

**EXTRACT FROM THE FOURTH
ANNUAL REPORT OF THE
COMMISSIONERS OF FISHERIES,
GAME AND FORESTS OF THE
STATE OF NEW YORK, PP. 175-190**

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GARY NATHAN CALKINS

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With the author's compliments

EXTRACT

from the

Fourth Annual Report

of the

Commissioners of Fisheries, Game
and Forests

OF THE STATE OF NEW YORK.

Report Upon the Recent Epidemic
Among Brook Trout (*Salvelinus
fontinalis*) on Long Island.

By

Gary N. Calkins.

1898.

Report Upon the Recent Epidemic Among Brook Trout (*Salvelinus fontinalis*) on Long Island.

BY GARY N. CALKINS.



HOLDING HARD.

IN May, 1899, an epidemic started among the brook trout in the hatcheries of a trout farm at Northport, Long Island, and did not abate until every fish had died. The painstaking care taken by the State Shellfish Commissioner, Mr. Edward Thompson, during the last ten years in developing an excellent hatchery and in raising a fine breed of trout, thus in one season received a serious check. At the request of the State Fish Culturist, Mr. A. Nelson Cheney, I undertook an examination of the fish for the purpose of ascertaining the direct cause of the epidemic, and if this were due to a parasite, of finding out something of its life history and affinities. Thanks to the courtesy of Mr. Cheney and Mr.

Thompson, I was able to get abundant material.

With the exception of the fungus *Saprolegnia*, which does not menace the life of the fish, the brook trout has apparently been very free from disastrous epidemics. In the literature at my command I find no mention of *Salvelinus fontinalis* or *Salmo fario*, as subject to any particular disease, and, to my knowledge, the only statement of a parasite in these forms, was made by Csokor in 1888, in a short description of Gregarinosis.* About ten years ago an epidemic killed off hundreds of the trout in the New York State hatcheries at Cold Spring Harbor, Long Island, but the cause of the trouble was not located and no report was made. From various sources, however,

* (Gregarinosis d. Forellen, *Oesterreich. Zeit. f. wiss. Veterinarik*. Wien 1888, 11, p. 56-58.)

I have obtained enough evidence to lead me to the conclusion that the epidemic at Cold Spring was quite similar to the present one and, if my surmise is correct, it is a significant fact that the same trouble should have occurred in two hatcheries in the same region.

Parasitic diseases are not uncommon among fish and the so-called psorosperms, in particular, have been recognized as disease-causing organisms since 1841, when Johannes Müller first called attention to them. These have since been called the Myxosporidia by Bütschli and other students of the Protozoa, and are now known to be minute unicellular animals which by the accumulation of spores, form great cysts in the muscles and connective tissues of fish. These are the most destructive parasites known to the fish-breeder, and in some cases great epidemics are due to them. During an epidemic among the barbels of the Meuse, in 1883 to 1885, hundreds of fish died every day from this cause. The Myxosporidia are such frequent parasites and so often the cause of fatal diseases in fish that it is not remarkable that I confidently expected to locate the cause of the epidemic in some organism belonging to this group. In this, however, I was disappointed, for the first glance at the diseased fish showed a complete absence of cysts or tumors which characterize many of the more common parasites. Although tumors were absent, the body was frequently ulcerated and great holes in the body walls were often present, while smaller holes were quite characteristic. As this condition frequently accompanies Myxosporidiosis, I was still confident that the organism could be readily determined upon sectioning some of the ulcerated spots. When this was done there were still no traces of Myxosporidia, but instead of them, I found myriads of minute forms belonging to the same group as the Myxosporida, *i. e.*, to the Sporozoa, but which cannot be classified among the usual fish parasites. This parasite, which has never been described, I shall name *Lymphosporidium trutta*, and in the following report I will give as much of its life history as could be made out.

Characteristic Symptoms of the Disease.

The epidemic was equally fatal to fish of all ages. Mr. Thompson estimates that 2,000 yearlings, 1,000 two and three year old fish, and some 10,000 "fingerlings" (from four to six inches long), were lost. They died as rapidly during the cold days of November as in the hot days of July and August; indeed, the ponds are fed by springs and Mr. Thompson asserts that the temperature of the water never rises above sixty degrees F.

The fish, especially the yearlings, were characterized by sluggish motion and inability to withstand rough treatment of any kind, most of them dying within a few minutes after removal from the waters of the runways to a pail. In the water the

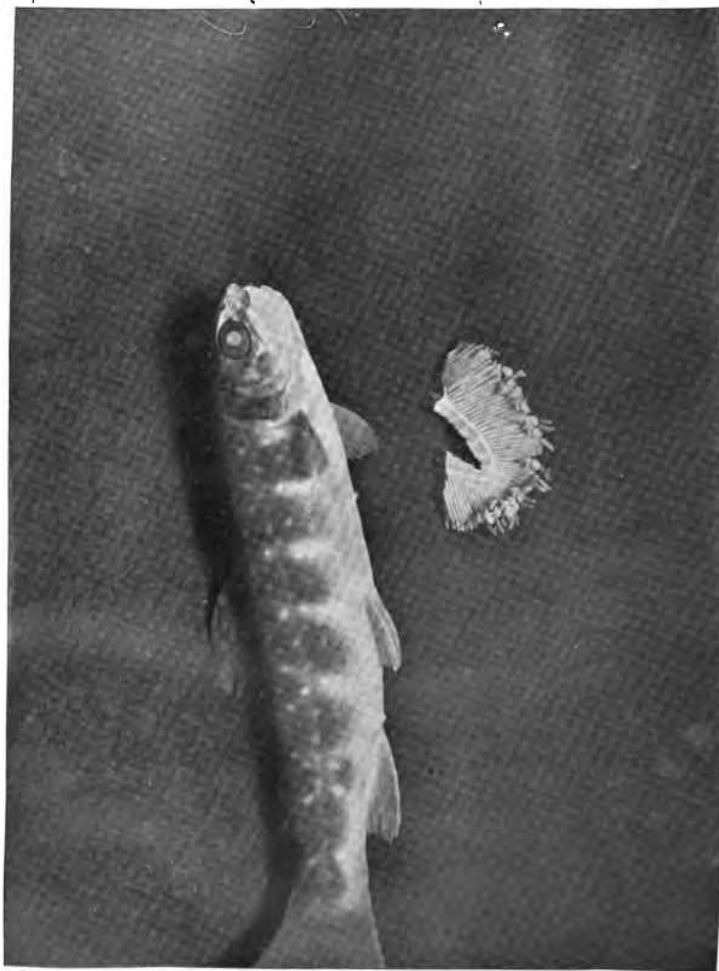


PLATE I.—YOUNG BROOK TROUT, DISEASED.—GILL OF LARGE FISH WITH COPEPOD PARASITES. ?

actions of the fish were indicative of their diseased condition, for they would frequently rise to the surface and swim upon the side or turn belly-up on the surface, while at one period hundreds of the dead fish were daily removed from the runways. In some of these there were no external indications of the disease; in others, and in the majority of the cases, great red spots or ulcers were visible, sometimes on the belly, again on the back, but most often on the sides. The bases of the fins were particularly subject to these sores and the eyes were often disfigured by them. More serious disfigurements were frequently seen in the entire loss of one half of the lower jaw, bone and tissues being eaten entirely away (Plate I); or, again, the ulcers in the sides would give rise to holes through the body wall and into the body cavity, and live fish were occasionally seen with parts of their viscera hanging out of the holes thus made (Plate II). The red ulcers which are due to the congestion of the blood at the sore spots give place to wide gaping wounds sometimes an inch in diameter where the flesh has dropped out (Plate II). In some cases the vertebræ in the caudal region were thus exposed. In many cases the holes or sores did not go entirely through the body wall but formed shallow and irregular wounds. These sores were most apparent on the small yearlings; the older fish, however, were not exempt but in these cases the sores were proportionately smaller and distributed in all regions of the body.

Methods Employed in the Investigation.

The wide distribution of the sores about the animal, from the posterior end of the body to the eyes and jaws, was sufficient evidence that the cause of the disease was pretty well distributed throughout the organism, and if further evidence was necessary, it was furnished by the cases mentioned above where the fish were found dead with no external sores of any kind. It was at once apparent from these facts that the cause of the trouble was of some deep-lying nature and that, if parasites were at the bottom of it, they must be widely distributed among the various organs in the body and probably carried to all parts by the blood and lymph circulation. The various organs of diseased fish were therefore cut into small pieces and preserved in diverse killing agents, including sublimate acetic, (saturated corrosive sublimate with five per cent. glacial acetic), saturated corrosive sublimate in normal salt solution, and Flemming's fluid (osmic acid, chromic acid, and glacial acetic acid in certain definite proportions) The organs thus preserved included the testis, kidney, ovary, gall bladder, pyloric cœca, digestive tract (including stomach and intestine), liver, gills, and sore spots in the outer wall. These were taken to the laboratory, where they were sectioned in paraffine and stained in various ways, the most satisfactory

stain being iron hæmatoxylin with a counterstain of orange or eosin; the Flemming triple stain of safranin, gentian violet and orange also gave very good results as did thionin and eosin.

There was little or no chance to try direct inoculation for, so far as could be seen, all of the fish in the hatchery were affected by the disease at the time my attention was called to it. One experiment, however, was tried. Some fresh trout were obtained from the northern part of the State and three of them were fed with bits of the flesh of diseased fish containing the ulcerated spots. All of these fish died within three months, probably from the same disease that killed off the other trout, but I had no chance to examine them.

The Specific Cause of the Disease.

The cause of the trouble is, I believe, a sporozoan parasite and the life history of the organism is presented in the present report. I hope to be able at a future time to complete the study begun here and to perform conclusive experiments upon inoculation. Owing to the failure to keep the fish alive in aquaria these experiments have not been attempted during the present winter.

The brook trout, like all others of the same family, is subject to the growth of the fungus *Saprolegnia*, but in the Northport hatchery this has never become a menace and has been easily taken care of. Other parasites which were found, especially in the larger fish, represent different groups of the animal kingdom. Among these were Nematelminthes, or round worms, and parasitic Copepoda or Crustacea. The round worms belong to a group—the Nematoda—which are very common in fish of different kinds, as well as in all other forms of Vertebrata. They were found chiefly in the swimming bladder and were present in considerable numbers and in all stages of development. They belong to the genus *Ascaris* of which there are 102 distinct species, and only a very few are known to produce fatal results. Each female individual produces thousands of eggs which are retained until the embryo has reached a considerable size. Each egg is surrounded by a thick capsule and is capable of resisting heat or chemicals for a considerable time. They are passed out of the body either through the mouth or the anus and ultimately get into a new host possibly after passing through an embryonic period in some lower form such as an insect or a mollusk.

The parasitic Copepod, *Tracheliaestes* sp., is also frequently found upon freshwater fishes where, especially in old or in diseased fish, they become attached to the gills, sometimes in great numbers (Plate I, figure of gill). When young, these parasites bore into the soft tissues of the gill, where they retain their position by an