Original: Fish Division
cc: Education-Game
Inst. for Fish. Res.
D. S. Shetter
E. H. Bacon
J. A. Scully
C. T. Yoder
R. S. Marks

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

December 9, 1953

Report No. 1392

STUDIES ON THE DISAPPEARANCE OF DEAD TROUT AND CREEK CHUBS IN THE PIGEON RIVER

By

Edward H. Bacon

Abstract

Experiments were conducted at the Pigeon River Trout Research Area during the periods of March 3 - April 20, 1950, and May 19 - June 10, 1953, to determine the length of time required for a dead trout or creek chub to disappear from a stream environment. A maximum of forty-four days was required for disintegration of the 1950 test fish as opposed to a maximum of twenty-two days for the 1953 test fish.

The 1950 test fish were enclosed in individual hardware cloth boxes whereas the 1953 test fish were tied out in the "open." While the 1950 test fish were immune from all but the smallest scavengers, the 1953 test fish were readily available to all sizes of scavengers. It is believed that snapping turtles (Chelydra serpentina) were largely responsible for the early disappearance of most of the 1953 test fish.

The accumulated data demonstrate the fact that the warmer the water the greater the rate of decomposition.

After the 1953 test fish had been in the stream for three days, silt and detritus had coated the body surfaces sufficiently to camouflage them from casual observation.

Original: Fish Division
cc: Education-Game
Inst. for Fish. Res.
D. S. Shetter
E. H. Bacon
J. A. Scully
C. T. Yoder
R. S. Marks

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

December 9, 1953

Report No. 1392

STUDIES ON THE DISAPPEARANCE OF DEAD TROUT AND CREEK CHUBS IN THE PIGEON RIVER

By

Edward H. Bacon

Since research has shown that a great many planted trout never enter the fishermen's creel or continue their existence elsewhere, the Conservation Department's Fish Division has been plagued with requests to account for this unexplainable disappearance. While predators do account for a small portion of the uncaught fish, it is the larger portion that disappears for some unknown cause. If these uncaught fish were to die "en masse," it is quite probable that they would be observed and reported by fishermen. It is when the fish die off singly or a few at a time that they escape casual observation and, depending on water temperatures, disintegrate within a short time. The purpose of this paper is to describe certain observations on what happens to dead trout and creek chubs in the stream and how long it takes for them to disappear.

During March and April, 1950, an experiment was conducted at the Pigeon River Trout Research Area to determine the length of time required for dead fish to completely disintegrate. Brook trout (Salvelinus fontinalis), brown trout (Salmo trutta), and creek chubs (Semotilus atromaculatus), two of each species, were put in individual hardware-cloth boxes, 1/4 inch mesh, and

placed in the stream, some over a silt bottom, others over gravel. The experiment was initiated on March 7 and terminated after forty-four days on April 20 when the fish were almost completely decayed and were thoroughly incorporated with algae, fungus, and detritus. No water temperatures were recorded. (Note: reports on file show the average stream temperature for the period of March 3 to April 20, 1951, was 38° F.; for the period of March 1 to 14, 1952, 36.5° F.) There were no differences in the rates of decomposition for the three species of fish.

A second experiment was conducted at the Pigeon River Trout Research Area during the period of May 19 to June 10, 1953. Dead brown trout, affixed to short lengths of monofilament line, were tied out in various types of stream environment. The purpose of this experiment was to determine the length of time required for a dead trout to completely disintegrate under warmer water temperatures than prevailed during the 1950 experiment.

The trout for the 1953 experiment were obtained from the Sturgeon River Rearing Station at Wolverine. All fish used for this test, ranging in size from 6.3 to 9.5 inches, were placed alive in a five-gallon container that was one-third full of water, and the fish were allowed to expire naturally. All fish were dead upon arrival at the Pigeon River Headquarters. The time interval between procuring the fish and tying them out in the stream was about four hours. The fish were staked out consecutively on alternate sides of the stream bank. The sites selected were specifically chosen so as to include a great variety of stream conditions. 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. The stream section used for this test is in the upper portion of the Research Area's Section B and is of relatively open character. Shrubs, comprised mainly of willows, tag alders, nine-bark, and red-osier dogwood, form the predominant bank cover. A few spots, devoid of shrubs, were grass

Table 1

Physical environment of each fish tied out in the Pigeon River

Fish No.	Size (in.)	Bottom type	Shore cover	Current	Depth of water(in.)	Notes
1	9.5	Silt-sand	Shrubs	Medium	10.3	Open part of stream
2	8.8	Sand-gravel	Open-logs	Medium	10.2	Chubs spawning in this area
3	8.5	Silt-sand	Shrubs	Medium	12.8	Medium shade
4	5.8	Silt	Shrubs	Medium	10.0	Open part of stream
5	8.5	Silt-sand	Shrubs	Reverse	7.8	Downstream side of deflector
6	7.0	Gravel	Shrubs	Strong	21.0	Fish suspended in water
7	8.5	Gravel	Shrubs	Strong	5.5	Shaded
8	7.0	Silt-grass	Shore pocket	Medium	8.5	Open edge of bank pool
9	9.1	Silt	Shrubs	Weak	0.7	Fish half-in half-out of water
10	6.5	Silt-gravel	Undercut bank	Reverse	10.0	Soil erosion at edge of bank
11	7.7	Sand-silt	Shrubs	Medium	25.5	Chubs spawning in this area
12	6.3	Sand	Shrubs	Medium	5.5	Open part of stream
13	8.5	Gravel	Undercut bank	Medium	15.5	Fish suspended in water
14	7.0	Silt-grass	Grass	None	2.5	Open part of stream
15	6.5	Silt	Open	Slight	3.7	Spring feeder here - 54° F.
16	8.0	Gravel	Shrubs	Strong	9.0	Shaded
17	7.8	Muck-algae	Open	Slight	3.5	Spring feeder here - 53° F.
18	7.5	Roots-rocks	Shrubs	Slight	2.8	Head end of deep pool
19	8.5	Debris-sand	Shrubs	Medium	6.0	Inside bend of pool
20	8.0	Silt-roots	Undercut bank	Medium	4.0	Edge of bank pool
21	9.3	Silt-sand	Grass	Slight	1.5	Fish half-in half-out of water
22	8.3	Silt-gravel	Open	None	17.0	Downstream side of deflector
23	8.8	Gravel	Undercut bank	Strong	7.0	Side channel - embedded logs
24	8.5	Silt	Stump-shrubs	Medium	4.0	Dense clumps of shrubs on shore
25	8.0	Silt-gravel	Undercut bank	Medium	13.0	Below old log jam - edge of pool

covered. Very few trees lined the stream bank, and they were limited to species of Populus. Logs that had become embedded in the stream bank constituted a small part of the bank cover.

Stream temperatures fluctuated between 49° F. and 67° F. during the 1953 experiment. Water temperatures fell to 49° F. on May 31 and June 1, after several days of cold, rainy weather. Fig. 1 is a record of stream and air temperatures taken during the experiment. Stream temperatures were taken from the automatic recording gauge of the Geological Survey's Water-stage Recorder on the Pigeon River. Maximum air temperatures were taken from records of daily observations at the weather station on the area and are included to show the great daily fluctuation occurring at this time of the year.

Table 2 is a record of the time interval, in days, between placing the dead brown trout in the stream and their complete disappearance. Disintegration undoubtedly started shortly after rigor mortis had occurred. During the period following placement in the stream, several of the fish became bloated and covered with a growth of fungus (Saprolegnia sp.) which served as a place for silt to be deposited. It is believed that the process of disintegration reached a point where breakdown of tissues was nearly complete and which enabled rising stream levels to literally "wash" them away. Some fish went to pieces over an extended period, others disappeared in a short time. No fish was recorded as entirely gone until every vestige of flesh or bone had been removed from the monofilament line. Fig. 2 shows the rate at which the fish disappeared from the stream. By the end of the first five days of the experiment, sixty percent of the fish had disappeared. As the fish became more bloated, fungused and silt encrusted, the fish disappeared more slowly. The two fish remaining throughout the test period of twenty-two days, and finally "washing away," were both suspended in the water, one near the surface

Fig. 1. Air and water temperatures on that portion of Section B of the Pigeon River used for the "dead trout" experiments, 1953.

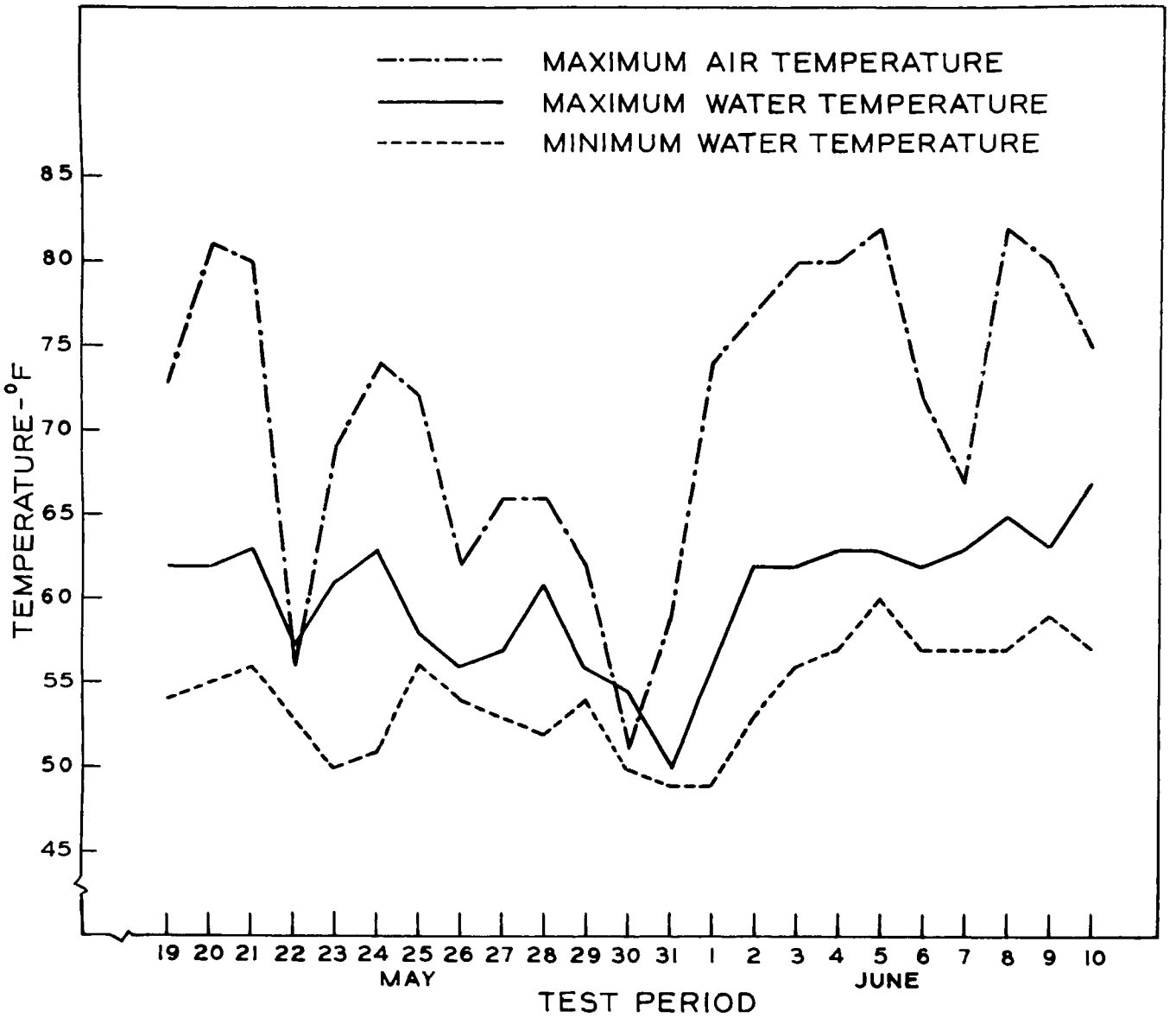
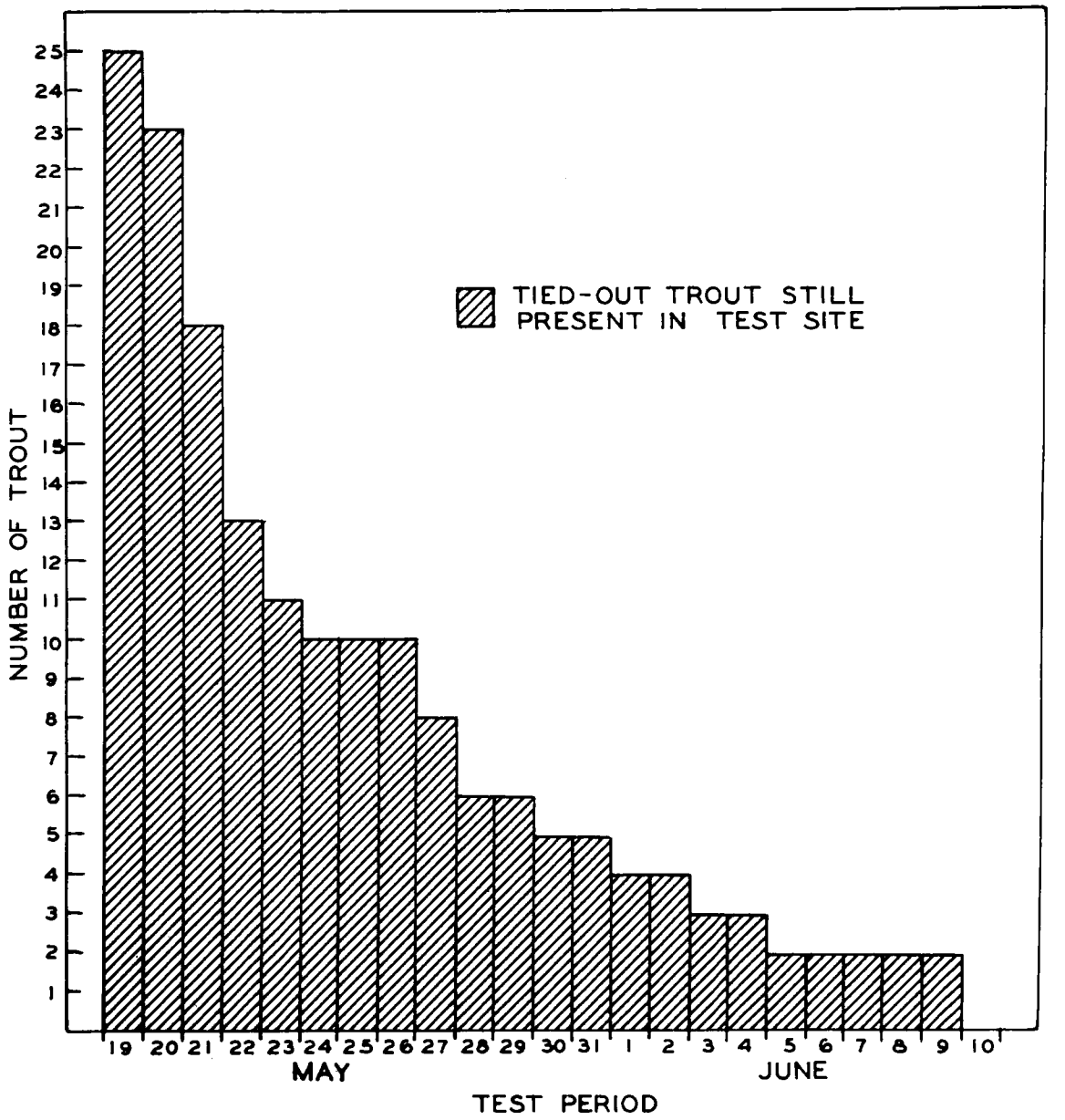

MAXIMUM AIR TEMPERATURE
MAXIMUM WATER TEMPERATURE
MINIMUM WATER TEMPERATURE
TEMPERATURE-°F
85
80
75
70
65
60
55
50
45
19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10
MAY
JUNE
TEST PERIOD

Table 2

Time interval (in days) between placing dead brown trout in Pigeon River and their complete disappearance

Fish No.	Partly gone	Nearly gone	Entirely gone
1	...	...	3
2	...	1	2
3	...	2	8
4	...	1	5
5	...	...	15
6	...	7	9
7	...	...	11
8	...	7	9
9	...	...	2
10	...	3	17
11	15	...	22
12	...	...	1
13	15	17	22
14	1	...	2
15	...	...	3
16	...	...	8
17	...	...	3
18	...	...	2
19	...	...	3
20	...	...	4
21	...	...	3
22	2	...	13
23	...	1	2
24	...	...	4
25	...	...	1

Fig. 2. Histogram showing numbers of tied-out dead trout still present at test sites, on consecutive dates during the experimental period, May 19 to June 10, 1953. The daily decrease in numbers of fish present indicates the rate at which the test fish disappeared.


NUMBER OF TROUT
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
TIED-OUT TROUT STILL PRESENT IN TEST SITE
19 20 21 22 23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10
MAY
JUNE
TEST PERIOD

of the stream and the other a few inches from the stream bottom. Both fish were well camouflaged from casual observation. At no time during the test period did any fisherman report seeing any dead fish. (Note: during the test period, seventy-seven anglers were issued fishing permits for Section B. While no attempt was made to enumerate the exact number of fishermen who fished the test area, it is known that a majority of those fishermen who fish in Section B would have fished through the test area on their way downstream). After the dead fish had been in the stream for three days, sufficient silt had coated them to make them difficult to see.

Creek chubs were apparently spawning in two of the sites selected for tying out dead trout. It was interesting to watch them grab a dead fish by the fins and attempt to pull it away from the area of their redd. Since one of the trout was gone the following day after being tied out, no further observations were made at that site. The other dead trout continued to annoy the creek chubs for several days until it started to fungus badly and from then on they left it alone.

As the test area was only two hundred yards long and twenty-five fish were tied out in that distance, any fish predator or scavenger could have had easy access to all the dead fish. Raccoons are common in this region, but signs of their disturbing the test fish were not noted. A snapping turtle was surprised while feeding on a dead trout that had been tied out two days previously and was removed. It is believed that turtles were largely responsible for the early disappearance of most of the test fish. Crayfish are also common in the stream but their nocturnal feeding habits prevented them from being noticed during daylight hours. Seagulls are frequently seen in this area, particularly after heavy rains, but it is doubtful that they assisted in the disappearance of the test fish. Muskrats, mink, and otter are known to inhabit the Pigeon River, and, while their menus include fish, alive or freshly

dead, it is not certain that they aided in the disappearance of the test fish. Bottle-flies were seen laying eggs on one of the specimens that was half-in and half-out of water, but before their larvae had developed the fish disappeared. Active caddis larvae were found on several dead fish but it is not certain whether these insects fed on the decomposing flesh as they did not remain throughout the test period.

In view of the experiments conducted with dead fish in 1950, the present experiment demonstrated that warmer water temperatures do hasten decomposition; a total of forty-four days were recorded for the 1950 test as opposed to a maximum of twenty-two days for the 1953 test.

Late spring or early summer finds scavengers more active than in late winter or early spring. Turtles were probably in hibernation for a greater proportion of the 1950 test period. However, the 1950 test fish were encased in individual boxes, and were immune from attack by any of the larger scavengers.

As most trout are planted in Michigan's streams just prior to or during the trout season, it would seem apparent, as a result of these tests, that any extensive mortality of trout occurring at this time of the year would be "cleaned up" much more quickly than would a mortality stemming from a planting of fish made in early or late winter. However, regardless of the fact that fishermen are more numerous during the early spring season, there have been very few reports, if any, of observations of quantities of dead trout in streams in early spring. It is reiterated here that dead fish become coated with silt in a short time and escape casual observation.

In view of the present study it becomes apparent that dead trout in a stream do escape casual observation, disappear, and so constitute a "hidden loss."

INSTITUTE FOR FISHERIES RESEARCH

Edward H. Bacon

Approved by: A. S. Hazzard

Typed by: P. R. Darling