

1963

SKEENA SALMON MANAGEMENT COMMITTEE

ANNUAL REPORT 1963



COMMITTEE MEMBERS

W.R. Hourston

P.A. Larkin

IN CHARGE OF INVESTIGATIONS

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ADVISORY BOARD MEMBERS

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Biological Station
Nanaimo, B. C.
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Terms of Reference

The Skeena Salmon Management Committee was established by the Minister of Fisheries in 1954 to investigate the condition of Skeena River salmon stocks, to improve management of the runs, and to increase the yield, if possible. To achieve its objectives the Committee uses both the administrative, fish culture, and research staffs of the Department of Fisheries. Present members of the Committee are Mr. W.R. Hourston, Director, Pacific Area, Department of Fisheries, and Dr. P.A. Larkin, Director of the Biological Station of the Fisheries Research Board of Canada at Nanaimo.

Upon establishing the Committee, the Minister of Fisheries appointed an Advisory Board representing the various sections of the industry concerned with the Skeena River salmon fishery. The Committee meets with its Advisory Board several times each year to discuss investigations and the basis for regulation of the fishery. Advisory Board members for the year 1963 are listed on the front page of this report.

Record of Meetings

The Committee met at Vancouver on December 10, 1962, to consider evidence bearing on the likely size of the 1963 Skeena sockeye and pink runs and to discuss and formulate appropriate regulation of the fishery.

It was noted that the probable range in size of the 1963 sockeye run was from 1,100,000 to 1,600,000. For the purpose of formulating regulations in advance of the season, the most probable size of the run was taken to be 1,350,000. A run of this size, with two days of fishing per week, would provide a catch of about 540,000 and an escapement of slightly more than 800,000, which approaches the optimum.

For pinks, an average return from the 1961 spawning would result in a run in 1963 of 3,800,000. A run of this size subjected to fishing on a 2-day-per-week basis would result in a substantial catch (about 1,500,000) and provide an escapement of about 2,300,000. An escapement of this size would be greater than those observed in recent odd years, but still below the level considered necessary for production at levels which prevailed in the peak years of the fishery.

On the basis of the above, the Committee released on December 20, 1962, a statement containing proposals for regulation of the 1963 fishery for consideration by the Advisory Board and the industry generally. The proposed regulations for the Skeena Gill-net Area and adjacent waters were as follows:

- (a) that the upriver commercial fishing boundary be maintained at the Mowitch-Veitch Point line;

- (b) that prior to 6:00 p.m., Sunday, June 16, 1963, only gillnets having mesh not less than 8" linen, or 8-1/2" 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 gill-nets of any mesh size be permitted after 6:00 p.m. Sunday, June 16, 1963, until the end of the fishing season as follows:
 - (i) from June 16 to August 25 - 120-hour weekly closed time 6:00 p.m. Tuesday to 6:00 p.m. Sunday;
 - (ii) from August 25 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 for adjacent fishing areas in order to extend similar protective measures for Skeena-bound sockeye and pink salmon whilst passing through those areas:

Area 3, Nass River - Sub Areas 3X and 3Y only

- (i) same weekly closed times as in (c) above from July 7, 1963, to August 18, 1963;

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

- (i) same weekly closed times as in (c) above from July 21, 1963, to August 18, 1963;

(e) Provisos:

- (i) that the weekly closed times outlined above shall be extended in the event that for any week or series of weeks during the 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 extra fishing time would be granted if, in the opinion of the Committee in the light of development of sockeye and pink runs at the time, such might safely be permitted consistent with attaining adequate escapements for reproduction.

The Committee met with its Advisory Board at Vancouver on February 13, 1963, and at Prince Rupert on February 15, 1963. At these meetings the prospects for the 1963 runs and the basis for the proposed regulations were examined. The views of Advisory Board members and other individuals and organizations were received.

In view of representations made regarding the economic needs of the Skeena fishermen and of the industry generally, and after taking into account the relationship of the Skeena fishery to that in adjacent areas, the Committee considered the following changes from the proposed regulations appropriate:

- (a) Postponement of the opening of sockeye fishing from June 16 to June 23. This change provided a uniform opening date for the Skeena and its adjoining fishing areas. Earlier opening of the Skeena would result in concentration of gear and overfishing of the stocks in the area at that time. Because of the present levels of abundance of these stocks, postponement of fishing until June 23, 1963, was not considered likely to result in over-escapement.
- (b) Reduction of the weekly closed time from June 23 to August 25 from 120 hours to 106 hours. This increase in weekly fishing time was recommended in view of representations which stressed the need of Skeena fishermen and the industry generally for a larger catch in 1963 than would have been provided by the original proposal. On the basis of the forecasted abundance of sockeye, the additional fishing time recommended was expected to result in an escapement considerably below the estimated optimum.

In view of the foregoing, the Committee recommended to the Department of Fisheries the following regulations for the 1963 Skeena salmon fishery:

- (a) that the upriver commercial fishing boundary be maintained at the Mowitch-Veitch Point line;
- (b) that prior to 6:00 p.m. Sunday, June 23, 1963, only gill-nets having mesh not less than 8" linen, or 8-1/2" 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 gill-nets of any mesh size be permitted after 6:00 p.m. Sunday, June 23, 1963, until the end of the fishing season as follows:
 - (i) from June 23 to August 25 - 106-hour weekly closed time 8:00 a.m. Wednesday to 6:00 p.m. Sunday;
 - (ii) from August 25 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 for adjacent fishing areas in order to extend similar protective measures for Skeena-bound sockeye and pink salmon whilst passing through those areas:

Area 3, Nass River - Sub Areas 3X and 3Y only

- (i) same weekly closed times as in (c) above from July 7, 1963, to August 18, 1963;

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

- (i) same weekly closed times as in (c) above from July 21, 1963 to August 18, 1963;

(e) Provisos:

- (i) that the weekly closed times outlined above shall be extended in the event that for any week or series of weeks during the 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 extra fishing time would be granted if, in the opinion of the Committee in the light of development of sockeye and pink runs at the time, such might safely be permitted consistent with attaining adequate escapements for reproduction.

At the conclusion of the 1963 fishing season the Committee met at Vancouver (December 10) to examine the 1963 Skeena runs and the effect of the regulations on catch and escapement. The pertinent information is given in the following section of this report.

The 1963 Skeena salmon fishery

In recommending the 1963 regulations for sockeye and pink salmon the Skeena Salmon Management Committee considered the following:

(1) The probable range in size of the 1963 sockeye run would be from 1,100,000 to 1,600,000. For the purpose of proposing regulation in advance of the season, the most probable size of the run was taken to be 1,350,000. It was anticipated that a run of this size, with two days fishing per week, would provide a catch of about 540,000 and an escapement of slightly more than 800,000, or approaching the optimum.

(2) An average return from the 1961 spawning would result in a run in 1963 of 3,800,000 pinks. A run of this size, subjected to fishing on a 2-day-per-week basis would result in a substantial catch (ca. 1,500,000) and provide an escapement of about 2,300,000. An escapement of this size is greater than that observed in recent odd years, but still below the level considered necessary for production at levels which prevailed from 1918 to 1930.

In view of (1) the above considerations, (2) the representations made regarding the economic needs of the Skeena fishermen and the industry generally, and (3) the relationship of the Skeena fishery to that in adjacent areas, the Committee recommended the following regulations for the 1963 Skeena salmon fishery:

- (a) that fishing for sockeye commence on June 23;
- (b) that 2-1/2 days fishing per week be permitted during the period June 23 to August 25.

In fact, the 1963 Skeena sockeye run was smaller than anticipated. The total run amounted to about 809,000 "large" sockeye and a minimum of 173,000 jacks or 3-year-olds. The return of 5₂'s from the 1958 spawning was small (179,000). This number of 5's, together with the return of 4's from the same 1958 spawning, represented one of the poorest rates of production observed in many years. The return of 4₂'s from the 1959 spawning was only moderate (563,000). The remainder of the 1963 run was composed largely of 5- and 6-year-olds which had gone to sea in the third year (5₃'s and 6₃'s).

Figure 1 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 estimated weekly rates of exploitation for pink and sockeye, the weekly number of deliveries, and the estimated weekly abundance (catch plus escapement) of pink and sockeye.

The sockeye run developed very slowly during the first half of the season. Fishing for 2-1/2 days per week was permitted in the weeks ending June 30 and July 7. The small number of sockeye entering the fishing area during these two weeks provided a small catch and much less than the required escapement. Consequently fishing was reduced to 1-1/2 days in the week ending July 14 to allow for additional spawners to the "early" Skeena streams.

A wage and fish-price dispute interrupted normal commercial fishing for most of the remaining part of the sockeye season. From the end of the second week of July until the end of the first week in August, commercial fishing was limited to a small fleet - less than one-tenth normal size. It was during the strike period that the bulk of the sockeye run passed through the fishing area.

Normal fishing recommenced in the week ending August 11. During this week an additional 24 hours of fishing time was provided on economic grounds. By this time, however, the sockeye run was rapidly declining and the estimated number of sockeye present in the area during the week of August 11 was only 80,000 or less than a third the number present in the peak week of July 28. Consequently, both catch and escapement were small.

In subsequent weeks only a few thousand sockeye were available. For all practical purposes the run terminated on August 25.

The total catch of sockeye in the Skeena area for the season was 142,000. The effective escapement (total escapement less the Indian food-fishery catch) was 620,000, considerably less than the estimated optimum. Most of the escapement, as usual, went to the Babine Lake system. The number of spawners observed in most other areas was extremely small.

Despite the fact that there was no substantial commercial fishery in the major part of the run, escapements to individual spawning areas were generally below the capacity of the spawning grounds. The only exception observed was on Fifteen Mile Creek in the Babine system where the number of spawners (65,000) was probably excessive.

The 1963 pink run to the Skeena area amounted to an estimated 1,494,000 fish, or a little better than one-third the number which would have resulted

DAYS FISHING RECOMENDED	
4	4 2½ 2½ 2½ 2½ 2½ 2½ 2½ 2½ 2½ 4 4 4
DAYS FISHED	
4	4 2½ 2½ 1½ 2½ 2½ 2½ 3½ 2½ 2½ 4 4 4
ESTIMATED RATES OF EXPLOITATION (%)	
PINK	26 0 2 9 58 30 37 74 67
SOCKEYE	29 50 44 0 4 10 57 27 46

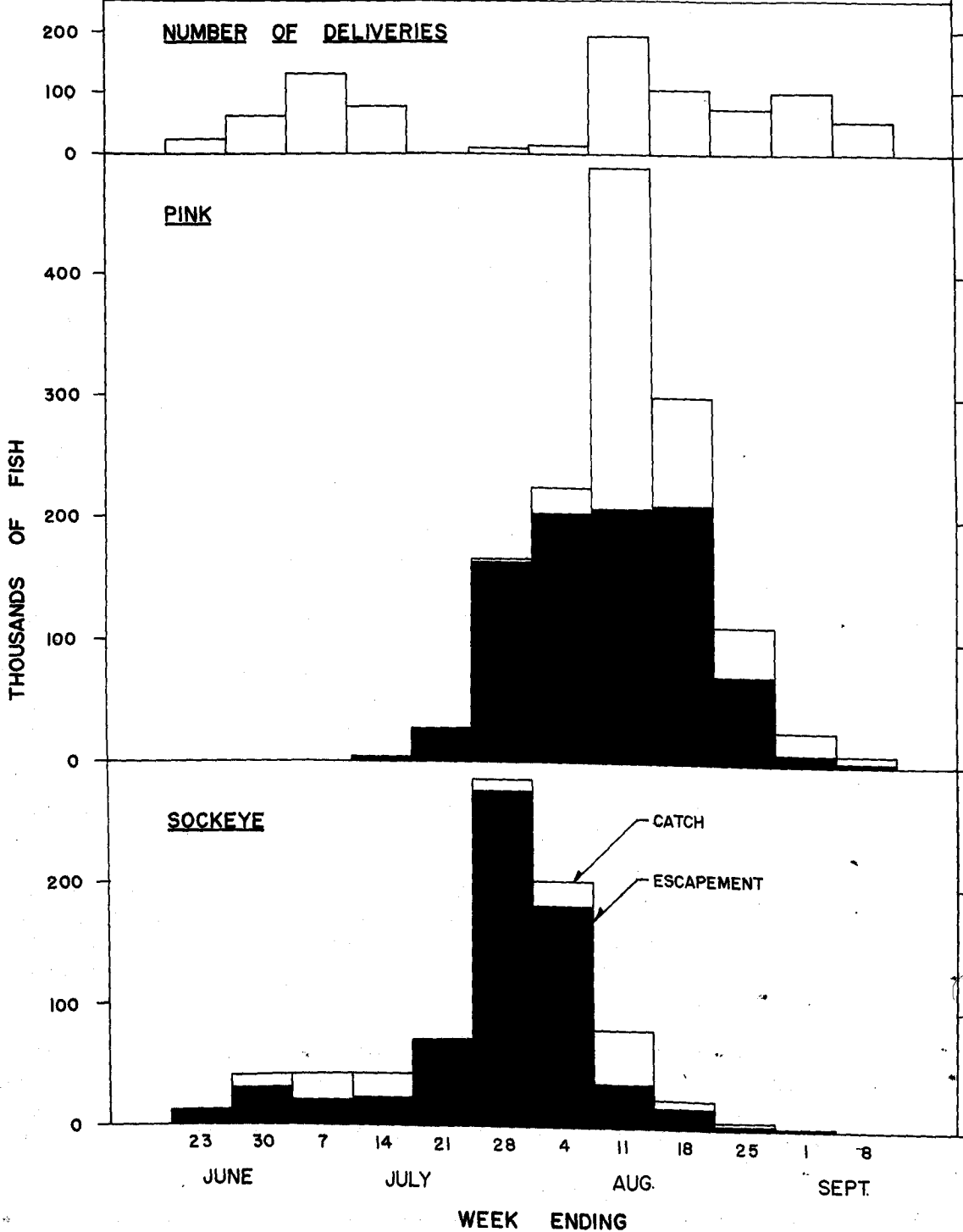


Figure 1

from an average return from the 1961 spawning. The catch of pinks in the Skeena Gillnet Area was 466,000. A few additional Skeena-bound fish were probably taken in adjoining British Columbia fishing areas. Figure 1 also illustrates the weekly abundance of pinks in 1963 and the division between catch and escapement. The pink run developed slowly and it wasn't until the last week of July (during the strike period) that large numbers were present in the area. Consequently, the catch of pinks up to August 4 amounted to only 26,000 pieces or less than 6% of the total run to that date. The peak of the run occurred in the week that normal commercial fishing resumed. With 3-1/2 days of fishing in the peak week (week ending August 11) a catch of 284,000 resulted or 58% of the total present. Subsequent weeks saw a continuing decline in the run. Because of the moderate size of the run, fishing was maintained at 2-1/2 days per week until August 25 when the run was essentially over. For the remainder of the season 4 days fishing per week was permitted.

The pink escapement to the Skeena system and to coastal streams within Area 4 was estimated to be 1,028,000, less than in the preceding two odd-numbered years and much less than required to bring the run to its former abundance. About 900,000 pinks spawned in tributaries of the Skeena River or in the river itself, while an estimated 128,000 spawned in coastal streams adjacent to the Skeena Gillnet Area. Escapements to the Babine, Kitwanga, and Lakelse Rivers and to the coastal streams were greater than in the parent year. The escapements to the Kispiox River and to the main stem of the Skeena River were drastically lower than those observed in the parent year.

The gillnet catch of spring salmon in the Skeena Gillnet Area was 10,100, the lowest catch since the present system of catch statistics was begun in 1950. The escapements of spring salmon were reported by Departmental officers to be moderate to the Ecstall, Bear, and Morice Rivers, and light to the Kitsumgalum River. About 56% of the low count of spring salmon through the Babine fence were jacks.

The Skeena gillnet catch of coho salmon was 48,600, less than the 1950-1962 average but greater than the catch in the parent year 1960. The escapements to the Lakelse and Bear Rivers were reported to be heavy, to the Bulkley River to be medium, and to the Morice and Kispiox Rivers to be light. The count of coho at the Babine fence was low.

The 1963 gillnet catch of 25,800 chum salmon was less than the 1950-1962 average. Escapements generally were reported as light.

The annual catches of sockeye and pink salmon since 1912 and 1903 respectively are shown in Figs. 2 and 3. The annual catches of spring, coho, and chum for the period 1950 to 1963 are shown in Fig. 4.

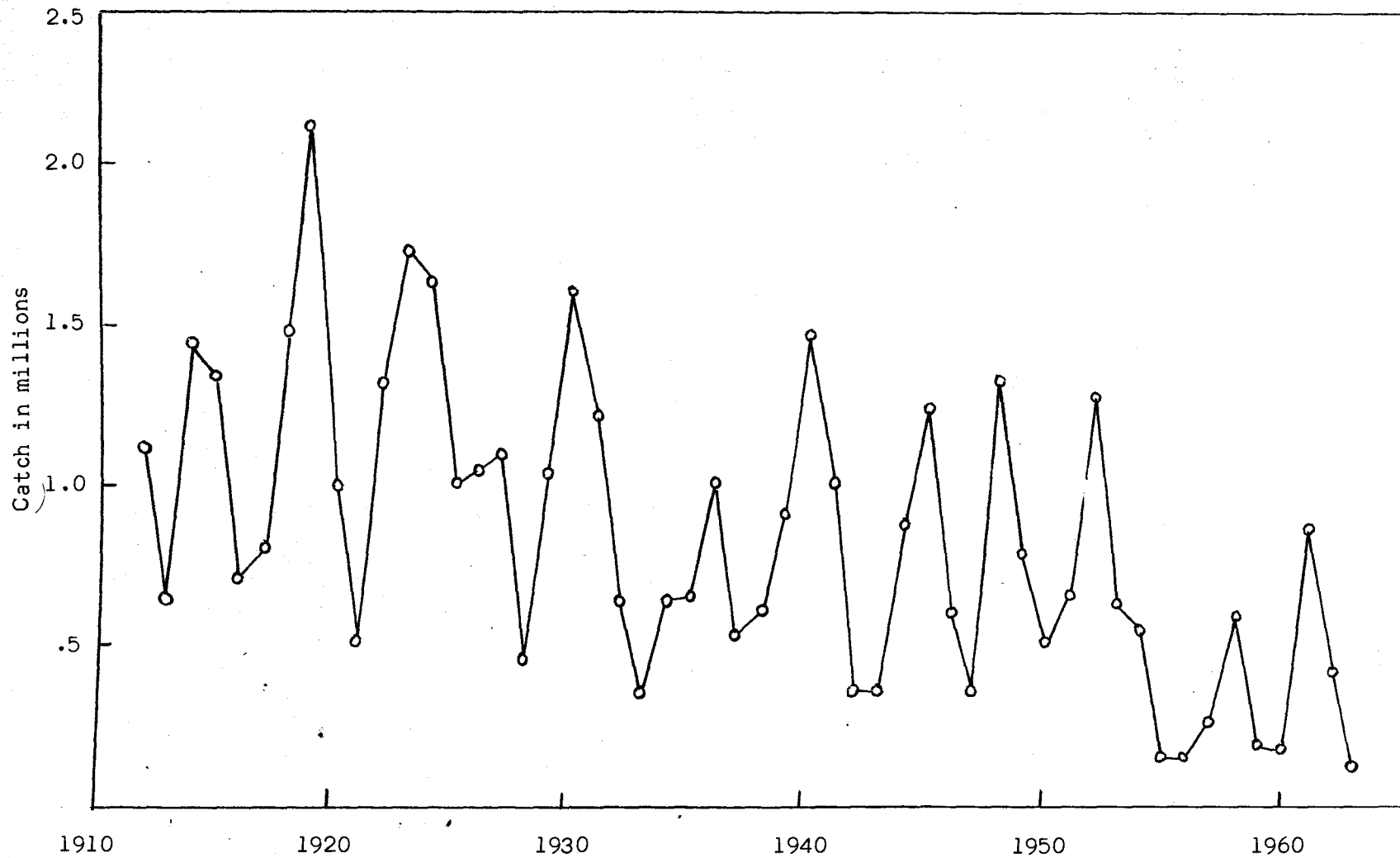


Fig. 2. Annual catch of sockeye in the Skeena Gill-net Area (from British Columbia Catch Statistics of the Department of Fisheries, 1950-1963, and from pack and sampling data, 1912-1949).

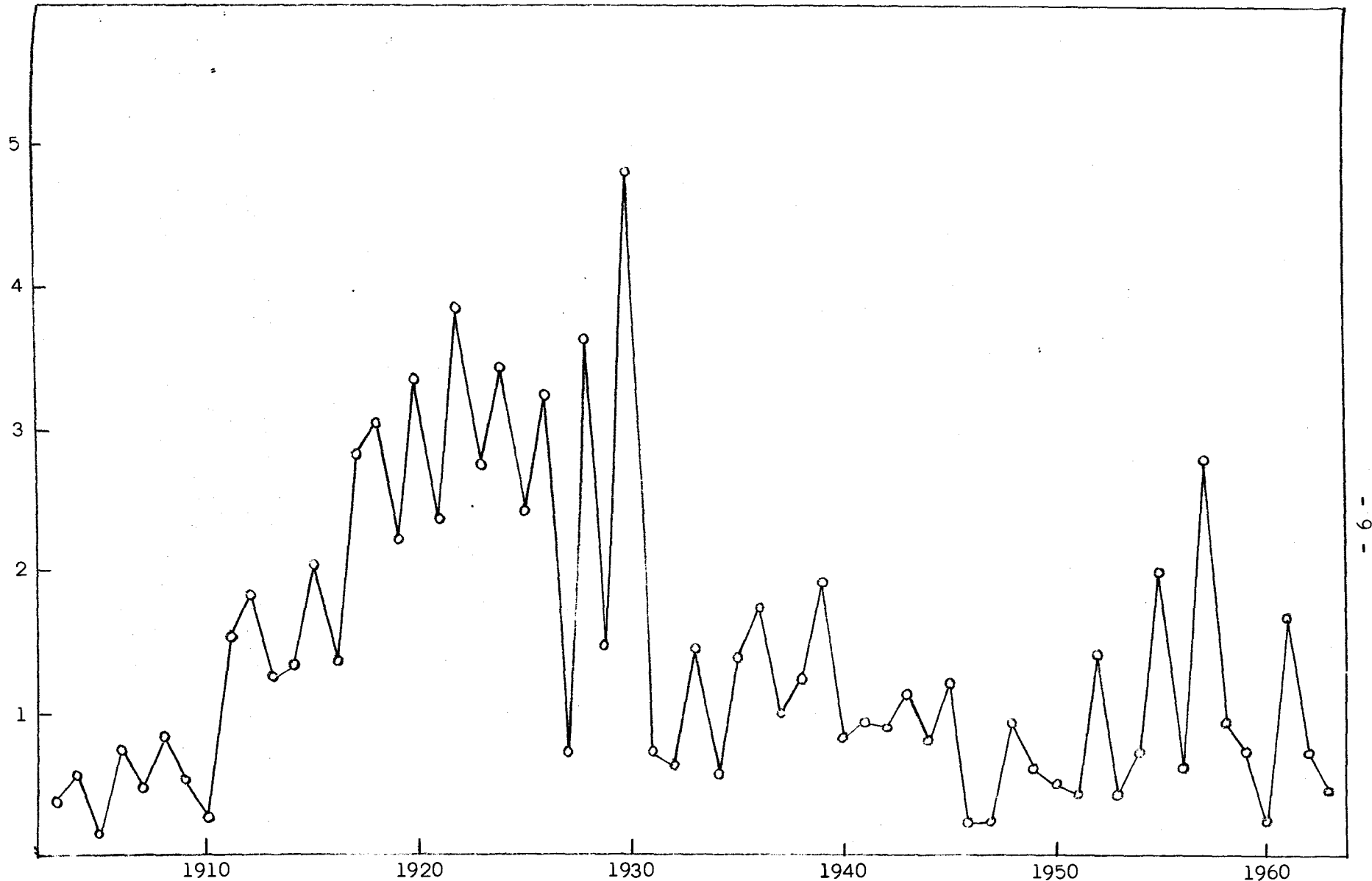


Fig. 3. Estimated annual catch of Skeena River pink salmon (1903-1949, using pack figures and available information of annual average fish per case; 1951-1961, from British Columbia catch statistics of the Department of Fisheries). In years 1955-1963 the estimated catches of Skeena fish caught in adjoining statistical areas 3 and 5 are included.

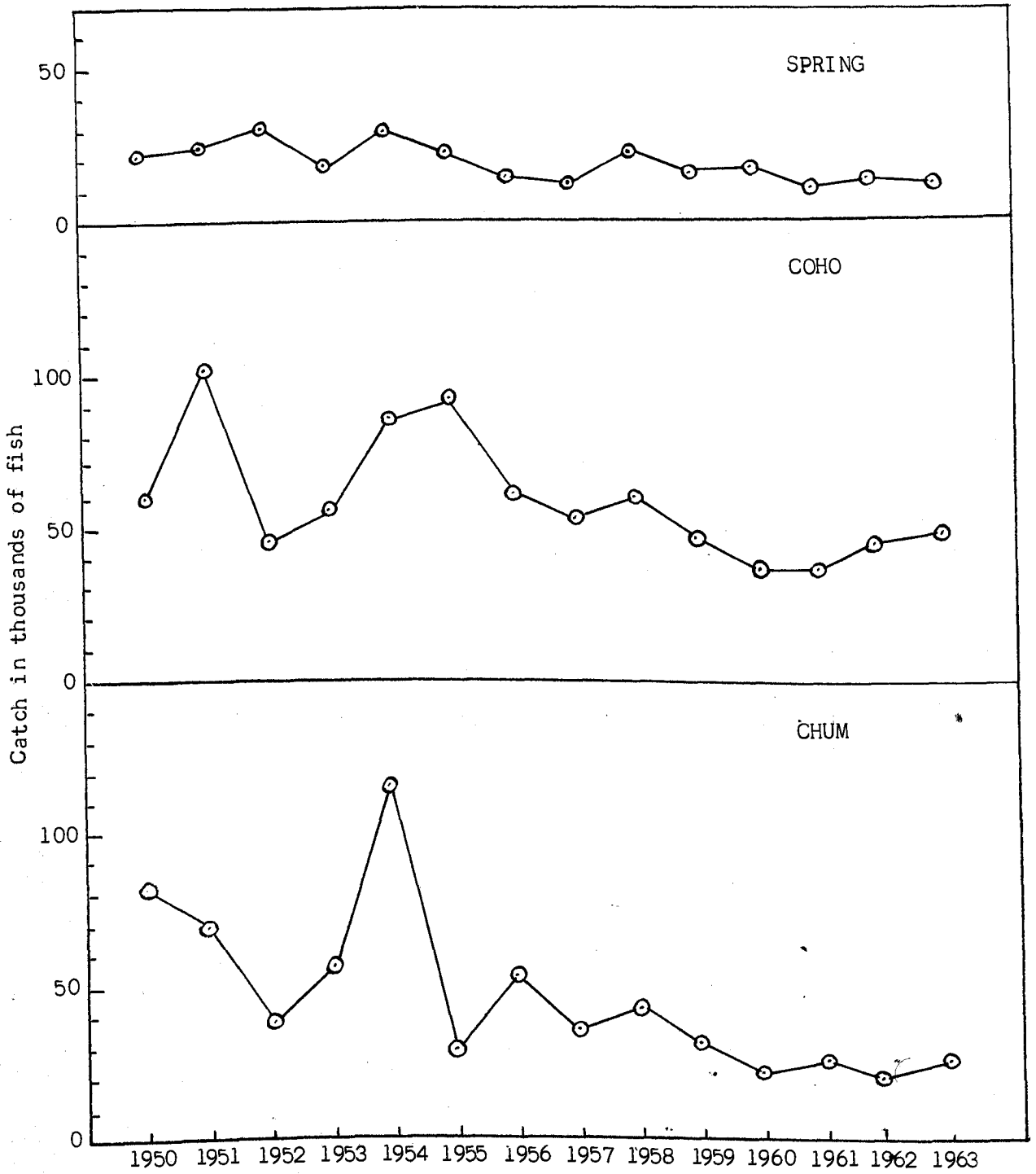


Fig. 4.. Annual gillnet catches of spring, coho and chum salmon in the Skeena Gillnet Area (from British Columbia Catch Statistics of the Department of Fisheries).

Investigations and Fish Cultural Projects

In 1963, Skeena salmon investigations continued to provide information required for both the seasonal and long-term management of the salmon runs. Catch-effort data were collected and analysed to provide information necessary to manage the commercial fishery effectively. Routine test-fishing again provided weekly estimates of sockeye and pink salmon escapements from the fishing area. These estimates, together with catch data, were used to indicate the size of the runs as they developed and the effect of the fishery on them.

A major part of the effort involved estimation of the numbers of sockeye and pink salmon which spawned in each major spawning area. The purpose of this work is to (1) further assess the effect of the fishery on the runs as a whole and on individual stocks, and (2) assess the return from brood-year escapements to further describe the parent-progeny relationship of major stocks.

Particular attention was again given to Babine Lake sockeye which, in recent years, have made up more than 90% of the Skeena sockeye run. Available information resulting from tagging programs and spawning ground observations reveals consistent differences in the time of upstream migration and spawning, and spawning area utilized by various components of the Babine run. In addition, studies of the distribution of young sockeye in this multi-basin lake system have shown that to a considerable extent the young produced by each spawning component may utilize a more or less discrete lake nursery area. The available evidence clearly indicates that the Babine run is composed of a number of spawning components - or sub-stocks - which will have their own specific requirements for optimum production. Further improvement in the management of Babine sockeye will therefore depend on the extent to which the requirements of each sub-stock are recognized and met through regulation of the fishery and fish cultural aids.

A more intensive study of the Babine sockeye escapement began in 1962 to provide information required to better define the various sub-stocks which contribute to the run as a whole. Tagging programs carried out in 1962 and again this year confirmed and "pointed up" migration and spawning periods of fish utilizing specific spawning areas. Estimates of the age composition of each sub-stock were also made from sampling data and revealed that differences existed in the proportions of 4- and 5-year-old fish from stream to stream. Continued study is required to better determine the number of spawners needed to utilize each spawning and lake nursery area to best advantage. Further study of the factors influencing age of maturity is also important. If the age composition of each spawning sub-stock is reflected in the age composition of the returning progeny then an improved basis for prediction of the annual runs to Babine and the Skeena will be provided.

Biological and engineering studies continued to provide information required to assess the possibility of increasing sockeye production at Babine Lake. Essentially the proposal under study involves the use of fish cultural aids (artificial spawning channels, water control, or other means of spawning ground improvement) to introduce additional fry (above the number possible by

natural means) into presently under-utilized lake nursery areas.

The Nanika River hatchery entered into its third year of sockeye fry production. The operation of this hatchery, part of the Department of Fisheries program for rehabilitation of the seriously depressed Morice Lake run, is to boost fry production above that possible by currently very small natural spawnings.

Reports of progress in investigations and fish culture development projects carried out in 1963 follow this section.

Reports of Progress in Investigations and Fish Culture Projects, 1963

1. Pink salmon escapements and freshwater survival in 1963

Escapements

Estimates of 1963 escapements were obtained by a variety of methods. As in the past, each escapement in each stream was considered as a separate problem requiring its own enumeration solution. Tag and recovery programs, strip counts, catch per unit of gillnet effort, aerial ground and boat surveys, and counting fences were employed.

In addition to obtaining counts, the enumerations group has studied the timing and distribution of the stocks on the spawning grounds. Efficient and accurate estimates are very largely dependent upon thorough understanding of the character of the runs. These studies have been carried on for nine years, and it now appears that further special effort to extend the knowledge of run character and to improve existing survey methods will, in most instances, produce a much smaller return in information per unit of effort than in the past.

On the Lakelse River in 1960, 1961, and 1962, population estimates by tag and recovery programs were compared with actual counts made possible by the operation of a counting fence. Tag and recovery data gave a weighted 3-year mean error of 30% (range 27-42%) in excess of the fence counts. Estimates by tag and recovery procedures on streams similar to Lakelse have been corrected accordingly. Both Lakelse and Kispiox River escapements were estimated by means of tag and recovery programs in 1963.

The Skeena mainstem escapement has consistently been the most difficult to estimate. Silted waters, and intermixtures of local with transient sub-stocks, have complicated the problem. However, useful indices to abundance are obtained annually from gillnet catches during peak spawning periods. Figure 5 shows the relative catch of pink salmon per standard unit of gillnet effort at 13 fishing sites in 1962 and 1963. Further information on the character of the mainstem pink run is required.

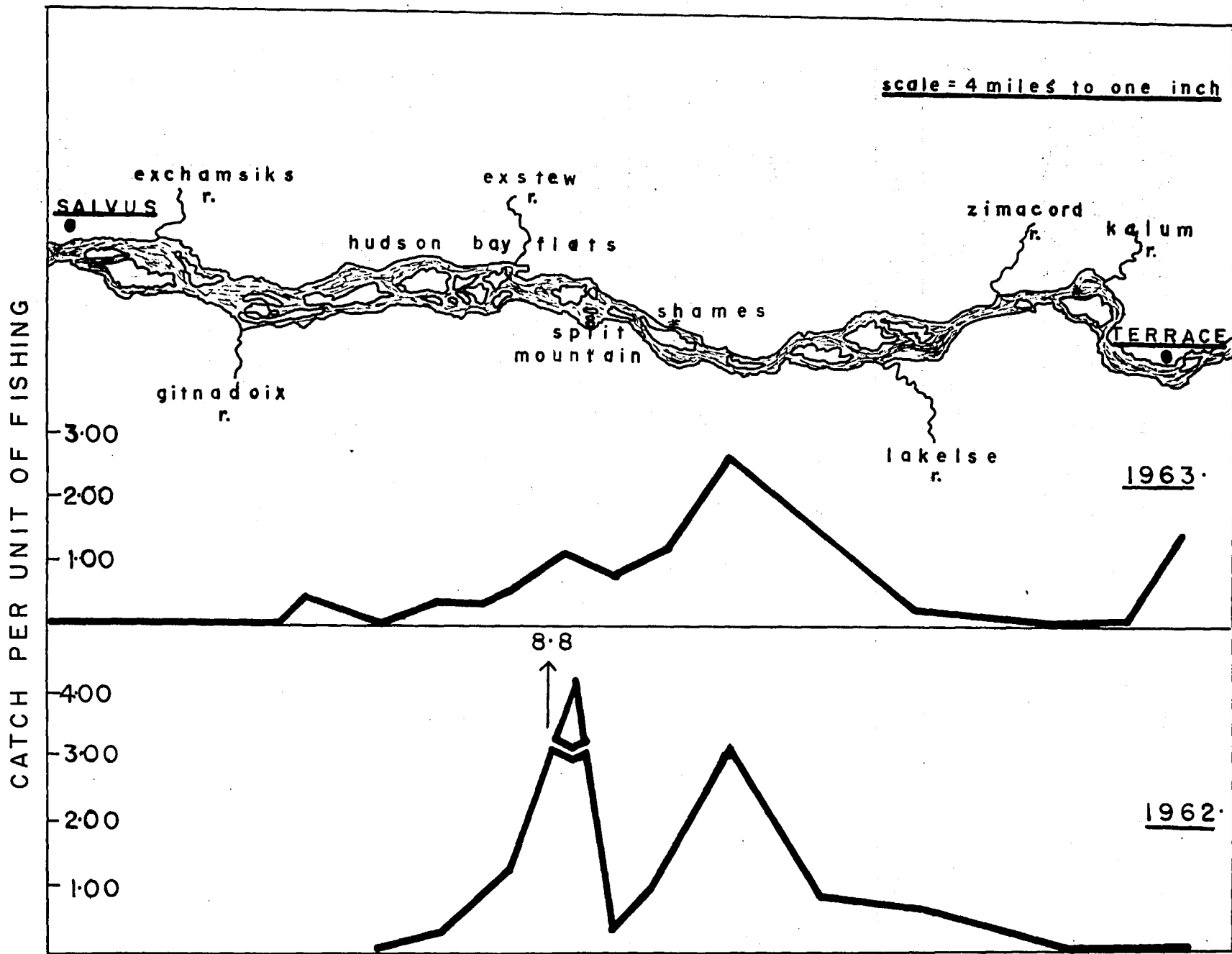
Estimated escapement of Skeena pink salmon, 1955 to 1963.

Place	1955	1956	1957	1958	1959	1960	1961	1962	1963
	(thousands)								
Kispiox River	540	75	360	66	650	45	280	50	32
Kitwanga River	125	35	160	158	250	27	100	65	170
Lakelse River	175	75	140	262	185	122	325	635	505
Babine River	5	3	27	10	77	7	75	40	93
Bear River	6	Nil	15	Nil	20	Nil	5	Nil	15
Skeena River	10	5	50	50	150	10	450	37	40
Others	119	10	113	10	54	5	100	8	45
Coastal Rivers	78	75	105	116	95	45	99	165	128
Total	1,058	278	970	672	1,478	261	1,434	1,000	1,028
Total upstream of test-fishing site	987	202	868	558	1,383	215	1,335	835	900

Escapements in 1963 were generally poor despite the strike. The Kispiox escapement was the smallest in nine years - about 10% of the parent year escapement - and it reflected a downward trend beyond that observed in 1961 in the odd-year cycle. The number of spawners in the Skeena mainstem was also very low and only about 10% of the parent year escapement.

Larger runs were observed in the Lakelse, Kitwanga and Babine Rivers. The Lakelse River now appears to have displaced the Kispiox River as the primary Skeena pink salmon spawning ground for it has received 49% of the total Skeena escapement in the past three years. The Babine run may have been particularly favoured by the fishermen's strike and the all-time high escapement through the fence probably did not reflect a similar record for the Babine stock as a whole.

An appreciable pink run in the Bulkley River above Moricetown is most encouraging as very few pink salmon have been observed there in other years. Estimates from several sources have suggested an escapement of between 5,000 and 35,000 pinks to the Upper Bulkley in 1963.



Relative catch of pinks in 1962 & 1963 in 13 spawning areas on the Skeena River between Terrace and Salvus.

Figure 5

Egg-to-fry survival

Egg-to-fry survival has been measured in a number of Skeena streams in the past but in 1963 only the Lakelse output was measured.

A mechanically driven fry trapping device has been used in recent years and was described in the report of 1962. While the device has functioned according to expectations during periods of normal and heavy flow, there has been some doubt as to the accuracy of estimates obtained during periods of low water.

In 1963, fry trapping stations were established at intervals along the adult counting fence (the structure was removed permanently later in 1963). These stations provided an exceptionally good estimate of the migration, and when operated at the same time as the trapping device they permitted an assessment of the effectiveness of the latter.

The 1962 report gave 4% as the best estimate of survival from the 1961 brood year, but cautioned that it might have been an underestimate. Low velocities which prevailed in the river during a part of the migration period might have permitted some fry to avoid the nets.

Estimates from catches at the counting fence in 1963 during periods of water level like those of 1962, were 2.5 times as great as those derived from the catches by the trapping device. An upward correction from 4% to 10% survival has been made and entered in the table below.

Survival of pink fry in Lakelse River, brood years 1959-62.

Brood year	Escapement	% fry survival
1959	185,000	18.0
1960	122,000	19.0
1961	325,000	10.0*
1962	635,000	13.0

*Given as 4% in 1962 but corrected according to measures made in 1963 and reported in this summary.

The estimate of the survival from brood year 1962 is considered very accurate. It reflects good survival from an exceptionally large spawning stock. Thus the prospects for the 1964 pink run to the Lakelse are very good.

2. The 1963 Babine escapement

The Babine Lake system comprises the largest sockeye salmon producing area in the Skeena system, having supported approximately 90% of the total Skeena escapement in past years. A count of the Babine escapement has been made each year since 1946 by the operation of a fence on the Babine River.

Babine fence counts and sampling are made (1) to show the effect of commercial fishing on the age, size and other features of the greatest part of the Skeena sockeye run, and (2) to provide a statistical record of characteristics of the escapement needed for assessing the year-by-year production of the Babine system.

The counts of the five species of salmon in the years 1946-63 (excepting 1948, when the fence was inoperative) are shown in the following table:

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
1960	262,719	49,396	2,855	4,876	6,794	6
1961	941,711	27,853	2,921	70,044	10,024	4
1962	548,000	46,200	3,030	37,500	11,000	23
1963	588,000	173,000	3,400	90,600	3,600	9

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

In 1963, fence operations began on July 12. The sockeye escapement was, as usual, bimodal in regard to time of entry to the lake. The first peak of 14,559 large sockeye occurred on August 3. The second peak of 34,470 occurred

on August 12. After the second peak the daily counts showed a fairly steady decline. By September 13 the daily run had declined to 466 large sockeye. Fence operations were then discontinued.

The 1963 escapement of 3,400 spring salmon was again below average. A separate count of "jack" springs and large springs was made. Of the total, 1,900 or 55.9% were large springs and 1,500 or 44.1% were "jacks". Spring salmon spawn below as well as above the fence. The count, therefore, represents only part of the total escapement.

The pink salmon run of 90,600 was the largest since fence counts began in 1946. Almost all pinks which pass the counting fence spawn in the lower Babine River between the counting fence and Nilkitkwa Lake. Every year a small number of pinks spawn below the fence. In 1963 the number spawning here was estimated to be between 3,000 and 4,000. During the first half of September an estimated total of 3,000 female pink salmon died unspawned. The majority of the unspawned dead fish were partly covered with fungus. It is suspected that the abnormally high temperature of the water contributed to this occurrence. The maximum water temperature was between 62°-64°F during the period when most fish died unspawned. This is the highest temperature ever recorded for September. With the cooling of the water, more and more fish spawned normally.

The coho run was below average. A total of 3,600 had passed the counting fence when operations were discontinued on September 13.

Only 9 chums passed the fence in 1963.

To determine the characteristic of the 1963 sockeye run about 1% of the fence count was sampled daily for length and sex. The long-term average for the sex ratio (1946-1962) and size (1949-1962) is compared with the 1963 measurements in the following table:

	Sex ratio		Fork length in cm		
	% males	% females	Large males	Jacks	Females
Long term average	45.2	54.8	56.2	37.8	58.7
1963	45.5	54.5	57.1	36.6	56.4

The 1% sample also showed that 91.5% were "normal" fish, 6.3% had net marks, and 2.2% were injured.

The average egg content of 1963 females was estimated to be 3,014. A total of 311,751 females are estimated to have escaped the Indian fishery above the counting fence, leaving a potential egg deposition of 890,600,000.

3. Age and length composition of Skeena sockeye stocks

The dynamics of Skeena sockeye stocks will be better understood when sub-stocks are recognized and studied separately. Age and size at return may serve to differentiate certain of these sub-stocks.

Source of data

Some age and length data have been obtained from time to time from a variety of Skeena stocks, and seven of these were sampled, some for the first time, in 1963. The best information is from the important Babine system where age and size composition of the fish in the annual escapements has been determined since 1946 from samples of 1% of the daily escapements at the counting fence. In 1958, and to a greater extent in 1962 and 1963, these statistics have also been obtained from samples on the Babine spawning grounds.

All age determinations were from otoliths taken on the grounds. (Scales demonstrate the freshwater age of spawning-ground fish, but saltwater age is rarely legible by the time the salmon reach the grounds.)

Age from otolith readings was compared with age from scales. Paired scales and otoliths were obtained from 176 sockeye caught in the test-fishing nets at the Skeena mouth. There was 94.3% agreement between the two methods:

Comparison of estimates of age composition of a sample of sockeye taken at the test-fishing site on the Skeena River in 1963 based upon scale reading and otolith reading.

Method of reading	Age										Total
	4 ₂		5 ₂		5 ₃		6 ₃		6 ₄		
	No.	%	No.	%	No.	%	No.	%	No.	%	
Scales	89	50.6	66	37.5	19	10.8	2	1.1	0	0	176 (100.0)
Otoliths	91	51.7	65	36.9	15	8.5	4	2.3	1	0.6	176 (100.0)

Length measurements were taken from the posterior edge of the eye-socket to the posterior edge of the hypural plate of dead salmon on the spawning grounds.

Age and length of sampled fish

A total of 212 otoliths was obtained from Skeena spawning grounds outside the Babine system and 3,766 were obtained from Babine itself.

Samples cannot be considered representative of the entire stocks. No 3-year-old ("jack") sockeye were sampled in the six areas outside Babine though some live ones were observed in all areas except Johanson Lake. On Babine, 173,000 "jacks" - distinguished from the 4- and 5-year-olds by their smaller size - were counted through the fence, and served as a basis for the numbers and percentages shown for spawning ground fish. Numbers and percentages of other Babine age groups are, like those from other stocks, unweighted samples of dead fish.

The results of these age determinations appear in Table I. In contrast to the Babine and Bear Lake samples wherein virtually all fish had spent a single winter in fresh water (sub-2 fish) Alistair, Johanson, Sustut and Nanika samples had a large proportion of fish which had spent two winters in fresh water (sub-3 fish).

In order to obtain representative age composition for the entire Babine escapement it is desirable to weight the age samples from each sex on each Babine stream according to the total numbers of fish of each sex that are present. Because the sex ratio is difficult to obtain stream-by-stream, the ratio of males to females for the entire escapement through the fence has been employed to weight data from each stream - even though this treatment may produce errors in some instances.

The weighted numbers of 4₂ and 5₂ fish appear with other pertinent data for both 1962 and 1963 in Table II. The other age groups are poorly represented and have been omitted.

The distribution of 4- and 5-year-old fish is illustrated by the plot of 4-year-old males in Babine streams in Fig. 6. Females follow the same general pattern as shown for males.

The figure suggests that the Upper and Lower Babine Rivers received a disproportionately low percentage of 4-year-old males in 1962. Fifteen Mile Creek received a very high percentage of 4-year-olds in both years, and a rather inconsistent pattern is apparent for the remaining streams.

Some sub-stocks might have a tendency to return most often after two, or alternately after three, winters at sea. This tendency would be reflected in disproportionate numbers of 4- or 5-year-old fish on certain spawning grounds year after year. However, the varying strengths of successive year classes, and the varying effects of a fishery which is selective for certain sizes of fish and is inconsistent in periods of operation, may together disguise such a tendency until several years of comparable data have been analyzed.

Lengths were obtained from all fish sampled except those from the Nanika River. We now have length measurements from nearly all Babine sub-stocks in

Table I. Age composition in several Skeena River sockeye stocks (aged from otoliths taken on spawning grounds), 1963.

		Ages						Total	
		3 ₂	4 ₂	5 ₂	5 ₃	6 ₂	6 ₃		6 ₄
Babine Lake (stream spawners)	males	*	1551	309	24	..	2	..	1886
	females	..	1669	222	16	..	..	..	1907
	Total	*	3220	531	40	..	2	..	3793
	Percent	22.7	65.7	10.8	0.8	..	0.0	..	100.0
Alastair Lake (stream spawners)	males	..	1	..	21	..	1	..	23
	females	..	..	2	15	..	1	..	18
	Total	..	1	2	36	..	2	..	41
	Percent	..	2.4	4.9	87.8	..	4.9	..	100.0
Johanson Lake (lake spawners)	males	..	..	..	6	..	16	1	23
	females	..	..	..	5	..	7	..	12
	Total	..	..	..	11	..	23	1	35
	Percent	..	..	..	31.4	..	65.7	2.9	100.0
Sustut Lake (lake spawners)	males	..	12	25	5	..	7	..	49
	females	..	10	15	10	1	5	..	41
	Total	..	22	40	15	1	12	..	90
	Percent	..	24.4	44.5	16.7	1.1	13.3	..	100.0
Nanika River (stream spawners)	males	..	..	..	4	..	7	..	11
	females	..	..	..	7	..	4	..	11
	Total	..	..	..	11	..	11	..	22
	Percent	..	..	..	50.0	..	50.0	..	100.0
Bear Lake (lake spawners)	males	..	8	1	..	..	..	..	9
	females	..	6	3	..	..	..	..	9
	Total	..	14	4	..	..	..	..	18
	Percent	..	77.8	22.2	..	..	..	..	100.0
Stevens Lake (stream spawners)	males	..	..	..	..	..	..	..	..
	females	..	6	..	..	..	..	..	6
	Total	..	6	..	..	..	..	..	6
	Percent	..	100.0	..	..	..	..	..	100.0

*Percent 3₂'s determined from fence count.

Table II. Weighted numbers of 4- and 5-year-old sockeye in Babine streams, 1962-1963.

Streams	Estimated escapement		No. otoliths		Weighted age composition			
	1962	1963	1962	1963	1962		1963	
					<u>42</u>	<u>52</u>	<u>42</u>	<u>52</u>
Four Mile	2,800	2,800	94	191	91.5	8.5	84.9	15.1
Six Mile	900	1,400	86	193	67.6	32.4	85.9	14.1
Nine Mile	600	1,000	13	57	46.0	54.0	89.5	10.5
Five Mile	..	..	..	..	..	..	..	..
Sockeye	1,000	2,400	17	188	74.0	26.0	99.5	0.5
Tachek	600	1,600	37	166	51.0	49.0	98.1	1.9
Twin	1,300	11,400	138	184	60.4	39.6	99.5	0.5
Pierre	4,100	28,400	132	453	52.1	47.9	96.6	3.4
Grizzly	4,600	11,400	98	192	66.7	33.3	68.0	32.0
Morrison	8,300	22,800	98	394	71.9	28.1	88.9	11.1
Tahlo	4,200	19,000	61	196	54.2	45.8	89.4	10.6
Fifteen Mile	27,200	46,200	95	385	78.2	21.8	93.8	6.2
Fulton	77,800	99,200	187	384	67.8	32.2	77.4	22.6
Lower Babine	61,000	34,500	382	389	41.4	58.6	68.5	31.5
Upper Babine	192,000	119,300	355	394	21.0	79.0	75.0	25.0
Totals	386,400	401,400	1,793	3,766	41.0	59.0	81.1	18.9

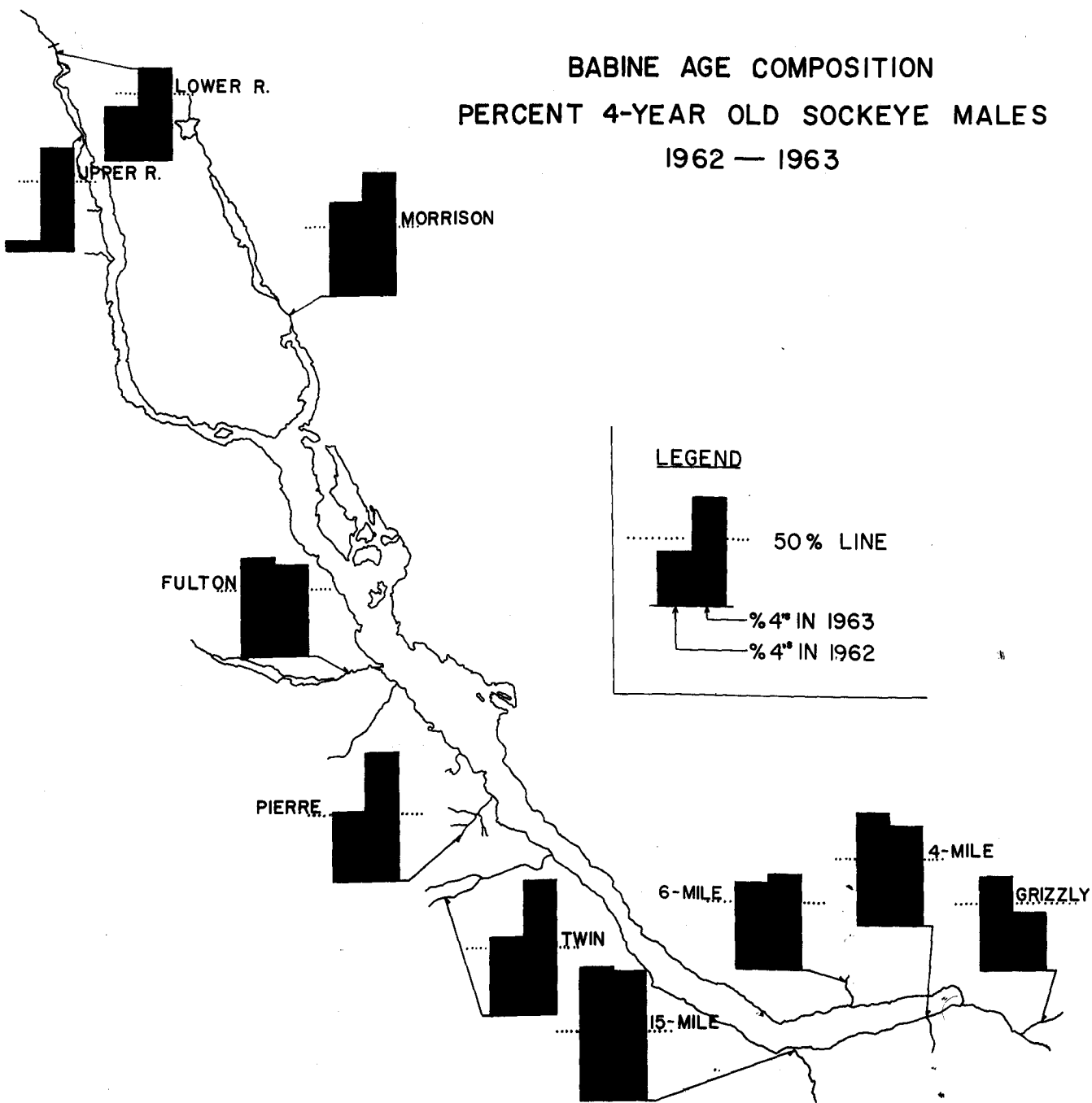


Figure 6.

two consecutive years, and it is desirable to see if there is consistency in mean length of fish by categories and sex in both years.

Consistency is apparent within the Upper and Lower Babine Rivers (both have fish of large mean length in 1962 and 1963) but it is not so apparent in most other streams. Babine River fish might be expected to be large because of their relatively long stay in the ocean. Their smolts migrate among the earliest groups in the spring and the adults are the last to return in the fall. A similar relationship may exist for other sub-stocks but we do not have so precise a measure of the time most groups of smolts leave the system. We have, therefore, combined the measurements from 7 sub-stocks which consistently return early, and 3 sub-stocks which return in mid-season. These two groups, along with the combined Upper and Lower Babine Rivers, and Fulton River and Fifteen Mile Creek, each taken independently, provide 5 mean lengths in each age and sex category. They are plotted in Fig. 7.

The very small mean size of 42 males on Fifteen Mile Creek deserves comment. It is caused by unusually strong representation in the smaller of two modes of length in this age group. Most Babine sub-stocks have been well represented in both modal groups, but only Fifteen Mile is so heavily weighted to the smaller.

4. Abundance, timing and distribution of Babine sockeye sub-stocks

Exclusive of lake spawners, 17 sub-stocks can be recognized in Babine at present (Fig. 8). Several streams with intermittent flow support small numbers of salmon from time to time but they are not perpetuated in these small streams and are not considered sub-stocks.

Abundance of sub-stocks

Counts of spawners in all Babine streams are obtained annually by the Department of Fisheries. In addition the Fisheries Research Board, and the Department of Fisheries Fish Culture and Development Branch have provided detailed accounts on the Upper and Lower Babine and Fulton Rivers in recent years. Table III gives the estimated escapements of large sockeye in the 17 sub-stocks in the years 1949-1963. The table also provides:

(1) The annual Babine fence count of large (4 years and older) sockeye, the Indian catch above the fence, and the difference between the two which comprises the spawning stock.

(2) The distribution of the stock to (a) the North Arm, (b) Morrison Arm, and (c) the Main Lake Basins.

(3) The average number of salmon in the 15-year period in each region (weighted to total numbers) by sub-stock, and in several other categories.

MEAN LENGTHS OF SOCKEYE IN BABINE SPAWNING GROUNDS 1962-1963

(COMBINED BY GROUPS OF SIMILAR SIZE)

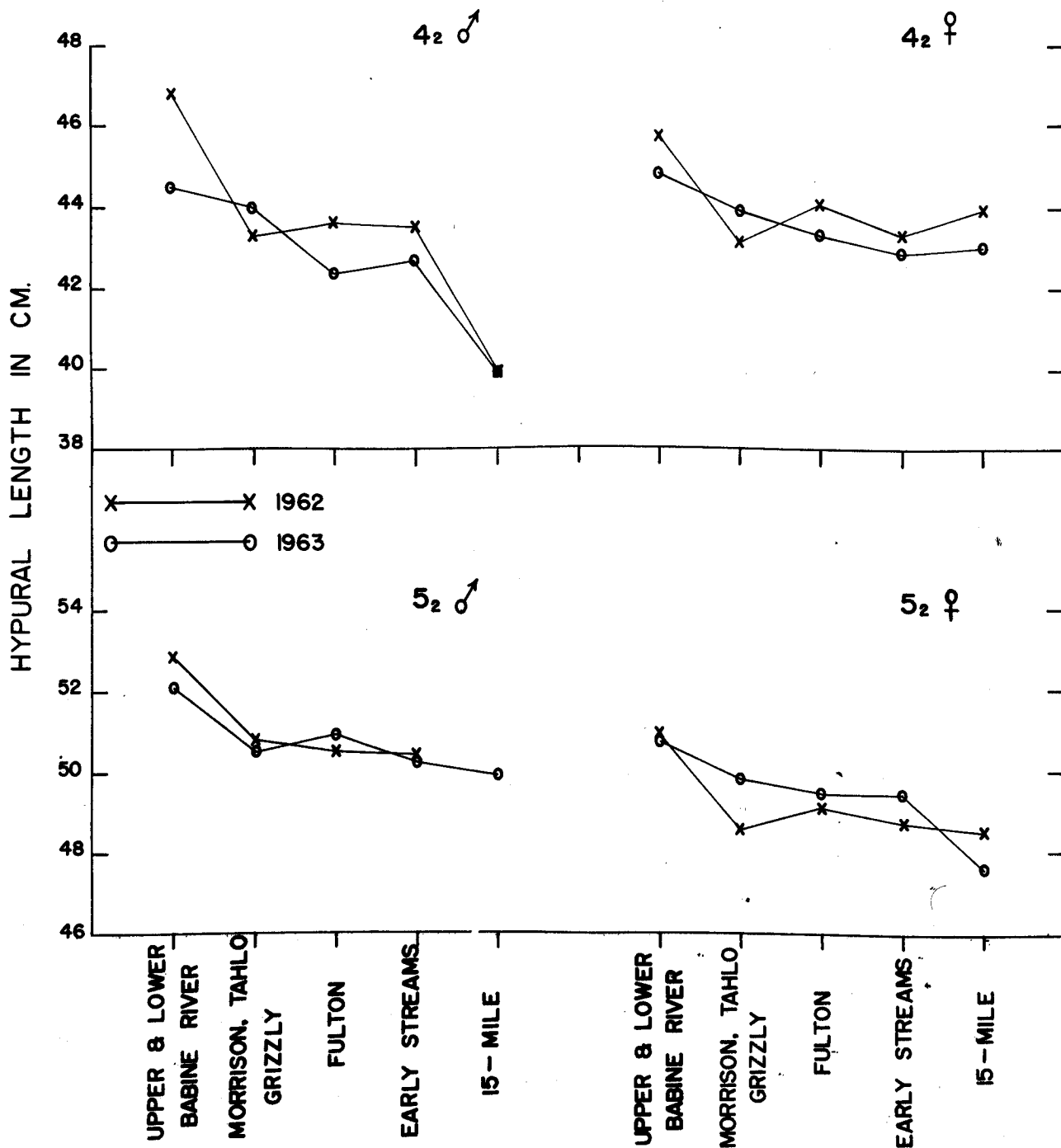


Figure 7.

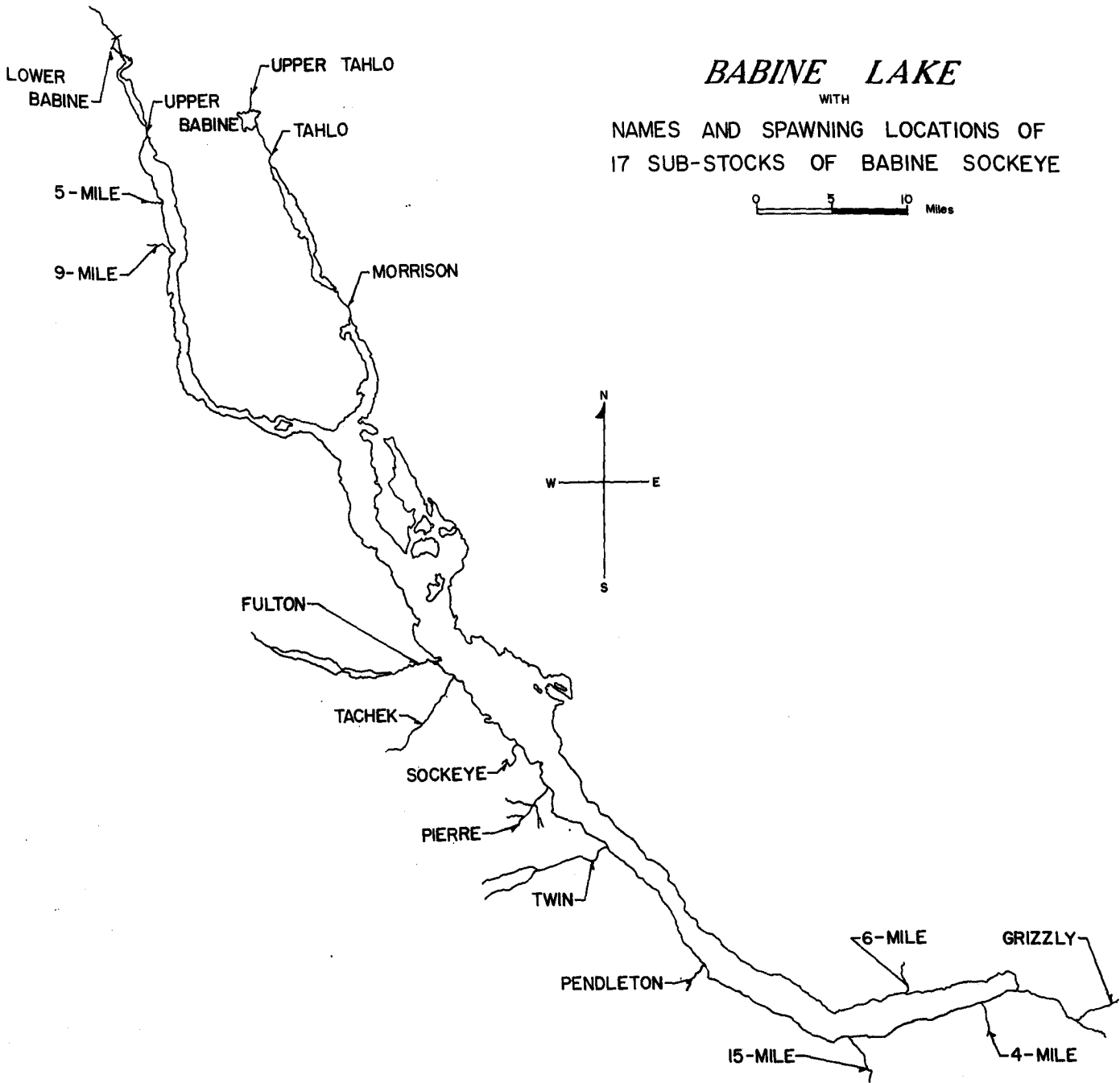


Figure 8.

Table III Babine sockeye escapements in thousands of fish¹, 1949-1963.

Year	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1949-1963	
																Sums	Means
Babine Fence count (large only)	461	364	141	349	687	494	71	355	433	812	783	263	942	548	588	7291	486.1
Indian catch	29	27	19	34	27	22	10	31	20	39	17	17	32	18	20	362	24.1
Spawning stock (count less catch)	432	337	122	315	660	472	61	324	413	773	766	246	910	530	568	6929	461.9
North Arm spawners																	
102-4 - Upper Babine River ²	216.0	65.0	13.3	78.2	147.0	136.7	9.7	66.5	117.8	156.8	156.7	36.9	196.0	192.0	119.3	1707.9	113.9
105-6 - Lower Babine River ²	135.0	116.0	10.8	69.0	127.4	100.0	9.0	52.3	66.5	107.8	123.5	54.0	171.5	61.0	34.5	1238.3	82.6
117 - 9 Mile Creek	0.9	1.0	0.4	0.1	2.5	1.0	0.1	0	4.0	0	2.4	1.8	2.5	0.5	1.0	18.2	12.1
109 - 5 Mile Creek	0	0.1	0.1	0	0.3	0.3	0.1	0	0.2	0	0.6	0	0.5	0.1	0	2.3	1.5
Total North Arm spawners	351.9	182.1	24.6	147.3	277.2	238.0	18.9	118.8	188.5	264.6	283.2	92.7	370.5	253.6	154.8	2966.7	197.8
Percent of spawning stock	81.5	54.0	20.2	46.8	42.0	50.4	31.0	36.7	45.6	34.2	37.0	37.7	40.7	47.8	27.3		(46.2%) ⁴
Main Lake spawners																	
Morrison system																	
115 - Morrison River	1.5	5.9	1.9	0.4	14.9	12.0	0.6	17.1	18.4	8.0	20.9	5.4	14.7	8.3	22.8	152.8	10.2
124 - Tahlo Creek	0.1	NR	1.0	0.4	9.8	12.0	1.2	9.9	9.0	10.0	12.5	4.5	6.9	4.2	18.9	100.4	6.7
- Upper Tahlo Creek	NR	NR	1.2	0.4	NR	NR	0	0	1.5	0	2.5	0	2.0	0	0.1	7.7	0.5
Total Morrison spawners	1.6	5.9	4.1	1.2	24.7	24.0	1.8	27.0	28.9	18.0	35.9	9.9	23.6	12.5	41.8	260.9	17.4
Percent of spawning stock	0.4	1.8	3.4	0.4	3.7	5.1	3.0	8.3	7.0	2.3	4.7	4.0	2.6	2.4	7.4		(3.8%) ⁴
Main Basins																	
112 - Fulton River ³	33.9	42.0	15.2	31.5	134.4	105.6	16.7	81.0	108.0	76.0	114.0	36.0	169.8	77.8	99.2	1141.1	76.1
101 - 15 Mile Creek	10.5	12.0	4.9	7.5	23.5	25.0	3.2	22.8	29.1	44.0	77.6	27.0	44.1	20.8	40.0	392.0	26.1
120 - Pierre Creek	4.2	17.9	11.5	3.3	19.2	17.0	3.2	18.0	21.2	29.4	33.0	9.9	24.5	4.1	28.4	244.8	16.3
113 - Grizzly Creek	1.5	2.7	2.1	3.5	6.0	3.1	0.5	4.8	7.0	30.0	14.0	10.8	23.5	4.6	11.4	125.5	8.4
128 - Twin Creek	2.3	7.6	4.8	0.4	9.8	14.0	2.4	4.5	5.4	12.0	9.0	5.4	6.9	1.3	11.4	97.2	6.5
111 - 4 Mile Creek	1.6	4.2	0.9	0.2	2.0	2.2	0.4	0.4	2.5	6.0	5.4	1.8	1.0	2.8	2.8	34.2	2.3
125 - Tacheek Creek	2.6	2.6	2.5	0	2.4	1.9	0.3	0	6.4	1.8	6.0	1.8	0	0.6	1.6	30.5	2.0
123 - Sockeye Creek	0.2	0.9	0.8	0	0.6	0.9	0.5	0	2.5	1.5	4.0	1.8	0	1.0	2.4	17.1	1.1
122 - 6 Mile Creek	0.4	1.2	0	0	2.6	1.8	0.1	0.1	0.6	2.3	3.5	0.9	0	0.9	1.4	15.8	1.1
- Pendleton Creek	1.1	1.2	0	0	1.4	1.1	0	0	0.3	0	2.5	0	0	0.2	0	7.8	0.5
Total Main Basin spawners	58.3	92.3	42.7	46.4	201.9	172.6	27.3	131.6	183.0	203.0	269.0	95.4	269.8	114.1	198.6	2106.0	140.4
Percent of spawning stock	13.5	27.4	35.0	14.7	30.6	36.6	44.8	40.6	44.3	26.3	35.1	38.8	29.6	21.5	35.0		(30.4%) ⁴
Totals Morrison and Main Basin	59.9	98.2	46.8	47.6	226.6	196.6	29.1	158.6	211.9	221.0	304.9	105.3	293.4	126.6	240.4		
Percent of spawning stock	13.9	29.1	38.4	15.1	34.3	41.7	47.7	49.0	51.3	28.6	39.8	42.8	32.2	23.9	42.3		
Total North Arm and Main Lake	411.8	280.3	71.4	194.9	503.8	434.6	48.0	277.4	400.4	485.6	588.1	198.0	663.9	380.2	395.2	5333.6	355.6
Fish died unspawned	0	0	20.0	70.0	0	0	0	0	0	72.5	0	0	49.5	0	0		
Fish taken for hatchery use	0	0	0	0	0	0	0	0	0	0	0	0.3	2.1	6.2	6.2		
Total spawning stock accounted for	411.8	280.3	91.4	264.9	503.8	434.6	48.0	277.4	400.4	558.1	588.1	198.3	715.5	386.4	401.4		
Percent accounted for ⁵	95.3	83.2	74.9	84.1	76.3	92.1	78.7	85.6	96.9	72.2	76.8	80.6	78.6	72.9	70.7	1218.9	81.3
Total spawning stock not accounted for	20.2	56.7	30.6	50.1	156.2	37.4	13.0	46.6	12.6	214.9	177.9	47.7	194.5	143.6	166.6	1368.6	91.2
Percent not accounted for	4.7	16.8	25.1	15.9	23.7	7.9	21.3	14.4	3.1	27.8	23.2	19.4	21.4	27.1	29.3	281.1	18.7
Occasional counts of non self-perpetuating runs	0	0	0	4400	1000	0	0	0	0	0	3900	0	200	0	0		

¹ As estimated by Inspection Branch except as noted. Live sockeye only.

² Upper and Lower Babine Rivers by FRB tag and recovery beginning in 1962.

³ Fulton River estimated by Fish Culture Branch beginning in 1961.

⁴ Weighted means.

⁵ Note that this percentage refers to total count from North Arm plus Main Lake - see especially last 4 columns.

(4) The losses in 1951, 1952, 1958 and 1961 of substantial numbers of sockeye which reached the grounds but failed to spawn.

(5) The numbers of salmon taken from Fifteen Mile Creek to provide eggs for a rehabilitation project on the Nanika River.

(6) The total of fish comprising the spawning stock but not accounted for in totals of sub-stocks counted on the grounds each year.

The percent of the spawning stock in each of the three main areas listed in (2) above, and in the "unaccounted for" category listed as (6) above, is shown in Fig. 9.

Certain features of the escapement data are of particular significance:

(1) The geographical distribution of the salmon in the escapements has been very similar from year to year. For instance the North Arm has nearly always received between 30 and 50% of the total of counts to all streams (weighted mean 46.2%), though there has been some trend toward a lesser percent escapement in the north end in recent years.

(2) As little as 3% (1957) and as much as 29% (1963) of the spawning stock has not been accounted for in the sum of annual counts on all streams. Presumably some of the missing fish are lake spawners.

(3) There have been considerable losses on the spawning grounds in some years. Losses in 1951 and 1952 resulted from injuries suffered by fish at the Babine slide. Those in 1958 and 1961 resulted from a combination of low water, warm temperatures, and possibly in 1958 at least, from overcrowding in certain streams. In Pierre Creek it is estimated that over half the 1958 escapement died in the stream unspawned. Pierre and Twin Creeks sub-stocks were adversely affected in 1961 also. In years of very low water, at least 5 Babine sub-stocks may be unable to enter their home streams.

(4) In the sum of 15 years of escapement data, more than 90% of the counted escapement has spawned in just 6 streams. In descending order of average production they are:

Upper Babine River
Lower Babine River
Fulton River
Fifteen Mile Creek
Pierre Creek
Morrison River

Timing and distribution of sub-stocks

Better definition of the timing and distribution of sub-stocks has resulted from tagging programs in the commercial fishing area and at the Babine fence. Since 1946 five such programs have been conducted at the fence. Details are as follows:

DISTRIBUTION OF BABINE SOCKEYE SPAWNING STOCK FROM 1949 - 1963:

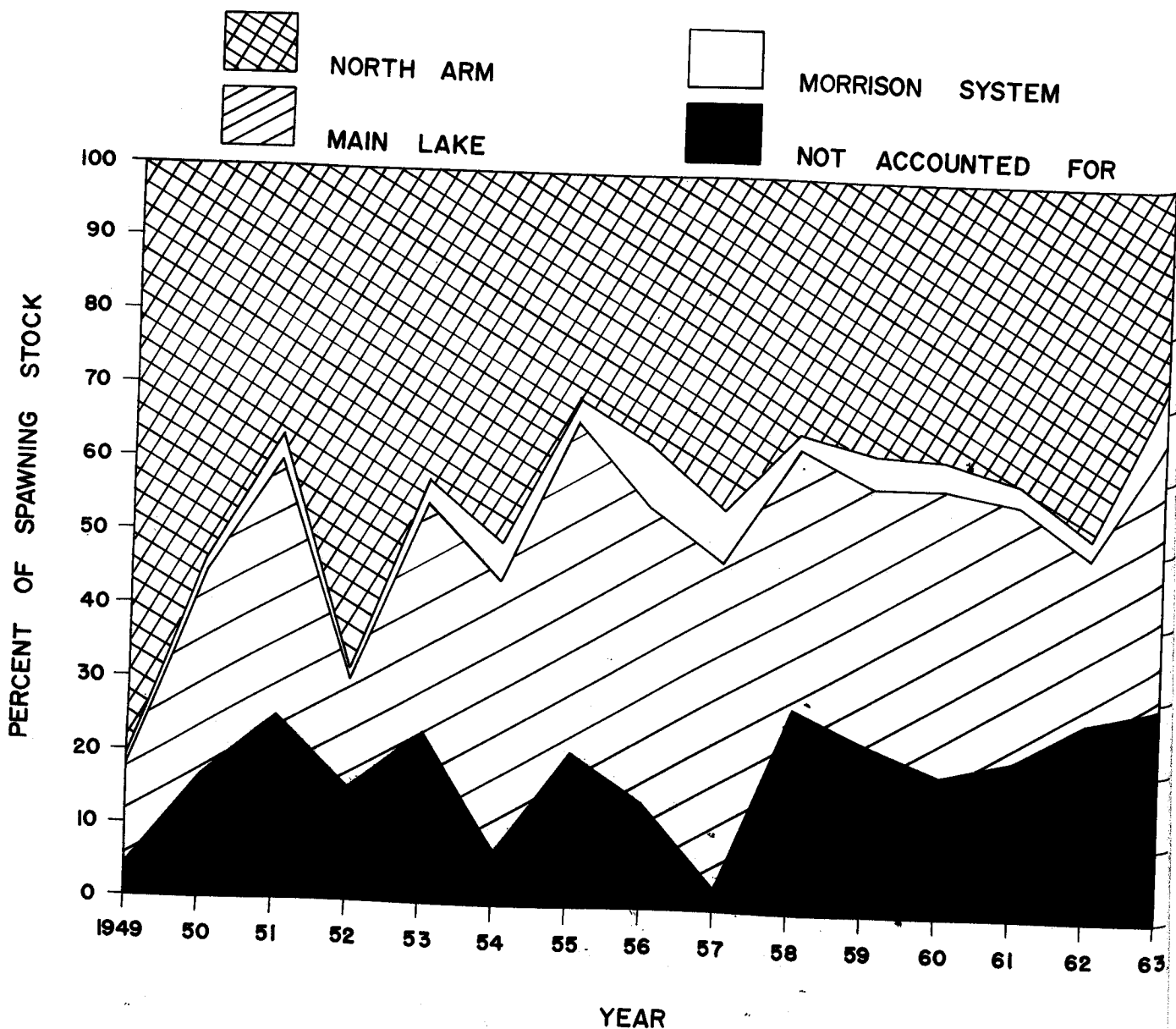


Figure 9

Year	Fence count	Tagging rate ¹		Recovery rate ²	
		Number	Per cent of fence count	Number	Per cent
1946	477,705	9,417	2.0	1,623	17.2
1947	522,561	5,225	1.0	803	15.4
1958	842,812	7,870	0.9	610	7.8
1962	594,200	6,200	1.0	1,548	25.0
1963	761,000	5,000	varied	1,153	23.1

¹In each of the first 4 years a fixed percentage of daily escapements was tagged. In 1963, the first 18 days 3%, the second 5 days 1%, and the next 5 days 0.5% of daily escapements were tagged.

²1946 and 1947 figures included tags sighted but not recovered.

The results of these tagging programs suggest that the Babine escapement can be divided into four parts on the basis of migration time. Each of these four appears to offer some opportunity for regulation with a minimum of interference with the other three. They are:

- (1) The "early run" which includes fish bound for about 10 streams - mainly in the southern half of the lake.
- (2) A combination of fish bound for Morrison River and Fifteen Mile Creek. Of these, 90% enter between August 1 and 18 but they overlap the following group considerably.
- (3) A large run to the Fulton River. More than 90% of Fulton fish pass between August 5 and August 30 but they overlap substantially both the preceding and following groups.
- (4) Upper and Lower Babine River sub-stocks. These constitute about 45% of the entire escapement on the average. Over 90% of the fish in these sub-stocks enter after August 15.

In 1963, the tagging was to provide (1) a comparison with results of former years of tagging in the early part of the run, and (2) a better understanding of the timing of the Morrison River and Tahlo Creek sub-stocks. Fish were tagged at the rate of 3% of the daily fence counts until July 8 by which time the bulk of the early run had passed. From July 9 to 13, 1% of the run was tagged, and from July 14 to 18, 0.5% were tagged. No tagging was conducted after August 18. Figure 10 illustrates the rate of tagging at the fence, and the recoveries in total, and in several streams and groups of streams.

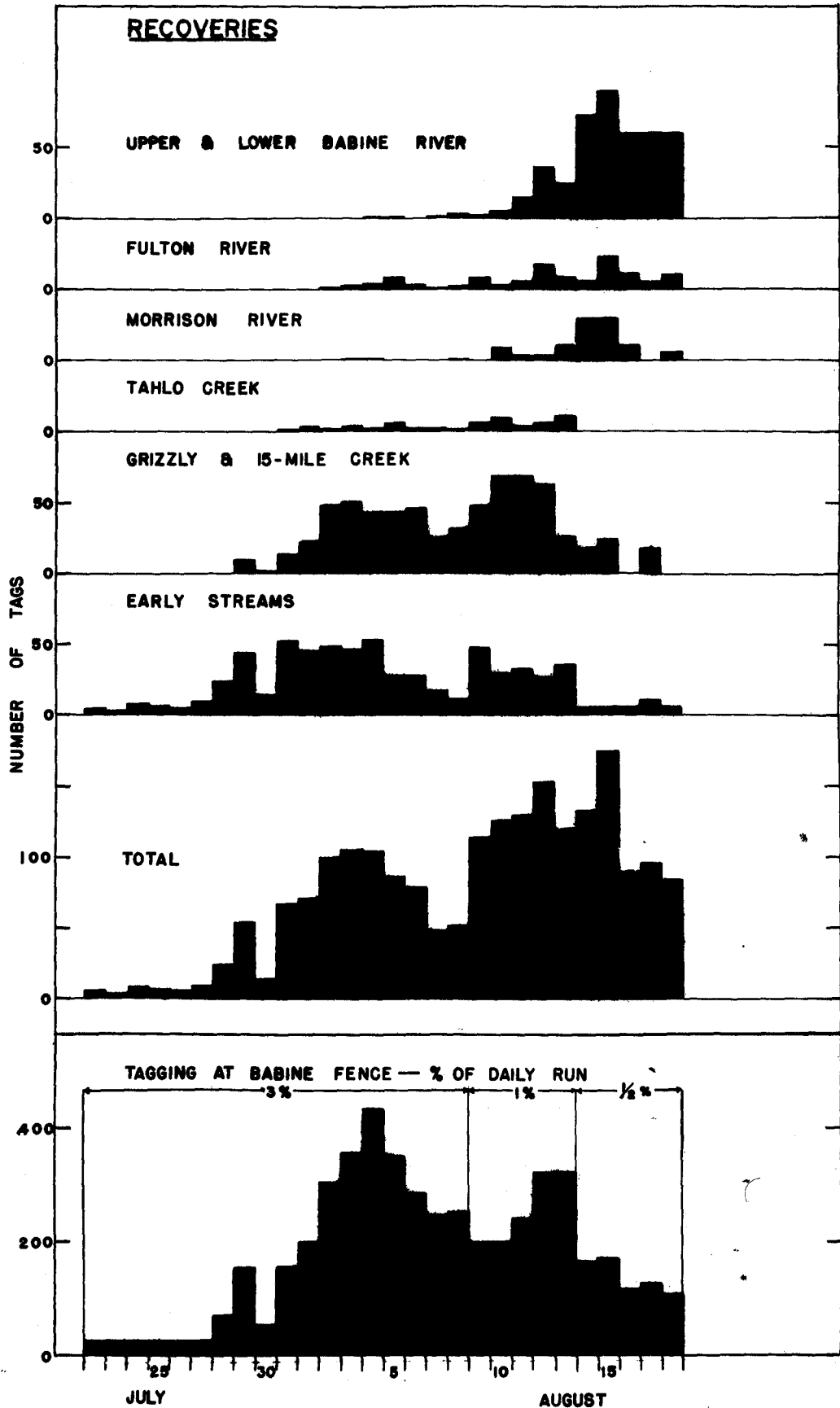


Figure 10

The general distribution was the same as that observed in other years. However, Grizzly Creek recoveries were distributed more like those in Fifteen Mile Creek than in the typical early stream pattern described in (1) above, and were grouped with Fifteen Mile Creek recoveries this year.

Recoveries from Morrison River and Tahlo Creek have been plotted separately. Recovery effort was not quite the same on both streams in 1963, but it is clear that most Tahlo fish passed through the Babine fence at least one week ahead of those bound for the Morrison River.

5. Babine River spawning ground studies

The part of the Babine River between the counting fence and the outlet of Nilkitkwa Lake includes about 30 acres of useful spawning gravel and has, in the past 5 years, accommodated an annual average of about 150,000 spawners of all species of salmon - mostly sockeye and pinks.

The spawning requirements of sockeye salmon in this valuable section of river are now being studied. Careful measurements of the number of salmon utilizing it have been made in each of the last two years, and studies have been initiated to provide information on optimum spawning density.

Estimates of total spawners on this, and the Upper Babine River (between Nilkitkwa and Babine Lakes), in 1962 and 1963 were made by tag and recovery programs. It is apparent that there is some tag loss in these experiments and that the uncorrected estimates will be somewhat high*. The Babine tagging probably gives an estimate of 110% of the true population and has been adjusted accordingly. Pertinent statistics and results of these enumerations are shown on following page.

In 1962 a section of the river was selected for studies of superimposition of redds, and rate of turnover. A pilot study was conducted and the results were reported briefly in the 1962 Annual Report. A study of the success of spawning in pens was initiated in 1963. Figure 11 shows the location of the pens in relation to the counting fence and the topography of the river. In February 1964, approximately one-tenth of the area in each pen was excavated to a depth of 14 inches by means of an hydraulic sampler (Fig. 12). If the sampling was representative, only 26% of the eggs deposited in September were available as eggs or alevins in February. Several test excavations in the area just below the pens failed to uncover live eggs or alevins, whereas excavations further upstream suggested that survival in most of the river was exceptionally high.

* Adult population estimates from tag and recovery programs have been evaluated at Babine, on Lakelse River in the Lower Skeena, and on the Glendale River on the southern British Columbia coast. These tests have all shown that uncorrected estimates are consistently too high.

POSITION OF EXPERIMENTAL PENS IN 1963

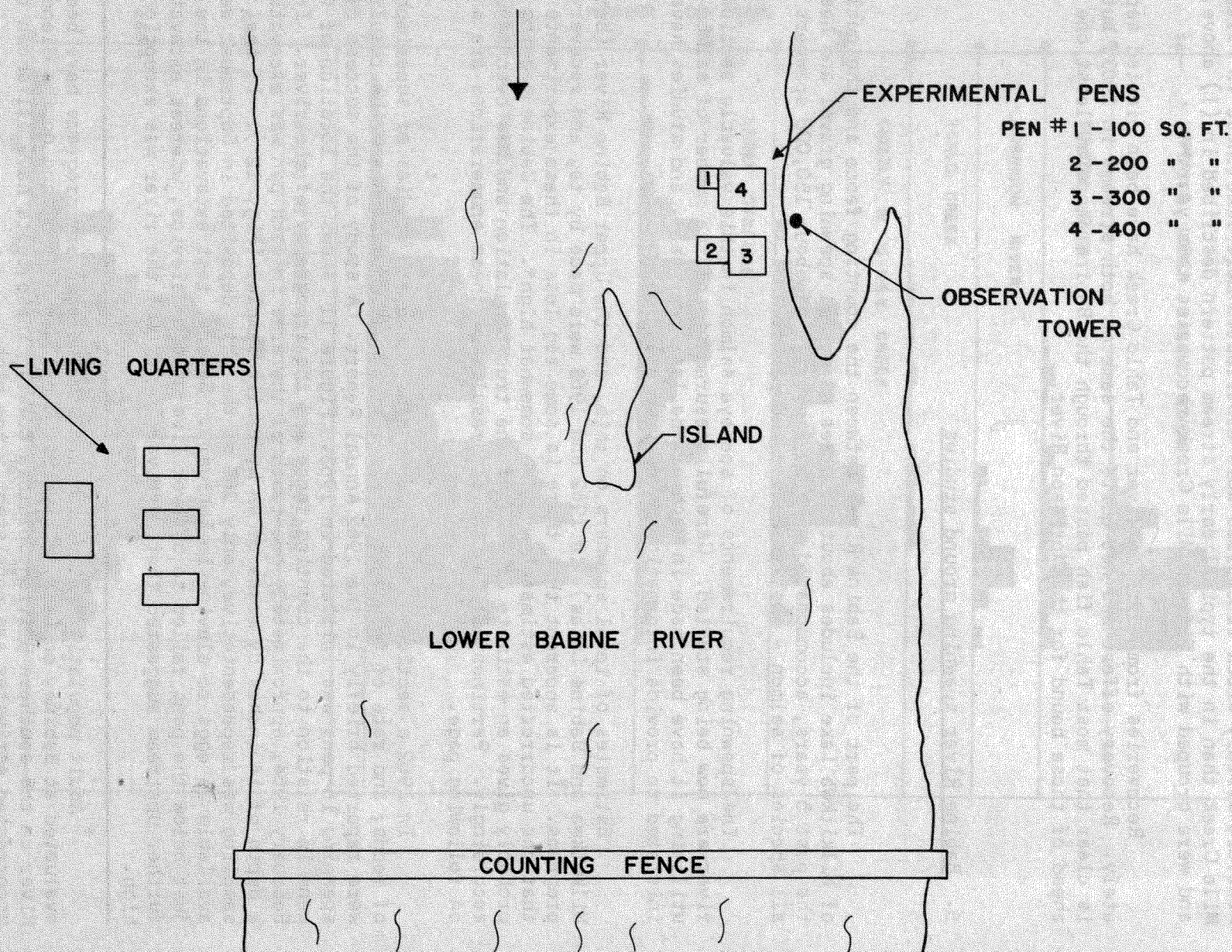




Figure 12.

It is concluded from this pilot experiment that it is feasible to have sockeye spawn under population densities at least as great as one fish per five square feet. Further work is necessary to assess the effect of this crowding upon subsequent success.

Details of tag and recovery programs for estimating sockeye populations on Upper and Lower Babine Rivers, 1962-63.

Year	Numbers			Population estimate	Estimate with 10% correction
	Tagged	Inspected	Recovered tags		
			<u>Upper Babine River</u>		
1962	1,420	53,027	392	192,088	174,625
1963	1,988	43,094	652	131,397	119,452
			<u>Lower Babine River</u>		
1962	985	28,673	465	63,737	55,215
1963	1,945	21,462	1,102	37,880	34,436

6. Babine Lake spawning

Quite large differences between the number of sockeye counted into Babine Lake and the number observed on the tributary streams have been noted over the years. These differences, together with some evidence which indicated that lake-spawning occurred, suggested the possibility that a sub-stock of substantial size may be presently overlooked. This prompted a study to confirm the existence of lake-spawning at Babine and to describe its extent.

In 1958 and each year since 1961, gillnetting around the periphery of the lake showed adult sockeye to be present in October and November - long after the adjacent stream populations had spawned and died. The catch per standardized gillnet effort in the last 3 years is shown with the fence count of large (4 years and older) sockeye, and the fraction of the escapement which was not accounted for by the sum of counts of salmon on the streams (see following table).

The location of the gillnet sets and the catches made in each are shown along with other pertinent information for the 1963 operation in Fig. 13.

BABINE LAKE

LOCATION OF DIVING EXPLORATIONS

OCTOBER 22-26 1963

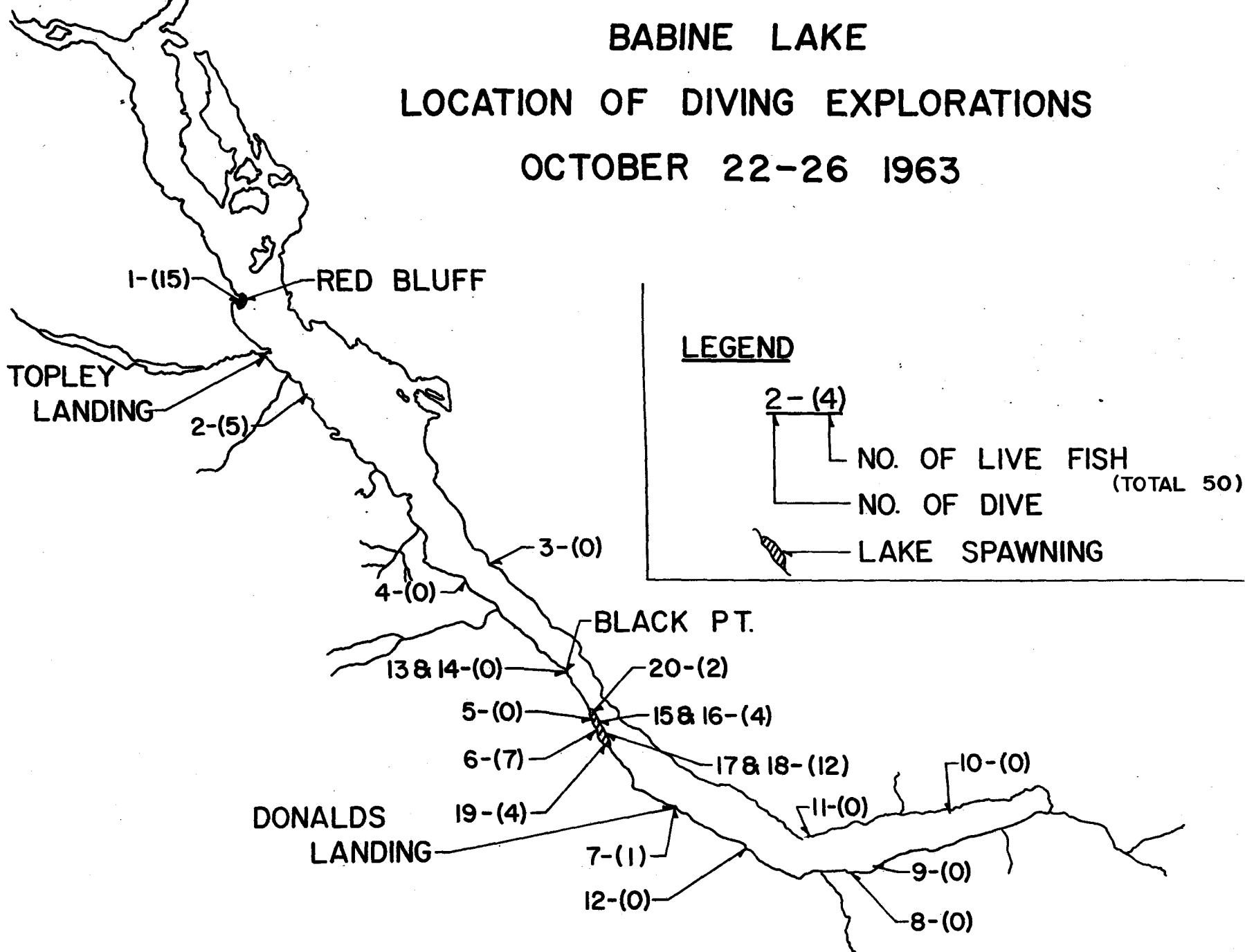


Figure 13.

Babine fence count, percent of count not accounted for on spawning grounds, and catch per standardized gillnet effort, 1961, 1962 and 1963.

Year	Fence count (large)	Percent of count not accounted for	Catch per gillnet effort
1961	942,000	21.4	10.0
1962	548,000	27.1	1.6
1963	588,000	29.3	1.7

In 1962 and 1963, scuba divers located groups of salmon spawning at Red Bluff near Topley in the central part of the lake, and at several locations between Pendleton Bay and Black Point in the southern basin of the lake. The Red Bluff spawning was reported in 1962. In all cases between Pendleton Bay and Black Point the spawning was on very steep slopes where the sand and silt, characteristic of the sloping bottom around most of the lake basin, had slipped to expose clean gravel. The slope of the spawning beds was determined from echo-sounding traces to be about a 1-foot drop in each 3 feet from shore.

Spawning near Black Point appeared to be nearly complete by October 26. Several females speared in the vicinity of the redds were spawned out. While searching for redds, divers uncovered dead fungused eggs from the previous year's spawning and small numbers of live and dead eggs from the 1963 spawning. A 300-foot gillnet was located in 70 feet of water close to one of the observed spawning locations on November 5 but no fish were taken, suggesting that post-spawning sockeye had disappeared by that time.

The lake spawning explorations have now shown that sockeye do spawn in Babine Lake and at considerable depth. Spawning areas have been difficult to locate because they cannot be seen from the surface of the lake, and because there is poor light penetration at spawning depth. It is quite probable that considerable area suitable for spawning is yet to be found.

7. Babine smolt output in 1963

The numbers of fish in the Babine smolt runs had been estimated annually since 1951. In the years 1951-1957 only the "late" run, consisting of smolts from the main lake basins, was measured. Starting in 1958, and continuing through 1963, the "early" run of fish originating in Nilkitkwa Lake and the North Arm of Babine was also examined.

In all years a mark and recovery program has been used to obtain a "Peterson-type" population estimate. Prior to 1960 various combinations of

fins were clipped to identify fish. From 1960 to 1963, small metal tags were used. Each year a portion of the population is marked as it moves through Nilkitkwa Lake. Samples of fish taken at the lake outlet yield a marked-to-unmarked ratio which can be used to estimate the size of the run. Figure 14 gives details of the tagging and recovery sites mentioned.

The totals of fish marked and inspected, and the total of marks recovered, since the current tagging with metal tags began, are as follows:

Summary of mark and inspection data for Babine smolts, 1960 to 1963.

Year	No. marked	No. inspected	No. recovered	% recovered
1960	71,500	655,400	987	1.37
1961	102,100	616,800	3,871	3.79
1962	74,000	463,800	3,809	5.15
1963	81,000	461,300	2,486	3.07

In the past the smolt run has been calculated as a single total each year, then divided into early and late components (since 1958).

There has long been a need for day-by-day totals of smolt output which could be used in weighting daily, or other short-term measurements of length, weight and other vital statistics of the run. Daily estimates of the number of tagged fish available can be obtained by identifying each day's releases with colour-coded tags at the marking site, and noting their rate of recovery at the recapture site. When day-by-day totals of migrants are summed to give the total smolt output for the season, they yield a larger figure than when the total is estimated from a single calculation utilizing season-long marking and recovery data. This disagreement is a property of Peterson-type population estimates. The sum of daily estimates is considered to be the best estimate for the entire run each year. Consequently figures for smolt output were revised (Table IV) for the late run only from 1951 to 1957 and for both early and late runs, separately and combined, from 1958 to 1963.

The daily totals are shown in Fig. 15. Smolt estimates in all years except 1960 are considered reasonably accurate. The 57 million estimate for 1960 is probably excessive. Metal tags of inferior quality were used that year. They caused heavy mortality among marked smolts and despite the use of a correction factor to offset the loss of marked fish before they reached the outlet there is some evidence that an overestimate of the population still resulted. In 1960 the recovery rate was substantially lower than that of the other three years, despite similar facilities for recapture.

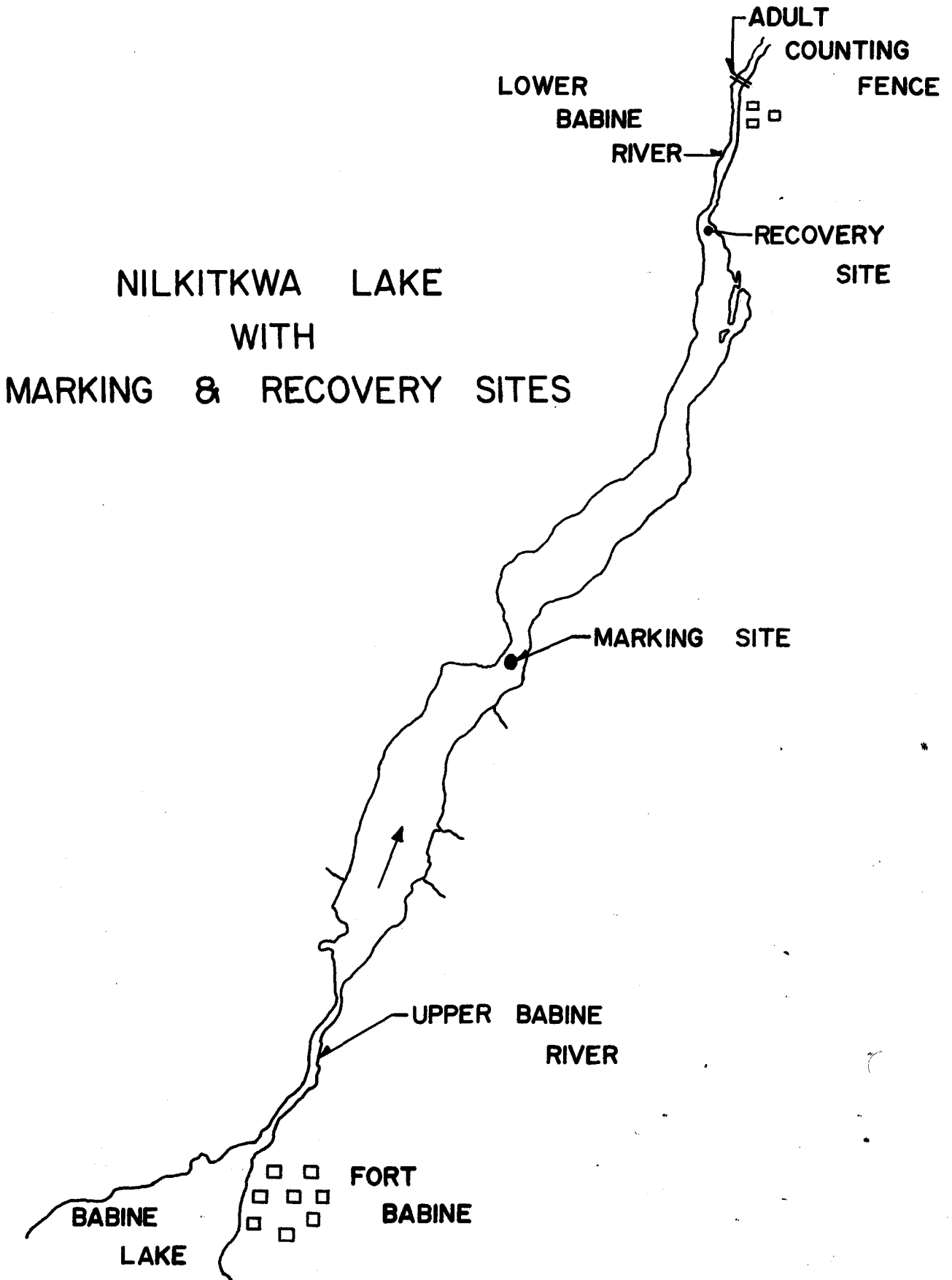


Figure 14.

Table IV. . Estimated smolt output from Babine Lake, 1951-1963 (millions).

Year	Early run total	Late run total	Combined totals
1951	not estimated	3.88	..
1952	"	4.19	..
1953	"	2.78	..
1954	"	2.35	..
1955	"	23.62	..
1956	"	13.19	..
1957	"	5.20	..
1958	14.40	8.40	22.80
1959	9.00	24.90	33.90
1960	26.00	31.10	57.10
1961	7.50	13.30	20.80
1962	4.70	12.40	17.10
1963	7.50	6.80	14.30

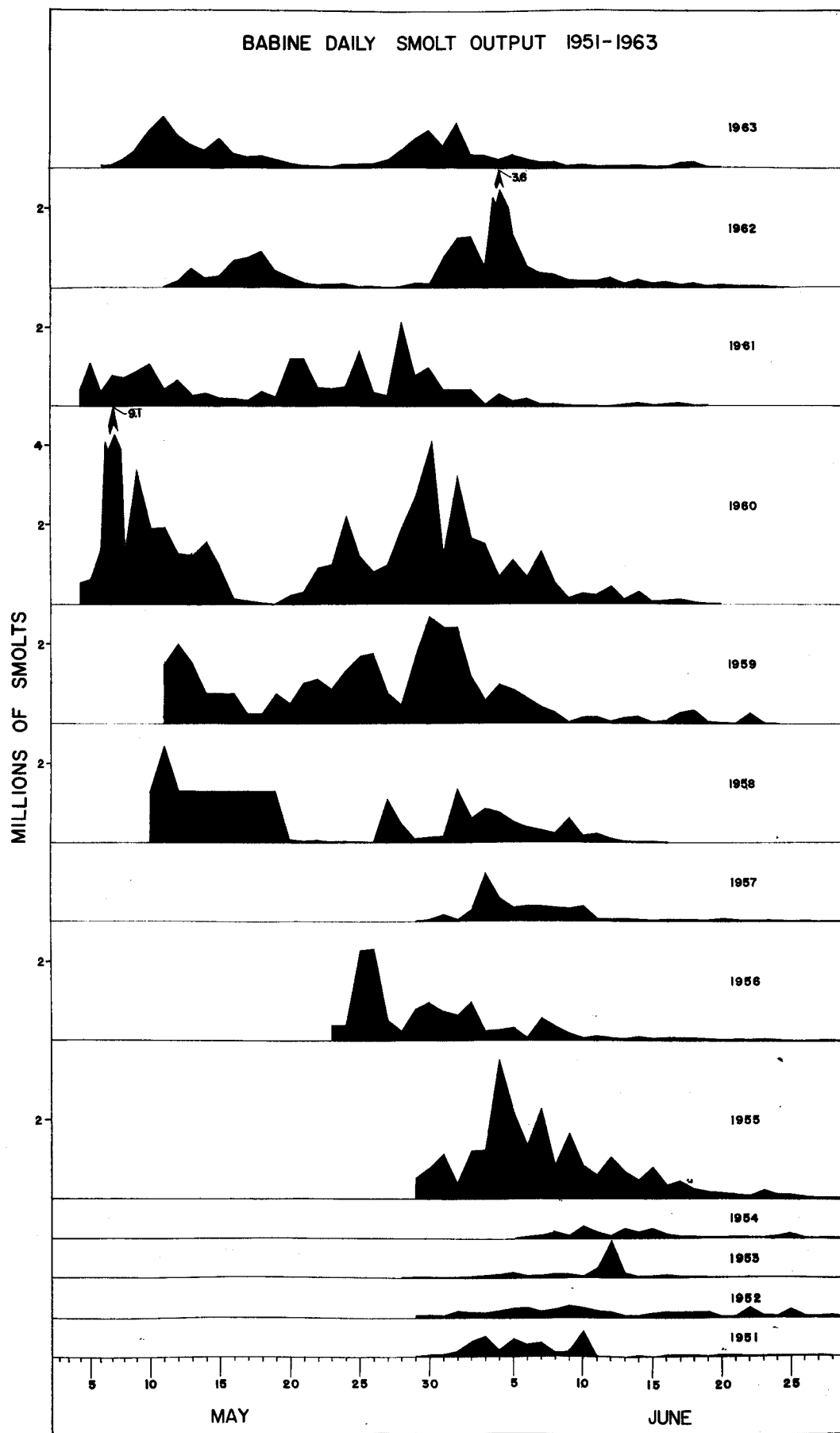


Figure 15.

The best estimate of survival from these smolt runs is presented in Table V. Returns from the 1958 brood year are not yet complete.

Table V. Partial survival estimates for Babine smolts from brood years 1956 to 1963.

Brood year	Fence count	Egg potential ($\times 10^6$)	Smolts produced	Return of 4 ₂ and 5 ₂ ($\times 10^3$) ^a	% survival		
					Egg-smolt	Smolt-adult	Egg-adult
1956	355,345	523	22.8	541	4.37	2.37	1.03
1957	433,149	653	33.9	2,179	5.18	6.43	3.34
1958	812,043	1,547	57.1	592 ^b	3.70	1.04	0.38
1959	782,868	1,554	20.8	511 ^c	1.34	..	..
1960	262,719	403	17.1	..	4.24	..	..
1961	941,700	1,511	14.3	..	0.94	..	..
1962	548,000	1,070	..	..	..	..	..
1963	588,000	940	..	..	..	..	..

^a includes small numbers destined for areas other than Babine.

^b preliminary

^c 4-year-olds only

At present it is not possible to relate smolts in different parts of the run to their streams of origin except in a very gross way. The early-running smolts originate from the area near the lake outlet while the late-running smolts come from the main lake area. Within these two runs extensive intermixture of the progeny from many sub-stocks can be expected. However, assessment of mean size and weight must be limited to the early and late components at present. An objective of future studies should be to develop ways of differentiating sub-stocks so they can be studied separately.

In the past, about 100 smolts have been taken at random from each night's run. These have been preserved in 5% formalin and weighed to the nearest gram, and measured to the nearest millimetre, 3 weeks to one month later. Though some changes in length and weight occurred in the interim, the mean values probably reflect quite well the changes in weight and length from one year to the next. These data were grouped to the same 5-day intervals each year and weighted to numbers of smolts migrating in the same periods.

Table VI gives the mean weights and mean lengths of smolts in the late runs of 1951-1963, the early runs of 1958-1963, and the early and late runs combined in 1958-1963.

Table VI. . Mean lengths and weights of smolts in early, late, and combined smolt runs, 1951-1963.

Year	Early run		Late run		Both runs	
	Length mm	Weight g	Length mm	Weight g	Length mm	Weight g
1951	..	..	81.3	5.44	..	..
1952	..	..	81.2	4.96	..	..
1953	..	..	85.9	6.17	..	..
1954	..	..	86.1	6.22	..	..
1955	..	..	83.2	5.67	..	..
1956	..	..	79.5	4.94	..	..
1957	..	..	84.1	6.05	..	..
1958	79.8	4.94	84.1	5.74	81.4	5.24
1959	74.3	4.08	80.8	5.11	79.1	4.84
1960	74.5	4.51	82.3	5.87	78.8	5.25
1961	72.4	3.98	78.8	5.15	76.5	4.78
1962	81.0	5.62	81.6	5.73	81.4	5.70
1963	75.1	4.35	80.2	5.42	77.5	4.85

Figure 16 shows the relationship of length to weight of late-run smolts in all available years. As might be expected the smolts in the two smallest runs (1953 and 1954) were the largest recorded. However, those of the 3 largest runs (1955, 1959 and 1960) were of average size or a little better.

In 1963 a photoelectric counting device was tested in the Lower Babine River. Eight cast aluminum frames (termed counting units), each containing eight 10-inch square apertures, were situated in the framework of the adult counting fence. Each aperture was monitored by a small light beam projected across the width of the aperture to fall on a photocell opposite.

As schools of fish passed through the frames on their seaward migration, individuals broke the light beam and were counted by a "count-pak" (Veedor-Root, Series A, 180707). Counting units were calibrated from time to time by placing nets behind the apertures.

Tests were generally satisfactory. There was a problem of maintaining constant sensitivity over long periods of operation but this does not appear likely to cause difficulty in future. Several modifications of the first assembly are underway.

LENGTH-WEIGHT RELATIONSHIP OF BABINE SMOLTS IN LATE RUNS

1951 - 1963

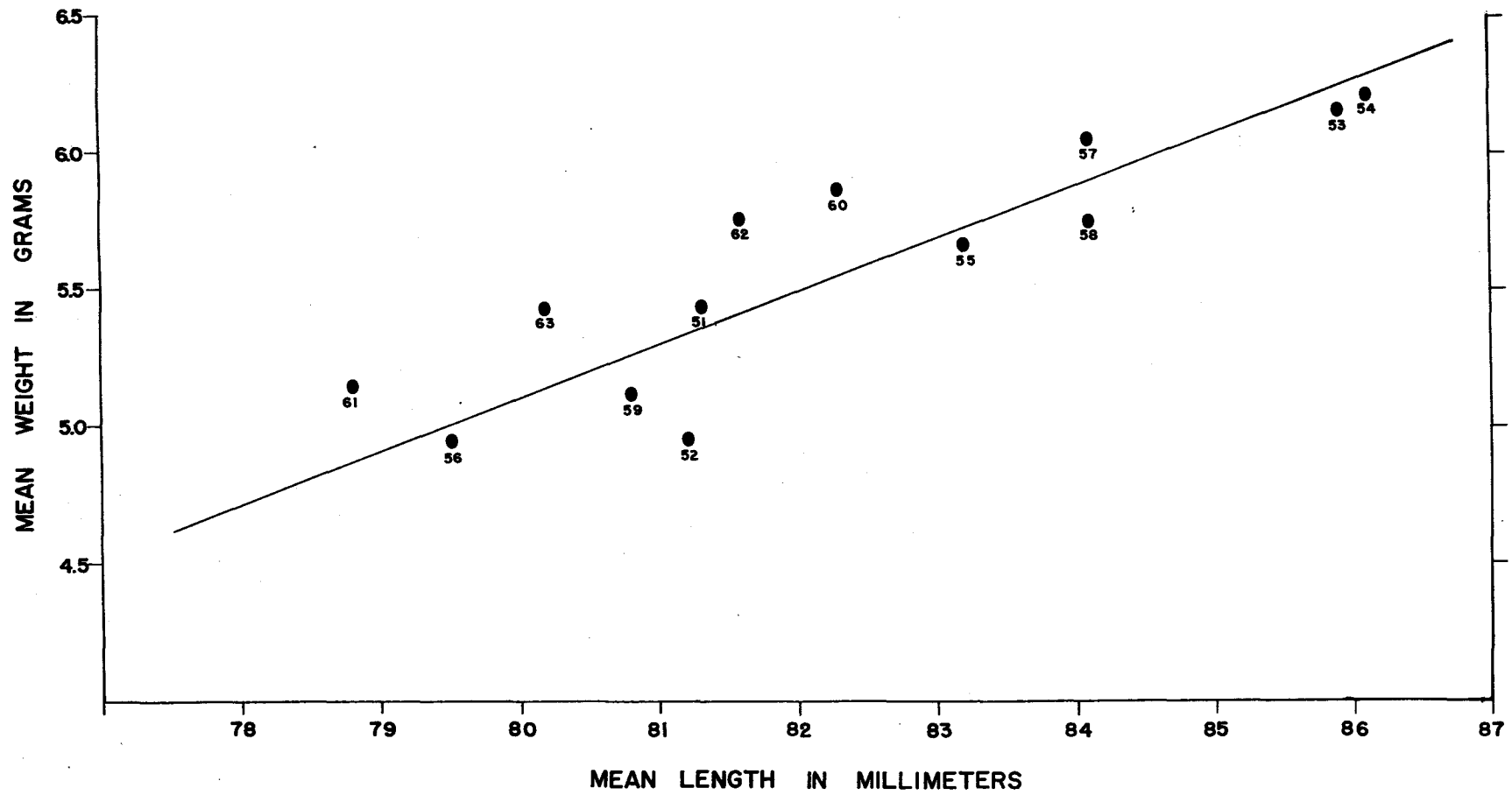


Figure 16.

8. Lake sockeye studies

Migration of smolts through Babine Lake

This was the concluding year of extensive field study of the sockeye smolt migration through the Babine Lake system. Major effort was placed on tagging (and recovery) at two sites, the head of Morrison Arm and Halifax Narrows (plus recovery at the outlet of Nilkitkwa Lake), extensive transplanting of marked smolts from all three of these sites to various parts of the system, and general air observations. The results in general confirm the earlier findings, much of which are now available in published form in J. Fish. Res. Bd. Canada, 20(4): 919-938.

Abundance, distribution and growth rate of underyearling sockeye

During the July-October period, tow-netting for young sockeye was carried on throughout the lake system. The resulting total estimate of age-0 sockeye present during August 15-30 was 100 million (48 million north of Halifax Narrows and 52 million in the lake areas south of Halifax Narrows). This was a total lake population considerably larger than that of the previous year, even though it was produced by a spawning escapement little more than half the size of the escapement parent to the previous year's population. A much better survival in the egg-to-fry stage is indicated. Population estimates for the various lake basins show that the young sockeye were distributed further uplake than usual from their spawning grounds. It appears likely that this was the result of a period of unusually strong uplake (NW) winds during the late June period. Evidence for such passive transport is now being sought in analysis of lake temperature data.

Results of all years of tow-net data are now in preparation for a paper on the abundance, dispersion and mortality of young sockeye which will appear in the Journal of the Fisheries Research Board. Similarly, all the growth data is in preparation for a paper on the growth of young sockeye for the same Journal. Data on the zooplankton of the Babine system is treated in a paper now in press (Vol. XV, Transactions of the International Association of Theoretical and Applied Limnology), and another paper is in preparation.

Lake tow-net estimates in relation to potential egg deposition and smolt estimates, and a prediction of the 1964 smolt run

The following table is largely self-explanatory: for each brood year for which reliable smolt estimates are available, it lists the fence count of large sockeye, the estimated potential egg deposition, the lake population of age-0 fingerlings for the following August as estimated by tow-netting, and the resulting smolts migrating from the lake the following spring as estimated by mark-recapture at the outlet. It also lists the percentage survivals indicated by these estimates.

Brood year	Fence count large sockeye	Egg potential	August fingerling population	Smolts	Percentage survival		
					Egg to fingerling	Fingerling to smolt	Egg to smolt
		<u>millions</u>	<u>millions</u>	<u>millions</u>			
1956	355,345	523	99.6	22.8	19.0	22.9	4.36
1957	433,149	653	108.5	33.9	16.1	31.2	5.19
1958	812,043	1,547	187.1	57.1	12.1	30.5	3.69
1959	782,868	1,554	94.1	20.8	6.1	22.1	1.34
1960	262,719	403	61.0	17.1	15.1	28.0	4.25
1961	941,711	1,511	88.9*	14.3	5.9	16.1	0.95
1962	548,000	1,072	99.7	..	9.3	..	..

*There was considerable evidence that this estimate was excessive (see 1962 Annual Report, page 43). If indeed this was true, then the percentage survival for egg to fingerling was somewhat lower than the 5.9% shown and that for fingerling to smolt somewhat higher than the 16.1% shown.

It is obvious from this table that there is considerable year-to-year variation in freshwater survival. And it is apparent that the great variability occurs before the August fingerling stage. Other evidence from tow-netting indicates that the variability likely occurs in the egg-to-fry stage.

Although total freshwater (egg to smolt) survival varies more than 5-fold, there is less than a 2-fold variation indicated for fingerling-to-smolt survival - even including the 1961 brood-year data which is believed in error. Excluding this, the fingerling-to-smolt survival appears remarkably constant from year to year, especially considering the fact that both fingerling and smolt data are only estimates. This lends confidence to the possible use of such fingerling estimates as a basis for estimating subsequent smolt output. Excluding the 1961 brood year about which there is considerable doubt, the mean fingerling-to-smolt survival is 26.9%, with range 21.1 to 31.2%. On this basis, the 1964 smolt run (from 99.7 million fingerlings in August, 1963) would be estimated as 26.8 million, or in the range 22 to 31 million. If we include the 1961 data, then we would estimate the 1964 smolt run at 25 million, or in the range 16+ to 31 million.

Other

A preliminary examination of circulation in Babine Lake, using the dynamic height method, was undertaken by Dr. Acara of the University of Istanbul and

presently at P.O.G. Analysis of this and other temperature data is now being carried out.

Testing of the pump-type sampler used in Alaska for sampling eggs and alevins from spawning grounds was carried out. Preliminary sampling using this method was carried out by Mr. McCart after he joined the staff in October.

9. Feasibility studies: development of Babine Lake potential for sockeye production

This program is aimed at determining whether it is biologically and economically feasible to increase sockeye production by substantially increasing the number of sockeye fry utilizing the large main-lake basins as a rearing area. The work outlined in the 1962 Annual Report has been continued. Biological studies assessed the numbers, timing and distribution of the spawning runs to the Fulton River and 15-Mile Creek. Fry output and the egg-to-fry survival rate was determined on the Fulton. The following table summarizes the data available on this facet of the work.

Brood year	No. of spawners	No. of females	Potential deposition ($\times 10^6$)	Fry estimate ($\times 10^6$)	% survival
1961	189,000	85,000	226.5	26.2	11.6
1962	86,000	44,900	137.2	41.7	30.4
1963	154,000	54,200	148.6	..	..

Aerial photography was completed on 15-Mile, Fulton, Twin, Pierre and Sockeye Creeks and topographic maps are being prepared from these photographs. Continuous hydrometric records are being obtained for 15-Mile and Fulton River and intermittent records for Morrison River and some of the smaller streams.

Preliminary layouts for spawning channels have been made at 15-Mile Creek and Fulton River. The 15-Mile Creek layout utilizes a 35-acre bench at the mouth of the creek and includes a water diversion dam and a low head storage dam at Taltapin Lake. The water used in the channel would be returned to the stream upstream of the most important natural spawning area. Indications are that the channel could provide up to 75,000 square yards of additional spawning area with a potential production of 75 million fry.

One of the preliminary spawning channel layouts at the Fulton River would provide an additional 15,000 square yards of spawning area.

Detailed study of the above proposals and further surveys of other development possibilities will be conducted in 1964.

10. Rehabilitation of salmon of the Bulkley River system

The Nanika River hatchery, which was constructed by the Department with a view to restoring the Nanika sockeye run which had severely declined in the years after 1953, is now in its third year of production.

The 7.6 million fry released to the river in the spring of 1963 migrated directly to Morice Lake, and subsequent samplings in the lake indicate that there has been a good rate of survival.

Unusually high losses occurred in the transfer of the 12.8 million eggs from the donor stream to the hatchery last fall. Subsequent losses, however, have been minimal and it is expected that at least 7 million fry will be released into the river in the spring of 1964.

A major biological program is being carried out to assess the contribution of the hatchery and to determine whether expected increases in the level of the sockeye stock result from the hatchery transplants or from natural increases in the native stocks.

The pink salmon run to the Bulkley River has showed significant increases each year since the removal of the obstruction at Hagwilget. Before the obstruction was removed only a few hundred pinks spawned in the lower part of the river. Two years ago several thousand moved well up into the river and spawned. This year up to 35,000 pinks were recorded well-distributed throughout many miles of under-utilized spawning area in the river system.

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