Original: Fish Division ✓
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Institute for Fisheries Research
R. S. Marks
C. T. Yoder
J. A. Scully
L. N. Allison

INSTITUTE FOR FISHERIES RESEARCH
DIVISION OF FISHERIES
MICHIGAN DEPARTMENT OF CONSERVATION
COOPERATING WITH THE
UNIVERSITY OF MICHIGAN

ALBERT S. HAZZARD, PH.D.
DIRECTOR

ADDRESS
UNIVERSITY MUSEUMS ANNEX
ANN ARBOR, MICHIGAN

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Report No. 1315

PROBLEMS OF FISH DISEASE IN MICHIGAN

By

Leonard N. Allison

Abstract

A laboratory for work in fish pathology was established at the State Fish Hatchery in Grayling, Michigan, in 1942. Grayling was chosen because of its central geographical location in respect to Michigan trout hatcheries.

Problems discussed are control of the bass tapeworm (Proteocephalus ambloplitis), the gill louse (Salmincola edwardsii) of brook trout, furunculosis (Bacterium salmonicida), octomitiasis (Octomitus salmonis), and gill trouble. The bass tapeworm is found in largemouth and smallmouth bass in most Michigan lakes. Smallmouth bass can be reared free of the infestation at the hatcheries, but largemouth bass fry are collected from lakes by seining and may or may not be infested. Brook trout infested with the gill louse are found in all conservation districts in the state. In the eight counties of the former Grayling district, however, this parasite is found only in several streams which originate there but flow through surrounding districts and are stocked

by other hatcheries. Brook trout in several hatcheries carry the gill louse and attempts to eradicate it by sterilization with a 200 ppm. solution of chlorine have failed, either because streams supplying the water harbor infested brook trout, or the parasite was returned to the hatchery in some unknown manner. The current policy is to stock only clean fish in waters known to be free of the gill louse.

Furunculosis has been epidemic at times among brown trout in streams of Michigan during the past decade. In the spring and fall of 1951 the first instance of mortality of rainbow trout in streams occurred in the Au Gres River, Iosco County, among migrants from Lake Huron. Further study of this phenomenon is planned.

A treatment with two grams of sulfamerazine and one gram of sulfaguanadine per one hundred pounds of fish for four consecutive days has been successful in controlling furunculosis in the hatcheries. This year, attempted prophylaxis apparently developed a strain of Bacterium salmonicida more resistant to sulfa drugs since the disease appeared in spite of the prophylaxis and at least four times the usual dose of sulfamerazine was required to bring it under control. Outbreaks of Octomitus salmonis have been successfully controlled by the use of carbarsone. Prophylaxis with this drug has also been of value in preventing octomitiasis. Gill trouble has been successfully controlled by the use of Pyridylmercuric Acetate (PMA). Weekly prophylaxis of trout fry with PMA and formalin has been used for several years with significant reduction in losses.

White blindness, a dietary malady among brook trout, is caused by a diet containing more than 25 percent horse liver. Discovery of

the specific characteristic of horse liver responsible for the disease could lead to application in human medicine since horse liver is in increasing demand by pharmaceutical companies for use in their products.

Paper presented to Midwest Wildlife Conference, St. Paul, Minnesota, December 13, 1951.

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Investigations of problems concerning fish diseases in Michigan, up to 1939, were made by Drs. Thomas Langlois, Jan Metzelaar, Louis Wolf, Wendel Krull and Lowell Woodbury, either as graduate students who were employed on a part time basis or as biologists with varied duties. I worked for the Institute for Fisheries Research from 1942 to 1947 as a District Biologist and study of fish diseases throughout the state was part of the assignment. The classification of Fish Pathologist was established by the Civil Service Commission in 1947, in which capacity I have served up to the present time. A laboratory for pathological work was set up on a small scale at the fish hatchery in Grayling in 1942 and has gradually been expanding since then. Grayling is in Crawford County, approximately ninety miles south of the Straits of Mackinac, so is centrally located in the state in respect to trout hatcheries. Since the pathologist is on call to all hatcheries in the state, a central location is important.

This paper will discuss briefly only several of the more important problems concerning diseases of fish in Michigan and will be for the

most part, limited to those problems concerning fish hatcheries, with no attempt to present a comprehensive survey. As for fish disease in nature, usually little can be done feasibly to arrest fish mortalities when they occur in our lakes and streams.

Among the problems in fish hatcheries that we elected to study were the control of the bass tapeworm (Proteocephalus ambloplitis), the gill louse (Salmincola edwardsii) of brook trout, furunculosis (Bacterium salmonicida), octomitiasis (Octomitus salmonis), and gill trouble. We were also concerned with dietary deficiencies.

The bass tapeworm, Proteocephalus ambloplitis, a parasite of large- and smallmouth bass, is now found in the majority of Michigan lakes and was also present in the bass hatcheries. When heavy infestations of plerocercoids occur in the body cavity, a severe inflammation is caused which results in a knotting of the intestines to form a hard ball, which is often noted by fishermen, who sometimes discard the fish although there is neither danger to human health nor impairment of flavor. Damage of another kind results when the larvae penetrates the ovaries in quantity, sometimes seriously reducing the reproductive capacity. Control of this parasite is therefore desired. Although control cannot be effected in a lake without removing all the fish and starting anew, the bass tapeworm can be controlled in hatcheries so that only clean bass will be introduced into new waters. In Michigan, largemouth bass fry have been collected from lakes by seining and transported to the hatchery for rearing. Since the fish become infested by the larval tapeworm when they ingest an infested copepod, the hatchery crews collect the fry as soon as possible after they leave the nest so they can be taken to clean ponds before they begin to feed. The success of this method is, of

course, quite variable as it is difficult to make collections at the proper time and to avoid collecting advanced and feeding fry with the younger uninfected fish. Brood stock smallmouth bass are held at the hatchery and the nests screened after spawning to retain all the hatching fry. To avoid possible infestation these are transferred to ponds with a spring water supply as soon as they rise from the nest. Here the method has been successful in producing smallmouth bass free of infestation by the bass tapeworm. The ultimate aim, of course, is to develop a brood stock completely free of the infestation. Attempts to do this have not met with success because the water supply to ponds available for holding brood stock bass comes from a lake harboring heavily infested adult bass.

The gill louse, Salmincola edwardsii, is found on brook trout in the streams of all twelve conservation districts of Michigan, having been well distributed by the stocking of infested fish from hatcheries. The former Grayling district, comprising eight counties, is the only area in which brook trout are free of the parasite, with the exception of a few streams that originate in the district and flow into other districts and are stocked by hatcheries in those areas.

As you know, Salmincola edwardsii, infests only brook trout, rarely causing death to the fish in natural water but making them unsightly to the angler by its presence on the gills. In small lakes and beaver dams, brook trout may be so heavily infested by the gill louse that the opercula are pushed away from the body of the trout. At the Oden hatchery holding infested brook trout, the water supply is derived from large spring ponds which harbored infested fish, thus providing a constant source of contamination. An attempt was made to eradicate the parasite by completely

sterilizing all buildings and ponds with chlorine at the strength of 200 ppm. This treatment was intended to serve a dual purpose in the elimination of furunculosis at the same time. All fish were removed from the premises, the ponds lowered and a strong solution of sodium hypochlorite added to give the desired dilution. The spring ponds were given special attention so that all fish might be killed. The treatment was patterned after the method developed in Wisconsin and Mr. D. John O'Donnell of the Wisconsin Conservation Department supervised the treatment. Mr. O'Donnell subsequently published a detailed account of the method in the Transactions of the American Fisheries Society, Volume 74. This treatment was successful for several years but the hatchery is again infested, whether by introduction of infective stages carried in stocking units, or by some other means is not known. At other stations where the gill louse is found, the water supply is obtained from streams in which infested brook trout live. Sand filters are effective in removing the infective stages of the parasite from water supplies. However, in our case they were considered too costly because of the large flow of water involved and because the gill louse could reinfest a station through unintentional relaxation of necessary quarantine measures or misfunction of the filters due to floods, etc. Since it is not feasible to eradicate the gill louse from the trout rearing stations, our management policy is to prevent the further spread of the louse by stocking infested trout only in waters known to be already contaminated and to stock clean waters with clean fish.

Furunculosis is a disease of fish caused by Bacterium salmonicida which produces external ulcerous filled with purulent pus and causes

hemorrhages in the vital organs resulting in a high rate of mortality among brook and brown trout in hatcheries, and occasionally in streams. It rarely causes mortality among rainbow trout, although they do harbor the bacteria and may serve as carriers. In Michigan, furunculosis has been present for many years in most hatcheries, and is apparently widely distributed in the streams of the state, but in such waters in this country it rarely assumes epidemic proportions. During the past ten years there have been only three serious mortalities among brown trout in the streams of Michigan, and each time the outbreak has occurred in only one stream. Although a few brown trout killed by the disease are found in the streams each year, it is unusual to find a brook trout with the characteristic external lesions. We must constantly be on guard, however, at certain rearing stations during the summer months because the disease may strike suddenly and claim high losses before control measures can be put into effect. Previous to 1946, the only known method of eradicating the disease from a station was to destroy all the trout, sterilize all ponds, buildings, equipment, clothes, etc., and begin anew. In 1946, J. S. Gutsell (1946) of the U. S. Fish and Wildlife Service discovered that certain sulfa drugs were effective in controlling furunculosis. S. F. Snieszko, J. S. Gutsell, S. B. Friddle, (1948) subsequently determined that sulfamerazine was the most valuable one for treatment of the disease. Since that time we have been successful in arresting the progress of an outbreak within four days time. Kenneth Flakas of the Wisconsin Conservation Department reported in the Transactions of the American Fisheries Society, Volume 78 (1948), that the addition of sulfaguanidine prevented recurrence of outbreaks after treatments with sulfamerazine alone. He reported that sulfamerazine destroyed the pathogen

in the blood stream but not in the intestine and that the latter reinfected the blood. The addition of sulfaguanidine eliminated the bacteria in the intestine and thus reinfection from this source was prevented. In some Michigan fish hatcheries, the water supply is derived from streams in which infected trout live and for this reason treatments are designed to control outbreaks as they occur rather than to completely eradicate the disease. The dose used, however, is considerably less than that employed in most other states. Gutsell and Snieszko recommended eight grams of sulfamerazine to one hundred pounds of fish fed daily for at least eight days. Our dose is approximately two grams per one hundred pounds of fish, plus one gram of sulfaguanidine fed daily for four consecutive days. Using this treatment losses were back to normal within the four days. This year, two stations undertook to use sulfamerazine as a prophylactic, with unfortunate results. After about two months of prophylaxis, furunculosis broke out and losses were heavy until the dose was increased to six grams per one hundred pounds of fish. This is evidence that a more resistant strain of Bacterium salmonicida was built up, although the Michigan strain is apparently less virulent than that encountered in some other states.

It is a well known fact that rainbow trout are resistant to furunculosis and rarely show symptoms of the disease, even when held in hatcheries where brook and brown trout are frequently affected. This year, however, a mortality among spawning rainbow trout from Lake Huron was observed in the Au Gres River, Iosco County, Michigan. External blisters, hemorrhages on the swim bladder and other common symptoms of furunculosis were found on the specimens. Since the disease is rare in this species of trout, we were hesitant to make a diagnosis of furunculosis, in spite of the obvious symptoms. However, cultures taken from the kidneys

were made on Dr. Snieszko's medium No. 4 for the isolation of Bacterium salmonicida and proved to be positive. The culture was sent to Dr. Snieszko, who verified the diagnosis. A mortality also occurred in the same river late in October and early in November this year (1951) among the fall run of rainbows from Lake Huron and furunculosis was again demonstrated. Further study of this phenomenon is planned to determine, if possible, whether the disease was present in the fish when they came from Lake Huron or whether the disease was contacted after entering the stream. Previous to the spawning run, the stream had been stocked with rainbow trout from a hatchery where furunculosis is of frequent occurrence.

Octomitus salmonis is a protozoan parasite occurring in the intestine of trout. Some authorities are of the opinion that heavy infestations of Octomitus are the cause of the high mortalities among fingerling trout and recommend treatment with calomel or carbarsone. Others believe that mortalities occurring in association with this parasite are caused by faulty diet and recommend a change in diet. Undoubtedly both views have merit but it has been our experience in Michigan that treatment with carbarsone has been beneficial in all cases. A loss was experienced every spring at two hatcheries when brook and rainbow trout fingerlings were transferred from troughs in the building to ponds outside. Although Octomitus could not be demonstrated in one hundred percent of the cases, this loss has been completely eliminated in recent years by treating the fish with carbarsone each week for three weeks prior to the time they are transferred, followed by one treatment after transfer. Occasional outbreaks at other stations have also been successfully brought under control by the use of carbarsone.

Gill trouble has, in the past, caused high mortalities among trout at various Michigan hatcheries where it usually affects small fingerlings but occasionally is found in four- and five-inch trout. In some instances it has been possible to demonstrate the long, slender bacteria described by H. S. Davis (1926, 1927) as the cause of the Eastern type of gill disease, but in many other cases, the characteristic bacteria are absent. F. F. Fish (1935) described a western form of gill disease but was unable to find a bacterium that might be responsible for the malady. Evins and Wales (1937) described gill trouble caused by irritation from diatoms and other sestons. And finally, L. Wolf (1944) reported that gill trouble similar in appearance to the western type was caused by a deficiency of pantothenic acid in the diet. This observation was confirmed by A. M. Phillips, unpublished. In all cases in Michigan, treatment with PMA (Pyridylmercuric acetate) has reduced the mortality, although several treatments are sometimes necessary. Although the recommended dilution is 1 to 500,000 we have successfully used a dilution of 1 to 350,000 on brook trout four and five inches long. We have learned, as have others, that rainbow trout fingerlings cannot stand as strong a solution of PMA as can brook and brown trout. Gill trouble in rainbow trout fingerlings from one-half to one inch long has been successfully controlled using a dilution of 1 to 600,000 for one hour.

For several years most Michigan trout hatcheries have been using a weekly prophylactic treatment with two chemicals combined, PMA (1 to 500,000) and formalin (1 to 4,000) for a period of one hour on brook and brown trout. The prophylaxis is initiated early in the sac fry stage and has resulted in a significant reduction of losses among trout fry held in troughs. Before the weekly treatments were given, losses among

the fry were caused by gyrodactylid worms, gill trouble, and Epistylus. Since prophylaxis was instituted, losses from these agents are rare, and when they do occur, the cause can usually be traced to irregularities in prophylaxis.

In these times of high prices and unavailability of choice meat products for trout diets, many problems involving dietary deficiencies arise. Several years ago we were confronted with a very interesting problem regarding the diet of brook and lake trout. We called the ailment white blindness because the skin of affected fish turned very pale in color and the crystalline lens became opaque. Brown and rainbow trout were not affected. Since white blindness was described in Volume 80 of the Transactions of the American Fisheries Society, it will not be necessary to discuss it in detail here. However, I would like to point out that the cause was traced to diets containing more than twenty-five percent raw horse liver fed continuously for at least seven months. Due to the lack of adequate facilities we do not plan any further studies to determine what specific characteristic of horse liver causes the ailment in brook trout or why brown and rainbow trout are not affected. It is a study, however, that might prove to be a profitable one. The study of fish diseases has been in several instances, of great importance to human medicine. One such instance is the well known study made by Marine and Lenhart (1910a, 1910b, 1911) of the cause of goitre in fish and its relation to goitre in man. They found goitre common in several species of fish from Lake Erie. Since the Great Lakes area was well known as an endemic area of goitre in man, they reasoned that since it also occurred in fish,, the cause might be found in the water. As you know, they found the cause

to be a lack of iodine and Marine presented his findings on the prevention and cure of goitre in the Journal of Experimental Medicine in 1914. Iodized salt has been in common use in much of the goitre area following this discovery. Since the use of horse liver in therapy of human ailments is increasing, as indicated by the demands for the product by prominent pharmaceutical companies, further study of its affects on fish might lead to valuable application in human medicine.

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Leonard N. Allison

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