The restoration of our salmon runs through artificial propagation.

As far back as 1424 laws were enacted in Scotland and England for the preservation of their salmon fisheries, and as late as the 18th century it was necessary to stipulate in Masters and Apprentices articles that salmon should not be served as a food o oftener than a stated number of meals per week.

These laws demonstrate that in those early times the rivers of Great Britain possessed salmon runs of considerable magnitude. Continuous fishing throughout subsequent years reduced the stock and extirmination seemed inevitable until the Government passed strict laws and regulations ~~fax~~ to protect the salmon. These government measures have not yet succeeded in restoring the runs to their original size, but in certain sections at least they have helped maintain the supply. Nothing approaching the hordes of centuries ago are now found in those waters, and many former salmon rivers are absolutely destitute of the fish to-day, but the partial success of governmental efforts gives promise of the object aimed at being ultimately accomplished. I believe the day will come when Scotch and Irish rivers will produce more salmon than at any time in the past, and that such increased production will be entirely due to artificial propagation.

Here in British Columbia the same proposition confronts us. Once we thought our supply was inexhaustible but to-day we know that if present methods are continued extirmination is only a question of time. Every day we put off employing the remedy lessens our chances of success since it also lessens the supply of fish, and makes the work of restoration more costly.

I have always been a firm believer in artificial propagation as the greatest - if not the only means - of maintaining our salmon supply. I have no faith however in the efficacy of the methods employed in the past in artificial propagation of the sockeye species. Until recently hatchery operations have been along lines which proved successful in spring salmon propagation. The success attained with spring salmon has been due to the methods employed coinciding with nature's own methods, and these methods should be equally successful when employed in artificially propagating cohoes, humpbacks and dog salmon, all of which have similar instincts and habits of spawning that spring salmon possess.

But sockeyes differ from these other species in many respects. The former deposit their eggs in waters that communicate directly with the sea. Sockeyes on the other hand, only ascend streams possessing a lake system and deposit their eggs in gravel beds on the lake margins or in the streams that flow into the lake. The other species in their fry stage seem able to withstand the transmission from fresh to salt water, but sockeyes appear to require at least one year's residence in lake waters if they are to attain maturity. There are but two known exceptions to this rule, and in the case of one of these, i.e., the Harrison river run, it is a question if the fish from that locality, possessing scale markings that show they went to sea as fry, are not salmon reared in the hatcheries and subsequently liberated in the waters to which as matured fish they returned.

It is only reasonable to suppose that if nature's methods are adherred to, success will follow. This has been proven with spring salmon on the Sacramento and Columbia rivers where their runs, once sadly depleted, have been restored. It has been proven through the introduction of this species in New Zealand waters, and I beleive the good catches of spring salmon off Vancouver Island are largely from fish artificially propagated in Puget Sound hatcheries. With humpback salmon equally successful results have been obtained. In 1914, an "off" year on Puget Sound, humpback eggs were brought from Alaska and the resultant fry liberated in Puget Sound waters. In 1916 the appearance of matured humpbacks demonstrated the success of the experiment, and 8,000,000 additional humpback eggs were secured from Alaska that year. In 1918 an increased run was observed and 6,605 cases of humpbacks were packed by Puget Sound canneries. The Pacific Fisherman in commenting on this matter said; "It is thus clearly demonstrated that the planting during the last four years is having results, and it is reasonable to hope that a Humpback run of real commercial value can be built up in what have formerly been the off years for this species."

The Pacific species of salmon are not native to Atlantic waters, consequently any found there to-day must be the product of artificial propagation. Humpback salmon eggs were shipped to Maine hatcheries and the resultant fry liberated in those waters. The U. S. Commissioner of Fisheries last year reported as follows;- "There is now in progress a run of humpbacks in the section between the Penobscot river and Passamoquoddy Bay. Quite a number of fish have been caught or observed at the dam in the Penobscot River at Bangor, but the principal run is in Passamoquoddy Bay and streams tributary thereto."

Now if artificial propagation has been successful with spring salmon and humpbacks why has not similar success been attained with the sockeye species ? I believe the answer to be; because our hatcheries have followed nature's methods with the two former, but ignored it entirely with the latter. In this connection I would quote the following extracts from former articles I have written on this subject.

Speaking of rearing fish in hatchery troughs I said;- "Hatchery troughs have smooth sides and bottom and offer no opportunity for the young fish to hide....fish raised therein at least partially lose the natural instinct to bury themselves under gravel when danger threatens..... It stands to reason that such fish, even when deposited in the waters of a lake, will fail, to protect themselves against their natural enemies, and, lacking the instinct to seek shelter, would doubtless swim around until, entering the current of the lake outlet, they would be swept seaward and perish in their fry stage upon reaching salt water."

To overcome this danger I mentioned that Mr Alex. Robertson, the very able superintendent of the Harrison Lake hatchery, had invented a system for hatching the eggs in gravelled boxes; had discovered the natural food of salmon fry in the wild state; and had gone back to nature as regards temperature of hatching water, methods of planting fry, etc,; and that his improved methods gave every promise of success.

I also contended that "stripping the spawning streams

years after year of the parent fish with no attempt made to replace them with hatchery fry, has eliminated natural propagation as a factor in those streams. Dr Gilbert, writing of Morris Creek, says,'This stream offered in the early days one of the most valuable spawning districts in the Harrison watershed..... The Dominion Government has operated a spawning station here since 1885, and with the exception of the year 1900 has never failed to take eggs. ..... None of the fry in the early days were returned to Morris Creek, as it was not believed that such proceedure was necessary to maintain the spawning run. Believing, then, that any increase in the run to a large river would equally benefit all the tributaries, there seemed no reason for labourously returning fry to Morris Creek in order that they should return there and help maintain the spawning run. Knowing, as we now do, that salmon will in general return to the district in which they were liberated the fate of the Morris Creek run seems to have been inevitable. It has steadily dwindled with the years until it can no longer be depended on for any considerable take of eggs. Natural propagation was reduced to a minimum in order to obtain eggs for the hatcheries, while the hatchery reared fry did not at maturity return to Morris Creek. The same has been the history of Silver Creek.... .... The run to Silver Creek is practically now extinct, and we cannot doubt that this process has been hastened by failure to replenish its run through the planting of fry. No better examples than these can be found of the necessity of working out completely the entire life history of our commercial fishes before it is possible to propagate them with success or to legislate wisely for their protection. Failure to follow this principle has discredited hatchery work from the beginning and has led to the well founded suspicion that in many instances they have been more of a detriment than an advantage to the runs.'

"Mr Babcock, Mr Robertson of the Harrison Lake hatchery, and many others who have given considerable study to the Fraser sockeye fishery have expressed the opinion that the "upper" Fraser district produced the bulk of the sockeye runs of the past. In this I do not agree. I believe that outside of the "big" year the "lower" Fraser should be regarded as the main area of production. All the historical records of the Fraser river bear out this contention. Over 100 years ago it was a recognized fact that the "upper" regions were practically without sockeye salmon every second year, and also failed occasionally in three years out of four, while, on the other hand, the runs to the Harrison-Lillooet watersheds were consistently satisfactory."

"The "upper" Fraser, where artificial propagation is a dead letter, has practically no runs to-day. The annual reports have shown the spawning beds becoming each year more barren than in the preceding season, until in 1919 they were almost entirely depleted. Under existing conditions there is neither expectation nor hope that the runs to this section can be restored."

Now let us turn to the Columbia river. Here they have a run of small sockeyes, locally known as "bluebacks", which are rich in colour and in oil. Through over fishing and losses caused by irrigation ditches the run has become depleted. The Government decided to restore it by bringing sockeye eggs from Alaska and

hatching them in Columbia river hatcheries. At first their efforts were unsuccessful since they failed to follow nature's methods, but when they held the fish in retaining ponds for a year before releasing them, they secured a return which was conservatively estimated at 4%. There was no question as to the identity of these hatchery sockeye as many had been marked before being liberated, and when they returned as matured fish were so much larger in size, and poorer in oil, than the native blueback that protest was made against their further introduction.

Similar results have been obtained in sockeye propagation at Baker Lake at the head of Skagit river, where the entire run has been maintained by artificial propagation. All the matured fish entering that lake were taken by the officials for hatchery use, and since 1906 no natural propagation has occurred in those waters.

The various results referred to above prove that sockeyes can be successfully propagated by artificial means. It only remains to employ the methods which will produce the greatest returns. In the case of Fraser river this means to plant strong vigorous fry, reared on natural lines, in those portions of the river system where the greatest amount of depletion has already occurred. In other words secure your supply of eggs from Skeena river, Rivers Inlet, Alaska, or wherever else obtainable, but release the fry in the streams that feed Stuart, Nechaco, Quesnel, Seaton, Anderson, Shuswap, and the other lakes of the "upper" Fraser river.

I cannot believe that closing down all commercial fishing for a period of years will restore a depleted salmon run to the Fraser river, or any other stream in any part of the world. Salmon are provided with the necessary quantity of eggs to maintain their place in marine life despite the depredations of their natural enemies. Commercial fishing is simply an additional cause of destruction not provided for in the original scheme of things and the toll it exacts can only be compensated for by increasing nature's maximum production. If we simply limit our fishing operations we can defer but will not prevent ultimate extirmination. All mature fish we take from a given locality must be replaced by a sufficient number of young fish to maintain the natural balance. This means that artificial production must keep pace with the commercial drain; that mankind's take of the fish be but the surplus man himself provides.

To traps, and I think quite rightly, is ascribed the principal depletion of our fisheries as far as commercial operations are concerned. But seines, gill nets, and all other fishing appliances contribute their share. And between them all extirmination proceeds apace. Each operator blames a competitive type of gear for depleting the supply, and each appears to think that by suppressing the others fish will be conserved. Canners and other purchasers of the raw materials share these same views as their interests may dictate, while government officials, both in Canada and the United States believe that restricted fishing, and closed times before, during, and after the salmon commence running, will permit the passage to the spawning grounds of sufficient matured fish to maintain production. To my mind all these supposed

remedial measures are but begging the question. If we carry artificial propagation to its logical conclusion we can increase the supply - not only of sockeyes but of all the other species as well - to such an extent that all types of fishing appliances could continue to find employment; no restrictions on fishing would be necessary; and only sufficient weekly closed times enforced as would insure government officials a supply of eggs to stock spawning areas to their maximum capacity. By such measures I believe every stream from California to the Arctic Ocean can be made to produce, and maintain the production of, far greater numbers than anything they have contained in the past. And I think if restoring the Fraser is carried out on the lines herein suggested, and on as expansive a scale, it will only be a matter of two or three natural cycles until the available sockeye supply will EVERY year produce a "big" run, and that these annual "big" runs will dwarf into insignificience the largest "big" year ever heard of on the Fraser in the past.