

## 25.—THE PROPAGATION OF BLACK BASS IN PONDS.

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About 1852 several gentlemen at private expense introduced the black bass into the Potomac River by transferring the adult fish from Wheeling Creek, West Virginia. The wonderful multiplication and dissemination of these fish throughout the entire Potomac basin attracted the attention of the various State fish commissions which were created in the seventies, and in many States the effort was made to add to the fish supply by broadening the habitat of the black bass. But while fish-culturists were everywhere striving to perfect the methods and apparatus employed with the salmonidæ and shad, nowhere was any systematic effort being made toward the propagation of the bass by artificial methods. Several reasons obtained for the apparent neglect of this prince of fishes, among which may be mentioned the meagerness of the appropriations for propagation; the fact that nearly all States, as well as the United States, engaged in fish-culture were annually, at the period of the bass spawning, devoting every energy toward the multiplication of the shad; and, above all, the fact that the eggs of the black bass belonged to the class commonly called glutinous, a class until recently considered impossible of treatment by artificial methods of impregnation and incubation.

In the light of late achievements in this direction, notably in the impregnation and freeing of the eggs of the wall-eyed pike by Prof. Jacob E. Reighard, and the successful hatching of the glutinous eggs of the white and yellow perch at the Central Station of the U. S. Commission of Fish and Fisheries, it is pertinent to ask if it was not a hasty judgment which placed the artificial propagation of the black bass beyond the pale of the possibilities. If I dared to express an opinion on this subject it would be that a part of the effort which has been expended on fishes of less value would place the secret in our hands. However, within the past decade the bass, by the demands of its ardent friends, the anglers of the United States, has commenced to attract and hold the attention of fish commissioners and fish-culturists. The U. S. Commission of Fish and Fisheries has for several years been engaged in collecting the adult fish from the overflow districts of Illinois and distributing them into new and depleted waters, on the same plan, though on a larger scale, which proved so successful in stocking the Potomac River. Not only this, but at the Neosho Station an effort was inaugurated, not without success, in 1889, to propagate the young in ponds. The fish commissioners of the State of Missouri have also been engaged for some time in the propagation of the black bass in ponds at Forest Park, in St. Louis. In the fourteenth report of the Wisconsin Fish Commission an earnest plea is presented for the construction of a system of ponds to be devoted to bass culture.

The following remarks on the propagation of black bass in ponds are based upon extracts from Dr. Henshall's "Book of the Black Bass," reports of the Missouri, Wisconsin, and Virginia Fish Commissions, newspaper articles, and the "log book" of the Neosho Station, embracing a period of four years. Recognizing the probability of the inaccuracy of a part of the data and conclusions, free criticism is invited.

In the first place, it should be understood that reference is had to the large-mouthed black bass (*Micropterus salmoides*) which nature has the better adapted to raising in ponds; and, in the second place, the object is to obtain a large number of young fish for stocking purposes, not a limited number of large fish for angling. When we come to consider the question of food for the bass under domestication the importance of this latter point will be recognized.

*Spawning period.*—Dr. Henshall says:

The period of spawning extends from early spring to midsummer, according to the section of country and temperature of water; \* \* \* in the Southern States occurring as early as March, and in the Northern States and Canada from the middle of May until the middle of July, always earlier in very shallow waters and somewhat later in those of greater depth.

This can be accepted as a safe guide, for in the main it is undoubtedly correct, though instances have come under my observation which would suggest a modification of the periods. In January, 1893, I saw the bass on their nests in San Marcos Spring at San Marcos, Texas, and in Olmos Creek at San Antonio, Texas. The questions which then presented themselves to me were, "Are these sporadic cases?" or "Do the bass in Texas produce more than one crop a year?" It should be understood that these waters (particularly the San Marcos Spring) are generous warm springs, never freezing, and at the time of which I speak the *Caladium esculentum* was luxuriating on the margin and the *Nelubium luteum* growing in mid-stream in full bud, ready to flower. From my knowledge of other fishes, close allies to the bass, I am of the opinion that under the conditions just described the generative organs of the bass do not wait upon the seasons, for under such conditions it is always summer.

*Nest-making material.*—However this may be, the fish-culturist having the bass under care will receive ample warning of their intended spawning. A few days in advance the fish pair off and select a place for their nest. The selection of the location as to depth of water, material for nest, environment, etc., seem in a large measure to be matters of individual choice. I have known bass to decline a nice lot of clean gravel, in water 3 feet deep and 8 feet away from the embankment of the pond, to build a nest on the naked clay bottom, within hand reach of the bank on which visitors were passing almost every hour. My experience is that a majority of the bass prefer a nest of clean gravel in water about 30 inches deep. But no matter how dirty the gravel may be, or how overgrown with moss and algæ, when the bass need it they will clean it as bright as if every particle had been polished with a brush. It is a fact worthy of comment that the nest-building on the part of the bass does not wear so hard upon their fins as in the case of the trout. In the ponds at Neosho are bass which we know to have built at least three series of nests. (As they were adult fish when captured from the Illinois River, they may have built more.) Not one of these bass shows the least fraying of the caudal fin. On the contrary, I have known trout, after one season's work, to seriously impair the caudal and anal fins. The nests are generally circular, though oftentimes irregular in shape, slightly depressed toward the center. In size they vary from 18 inches to 3 feet in diameter. Dr. Henshall says: "The diameter of the nest is usually twice the length of the fish."

*Nest guarding*—As before intimated, the eggs are viscid and attach themselves as soon as voided and impregnated to the floor of the nest. Then commences a parental devotion worthy of imitation on the part of some higher animals. For a time I was under the impression that the female deserted the nest and the male fish took charge. From closer and more extended observation I am now of the opinion that the female is in direct charge, whilst the male acts as an outer sentinel, patrolling 8 or 10 feet away. There is nothing smaller than a man that a bass won't attack when on duty guarding a nest, and there is nothing smaller than a man who attacks a bass at this time. It might be well here to remark that because the nest is bright it makes the female a shining mark for the natural enemies of the bass. On one occasion I saw a fishhawk dart down and take a female from over her nest. The fish-culturist can lessen the probabilities of such disasters by planting a variety of water lilies in the spawning pond, under the broad leaves of which the bass may seek shelter when in danger.

*Hatching*—The eggs usually hatch in from 8 to 10 days (9 days is the average at Neosho), though undoubtedly the period of incubation, as with all other fish eggs, is dependent upon temperature. Prior to the hatching of the eggs the female stands guard directly over the nest, maintaining a gentle motion of the fins for the purpose, it is thought, of providing a change of water over the eggs. When the fry leave the eggs the tactics of the mother fish are changed. She no longer stands guard over the nest, but circles around the school, whipping back truants and driving off intruders.

*Size and appearance of the fry*.—In the Missouri Fish Commission report (fourth) it is stated that the young bass when first hatched are of minute size. The Wisconsin report (fourteenth) says they are transparent and so small as to be invisible to the naked eye. Dr. Henshall says:

When hatched, the young bass are almost perfectly formed, from one-fourth to one-half inch in length, and cover the entire bed, where they can be easily detected by their constant motion.

The bass which have been under my care do not fill either of these descriptions. They do not average over one-fourth inch in length and are colorless for the first three to five days. At the end of that time they are schooling well and pigment forms along the back, making them appear quite dark when viewed from above looking downward; though when caught upon a fine net of bolting cloth or cheese cloth the color in an individual fish is hard to distinguish.

*The school*.—It is not easy to determine any definite time or age at which the school disperses. I have found individual members of a school, scarcely half an inch long, widely separated in a pond; and again, have removed an entire school of perfectly formed bass over an inch in length. The breaking up and dispersal of the school would seem to depend partly upon the scarcity or abundance of food, the continued watchfulness or neglect of the parent, and possibly to some extent upon the degree of venturesomeness animating a particular school. When the school has dispersed the young seek the minute crustacea, larvæ, and insects in the shallow water. The Wisconsin report asserts that the female locates the young in the shallow waters, but I am inclined to think that it is not a matter of parental direction but of instinct which guides the young bass to the source of greatest safety and food supply.

*Necessity for the work*.—It may be asked, if bass are such excellent parents and accomplish the high rate of impregnation which some writers ascribe to them, where is the necessity of putting more than a few adults in a pond, letting them alone, and later harvesting a crop of young? To such a question I would answer that after the

dispersal of the school, unless food of an acceptable kind be present in abundance, an adult bass does not stop to examine the birth-marks of a straggling youngster who may cross his path. There can be no question but that the largest part of the young so zealously guarded early in the season later furnish food for some adult bass, possibly its own progenitor. Again, the bass are like the trout in that every school furnishes its examples of giants, which make short work of their weaker brethren. In the autumn sorting of the spring crop, left undisturbed through the summer in the nursery pond, three and sometimes four sizes of young bass will be found, the largest of which show by their very size they have been guilty of fratricide.

*Propagating ponds.*—The Missouri Fish Commission, in their report for 1885-86, recommend for ordinary pond culture stocking on the basis of three males and three females per acre. In their propagating ponds in Forest Park they formerly used 75 breeders for a lake of  $3\frac{1}{2}$  acres, though last year they employed 100 males and 100 females for the same lake. So far as I have been able to determine, Mr. W. C. Germain, an employé of the Missouri Fish Commission, was the first to copy from the German carp-culturists the method of transferring young bass to nursery ponds. Mr. Charles Wilmot, superintendent of fish-culture for the Dominion of Canada, recommends the opposite course of removing the breeders after the nests are hatched out. This latter method is open to objection in that it is difficult to capture the breeders without injury either to them or their young.

*Spawning pond.*—With my present information I recommend the following course: Let the spawning pond be built so that at least one-fourth of it will have a depth ranging from feather edge to 1 foot deep. In this portion of the pond plant *Potamogeton* to facilitate the propagation of crustacea to furnish food for the young bass which will escape the net in the process of transferring from the spawning pond to the rearing pond. The remainder of the pond should have a gradually sloping bottom, and consequent increase of depth, to the kettle (or draw off), where the water should be at least 3 feet deep for the warm Southern States and 12 to 14 feet deep for the Northern States or Canada. In the middle third of the pond plant lilies, preferably those having the largest pads. These will not only furnish the breeding fish with a place to hide from the fishhawks, but also serve as sunshades during the summer.

*Preparation and management of spawning pond.*—Clean gravel ranging from the smallest shot to hazelnut size should be provided in the pond. The disposition of this gravel is a matter of some importance. I prefer it put in water from 18 inches to 3 feet deep and near the pond bank. As before stated, the fish will not always use the gravel, but the majority will. By putting the gravel near banks, and so inducing the fish to make their nests there, the entire process of spawning and incubation is under easier observation, and labor and time are saved in transferring the young. Moreover, if it is desirable to remove a nest 10 feet or more from the bank it can be done only by wading into the pond. This is not only awkward work but it disturbs the other fish at a time when nature is demanding the greatest degree of quiet. Put the gravel about 5 or 6 feet from the banks in a number of small heaps. When the bass commence nest-building the attendant will do well to keep the pond and its contents under constant surveillance. Maintain a close watch for fishhawks and herons; but frogs, snakes, and turtles getting into the pond just now need occasion no immediate alarm. A few years since I disturbed a snake, which, running into the pond, crossed the dead-line of a bass nest. Quick as a flash the bass had his snakeship by

the middle and was shaking him as a terrier does a rat. Observe and record, as near as may be, the date each lot of eggs is laid, and so know the better when to expect the young to hatch.

*The nets.*—Before the fry leave the eggs be prepared with a net of cheese cloth to use in collecting them for transferring to the nursery pond. Two nets will be found serviceable for this purpose. The main net should be about 30 inches square, supported by ribs from above. To the center of the ribs arrangement should be made for attaching a handle when the net is to be used 5 or 6 feet from the shore. The net should sag to an open pocket in the center, which can be closed and tied with a draw string. Messrs. A. B. Shipley & Son, of 503 Commerce street, Philadelphia, Pa., advertise a folding minnow net which answers admirably, except that the mesh they furnish is too coarse and needs to be replaced with a yard of closely-woven cheese cloth. The secondary net is easily made from an ordinary landing net by replacing the netting with cheese cloth. This will be found of service in finishing up the remnants of schools which escape the larger net.

*When to net.*—After the hatching is completed and the young, under the guidance of the parent fish, are schooling, commence to net them out into tubs filled with water from the pond. Do not make the mistake of filling the tubs with any other water than that from the spawning pond—not because this water has any virtue in itself, but because by using it you avoid the risk of change of temperature. I have yet to handle an embryo fish more sensitive to change of temperature than the bass.

*How to net.*—The process of netting, to be thorough, requires patience and that degree of skill which comes only with practice. When possible stand on the bank, introduce the net with a gentle, scarcely perceptible side movement under the school of bass, and cautiously lift it out. As soon as the net has cleared the water, with a quick turn bring it over the tub so that that part of the net holding water and fish comes into the water in the tub. An assistant standing near the tub, by catching the sides of the net, helps in the accuracy of the latter part of this operation. The operator continues to hold the rod to which the frame of the net is attached; the assistant slips his hands into the tub and unties the draw string of the net pocket. The net is then gently lifted out of the tub. Alongside of the tub should be a pail of pond water and a dipper. As the operator lifts out the net the assistant should wash off such fish as may stick to the cheese cloth with water from the pail. For this purpose never use anything but water. By no means resort to a feather or the equally bad practice of shaking the net. There is but one portion of the operation of collecting the young bass which requires celerity. It is the time when the net is being moved from the pond to the tub. All the remainder requires the utmost degree of painstaking care and time.

*Transferring and planting.*—The fish being in the tub, it remains to transfer them without loss of time to the nursery pond. It is, of course, a simple matter to take up the tub and walk the few steps intervening between the ponds, but the proper introduction of the young bass into the nursery pond is an operation requiring some degree of care, patience, and skill. In the first place the water supplying the two ponds should be from the same source, in which case it will be found that there is but slight difference in the temperature of the shallowest part of the nursery pond and the surface water of the spawning pond. However it may be, the water in the tub should slowly be brought to the temperature of that of the shallowest part of the nursery

pond. It is here will be found the minute crustacea, daphnia, cyclops, and larvæ of the gnats on which the young bass are to forage; and it is here, in this shallow water, that they should be liberated. Not all dumped in at one spot, but slowly, carefully, gently ladled in—scattered all around the margin of the pond.

*Construction of the nursery.*—To attain the survival of the largest number of the young bass, the construction and management of the nursery pond demand their protection from enemies and the production of the greatest quantity of insect life suited to their sustenance. It will be found advantageous to have a number of small ponds rather than one large one. A good working-size will be a width not exceeding 12 or 15 feet, from 40 to 50 feet long, with a depth from 30 to 36 inches at the kettle. Where the lay of the ground is such as to permit, it is recommended to have the nurseries immediately adjoining and supplied by the same water as feeds the spawning pond. Such an arrangement simplifies the operation of transferring the young fish, and at the same time robs it of some of its dangers. As in all other ponds for fish propagation, the supply and discharge for each nursery pond should be independent of any other. They will be better when provided with bottoms sloping to the kettle. If the locality is infested with crawfish it is advised to pile or otherwise protect the banks. The entrance of snakes, frogs, and such enemies may be prevented by surrounding the pond with finely-woven screen, or, better yet, boards let into the earth a few inches and projecting 18 inches above the ground.

*Amount and temperature of water for nursery.*—The proper amount of water for the nursery is the minimum which will replace evaporation and seepage. In the early age of the bass any approach to a current must be strictly guarded against, for the young large-mouthed bass is not a strong fish or one loving a current. A current sweeping through the nursery pond would be about as desirable as a colony of snakes. Whilst these remarks are intended for the nursery pond they will apply to the spawning pond, especially at and for some time after the spawning period.

The young bass is able to stand any temperature to which the sun raises the water of the nursery. I have found the bass, just hatched, in water at 56° F., and two months later they were thriving with the temperature at 86° F. The first week in August, 1893, I found wild young bass in stagnant water at 98° F. Caution should be accepted here that bass grown in such very high temperatures are exceedingly tender and impossible of handling and transportation until the approach of fall and winter has gradually reduced the temperature and so hardened them. Moreover, under such conditions they are more liable to the attack of parasites, both external and internal. Whilst the bass has the ability to live in the extremes of 33° to 98° F., there are limits which, if they can be secured, will be found advantageous. M. Durand, of the National Society of Agriculture of France, states, as the result of his experiments, that the cyclops reproduces best at a temperature between 68° and 77° F., and that they can not resist higher than 95°. The young bass being so adaptable as to temperature, it is a safe conclusion that the best temperature for them is that at which their food best multiplies.

*Stocking the nursery.*—How many young bass shall be put into a pond? This very natural question is not easy to answer, for it depends upon the size of the pond and its capacity to produce food. With an unlimited quantity of food there would be little liability of overstocking. The secret how to produce natural food without limit is

not yet in the possession of the mass of fish-culturists, and until this secret is common knowledge we must move with caution. If the nursery has been prepared in advance with the aquatic plants already suggested, some crustacea will be found to have taken up a home and commenced their reproduction. To a nursery in fair condition from 3,000 to 5,000 young bass may be allotted. The death of a part of these must be expected. However, should a large part of them by good fortune survive the first few weeks, they can later be divided into other nurseries.

*Management of the nursery.*—As the summer advances those fish which have commenced life with the highest degree of initial vitality will be noticed to be outstripping the less vigorous ones, and a closer observation will disclose that some of the larger ones are guilty of cannibalism. On the first signs of this—sooner would be better—the young bass should be collected and the sizes sorted into different ponds. It may be urged that when the work is conducted on a large scale this operation would require too much time and expense of labor. The answer is, neglect to do it and you will reap a diminished harvest of large fish. In my opinion the midsummer sorting of the young bass is of importance surpassed only by the necessity for removing the young from the spawning pond. The average length of six months' bass at Neosho is 3 inches, though I have frequently seen them of the same age measuring from 8 to 10 inches. Whoever has seen a bass choked to death by trying to swallow one of equal size will not doubt that the 8-inch fellow will diminish the number of the 3-inch fishes.

*Food for the nursery.*—So far I have been going on the supposition that no artificial food will be used, or any natural food supplied in addition to that which the pond will produce. It is evident that if even a fair per cent of the 3,000 or 5,000 fish in a nursery of the size recommended are to survive they must have more food than the pond can grow. For reasons already given, any addition of the smaller crustacea (except the *Gammarus*) can not yet be undertaken. At Neosho we resort to finely chopped beef-liver for the bass, and I am free to confess with not the most satisfactory results. At the Forest Park ponds of the Missouri Fish Commission a method is pursued which is not without advantages, but one which I am not prepared to unqualifiedly indorse. Several weeks before the bass spawn the attendant catches the little branch chub and puts them into the pond. The chub spawns and hatches out before the bass. When the young bass are transferred to the nursery they find a lot of young chub waiting to be eaten. One of my objections is that they also find a lot of old chub waiting to eat them. It is true that this objection could be obviated by hatching the chub artificially (as can easily be done) and turning only the young chub into the pond. To those who do not fear the risk of pampering to the natural cannibalistic propensity of the bass, this method will appeal by reason of its simplicity and cheapness; but this is something that I fear as much as any other factor yet encountered in the cultivation of the bass. My advice is, never feed your bass, old or young, on any kind of fish, unless it be crayfish; but start with the determination that they must be trained while under domestication to forego their natural inclination for fish diet. I am aware of the excellent work done with the bass at the Carp Pond, at Washington, D. C., in the summer 1892, when the ponds were infested with sunfish. But there are no means of determining what proportion of the young bass were devoured by the sunfish before they fell a victim to the parent bass.

*Harvesting.*—The harvesting should occur in the cool days of autumn, at which time the young bass with the greater ease and safety can be transported for distribu-

tion, and the ponds be allowed to remain bare during the winter to increase the quantity of insect life to serve as food for the next year's crop. Whatever necessity there is to avoid leaving any carp in the nursery or growing pond, the necessity is increased many fold in the case of the bass. The pond should be drawn very slowly, every opportunity allowed the fish to follow the receding water, and every circumstance avoided which would tend to frighten the fish into burrowing into the mud. Under fright the bass will burrow into the mud and live there an incredible length of time. Some three years ago we used a pond for bass one season, and when it was concluded to use it for shad the following season it was drawn off in the autumn to harvest the young and thoroughly rid it of bass. Unusual precaution was exercised to remove every fish. The pond was left empty for three weeks exposed to the frosts and winds of November, until the mud was dry and cross-checked. The pond was then filled, and in December 200 tons of ice were cut from it. To make assurance doubly sure the pond was again drawn in the following April and left empty for ten days. The young shad were introduced the first week in June. By the first of August it was noticed that other fish than shad were jumping for the flies in the dusk of early morning and evening. One hundred and fifty bass, averaging half a pound each, were captured from this pond, from which all the bass had been so carefully removed. There were no means within the limits of reasonable probability for 150 fish to have gotten into this pond, except by having burrowed in the mud and lived there several weeks while it was drying.