THE DESTRUCTION OF TROUT FRY BY HYDRA.

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The following observations were made during an investigation at the United States Fish Commission hatchery, Leadville, Colo., in August, 1902. On August 4, some eggs of the black-spotted trout in a number of the hatching-troughs were just hatching, while in others the young fish were several days old. Each trough was separated by screens into three divisions. The first division—that into which the water enters from the supply pipes—contained no eggs, these having all been removed several days before on account of the great mortality of the young fishes hatched in this division of the troughs. In the second, or middle, division, the newly hatched fry were dying in considerable numbers, some before leaving the egg trays. In the third division of these troughs, as well as in the troughs not directly fed from the supply pipes, the death rate was merely nominal.

These facts clearly indicated that the cause of the mortality was directly connected with the water supply, which was found to be derived chiefly from two sources. The main supply pipes were fed from Rock Creek, and an auxiliary set of pipes led from a spring near the hatchery. Connected with the main pipes was a branch leading from the third or lowest of the Evergreen lakes. This was closed at the time, only a small quantity of water coming through leaks around the gate at the head of the pipe.

The water from the main pipes was clear, containing very little sediment, and with a temperature of 48° F.; that from the spring was very clear and pure, without sediment, its temperature being 43° F. There was very little sediment in the hatching-troughs. In this, however, microscopical examination disclosed the presence of great numbers of a very transparent hydra, which had been discovered by the attendants at the hatchery a few days before, when the sun's rays, just before sunset, had fallen obliquely into one of the troughs. In the dim light of the hatchery this hydra was quite invisible, but by placing a large mirror outside of the building so as to throw a beam of sunlight through the window, with a hand mirror reflecting this beam so as to throw it into the trough, the hydras could be plainly seen as slender, whitish threads, 1 to 2 centimeters in length and 0.15 to 0.30 millimeter in diameter, fixed by one end to the bottom or to the side of the trough, and bearing a crown of 5 or 6 long tentacles around the mouth at the free end. The

hydras were found quite equally distributed through the first division of all troughs supplied directly from the main pipes. A careful count of the number on several square inches in different troughs gave an average of 131 hydras per square inch (20+ per square centimeter). Comparatively few were found in the middle division of the troughs, most of them having fixed themselves before reaching the first screen. Very little animal life other than hydra was found in the sediment of the troughs.

Since no other cause for the mortality of the young fishes could be discovered, and as the hydras were exceedingly abundant and are well known to be armed with great numbers of dart cells or nettling cells which secrete a fluid that quickly causes paralysis in small crustaceans and other minute forms of animal life, it appeared that the injury was probably due to the hydras. In so far as the writer is aware, no injury to fishes by hydra has heretofore been known. The following experiment was therefore instituted to determine what injury, if any, was to be attributed to this cause:

Five beakers, each of 250 cubic centimeters capacity, were filled with water from the supply pipes; in each of the first four of these was placed the sediment from 21 square centimeters of the bottom of the first division of one of the hatching-troughs, containing about 430 hydras; the fifth beaker was intended as a control, and contained water only. Five trout newly hatched and apparently in good health were taken from the hatching-trays and placed in each beaker. Nos. 1 and 2 were filled with water from the spring and were placed in running water, so that the temperature was nearly constant; Nos. 3, 4, and 5 were filled from the main supply pipes, No. 4 having been kept over night in the office, and all three were set on a shelf in the hatching-room. At the end of the experiment, Nos. 1 and 2 were at nearly the same temperature as at the beginning, while Nos. 3, 4, and 5 had acquired the temperature of the hatching-room.

The following table shows the result of this experiment:

	1.	2.	3.	4.	5.
Temperature at beginning of experiment.	43° F.	43° F.	48° F.	58° F.	48° F.
Hour of beginning	9.13 a. m	9.16 a. m	9.20 a. m	9.22 a. m	9.23 a. m.
Result at 9.45 a. m	1 dead	1 dead	2 nearly dead.	3 dead[a]	0 dead.
10 a. m	4 dead	1 dead	3 dead	4 dead	0 dead.
10.15 a. m	4 dead	4 dead	4 dead	4 dead	0 dead.
10.30 a. m	5 dead	5 dead	5 dead	5 dead	0 dead.
Temperature at end of experiment.	44° F.	44° F.	55° F.	55° F.	55° F.

[a] One of these had burst the yolk-sac in its struggles.

In this experiment 25 per cent of the trout were killed by hydras in less than 30 minutes, 60 per cent in 45 minutes, 80 per cent in 60 minutes, and 100 per cent in 75 minutes; those trout which were least active in the beginning of the experiment were the ones that survived longest, probably because they came in contact with a smaller number of stinging cells of the hydra. With the aid of a lens, the hydras could be seen with their mouths closely applied to the surface of the fish, particularly on the yolk-sac; in some cases more than a dozen hydras were seen attached to a single fish. Soon after the fishes were placed in the beakers most of them were seen to struggle violently, one of them bursting its yolk-sac in its struggles and dying immediately; these struggles recurred at intervals, but with diminishing intensity, until death

supervened. The five trout in the beaker without hydras were kept in the beaker until the next day and were then found to be all alive and in good health.

No other cause of injury having been discovered after the most careful search, the destructive effects of the hydras upon the fishes in the foregoing experiment were taken as conclusive evidence that these were the cause of the unusual mortality of the trout fry. This fact being demonstrated, a careful examination of all the sources of water supply to the hatchery was made. The lower of the three lakes was first visited. This lake is quite shallow, being about 12 feet (4 meters) in depth in the deepest part; along the borders there is considerable aquatic vegetation, consisting of sedges and cat-tails; here the hydras were found in immense numbers, clinging to the submerged stems and leaves as well as to the green filamentous alga which was growing abundantly on the bowlders which are scattered over the bottom. The other lakes, and Rock Creek for a distance of about half a mile above the head of the supply pipe, as well as the spring, were examined in turn, but although very careful search was made, no hydras were found in either of these waters.

The temperature of the water in each of the three lakes at 1 foot below the surface was taken August 8, about 2 p. m., and was found to be as follows: Upper Evergreen Lake, 60° F.; Middle Evergreen Lake, 64°; Lower Evergreen Lake, 65°.

The leaks about the head of the pipe leading from the lower lake were immediately stopped and no water from the lake is now entering the hatchery.

The natural causes which control the development of the different species of hydra, favoring or retarding it, are as yet but little understood. At one period hydras may be very abundant at a given point, and soon afterwards entirely disappear without any apparent cause. They have been found in the vicinity of Greeley, Colo., during all months of the year, sometimes in great abundance; sometimes, however, a whole year has passed without a single one being seen, although searched for most diligently. They occur in lakes, ponds, and marshes, usually in clear water. Warm water (60° to 80° F.) appears to favor their rapid multiplication, since they are usually most abundant in summer and early autumn; cold water does not apparently injure them, however, as the writer has frequently taken vigorous individuals in the winter, through holes in the ice. Hydras reproduce at certain times by eggs, which settle to the bottom and probably remain dormant through the winter, but the usual and most rapid mode of multiplication is by budding. Little buds arise from the side of the parent, soon acquire a mouth and tentacles like the parent, and after a time break loose and lead an independent existence. In the lake most of the hydras examined were bearing from two to six buds, showing that the conditions there were favorable to their rapid multiplication. In the hatchery troughs, on the contrary, very few were found bearing buds, and these were probably recent arrivals. The conditions within the hatchery do not, therefore, appear favorable for their increase, and it only remains to rid the troughs of them in the most practicable manner.

As the hydra is very tenacious of life and may even be cut into several pieces without serious injury, each piece developing the lost parts and becoming, in a few days, a complete hydra, it is not probable that it can be destroyed in the troughs without injury to the fish eggs or young fry. By removing all eggs and fry, briskly scrubbing the bottom and sides of the trough with a stiff brush so as to cause the hydras to loosen their hold, then quickly flushing the trough into the waste-pipe, most of them can be removed.

When the lower divisions of the trough contain hatching eggs and fry that can not readily be removed without injury, the first or upper division (in which nearly all the hydras will have fixed themselves) may be cleaned by shutting off the supply pipes, placing a temporary partition between the upper and lower divisions, and, after a brisk scrubbing, quickly siphoning off the water and floating hydras from the upper division of the trough.

As the water now entering the hatchery is taken from Rock Creek and from the spring, both of which are free from hydras, it is probable that loss from this cause will cease as soon as all the hydras now in the hatching troughs and supply pipes can be removed.

It was impossible to find characters other than those of color and size by which to differentiate this hydra specifically from the well-known *H. fusca* Linnæus. It differs from that common form only in being of larger size and in the entire absence of coloration. Among the large number of individuals observed, both in the troughs of the hatchery and at the lake, not one showed a trace of fuscous coloration. These differences appear to be constant, and I propose the name *pallida* for the new species, in allusion to its lack of color. It may be described as follows:

Hydra pallida Beardsley, new species.

Characters.—Body cylindrical, 1 to 2 cm. in length and .15 to .30 mm. in diameter; tentacles 5 or 6, when fully extended two or three times as long as the body; color, milk-white in reflected light, whitish and translucent in transmitted light.

Differs from typical *Hydra fusca* in being somewhat larger in average size and in the entire absence of fuscous coloration.

Type locality.—United States fish-cultural station, Leadville, Colorado.