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STUDIES ON THE DISAPPEARANCE OF DEAD TROUT IN THE PIGEON RIVER

By

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This paper presents the results of the third in a series of observational studies to determine the length of time required for dead trout to completely disintegrate in a stream environment. As indicated in a preceding report, I. F. R. Report No. 1392, the reason for this study was to acquire data which would be of use in answering questions concerning the disappearance of planted trout; many planted trout do not reach the fishermen's creel and their fate is unknown. Previous studies were conducted by using brook trout (Salvelinus fontinalis), brown trout (Salmo trutta), and creek chubs (Semotilus atromaculatus). This third study involved the use of rainbow trout (Salmo gairdneri).

Experiments were conducted during the period of August 12 to September 13, 1954, at the Pigeon River Trout Research Area, in the same section (Section B) of stream where the 1953 study was carried out. The period of study was selected so as to have the dead trout in waters that were of warmer temperatures than prevailed during the previous studies.

The fish for the 1954 study were obtained from the Sturgeon River Rearing Station at Wolverine. These fish ranged in size from 4.2 to 7.5 inches. They were placed alive in a five-gallon container that was one-half full of water, and allowed to expire naturally. They were then measured and weighed, and an identification tag was attached to each one. The fish were obtained from the

rearing station at 5:00 P.M. on August 11; in the container they were all dead by 8:00 P.M.; and they were left in water in the container until 9:00 A.M. on August 12, at which time they were tied out in the stream.

As in the 1953 study, each fish was affixed by its lower jaw to a short length of monofilament line. The series of fish were staked out in a consecutively alternate sequence from the two stream banks. No fish were tied out in the middle of the stream. Table 1 lists the physical conditions in the stream at the site of each fish. Current was rated according to the manner in which it acted on the tied-out fish. A current was recorded as strong when the monofilament line was consistently taut between the dead fish and the point of attachment; as medium, when the line was occasionally taut; as mild, when the line was occasionally billowed out from its point of attachment; and as slow, when there was some perceptible movement of the suspended fish. Current was labelled as "reverse," or as "whirlpools," when in direct opposition to the main flow of the stream. The Pigeon River is of relatively open character in this section, and bank cover is predominately shrubs with a few open grassy spots and embedded logs comprising the rest of the shore cover.

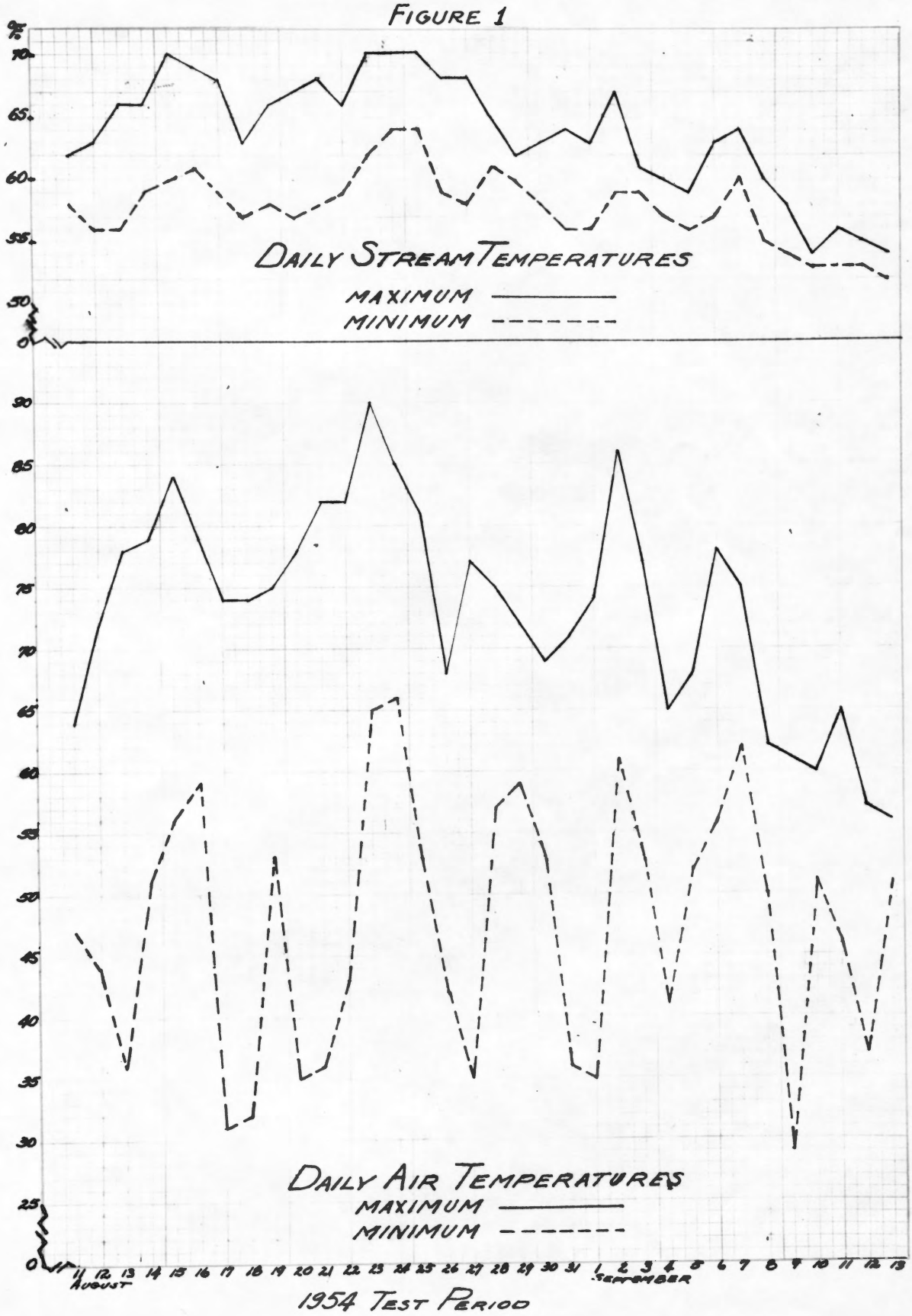
Stream temperatures fluctuated between 52° F. and 70° F., with an average daily maximum of 64° F. and an average minimum of 58° F. for the 1954 study as compared to a range of 49° F. to 67° F. with an average daily maximum of 60° F. and an average minimum of 54° F. for the 1953 study. Stream temperatures were taken from the U. S. Geological Survey's Water-Stage Recorder on the Pigeon River. Air temperatures were taken from records of daily observations at the weather station on the research grounds. Figure 1 is a graph of the daily fluctuations of maximum and minimum stream and air temperatures recorded during the study.

Figure 2 shows the rate at which the fish disappeared from the stream, both in terms of partial and complete disappearance.

Table 1.--Physical environment where each test fish was tied out in the Pigeon River

Fish No.	Size (inches)	Bottom type	Shore cover	Current	Stream depth (inches)	Notes
1	7.1	Gravel	Shrubs	Medium	14	Upper end of pool
2	6.4	Sand-silt	Shrubs	Whirlpool	12	Undercut bank
3	6.7	Sand	Shrubs	Medium	6	Shaded
4	7.5	Sand-silt	Shrubs	Medium	12	Upper edge of bank pool
5	6.1	Gravel	Shrubs	Medium	3	Shaded
6	6.5	Sand-silt	Shrubs	Whirlpool	8	Shore pocket
7	6.7	Sand	Shrubs	Medium	6	Shaded
8	5.7	Gravel	Shrubs	Strong	34	Upper edge of bank pool
9	7.0	Silt	Shrubs	Mild	1	Open part of stream
10	7.3	Gravel-sand	Shrubs	Mild	30	Shaded
11	5.8	Silt	Logs-shrubs	None	12	Behind log deflector
12	5.8	Sand	Shrubs	None	1	Inside edge of bank pool
13	7.0	Gravel	Shrubs	Reverse	14	Upper edge of pool
14	5.4	Silt-muck	Shrubs	None	3	Inside edge of bank pool
15	5.3	Gravel	Logs-shrubs	Slow	24	Lower edge of pool
16	6.4	Sand	Grass	Medium	12	Open part of stream
17	6.1	Gravel	Shrubs	Strong	8	Edge of gravel riffle
18	6.1	Sand	Shrubs	Mild	2	Under stump
19	5.7	Silt-sand	Shrubs	Medium	8	Dense patch of aquatics
20	6.3	Gravel	Shrubs	Strong	8	Edge of bank pool
21	5.5	Sand	Shrubs	Medium	3	Inside edge of pool
22	5.3	Gravel	Shrubs	Medium	10	Lower edge of bank pool
23	5.8	Silt	Shrubs	Mild	1	Open part of stream
24	5.9	Gravel	Logs	Med.-strong	1	Behind embedded logs
25	4.8	Sand	Shrubs	Med.-strong	6	Dense patch of aquatics
26	5.0	Sand	Logs	None	14	Behind log deflector
27	5.0	Gravel	Shrubs	Mild	2	Open part of stream
28	4.2	Silt	Shrubs	Mild	2	Dense patch of aquatics

FIGURE 1



1954 TEST PERIOD

FIGURA 2

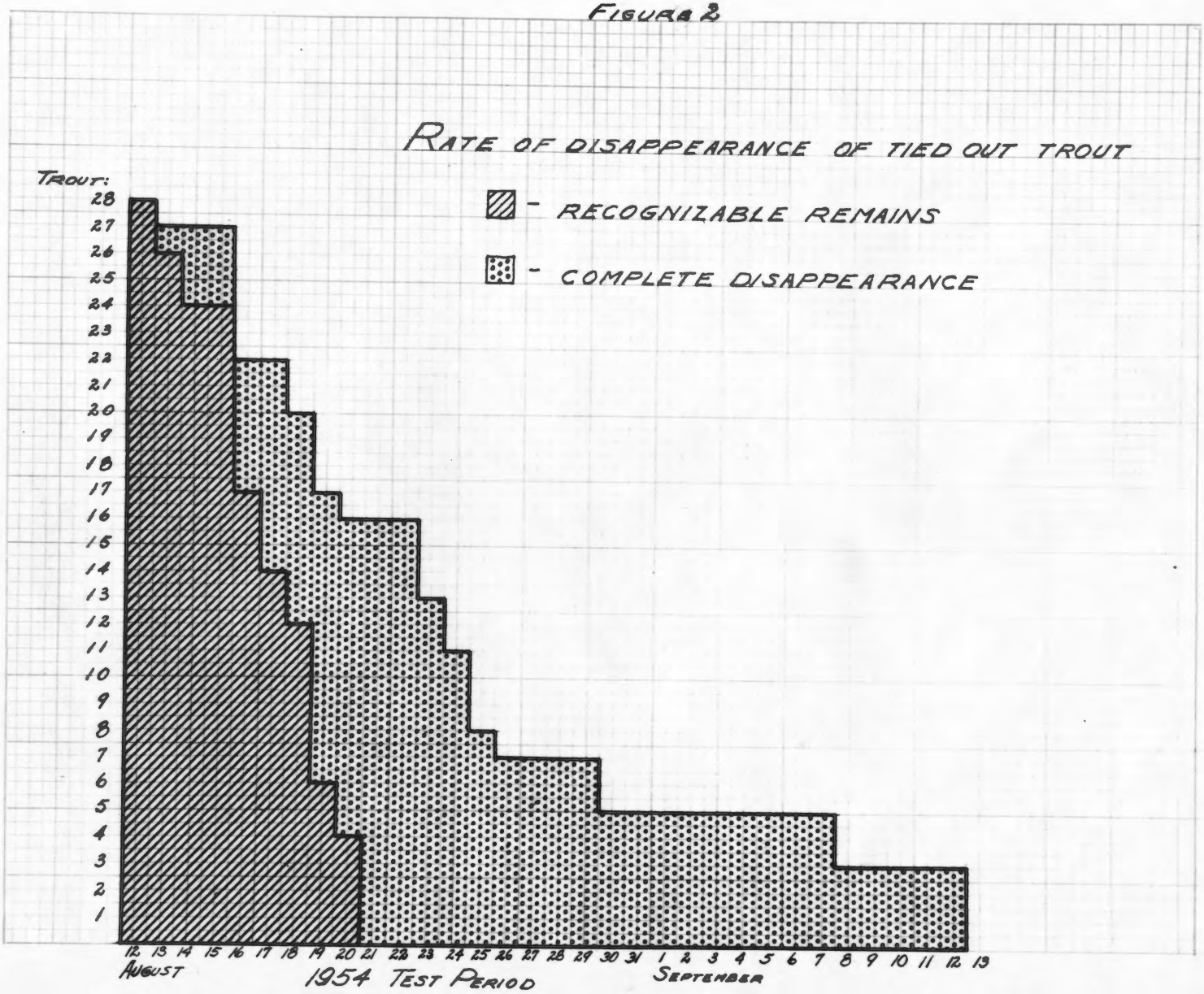

RATE OF DISAPPEARANCE OF TIED OUT TROUT
TROUT:
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
- RECOGNIZABLE REMAINS
- COMPLETE DISAPPEARANCE
12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13
AUGUST
1954 TEST PERIOD
SEPTEMBER

Table 2 is a record of the time interval, in days, between the placing of the dead fish in the stream and different degrees of disintegration.

The amount of time for disintegration to a stage where the remains are still recognizable as a fish is of greater significance than the time involved in disintegration to the last vestige of bone. An untied lower jaw bone of a small trout would be difficult, if not impossible, to notice in a stream environment. In Table 2, the column titled "Recognizable remains" represents the stage of disintegration beyond which recognition of the fish remains would be very difficult. The average time required for all fish to disintegrate to a point where there were still recognizable remains was 4.5 days with a range of 1 to 8 days, while an average of 12.8 days, with a range of 1 to 32 days, was the time required for all fish to completely disappear.

Rates of decomposition were not greatly influenced by either strength of current or depth of water in which the dead fish were placed. Invariably, all tied-out trout, with the exception of those placed in a strong current or deep water, would sink to the bottom when first placed in the stream. The bloating of the flesh which ensued within forty-eight hours caused the fish to float or, because of the current, to come to rest or be swept behind some underwater object. The coating of fungus (Saprolegnia sp.), which inevitably enveloped the fish and was generally apparent within seventy-two hours after the fish had been placed in the stream, entrapped silt and detritus and became an effective agent in camouflaging the dead fish. When the fungus had reached its maximum growth, all recognizable features of the fish were entirely covered and the silhouette of the fish had been completely changed.

Until some part of the body wall had been broken--usually occurring in the abdominal region--the dead fish continued to float. Although the posterior extremities of the fish might be the first to erode away, there was no constant pattern of disintegration. In a great many cases, a complete

Table 2.--Time interval in days between placing dead rainbow trout in Pigeon River and their complete disappearance

Fish No.	Degree of disintegration					
	1/4 gone	1/2 gone	Recognizable remains	3/4 gone	Only mandible remaining	Entirely gone
1	5	...	6	...	...	7
2	1	...	6	...	7	32
3	...	...	3	...	...	4
4	4	...	6	7	...	12
5	...	...	...	1	...	4
6	...	...	8	...	11	13
7	...	...	...	...	...	1
8	4	7	8	...	...	11
9	...	...	3	...	...	4
10	...	...	1	5	7	8
11	...	...	6	7	...	13
12	1	...	3	...	4	18
13	7	...	7	8	12	32
14	7	...	8	11	...	12
15	1	5	5	6	...	7
16	1	...	6	...	7	27
17	4	...	7	...	...	8
18	1	...	3	...	...	4
19	...	...	3	4	6	18
20	...	...	6	...	7	32
21	...	1	3	...	...	4
22	...	1	4	5	...	6
23	...	...	3	4	...	6
24	...	...	8	...	...	11
25	1	4	5	6	7	11
26	...	...	1	...	4	27
27	1	...	4	5	...	14
28	...	...	4	5	...	13

separation would occur between the head and body regions, the head remaining attached to the monofilament line until further breakdown caused complete separation of all connecting bones and left only the mandible attached to the line. The then well-cleaned lower jaw bone was quite free from further decay and no doubt would have remained attached to the monofilament line for an extended period had there not been any unusual stream level fluctuations.

On August 26, fourteen days after the installation of the dead trout in the stream, only the mandibles of seven fish remained attached to the monofilament lines. These seemingly non-disintegrating bones disappeared slowly during the next eighteen days. This extended period of eighteen days, in view of the 1953 data, misrepresents what had actually occurred. In reality the fish had disintegrated but the retention of the jaw bone (perhaps the knots securing the mandible to the monofilament were more snug in these instances than in the other fish) extended the period recorded as required for the complete disintegration of the fish. In 1954, it took 32 days for disappearance of the final jaw bone, whereas in 1953, the last jaw bone disappeared in 22 days.

During the 1954 study, 138 anglers were issued permits for Section B, and it is known that a major, but unrecorded, portion of the anglers fished through the test area. No angler reported seeing any dead trout during the 1954 study, nor were any dead fish reported during the 1953 study. As mentioned before, after the fish had become silt-encrusted they were camouflaged from detection by casual observation.

The twenty-eight test fish tied out in this study area, which was two hundred yards long, were readily available to any scavenger working this section of the stream. Again, for the 1954 study, as for the 1953 study, it is believed that snapping turtles (Chelydra serpentina) were largely

responsible for the early disappearance of some of the test fish. One observational trip made after dark revealed that crayfish (Cambarus sp.) were actively feeding on most of the dead fish. Creek chubs were noticed trying to remove the trout from two of the sites when they were first placed in the stream, but as soon as a coating of fungus had covered the dead fish the chubs left them alone. Active, larval caddis flies were seen on several of the fish that were lying on the bottom of the stream, but they did not appear to be feeding on the flesh. Sea gulls and raccoons, which are frequently seen in the area, were not noticed during the 1954 test period.

The 1954 test fish appeared to become soft and to show the advanced stages of decomposition much sooner than the 1953 test fish. While the fact can not be overlooked that two different species of fish were involved, brown trout in 1953 and rainbow trout in 1954, and in view of the observations recorded during previous tests, this third study also demonstrated that warm waters hasten decomposition. It is also believed that the higher average water temperatures induced a greater population of microorganisms which materially aided in the rapid disintegration of the 1954 test fish.

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