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TITLE

Skeena Salmon Management Committee Annual Report 1959 January 1, 1959 - December 31, 1959.

AUTHORSHIP

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Establishment

Biological Station, Nanaimo, B. C.

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Terms of Reference

The Skeena Salmon Management Committee was appointed in the fall of 1954 by the Minister of Fisheries. Its members are Dr. A.W.H. Needler, Director of the Biological Station of the Fisheries Research Board at Nanaimo, and Mr. A.J. Whitmore, Chief Supervisor of Fisheries for the Pacific Area (now Area Director of Fisheries). The Committee was directed to investigate thoroughly the condition of Skeena River salmon stocks to improve the management of the runs and increase the yields. Special attention was to be paid to rehabilitation of the Babine Lake sockeye run, the Skeena's largest, which had been seriously depressed by the 1951-52 Babine River rock slide.

To achieve its objectives the Committee was directed to use fully the administrative and research staffs of the Federal Department of Fisheries. Both staffs had worked extensively on Skeena salmon stocks prior to 1954; the Committee was directed to co-ordinate and, where necessary, extend these activities.

After establishing the Committee, the Minister appointed an Advisory Board representing the various sections of the industry concerned with the Skeena salmon fishery. The Committee meets with its Advisory Board several times each year to discuss new developments arising from investigations and the basis for recommendations for regulation of the Skeena fishery. Advisory Board members for the year 1959 are listed on the front page of this report.

Record of Meetings

The Committee met at Nanaimo on December 5, 1958, to review the results of investigations in 1958 and to examine the performance of the 1958 Skeena salmon stocks under the regulations applied to the Skeena fishery at the Committee's recommendation. The Committee then examined the available evidence concerning the likely abundance of Skeena sockeye and pink runs in 1959, and discussed the regulations which would be necessary to harvest those salmon not required for reproduction of the stock.

The Committee noted that Skeena sockeye return predominantly as 4- and 5-year-olds. The 4's would be returning from a total escapement of about 100,000 in 1955, of which 71,000 had entered Babine Lake. The Babine smolt output had been estimated at about 6,000,000, which was low. The total return of 4's would be small, perhaps in the order of 150,000.

The 5's would return from a total escapement of 510,000 in 1954, of which 490,000 had gone to Babine. The Babine smolt output from this run had been estimated at about 21,000,000, which was comparatively good. The return as 4's in 1958 from the same 1954 brood had been 600,000. On the basis of the ratio of total return of 4's and 5's from spawnings of the size of that of 1954, about 750,000 or slightly more 5's could be expected in 1959.

The best estimate of the total 1959 Skeena sockeye run would be 900,000 or slightly more.

The 1959 Skeena pink run would be returning from the 1957 spawning which totalled 900,000, slightly less than the 1955 spawning which produced a total stock of about 3,700,000 in 1957. The fry output from the 1957 escapement was assessed to be twice as great as for the 1955 spawning when, however, the ocean survival had been high. Since no information was available to assess

ocean survival conditions confronting the fry from the 1957 spawning, for prediction purposes they must be assumed to have been average. On this basis, the expected total stock of Skeena pinks in 1959 would be about equal to that of 1957, say 4,000,000.

In considering the form which the 1959 regulations for Skeena salmon fishing might take, the Committee bore in mind the following points:

(1) The expected abundance of Skeena sockeye in 1959 was only slightly greater than the indicated optimum escapement. However, it was understood that it is difficult to predict the abundance of runs with precision and that some restricted early fishing for sockeye might be desirable to harvest any surplus over conservation needs should such appear.

(2) The studies of growth and distribution of young sockeye in Babine Lake indicated that it was desirable to build up the runs to streams adjacent to the main body of the lake. Hence special protection of the early sockeye runs was necessary.

(3) The 4-year-old sockeye returning from the slide-depleted 1955 run would enter the Skeena Gillnet Area during the last two weeks of July and the first week of August. Those which escaped the fishery would spawn in the Upper and Lower Babine Rivers which in recent years had provided the bulk of the Babine sockeye run. If the numbers of these late-running sockeye should be even less than expected, special protective measures might be necessary.

(4) The expected abundance of Skeena pinks in 1959 would permit a substantial fishery and yet provide a good escapement.

With the above points in mind, the Committee released on December 17, 1958, a statement containing tentative proposals for regulation of the 1959 Skeena salmon fishery for consideration by the industry generally, in order that discussion and suggestions might be solicited at the forthcoming meetings of the Committee with its Advisory Board. The proposals for regulation of the Skeena Gillnet Area and adjacent waters were as follows:

(a) That the upriver commercial fishing boundary in the Skeena Gillnet Area in 1959 be maintained at the Mowitch-Veitch Point line.

(b) That prior to 6:00 p.m. Sunday, June 28, 1959, only gillnets having mesh not less than 8" linen, or 8½" nylon, stretched measure, be permitted and that prior to this date a 72-hour weekly closed period from 6:00 p.m. Thursday until 6:00 p.m. Sunday be maintained.

(c) That fishing for salmon with gillnets of any mesh size be permitted after 6:00 p.m. June 28, 1959, until the end of the fishing season, as follows:

  (i) From June 28 to July 26 - 120-hour weekly closed time, 6:00 p.m. Tuesday to 6:00 p.m. Sunday.

  (ii) From July 26 to August 30 - 96-hour weekly closed time, 6:00 p.m. Wednesday to 6:00 p.m. Sunday.

(iii) From August 30 to the end of the fishing season - 72-hour weekly closed time, 6:00 p.m. Thursday to 6:00 p.m. Sunday.

(d) The Committee also proposes to make recommendations as follows relating to adjacent fishing areas to the end of extending similar protective measures for Skeena-bound sockeye and pink salmon whilst passing through those areas:

Nass Gillnet Area - Sub Area 3X and 3Y only

(i) Same weekly closed times from July 5, 1959 to August 23, 1959.

Salmon Purse Seine Area No. 5 - Beaver Passage and Ogden Channel only

(i) Same weekly closed times from July 26, 1959 to August 23, 1959.

(e) Proviso:

(i) That the weekly closed times outlined above shall be extended in the event that for any week or series of weeks during progress of the fishing season the proposed weekly closures, in the opinion of the Committee, are deemed insufficient to provide adequate escapement of salmon for reproduction purposes.

(ii) That granting of extra fishing time would be considered if, in the opinion of the Committee in the light of developing runs of sockeye and pink runs at the time, such might safely be permitted consistent with the attaining of adequate escapements for reproduction.

The Committee met with its Advisory Board at Vancouver on January 23, 1959, and at Prince Rupert on February 4, 1959, to review the performance of the 1958 Skeena salmon runs and the results of investigations. All available evidence concerning the likely size of the 1959 Skeena sockeye and pink runs was elaborated, and discussion of the Committee's proposals for regulation, as put forward in the release of December 17, 1959, invited.

Advisory Board members present at the Vancouver meeting were R. Bell-Irving, A.E. MacMillan and R. Nelson. D.F. Miller and D. Souter, representing R. Hager and R.E. Walker, were also present. In considering the proposals for regulation in 1959, Advisory Board members strongly contended that the 2-day weekly fishing times proposed for the period June 28 to July 26, 1959, were too short to permit an economic operation, either by canners or by fishermen. It was suggested that the weekly fishing time recommended for this period should be 3 days per week and that this time be shortened only if conservation needs at the time of fishing were not being met. Alternative proposals to increase the fishing time without endangering the escapement, such as moving the upriver fishing boundary seaward, were discussed but no method meeting the unanimous approval of the group was derived.

At Prince Rupert, Advisory Board members present were S. Oddsun and O. Olafson. N. Bellis represented K. Harding. The 2-day weekly fishing times proposed for the period June 28 to July 26 met strong opposition; most of those present favoured a 3-day weekly fishing time on the grounds that a 2-day fishing week was not economically feasible for fishermen. Alternative

proposals to decrease fishing effectiveness to permit increased fishing time, such as restricting the use of fine twine gillnets, were discussed.

At both meetings, attention of the Advisory Board was directed toward the problem of rehabilitation of the once-important Morice Lake sockeye stock. Studies carried out by the Fisheries Research Board and the Fish Culture Development Branch leading to construction of fishways at Moricetown Falls and removal of the obstruction at Hagwilget Canyon were reviewed. Currently, the various methods by which the Morice sockeye run could be restored were being explored; the Committee had already expressed concern that steps to rehabilitate the run should be taken as soon as promising techniques were discovered.

Following the meetings with its Advisory Board, the Committee held a meeting at Nanaimo on March 5, 1959, at which it studied the alternative proposals for regulation of the 1959 Skeena fishery as put forward by members and other interested persons. It noted particularly the concern expressed by fishermen and canners alike regarding the proposed 2-day weekly fishing time between June 28 and July 26. In a release dated March 18, 1959, the Committee recommended to the Department of Fisheries modified regulations which, while shortening the overall period during which sockeye fishing would be permitted, extended the weekly fishing period to 2½ days. The recommended regulations were as follows:

(a) That the upriver commercial fishing boundary in the Skeena Gillnet Area in 1959 be maintained at the Mowitch-Veitch Point line.

(b) That prior to 6:00 p.m. Sunday, July 5, 1959, only gillnets having mesh not less than 8" linen, or 8½" nylon, stretched measure, be permitted and that prior to this date a 72-hour weekly closed period from 6:00 p.m. Thursday until 6:00 p.m. Sunday be maintained.

(c) That fishing for salmon with gillnets of any mesh size be permitted after 6:00 p.m. July 5, 1959 until the end of the fishing season, as follows:

  (i) From July 5 to July 26 - 106-hour weekly closed time, 8:00 a.m. Wednesday to 6:00 p.m. Sunday.

  (ii) From July 26 to August 30 - 96-hour weekly closed time, 6:00 p.m. Wednesday to 6:00 p.m. Sunday.

  (iii) From August 30 to the end of the fishing season - 72-hour weekly closed time, 6:00 p.m. Thursday to 6:00 p.m. Sunday.

(d) The Committee also proposed to make recommendations as follows relating to adjacent fishing areas to the end of extending similar protective measures for Skeena-bound sockeye and pink salmon whilst passing through those areas:

  <u>Nass Gillnet Area - Sub Area 3X and 3Y only</u>

  (i) Same weekly closed times from July 5, 1959 to August 23, 1959.

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(i) That the weekly closed times outlined above shall be extended in the event that for any week or series of weeks during progress of the fishing season the proposed weekly closures, in the opinion of the Committee, are deemed insufficient to provide adequate escapement of salmon for reproduction purposes.

(ii) That granting of extra fishing time would be considered if, in the opinion of the Committee in the light of developing runs of sockeye and pinks at the time, such might safely be permitted and still allow adequate escapements for reproduction.

Two meetings of the Committee with its Advisory Board were held during the fishing season. On July 16, 1959, the Committee met with available members in Vancouver to consider what action might be taken to protect sockeye which up to that time had been less abundant than expected, and whose escapement was below that needed for an optimum escapement. After reviewing catches and escapement and the prospect for adequate escapement during the following week, the Committee recommended that the weekly fishing time during the week ending July 26 be shortened by 22 hours, i.e., that fishing be permitted only from 6:00 p.m. Sunday, July 19, to 8:00 a.m. Tuesday, July 21.

A further meeting was held on August 3, 1959, at Prince Rupert with available Advisory Board members. The Committee expressed concern that the Advisory Board be kept informed as fully as possible of the trends in escapement in view of the lack of information from fishing. (The salmon net fishing fleet was tied up during the weeks ending August 2 and 9 pending settlement of negotiations for fish prices.) The status of the Skeena sockeye and pink runs up to August 3 was reviewed in detail. Members present also enquired about continued fishing by United States boats in the vicinity of Noyes Island where tagging in 1957 and 1958 had shown that sockeye and pink salmon bound for Canadian rivers had been intercepted by the United States fleet. It was noted further that fishing in the vicinity of Noyes Island was much less restricted than for the Canadian fleet in northern British Columbia waters, where rehabilitation of the Skeena sockeye and pink runs was being undertaken. Those present at the meeting wished to record their serious interest and concern over the effect of the Noyes Island fishery on Skeena River stocks.

Extra fishing time (24 hours) was recommended by the Committee during the week ending August 16, 1959. The tie-up of the fleet during the weeks ending August 2 and 9 had permitted substantial numbers of both sockeye and pinks to escape, so that increased fishing effort during the week immediately following was deemed permissible without endangering escapement requirements.

At a meeting of the Committee only at Nanaimo on December 9, 1959, the performance of the 1959 Skeena runs was reviewed, and the effect of the Committee's 1959 regulations on the catch and escapement of the stocks studied. The pertinent information is presented in the following section.

The 1959 Skeena Salmon Catch and Escapement

The following table summarizes the weekly catches by gillnets for all species in the 1959 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
April				21		
May	9			8		
	16			41		
	23			91		
	30			147		
June	6			438		1
	13	15		1,164		5
	20	49		1,653		45
	27	91		1,633		4
July	4	158		2,016		1
	11	14,743	1,509	3,215	253	487
	18	17,388	8,961	4,121	656	1,372
	25	43,189	50,881	2,580	947	1,775
August	1	36	9	3		
	8					
	15	77,952	381,321	400	12,932	9,906
	22	30,866	95,221	186	11,977	6,814
	29	8,568	30,304	161	8,576	7,461
September	5	2,019	3,552	50	5,806	3,275
	12	624	858	23	5,964	678
Total		195,698	572,616	17,951	47,111	31,824

As fishing progressed, it became apparent that the sockeye run was moderate in abundance, and was especially small in the early and middle portions of the season. The figure following shows, for the Skeena Gillnet Area, the numbers of days fishing recommended by the Committee prior to the season, the actual number of days fishing allowed each week, the weekly number of gillnet boat deliveries, and the estimated weekly total abundance of sockeye and pinks (catch plus escapement estimates derived from test fishing above the upriver commercial fishing boundary). It will be seen from the diagram that the abundance of sockeye prior to the commencement of sockeye fishing on July 5 provided only a relatively small escapement. During the first two weeks of sockeye fishing ending July 12 and 19, the run remained small, and about 25% of sockeye entering the Skeena Gillnet Area were caught. During the week ending July 26, when the fishing time was decreased to 1½ days to permit more middle-run sockeye to escape, the run increased somewhat in number, and again about 25% of the total present were caught. During the weeks ending August 2

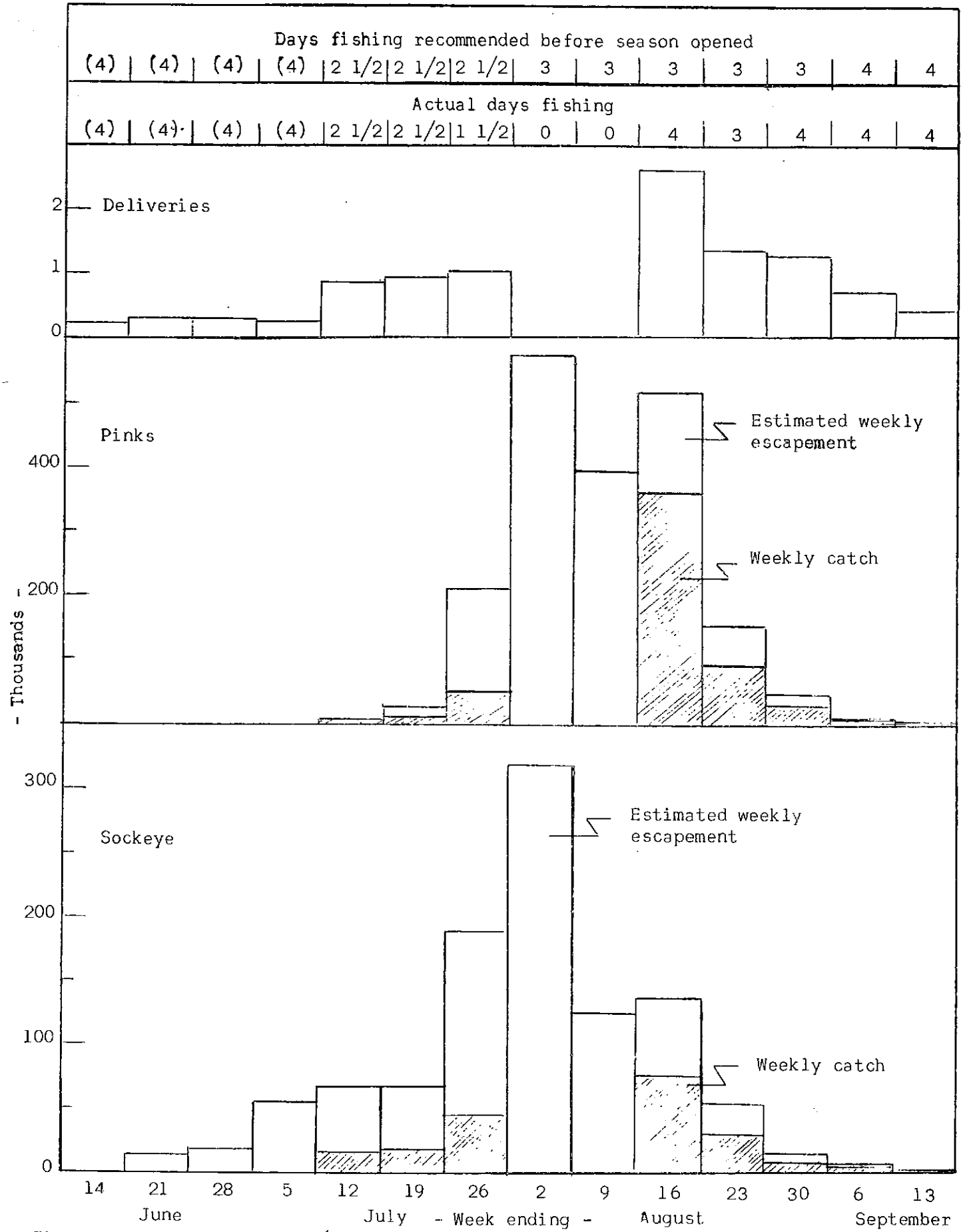

Fig. 1. Catch, escapement (based on test fishing catches), and fishing effort (boat deliveries) by week, Skeena sockeye and pinks, 1959. Days fishing in brackets refer to days when spring salmon nets only were permitted.

and 9, when the fleet was tied up pending settlement of negotiations on fish prices, the run was most abundant and about 435,000 sockeye escaped upriver. During the week ending August 16, when fishing time was extended to 4 days to permit fishermen to make up for fishing lost during the tie-up, 55% of the sockeye were taken from the last part of the run. Thus, as a consequence of only a moderate-sized run being present, and of the fleet being tied up during the period when sockeye were most abundant, the catch was small - only 196,000 fish.

Conversely, the escapement was good, amounting to some 854,000. Of these, 783,000 entered the Babine-Nilkitkwa watershed, providing the second largest run to Babine since counts began in 1946. The spawners were well distributed over the Babine spawning grounds, with slightly over half entering streams tributary to the underused southern basins. Three large, stable streams in this region - Fulton, Morrison, and 15-Mile Rivers - carried over 220,000 spawners. In contrast to the low-water spawning conditions attending the larger 1958 run when 75,000 died unspawned, conditions in 1959 were very favourable and no losses due to low water occurred. Because of this more favourable condition, the 1959 Babine spawning run actually exceeded the 1958 run in terms of eggs available for seeding. Other Skeena sockeye spawning areas were moderately to well seeded, with the exception of the Morice Lake watershed. Here, for the sixth year in a row, the escapement to the main spawning area was about 1,000, approximately 2% of its abundance in the years up to 1951.

The 1959 Skeena pink run was only one-half as abundant as expected, due to a poorer than average survival of the 1957 brood in the sea. The total run amounted to slightly over 2,000,000. Figure 1 illustrates the weekly abundance of pinks in the Skeena Gillnet Area and the division of the stock by week into catch and remaining escapement upriver. Pinks appeared in relatively small numbers during the week ending July 26, when fishing was reduced to 1½ days to permit more middle-season sockeye to escape. About 25% of the pinks present were caught. The early and middle pink run appeared in the next two weeks, ending August 2 and 9, while the fleet was tied up pending settlement of price negotiations. During this time 965,000 pinks escaped upriver. During the week ending August 16, when fishing was extended to 4 days to permit fishermen to make up for fishing lost during the tie-up, the pinks were still abundant and 70% of those present were caught. The pink run declined rapidly during the weeks ending August 23 and 30 when about 60% were caught. The effect of the tie-up was to reduce markedly the proportion of the moderate pink run taken, so that the season's catch amounted to 573,000.

The escapement was 1,478,000, the largest recorded in recent years and 1½ times as great as that of the brood year 1957. Some 1,383,000 spawned in tributaries of the Skeena River or in the river itself, while 95,000 spawned in coastal streams adjacent to the Skeena Gillnet Area. The tie-up in late July and early August permitted a high proportion of early-run fish to escape. The effects were reflected in substantially increased spawnings on the Kispiox, Kitwanga, Bear and Babine Rivers over those in 1957. The increase to the Lakelse River was not so marked because fishing resumed during the week ending August 16 when the pinks in the fishing area were preponderantly bound for Lakelse. The spawning in the main stem of the Skeena, while difficult to assess accurately, appeared to be about 3 times heavier than in 1957.

The 1959 Skeena gillnet catch of spring salmon was about 18,000, which is below average for the period since 1950. The escapement to the Bulkley River was reported by Departmental officers to be small, to the Ecstall

and Khyex Rivers, and to Johnson Creek to be fair, to the Morice, Kitsumgalum, and Kitwanga Rivers to be moderate, to the Lower Babine River to be above average, and to the Bear and Kispiox Rivers, heavy.

The 1959 gillnet catch of coho salmon in the Skeena area was approximately 47,000, which is less than the 1950-58 average. The escapements to the Bulkley, Bear, and Kispiox Rivers, to the streams in the Skeena-Lakelse area, and to the streams tributary to the Skeena estuary were reported to be light, to the Morice River to be of medium intensity, and to the Babine system, slightly above average. The low catch of coho can be attributed partly to the reduced fishing for the season caused by the tie-up.

The 1958 Skeena gillnet area catch of chums was about 32,000, which is below the average of the preceding 9 years. The escapement to the streams in the Skeena-Lakelse area was reported to be above average; to the streams tributary to the Skeena estuary, very light. The tie-up affected the chum catch adversely.

The 1959 catches of each species of salmon in the Skeena Gillnet Area are compared with previous years' catches in the following figures.

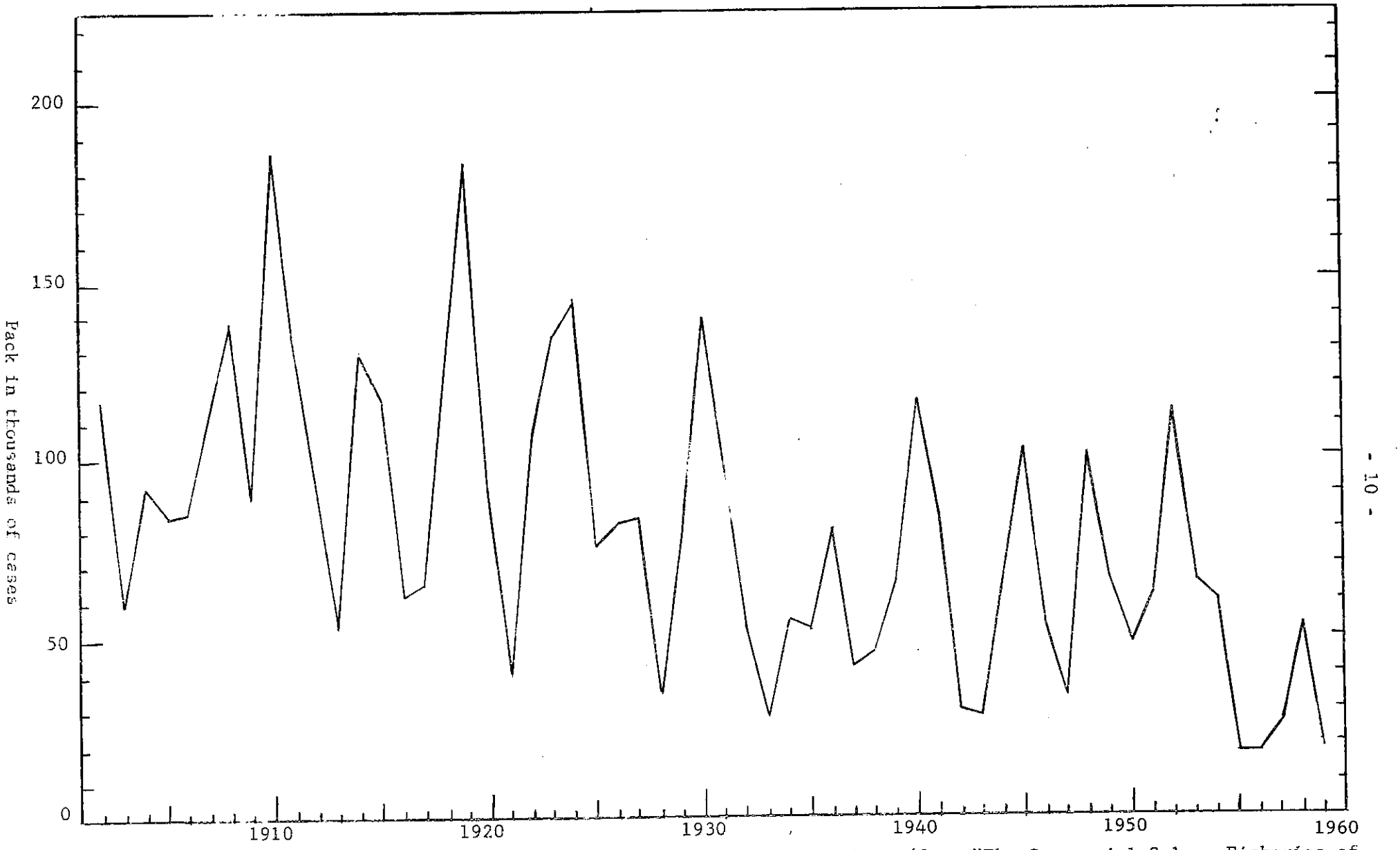

Fig. 2. Annual packs of sockeye salmon caught in the Skeena Gillnet Area (from "The Commercial Salmon Fisheries of British Columbia", Statistical Basebook, No. 3, and B.C. Catch Statistics of the Department of Fisheries).

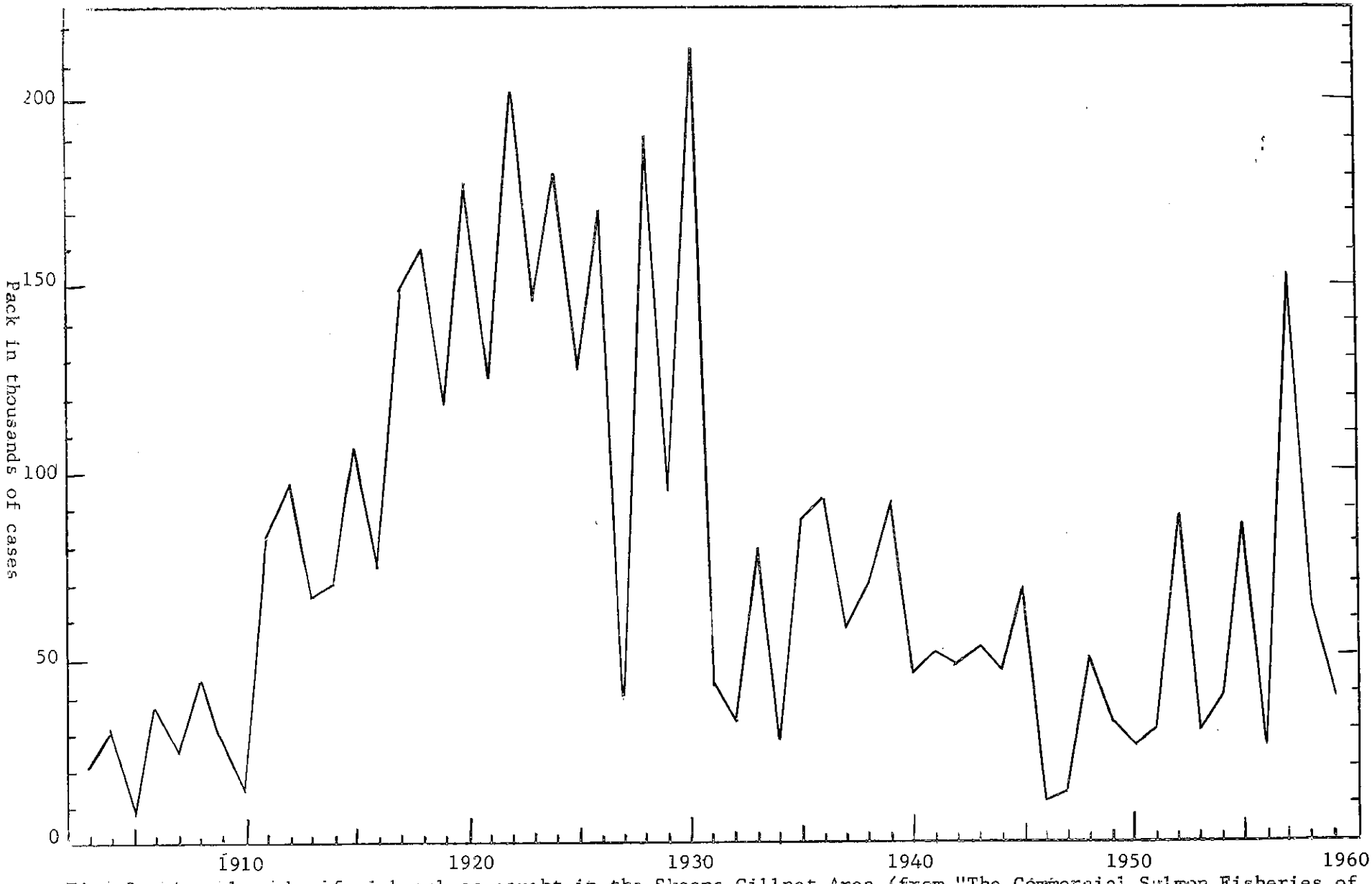

Fig. 3. Annual packs of pink salmon caught in the Skeena Gillnet Area (from "The Commercial Salmon Fisheries of British Columbia", Statistical Basebook, No. 3, and B. C. Catch Statistics of the Department of Fisheries).

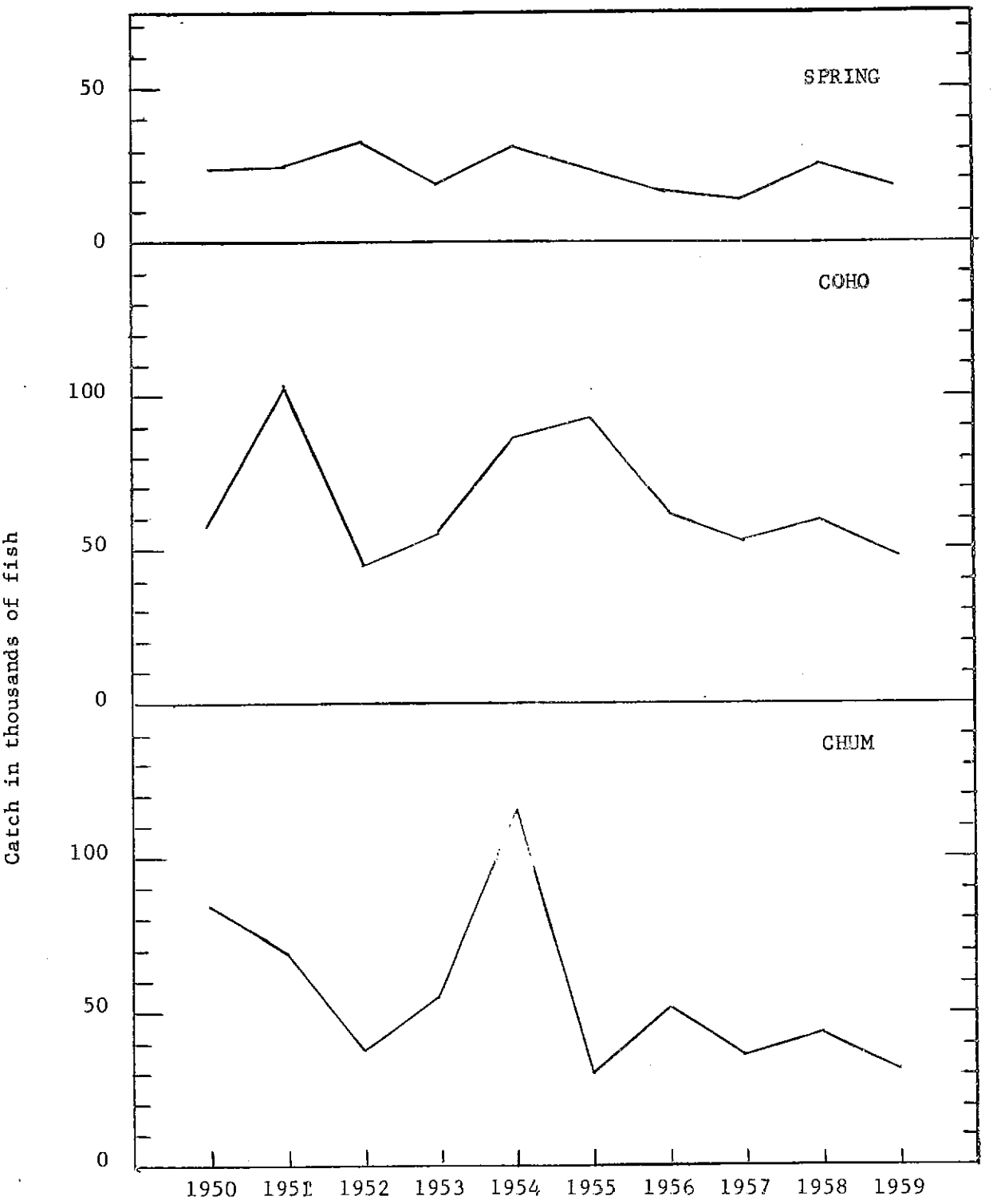

Fig. 4. Annual gillnet catches of spring, coho and chum salmon in the Skeena Gillnet Area (from the B. C. Catch Statistics of the Department of Fisheries).

Investigations

Knowledge gained by investigation of the stocks about the requirements for maximum sustained production is readily applied through the Skeena Salmon Management Committee, which represents the administrative and fish cultural arms of the Department of Fisheries, as well as that of research. The Committee, which was formed in the fall of 1954, has now completed five seasons during which it has been responsible for recommendation of appropriate fishing regulations, of fish cultural aid to the stock, and of research to provide information for management. Reports of progress in research during 1959-60 follow this section; only a general review of progress of studies and application is given here.

Pacific salmon reproduce in fresh water and do most of their growing in the sea. Although annual variations in the sea environment exert important effects on their survival and growth, their wide distribution in the ocean suggests that space and food available there are not factors limiting abundance. Such being the case, achieving maximum production depends upon making the fullest use of the freshwater environments. Regulation of salmon fisheries is therefore mainly concerned with providing spawning escapements which will, as nearly as possible, provide the greatest return to the fishery.

In this perspective, the Skeena salmon investigation has been concerned chiefly with two questions: What escapements are required to provide the greatest return to the fishery? How may the fishery be regulated to provide such escapements?

Sockeye stocks. In realizing its objective of providing optimum spawning escapements, the Committee immediately faced the problem of greatly reduced returns from the slide-blocked Babine sockeye escapements of 1951 and 1952, parents of sockeye runs of 1955, 1956, and 1957. Observations at the slide and on the spawning grounds in 1951 and 1952 had demonstrated the seriousness of the block - the escapements had been reduced to one-third their effectiveness. Stringent restriction of the fishery in 1955, 1956, and 1957 was enforced to restore the damaged runs.

Meanwhile, observations had begun on the distribution and growth of young sockeye in Babine Lake by collection with high speed townets, which had been developed in 1953 and 1954 at Lakelse Lake. These collections showed that, for the young from the substantial 1954 spawning, the distribution within the lake was markedly uneven due to the concentration of over one-half of the spawners in the outlet region of the lake coupled with the inability of the young to move far from their natal stream whilst in the lake. The result was that the large southern basins of the lake (comprising 90% of the total area) were sparsely populated, and the fish were large; the restricted North Arm-Nilkitkwa region (10% of the area) adjacent to the large outlet spawning grounds was densely populated, and the young fish markedly smaller than in the southern basins. Further study of the young sockeye in subsequent years confirmed the opinion that, in the restricted northern area, the escapements were large enough in most years to provide enough young to use the nursery area to nearly its capacity. In the large southern basins, where the amount of spawning area available was a factor limiting production, escapements were less than those needed to fully use the streams, let alone the lake area.

Tagging of sockeye in the sea from 1944-48, and later from 1956-58, showed that sockeye runs to streams tributary to the main southern basins passed through the fishing area in the early and middle portions of the sockeye fishing season. Hence a means of adjusting the distribution of escapements to the Babine spawning grounds was available through regulation of the fishery. Since 1956 stringent restriction of the early sockeye fishery has been applied.

Studies of the performance of Skeena salmon stocks in the past also shed light on the optimum sockeye escapements required for maximum sustained production. Information on catches and escapements of Skeena sockeye since 1908 was examined to determine the relationship between the abundance of spawners and the size of the resulting stock. By comparing recent relatively complete records of effort, catch, and escapement with catch and effort data for the earlier years, it was possible to compare escapement and resultant return for the period 1908 to 1952. In general, the return and the number of spawners tended to vary together - small spawnings tended to provide small returns, the largest returns were obtained from large - though not the largest - escapements. Spawnings below 500,000 never produced better than moderate resultant stocks, spawnings between 500,000 and 900,000 produced larger returns on the average and resulted in the really big returns. With spawnings of over 900,000 the average return diminished.

Since 1955, the Skeena sockeye escapement has been increased each year closer to the apparent optimum required for best use of the spawning and nursery areas; regulation of the fishery has provided better distribution of the spawners over the Babine spawning grounds where the major portion of the sockeye stock is produced. In 1958 and 1959, the total sockeye escapements were 885,000 and 854,000. The effects of near-optimum escapement and better distribution will be demonstrated in the smolt production of 1960 and 1961. Encouraging signs are already apparent in the number and size of underyearlings present in Babine in 1959.

Pink stocks. Since young pinks go to sea directly, the problem of freshwater capacity is restricted to consideration of the available spawning ground only. Intensive study of Skeena pinks began only in 1956, and little was known of escapements prior to that time. Intensive survey methods showed that the bulk of spawners used three major spawning streams - Kispiox, Kitwanga, and Lakelse Rivers. More recently, extensive spawning has also been observed in the main stem of the river. Tagging in the sea showed that, while there is considerable overlap in time, the major pink runs tended to pass the fishery earlier or later in accordance with the distance to be travelled in fresh water; the Kispiox and Kitwanga runs appeared first, the Lakelse run last.

Analysis of past pink catch statistics has shown that spawnings in years of abundance more often resulted in large returns than did spawnings in years of scarcity. This evidence, plus the fact that direct observation of even the largest recent spawning densities does not suggest them to be excessive, strongly indicates that spawning populations need to be larger before pink production can be returned to former high levels. In four years of observation, indices of fry production have been roughly proportional to the size of spawning escapement, further suggesting that the densities so far observed have not taxed the capacities of the spawning grounds to produce young pinks.

With this background, regulation of the fishery has been directed toward increasing pink escapements generally, but particularly in the even-

numbered years in which the spawning stock has recently been only about one-quarter to one-half as abundant as in the odd years. Escapements in both cycles are increasing; in 1959, as a consequence of a tie-up of the fishing fleet, the escapement was greater than any in the past five years - almost 1,500,000. A total return of over 4,000,000 is expected in 1961.

Escapement indices from test fishing

Catches of salmon in standard test drifts of gill-nets above the upriver commercial fishing boundary have been used to provide information about the weekly escapement of sockeye and pinks from the commercial fishery. These estimates, when used with catch statistics, permit assessment of seasonal changes in rate of exploitation.

Comparison of the seasonal patterns of test fishing catches with those of escapements on the spawning grounds has shown that test fishing catches within each season were roughly proportional to the daily escapements. Thus, it is possible to derive indices converting catch/hour to escapement for each year by summing the daily catch/hour figures and dividing this number into the total escapement to areas upstream from the test fishing site. The indices so derived for the years 1955 to 1959 are shown in the following table:

Year	Sum-daily catch/hour		Total escapement (1,000's fish)		Escapement per daily catch of 1 fish/hour	
	Sockeye	Pink	Sockeye	Pink	Sockeye	Pink
1955	377	1,672	125	987	333	584
1956	834*	522	441	202	530	387
1957	769*	1,929	485	868	632	451
1958	1,203*	1,149	884	556	735	484
1959	1,111*	1,909	854	1,383	769	724

*Adjusted to correct for differences in efficiency of boat skippers.

There was a relatively large difference between escapement indices derived from the years 1955 and 1956, and this discrepancy has been attributed largely to differences between nets used in the two years. The large difference between the indices for pink escapement in 1959 and those in 1956 to 1958 cannot be accounted for in this way. It is now believed that when the salmon at the test fishing site are very abundant, as was the case during the two-week tie-up of the fleet in 1959, the nets catch a smaller proportion of the fish because the presence of large numbers already in the net tends to discourage others in the vicinity from approaching. The data are being re-examined to determine the changes in proportions caught with extreme changes in abundance.

Babine fence counts in 1959

Since the sockeye escapement to Babine Lake constitutes about 75% of the total escapement to the Skeena River, the Babine fence count, which was carried out in 1959 as in all other years since 1946 (except in 1948 when floods damaged the fence), provides the best single measure of sockeye escapement to the Skeena River. The fence data have been of especial importance since 1951 in assessing the effect on the salmon runs of the partial block by the Babine River rockslide. In conjunction with estimates of smolts, they also give information on the relationship between the number of spawners in the Babine area and the resulting smolt production.

The numbers of the five species of Pacific salmon which were counted in 1959 are compared in Table 1 with counts made in the other years of operation.

The sockeye run in 1959 was the second largest recorded to Babine Lake since fence operation began in 1946. The count began on July 19 and by July 30 the daily count rose to a peak of 19,613 sockeye. This early peak which has been characteristic of most years is composed of early running fish to smaller streams of the south end of the lake. Following the early peak the run declined and rose again to a peak of 37,140 sockeye on August 15. This second peak was larger than usual. The daily count stood at over 30,000 sockeye for 9 days. On August 22 the run dropped below 30,000 and declined further until on October 2 the daily count was 250 sockeye. Fence operations were discontinued on October 3.

Table 1. Counts of salmon passing the Babine fence.

Year	Sockeye		Spring	Pink	Coho	Chum
	Large	Jack				
1946	444,551	31,154	10,528	28,161	12,489	18
1947	261,460	261,101	15,614	55,421	10,252	7
1948*	650,000					
1949	461,139	47,993	7,433	13,663	11,938	5
1950	364,356	179,302	6,838	38,728	11,654	7
1951	141,415	11,042	2,778	50	2,122	0
1952	349,011	27,936	5,915	2,706	10,554	1
1953	686,586	28,028	8,353	1,108	7,648	17
1954	493,677	9,745	5,925	4,604	3,094	66
1955	71,352	30,624	3,528	2,151	8,947	3
1956	355,345	18,164	4,345	2,691	9,250	3
1957	433,149	50,162	7,509	25,865	4,421	15
1958	812,043	30,769	8,274	6,600	7,606	8
1959	782,868	31,920	9,597	56,766	10,947	20

*Total sockeye estimated from comparison with stream surveys and fence counts of other years.

The run of spring salmon was above average. During the early part of the season it consisted mainly of "jacks" while later the run consisted mainly of large fish. Since spring salmon spawn below as well as above the fence, the count is only an index of the total Babine River run. The pink salmon run was the largest since weir operations began in 1946. As with springs, some pinks spawn below the fence. The coho salmon run was slightly above average. A few chum salmon again reached the Babine fence.

Sockeye sampling at the Babine fence in 1959

To examine the composition of the 1959 Babine sockeye run, 1% of the previous half-day's fence count was sampled twice daily for length and sex. In addition sampling was carried out to determine the proportion of the large sockeye which were normal, net marked or injured.

Female sockeye in the 1959 Babine run outnumbered the large male sockeye as in all other years with the exception of 1951 and 1952. The 1% sample indicated that 39.6% of the large sockeye were males and 60.4% were females. A comparison of percentages in other years of the Babine fence operation is made in Table 2.

The sampling indicated that the "jacks" were of average size, while the males and females were slightly larger than average. Length-frequency plots suggest that the age composition of the large sockeye was about 73% 5-year-olds and 27% 4-year-olds. Almost identical proportions of 4- and 5-year-old sockeye were present at the test fishing site in the mouth of the Skeena River.

Table 2. Percentages of male and female sockeye passing the Babine fence.

Year	% male sockeye	% female sockeye
1946	43.52	56.48
1947	45.56	54.44
1948	--	--
1949	40.99	59.01
1950	43.74	56.26
1951	51.88	48.12
1952	58.90	41.10
1953	44.15	55.85
1954	39.72	60.28
1955	47.16	52.84
1956	48.62	51.38
1957	49.00	51.00
1958	39.38	60.62
1959	39.56	60.44

Sampling to determine the condition of the large sockeye showed that 14% had net marks, 2.4% had other injuries and 83.6% had no injuries or net marks. Comparison with comparable sampling in previous years of fence operation are shown in Table 3.

Table 3. Condition of sockeye passing the Babine fence.

Year	Normal	Net-marked	Injured
1946	--	--	--
1947	84.5	11.35	4.2
1948	--	--	--
1949	86.9	6.22	6.8
1950	84.2	12.34	3.5
1951	51.6	18.33	31.1
1952	69.2	1.00	29.9
1953	93.0	4.27	2.7
1954	89.3	8.26	2.5
1955	87.2	6.12	6.7
1956	94.2	4.27	1.5
1957	90.2	8.26	1.5
1958	83.5	13.91	2.6
1959	91.5	4.17	4.3
1960	83.6	--	2.4

The average egg content in 1959 was estimated to be 3,343 eggs per female. Since the number of female sockeye surviving the Indian fishery above the weir was estimated to be 464,906, the potential egg deposition was approximately 1,554,000,000. This figure constitutes the highest deposition since 1946 when Babine weir operations began.

Babine sockeye smolt run

The number of smolts emigrating from Babine Lake has been estimated annually since 1951 by means of a marking and recovery technique. Smolts are captured, marked by the removal of one or more fins, then released near the lake outlet. The proportion of marked fish in the run is determined from samples taken 10 miles downstream near the outlet of Nilkitkwa Lake.

The estimated abundance of the annual smolt run since 1951 is shown in Table 4.

Table 4. Babine smolt runs.

Year	Estimated size of run (millions)	95% confidence limits (millions)
1951	4.2	3.7 to 4.8
1952	4.5	4.2 to 4.9
1953	3.1	3.0 to 3.2
1954	2.8	2.7 to 3.0
1955	30.9	28.6 to 32.6
1956	21.1	18.5 to 22.9
1957	6.4	6.0 to 6.8
1958	15.9 + 6.3 = 22.2	13.8 to 18.9
1959	28.5 + 10.0 = 38.5	26.9 to 30.3

In 1958 and again in 1959 considerable numbers of smolts migrated prior to the time that the mark and recovery program was underway. Fyke net catches and school counts in 1958 indicated that this "early" migration amounted to 6,300,000 smolts. Observation made in 1959 indicated that this "early" run was about 1 1/2 times that of the previous year and probably amounted to 10,000,000 smolts. The total number of smolts emigrating from the Babine area in 1959 is, therefore, estimated to be 28,500,000 plus 10,000,000 "early" smolts or a total of 38.5 million.

Since almost all Babine smolts migrate after one year in the lake estimates of survival from egg to smolt for each brood year from 1949 to 1957 are shown in Table 5.

Table 5. Sockeye survival from egg to smolt in the Babine area.

Brood year	Eggs potentially available (millions)	Year smolts emigrate	Estimated number of smolts (millions)	Survival egg to smolt (%)
1949	853	1951	4.2	0.49
1950	591	1952	4.5	0.76
1951	194	1953	3.1	1.60
1952*	409	1954	2.8	0.68
1953	1,241	1955	30.9	2.49
1954	1,020	1956	21.1	2.07
1955	105	1957	6.4	6.10
1956	523	1958	22.2	4.24
1957	653	1959	38.5	5.90

*Only about one-third of this run spawned successfully due to adverse effects of the Babine slide. An adjusted estimate of the survival to smolts would be about 2%.

Studies of young sockeye salmon in the Babine Lake system

Distribution throughout the lake system. Study of the distribution of underyearling sockeye throughout the many basins of Babine and Nilkitkwa Lakes has shown that they travel only limited distances from their natal streams. Thus, the overall distribution of young sockeye in Babine is controlled largely by the distribution of the parent spawners to the various tributary spawning streams. On this basis the Babine-Nilkitkwa Lake nursery area can be divided into two general regions: (1) the areas north of Halifax Narrows (Nilkitkwa Lake and the North Arm of Babine) which serve the young sockeye produced by late-running fish which spawn on the outlet Babine River spawning grounds, and (2) the lake areas south of Halifax Narrows (about 90% of the total area) which accommodate the young sockeye from the earlier-running fish which spawn on grounds tributary to these areas.

In the years prior to 1955 for which we have escapement records, more than half (and up to 80%) of the Babine sockeye escapements were later-running fish which spawned in the outlet Babine River - above and below Nilkitkwa Lake. The majority of the resulting young sockeye were therefore contained in the small lake area (about 10% of the total) north of Halifax Narrows. Because of this restricted nursery area, the smolts produced in many of these years must have been quite small.

Regulation of the fishery since 1956 has been directed toward distribution of spawners in such a way as to achieve a better distribution of young sockeye throughout the entire Babine Lake nursery area. The better distribution of spawners has been achieved by restricting the fishery for the earlier-running sockeye which spawn in streams tributary to the lake regions south of Halifax Narrows. As shown in Table 6 this policy has been successful in achieving better distribution of the young sockeye throughout the lake system. With an increasing proportion of spawners to regions south of Halifax Narrows there has been a corresponding change in distribution of the young sockeye toward greater numbers south of Halifax Narrows. Also, as a result of this change in distribution of the

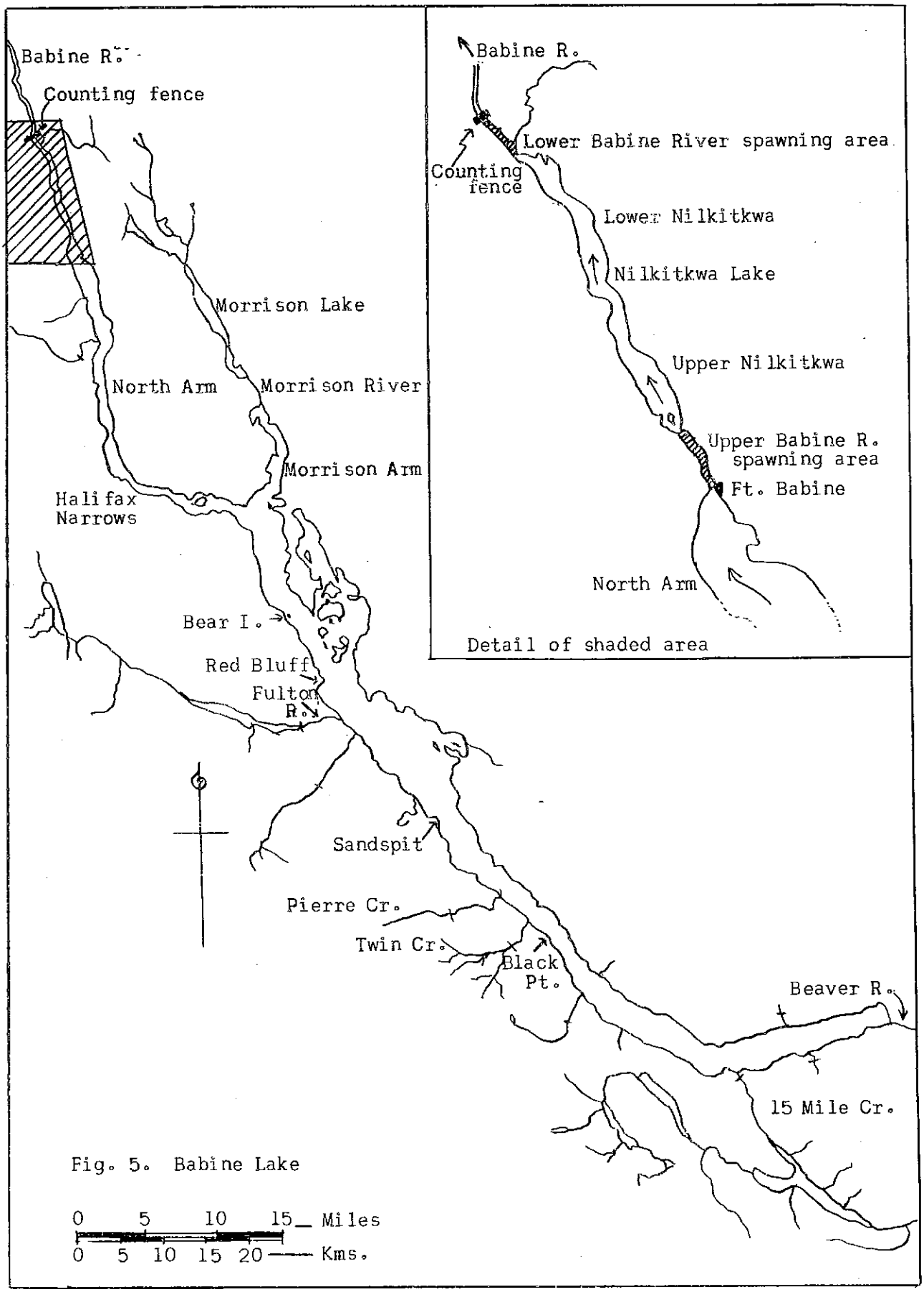

Fig. 5. Babine Lake

Table 6. Distribution and size of young sockeye in the Babine Lake system.

Lake Region	Number of adult sockeye spawning excluding "jacks" (thousands)	Estimated number of age-0 sockeye in late August (millions)	Approximate mean weight of age-0 sockeye in mid-Oct. (grams)
	1954	1955[b]	
North of Halifax Narrows	256.3	38.2 to 52.9	1.5
South of Halifax Narrows	185.6	7.1 to 19.3	4.0+
Total	441.9	45.3 to 72.2	
	1955	1956	
North of Halifax Narrows	19.2	2.0	3.8
South of Halifax Narrows	27.8	3.1 + (7.4)[a]	4.0+
Total	47.0	5.1 + (7.4)[a]	
	1956	1957	
North of Halifax Narrows	119.5	26.5	3.3
South of Halifax Narrows	148.9	34.8 + (22.3)[a]	4.0+
Total	268.4	61.3 + (22.3)[a]	
	1957	1958	
North of Halifax Narrows	188.2	45.0	2.4
South of Halifax Narrows	202.8	46.5 + (20.0)[a]	4.0+
Total	391.0	91.5 + (20.0)[a]	
	1958	1959	
North of Halifax Narrows	270.0+	66.0	2.7
South of Halifax Narrows	290.0+	85.1 + (20.0)[a]	4.0+
Total	560.0+	151.1 + (20.0)[a]	

[a]Additional millions of age-0 sockeye believed progeny of "kokanee".

[b]1955 data from very limited sampling, so estimates are only roughly approximate.

young sockeye, their growth rates have been increased and smolts of larger mean size are being produced.

Growth rate of young sockeye salmon. During their one year of lake residence in the Babine system young sockeye attain most growth in the first few months, that is, during the period of summer thermal stratification. For example, fish weighing 0.2 grams when entering the lake as fry in mid-June attain 4.5 grams by mid-October, but weigh only about 5.5 grams when emigrating from the lake as smolts the following spring. Observations of the growth rate of under-yearling sockeye, their abundance, and the abundance of their zooplankton food in the various lake basins of this system in the years 1956 to 1959 provide a basis for comparing mid-June to mid-October growth rates under a wide range of conditions. Near-surface water temperatures for this period have been roughly comparable throughout, and there are no known genetic differences involved; thus, growth rate is believed to have been largely determined by intraspecific competition and food abundance. The results strongly support this belief.

Using logarithmic scales throughout, Figure 6 presents graphically the relationship of growth rate to food abundance and intraspecific competition. Figure 6a implies a general direct relationship between growth rate and zooplankton abundance over the range shown, Figure 6b shows the growth rate is increasingly depressed by intraspecific competition after population densities exceed approximately 6,500 fish per hectare (2,600 per acre).

At a glance it appears that there is a simple explanation of the relationship between growth rate, competition and food abundance, i.e. that with an increasing number of young sockeye present an increasing reduction of the food supply is brought about resulting in an increasing reduction of the growth rate. Although cropping of the zooplankton by large populations of young sockeye is obvious in much of these data, critical examination (beyond the scope of this brief report) does not verify such a simple explanation of growth-competition-food relations based on food abundance alone. Detailed examination suggests there is an effect of competition on growth rate which is expressed independently of absolute food abundance. In spite of the complexities of the mechanisms involved, the rather well-defined relation between growth rate and population density as shown by the solid line in Figure 6b will serve to evaluate the potentials of this lake nursery area.

The 4 points to the right of the descending part of the solid line in Figure 6b are of special interest. These 4 points represent 1959 observations in the 2 basins of Nilkitkwa Lake and the 2 basins of the North Arm of Babine nearest the outlet. In spite of the high densities of young sockeye present in these basins in 1959, the zooplankton maintained itself at much higher levels than in some former years when the young sockeye were even less abundant. This greater abundance of food is believed responsible for the higher than expected growth rates observed. The maintenance of greater mean zooplankton abundance in the presence of large populations of young sockeye in these basins (during mid-June to mid-October) than in previous years may indicate a greater production of zooplankton during 1959. On the other hand, it may be only a result of the fact that the spring pulse of crustacean zooplankton appeared considerably later than in previous years. Whichever the case, this one year of greater food abundance in the four years of observation to date will be of interest in examining production in future years - especially in evaluation of its possible contribution toward a dominant year class.

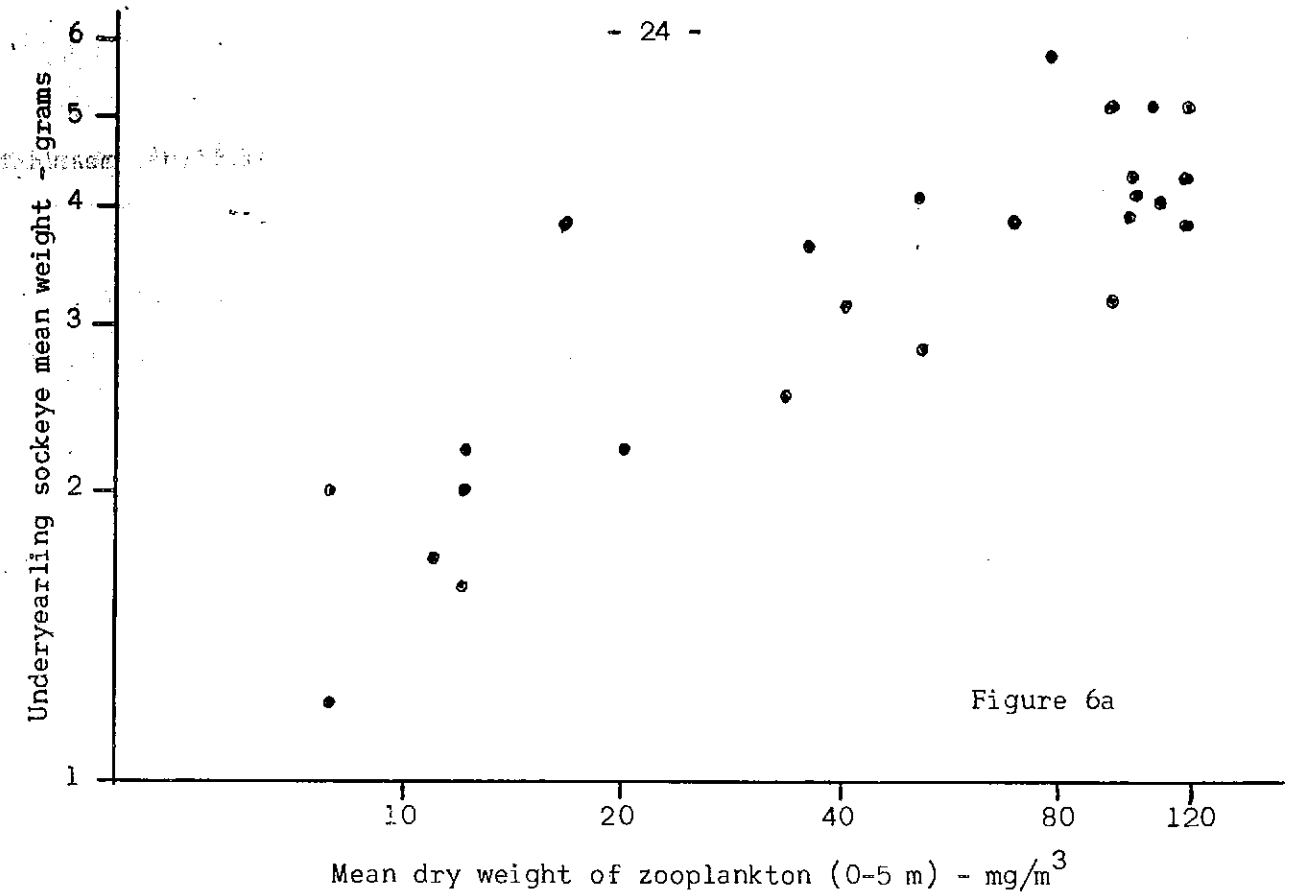

Figure 6a

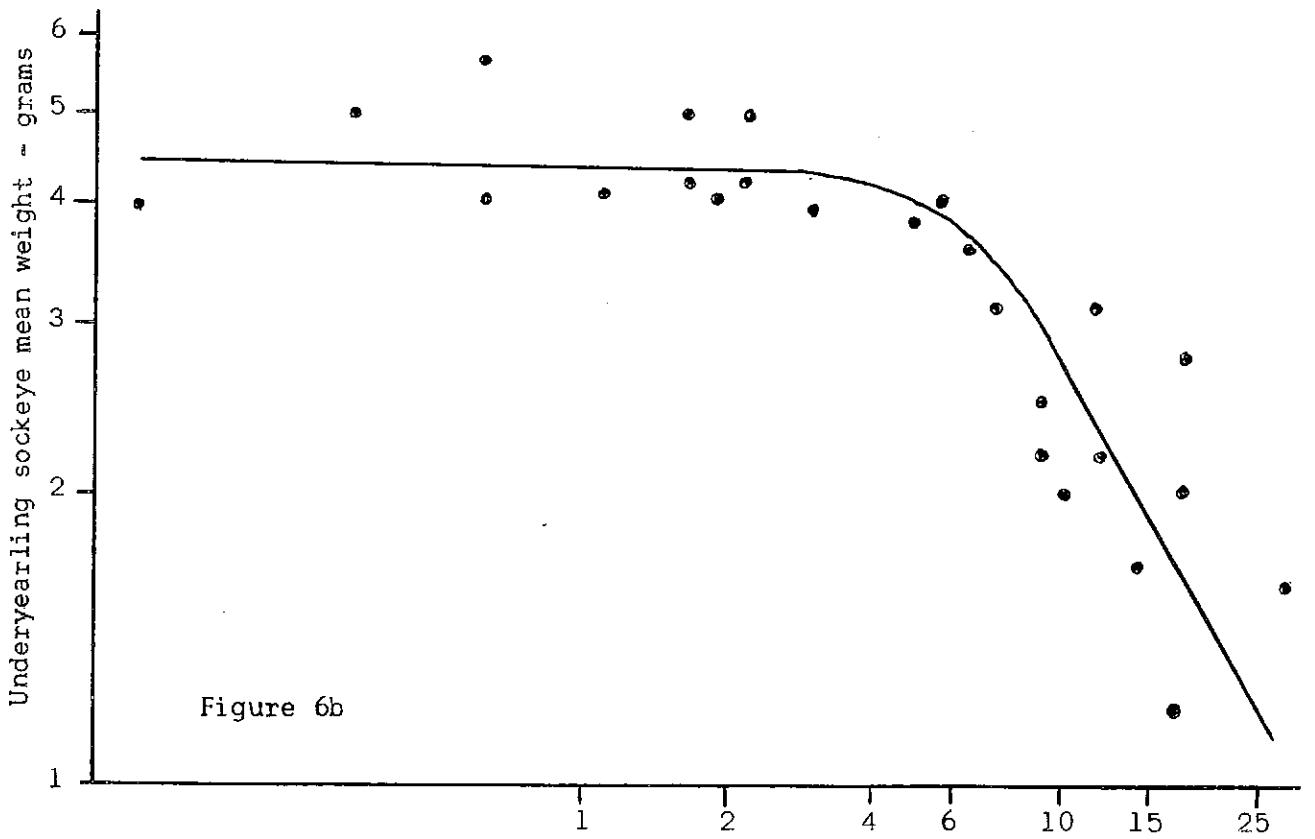

Figure 6b

Figure 6. Density and size of young sockeye in the Babine Lake system.

The combination of great numbers of young sockeye and relatively high growth rate during 1959 gives promise not only of an extremely large smolt output in 1960 (probably of the order of 60 million) but of a larger mean size than expected.

Capacity of the Babine system as a sockeye producer. The curve in Figure 6a demonstrates the growth rate of young sockeye which may be expected at various levels of population density. In an earlier study at Cultus Lake, Foerster has shown that there is a direct relationship between smolt size and subsequent survival rate to maturity. Evidence that this relationship might hold generally is available from recent research on sockeye in Alaska. Combining the curve of Figure 6b and Foerster's relationship between smolt size and survival rate, Figure 7 describes the relationship between lake population density per unit area and the likely numbers of returning adults per unit area. No units are given for the likely number of returning adults as we cannot reasonably apply the same survival rates found by Foerster for Cultus Lake sockeye. However, for consideration of this general relationship we need only assume that there is a direct relation between smolt size and survival.

The relationship shown by Figure 7 follows the law of diminishing returns. With the progressive addition of more units of production (young sockeye) there is an increase in total production (returning adults) up to a point where the addition of further units of production results in a decrease in total production. The critical point (where production is at a maximum) corresponds to a late-August lake population of approximately 10,000 young sockeye per hectare (4,050 per acre). At this population density young sockeye would attain a size of about 2.5 grams by mid-October and emigrate as smolts of about 3 grams mean weight. For such optimum or maximum production, then, the Babine Lake system would require an evenly distributed late-August young sockeye population of 4,050 per acre or a total of the order of 500,000,000 - which would give a smolt output of roughly 200,000,000.

This estimation of the maximum potential is based only on the potential of the lake nursery area for rearing of smolts. In the Babine system there are insufficient spawning grounds to produce naturally the numbers of fry required, and achievement of such a maximum production would of course require large-scale fish culture techniques as yet unproven.

In considering the practicable potential of this sockeye-producing area, we must again make the broad separation into those regions located north and south of Halifax Narrows.

The region north of Halifax Narrows is characterized by having large-capacity spawning grounds (the Babine River above and below Nilkitkwa Lake) in relation to the lake nursery area available. With this situation the ultimate potential of the lake area can be realized and the problem becomes one of providing an escapement of the proper size to these outlet spawning grounds. Escapements of the order of 250,000 to 300,000, as provided in 1958 and 1959, appear to be of the proper magnitude.

The region south of Halifax Narrows is characterized by the opposite situation. An extremely large lake nursery area is available in proportion to the capacity of the tributary spawning grounds. The problem of attaining the highest natural production of sockeye from this region is then one of providing escapements which will make fullest possible use of the available spawning grounds. Such has been the aim of recent regulations and the large escapements of 1958 and 1959 have approximated this ideal.

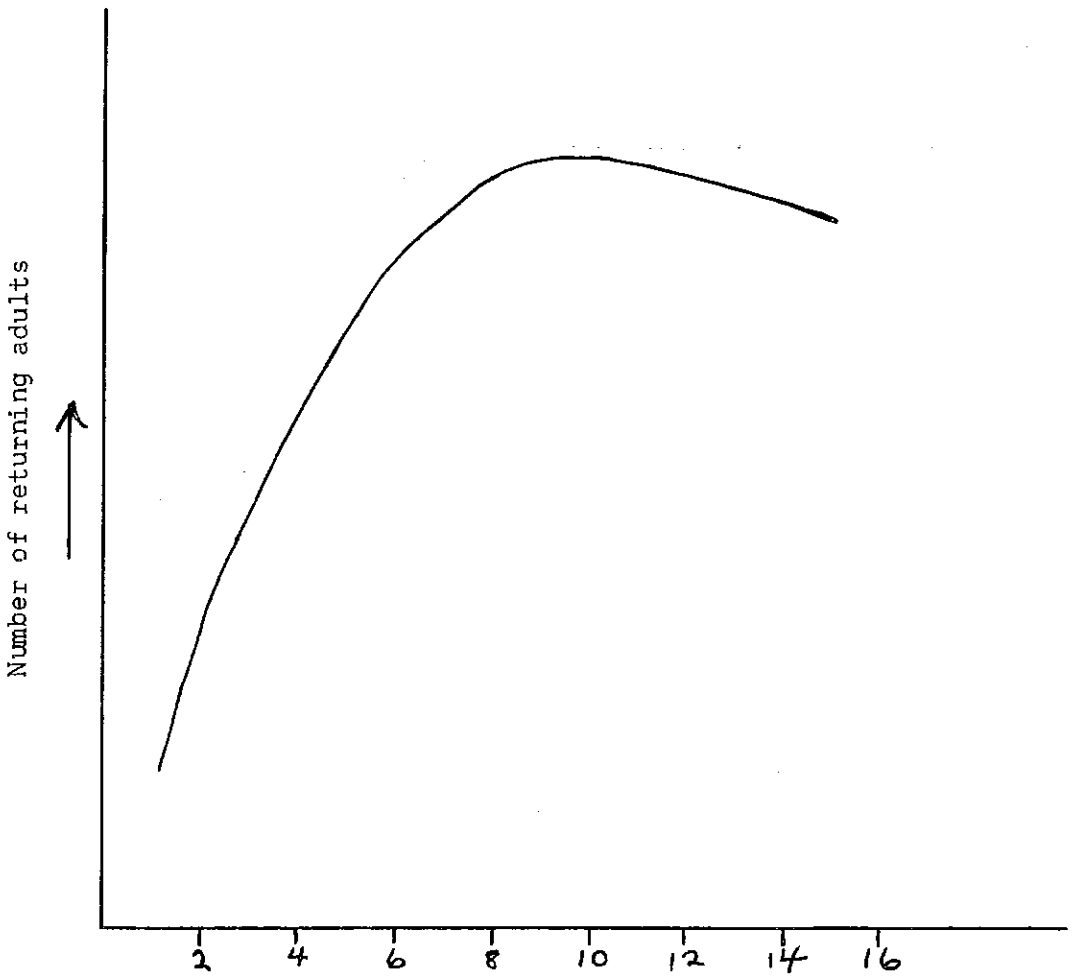

Figure 7. Density of young sockeye and probable numbers of returning adults per unit area.

The 1959 Skeena pink salmon escapement

Estimates of the number of spawning pink salmon are based in part on surveys carried out annually by the officers of the Department of Fisheries. In 1959, as in other recent years, Fisheries Research Board personnel have been employed to supplement these surveys and to carry out tagging and recovery programs and fence counts in order to obtain more precise information on escapement size.

In 1959 the abundance of escapements to most large pink salmon-producing areas were estimated by tag and recovery procedures (Lakelse and Kispiox Rivers) and by fence counts (Babine and Kitwanga Rivers). The escapements to other areas were estimated by direct counts or estimates of the number of fish observed on the spawning grounds.

Table 7 gives the total estimated escapement in 1959 and other recent years.

Table 7. Estimated escapements of Skeena pink salmon.

Place	1955	1956	1957	1958	1959
Kispiox River	540,000	75,000	360,000	66,000	650,000
Kitwanga River	125,000	35,000	160,000	158,000	250,000
Lakelse River	175,000	75,000	140,000	262,000	185,000
Babine River	5,000	3,000	27,000	10,000	77,000
Bear River	6,000	Nil	15,000	Nil	20,000
Skeena River	10,000	5,000	50,000	50,000	150,000
Others	119,000	10,000	113,000	10,400	54,000
Coastal Rivers	78,000	75,000	105,000	116,000	95,000
Total	1,058,000	278,000	970,000	672,000	1,478,000
Total upstream of test fishing site	987,000	202,000	868,000	558,000	1,383,000

The 1959 escapement was the largest recorded in recent years and was 1 1/2 times that observed in the parent year. This was a direct result of the commercial fishing tie-up during the last week of July and the first week of August. The tie-up resulted in a considerable increase in the number of spawners in the Kispiox, Kitwanga, Babine, and Bear Rivers as compared to the parent year. The run to the Babine River was the largest recorded since 1946. The escapement to the Lakelse River was only slightly larger than in 1957; a large proportion of this run was in the fishery after the fishing tie-up ended.

For the third consecutive year pink salmon were observed to spawn in the main stem of the Skeena River. Most spawning took place in a 40-mile stretch downstream of Terrace, B. C. The number of pinks which spawned there was estimated to be between 100,000 and 200,000. This estimate was based on the number of spawned-out fish recovered as compared to other spawning grounds where more precise information could be obtained.

The timing of Skeena pink salmon runs in 1959

Tagging programs carried out in 1957 and 1958 provided information on the timing of the major pink salmon runs through the commercial fishing area. In 1959 another tagging program was carried out to supplement the earlier information, particularly to indicate the period when pinks which spawn in the main stem of the Skeena River are present in the fishing area.

The salmon were captured in beach seines at McLean Point, situated on the Skeena River about 20 miles upstream of the up-river fishing boundary. A total of 6,845 pinks were tagged with Petersen disc tags between July 24 and August 21. Spawned out fish were examined for tags in most large spawning areas. The number and place of tags recovered on specific spawning grounds was as follows:

Kispiox R.	Kitwanga R.	Lakelse R.	Skeena R.	Babine R.	Bulkley R.	Total
72	59	70	25	54	11	291

The date that fish proceeding to the various spawning grounds were present at the river boundary can be shown by adjusting the date on which they were tagged by the time required for the fish to travel from the boundary to the tagging site. This "time out" has been estimated by comparing daily catches at the test fishing site at Tyee, which is adjacent to the boundary, to the daily catches at McLean Point. Throughout most of the season extreme fluctuation in the catch at test fishing was reflected in the McLean Point catch approximately 3 days later. In Figure 8 the date of tagging has been predated three days to adjust for "time out". The bars in the figure indicate the relative abundance of fish proceeding to specific spawning grounds present at the up-river fishing boundary each day. The daily average catch per hour at the test fishing site is also shown to describe the relative abundance of the total escapement throughout the season.

The timing of the various runs in 1959 was similar to that observed in 1957 and 1958. The runs to the Kispiox and Babine Rivers were amongst the earliest. The Lakelse run was again the last major run to enter the fishery. There appeared to be considerably more overlap of the runs in 1959 than in other years. This may have resulted from the fishing tie-up which lasted throughout the peak of the migration period.

The first peak in the escapement was recorded on July 28 and tag recoveries indicate that fish going to all major spawning grounds were present at that time. This was also the case during the period of the second peak of August 3 although Lakelse River fish began to predominate. After fishing resumed on August 9, the Lakelse run was the only one present in abundance in the fishing area.

Fish proceeding to spawn in the main stem of the river were present in the fishing area throughout most of the season. Tag recoveries suggest they were in greatest abundance in the last days of July and fewer in number from then until the middle of August.

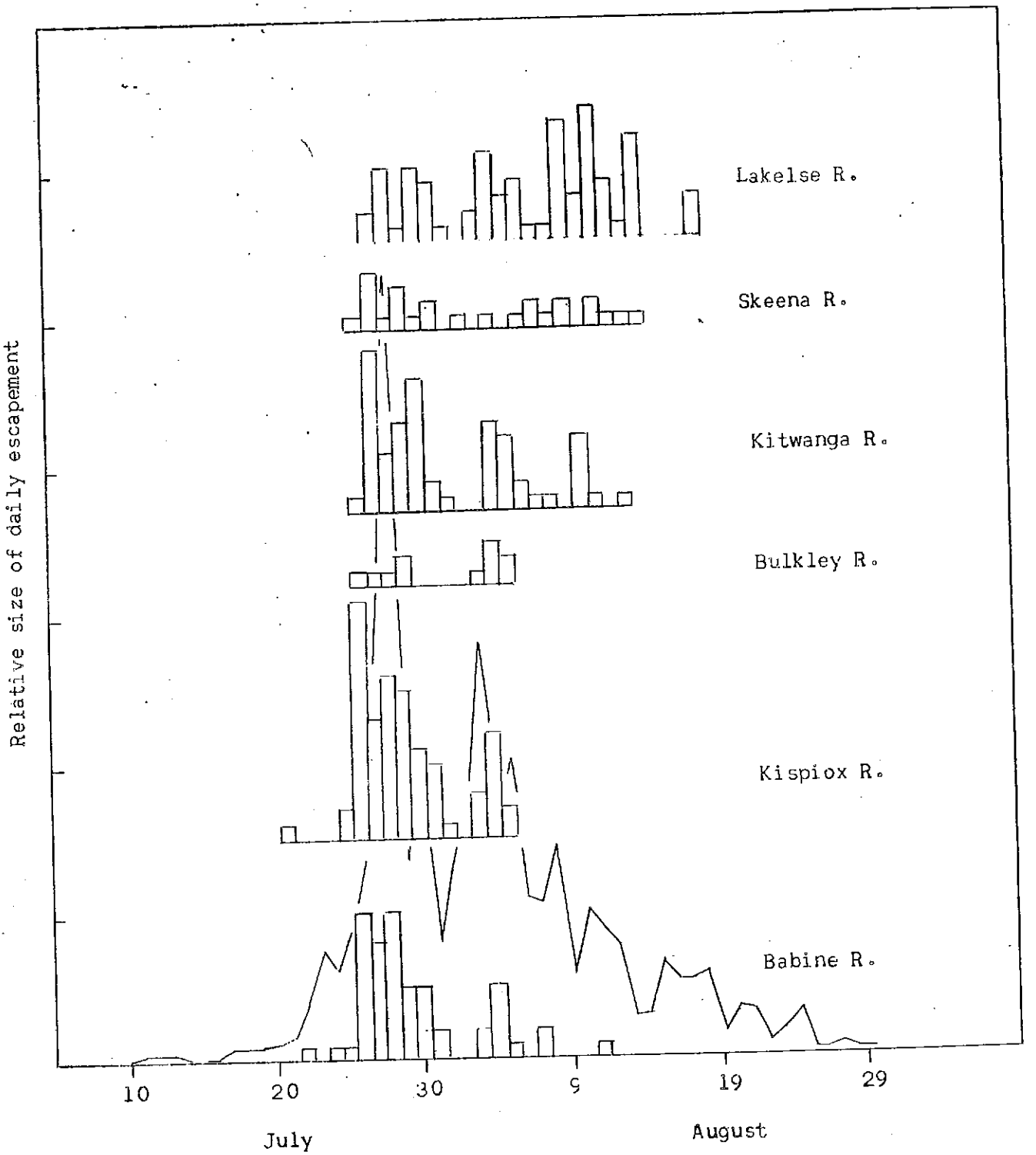

Figure 8. Timing of Skeena pink salmon runs in 1959.

Fry output from the 1958 Skeena pink salmon run

Trap-netting for pink fry has been carried out annually since 1956 to indicate the number of fry produced from the spawning run of the previous fall on the Lakelse, Kispiox and Kitwanga Rivers, three of the largest spawning areas in the Skeena drainage. The object of the work is to determine the escapement size which will efficiently produce the greatest number of fry and hence the greatest number of adult salmon. Since the fry output from the three tributaries mentioned above would constitute a major part of the total output from the whole of the Skeena system, the information is also used to indicate very generally the magnitude of the total Skeena output and the most likely number of returning adults.

The same method of fry trapping has been used each year. A small meshed net, which strains the water to a depth of one foot, is fished at a number of stations across each river mouth, usually two or three times each week of the migration. The average catch per hour is used to calculate an index which is a relative measure of the total number of migrants. The degree of accuracy obtained has not been fully determined. Special netting was carried out in 1958 and 1959 and has shown that the proportion of the fry present in the top foot of water (and thereby captured in the standard net), may vary with changes in the total depth of the river at the trapping site. Error in comparing each year's run arising from these changes in the vertical distribution of the fry has been minimized by using the same trap site whenever possible. Any variation in water depth was therefore due only to seasonal changes in the runoff, which tend to follow a similar annual pattern.

In 1957 and again in 1959 it was necessary to change the location of the Lakelse River trapping site. The sites used from 1956 to 1958 were comparable in depth and other physical characteristics. However, the depth of water at the 1959 site was about twice that at the sites used previously. The 1959 index is therefore not comparable to that obtained in other years and on the basis of information now at hand the 1959 index would be relatively very low.

The indices of fry output and the best estimates of the escapement size in the parent year are given below:

Table 8. Pink salmon escapement size and fry output in Skeena tributaries.

Place	Parent year	Estimated escapement	Index of fry output
Lakelse River	1955	175,000	3.2
	1956	75,000	1.9
	1957	140,000	13.5
	1958	262,000	3.3+
Kispiox River	1955	540,000	8.6
	1956	75,000	1.4
	1957	360,000	13.2
	1958	66,000	5.4
Kitwanga River	1955	125,000	--
	1956	35,000	3.7
	1957	160,000	7.6
	1958	158,000	7.3

Kispiox River. Since the brood year of 1955 the index of fry output has varied from 1.4 to 13.2 or about 9 times while the escapement has varied from 75,000 to 540,000 or about 7 times. The largest numbers of fry have resulted from the largest spawning runs. The smallest spawning escapement (1956) produced the smallest fry output. However, the second largest escapement resulted in the highest fry index. The index of 5.0 from the small escapement of 1958 indicates an above-average survival of fry from this deposition.

Kitwanga River. Three years' data indicate a twofold increase in the number of fry resulting from an increase in the brood stock of over four times. The 1957 and 1958 brood stocks were of comparable size and produced a comparable number of fry.

Lakelse River. As was mentioned previously, the index of the output from the 1958 escapement cannot be compared to the indices obtained previously. Special netting carried out in addition to the routine netting has indicated that this index is relatively low and that the number of fry from the 1958 spawning was large.