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BUILDING NEW SALMON RUNS

PUGET SOUND SOCKEYE SALMON PLANTINGS SHOW VARYING DEGREES OF SUCCESS

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ATTEMPTS TO establish sockeye salmon, Oncorhynchus nerka, in streams of the Puget Sound area previously barren of the species yielded most interesting returns in the fall of 1940. These returns, which resulted from plantings of hatchery-raised fry and fingerlings, ranged from complete failure of any adult sockeye salmon to return to May Creek to a surprisingly large return of an estimated 9,099 mature individuals to Issaquah Creek.

All of the streams had been stocked with sockeye salmon raised from eggs taken at the hatchery of the former United States Bureau of Fisheries at Birdsvew. In the fall of 1936 this hatchery received an exceptionally large return of sockeye salmon in Grandy Creek. The Grandy Creek run originated from eggs transplanted from Baker Lake sockeye salmon, both Grandy Creek and Baker Lake being tributaries to the Skagit River. Because the flow of water in Grandy Creek diminished progressively during the fall months, the former Bureau of Fisheries decided to ship a considerable quantity of the eggs away from the Birdsvew station and offered the Washington State Department of Fisheries a total of about 4,000,000. Of this number 1,250,000 eyed eggs were shipped from Birdsvew in December 1936 to be reared in 3 of the State's hatcheries. The remainder of the eggs were retained at Birdsvew and later transferred as fry to streams in the Puget Sound area specified by the Washington State Department of Fisheries.

Some care had to be exercised in selecting a locality for planting this species owing to the natural tendency of mature sockeye salmon to seek spawning areas in a stream tributary to a lake. For this reason the fry were planted only in a water system in which a lake could be found somewhere along its course. Five localities were chosen.

One of the streams selected was May Creek, the outlet of Lake Isabel and tributary to the Snohomish River system, which lies about 30 miles north of Seattle. May Creek is similar to Grandy Creek in that both are small streams, outlets from a lake and tributary to a large river. A shipment of 250,000 eyed eggs was sent from Birdsvew to the Skykomish Hatchery on May Creek December 22, 1936. On April 5, 1937, 246,402 fry were released from the hatchery in May Creek near its mouth and several miles below Lake Isabel. No adult sockeye salmon returned from this planting and the lack of return may be explained in part or in whole by the fact that the planting was made below the lake.

Another planting location was Samish Lake, a lake about 4 miles long and less than a mile wide. It has no tributaries of any consequence and drains into Puget Sound 75 miles north of Seattle. From the outlet of the lake to Puget Sound is a distance of 20 miles following Friday Creek and the Samish River. Five hundred thousand eyed eggs from Birdsvew were delivered to Samish Hatchery December 2, 1936. Between March 17 and June 28, 1937, 487,170 sockeye fry from this lot were planted in Samish Lake. The returning mature sockeye in the fall of 1940 were estimated at between 300 and 400.

The three other places where sockeye fry were planted - Bear Creek, Cedar River and Issaquah Creek- are all within a few miles of each other. Ten miles



The Issaquah salmon hatchery of the Washington State Department of Fisheries.

to the east of the City of Seattle lies Lake Sammamish. It is 8 miles long and 1 mile wide and its only important tributary is Issaquah Creek, which enters the lake at its southern end. The outlet of the lake is the Sammamish River, a sluggish meandering stream, which flows from the northern end of the lake in a westerly direction for 12 miles into the northern end of Lake Washington. Tributary to the Sammamish River are two small streams, the largest being Bear Creek, the outlet from Cottage Lake. Lake Washington is 20 miles long and 2 miles wide and has two rivers and several smaller streams as tributaries. The rivers are the Sammamish and the Cedar. The Cedar is the larger of the two and flows into Lake Washington at its southern end. The outlet is the Lake Washington ship canal which leaves the lake midway along its western shore. The canal is 6 miles long and passes in a westerly direction through the City of Seattle and Lake Union and enters Puget Sound at the Government locks.

Plantings of sockeye salmon, Oncorhynchus nerka, in these last three places (Bear Creek, Cedar River and Issaquah Creek) were of unusual interest because the

land-locked form of the species, O. nerka kennerlyi, commonly known as silver trout, redfish or kokanee, is native to both Lake Washington and Lake Sammamish. There is also a run of silver salmon, O. kisutch, to Bear Creek; a run of chinook salmon, O. tshawytscha, to Cedar River; runs of both of these species to Issaquah Creek; and runs of land-locked sockeye, steelhead and cutthroat trout to all three.

Bear Creek is a small stream that is an outlet of a lake and tributary to a river that is tributary to a lake. Of the 1936 brood reared at Birdsvew, 576,000 fry were liberated in this creek on March 25, 1937. In September 1940 no sockeye salmon were observed here but in October two were counted over a rack installed by the State Game Department.

Cedar River, another planting location, is the largest stream in which sockeye salmon were released and is tributary to a lake. Between March 25 and April 8, 1937, plantings of 656,000 sockeye fry of the 1936 brood reared at Birdsvew were made in this stream. Returning adult sockeye to the number of 263 were counted over a Game Department rack between August 18 and September 20, 1940. From a survey made of the entire river on October 4, the total run was estimated at nearly 400 fish.

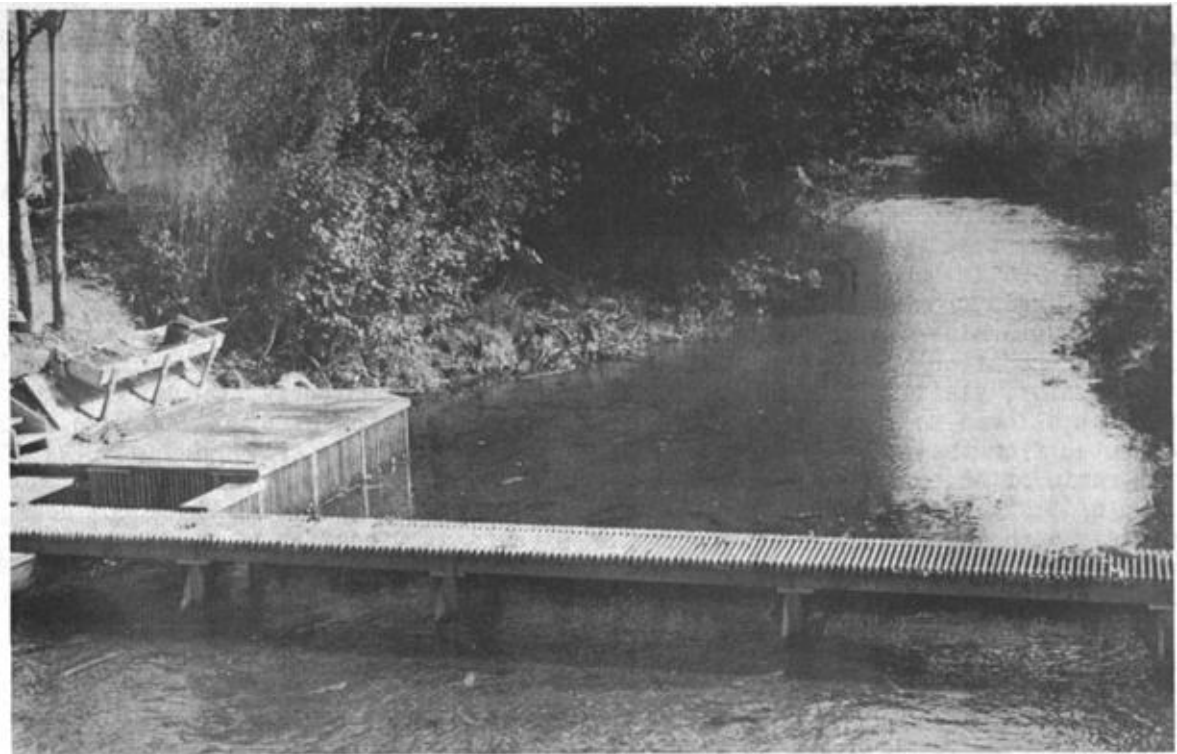
Issaquah Creek, the fifth place chosen for planting sockeye salmon, gave the most gratifying returns. From plantings of 1,257,000 fry and fingerlings in the spring and fall of 1937, an estimated 9,099 adults returned in the fall of 1940.

To understand why the 1937 planting in Issaquah Creek should be so successful, it seems relevant to find out what type of stream these fish selected to spawn in, to investigate all known life history facts, to estimate as accurately as possible the size of the run, and to determine the degree and success of spawning as an index as to whether the run can propagate itself under natural conditions.

Issaquah Creek is tributary to a lake which in turn is tributary to a second lake. It is a small stream about 14 miles in length and originates from a small lake and springs. Its minimum flow is about 30 cubic feet per second and will increase to several times that size during times of prolonged rain. Except in the lower reaches, the creek is generally fast-flowing with a gravel bottom. Temperatures during the time of the spawning migration ranged from 50-58° F. Summer temperatures run as high as 76° F., and the winter temperatures vary from 35 to 48° F.

Before liberation some of the fish were reared in the Green River and Issaquah hatcheries and the others in the Birdsvew Hatchery. On December 5, 1936, 500,000 eyed sockeye salmon eggs were received at the Green River Hatchery of the Washington State Department of Fisheries from the Birdsvew Station. Between March 13 and 16, 1937, 490,000 were transferred to the Issaquah Hatchery as fry that had been feeding for 3 weeks. Of these fish, 456,176 were liberated in Issaquah Creek from the hatchery between May 20 and June 12, 1937. The remaining 12,900 fish were planted in the creek on November 13, 1937. At the time of planting this last group, the hatchery superintendent noted that they appeared to be in exceptionally good condition. The total number of sockeye fry and fingerlings planted in Issaquah Creek from the Issaquah Hatchery was 469,076. These plantings were augmented by plantings of sockeye reared at the Birdsvew Station and liberated directly in Issaquah Creek. Between March 31 and April 6, 1937, a total of 768,000 fry and fingerlings were so planted.

Little is known of the wanderings of these fish between the time of liberation and the time of return, but some information was obtained from the 16 returning sockeye that bore the celluloid bull's-eye tag of the International Pacific Salmon Fisheries Commission. The Commission had tagged these fish between June 13 and July 11, 1940, at Sooke on Vancouver Island. Sooke is about 90 miles up the Sound and toward the ocean from Seattle. From these returns it can reasonably



Spawning sockeye salmon above hatchery rack, Issaquah Creek, September, 1940.

Mature sockeye salmon between hatchery rack and intake dam, September, 1940



be assumed that the bulk of this run passed Sooke during the last of June and the first of July. This being the case, the large return may be attributed in part to the fact that they escaped the "outside" fishery before the largest catches were made and were through the "inside" fishery before it opened.

After passing Sooke, the return of the planted sockeye on their spawning migration into Issaquah Creek began the first of September and continued until the middle of October. On October 26 there were no remaining live sockeye in the creek. The total run was estimated at 9,099.¹ The mean standard length of 204 males was 23.47 inches and of 324 females, 21.68 inches. In weight the fish examined ranged from 4 to 6 pounds.

To determine the degree and success of spawning, it is necessary to know the stream deposition of eggs and the condition of the eggs in the nest. Although 284 females, yielding 837,000 eggs, were spawned at the hatchery, the bulk of the run was allowed to spawn naturally. A stream deposition of 6,600,000 eggs was computed from the following facts: (1) an estimated run of 9,099 fish; (2) a sex ratio of 36 percent males and 64 percent females as determined by examination of 5,775 fish; (3) an estimated egg count of 2,900 per female, which compares closely with the average of averages for 6 years at Birdsvie of 2,896; and (4) the condition of the ovaries of 3,634 dead females in which 57 percent were unspawned, 12 percent were partially spawned, and 31 percent were spent.

All dead females that were inspected were classified either as unspawned, partially spawned (one-half the eggs being spent), or spent (less than 250 eggs remaining in ovaries). The percentage of unspawned females varied between the areas and on different days of examination but the season's totals are as follows:

Area No.	Number of dead females	Percentage unspawned	Percentage partly spent	Percentage spent
1	708	60	10	30
2	2,507	58	14	28
3	419	37	16	47
Total	3,634	57	12	31

This unusual number of unspawned fish dying in the creek apparently was the result of fungus growth on the head and especially on the snout and eyes. This fungus was not characteristic of this species alone since the early run of silver salmon was found in the same condition. The fungus was not observed on the later runs of silver salmon occurring after the sockeye run.

The condition of the eggs in the nests was determined by digging up 2 nests. On November 16, 170 eggs were recovered from a nest just below the intake dam pond. Of these eggs 168 were eyed out and 2 were blanks. On the same day 3 miles upstream from the intake dam, 1,331 eggs were recovered from a nest. Of these 1,264 were eyed out and 67 were blanks. This count was not intended to estimate the number of deposited eggs that were fertilized but merely to establish the fact that at least some of the eggs successfully completed the early embryonic stages.

These facts have been presented as a clear cut example of the ability of artificially propagated sockeye to establish themselves, at least for one cycle, in a watershed heretofore uninhabited by the species. Because of geographical

¹All data on the 1940 spawning migration of sockeye in Issaquah Creek are from a report of D. W. Erickson of the State of Washington Department of Fisheries.

location, the probability that the run to Issaquah Creek might consist of a group of strays is very remote since between salt water and the mouth of Issaquah Creek there are locks, a ship canal, 3 lakes and a river. It is important to note as additional evidence that sockeye salmon, other than an occasional individual, have never before been reported from the lower Puget Sound area. The nearest natural run is to the Skagit River about 55 miles north of Seattle. Whether or not the plantings in the two streams, Bear Creek and Cedar River, in the immediate vicinity of Issaquah Creek could have been the plantings from which the 1940 Issaquah Creek run resulted in whole or in part is not known. Since none of the fry were marked it would be impossible to settle this point one way or another unless the scales showed characteristic markings. Scale examinations to date have shown no such markings. Therefore, since evidence exists that the parent stream theory applies to this species, it is assumed that the 1940 run of spawning sockeye to Issaquah Creek was the result of planting fry and fingerlings in that stream in 1937.

The success of any transplanting experiment is measured by the ability of the fish to propagate and maintain themselves under natural conditions in the new habitat. This success can be estimated at the time of spawning, or at the time of downstream migration, but is not definitely known until the spawning migrants return to the parent stream. To determine the success of the 1940 Issaquah Creek run and to compare the efficiency of artificial propagation with natural propagation, all hatchery-reared fish from this brood that are planted in Issaquah Creek will be marked. Hence if the 1940 brood returns in 1944, a comparison can be made between the hatchery-reared marked fish and the naturally-reared unmarked fish.

Two problems remain to be solved in the future: First, to determine the ability of the transplanted fish to propagate and maintain themselves naturally as well as artificially; and second, to determine why this planting has been so successful while many other similar experiments have been unsuccessful to an equal degree.

KING SALMON IN MAINE

On August 27, 1940, a 33½-pound king salmon was caught in a trap near Pemaquid Point. On September 15, a 40-pound king was caught at the mouth of the Pemaquid River. A school of these large salmon estimated to be comprised of at least 50 fish, was playing about in the shallow estuary at the mouth of the Pemaquid River.

Scales from the 33½- and 40-pound salmon were collected by biologists and forwarded to the Cambridge laboratory of the Fish and Wildlife Service where they were examined by Dr. George Rounsefell. He reports that these two salmon were spawned in the fall of 1933 and may well have come from a shipment from the Pacific coast that was planted in Biscay Pond, several miles up the Pemaquid River, in 1934, for the purpose of providing fresh-water angling. They appear to have spent the summers of 1935, 1936, and 1937 in fresh water before escaping to the sea, as growth during these years was not very rapid. The summers of 1938, 1939, and 1940 were undoubtedly spent in the ocean as attested by the tremendous growth made during those 3 years.

As a result of the interest aroused by these salmon, it is likely that requests will be made for the Service to ship additional quantities of eggs from the West coast for further plantings. Because of the rather general unsatisfactory experience with transplanting exotic species, Service officials announce that no eggs will be transported for planting in East coast streams until the necessary biological studies have been made. Only if the studies indicate that ecological conditions are favorable, and that the probable survival rate is high, will further transplantation of Pacific salmon be considered.
