NATURALIZATION OF AMERICAN FISHES IN AUSTRIAN WATERS

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Paper presented before the Fourth International Fishery Congress held at Washington, U. S. A., September 22 to 26, 1908

BULLETIN OF THE BUREAU OF FISHERIES : : : : : : VOL. XXVIII, P. 977-982
Document No. 698 : Issued April, 1910

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In the belief that it might greatly interest American fish breeders to know what experiences and observations have been made by Austrian pisciculturists in regard to fish imported from America for breeding purposes, and in compliance with a special invitation from the committee of the Fourth International Fishery Congress, Washington, 1908, the Imperial and Royal Austrian Fishery Society has called upon the prominent fish breeders to furnish their observations regarding the results obtained with such American fish. These results, which are briefly set forth here, warrant the conclusion that of all the Salmonidæ which can be taken into account for breeding purposes the American rainbow trout must be regarded as the most important. This trout, which has now been in Austrian waters for a quarter of a century, despite manifold opposition has gained, so to say, the rights of citizenship there. Owing to its excellent qualities it has been quickly introduced into all pond fisheries and is really a first-class salmonid. In consequence of its ability to endure deep water, the number of ponds in which it can grow is quite considerable, and pond-fish owners would be well advised to allow plenty of room for the rainbow trout, without forgetting, however, that after all it is a salmonid. Its capacity to stand high temperatures enables it to replace the pike in carp ponds, the more so as it does not possess the dangerous qualities of the latter.

The *irideus* is just as indifferent to high temperatures as to cold. Therefore at a time when the *Salmo fontinalis*, or brook char, and the native brook trout have long ceased to take food the *irideus* still comes to its meals, and the advantage offered to the breeder by its appetite, displayed even when the pond is covered with ice, must not be underestimated. In addition to this its power of resistance against diseases is amazing. It is not only—perhaps owing to its perceptibly thicker skin—far less exposed to the attacks of the malignant Saprolegniaceæ than all the other Salmonidæ, and therefore very rarely seized with fungus, but it also appears to possess immunity from the most dangerous bacterial diseases, such as furunculosis. Its indifference to polluted waters enables it to live in water

courses where no other salmonid could thrive. Even in the immediate neighborhood of factories discharging waste water and refuse, where both the brook trout and the char could certainly not exist, the *irideus* flourishes and grows fat. It appears to be specially valuable for exclusively or partially populating the numerous cold ponds in the forests of lower Austria, which in consequence of their low temperature, severe climate, and exposed situation are less adapted for carp breeding. Altogether it must be said that the *irideus* has fully come up to all that has been expected from it in nearly every instance.

Thus until very recently all breeders joined in a panegyric of the *irideus*. But things have now changed. The sad discovery has been made that the much-praised power of resistance of the rainbow trout in ponds against disease rapidly decreases and that this fish if strongly fed nowadays suddenly shows a remarkable frailty, nay an exotic weakness, which had been entirely unforeseen. The most unpleasant phenomenon for the breeder is the increasing spread of anæmia, which frequently causes great losses. The extraordinary weakness becomes manifest in the death of numerous fish through simple sorting operations, the clearing out of ponds, or short transportation. Quite frequently examination of the dead fish reveals no other symptoms but those of a greater or less poorness of blood. The fish are pale, particularly in the gills, the regular color of which ought to be a very bright red. The internal organs are also pale, and the liver yellow. This organ frequently shows fatty degeneration and is interspersed with hemorrhages, as the result of ruptures of the sides of the vessels. Searches for any other causes, such as bacteria and parasites, have proved unsuccessful. Consequently anæmia must be regarded as a symptom of general deterioration of the breed. As a rule these symptoms become visible in the second year, and it may be that frequently the death of the fry as well as the outbreak of dropsy of the yolk sacs is due to this circumstance. As a matter of course such fish are not very well qualified to act later as mother fish, as they give bad eggs and sometimes remain sterile because of degeneration of the sexual organs. Undoubtedly the unfitness of the rainbow trout for acclimatization here is the cause of this degeneration. The conditions in which the fish lives in its native country, where it migrates even at the spawning time, are it appears different from those in Austria. It may therefore be truly said that the rainbow trout is decreasing at a rapid rate and before long will disappear from our ponds, unless there is a speedy introduction of fresh blood by the importation of eggs from America. In the unfortunately somewhat limited number of brooks and small rivers which for some time have been stocked with *irideus* in a regular and rational manner, a good stock has developed which spawn in open water and multiply in a natural way although not in great numbers. These do not show any of the symptoms of degeneration of the pond and fattened fish of this species.

Not less valued than the rainbow trout was the American brook char, *Salvelinus fontinalis*. It is true it was less utilized than the *irideus*, as it can only live in spring water; its breeding gave very satisfactory results, however, in the first years after its introduction. Not inferior to the *irideus* as regards early growth, it behaved excellently even in ponds watered exclusively by precipitation of the atmosphere and it appeared as though the brook char might be qualified to replace our brook trout, whose breeding offers far greater difficulties. In the course of time, however, these sanguine expectations gave place to bitter disappointment, and it became obvious that all the hopes entertained were chimerical.

Even before birth the char causes great trouble. The losses in eggs are enormous, as despite scrupulous attention at spawning time the number of sterile eggs is great beyond measure, and miscarriages are far more frequent than with other fish. On the other hand, it is true that the bringing-up of the brood gives very little trouble. The small fish take artificial food very early and in autumn the pond is alive with fry. But soon an unpleasant feature becomes visible, viz, premature growth, which attribute is the more unfortunate as the char indulges in cannibalism more than any other fish. In this respect it comes very near the pike. Its voracity very greatly promotes its growth in the first and second years, but later it suddenly stops growing and fine large fish are seldom seen.

Its capacity to resist disease, which quality we value so highly in the *irideus*, is extremely small. Bacterial infections, fungus, and intestinal disorders often kill whole stocks, and it is also much more liable to furunculosis than is its American brother. Besides, the char suffers from a peculiarly special form of petechial affection. This manifests itself in irregularly shaped flat defects of the surface skin, dull gray spots with byssus, the origin of which has not yet been definitely ascertained. This disease has discouraged many pisciculturists from continuing to breed the *fontinalis*.

Another circumstance must be mentioned which makes the cultivation of the brook char in the second year very unprofitable, namely, degeneration of the eggs caused by overfeeding. That the brood product of such fish as are artificially fed is entirely worthless would be a lesser evil were it not also that the fish themselves perish in great numbers at the spawning time through overfattening of the internal organs. It is chiefly the spawners that die, as they can not deposit their spawn, which is not thoroughly and normally matured. The char, moreover, requires special qualities and temperature of water. It only thrives in hard, clear spring water of even temperature ranging from 42° to 54° F. The risk connected with its fattening rapidly increases with rising temperature of water, whilst if this is much below the above-mentioned degrees the food taken no longer affords proper nourishment. It has often been proposed to rear the char in running water, but to this the objection must be made that the char would immediately become too formidable a competitor of our brook trout with

regard to feeding, and in all likelihood there is hardly a pisciculturist who would be prepared to substitute the brook char, which can not be disposed of so easily here, for the popular brook trout. For these reasons the breeding of the brook char has been generally neglected in Austria for the last few years, and in some fisheries has even been abandoned altogether.

A promising future appears to lie before the *purpurata*. In growth it develops as rapidly as the *irideus* and it thrives under the same conditions. Its brilliant exterior and slender body, similar to that of the brook trout, are advantages which must not be underestimated. So far, however, the *purpurata* is bred in Austria only in isolated fisheries, and it would be premature to-day to pronounce a definitive decision regarding the value of this beautiful fish to breeders.

The American black bass, *Micropterus salmoides*, is being bred in several pond fisheries side by side with carp. The conditions of growth are favorable. The objections raised against this fish are that it is a great truant and extremely sensitive to the effects of muddy water, which latter occasions great losses in the clearing out of ponds. There is also no great demand for the fish, though it is fleshy and palatable, for the public show a certain aversion to the disproportionate size of the head, which, in fact, equals a quarter of the weight of the whole fish. As the fish is tenacious of life, however, can be easily transported, and is not very dainty in feeding, it may be that in time it will become more popular, especially if breeders succeed in producing it with a smaller head. In the tributaries of the Danube and in pools and stagnant water it could not exist at all.

The tiny California sheatfish is not yet well known in Austria, and as its many good qualities are much underestimated it is not very popular. It is a harmless fish, extremely tenacious of life, and, like the black bass, is often bred in carp ponds. As it is a decided mud fish, attempts have been made to introduce it in waters in which our finer fish have been destroyed through the discharge of factory refuse, river regulating works, and exploitation of water power. The tiny sheatfish has fulfilled all the hopes placed in it and thrives splendidly even in strongly polluted waters. Though it offers only an inferior substitute for our better kinds of fish, it may yet perhaps be destined to play an important part in Austrian pisciculture.

From all this it follows that our most precious acquisition from America is the rainbow trout, as we do not yet sufficiently know the *purpurata*, provided that we shall be able to renew the breed by the speedy importation of eggs from America, and in this conviction we heartily join the Austrian pisciculturist who writes at the close of his observations, "May our friends in America add a new gift to that which they have made us already in the *irideus*, and give us a little from their superabundance. The fish breeders of Austria would be very grateful to them."