Skeena Salmon Management Committee

Annual Report 1955

Oct. 7, 1954 - Dec. 31, 1955

Committee Members

A.W.H. Needler

A.J. Whitmore

In Charge of Investigations

F.C. Withler

Advisory Board Members

Walter Johnson (March to May)

S.S. Kristmanson (March to May)

S. Oddsun (June -)

O. Olafson (June -)

E. Bolton

R.E. Walker

K.F. Harding

R.T. Hager

Richard Nelson

E. MacMillan

Richard Bell-Irving

Terms of Reference

In a directive dated October 7, 1954, the Minister of Fisheries appointed Mr. A.J. Whitmore, Chief Supervisor of Fisheries for the Pacific Area, and Dr. A.W.H. Needler, Director of the Fisheries Research Board Station at Nanaimo to Committee on Management for the Skeena River Salmon Fisheries. The Committee was directed to investigate thoroughly conditions in the Skeena River with a view to improving the management of the runs and to increasing the yield. The Minister noted that the Skeena River salmon stocks required immediate attention; in particular the rock slide in the Babine River in 1951 had destroyed two-thirds of the 1951 and 1952 sockeye runs to Babine Lake, the major producer. Special measures would be necessary to rebuild these runs.

To achieve its aims, the Committee would make full use of the administrative and research staffs of the Federal Department of Fisheries in British Columbia, both of which had carried out considerable work on Skeena salmon stocks in the past; and it would bring about full coordination and extension of these activities.

The Minister subsequently appointed an Advisory Board as noted on the front page of this report, and on the recommendation of the Committee the Fisheries Research Board assigned Mr. F.C. Withler to direct investigations for the Committee.

Record of Meetings

At its first meeting at Nanaimo on November 29, 1954, the Committee reviewed the available evidence concerning the likely size of the 1955 sockeye run to the Skeena, and concluded that fishing for sockeye salmon should be permitted, but that some additional restrictions would be necessary to offset the increased efficiency resulting from the introduction of nylon gear. Two points affecting the size of the 1955 sockeye runs were noted:

(1) A 20% reduction by the Babine Slide of the smolts leaving Babine Lake in 1953 as compared with the two preceding years, and, consequently, an expected 20% reduction in the return of 4-year-olds in 1955.

(2) The 5-year-olds would result from the 1950 spawning which was unaffected by the slide. The relatively low return of 3- and 4-year-olds from the 1950 brood and the general level of abundance of 5-year-olds in recent years gave no indication of a larger than average run. Thus the available evidence pointed to a moderately low sockeye run in 1955.

The above considerations were reported in a release to the Industry on December 2, 1954.

On December 3, 1954, the Committee met in Vancouver with canners to consider what form the additional restrictions proposed in the December 2 release might take. Two differing proposals were made:

(1) That the upriver sockeye fishing boundary be moved seaward, keeping the weekly closed period at 48 hours, as in the past, or alternatively,

(2) that the upriver sockeye fishing boundary remain where it had been in recent years, but that the weekly closed period be extended to 72 hours, or more if necessary.

At a meeting in Vancouver on January 20, 1955, the Committee discussed a tentative program of investigations for 1955. It then also reviewed briefly the representations of the canners made at the meeting of December 3, 1954, and set February 3, 1955, as the date upon which to discuss the form which the additional restrictions might take with fishermen and others at Prince Rupert.

At a public meeting, held on February 3, 1955, at Prince Rupert, the evidence bearing on the size of the 1955 sockeye run was reviewed for the benefit of fishermen and local cannery representatives. All fishermen favoured leaving the upriver fishing boundary where it had been in recent years, and the extension of the weekly closed period to 72 hours.

After consideration of the available evidence on the Skeena salmon stocks in 1955, and of all representations concerning the nature of additional restrictions to be applied, the Committee recommended the following regulations, as reported in a statement released on March 8, 1955:

(1) That the upriver commercial boundary for all salmon fishing should be maintained at the lower boundary, which had been in effect for sockeye and pink fishing for many years,

(2) that a 72-hour weekly closed time should be put into effect, instead of 48 hours as previously, and

(3) that the weekly closed time of 72 hours should be extended, if for any week or series of weeks it was insufficient to provide an adequate number of spawners.

The statement also announced the membership of the Advisory Board to the Committee, approved by the Minister of Fisheries.

At a meeting in Vancouver on April 27, 1955, the Committee discussed procedures to be followed, and particularly the responsibilities of the Director of Investigations with respect to reporting and carrying out Committee investigations. A report of progress by the Committee and a program of investigations for 1955 was submitted by the Director and approved for distribution by the Committee.

The above report, dated April, 1955, was distributed immediately following the meeting.

On July 23, 1955, the Committee held its first meeting with its Advisory Board at Port Edward, B.C. Members of the Advisory Board present were Messrs. R. Nelson, E.A. MacMillan and S. Oddsun; proxies for absent members were Messrs. K. Fraser (for R.E. Walker), C. Salter (for R. Hager), O. Philipson (for R. Bell-Irving) and N. Bellas (for K.F. Harding). Mr. G.S. Reade represented Mr. A.J. Whitmore. The origin and terms of

reference of the Committee were reviewed. The meetings and the evidence which had led to the Committee's recommendations for 1955 Skeena salmon fishing regulations were then outlined. Mr. Withler reviewed the progress of 1955 investigations and the evidence bearing on the size of the 1955 Skeena sockeye run. It was agreed that the run was unexpectedly low and that additional restrictions would be necessary to allow all possible sockeye to escape, especially to Babine Lake, for conservation purposes. It was further agreed that, for the week ending July 31, the Skeena Gillnet Area (Area 4) and the northern portion of Area 5 should be closed completely, and that a line drawn between Hunt Point on Porcher Island and Kitson Island should apply as the inshore fishing boundary of Area 4 during the following week unless test fishing indicated that sufficient sockeye had passed upriver during the week ending July 31.

These recommendations were forwarded immediately to the Chief Supervisor and subsequently put into effect. The recommendation concerning the inshore boundary was put into effect in the week ending August 7, since in the Committee's view, sufficient sockeye had not escaped in the week ending July 31.

The Committee met on August 16, 1955, in Nanaimo, to review the progress of the 1955 investigations. Two points merited special interest: the test fishing just above the commercial fishery, which was designed to give an early indication of the size of the escapement, appeared to be providing reliable information; and the 1955 Babine smolt estimation indicated that a very much larger than usual sockeye smolt run from the 1953 spawning had left the lake. A tentative program of investigations for 1956 was discussed. It was agreed that further information on the routes and timing of salmon through the Skeena Gillnet Area was required to improve regulation, and tagging in the offshore regions of the Area was proposed for 1956.

At a meeting held in Vancouver on November 26, 1955, the Committee reviewed the available evidence on the likely size of the 1956 Skeena sockeye run. The best estimate indicated a total sockeye run in 1956 not exceeding that of 1955 (about 300,000), and a total run to Babine Lake not exceeding 200,000. It was agreed that the anticipated run would not provide an adequate spawning for Babine Lake, and that closure of the 1956 sockeye fishery would be necessary to protect the small run.

In a statement issued immediately after the meeting, the Committee reviewed the evidence bearing on the size of the 1956 sockeye run and proposed tentative regulations in accordance with the expected small size of the run. It was proposed:

(1) That fishing for sockeye salmon should not be permitted until 6:00 P.M. Sunday, July 29, 1956,

(2) that fishing for spring salmon, using gillnets having mesh not less than 8" linen, or 8 1/2" nylon, stretched measure, should be permitted, and

(3) that the 72-hour weekly closed period and the upriver boundary from Mowitch Point to Veitch Point should continue to apply in 1956.

The evidence bearing on the size of the 1956 sockeye run was reviewed with the Committee's Advisory Board at a meeting held in Vancouver on December 8, 1955. Members of the Advisory Board present were Messrs. R.E. Walker, R.T. Hager, R. Nelson, A.E. MacMillan and R. Bell-Irving. After consideration of the evidence, the Advisory Board members discussed the proposed regulations with the Committee. It was agreed that special protection for the sockeye was required in 1956: most members agreed with the proposed opening date for sockeye, others suggested that it might be even later. The proposed program of investigation for 1956 was briefly outlined.

At Prince Rupert on December 16, 1955, the evidence bearing on the size of the 1956 sockeye runs was reviewed with the Prince Rupert members of the Advisory Board: Messrs. K.F. Harding, O. Olafson, and S. Oddsun. Further advice and opinion concerning the opening date for sockeye and pink fishing was obtained by the Committee, and the tentative program of investigations for 1956 briefly outlined.

The regulations proposed in the statement of November 26, 1955, were reviewed in the light of representations made at the above Advisory Board meetings at a meeting of the Committee held on January 30 in Vancouver. On February 9, 1956, the Committee issued a statement in which the following regulations for salmon fishing in 1956 in the Skeena were recommended to the Department of Fisheries:

(1) That sockeye fishing be not permitted until 6:00 P.M. Tuesday, July 31, 1956,

(2) that up to this date only gillnets having mesh not less than 8" linen, or 8 1/2" nylon, stretched measure, be permitted, to allow normal fishing operations for spring salmon (fishing for spring salmon to be terminated earlier if such is found to be necessary for conservation purposes),

(3) that the 72-hour weekly closed period and the upriver boundary from Mowitch Point to Veitch Point continue to apply to all salmon net fishing in 1956, except

(4) that the 72-hour weekly closed time be extended in the event that for any week or series of weeks the 72-hour weekly closure is deemed insufficient to provide for the escapement of an adequate number of spawners.

The 1955 Skeena Salmon Runs

The 1955 Skeena salmon fishery was characterized by a failure of the sockeye run, which was compensated for, to some extent, by a good pink run. The sockeye catch was the poorest in fifty years of record and amounted to only 20% of the average for the past 5 years. On the other hand, the pink salmon catch, which was about 100% greater than the average for the past 5 years, was one of the best since the very large catches of the 1920's.

The spring salmon catch was average, while the coho catch was above average. The catch of chums was the poorest in recent years.

The 1955 regulations for the Skeena Gillnet Area provided increased protection for all species in two ways:

(1) the application of a 72-hour weekly closed period, which was 24 hours longer than in previous years, and

(2) the lowering of the upriver commercial fishing boundary during the early spring salmon and late coho and chum runs.

In addition, to protect the extremely low sockeye run, a special complete closure of the Area for one week and a special closure of part of the Area in the following week were put into effect during the latter part of the sockeye run.

The following table summarizes the weekly catches for all species in the 1955 season (as reported in the B. C. Catch Statistics of the Department of Fisheries) for Statistical Area 4.

Week ending		Sockeye	Pink	Spring	Coho	Chum	Remarks
April	30			120			
May	7			206			
	14			142			
	21			704			
	28			673			
June	4	1		747			
	11	36		1,831	16		
	18	2,271		1,911	85	8	
	25	27,703	43	5,095	1,169	448	
July	2	15,961	86	3,084	1,894	645	
	9	32,278	685	6,460	2,619	1,250	
	16	32,681	2,323	7,823	3,904	1,154	
	23	23,470	8,939	4,692	6,444	1,272	
	30	761	2,053	772	17,094	143	
Aug	6	5,990	151,849	619	13,749	1,334	
	13	9,280	543,422	697	26,904	4,544	
	20	4,531	457,097	334	22,667	5,301	
	27	2,099	153,639	390	15,128	7,916	
Sep	3	223	6,892	588	8,494	3,437	
	10	84	2,623	235	14,579	1,347	
	17	19	197	111	4,782	602	
	24	2	97	39	2,530	160	
Oct	1				528	20	
	8				3		
Total		157,390	1,329,945	37,273	142,589	29,581	

The Sockeye Run. Even with the special closures mentioned above the total sockeye escapement was extremely low (approximately 150,000). The run to Babine which provides the greatest part of the Skeena escapement numbered only 102,000, of which 30% were jacks, leaving an escapement to Babine of 71,000 commercial-sized fish. Escapements to most other spawning areas were also low. The total Skeena sockeye stock (catch plus escapement) returning in 1955 was far below the spawning runs which gave rise to it. Two factors contributed to the small return: the effects of the Babine River Slide on the 1951 escapement and an apparent poor survival in the sea which affected the 1955 runs to all Skeena spawning areas.

The seeding which gave rise to the 4-year-old sockeye in the 1955 run was badly reduced as a result of the slide. Of the half million sockeye bound for Babine Lake in 1951, only 150,000 managed to reach the spawning area, and the actual number of fish spawning was even less because a high proportion was injured. However, whereas the adult run was less than 30% of the average for the previous two years, the resultant production of smolts was over 70% of the average number for the same period. Since prior adult-to-smolt survival data are available only for the 1949 and 1950 seedings, the production figures for these two years are used for comparison. Thus it was expected that the run of 4-year-olds in the fishery would not be much less than in former years. Actually, the catch of 4-year-olds was much smaller than expectation and in fact was the lowest on record, indicating that depletion by the slide was only a partial cause of the exceptionally low return.

The second cause contributing to the low return was the poor production in the sea sometime during the marine phase of the 1950 and 1951 broods. On the Skeena poor marine survival was apparent in the low return of 4-year-olds in the 1955 run, and also in the fact that the catch of 5-year-olds in 1955 was also the lowest on record despite the fact that the parent run of this age-group in 1950 was normal.

The Pink Run. The large 1955 Skeena pink catch (which far exceeded the catch of the brood year) resulted from a relatively light escapement. Without further data on the factors affecting pink production on the Skeena, no explanation can be offered for the increase. However, it may be noted that marine conditions appeared to have been favourable since the fish of the 1955 catch were unusually large.

In addition to a large catch, this year's escapement was well above the average for recent years and was reported to have been exceptional in the important Kispiox system.

The Spring Run. Since spring salmon are taken by troll before reaching river estuaries, it is impossible to distinguish stocks as to river of origin. However, the spring salmon catch in the Skeena Gillnet Area was above average, and aided by the lowered early spring salmon fishing boundary and the longer weekly closed period, the escapement was moderate.

The Coho Run. As with spring salmon, it is probable that many Skeena coho are caught in outside waters by troll fishermen, making it difficult to

estimate the total catch of Skeena cohos. However, the catch in the Skeena Gillnet Area was above the average of the last five years. The lowering of the late fishing boundary, the extended weekly closed period and the special closures (which were applied primarily to protect the sockeye) were instruments in providing a good coho escapement.

The Chum Run. As with sockeye, the chum catch was exceptionally poor this year. Despite the increased restrictions on fall fishing, the escapement was equally poor. Although no specific data are available to explain the failure of the Skeena run, it is of interest that chum salmon runs throughout B.C. were generally lower than in the brood years. In this way, 1955 chum salmon production parallels that of sockeye suggesting that conditions in the sea were also unfavourable for chum survival.

Record of Investigations

Several projects were carried out by the Fisheries Research Board for the Committee in 1955 to provide the necessary background knowledge for improvement of management of the Skeena River salmon fishery. These were mainly concerned with the sockeye stocks, although some research on pink salmon was initiated, and some on the other species was carried out in conjunction with sockeye and pink studies. Some of the projects (e.g., enumeration at Babine Lake) were continuations of earlier work but some (e.g., test fishing and pink salmon studies) were new.

Since the sockeye stock originating in the Babine watershed provides about two-thirds of the Skeena commercial sockeye catch, management of Skeena sockeye is primarily concerned with Babine salmon. Need for special measures in management have become most acute since 1951 and 1952 when the Babine spawning escapements were drastically reduced by a slide in the Babine River.

The main problem in managing any sockeye stock is to provide spawning runs of such a size as to insure fullest possible utilization of the food resources of nursery lakes, because the number of adults available to the fishery is closely related to the output of young fish to the sea. To determine the optimum escapement to Babine, several projects are under way. For the past 5 years, the spawning escapement to Babine has been counted and the numbers of resultant seaward migrating smolts has been estimated. The remarkable 1955 smolt run of about 30 million (as compared to 3-5 million in other years) resulted from the largest escapement so far recorded. This fact indicates that Babine spawning stocks have been too low in recent years to provide maximum outputs of young sockeye. However, evidence has been obtained that, even though total escapements are increased, maximum utilization of Babine Lake still may not be achieved. In 1955, collections of under-yearling sockeye were made in different areas of the Babine Lake system. These showed that the distribution of young sockeye paralleled the distribution of the parent spawning population, and that about 70% were concentrated in 12% of the total nursery area available. It therefore appears that almost 90% of the lake was being underutilized in 1955. If the spawning distribution could be changed to provide more young fish in the poorly used areas, it is probable that smolt production exceeding that of 1955 could be achieved.

If changes in the distribution of Babine sockeye spawning are found to be desirable, it will be necessary to control, by regulation of the fishery, the sizes of runs to specific areas of Babine Lake. To obtain information on the timing of runs, special test fishing and tagging was carried out above the Skeena commercial fishing boundary. The results indicate that the times of passage of most of the major runs to Babine are sufficiently distinct to allow the required protection to certain spawning areas. To permit special regulation, it will be necessary to measure the escapements to specific areas as they leave the fishery. Analysis of 1955 test fishing data indicates that the catches made generally reflect the abundance of fish above the boundary. Further test fishing will be needed before the catches can be used as an accurate measure of abundance of runs to specific areas.

Next to Babine, Bear and Morice Lakes are the most productive sockeye areas on the Skeena. Since growth of young sockeye is an indication of the ability of a lake to support sockeye and since growth bears an inverse relationship to population abundance when crowding occurs, collections of smolt migrants were made in both these areas. The Bear Lake smolts proved to be the largest so far obtained on the Skeena River, suggesting that the lake's capacity to support young sockeye was not taxed by the 1953 seeding and that provision of larger escapements would undoubtedly increase the run. Further study is needed to determine if sufficient spawning area is available to accommodate increased escapements. Sampling at Morice Lake was less successful and further observation will be necessary to obtain reliable data. Along with other projects, the adult to smolt relationship at Lakelse Lake, a minor producer, has been studied for several years.

It may be possible to improve production in areas other than Babine through regulation of the fishery. Recovery of test fishing tags in these other areas will provide the necessary information concerning the time of passage of runs through the fishery.

Factors affecting pink salmon production on the Skeena are less well known than is the case for sockeye. The spawning runs which support the fishery are mainly confined to the larger tributaries of the lower Skeena. To manage pink salmon, it is necessary to determine the number of spawners required to produce the greatest number of fry from a particular stream, with the assumption that the carrying capacity of the sea is unlimited. Research has now been initiated to provide information about the relation between abundance of spawners and the size of fry outputs. In 1955 a start was made through tagging and stream surveys to estimate the size of the important Lakelse River spawning run. Preparations are under way to estimate the resultant fry output in the spring of 1956. The results of these studies may indicate that special protection of specific spawning stocks is necessary to provide maximum production. In this case the test fishing and tagging program will provide essential information on the pink escapement from the fishery and on the timing of runs.

No specific research is being carried out on spring, coho or chum salmon, but the test fishing program embraces all species and should aid in

formulating special protective regulation if required, in the same manner as for sockeye and pinks.

Test Fishing and Tagging in the Skeena Estuary

To obtain an index of the size and composition of salmon escapements from the Skeena fishery early enough to be useful for regulation, and to secure salmon for tagging to determine the timing through the fishery of the runs to various spawning areas, special fishing was carried out by two chartered gillnet boats above the Skeena commercial fishing boundary in 1955.

A total of 291 drifts of approximately one-hour duration each was made from May 26 to September 28. Fishing was carried out only on slack tides, and the procedure was made as uniform as possible in all respects in order that catches might be compared. Up to July 17 a 200-fathom, 50-mesh commercial nylon net of 5 1/8 inches stretched measure was used; after July 17 fishing was carried out with a 200-fathom gillnet composed of different meshes ranging from 3 1/2 inches to 8 inches stretched measure.

The numbers of each species of salmon caught, the numbers tagged, and the numbers of recoveries are given in the following table:

	No. caught	No. tagged	No. recovered	
			from fishery	from upriver
Sockeye	1,173	822	113	69
Spring	782	376	48	22
Pink	3,590	1,488	28	34
Coho	483	233	27	2
Chum	124	45	1	0
Total	6,152	2,964	217	127

Analysis of the deviation of sockeye catches from the trend line shows that the state of the tide when the drift was made (high water slack as opposed to low water), in the 291 sets made, did not affect the catches significantly. A similar analysis to determine whether or not sockeye catches are affected by an open or closed period in the fishery shows this factor to be highly significant: catches were higher during closure of the fishery, lower when the fishery was open. These results indicate that the method employed will provide a reliable index of the abundance of salmon immediately above the fishing boundary. It will require one or two more seasons to relate the size of catches above the fishing boundary to the size of escapements to the spawning grounds.

Before such information can be used to permit desirable escapements by regulation, it is necessary to determine the times at which stocks bound for various spawning areas are present in the fishing area. The tagging data of 1944-48 have been re-analyzed and added to the information obtained in 1955: for all years 10,741 tags have been applied to sockeye salmon and of these 1,486 have been recovered on spawning grounds or enroute.

In general, the recoveries show the following with regard to time of passage:

(a) Babine sockeye are present in the fishing area throughout the sockeye fishing season (approximately June 15 - August 10).

(b) Lakelse and Alastair Lake sockeye are present up to the end of June.

(c) Bulkley River sockeye (migrating largely to Morice Lake) are present from June 15 to July 30.

(d) Kitwanga and Johanson Lake sockeye have been found to be present during the period July 19 to July 27.

Considerable separation of sockeye runs to different spawning areas within Babine Lake are also possible on the basis of ocean- and estuary-affixed tags:

(a) Babine sockeye bound for Nine Mile, Six Mile, Pendleton and Sockeye Creeks are present in the fishery in June.

(b) Sockeye migrating to Twin, Pierre, Tachek and Four Mile Creeks are present from about June 15 to July 10.

(c) Sockeye migrating to Fifteen Mile, Morrison, Grizzly and Five Mile Creeks are present from about July 7 to July 21.

(d) Those bound for Fulton and the Upper and Lower Babine Rivers are present from about July 15 to August 10.

Tagging data to provide information on the timing of runs of other species is still too scant to be useful, but some is now available for pink and spring salmon.

Salmon Enumeration at the Babine Fence in 1955

The runs of sockeye salmon to the Babine Lake watershed have been counted annually since 1946 at the Babine River adult counting fence with the exception of 1948 when floods damaged the structure. The size of the 1948 run was estimated by observations on the spawning grounds. The weir count has been accepted as the best single measure of the sockeye escapement to the Skeena River since the initial discovery that the runs to the Babine watershed constitute about 70% of the Skeena escapement. The data from the fence took on further importance since 1951 when the blockage occurred on the Babine River.

The 1955 adult count, which is reported below, is of great interest because the 4-year-olds, which are usually the most important single component of the run, were the progeny of those fish which surmounted the rock slide in 1951. In addition the 3-year-old sockeye were the young of the slide-affected fish of 1952.

The counts of the five species of salmon which passed the Babine fence during the period of operation (July 4 to October 3) in 1955 are compared in the following table with counts obtained in other years.

Year	Sockeye Number	% "Jack"	Spring	Pink	Coho	Chum
1946	475,705	12.2	10,528	28,161	12,489	18
1947	522,561	50.0	15,614	55,421	10,252	7
1948	560,000[X]					
1949	509,132	9.4	7,433	13,663	11,938	5
1950	543,658	33.0	6,838	38,728	11,654	7
1951	152,457	7.2	2,778	50	2,122	0
1952	376,947	7.4	5,915	2,706	10,554	1
1953	714,614	3.9	8,353	1,108	7,648	17
1954	503,422	1.9	5,925	4,604	3,094	66
1955	101,976	30.0	3,528	2,151	8,947	3

[X]Estimated from comparison with stream survey counts and fence counts of previous years.

The count of sockeye salmon in 1955 was the lowest recorded since fence operations began in 1946. The first sockeye passed the fence on July 6. Thereafter the count increased very slowly until August 1 when 2,750 sockeye passed the fence. Following this early peak the count declined to 810 sockeye on August 10 and then rose to the main peak of 5,505 sockeye on August 24 after which the run declined until only 40 sockeye were counted on October 3, the last day of counting. The low total count is due in part to a poor return of 4-year-old sockeye which are the progeny of the small run which managed to pass the Babine River rock slide in 1951. However, even when the effects of the slide are taken into account the run was below expectation, as were many sockeye runs from the Fraser to Alaska.

In order to obtain details on the size and sex ratios of Babine sockeye, samples amounting to 2% of the previous half day's count were measured and sexed throughout the period of the run. The numbers of "jacks" (3-year-old males) as compared to larger sockeye were calculated from the "jack count" which is made for an hour daily. The proportions of normal, injured, and net-marked individuals among the larger sockeye were also noted.

The jack count, which represented 22% of the total sockeye count, indicated that 30% of the run were jacks and 70% were larger sockeye. The calculated number (71,352) of larger sockeye in 1955 was only one-half of that in the previous low year, 1951. The jack count showed that among the larger sockeye 6.1% had net marks, 6.7% were injured, and 87.2% were normal. The percentage of injured fish was slightly higher, and that of net-marked fish, lower than in other non-slide years. The lower percentage of fish with net marks probably indicates the effectiveness of the special closure in the Skeena gill-net area in permitting escapement of the main portion of the Babine sockeye run.

From the 2% sample, the sex ratio of the larger sockeye was 47.2% males and 52.8% females. Length-sex frequency plots suggest that the larger sockeye was comprised of about 60% of 4-year-old fish and 40% of 5-year-olds. The sample also showed that the average size of the jacks, larger males, and females was 38.2, 55.7 and 57.9 centimetres, respectively. In each case the sockeye were smaller than the nine-year average.

A probable egg content of 3,126 was calculated by applying the average length of the females to the egg-length regression formula which had been determined from the egg samples of previous years. The potential egg deposition, the product of the probable egg content and the calculated number of females (37,700) was 118 million eggs. This seeding was lower than the low seedings recorded during the years when the Babine River rock slide was in effect.

The run of spring salmon was smaller in 1955 than in any non-slide year but was larger than in the slide-blocked run of 1951 from which many of the 1955 spawners were derived. The count provides an index of the run to the Babine River. Spring salmon spawn below the fence as well as above it.

Pink salmon passed the fence in numbers twice that in the cycle year 1953 and 40 times that in the slide-blocked cycle year 1951. Though the pink salmon runs are still much smaller than prior to the Babine River rock slide, the recent increases indicate a gradual recovery of the Babine River pink salmon runs. As with springs, some pinks spawn below the fence. In 1955 it was estimated that equal if not slightly greater numbers spawned immediately below the fence than above it.

The coho salmon run was slightly smaller than in 1952, the cycle year, and in the pre-slide years.

A few chum salmon again reached the Babine River.

Size of Babine Sockeye Smolt Runs, 1951-1955

Since 1951, estimates have been made of the size of the sockeye smolt emigration from the Babine watershed by marking and recovery technique employing smolt traps at the outlets of Babine and Nilkitkwa Lakes. Using estimates from Babine fence data of potential egg depositions in the area from 1949 to 1953, it has been possible to calculate survival to smolt stage from eggs carried into the system each year. The egg depositions in 1951-52 were much below normal because of the effect of the Babine River rock slide, while the 1953 egg deposition was much above normal because of the large escapement which entered Babine Lake as a result of the special closure in the Skeena gill-net area. The smolt runs which have emanated from these variable egg depositions have provided information on the relationship between broods of varying size and subsequent smolt production.

Employing the technique used from 1951 to 1954 to obtain an estimate of the size of the Babine smolt run, the 1955 smolt run was estimated to be

30.9 million, several times greater than the largest run in the previous five years of operation. The method employed involves the capture and marking of portions of the run as it passes the outlet of Babine Lake, and the subsequent recovery of some of the marked fish in examination of the catches at the outlet of Nilkitkwa Lake some eight miles downstream from the Fort Babine trap site. Ratios of marked to unmarked smolts in the samples are used to estimate the size of the run passing the upstream trapping device.

The total numbers of smolts marked and released, the total numbers of marked fish recovered, and the total samples recovered in each year are given in the following table. Final estimates of the run for each year have been adjusted to conform with known changes in the mark/catch ratio at Fort Babine and to allow for the late installation of trapping structures in 1951 and 1955, when portions of the run had passed before trapping began.

Year	No. of smolts marked	No. of marked smolts recovered	Size of sample examined	Estimated size of runs	95% limits
1951	34,689	200	21,855	4.2×10^6	3.7 to 4.8 $\times 10^6$
1952	33,880	646	86,391	4.5×10^6	4.2 to 4.9 $\times 10^6$
1953	61,950	2,498	124,396	3.1×10^6	3.0 to 3.2 $\times 10^6$
1954	42,631	1,156	81,082	2.8×10^6	2.7 to 3.0 $\times 10^6$
1955	113,931	1,287	270,546	30.9×10^6	28.6 to 32.6 $\times 10^6$

Certain errors associated with the possibility of increased mortality due to marking by fin-clipping and with the likelihood of disproportionate intensities of marking with relation to the run passing Fort Babine each day cannot be assessed and have been treated as constant each year.

Assuming that all smolts are 1-year-olds, survival from eggs potentially available in the spawning run to resulting smolts have been calculated and are shown in the table below for the brood years from 1949 to 1953.

	1949	1950	1951	1952[x]	1953
Eggs potentially available	869×10^6	583×10^6	198×10^6	411×10^6	1254×10^6
Year smolts appear	1951	1952	1953	1954	1955
Estimated no. of smolts	4.2×10^6	4.5×10^6	3.1×10^6	2.8×10^6	30.9×10^6
Survival egg to smolt	0.48%	0.77%	1.57%	0.68%	2.46%

[x]Only about one-third of this run spawned successfully, reducing the potential egg deposition and raising smolt survival to about 2%.

A tendency for greater numbers of smolts to result from increased egg depositions seems to obtain at Babine; an increase in the survival to smolts from smaller egg depositions is also indicated for the adult runs from 1949 to 1952. However, the egg to smolt survival from the 1953 spawning run, which was by far the largest recorded in the years of Babine Fence operation, was higher than that of any other run. Recent work (reported elsewhere in this record) shows that the Babine Lake system appears to be composed of several distinct nursery areas. The survival rate within these areas may vary considerably depending upon a number of factors, including the food available and the concentration of young sockeye. It is known from spawning stream surveys that the proportions of adult sockeye spawning in the streams tributary to these areas may vary considerably from year to year. Therefore the survival rates obtained for Babine Lake as a whole are composites of the survivals in the several nursery areas and may not show a consistent relationship to the size of the annual broods.

Since 1950, samples of sockeye smolts have been taken either for special study or in conjunction with the smolt run estimation project. The sampling site has varied in years between the Babine fence, the Nilkitkwa Lake smolt trap and the Fort Babine smolt trap. In 1955 because of water level conditions the sample was taken first at the Nilkitkwa Lake trap and later at the Fort Babine trap.

Examination of scales has shown, as indicated in the following table, that the smolts leaving Babine Lake are predominantly 1-year-old fish. The table also indicates that the sex ratios in each age-group do not depart significantly from a 50:50 sex ratio.

	1-year-old		2-year-old	
Year	Males	Females	Males	Females
1950	1,296	1,320	5	9
1951	1,428	1,367	6	4
1952	826	828	6	5
1953	629	605	8	14
1954	467	505		
1955	966	978	1	1

Distribution of Underyearling Sockeye in the Babine-Nilkitkwa Lake Nursery Areas

During 1954 a method of capturing underyearling sockeye with a tow-net was developed at Lakelse Lake. Two series of tow-net collections were made in Nilkitkwa and Babine Lakes in August and October, 1955. Marked differences in the catches and in the size of individuals captured in the different areas indicate that there was a highly unequal distribution of young sockeye in the Babine-Nilkitkwa Lake nursery area.

In the following table the proportions of young sockeye in the three main sections of the watershed (as estimated from the catch data) are listed with the area of each section.

	Area as % of total	August Sockeye population as % of total	October Sockeye population as % of total
Nilkitkwa Lake	1.1	9.2	12.5
North Arm of Babine Lake	10.3	78.9	71.6
Babine Lake south of Halifax Narrows	88.6	11.9	15.9
Totals	100.0	100.0	100.0

It is apparent from the above figures that well over 80% of the total population was concentrated in less than 12% of the total area of the lake system. Data on the size of fish taken in the various areas indicated that the young fish in densely-populated North Arm and Nilkitkwa Lake areas exhibited a much lower rate of growth than those in the sparsely-populated southern area. On the basis of these data, very inefficient use of the food resources of Babine Lake was made by the young sockeye in 1955.

The factors believed responsible for the unequal distribution of young sockeye are the distribution of the parent spawning population and the apparent inability of the young fish to move long distances from their point of entrance into the lake as fry. The concentration of fish in the North Arm-Nilkitkwa region was due in part to the fact that over half (56%) of the total spawning run to Babine in 1954 spawned in the streams of this small area. It is probable that the fry emigrating from these streams remained in the adjacent basins and did not migrate through the constriction at Halifax Narrows, which divides the North Arm from the southern area of Babine Lake.

The growth of fish in the southern area suggests that it could support many more fish than it did in 1955 (and probably in most other years). To fully utilize Babine Lake as a nursery area, it will be necessary to obtain larger outputs of fry in the southern part of Babine Lake.

Studies on Bear and Morice Lake Sockeye Smolts

In order to obtain sockeye smolt samples, Bear Lake was visited for the period from June 21 to June 29 and Morice Lake for the period July 6 to July 16. Smolts were caught in both lakes by means of fine nylon gill-nets of 3/4" and 1" mesh placed at the lake outlets. At Bear Lake a total of 694 sockeye smolts were caught, while at Morice Lake, because of the lateness of the season, only one sockeye was captured. Many coho smolts and small fish of other species were captured at both lakes.

Examination of scales of the Bear Lake smolts showed that they were all 1-year-olds but that considerable growth had been made in the spring prior to emigration. The sex ratio of 544 Bear Lake fish examined for sex was 276 males to 268 females which does not depart significantly from a 1:1 ratio. Lengths and weights of the smolts are shown in the following table.

Fork Length (mm.)		Weight (gm.)	
Range	Average	Range	Average
81-105	91.0	5.6-12.4	7.8

Comparison with Babine and Lakelse Lake sockeye smolts shows that the average size of smolts sampled at Bear Lake in 1955 was greater than that of smolts sampled in any year at Babine or Lakelse Lakes.

The Pink Salmon Run to the Lakelse River, 1955

The Lakelse River is one of the main pink producing areas of the Skeena drainage. As an initial step in a program aimed at laying the basis for management of the Skeena pink salmon fishery to provide optimum escapements, the 1955 adult run to the Lakelse River was estimated by stream surveys and a tagging program. In January, 1956, redd sampling was carried out to provide information on survival during the incubation period. In the spring of 1956 attempts will be made to estimate the numbers of fry moving out of the river.

Estimation of number of adults. To estimate the abundance of the adult run, the number of pinks in yard-wide sample strips extending from bank to bank were counted or estimated at representative points down the 13 miles of river between Lakelse Lake and the Skeena. An estimate of the population could then be gained by multiplying the average figure for the whole river by the length of the river.

To check this method, the Lakelse River fence (located above 600 yards downstream from the upper limit of spawning in the river) was installed and the number of fish spawning in the area above the fence estimated by the sample strip technique and by tagging. The results suggested that not all the fish in each sample strip were visible and that by multiplying the estimates obtained by the strip technique by 1.3 a more accurate assessment of the runs would be gained.

The results of the survey (and of fence data from earlier years) indicated that:

(1) The peak of the pink run to the upstream part of the Lakelse River occurs in mid-September (about September 16th in 1955), while the run in the lower part of the river tended to be somewhat later.

(2) The interval between arrival of fresh fish on the grounds and their death was of the order of 3 weeks.

(3) The total spawning run to the Lakelse River was about 172,000 (approximate limits 128,000 to 216,000). With an estimated male/female ratio of 0.96 and an average egg content of about 1,600 per female, the potential deposition was of the order of 140,000,000 eggs (approximate limits 105,000,000 to 177,000,000).

(4) The fish were present in greatest concentration in the upstream part of the spawning area, with over half the observed spawners being found in the mile immediately below the upper limit of spawning.

Redd sampling. Forty-six redds were sampled between January 18 and 23 in six sections comprising the upper end of the Lakelse River. The total length of river covered was approximately three miles and about 75% of the spawning occurred in this area. The sampling should therefore be fairly representative of the run as a whole.

Living eggs and young were present in almost all stages of development. The majority (75%) were in the late eyed stage, while 22% were not yet eyed and 7% were alevins.

The total number of eggs in the 46 samples was 17,626. Of these, 12,679 were alive, indicating a survival of about 72%. The survival in individual redds ranged from 0 to 99%. Survival was generally lower in the uppermost sections of the spawning area. This may be related to three factors: firstly, superimposition by later-running coho which spawned in this section; secondly, the relatively large amount of silt observed in the redds at the time of sampling; and thirdly, the relatively high density of spawners in this section.

It was apparent that many dead eggs had been partially eaten, presumably by the insect larvae and nymphs found in the samples. The possibility therefore exists that some loss of dead eggs had occurred and that consequently the survival values are erroneously high. However, a close examination of the samples suggested that the disintegration of eggs either through the actions of the insects or of fungus had not occurred to any great extent. It was concluded that a fairly representative picture of survival up to the time of the examinations had been obtained.