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Sockeye salmon migration in Babine River and Lake
as indicated by tagging at Babine fence in 1946

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A second objective in tagging sockeye salmon as they passed through the Babine fence into Milkikwa and Babine Lakes was to procure information on the quality and speed of migration through the lakes to the spawning tributaries and to determine whether there was any segregation of populations in point of time of arrival and movement.

As noted in another manuscript - "The Use of a Tagging Ratio to Estimate Escapement - Babine Fence, 1946"* - it was possible to tag a constant proportion of the migrants as they passed the weir (in this case ca. 2%). Tagging began on July 17 by which date 8,337 sockeye had been counted. Since the desired proportion was to be 1 in 50, heavier tagging was carried out for the first few days to balance. Thereafter the practice was to tag 1/50 of the total run on the day immediately subsequent to the count in question. Tagging thus lagged one day behind the run but provided a means of knowing each day exactly how many fish were to be tagged. Full details are submitted in the table on pages 5 and 6 of the above mentioned summary.

Returns from this tagging were collected from two sources - the Indian fishery and from stream surveys conducted mainly by the employees of the Fisheries Research Board but, at the end of the season, also by the guardians of the Department of Fisheries. The Indians were offered a reward of twenty-five cents for all fence tags (a white numbered disc and a white baffle) and the usual fifty cents for ocean tags (a white numbered disc and a cerise baffle). They were encouraged to return all tags which they

* MS report No. 531 of the Pacific Biological Station, Nanaimo, B. C.

took but definitely discouraged from fishing for them, particularly from gaffing on the spawning streams. All members of the Board's parties, the officers of the Dominion Department and the Hudson's Bay Company redeemed any tag immediately and were later reimbursed. A record of the catch is given on page 12 of the paper listed.

A very definite and continuous procedure of stream investigations was carried out. This involved briefly inspections at seven to ten day intervals by each of the three parties of the streams in their divisions. On every trip a record was made of the numbers of fish DEAD - tagged and untagged, and LIVE - tagged and untagged. The detail of returns are submitted on pages 8 and 9 and a summary on page 10 of the paper cited.

Results

Numbers tagged and recovered.

Over the period from July 17 to September 30, 9,417 fence tags were affixed. In addition 48 ocean tags were allowed through the fence making a total of 9,465 in a migration of 475,705. Of these there have been returned: Indian Fishery - 1,151, Fishery officers - 37, Fisheries Research Board nets - 2, Babine fence - 32, stream surveys - 517 or a total of 1,739. In addition 1,074 were seen alive on the spawning grounds, over half being recorded and released thus adding additional records for the migration and distribution studies.

Speed of Migration

The speed of migration was calculated as the time between the passage through the fence and that reported for capture in the Indian fishery. It is evident that several complicating factors can influence this determination. In the first place, the Indians may report the time of capture

inaccurately or may even hold the tags until they have forgotten the date. This effect was minimized by making as frequent collection visits as possible and leaving no real excuse for tardiness. In the second place in some areas, e.g. Fort Babine, Halifax, McKendrick Island and Old Fort, where there are no or only small spawning streams, the fish captured are travelling and the estimate is likely to be fairly accurate. In other localities such as the Babine River, Topley Landing and Fifteen Mile, the run may be constituted of salmon moving down the lake and the spawning population for the rivers nearby. These latter waiting to migrate upstream will tend to raise the average time.

In figure 1, are plotted the times taken for the fish to reach specific areas uplake after leaving the Babine fence. The following comments are pertinent:

- (1) Nilkitkwa - Fish after passing the Babine fence may reach Nilkitkwa Lake on the same day and remain up to 52 days thereafter. The average time is 8.8 days. Over 57% were through in 5 days.
- (2) Babine River - The average here is 40.2 days for the time above the fence. There is no doubt that this is due to the spawning population which has been waiting to spawn. The extreme was 84 days.
- (3) Fort Babine - The average time taken to Fort Babine is 15.3 days, but over fifty per cent are through in 10 days. As in the case of the Babine River, the fish destined to spawn in the area are lengthening the average period.
- (4) Halifax - These are travelling fish and the average of 6.2 days is probably close to accurate.
- (5) Old Fort - These also are travelling salmon and give a fairly accurate count of 14.2 days.

- (6) Topley Landing and Pendleton Bay - In both these cases but more particularly in the former fish destined to spawn in the rivers nearby are waiting to migrate upstream and tend to increase the average time.

To give some idea of the general progression, it is interesting to record the modes of time taken to reach each locality - - the number of days after passing the Babine fence when the largest number were present as indicated by the Indian catches: Nilkitkwa - 1st day, Babine River - 5th day, Fort Babine - 1st and 2nd days, Halifax - 2nd and 5th days, Topley Landing - 8th day, and Pendleton Bay - 10th and 19th days.

Perhaps more revealing is the day on which just over 50% of the recoveries had been made in each area: Nilkitkwa - 4th day, Babine River - 36th day, Fort Babine - 7th day, Halifax - 6th day, Old Fort - 11th day, Topley Landing - 16th day and Pendleton Bay - 18th day.

In summary, therefore, in spite of the fact that the average times calculated for sockeye salmon to move from the Babine fence to designated areas are more or less unreliable due to factors beyond control, they do show a rough progression in time. The day on which the mode occurs in various areas is more revealing while the time at which 50 per cent reach the locality gives the clearest picture. Omitting those areas where local spawning populations are known to interfere, it can be stated in general that the fish reach Nilkitkwa on the same day up to the 3rd day thereafter, Fort Babine in from 0 to 5 days, Halifax in 0 to 6 days, Old Fort in 0 to 14 days, Topley Landing in 0 to 15 days and Pendleton in 0 to 27. (That the fish should go all the way from the Babine fence to Old Fort, Topley Landing and Pendleton, Ca. 50, 70 and 100 miles respectively, within one day is doubtful. The records here are probably affected by inaccurate recording by the Indians).

Time Taken to Spawning Completion after Passing Babine Fence

General Observations

From the stream surveys made continuously throughout the summer and autumn, data are available regarding the date when the tagged fish were spawned out and dead. These observations have been collected and summarized, and are shown graphically in Figure 2. This shows the number of days after leaving Babine fence on which death occurred and the number of fish dead on the particular day. It is quite possible that the times given are maximal since the fish may be dead for some days before being observed, but it is felt that the error is not too great in view of the regular visits to the rivers.

The graph indicates that all the sockeye passing the Babine fence live for at least ten days before spawning out and dying. As a matter of fact, with moderately few exceptions the life period is over twenty days. The range in length of life appears to vary from river to river being smallest in creeks such as Grizzly, 4-Mile, 6-Mile, Pendleton and 9-Mile where there are comparatively few fish and greatest in the larger streams such as Twin, Pierre, Tachek, 15-Mile, Fulton and Morrison. The extremes are 14 to 34 days in 9-Mile as compared with 11 to 79 days in Fulton and 11 to 82 days for Tachek.

The time at which just over 50% of the fish have died varies as well, e.g. Morrison Creek - 44 days, Grizzly Creek - 28 days, 4-Mile - 30 days, 6-Mile - 33 days, 15-Mile - 41 days, Pendleton Creek - 28 days, Twin Creek - 26 days, Pierre Creek - 37 days, Tachek Creek - 35 days, Fulton River - 44 days and 9-Mile - 25 days.

Such variations are to be expected since they will depend on the state of maturity of the fish entering the lake which condition is in turn

affected by environmental and climatic conditons as they may retard or speed migration or slow down or speed up sexual development. All that the present figures can give is an extremely general outline of behaviour.

Change in Time to Spawning Completion with the Progression of the Run

In plotting Figure 2, it was evident that in almost every case, the later in the season the sockeye salmon reached the Babine fence, the shorter would be the period before it reached the river, spawned and died. Although evident in every case where sufficient numbers were at hand for comparison, it was particularly noticeable in the case of Morrison Creek. So evident was the condition that no plot was made but these can quickly and easily be obtained by reference to the original data.*

Segregation of Runs to Various Rivers.

The best method of determining whether there was any segregation of populations for different rivers as the runs enter the lake, was to refer the tags taken in each locality to the time when the particular sockeye passed the Babine fence. In Figure 3, a frequency diagram is given showing the numbers recovered in each locality which were handled on a given date at the weir.

From the figure it is immediately evident that there is no complete segregation of the runs. From July 17 to July 30, fish from as many as six rivers are involved. For the next two weeks, populations from more streams are in evidence. After August 24, 15-Mile, Morrison and Fulton are immediately concerned. Such information can be of interest especially in relation to the distribution and intensity of the Indian fishery.

* These data are recorded on cards at the Pacific Biological Station, Nanaimo, B.C.

At certain periods of the summer this will drain mainly certain streams while at other times another group of tributaries will be affected.

It is apparent from the plot that the runs to some of the rivers were in progress before tagging began on July 17. Particularly does this seem to be true of 9-Mile Creek, Pierre Creek, Twin Creek and Donalds Landing Creek, since the returns are high even for the first day. To further explore this situation tagging should begin at the commencement of the migration.

At the bottom of the graph are indicated the ranges in time for each river. From this it can be seen that those to Donalds Landing, 9-Mile, 4-Mile, Twin, Tachek and Pierre Creeks are early, appearing at the very beginning. Pendleton and 6-Mile are slightly later. 15-Mile, Fulton, Grizzly and Morrison are the latest to arrive.

The period over which the runs extend would seem to be affected mainly by the number of fish involved. Thus the small creeks, 9-Mile, Sockeye, etc. have limited periods, while Fulton and Morrison extend over a month to six weeks.

It has long been held that in certain Babine Lake tributaries two very definite runs occur - an early one followed by another a week to ten days later. This could be caused by peculiar environmental or climatic conditions which would allow a surge of salmon into a given river but as a result of a sudden change - lowering water etc. - would hold them out for a while before the second surge. Because of the fact that the phenomenon apparently occurred year after year, it was felt that this explanation would not suffice, since it was unlikely that these changes would repeat themselves with sufficient exactitude. The figure (3) indicates that this separation may even be evident as the fish come into the

lake, not in all rivers, but at least in those most often mentioned in this regard. In pierre and Twin Creeks, there are definite modes early in the season followed by a period of low returns and then another mode. Faint indications are also given in the case of 15-Mile. The evidence is not convincing for the other creeks.

Discussion and Suggestions

The experiment of 1946 was conducted without the benefit of previous experience with such a project either in that area or elsewhere. The result has been that some indefiniteness has occurred because of the failure of certain phases of the methods. Particularly this applies to the accuracy of the return dates. It is suggested that every effort be made to pick up tags immediately or at least regularly so that the recovery dates can be tied down to a limited period. In the case of the Indian Fishery, this can be done by putting further pressure on all collecting agencies, the Fisheries officers, etc. to cover the "customers" regularly. Perhaps a little judicious urging and explanation will have a salutary effect. In the case of the river surveys, the prime consideration seems to be that these be regularly spaced and that accurate records be maintained.

The ultimate aim of such work should perhaps be to get as accurate an idea of the speed of migration as possible, to determine the duration and time of runs, both travelling and spawning phases, and to delineate what segregation exists. Only when that material is available will it be possible to coordinate the Indian catch with the migration and determine where it is having most effect.

This presentation is not intended as a final effort. For further detail future workers may have to go back to the original data. It is designed merely to present some ideas and to indicate where methods may be improved to give further information.

Appendix I. Table showing the number of tagged sockeye recovered at the Indian fishery sites of Babine Lake after different lengths of time from tagging at the Babine fence, 1946 (Fig. 1).

| No. of days after passing Babine fence | Milkikwa Lake | Babine River | Fort Babine | Halifax | Old Fort | Topley Landing | Pendleton Bay |
|--|---------------|--------------|-------------|---------|----------|----------------|---------------|
| 0 | 50 | | 12 | 1 | | | 5 |
| 1 | 75 | | 23 | | | | 2 |
| 2 | 43 | 1 | 21 | 6 | 1 | 1 | 2 |
| 3 | 43 | 2 | 8 | 1 | 2 | 1 | 2 |
| 4 | 32 | | 4 | 1 | 1 | 1 | 1 |
| 5 | 26 | 3 | 4 | 6 | 1 | 2 | 4 |
| 6 | 23 | | 8 | 8 | 2 | | 2 |
| 7 | 14 | 1 | 3 | 1 | | 3 | 3 |
| 8 | 10 | | 5 | 2 | | 7 | 5 |
| 9 | 11 | | 6 | 1 | | | 2 |
| 10 | 14 | | 3 | 1 | | 1 | 3 |
| 11 | 7 | | 2 | | | 2 | 3 |
| 12 | 6 | | 3 | 1 | 1 | 3 | 4 |
| 13 | 5 | 1 | 1 | | 1 | 1 | |
| 14 | 2 | | 1 | | 2 | | 1 |
| 15 | 6 | | 2 | | | | 5 |
| 16 | 9 | 2 | 4 | | | 1 | 4 |
| 17 | 7 | | | | | 1 | 3 |
| 18 | 5 | | | | | 2 | 4 |
| 19 | 9 | | 3 | | | 1 | 10 |
| 20 | 7 | 1 | 1 | 2 | | 2 | 2 |
| 21 | 6 | | 2 | | | 4 | 6 |
| 22 | 8 | | 1 | | | 1 | 3 |
| 23 | 7 | 1 | 3 | | | | 4 |
| 24 | 5 | | 1 | | | | 3 |
| 25 | 2 | | 1 | | | | 5 |
| 26 | 3 | | 3 | | | | 3 |
| 27 | 1 | 1 | 2 | | | 2 | 4 |
| 28 | 2 | 1 | 2 | | | | |

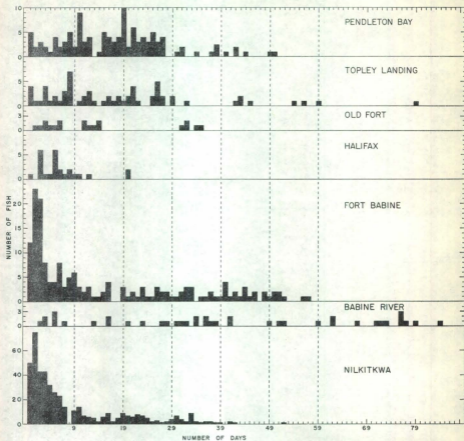


Fig. 1 - graph showing the number of tagged sockeye recovered at the Indian fishery sites of Babine Lake after different lengths of time from tagging at the Babine fence, 1946.

Appendix II. Table showing the number of sockeyes recovered spawned out and dead on Babine Lake spawning streams after different lengths of time from tagging at the Babine fence, 1946 (Fig. 2).

| No. of days after passing Babine fence | Nine-Mile Creek | Fulton River | Tschek Creek | Pierre Creek | Twin Creek | Fendleton Creek | Fifteen-Mile Creek | Six-Mile Creek | Four-Mile Creek | Grizzly Creek | Morrison Creek |
|--|-----------------|--------------|--------------|--------------|------------|-----------------|--------------------|----------------|-----------------|---------------|----------------|
| 9 | | | | 1 | | | | | | | |
| 10 | | | | | | | | | | | |
| 11 | | 1 | 1 | | | | | | | | |
| 14 | 1 | | | | 1 | | | | | | |
| 15 | | 1 | | | | | | | | | |
| 16 | | 2 | 1 | 2 | 1 | | 1 | | 1 | 1 | |
| 17 | | | 1 | 1 | 1 | | 1 | | 1 | | |
| 18 | | | 2 | 1 | 1 | 1 | | 1 | | | |
| 19 | | | 1 | 1 | | | | | | | |
| 20 | | 1 | | 3 | 2 | | | | | | 3 |
| 21 | 1 | 1 | | 3 | 2 | | | 1 | | | |
| 22 | 2 | | | 1 | 2 | | 1 | | 1 | 1 | 1 |
| 23 | | 3 | 1 | 2 | 2 | | | | 2 | 1 | 1 |
| 24 | | 1 | | 7 | 4 | | | | 1 | 1 | 1 |
| 25 | 3 | 2 | 2 | 3 | 8 | | 1 | | | | 1 |
| 26 | | 3 | | 2 | 4 | | | | 1 | 1 | 1 |
| 27 | | | | 7 | 7 | | 2 | | | 1 | |
| 28 | | 3 | 1 | 3 | 5 | 1 | 1 | | | | 1 |
| 29 | | 4 | | 2 | | 1 | 1 | | | 1 | |
| 30 | 1 | 3 | 2 | 4 | | | 2 | | 3 | | |
| 31 | | 8 | 1 | 5 | 1 | | | | | | 1 |
| 32 | | 7 | 2 | 3 | | 1 | 1 | | | | 1 |
| 33 | | 3 | 1 | 4 | 2 | | 1 | 1 | 3 | | 1 |
| 34 | 4 | 7 | | 1 | | | 4 | 1 | | | 2 |
| 35 | | 2 | 1 | 2 | 3 | | 1 | | 1 | 1 | 4 |

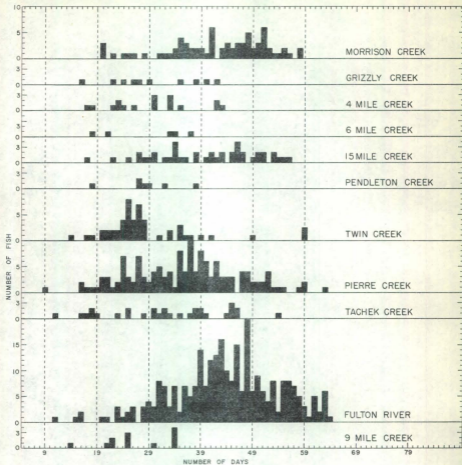


Fig. 2 - Graph showing the number of tagged sockeye recovered spawned out and dead on Babine Lake spawning streams after different lengths of time from tagging at the Babine fence, 1946.

Appendix III. Table showing the numbers of tagged sockeye passing the Babine fence on given dates and later recovered on the spawning streams of Babine Lake, 1946 (Fig. 3).

| Date fish passed Babine fence | Nine-Mile Creek | Wulton River | Tuchek Creek | Sockeye Creek | Pierre Creek | Twin Creek | Pendleton Creek | Donald's Lds. Creek | Fifteen-Mile Creek | Six-Mile Creek | Four-Mile Creek | Grizzly Creek | Morrison Creek |
|-------------------------------|-----------------|--------------|--------------|---------------|--------------|------------|-----------------|---------------------|--------------------|----------------|-----------------|---------------|----------------|
| July 17 | 7 | | 3 | | 5 | 5 | | 3 | 1 | | 3 | | |
| 18 | | | 2 | | 6 | 10 | | 1 | | | | | |
| 19 | | | | | 1 | 2 | | 1 | | | | | |
| 20 | 1 | | 2 | | 7 | 4 | | | | | | | |
| 21 | | | 1 | | 1 | 5 | 1 | | | | | | |
| 22 | | | | | 1 | 2 | | | | 1 | | | |
| 23 | | | | 1 | 3 | 4 | | | | | | | |
| 24 | | | | | 2 | | | | | | 1 | | |
| 25 | | | 1 | | 2 | 3 | 1 | | | 1 | 1 | | |
| 26 | | | 1 | | 1 | | | | | 1 | | | |
| 27 | 1 | | 5 | | 5 | 1 | | | | | 2 | | |
| 28 | | | 1 | | 4 | | | | | | | | |
| 29 | 2 | 1 | | | 3 | | 1 | | | 1 | 1 | | |
| 30 | | 1 | 2 | | 1 | 2 | 2 | | 1 | | 1 | 1 | |
| 31 | | | 1 | 1 | 8 | 6 | | | 1 | | | 1 | |
| Aug 1 | | | | | 8 | 1 | | | 2 | | | 1 | |
| 2 | | | 2 | | 4 | 1 | | | | | | | |
| 3 | | 7 | | | 14 | | 1 | | 2 | | 1 | 2 | 3 |
| 4 | | 4 | | | 7 | 2 | | | 2 | | | | 1 |
| 5 | | 7 | | | 7 | 1 | | | 1 | | 1 | 1 | 2 |
| 6 | | 5 | | | 3 | 1 | | | | | 1 | 1 | 4 |
| 7 | | 10 | | | 7 | | | | | 1 | 1 | 1 | |
| 8 | | 9 | 1 | | 4 | 2 | | | 5 | | | | 1 |
| 9 | | 5 | 1 | | 2 | | | | 2 | | 1 | | 2 |
| 10 | | 7 | | | 6 | | | | 2 | | | | 6 |
| 11 | | 7 | 2 | | 4 | | | | 2 | | | | 2 |

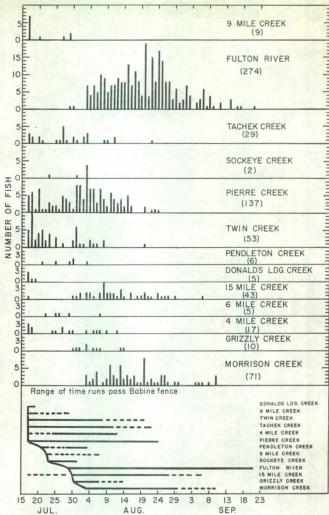


Fig. 3 - Graph showing the numbers of tagged sockeye passing the Babine fence on given dates and later recovered on the spawning streams of Babine Lake, 1946.

