

## XXXVI.—HOW TO RAISE CARP AND OTHER POND FISH WHICH SPAWN IN SUMMER.\*

BY MAX VON DEM BORNE.

In artificial fish-culture we possess a very efficient means of improving our fisheries; but the much older method of fish-culture in ponds has not been rendered superfluous thereby. By artificial fish-culture we understand the artificial impregnation of fish-eggs by extracting the spawn from fish and mixing the eggs with milt and water, and also the hatching of these impregnated eggs in hatching-boxes. Fish-culture in ponds, which, even in the Middle Ages, had reached a high degree of perfection on estates belonging to monasteries, leaves the propagation to the fish themselves. The different kinds of fish may be classified as they are suited for artificial fish-culture or for being raised in raising-ponds.

I. *Artificial fish-culture*.—The following are adapted to artificial fish-culture: The salmonoids (the salmon, the different kinds of trout, the salbling (*Salmo salvelinus*), grayling, the different varieties of the *Coregonus*), the may-fish, pike, sturgeon, and different kinds of salt-water fish.

II. *Pond culture*.—The following are adapted to pond culture: (a) On soft bottom: The varieties of *Cyprinus* (carp, crucian, tench, bleak, ide, goldfish, &c.), river-perch, *Silurus*, pike, &c. (b) On sandy, gravelly, stony bottom: The perch-pike, the American black perch, &c.

Herr von Behr, of Schmoldow, president of the German Fishery Association, has requested me to describe in a few pages and in as simple a manner as possible, how fish-culture in ponds, apart from a well-regulated carp culture, can be raised to much greater importance than it possesses at present. I gladly comply with this request by endeavoring to describe how fish which spawn in summer can be raised in ponds.

We aim at introducing again into our rivers, where the old spawning places have been destroyed by the different river improvements, large masses of the fry of carp, bleak, tench, crucians, perch, perch-pike, &c. We also aim at making small ponds, marl-pits, and peat-bogs sources of income by stocking them with fry. I shall, therefore, attempt to show how young fry for these purposes can easily and cheaply be procured at home, instead of getting it from abroad at a comparatively heavy

\* *Züchtet Sommerlaichfische.* Translated from the German by HERMAN JACOBSON.

expense. How often does a ditch with running water or a little brook offer an opportunity to transform a hitherto dry area into a pond, and many of our large estates have watercourses which are admirably adapted to this purpose.

On the estates of Archduke Albrecht, near Teschen and Saybusch, Thomas Dubisch, inspector of fisheries, has introduced into carp-pond culture a method invented by himself, by which the production of carp fry is secured, and by which the yield of the ponds has been considerably increased. I will here state what I learned during a visit to these estates. The archducal farmer, Adolf Gasch, of Kaniow, informed me that he had made an improvement on the method of Dubisch; but as it was a professional secret, I am unable to judge of it. I am under great obligations to the director of the archducal farms, Mr. Walcher-Uysdal, at Teschen, for his friendly assistance. The carp-raising pond which Dubisch uses is also adapted to the raising of bleak, tench, crucians, perch, and other fish, which spawn on a soft bottom. The pond need not be larger than 0.1 hectare [ $\frac{1}{4}$  acre]; and a depth of from 0.3 to 1 meter [12 to 39 inches] is quite sufficient. When the water is to be let off, the bottom water should be brought down to at least one-third meter [13 inches] below the bottom of the pond, so that it can dry out completely; it is therefore crossed by a number of ditches of sufficient depth, whereby all injurious animals, such as frogs, beetles, larvæ, &c., are removed and the acids are withdrawn from the bottom. A soft bottom of clay, peat, or sand, and the possibility of laying the pond entirely dry, are essential conditions of success. The pond lies dry during winter and spring, and is filled with water only a short time before the spawning fish are placed in it. In order to keep strange fish away from the pond, Dubisch leads the water which feeds the pond through a gravel grate, which completely answers the purpose. With laths a box is constructed, measuring 6 to 8 meters [20 to 26½ feet] in length, which is filled with sifted gravel, varying in size from a hazel-nut to a hen's egg. When too much mud accumulates it is removed by shoveling. A set of spawning carp comprises one spawner and two small milers. Young carp generally spawn more vigorously than old ones; but Dubisch is certain that he has also obtained offspring from spawners weighing 15 pounds. The spawning carp and the young carp are during winter kept in a winter-pond, and in spring are placed in a wooden or walled tank, where they do not eat anything and have no desire for spawning. It is best to keep fish of different sexes separately.

The spawning pond is generally stocked during the second half of May. The carp may be used still later, however, as they do not spawn in the tank. A temperature of the water of more than  $+14^{\circ}$  R. [ $63\frac{1}{2}^{\circ}$  F.] is so essential for spawning that the water should be raised to that temperature by artificial means. In this manner Christian Wagner, at Oldenburg, the well-known breeder of goldfish, has caused his carp to spawn as early as March. As a general rule the fish will spawn as

soon as they are placed in the pond, provided that the temperature of the water is at least 14° R. If this is not the case after a few days, and if the water begins to be turbid, the fish may not spawn at all. If the same fish, however, are placed in another spawning pond which has just been filled, they will, as a rule, spawn at once. It is necessary to have several spawning ponds and a reserve of several sets of spawning carp, although they may be used only on rare occasions.

After a few days the pond swarms with small carp. Dubisch thinks that a spawner weighing 7 or 8 pounds produces 100,000, and one weighing 12 to 15 pounds produces 200,000 young ones. These are amply sufficient for a farm having a pond area of 500 hectares [1,236 acres]. For spawning carp the largest and best-formed fish are carefully selected from fish of the same age, because rapid growth is hereditary among fish. It is important that the young fish should grow as large as possible during the first summer. It is therefore necessary that the carp should spawn as early in the season as possible.

**RAISING-PONDS.**—As the little fish grow larger their demand for food increases. Large fish, therefore, need a greater water area than small fish in order to obtain sufficient food. Only when there is at no time any lack of food will the fish develop in a favorable manner, and will put the food which is supplied to the best possible use. After the young fish have consumed the umbilical sac they commence to seek food, and the pond soon becomes too small for them. If care is not taken to supply more food, the numerous fry will disappear almost entirely in a few days, dying from hunger. About five days after the fish have been hatched they are taken out of the spawning pond and are placed in raising-pond No. 1, so that, according to estimate, 100,000 young fish get 3 hectares [7½ acres] of pond area.

The fishing of the fry is done in the following manner: The water of the pond is either let off slowly through a fine wire grate (6 wires to 1 centimeter) [15 wires to 1 inch] while fishing is going on at the same time, or the water is not let off, and the fry are caught with a gauze dipper measuring 0.5 meter [20 inches] in diameter. To receive the fry temporarily Dubisch uses a large seine floating in the pond with a high wooden edge, and a bottom of exceedingly fine wire grating. Thence the fry are dipped out with a smaller gauze dipper, measuring about 0.2 meter [8 inches] in diameter and placed in a spacious tin vessel, taking out as near as possible by estimate 1,000 at a time. From the tin vessel they get into the transporting can. This can has a double bottom, the upper one of wire grating, the lower end of a tin tube opening between the two bottoms, and its upper end a few centimeters above the lower edge of the transporting can. When water is poured in the can it flows off through the tube, and carries away dirt and excrements which may have accumulated underneath the wire bottom. Mr. Mühlbach, a tin-smith of Neudamm, sells such cans at 13 marks [\$3.09] apiece. The raising-pond No. 1 has lain dry as long as possible, so that it may be

free from enemies of the fish and contain sufficient food. In about four weeks the young fish have reached the length of several centimeters, and are transplanted once more, because they can no longer find sufficient food in a pond having an area of 3 hectares [ $7\frac{1}{2}$  acres]. So far about 25 per cent have been lost, so that only 75,000 young fish are taken out.

The raising-pond No. 2 has likewise lain dry as long as possible. It had been sown with grass or clover, which has been harvested. The pond is stocked at the rate of 1,050 fish per hectare [ $2\frac{1}{2}$  acres], of which number, as a general rule, 1,000 are caught again in autumn, when they have reached the weight of one-quarter of a pound and more. If the pond is only stocked at the rate of 300 or 500 fish per hectare, carp weighing 1 pound may be obtained during the first summer.

The raising-pond No. 3 is stocked with carp of one summer, counting 520 fish per hectare [ $2\frac{1}{2}$  acres]; and if fish of prey are kept out by means of a gravel grating, one will in autumn get of this number 500 carp of two summers, weighing from 1 to  $1\frac{1}{2}$  pounds and rarely 2 pounds (but not the latter unless the number of carp per hectare has been less than 520).

The stock pond Dubisch stocks with 206 carp of two summers per hectare, and gets in autumn 200 carp less than two and one-half years old, weighing from 2 to 4 pounds.

From the above we gain the following relative size of the different classes of ponds. This relative size will, of course, be changed, if there is a change in the number of fish with which the ponds are stocked, in the losses and in the growth of the fish, or if some of the fish are sold before they have reached the age of two or two and one-half years. In making the calculation the average weight of 2.2 pounds per fish has been made the basis. This weight had in 1883 been reached by the carp on the estate of Perstetz, near Teschen, where pond farming had been carried on according to the method described above.

Ponds.	Size of ponds.		Number of fish placed in ponds.		Loss.		Yield.	
	Hec-tares.	Percentage of the total area.	Per hec-tare.	Per pond.	Per hec-tare.	Per pond.	Per hec-tare.	Per pond.
Spawning pond.....	0.1	0.018		3				100,000
Raising-pond No. 1.....	3.0	0.551	33,333	100,000	8,333	25,000	25,000	75,000
Raising-pond No. 2.....	71.4	13.111	1,050	75,000	50	3,570	1,000	71,430
Raising-pond No. 3.....	137.1	25.175	520	71,430	20	2,742	500	68,688
Stock pond .....	333.0	61.145	206	68,688	6	1,998	200	66,690

A total pond area of 544.6 hectares therefore yields annually 66,690 carp, at 2.2 pounds, or 146,718 pounds, *i. e.*, 269.4 pounds per hectare.

ECKARDT'S METHOD OF OBTAINING EMBRYONATED CARP EGGS.—A spawning pond of 0.1 hectare [one-fourth acre] is stocked with

about 60 spawning carp, and the edges of the pond are covered with juniper brush. Spawning proceeds on a gigantic scale, and the brush is soon entirely covered with spawn. As soon as the eye-dots become visible in the eggs, which, according to the temperature of the water, takes place in from two to six days, the brush with the spawn is packed like other embryonated fish-eggs and sent to considerable distances. Even after a journey of two days a great many young fish have been hatched from such eggs. The fish are hatched after from three to twelve days, and the pond swarms with innumerable little carp, whose further development is intrusted to the care of the pond cultivator.

For feeding carp and the fry of carp there are recommended ground meat, kitchen refuse [slops], and the excrements of hogs and sheep. In using artificial food care should be exercised, as the experience of our most prominent pond cultivators has so far not been very satisfactory, either as regards the feeding of fry or of older carp.

**RAISING PERCH-PIKE IN PONDS.**—Mr. Reuter, superintendent of forests at Siehdichum, district of Guben, has been very successful in establishing artificial spawning places in lakes in which perch-pike had hitherto not propagated. I, as well as Al. von Gostkowski, in Galicia, have in the same manner raised perch-pike in ponds. A full description of Gostkowski's establishment has been given by Professor Nowicki, of Cracow, in the circulars of the German Fishery Association for 1883 [pp. 9-12 and 20]. The Galician pond has an area of 13 hectares [32 acres], and mine one of 11.5 hectares [28½ acres]. At a depth of 1 meter [39.37 inches] and more, places of considerable extent are covered with coarse gravel and stones, and here and there some heaps of stones are piled up. Near to these there are placed tree tops having many branches, which are cut just above the surface of the water. The gravel is cleaned every year, and the pond is allowed to lie dry as long as possible. In 1882 Gostkowski stocked his pond with 9 perch-pike and a number of small fish as food for the perch-pike, and in autumn he caught 120,000 young perch-pike measuring from 5 to 10 centimeters [2 to 4 inches] in length; but many of the fish had no doubt escaped from the pond before he could catch them.

At Wittingau perch-pike have often spawned in deep tanks which constantly had a good supply of water. It may, therefore, be presumed that they will do the same in small ponds, if these are sufficiently deep, are naturally or by artificial means, as described above, adapted to spawning, and contain suitable food for the perch-pike. In ponds arranged in this manner the American black perch can also be raised.

**STOCKING OF LAKES AND RIVERS WITH THE FRY OF FISH WHICH SPAWN IN SUMMER, OBTAINED FROM RAISING-PONDS.**—In the same manner the fry of bleak, tench, crucians, and other cyprinoids, as well as of perch, can be successfully raised in large numbers in ponds with soft bottom; and the fry of perch-pike in ponds with sandy and gravelly bottom. We have seen that a properly constructed spawn-

ing pond of 0.1 hectare [one-fourth acre] will certainly produce 100,000 to 200,000 fry of carp and similar fish, but it cannot feed so large a number of young fish even for a few days. The fry should, therefore, soon after they have been hatched and have lost the umbilical sac, say, in about five days, be placed in the lake or river which is to be stocked. Wherever it can be done the contents of the pond should be allowed to flow slowly into the lake or river, and if possible at night, so the tender fish may escape the attention of their enemies. I do not consider it probable that these small fish will all be eaten by fish of prey, for all the large fish have once been small and been in danger of being devoured by larger fish. The fry may also be assigned to a larger pond and raised there. As has already been observed, 100,000 carp fry will in a raising-pond of 3 hectares [7½ acres] and in one month reach the length of several centimeters, and are much better able to defend themselves against their enemies. It should not be forgotten, however, that this requires thirty times more pond area, which used as a raising-pond could produce thirty times as large a quantity of fry. If, according to the old method, the spawning pond is not fished until autumn, 50,000 carp may be obtained from 1 hectare [2½ acres], but these fish will only measure 4 or 5 centimeters [1½ to 2 inches] in length. From my own experience I have gained the conviction that 250 such carp are amply sufficient to supply 1 hectare [2½ acres] of water area, even if it contains many fish of prey. In this manner I have in my own lakes created very productive carp fisheries. In planting the fry they should be distributed as much as possible over the entire water area; the water should be shallow and contain a good many aquatic plants, as this will insure a supply of food and protection against fish of prey.

The larger the carp the smaller should be the number placed in a pond. It may also pay to place large carp in open waters, even if the fish have to be bought. A very intelligent pond farmer in Schleswig-Holstein has for a long time been in the habit of buying a large number of carp measuring 20 centimeters [8 inches] and more in length. With these fish he stocks several lakes where fishing is easy, and in this manner he has become a wealthy man. A few years ago he placed in his lakes carp weighing 1½ pounds, and in the following winter he caught fish weighing 2½ pounds.

I am happy to say that at present a great interest is taken in the cultivation of our waters throughout all Germany, and that people begin to feel that we have some duties as regards our many and beautiful sheets of water. Would it be too much to hope that some liberal-minded landowners, and especially the largest landowner, the Government, will here and there on their fields and in their forests, along their rivers and lakes, establish a normal spawning pond of about one-tenth hectare [one-fourth acre], place in it three spawning carp, or other spawning fish, and annually place in our open waters 100,000 or more young fish?

What magnificent carp, both as to size and flavor, are occasionally caught in our streams! There can hardly be a doubt that they escaped, as young fry, from some pond farm, or were allowed to escape, because their number was too large.

Much has been said in our days about mirror, leather, and blue carp. They are generally thought to possess a more delicate flavor than carp with scales, and if properly raised they will grow just as rapidly. Dubisch justly considers it very important that only the best-formed carp and those which have grown most rapidly should be used for raising purposes.

**CONSTRUCTION OF A POND.**—Only in rare cases is a pond constructed by digging a great pit in the ground. Generally it is done by erecting a dike in the lowest place of some low ground. A pond may often be constructed at very slight expense by closing up the ditch which in former times has served to drain swamps or lakes. According to the different manner in which ponds are supplied with water, we distinguish:

*Brook and river ponds*, which are fed by running water;

*Spring ponds*, which are fed by springs; and

*Sky ponds*, which are fed by the rain and snow water or from ditches which dry up in hot weather.

The dike is made from the nearest material at hand, and at the same time the fish-pit is constructed. The best material is loam and clay. In sandy soil the dike and the pond should have a foundation of loam and clay, unless the supply of water is ample at all times, as otherwise there is danger that the water of the pond will gradually leak through the ground.

To drain the pond a pipe is laid right through the dike, which can be closed and opened on the water side. This pipe may be either of wood or of burnt clay or of bricks laid in cement. In sandy bottom the pipe must be tight, as otherwise the sand will enter and be carried away with the water, so that the dike begins to sink and the water of the pond flows out. In sandy bottom, wooden pipes should therefore always be set in cement. The tap-house is located at the end of the pipe on the water side. It consists of a wooden grate, which prevents the fish from entering the pipe, and of a safety-valve for letting off the water. Iron grates are not suitable, as they are soon destroyed by rust.

The fish-pit is a deep place near the tap-house, in which the fish congregate when the water is let off. It should be so constructed that it can be laid entirely dry, be large enough, and have a firm bottom. If the soil is loose, its bottom should therefore be strengthened by sand, gravel, and stones.

The outer pit is a deep place where the water goes after it has left the pipe. It is destined to receive the fish in case the grate has been damaged; and at the place where the water flows out of it there should

therefore be a grate. It is not advisable to let many fish get in the outer pit, as they are easily injured in passing through the pipe.

The bottom of the pond is crossed by numerous ditches, so that the water can everywhere flow off easily and rapidly, and that the fish can readily find their way to the fish-pit.

If a brook or river passes through the pond, an outer ditch is constructed along the edge of the pond, so that the superfluous water can be let off. Thereby stones, sand, and mud are kept away from the pond, which would otherwise gradually fill it. At times, when the water is very high, it may be led off through the outer ditch, and breaks in the dike may thus be avoided.

The pond fisheries take place during the cool season, either in spring or autumn, when there is no danger of frosts. It is well if during the fisheries fresh water can be led into the fish-pit, so as to refresh the fish at all times. After most of the water of the pond has been let off, and the water area has been reduced to about one-fifth or one-tenth of its original size, fishing commences. Care should be taken that the fish are at no time without water, by occasionally introducing fresh water into the pond. The edge of the fish-pit is covered with boards and reeds, on which are placed tubs filled with fresh water. From the nets the carp are put into these tubs, cleaned of dirt and slime, counted, put in kegs, and carried to their destination as rapidly as possible. As during the fisheries the water is stirred up and becomes turbid, and as the fish will more or less swallow some of this muddy water, it should be removed from their gills. If carp are to be transported a considerable distance, they should a few days previous be placed in clear running water where they do not receive any food, so that they may clean themselves thoroughly and not pollute the water during the journey with their excrements. The temperature of the water should be at most 10° R. (54½° F.), the lower the better. The quantity of water which is needed is calculated in the following manner from the weight of the fish and the length of the journey.

*Excess of weight of water over the weight of the carp during a journey of 10 to 40 hours.*

Length of time of journey.	Water should weigh—
10 hours .....	9 times the weight of the carp.
20 hours .....	12 times the weight of the carp.
30 hours .....	15 times the weight of the carp.
40 hours .....	18 times the weight of the carp.

Wilhelm Neue, of Neudamm, supplies wooden kegs, for transporting large fish, with a double bottom and pipe, for 16 marks [\$3.80]; the same kegs with iron handles, 17 marks [\$4.04]; the same kegs with a lid for ice, 19 marks [\$4.52]; the same kegs (first quality), 20 marks [\$4.76].

The otter is a dangerous enemy of the fish, and should be destroyed if one expects to raise any carp; herons, cormorants, ducks, and other



aquatic birds and animals will likewise diminish the productions of the spawning ponds. It is therefore necessary to fight these enemies energetically and persistently. In my Fish-Culture (*Fischzucht*) and my Manual of Fisheries and Fish-Culture (*Lehrbuch der Fischerei und Fischzucht*), which will be published during the coming summer, I have treated all these subjects at considerable length, and would, therefore, refer the reader to these works.

## APPENDIX.

In several respects it is of great importance that ponds should lie dry as long as possible, and that the draining should be thorough.

It causes the spawning carp to spawn immediately; the principal cause of this may be that the soil is more thoroughly heated by the sun when it is quite dry. At Berneuchen the water in ponds treated in this manner had in the middle of May a temperature of  $+16^{\circ}$  R., whilst in ponds which had been filled with water for a longer time the temperature was only  $+14^{\circ}$  R. In consequence of this circumstance the carp spawned at once in the first-mentioned ponds, and produced an extraordinary quantity of fry, while in the other ponds they had not yet spawned on the 20th June.

If the ponds are allowed to lie dry, the increase of small crustaceans, on which the young fish principally feed, is greatly favored. All the ponds which I treated in this manner in a very short time literally swarmed with small crustaceans. Professor Benecke, of Königsberg, had the kindness to examine them, and found principally *Daphnia mucronata*, and, in smaller quantities, *Daphnia hyalina* and *Polyphemus oculus*. To explain the phenomenon I quote the following from Bronn "*Klassen und Ordnungen des Thierreichs*"—Classes and Orders of the Animal Kingdom—(Vol. V, part 1, p. 955): "The eggs of many branchiopods, especially those of the *Cladocera* and the *Phyllopods*, which by the females are partly deposited on plants, and partly simply ejected into the water, have to stay there a considerable time, sometimes even several months, till they develop, but are in many cases, *e. g.*, by the evaporation of the water in shallow ponds or ditches, laid entirely dry for a longer or shorter period. For most of the varieties of the *Phyllopod* the consequent imbedding of the eggs in the hardened mud seems to be an essential condition for their development."

Professor Benecke told me that the freezing of the eggs also seems to favor their development. Dubisch has observed for a number of years that in ponds which have been absolutely laid dry for a considerable period, a very large number of diminutive aquatic animals will develop immediately after the ponds have been filled with water. He is of opinion that it is an advantage to have the ponds filled with water for as short a period as possible prior to stocking them with young fry of the carp, in order that these small animals which are to serve as

food for the fry do not reach too large a size. It is of the greatest importance for the raising of all kinds of fish that we should be furnished the means of producing the natural food of the young fish in large quantities.

Frogs are hurtful in spawning-ponds, because they devour too many small fish. For larger carp, however, frogs form a very valuable article of food. For this purpose Dubisch gathers the spawn of frogs from the spawning-ponds and transfers it to the raising-ponds and growing-ponds. The larvæ of the frogs seem to be a favorite food of the carp, and to further its growth very much.