease in numbers of salmon frequenting certain of the other creeks. In particular Granite creek has gone down to a low ebb. The main reason for this decline is found two hundred and fifty yards up from the outlet where felled trees

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have sufficiently jammed up the old water course, forcing it to traverse both over and underground in such a way that a complete barrier to further migration of salmon up-stream is presented. One other creek of past importance which now is hardly worthy of mention is Salmon creek. This at one time appeared to be over-spawned. The factors responsible for the drop in run for this stream are as yet unknown. It appears, however, to have changed course and to be somewhat reduced in flow at present.

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Spawning Ground Surveys - Kitsumgallum Lake Area

The eight principal rivers tributary to Kitsumgallum (Kalum) lake are of two main types. The first, which would include Douglas creek, Falls creek, Maroon creek and Camp creek, is that of the very fast flowing mountain run-off, characterized by white water, many boulders, little gravel or sand and with no salmon migrations up-stream. Each of these rivers has a gravel and sand deposition area at the outlet, which, though relatively small, probably provides some spawning grounds for salmon.

The second type is that of a fairly slow flowing, heavily silted, wide river passing through rather flat country in the lower reaches of its water course. This type includes the Nelson river, the Cedar river and the Kalum or Beaver river.

The Nelson river is exceptionally opaque, carrying a considerable amount of glacial silt which is deposited over a large delta at the outlet. A falls is reported to exist not far upstream. Whatever the reason, however, no salmon migrate up this river.

Very similar in many ways although not as opaque or silty, is the Kalum or Beaver river. There are numerous outlets, six in all, forming a large delta of several islands and an extensive "flats" some distance out into the lake. The river breaks up into many branches further upstream in low-lying marsh land in the wide valley between the mountains which it drains. It also receives the complete flow from the Cedar river about one mile up from the lake. It is questionable to what extent salmon travel up this river and spawn. They certainly travel up the first mile as they can be found in the Cedar river. None were observed nor could any definite reports be obtained concerning the existence of runs further up into the low flat valley of this river. About one quarter mile up one of the two main outlets is a log jam of considerable dimensions. The flow is partly blocked and diverted to either side of the jam, however, it is not a complete barrier to movement of salmon upstream but must be continually getting worse.

The Cedar river, the main sockeye spawning river for this area, is a little faster flowing than the Kalum river. The water visibility is fairly poor above the entrance of the Little Cedar river, four miles from the lake. This latter river deposits a very heavy silt into the Cedar river, making it extremely opaque from this point down to its entrance into the Kalum river. On the average the river does not appear to have good sockeye spawning grounds. It is characterized by many boulders, and, when spawning, the fish choose

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definite spots here and there along the edge, often from 50 up to 400 yards apart. There are a number of side channels which are quite clear and in which a proportionately large concentration of fish was observed. For the ten miles of river course utilized to varying degrees by the sockeye, the majority of salmon counted were in these clear side-channels eight to ten miles up the river.

Two rivers remain which do not fit into the above general classification. These are Clear creek and Dry creek. Both these flow into an inlet on the north-eastern end of the lake which is continuous with one of the outlets of the Kalum river. Dry creek is spring fed and is reported never to change its flow or level. Although clear and cold with apparently good spawning grounds for about one mile, sockeye are found to spawn only close to the outlet. Clear creek is very similar to Dry creek but considerably larger than the latter. There are a number of sloughs and side channels in its lower drainage area which is flat and covered with reeds and rushes. Further up it is quite shallow and appears to have changed its course a number of times in recent years. Approximately two and one half miles of the river are used for spawning by the sockeye.

As far as the lake itself is concerned, certain restricted areas were being utilized by the sockeye for spawning purposes. Observation is so limited because of the opaque nature of the water that it is almost necessary for a fish to break water before it can be either located or recognized. However, sockeye were observed to be spawning along the edge of the lake from a point just beyond the outlet of Falls creek north to Rosswood, a distance of less than one half mile. This area has a gradually sloping sand and gravel edge with clear spring water seepage at many points. No other area observed in the lake had the same combination of characteristics, with the probable exception of one or two small beaches.

The task of estimating the number of spawning sockeye is thus exceptionally difficult by virtue of the opaque nature of the water, Clear creek and Dry creek being the only exceptions. With this reservation the following figures are listed as estimates of the number of sockeye spawning in the Kalum lake area.

Cedar river	6,000
Clear creek	2,000
Dry creek	200
Kalum lake	1,800
Total	10,000

D.R. Foskett, Appendix No. 20

Spawning Ground Surveys - Babine Lake Area

The first sockeye caught in Babine lake was taken at Fort Babine on July 4. Sockeye were still at the head of the Babine river on October 8 but it is unlikely that these would be migrating up the lake. Spawning had commenced in some of the creeks by the fourth week in July. Other creeks still had spawning populations on October 15. Sockeye spawning apparently is at its height during the first week of September.

D.R. Foskett — Appendix No. 20

The main spawning streams in order of importance this year seemed to be: Fulton river, Babine river, Tachek creek, Pierre creek, Twin creek and Morrison river (Hatchery creek). The last four had populations of approximately the same size. Six other streams had populations of the general order of 5000 fish. These were Four Mile creek, Fifteen Mile creek, Grizzly creek, Nine Mile creek, Salmon creek and Six Mile creek.

All the above streams have a recognizable percentage of bed rock or boulder area. Sockeye in all cases spawn in these areas as well as those generally judged suitable for spawning.

Several streams were examined for adult sockeye in which no sockeye were seen. These streams were without exception unnamed. Several areas were not examined as thoroughly as was desired due to lack of time.

Spawning conditions seemed on the whole to be normal. Some of the streams appeared to have a number of eggs exposed on top of the gravel. It is presumed this was due to slight overcrowding. One or two of the smaller streams were badly obstructed but the small runs present in these cases seemed to find adequate spawning gravel. The obstructions had the effect of making it easy for predator bears to catch the salmon in one of the streams. This was the only case noted this year where predation by animals on the redds amounted to more than one or two per cent. Indians had been taking sockeye on the redds at one small creek.

Counting fish on the redds could be presumed to be reasonably accurate in the smaller streams. On the larger streams and on these streams with dark coloured water the error is apt to be very large. Runs were discovered in two streams where no runs had been previously reported. It is likely that other unreported runs also exist.

The following list includes the known spawning streams in the Babine area with the populations obtained from counts or estimates. The estimates are marked with an asterisk. Babine river *20,000; Trail creek 169; Unnamed creek 75; Five Mile creek 571; Nine Mile creek 5,045; Bear Island creeks 32; Fulton river *35,000; Tachek creek 14,021; Sockeye creek 2,255; Pierre creek 13,246; Twin creek 13,500; Pendleton creek 350; Fifteen Mile creek 5,200; Four Mile creek 6,107; Grizzly creek 5,100; Six Mile creek 4,110; Morrison creek 12,785; Salmon creek *5,000. This gives a total of 142,566 sockeye. As counts on streams are almost always low it is likely that the population of the known streams was around 150,000 sockeye, though there could be a considerable error either way in the estimated populations.

D.F. Alderdice and D.K. Foerster — Appendix No. 21

Stream Survey - Morice Lake Area

The character of the numerous smaller creeks draining into Morice lake is one of fast flow, irregular and precipitous course, and heavy glacial silt content with the result that few if any have available or possible spawning grounds. At no time were salmon observed passing up these streams. Thus, the area resolves itself into two main spawning grounds, the Morice river and the Nanika river.

D.F. Aldercice and D.K. Foerster — Appendix No. 21

One other possible area is that on the Atna river although no salmon were actually seen in early September. About three-quarters of a mile up, this creek widens into a small lake one-quarter mile long above which there is a short stretch of river leading to two falls, one just above the other. These falls, being respectively about fifteen and twenty feet in height, would appear to constitute a definite barrier to any salmon migration, if present, further up-stream.

The Nanika river which empties into Morice lake at the north-east extremity was observed to carry a considerable number of salmon although the inspection was too brief for any estimate of numbers. The river was found to be distinctly opaque and rocky, running in a fairly direct course for over fifteen miles southward to Kidprice lake. Passage for fish is possible over the entire length just short of Kidprice lake where a large falls forty feet or more in height completely obstructs any further migration.

Much more difficult and problematical for inspection is the long and winding Morice river with its many islands, irregularities and variations in character. It was evident that many salmon traverse this river, either en route to Morice lake and its tributaries or stopping to spawn on the many available gravel stretches over the fifty miles of river bed between the Bulkley river and Morice lake.

Some indication of the large numbers of sockeye migrating into this area was to be had from observing their movement up the Moricetown gorge and ascending the falls there. There is no doubt of the importance of much more extensive surveys of all parts of this area. A big step has been taken by this brief yet extensive first effort.

R.E. Foerster and A.L. Pritchard — Appendix No. 22

Stream Surveys During 1944 - Notes on Isolated Rivers and General Summary

During the summer and autumn of 1944 visits were made to many streams in the Skeena system in an attempt to gain familiarity with the disposition and condition of the spawning grounds. Certain districts were inspected while the sockeye salmon were spawning which were not covered by any of the other parties in the field. From September 11 to September 28 an aeroplane trip was completed with landings at Morice lake, Kidprice lake, Fifteen Mile creek (Babine), Fort Babine, Fulton river(Babine), Bear lake, Lakelse lake, Kitwanga lake, Stephens lake (Kispiox river), Swan lake (Kispiox river), Quinigeste lake (Nass river), and Blackwater lake (Nass river). Notes on these areas not otherwise covered elsewhere in these reports are submitted herein, together with brief general summaries of the findings for the whole system.

Kitwanga Lake and River. Kitwanga lake is drained into the Skeena river at the village of Kitwanga about 25 miles west of Hazelton, B.C., by the Kitwanga river. The stream slightly over 20 miles in length and flowing through a wide valley, is not particularly steep or torrential. There was no opportunity to examine all the spawning area in detail but indications of good gravel beds were seen at the upper end.

During the summer on visits to Kitwanga village in connection with tag recoveries, frequent reports were received of large runs of pink salmon entering the Kitwanga river. Sockeye were apparently also present in quite sizeable numbers since the tag returns were good. Indians consulted on September 19 at the lake confirmed the fact that a good run of sockeye had arrived and pointed out that quantities of pink salmon were spawning at the time. Some of these latter were observed.

Kispiox River System - Stephens Lake, Club Creek, and Falls Creek. Stephens lake is one of a series of three lakes which forms one of the main sources of the Kispiox river. Stephens creek, moderately slow-flowing and about 40 feet in width, joins the lake to the Kispiox. On September 20 only about 200 sockeye and 100 coho salmon were seen over the three quarter mile of gravelly and sandy bottom. Apparently many of the salmon had migrated up through the lake into Club creek which joins Stephens to the next lake in the series, Club. Club creek at first glance would appear very disappointing as a spawning ground since the bottom is mainly constituted of flat rocks and boulders. Only infrequent patches of gravel occur. Peculiarly, however, one of the largest concentrations of sockeye for the season was seen in this three-quarter mile stream. Rough estimates only could be made, but it was felt that the numbers approached 10,000. Relatively few eggs appeared to be exposed and wasted. It was striking how most of them had safely nestled in the cracks between the rocks. There is no doubt that this inspection changed radically any previous ideas which the writers may have had regarding the type of bottom which could be utilized more or less efficiently for spawning by the sockeye salmon. Falls creek tributary to the third or Swan lake, is a small stream, in most places between 10 to 20 feet in width, but possesses a good bottom of moderately fine gravel. About 200 sockeye were observed. There were evidences, however, that more fish had been present because of the number of bear trails and the remains of salmon in the bush surrounding the stream.

Bear Lake area. The visit to Bear lake established the fact that the main spawning grounds in the area are in the Bear river which drains the lake into the Sustut river. Only a few fish were found in the short small creeks which are tributary to the lake itself. Close inspection of the whole Bear river, about 12 miles, was not possible, but the first four miles were briefly covered. Apparently immediately below the lake the river is swift and rocky but the contour soon flattens out with the result that there are miles of good gravelly spawning beds.

Worthy of particular mention are the large numbers of medium to big spring salmon which were observed. As a matter of fact this was quite the largest concentration of the species observed to date on the spawning grounds. These findings together with the examination of the large numbers of spring salmon on the Indian drying racks, was sufficient proof of the fact that the Bear is one of the main spring salmon rivers in the system. Sockeye salmon were also present in medium numbers although the peak of the run had passed. No estimate of their abundance could be made.

Upper Bulkley River. This stream, draining Bulkley and a number of other small lakes, flows in a westerly direction for about 40 miles to join the Morice river below the village of Huston. Since the valley in which it is situated is wide and contains much agricultural land, the creek is relatively slow

flowing yet possesses fine gravel bars for spawning. For at least ten miles above its junction with the Morice, there are no obstructions which could possibly interfere with the ascent of fish. In the upper reaches there are several log jams and beaver dams but even these are not in most cases absolute barriers. The fact that throughout the whole season only a few cohoes and one or two sockeye were observed to have taken advantage of these spawning grounds constitutes quite a problem. There is no doubt that there were plenty of salmon in the lower system since the fish had been passing Moricetown on the lower Bulkley in large numbers throughout the season. Why the fish chose to continue up the Morice and avoid the good areas of the Upper Bulkley is not known.

General Deductions from the 1944 Skeena Stream Surveys. From the various inspections of the summer some general deductions have been made:

1. In spite of the expanded survey which resulted from increased personnel and better transportation facilities, much of the spawning escapement in the Skeena system was not observed in 1944. Tagging returns have shown that the fishery took slightly over 40 per cent. of the salmon entering the river. Actually over 800,000 salmon were captured. The same number at least should have been visible on the spawning grounds. It is doubtful if more than 250,000 were seen including 150,000 in the Babine area, 25,000 at Lakelse, and 10,000 at Kitsumgallum. Such a condition poses quite a problem. More complete observations can be obtained by increasing the number of parties. For instance, a party in Bear lake could obtain fuller observation on the immediate region, and with infrequent trips to Sustut and Motase lakes nearby, could produce data for the completion of the general picture. A permanent party on the Morice system might bring out descriptions on spawning distribution of definite value. The Kitwanga system could be made the responsibility of the Lakelse-Kitsumgallum observers. If such an expansion is carried out, one thing is evident. The usual methods of transportation are not suitable because of the type of country and lack of trails. The parties would have to be located and serviced by plane.
2. In certain areas, e.g. Morice lake and Kitsumgallum lake, the usual methods of observation will not suffice because the heavy glacial silt in the rivers makes the water so opaque that the salmon cannot be seen. At the present the only alternative which can be suggested is to install fences lower down in the system to make actual counts. This is not easy because of the size of the rivers and the inaccessibility of the areas. Other devices will be sought.
3. For no apparent reason some good spawning grounds like the Upper Bulkley are not utilized to anything approaching capacity. Further investigation of the reasons for this situation should be carried out.
4. Using as a basis for conclusions those districts which have been observed, it can be stated that the escapement to the Skeena this year was moderately good. The spring salmon appeared on the spawning grounds in fair abundance as indicated by the runs to Bear lake and Babine. The sockeye spawning in the Babine was heavy and medium in the Morice and Lakelse districts. More pink salmon reached the beds than would have been expected from the small catches. The run to the Lakelse area was good, that to Kitwanga heavy, and that to the Babine medium. Cohoes were in evidence in fair numbers throughout the system.

R.E. Foerster and A.L. Pritchard

Appendix No. 23

The Drain of the Fisheries on the Skeena River Salmon Runs

There is little doubt that the chief drain on the salmon runs to the Skeena river is from the fishery - commercial and Indian. While the exploitation may not be so great as to have been the cause of the decline in catches, it is certainly of sufficient importance to merit investigation. For that reason many enquiries were made as to what figures were available for the commercial operations. The location and extent of the Indian food fishery was examined and the method of collecting statistics examined. A general digest of the findings is submitted.

Commercial Fishery. There is available at most of the canneries for a period of years the numbers of fishermen operating, the numbers of fish taken and the districts in which the catches were made. No record has been kept of the number of sets made by each net during fishing. The main difficulty in utilizing such material to calculate a catch per unit of gear and thus get some idea of the trend of the abundance is not the inadequacy of the data but the fact that as yet no definite and accurate idea is available on the general distribution of the fish from the Skeena. It is not known for instance whether those salmon taken in the Big bay area north of the Skeena should be considered as belonging to the Nass or the Skeena. Tagging experiments have been initiated to settle this difficulty but in the meantime catches from definite known Skeena runs might be used as an indication. As soon as is possible an effort will be made to continue the work from the small beginning that was made in 1938.

Indian Fishery. To obtain a complete record of the Indian fishery constitutes a difficult problem yet one which is not impossible of solution. At the present time, the natives under an agreement with the Department of Fisheries, may take salmon for food in any area. There is no limit on the amount which may be captured although a reasonable catch is usually maintained through the persuasion of the fishery guardians throughout the district and because the Indian himself is not sufficiently ambitious to work for fish which he does not need. The methods used vary from gillnets to gaffs and spears depending on the conditions under which the fish are taken.

The statistics at present collected are far from complete although as good as could be expected with the limited personnel available. At Terrace, the guardian gets a record from the smokehouses of the take and watches to see that no selling of the product occurs. The Hazelton guardian visits the Hagwilget canyon location almost daily. The same man makes a weekly trip to Kispiox and Glen Vowell on the Skeena. A guardian is stationed permanently at Moricetown and keeps close check on the operations. The same situation obtains at Fort Babine and at Fifteen Mile creek in the Babine system. No record is maintained of the catches in isolated areas.

It would appear that an improvement could be worked in the system of checking and collecting information by increasing the personnel and improving their transportation facilities. Too much area is now the responsibility of one person. If the psychological opposition of the Indians could be overcome with the aid of the Indian Department, a law might be passed requiring a statement of catches. These might not be absolutely accurate in all cases but they would be a guide especially for the remote districts where visits cannot be made. Under such circumstances the Indians would have to be assured that there was no desire to relieve him of the chance to get food.

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Indian catches cannot be neglected in the Skeena river investigation since the number of salmon taken is not negligible. Certain fishing practices are definitely detrimental to the runs and should be carefully watched. It may be that reduction will have to be effected. This can be done to a large extent without harm to the general Indian population by limiting the privilege of taking fish to those individuals who live on the reserves and do not compete in the economic sphere with other citizens of the province.

Ferris Neave — Appendix No. 24

Recoveries of Marked Trout in the Cowichan River System

In 1944 the following recoveries were made of trout marked and liberated in the Cowichan river system in previous years.

Kind	Brood Year	Number released	Place of release	Place of recovery	No. of returns in 1944	returns In all
Steelhead	1940	34,800	lake	River & creek	7	19
Kamloops	1941	52,384	lake	Beadnell creek	1	6
Cutthroat	1941	2,044	river	Oliver creek	9	24

The return of marked sea-run steelheads to the river in their fourth year, represented by the seven recoveries noted above, is in accordance with the experience of the previous two years. Scale readings had previously indicated that most of the Cowichan river steelheads return to spawn at this age. The previous recoveries from the 1940 steelheads were all made prior to the fish leaving fresh water.

Recoveries of Kamloops trout continue to be very few in relation to the numbers released.

All the marked cutthroats which were recaptured in 1944 appeared in the spawning run to Oliver creek. Eight of the nine fish were males. Their appearance in the spawning run agrees with previous conclusions that cutthroats in this river system usually spawn for the first time at three or four years of age and that the males tend to mature when younger than the females.