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THE SPREAD OF WHIRLING DISEASE, MYXOSOMA CEREBRALIS,
INTO NATIVE TROUT POPULATIONS IN MICHIGAN¹

By Warren G. Yoder

Abstract

Whirling disease of salmonids, caused by Myxosoma cerebralis, was discovered in north-central Michigan in 1968. Examinations of trout 2 years later revealed that this disease had spread from infected rainbow trout (Salmo gairdneri) in the hatchery to native brook trout (Salvelinus fontinalis) and brown trout (Salmo trutta). These infected native trout were collected from the 6-7 miles of stream below the infected source. Brook trout had a higher incidence of whirling disease than did the brown trout, although both species were in nearly equal abundance.

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Introduction

Whirling disease, caused by the Myxosporidian (Protozoa) Myxosoma cerebralis, has spread across the continental United States since it was first identified at a Pennsylvania trout hatchery in 1956 (Hoffman et al., 1961). In August 1968, this disease was discovered in Michigan in three commercial trout hatcheries. These hatcheries were owned and operated by a group of three businessmen. Subsequent investigations revealed that whirling disease had been spread to other trout ponds, both commercial and private, by fish transfers from the originally infected hatcheries (unpublished data). The trout infected were rainbow trout, Salmo gairdneri.

The spread of whirling disease from infective sources into natural watersheds has not been well documented. Outbreaks of the disease have been reported from hatcheries, but fish in natural watersheds below these infected sources were not monitored for the disease. However, there is evidence that whirling disease is carried to locations downstream. In 1957 and 1958, the disease was present in a private hatchery in Pennsylvania upstream in the watershed from the Lamar National Fish Hatchery (Hoffman et al., 1961); by 1960, the disease was discovered in fish at the Lamar Hatchery.

The only reference reporting infected fish in a stream is from Russia (Uspenskaya, 1957). There, in 1954, M. cerebralis was found in a trout hatchery where brood stock rainbow trout (Salmo irideus) had

been introduced several years earlier. In 1956, wild brown and rainbow trout infected with this parasite were found in the watershed downstream from the hatchery.

The whirling disease infection studied in this report occurred in the upper watershed of the North Branch of the Tobacco River, Clare County, Michigan (Fig. 1). The commercial hatchery which was initially infected is located on the uppermost tributary (Jose Creek); this hatchery reared only rainbow trout (Salmo gairdneri). The purpose of the present study was to assess the spread of the disease from the hatchery to wild trout, and to determine the extent of the disease in the watershed. The watershed flows into Lake Huron. The Tobacco River produces brook and brown trout; two rainbow trout which I examined were escapees from the hatchery.

Procedures

Trout samples were collected from the streams with electrofishing equipment, and the trout were either kept fresh on ice in the field, or they were preserved in 10% formalin. The fresh samples were brought to the Grayling Research Station, separated according to species, and frozen for temporary storage. The collection sites were selected on the basis of ease of access, distance from the commercial hatchery, and as tributaries to the main infected stream. The 1968 trout samples were collected during a short time span, whereas the 1970 sampling was conducted at each site until 50 trout were obtained.

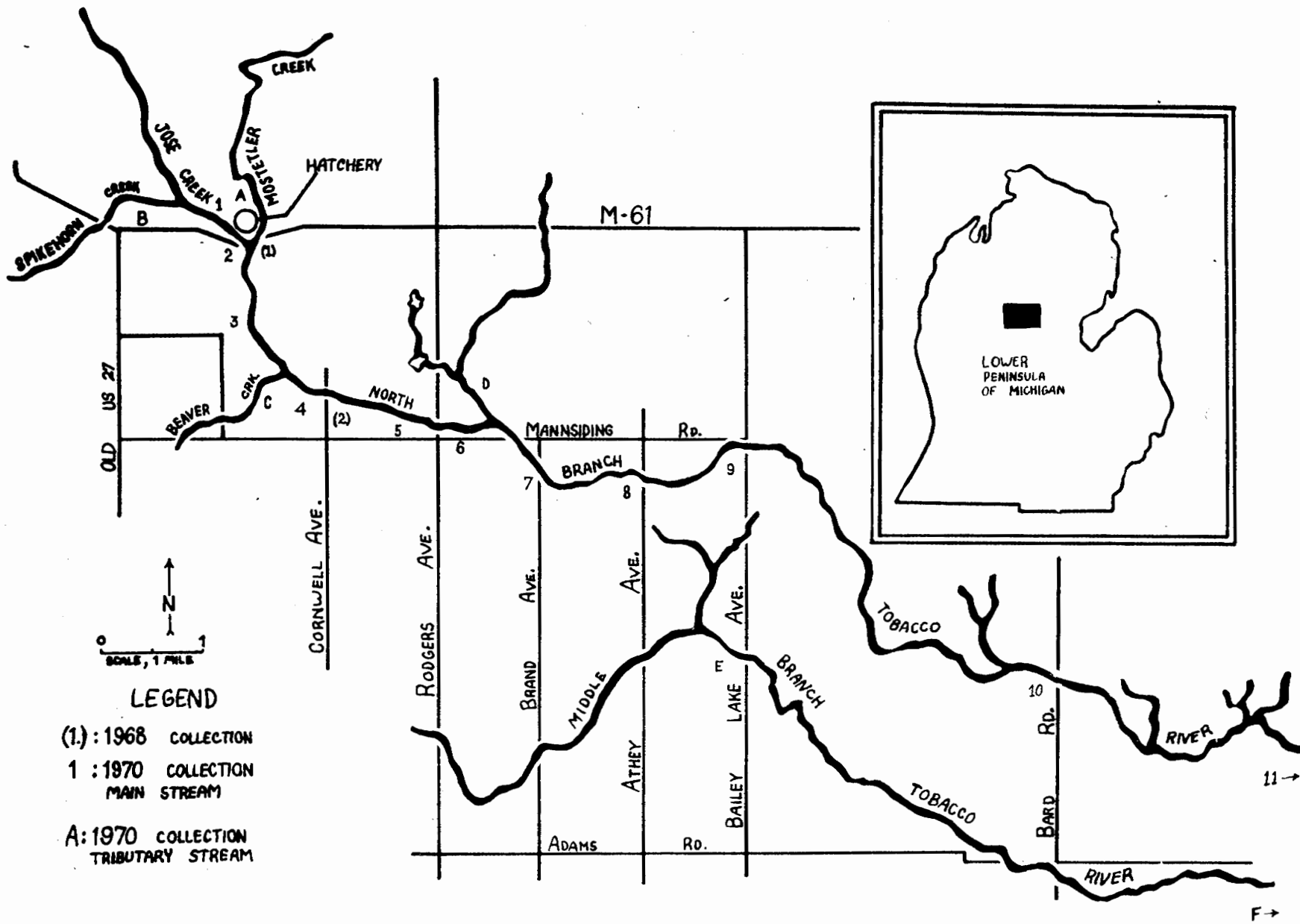


Figure 1. --Map of North Branch of Tobacco River, Clare County, showing collection stations on the river and on tributaries, 1968-1970.

The first collections were made in November 1968, approximately 3 months after the initial infection was found in the trout hatchery on Jose Creek. The 1970 collections were started some 16 months after the initial infection was discovered; 17 collections were made on the mainstream and tributaries thereof. Eleven of the 17 collections came from Jose Creek and the North Branch of the Tobacco River.

The diagnosis for whirling disease was based on the presence or absence of M. cerebralis spores. The trout from the collections were grouped into "pools," or lots of five trout each, with some exceptions where single fish were examined. The heads were removed from the fish and placed in "hot" water (40-45 C) for 2-3 minutes or until the skin and flesh readily fell away from the cranium (Meyers and Scala, 1969). The cranium was dissected, and portions of bone, cartilage, and the auditory capsule were placed in a mortar. The materials were mascerated with scissors and then ground with a pestle to create a pulp (Hoffman et al., 1962). About 10-15 ml of distilled water was added to the pulp to create a slurry. Drops of this slurry were then examined microscopically at 450X for spores of M. cerebralis.

Results

The 1968 stream collections of trout (Table 1) contained brook (Salvelinus fontinalis), brown (Salmo trutta), and 1 rainbow (Salmo gairdneri) trout. The single rainbow trout (5.6 inches long)

Table 1. --Whirling disease examination results on mainstream of the North Branch Tobacco River

Station number ¹	Collection date	Trout species	Number of fish	Examination results ²	Number of slurries ³
(1)	11-21-68	Rainbow	1	+	1/1
		Brook	1	-	0/1
		Brown	12	-	0/5
(2)	11-21-68	Brook	9	-	0/5
		Brown	6	-	0/2
1	4-13-70	Brook	20	+	1/4
		Brown	38	-	0/8
2	1-28-70	Rainbow	1	-	0/1
		Brook	13	+	1/2
		Brown	51	+	3/19
3	3-31-70	Brook	11	+	2/2
		Brown	15	+	1/3
4	4-13-70	Brook	17	+	4/6
		Brown	33	-	0/5
5	4-14-70	Brook	29	+	5/6
		Brown	21	-	0/4
6	5-11-70	Brook	10	+	2/2
		Brown	43	-	0/8
7	4-14-70	Brown	49	-	0/10
8	4-14-70	Brook	1	-	0/1
		Brown	49	-	0/10
9	4-23-70	Brook	2	-	0/2
		Brown	48	-	0/9
10	4-23-70	Brown	25	-	0/5
11	4-18-70	Brown	50	-	0/10

¹ Numbered consecutively downstream by the collection station.

² + denotes that infected trout were present
 - denotes that no infected fish were found.

³ Number of infected slurries per total slurries.

was infected with M. cerebralis. This rainbow trout was collected about 1 mile downstream from where the hatchery outlet enters Jose Creek (Fig. 1). It was considered to be an escapee from the infected hatchery. The brook trout (6 slurries) and brown trout (7 slurries) were not found to be infected. The brook trout ranged in length from 2.5 to 5.8 inches, and the brown trout were from 3.1 to 4.8 inches long.

The 1970 collections (Table 1 and Fig. 1) consisted again of brook trout, brown trout, and 1 rainbow trout. Their length ranges were as follows: rainbow, 9.6 inches; brook, 2.3 to 10.7 inches; and brown, 1.5 to 15.1 inches. Brook trout were collected at 8 of the 11 mainstream stations (Jose Creek and North Branch Tobacco River), and some infected fish were found at each of the first six stations (1-6, Fig. 1); for these six stations, 15 slurries out of 22 (or 68%) were infected. Brown trout were collected at all 11 mainstream stations; infected brown trout were found only at Stations 2 and 3; for Stations 1-3, 4 slurries out of 30 (13%) were infected. No infected trout were found in 47 slurries from 221 brown trout and 3 brook trout at Stations 7-11. The single rainbow trout from Station 2 was not infected.

In the six collections taken during 1970 from tributaries of Jose Creek and the North Branch Tobacco River (Fig. 1), no infection was found among 112 brook trout and 152 brown trout (Table 2).

During the 2 years, from 1968 to 1970, the disease has become established among native brook trout and brown trout, and has spread

Table 2. --Whirling disease examination results for tributaries of the North Branch Tobacco River

Station letter ¹	Collection date	Trout species	Number of fish	Examination results ²	Number of slurries
A	3-25-70	Brook	50	-	10
		Brown	1	-	1
B	3-31-70	Brook	24	-	5
		Brown	39	-	8
C	4-21-70	Brook	26	-	5
		Brown	28	-	6
D	4-24-70	Brook	9	-	2
		Brown	10	-	2
E	4-18-70	Brook	3	-	1
		Brown	47	-	10
F	4-18-70	Brown	27	-	6

¹ Lettered consecutively downstream.

² No evidence of infection was found.

downstream about 6 miles below the hatchery where it started. It was more prevalent among brook trout than among brown trout, and I did not find it in tributaries.

With the exception of one brown trout, none of the 1970 trout examined exhibited physical symptoms of whirling disease. The single brown trout was from the area below the outlet on Jose Creek (Station 2). It had an obviously sunken skull, a characteristic of whirling disease; however, in extensive microscopic examination I could not find spores of M. cerebralis. No histological examination was made on this trout.

Discussion

It is apparent that whirling disease spread rapidly down the first 6 miles of stream. Rapid spread was favored by heavy disease incidence at the hatchery, abundance of susceptible trout, and trout movement. The disease at the hatchery was present in rainbow trout in six of seven dirt ponds (unpublished data). This infection of the hatchery was assumed to have begun in the late summer of 1967. Thus, the disease had at least a year to increase in the ponds and infect the stream, before it was discovered in August of 1968. The total time span, from introduction to discovery among native trout in 1970, was about 28 months.

Some infected trout moved upstream into Jose Creek (Station 1) above the hatchery outlet. Infected trout were collected from this stretch of stream, beginning just above the outlet and extending 1,500

feet upstream. The incidence of the disease here was lower than below the outlet (Station 2). Above the outlet, 1 slurry in 4 showed infection of brook trout; none in 8 for brown trout. Below the outlet brook trout were infected in 1 of 2 slurries, and brown trout in 3 of 19 slurries.

The pooling of trout into the examination slurries does not give an accurate percentage figure of infected trout. Brook trout were estimated to be 50% infected, and the brown trout 1%, in the 6-7 miles of stream immediately below the hatchery outlet. The rates of infection should be related to the abundance of the two trout species. In the upper 6-7 miles of the North Branch Tobacco River, the brook trout and brown trout are about equally abundant. Progressively downstream the brown trout is more abundant. The natural resistance of brown trout to whirling disease, along with a diminished spore concentration downstream, may explain the non-infection of brown trout beyond the first mile or two below the hatchery. The occurrence of whirling disease in brook trout and brown trout in the Tobacco River corresponds to host reports from the United States (Hoffman et al., 1961).

Based on the results of this study, Jose Creek, the North Branch Tobacco River, and their tributaries were treated in 1970 to remove the infected fish populations (Hnath, 1970).

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INSTITUTE FOR FISHERIES RESEARCH

Warren G. Yoder

Report approved by G. P. Cooper

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