

FURTHER PROOF OF THE PARENT STREAM THEORY

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Considerable attention has been paid by fish culturists to the so-called parent stream theory, that is, the assumption that anadromous fish return to the stream in which they were bred, to reproduce their species. In the course of time the consensus of opinion was that the salmon of the larger rivers, such as the Columbia and Fraser, certainly returned to these rivers, and the controversy narrowed down to whether the fish returned to the individual tributary in which they were hatched. By scale readings of the Pacific Coast salmon Dr. Charles H. Gilbert came to the conclusion that they returned to the actual creek in which they were bred. Further light on the subject, by one who has made a study of it on the spawning grounds for nearly twenty years, may be of interest to those engaged in fish culture.

Ever since the first hatchery was built on the Fraser River it has been common knowledge among hatcherymen that the runs of sockeye salmon to its various tributaries differed in many ways, chief among which was the time of arrival at the spawning grounds. The latter could be depended upon to such an extent that one crew of spawntakers could operate several stations, one after another, from September to January, with no variation in the sequence from year to year.

Another characteristic, and one which as far as the writer is aware has never been given much prominence, is that the difference in the size of the sockeye eggs at the different creeks has been so apparent and constant in the course of time as to pass without comment.

In 1914 the writer began a series of measurements of sockeye eggs taken at Morris Creek, Harrison Rapids, and Cultus Lake, which has been continued each year since. Morris Creek enters Harrison River two miles above the rapids and Cultus Lake lies twelve miles southwest. The three stations are thus comparatively close together, which fact adds interest to the subject.

To obviate the inaccuracies of imperfect chambering such as occurs when a graduated glass or similar measure is used, a new method of measurement was devised. A light V-trough one meter in length was set up at an inclination of twenty-five degrees and the eggs allowed to roll down until the trough was filled from end to end with

one row of eggs, the figures appearing in the tables herewith being the number of eggs required to fill the trough. As far as the exigencies of the regular hatchery work permitted, the eggs were measured twenty-four hours after spawning and from three to five counts were made during the season.

SERIES OF YEARLY MEASUREMENTS OF SOCKEYE SALMON EGGS

Year.	Morris Creek.	Harrison Rapids.	Cultus Lake.
1914	166.0	152.0	182.0
1915	162.8	150.0	183.0
1916	164.0	153.2	181.3
1917	166.7	149.8	185.2
1918	163.0	153.5	185.5
1919	162.6	150.0	184.0
1920	165.4	151.6	182.6
Average	164.3	151.4	183.3

The uniformity from year to year is very evident and the fact that the figures for one locality never overlap or even approach those of another shows that there is a distinctive species of sockeye at each of these places.

Another interesting phase is that the size of the egg does not correspond with the size of the fish or the time of spawning, for the smallest fish of the three, that from Harrison Rapids, has much the larger egg, as will be seen from the following table which shows the length in inches, dates of spawning, and average measurement of eggs:

VARIATION IN SPAWNING SEASON AND SIZE OF SOCKEYE SALMON EGGS

Locality.	Males.	Females.	Spawning season.	Number of eggs to meter.
Morris Creek . .	26.3	23.9	Sept. 25—Nov. 15	164.3
Harrison Rapids	23.6	23.1	Oct. 25—Dec. 10	151.4
Cultus Lake . .	25.3	23.2	Nov. 15—Jan. 1	183.3

That the size of the egg is not due to fuller development in the later spawning fish is shown by the fact that the Cultus Lake sockeye, the last to spawn, has, as far as the writer is aware, the smallest egg of all the Pacific Coast sockeyes.

A summary of the whole subject shows that at Morris Creek there is a run of large, early-spawning sockeyes with medium sized eggs; at Harrison Rapids very small, late-spawning sockeyes with very large eggs, while at Cultus Lake there are also small, late-spawning fish with exceptionally small eggs.

Discussion.

MR. WARD T. BOWER, Washington, D. C.: The method of measuring eggs referred to is not unlike that devised by Mr. Hector von Bayer, formerly architect and engineer of the Bureau of Fisheries, which was reported fully in a publication of the Bureau. It would seem that the same principle is involved. Years ago in my experience at the station at Battle Creek, California, where we handled in one season more than 57,000,000 chinook salmon eggs, it was well known that their average size varied considerably through the season. Several times during the continuance of operations very careful counts of the eggs were made a few hours after they were taken, and a variation of 200 to 300 eggs per quart would be found, the eggs increasing slowly in size as the period of incubation advanced.

DR. G. C. EMBODY, Ithaca, N. Y.: The claim made in this paper is that because the eggs do not vary in size in one particular stream, those eggs came from parents that were hatched there and have returned to that same stream, and that since there is a variation in the three different streams, each having a different size of egg, each must have been produced by parents that were hatched there. Mr. Robertson does not indicate here which of the three streams was entered first by the fish, but he says that the larger size of the egg is not due to fuller development in the later spawning fish, for apparently the sockeye which spawns latest in the season has the smallest egg of all of the Pacific coast sockeyes.

MR. G. C. LEACH, Washington, D. C.: I do not believe that sockeye eggs vary in size as do brook trout eggs, where we find a variation of possibly 300 per ounce. Yes Bay, Alaska, has a run of sockeye salmon that enters the lake along in July, begins to spawn about the first of September, and continues until along in January. There is a considerable variation in the size of the eggs between the first spawners and those later in the season. The cannerymen in Alaska know the number of salmon from a particular stream required to fill a case, and that this average per case varies little from year to year. I believe it is generally conceded that there is some slight variation in the size of the eggs.

DR. D. L. BELDING, Hingham, Mass.: This paper is especially valuable in adding one more bit of presumptive evidence in favor of the parent stream theory. I do not believe that we can say absolutely that the measurement of eggs alone proves the parent stream theory, but it certainly offers strong circumstantial evidence. There is little doubt that the alewife or branch herring returns to a particular river to spawn. When there are several branches with separate spawning ponds, there is some question whether fish return to the identical pond where they were hatched. That this specializing tendency exists has been shown by creating fisheries through planting adult alewives in unfrequented waters to which they return for spawning in three or four years. However, there is also evidence that they do not always return to these particular ponds.

In 1920 a fishway was installed at the Lawrence dam on the Merrimac River, which for years had formed an impassable barrier to fish. Alewives had spawned in certain tributaries and even in the river below the dam, when they could not get to the spawning ponds, and they now ran

up this new fishway into regions where they had never been before. Thus there is evidence that though the alewife comes back to a definite spawning ground, it will also seek new territory.

MR. W. E. BARBER, Madison, Wis.: The parent fish stream theory is not nearly as hard to understand and believe as that the migratory birds after traveling thousands of miles come back to their home nests. It is true that demonstrations as to the migratory birds are easily made. Strict account has been kept of their flights, and it has been found that they cover the same territory and come back to the same nest each year.

MR. TITCOMB: Dr. Belding's remarks on the alewife remind me of the introduction of shad on the Pacific coast in California. Most of them probably return to the stream where first planted, but they have spread gradually until they are up in the Columbia River. I am not combatting this parent stream theory, but the shad spreading on the Pacific coast seem to furnish an example to the contrary.

MR. BOWER: Perhaps it should be made clear that Mr. Titcomb does not challenge the parent stream theory with respect to the Pacific salmon. He has gone beyond that and has spoken of fishes to which the parent stream theory has never been applied so far as I am aware. Shad were introduced on the Pacific coast in the seventies and have spread widely. I personally have seen shad in Alaska of the same species that I have noted in the Potomac River in the East. The parent stream theory has never been entertained, so far as I am aware, in regard to shad; but I believe that it is the consensus of opinion that the Pacific salmon return to the parent stream. Dr. Charles H. Gilbert, of Stanford University, California, the greatest authority on the Pacific salmon today, has demonstrated clearly that they undoubtedly return to the parent stream, and moreover, that they seek the particular side tributary where they were originally hatched or planted. Dr. Gilbert bases his conclusions chiefly upon a study of the scales of the salmon, thus securing a most accurate life history of the fish.