

95.—ON THE BEARING, GROWTH, AND BREEDING OF SALMON IN FRESH WATER IN GREAT BRITAIN.

By FRANCIS DAY.

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In December, 1880, Sir James Maitland, at Howieton, obtained salmon eggs and milt from fish captured in the Teith, and from which ova hatched in March, 1881. In July, 1883, it was seen that some of the young salmon, then two years and four months old, were in parr livery or had assumed the dress of the silvery smolts, the latter in certain lights showing parr bands. On November 7, 1884, a smolt $1\frac{1}{2}$ pounds weight jumped out of the pond and from this fish about 100 eggs were taken. As they seemed to be ripe they were milted from a Loch Leven trout. On January 23, 1885, 18 of these eggs hatched, and the young were strong and healthy. On November 11, 1884, about 12,000 Loch Leven trout eggs were milted from one of the foregoing smolts and they hatched on January 28, 1885. On December 1, 1884, 1,500 eggs were taken from two of the foregoing smolts, and milted from one of the males. On the 9th about 4,000 eggs from these smolts were fertilized from one of the males, and on the 13th 2,500 smolt eggs were milted from a parr. Pure salmon eggs have been hatched in the Howieton fishery; the young have grown to parr, smolts, and grilse; these latter have yielded eggs, and their eggs have been hatched with a fair degree of success.

Although some time must elapse before it can be ascertained how these young salmon will thrive, how large they will eventually become in freshwater ponds, and whether a landlocked race may be expected from them, still the following points seem to have been established: That male parrs or smolts may afford milt capable of fertilizing ova, but if taken from fish in their second season, at thirty-two months of age, they are insufficient to produce vigorous fry; that female smolts or grilse may yield eggs at thirty-two months of age, but those a year older are better adapted for the production of vigorous fry; wherefore to develop ova a visit to the sea is not a physiological necessity; that young male salmon are more matured for breeding purposes than are young females of the same season's growth; that female *Salmonidæ* under twenty-four months of age, although they may yield ova, are of little use for breeding purposes, the young, if produced, being generally weak or malformed; that at Howieton hybrids between trout and salmon have so far proved to be sterile. Furthermore, it was stated that the size of eggs of the *Salmonidæ* vary with the age and condition of the parent; but, as a rule, older fish yield larger ova than the younger ones. Even among the eggs of individual fish variations occur

in the size of the ova. From larger ova finer and rapidly growing fry are produced; consequently, by a judicious selection of breeding fish, races may be improved, while it is only where segregation is efficiently carried out that such selection is possible.

96.—EFFECT OF SUNLIGHT UPON SHAD EGGS.

By W. F. PAGE.

In May, 1881, at Gunston, Va., on the Fish Commission barges, I observed for the first time the peculiar and astonishing effect of direct sunlight falling on shad eggs. Having occasion to make an unusually large deposit of embryo shad in the channel of the river at a time when our buckets and cans were in use, I used a large shallow tin pan in which to transport the "leavings" of the cones. Previous to taking the row-boat out to the channel, I placed the pan on the outer deck of the barge and went back to some work in the hatchery. Returning in a few minutes, I was surprised to see the pan alive with fish, and it occurred to me that this might be brought about by the direct sunlight falling upon the eggs. Since that time I have had abundant opportunity to test this phenomenon, and have adduced the following facts: (1) That the time of hatching any particular lot of shad eggs can be shortened from twelve to fifteen hours by judiciously exposing them to direct sunlight in shallow, highly-polished pans; and (2) that the fish so procured are fully equal in vitality to those allowed their full time in the eggs. During the spring of 1884, I made a practice at Central Station, when a car shipment was wanted by a given time, of placing the youngest eggs where the greatest amount of direct sunlight would fall on the hatching jars, at the same time giving the older eggs less light as development was more advanced. This was done with a view to hastening the younger eggs and retarding the older, so that the fish for the entire shipment might all hatch about the same time. By this means I have, on several occasions, been enabled to hatch out at the same time different lots of eggs having a variation in their ages of as much as thirty hours. In my reports of the work at Central Station for the seasons of 1883 and 1884 it will be observed that there are considerable variations in the time of the incubation of eggs of the same age; which is to be explained by the difference in the amount of light the hatching jars received. I have not been able to observe with the thermometers at my command any increase of temperature in the water employed in the work with the pans, and the pans painted black are entirely useless for the purpose. Though many fish-culturists deprecate the effect of direct sunlight on fish eggs as having a weakening effect on the embryo, experience has demonstrated that the fish assisted in this way are as strong and travel as well as those allowed their full time in the egg.

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