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A PLAN FOR PROMOTING THE WHITEFISH PRODUCTION  
OF THE GREAT LAKES



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In discussing this subject it will first be necessary that we understand something of the habits and the manner of reproduction of these fishes, and the probable increase and losses in numbers under natural conditions. Since the same conditions exist and the same reasoning will apply to all the lakes of the chain, we will confine our remarks to the conditions in Lake Erie.

## BREEDING HABITS AND NATURAL REPRODUCTIVITY OF WHITEFISH.

The adult whitefishes are migratory, leaving the lower end of the lake and the deeper waters each year as the spawning season approaches and the breeding instinct prompts them, and seeking their natural spawning beds, which consist of the reefs among the islands and the rocky and sandy bottoms of the shoaler portions of the lake. Most of these reefs and shoals are of that peculiar formation called honeycombed rock; that is, instead of being gravelly or smooth these rocks are dotted with holes and small cavities into which the eggs, as they are voided by the fish, may drop and be comparatively safe from being eaten by the suckers and other spawn-eating fishes, water lizards, or other enemies, and also from being covered by mud, silt, and other filth, and smothered, as they would be if deposited on mud bottom.

Were the whitefish nest builders, and did they pair as some of the other fishes do so as to perform the function of fertilizing their eggs with any degree of certainty, the chances for a large production of young under such favorable conditions would be very good, indeed; but they are not nest builders, neither do they mate; on the contrary they approach the spawning grounds singly and in schools, and are what is known as "school spawners," the female extruding her eggs wherever she may happen to be, regardless of whether there is a male fish within close proximity or not. In consequence but very few of the fish come together so as properly to perform the functions of fertilization; and when it is

known, as was demonstrated by Mr. J. J. Stranahan by a very careful experiment in the fall of 1897, that the life of an unfertilized whitefish egg, if left in the water, is less than 4 minutes, while more than 50 per cent of them perish in  $1\frac{1}{2}$  minutes, and the life germ contained in the milt of the male fish may be fairly supposed to live no longer under the same conditions, it will readily be seen that the percentage of eggs fertilized under natural conditions must of a necessity be very small. In fact, it is estimated by those fish culturists who have had most to do with the propagation of whitefish that not more than 1 per cent of the eggs are fertilized when deposited under natural conditions. At this rate let us see how many fertile eggs each pair of whitefish will produce each season.

It is estimated that the average number of eggs produced annually by each female whitefish is 35,000. The greatest number the writer has ever known to be secured from one fish was 150,000, from a fish weighing 11 pounds, giving 13,636 eggs to the pound of fish. This would be equivalent to a little more than 37,000 eggs from a fish weighing  $2\frac{3}{4}$  pounds, and as the average weight of the spawning whitefish is from  $2\frac{1}{2}$  to 3 pounds it will be seen that 35,000 eggs to the fish should be nearly correct. Then if each pair of whitefish produce 35,000 eggs, and but 1 per cent of them are fertilized, 350 fertile eggs to the pair is all that can be expected to commence with. As the period of incubation for whitefish eggs is from 128 to 150 days, and as these fertile eggs must lie on the lake bottom all this time, in danger of destruction by being smothered in mud and filth as previously shown, and exposed to the still greater danger of being eaten by all kinds of aquatic animals that feed at the lake bottom, it is quite evident that but few of these 350 fertile eggs will survive to reach the fry stage.

It is evident, moreover, that nature never intended there should be such a large increase in numbers as would result from anything like a perfect fertilization, for in that case the lake in a short time would be so densely inhabited that the waters could not produce sufficient food for all; neither would there be room in the lake for them if they came to maturity. It is therefore safe to suppose that naturally the number increases but little if it more than overbalances the loss, and reasoning from the known to the unknown we are sure that this is true.

The number of young produced each year by those fishes, of which there is a large family, that carry their young through the period of incubation and produce them alive, ranges, so far as the writer has been able to learn, from 1 to 22, giving an average of 11 young to each pair of fish; and as these fishes are very numerous where found, it appears that this rate of increase in the fry state is sufficient to more than overcome the losses under natural conditions. Thus by analogy we have the proof that an increase of 11 young from each pair of fish of any kind, including whitefish, is more than enough to overbalance the natural losses.

## WORK OF THE HATCHERIES.

But the whitefish, on account of being such an excellent food fish, is more sought after than many others and is taken by every device that man has been able to invent and in the greatest numbers possible on all occasions, so that the natural losses are many times multiplied by this take of fish which may justly be termed "artificial" losses. If this artificial loss is continued, then in order that the loss shall not greatly overbalance the natural increase there must of necessity be introduced an artificial increase. Happily this can be accomplished, in fact is being accomplished, in several places by the aid of the hatcheries. The method employed is to have men go out with the commercial fishermen when they raise their nets and collect the eggs from the ripe fish. This is done by expelling the eggs into a common milk pan in as dry a state as possible, after which they are immediately fertilized by using the milt of the ripe male fish. They are then carefully washed, brought to the station and placed in the hatching jars, where they remain until hatched. In addition to this method of saving the eggs we also pen several thousand fish each year. To do this a net is hung on the back of that part of the pound net called the crib, and when the fish commence coming on the grounds, before they are ripe enough to spawn, the fishermen as they raise their nets take out the unripe fish and place them in these nets on the back of the crib. The station tug, which is provided with large tanks through which a stream of water is constantly pumped, visits these nets and takes the fish out, transferring them to the tanks and conveying them to the station, where they are then transferred to the pens. Here they are held until they ripen, when the eggs are secured; and the fish after a few days, when they have regained their normal condition, are returned to the fishermen from whom they were obtained and are sent to market. It is perhaps well to say in this connection that spawning the fish in this manner in no way injures them for food—in fact these fish that are spawned and then held a few days before being put on the market are in much better condition for consumption than if they had been marketed when first caught. Moreover, the whitefish, unlike many others, is in the best condition for food at spawning time, for the reason that it is very fat and the flesh is juicy, sweet, and, the water temperature at this time being low, firm and flaky, while earlier in the season when the water is yet warm the flesh is much softer and not of as fine a flavor.

Not to digress further, however, we will continue by saying that from the fish collected and held in pens as described above, at one point alone last season over 47,000,000 eggs of the very best quality were secured. In other instances, where the fishermen operate on a small scale and small boats are used for the purpose, arrangements are made whereby the fisherman collects the eggs himself

and is paid for them at so much per quart for fertile eggs. These men operate gill nets and fish on the reefs, and as the whitefish do not frequent the reefs to any extent until ready to spawn, usually more than 50 per cent of their catch is ripe fish.

#### MEASURES NECESSARY TO INSURE INCREASED PRODUCTION.

From a practical experience of sixteen seasons in the hatching of whitefish and by consultation with other fish culturists, we find that the average hatch of the eggs collected and taken to the hatcheries is from 75 to 80 per cent. Assuming the lower figure to be the correct one, if each pair of whitefish, as previously shown, produce 35,000 eggs, by the assistance of the hatcheries we get three-fourths of 35,000 or 26,331 fry as against the 11 the same fish would have produced if the eggs had been left to themselves, or 2,393 times as many as it was intended by nature for them to produce, as just now shown. Even allowing that the whole of the 1 per cent naturally fertilized hatch, giving 350 fry as the number produced by each pair of fish, the hatchery would still beat nature by 25,981 fry or 750 times as many, and the fry produced in the hatcheries are just as strong and vigorous and their chances for reaching maturity are just as great as are those hatched naturally. Then, if by the lower calculation we produce 750 times as many fry by collecting the eggs and hatching them at the hatcheries as the fish would produce if left to themselves, it is obvious that the best plan to promote the whitefish production of the Great Lakes is:

To so arrange matters that artificial propagation shall be generally applied to reproduction by having hatcheries established at every available point where a sufficient number of eggs can be secured to warrant their maintenance. It is not necessary that the hatcheries be operated on as large a scale as those at Detroit and at Put-in Bay, but wherever enough eggs can be secured to give a hatch of from 25 to 50 millions, if these points are remote from the larger stations put up a hatchery and operate upon as economical a scale as possible; to stock these hatcheries not only collecting the eggs from the ripe fish as caught by the fishermen, but penning and holding the green fish until they ripen, pursuing the method just described, so that practically all the fish caught will have contributed toward this production before being placed upon the market.

To make this plan the more effective, so as to get the greatest increase possible from the fish caught, a law should be enacted compelling the fishermen to collect, or allow the hatcheries to collect, all the eggs from the ripe fish, and to place the green fish in the auxiliary nets for penning; the fishermen to be paid a fair price for the eggs so taken by them and for their trouble in penning the fish, and to receive a fair remuneration for all fish lost by penning.

As a further part of the plan we would have a law enacted prohibiting the taking or the offering for sale of any undersized whitefish, making the size limit large enough so that every fish before being placed upon the market would have had a chance to have spawned at least once and thereby contributed toward increasing the production.

This plan should not only be universal with the states bordering upon the Great Lakes, but should be international, making the same conditions on the Canadian side as in the states and preventing any loophole through which the regulations could be evaded.

This plan would be strengthened by making a closed season during the summer months when it is so nearly impossible to get the fish to market in an edible condition on account of the warm weather and the high temperature of the water from which they must of a necessity be taken. All the fish so taken are a total loss to reproduction, as they go to market with all their unripe eggs still in the ovaries, and for every female whitefish taken at this period there is a loss to reproduction of 11 to 350 fry if left to spawn naturally, or of approximately 26,000 if the eggs were allowed to ripen and hatch at a hatchery.

If this plan is adopted, the writer will cheerfully stake his reputation as a fish culturist that at the end of ten years it will have been proved the best offered up to date.