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

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May 17, 1951

Report No. 1285

AUTOPSY OF BROOK TROUT THAT DIED DURING THE HOOKING-LOSS EXPERIMENT
AT HUNT CREEK EXPERIMENT STATION DURING SUMMER OF 1950

By
Leonard N. Allison

Abstract

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Brook trout that died during the hooking-loss experiment at the Hunt Creek Experiment Station during the summer of 1950 were examined for cause of death. Sections made from the tissue of vital organs of specimens chosen at random were studied for presence of furunculosis. Only 25 of the 53 fish from the fly-fishing section had been caught and only 3 of these had been fatally injured by the hook. Bacteria were found in 10 of the 11 tissue sections studied. In the bait-fishing section, 30 of the 45 fish had been hooked and hook damage was fatal to 20 of these. Bacteria were present in only 3 of the 12 tissue sections studied from this group. It was not determined whether necrosis or disease was responsible for bacteria found in the tissue. No reason could be found to account for the greater number of specimens of the fly-fishing section with bacteria; all fish came from the Grayling hatchery, all fish were handled alike, and dead fish were collected and preserved with equal care.

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During the summer of 1950, an experiment designed to determine the rate of mortality among bait-caught and artificial fly-caught brook trout was conducted by Dr. David S. Shetter at the Hunt Creek Experiment Station near Lewiston, Michigan. All dead fish collected before advanced decomposition made them useless for autopsy were preserved in 10 percent formalin for later study. There were 111 specimens delivered to the pathologist in December, 1950, to determine the cause of death. A number of the fish died before being hooked and it was thought desirable to check them also for the effects of disease. The following report is a summary of the findings.

Autopsy

The fish were examined externally for hook damage or injury due to rough handling, disease or predator marks, and internally for hook damage, injury due to rough handling or evidence of disease. The accompanying tables record the findings. Under the heading "Probable cause of death" two phrases are found that may be confusing, to wit, "No

cause found," and "Not determined." The former phrase is used to indicate that the fish appeared entirely normal with no injury or evidence of disease. The latter phrase indicates that injury or disease, or both, were present but it could not be determined whether the results of either were intense enough to cause death. Because many of the specimens were not well enough preserved for a study of this type, and it was suspected that furunculosis may have been present in the hatchery stock from which these fish came, the autopsy was confined to observation of gross damage due to hooking, and to study of tissue sections of the kidneys (as a check for furunculosis) when they were found undamaged by decomposition.

Fly-fishing Section

Of the 53 fish examined, 25 had been hooked at least once and 28 had never been hooked. Only 3 of the 25 hooked fish demonstrated injuries caused by the hook that obviously could have caused death. Two of the fish that had never been hooked were blind and emaciated. This condition probably caused their death. Another fish of this group was egg-bound, which was the probable cause of its death. Twenty-four fish were damaged to some extent by hook and disease but the effects appeared to be of a minor nature. Twenty-three fish appeared perfectly normal in every respect and no cause of death could be found. Nothing definite could be found to cause the death of the remaining 49 specimens.

Bait-fishing Section

In this group, 30 fish had been hooked and 15 had never been hooked. Of the 30 hooked specimens, a definite diagnosis could be made on 20 of them. Causes of death were as follows: Rupture of heart by hook, 12; gill damage, 3; brain injury, 2; damage to eye, 2; rough handling, 1. Of the remainder, 1 unhooked fish died from starvation; 8 fish were injured but a definite diagnosis could not be made; 15 appeared to be normal and no possible cause of death was apparent.

Sectioned Material

Due to the lack of sections of tissue known to be infected with furunculosis for comparative study, a critical diagnosis of the material sectioned for this investigation cannot be given at the present writing. As soon as infected tissues are available for comparison a report of the findings will be made. A few remarks concerning the sections can be made at this time.

The kidney was selected in most cases for sectioning. In several instances, however, it was not well enough preserved and the liver or heart was substituted. Eleven of the fly-fished group and 12 of the bait-fished group were represented by tissue sections. In the former group, bacteria were found in all but one section and in the latter group, in only three sections. In all cases, where bacteria were present in clumps in the kidney sections, they were accompanied by a general necrosis of the tissue. This was not the case in the liver as only tissue surrounding clumps of bacteria were affected. The heart tissue appeared normal in spite of the clumps of bacteria. Pathologists at the University of Michigan Medical School were of the opinion that the bacteria appeared after necrosis of the cells as a post-mortem change and had not caused necrosis. Their observations, however, were very limited and they were entirely unacquainted with furunculosis.

The information supplied by a study of the sections is rather confusing. Fish for the experiment were obtained from the Grayling hatchery, divided into two equal groups and tagged. This procedure was repeated in the second test and all fish were subject to identical conditions as to handling each time. Dead fish were removed from fly- and bait-fished sections and were presumed to have been preserved in the same manner. Yet the sections indicate that if disease was responsible for a mortality, fish in the fly-fished group were more susceptible

to it since bacteria were found in 10 of the 11 specimens sectioned but in only 3 of the 12 specimens sectioned from the bait-fished section. Since all fish were originally from the same hatchery group, the tissue study (if disease is involved) would support the theory that fishing with flies caused disease. If necrosis of the tissue is responsible for the bacteria therein, a difference in the method of collection and preservation would be indicated. That is, the dead fish from the fly-fished group either were dead longer before they were collected or were not preserved properly when collected. The latter theory is, of course, the more probable of the two, although, why it should be so, is difficult to understand because of the random method necessarily employed in the collection from each group. Dr. Shetter may be able to offer some explanation.

Discussion

The condition of the trout dying in the two groups was considerably different. The hook in the bait-caught group took a definite toll of fish whereas the effect of the hook in the fly-caught group was very obscure. It is evident here that the bait-caught trout suffered greater apparent injury from the hook than did the fly-caught trout, although the total loss from both groups was nearly the same. If disease is considered, the data suggests that the fish in the fly-caught group were more susceptible than those of the bait-caught group. However, this could hardly be true because fish in both groups were taken at random from one large group from the Grayling hatchery. Also, if disease had caused a loss in both groups, the total loss among the bait-fished group should have been higher since 66.6 percent of the recovered dead fish had been caught at least once whereas only 47.1 percent of the fly-fished specimens recovered dead had been hooked previously. The size of the sample, however, is small and the discrepancies may be

insignificant. Inadequate preservation may also have been responsible for the necrosis to a considerable degree, but there seems to be no explanation as to why the bait-fished group might have been better preserved than the fly-fished group.

I would suggest that when fish are collected for future pathological examination they should be carefully opened by an incision made with a knife. The opening should be large enough to permit free entry of the preserving fluid to the body cavity, and so made as to leave the internal organs undisturbed. The incision in the majority of the specimens in the present collection was not large enough to permit adequate preservation of the kidneys and some other vital organs. An attempt should also be made to secure specimens injured or sick fish before they die and preserve and identify them separately.

INSTITUTE FOR FISHERIES RESEARCH

Leonard N. Allison

Report approved by A. S. Hazzard

Report typed by B. A. Lowell

Table 1

BAIT SECTION

✓ Died before hooking

✓ Died after hooking

Micro Slide Code - Ehc

Tag Number	Condition of Specimen	Section Study	Probable Cause of Death
✓ 46201	Gill lice. Heart ruptured by hook.	.....	Rupture of heart by hook.
✓ 46203	Badly decomposed	.....	No cause found.
✓ 46210	Heart ruptured by hook	.....	Rupture of heart by hook.
✓ 46212	Gill lice. First gill arch on right side severed.	Kidney section. Necrotic tissue. Diagnosis obscured. (Ehc13)	Severed gill arch possible cause.
✓ 46213	Badly decomposed.	.....	No cause found.
✓ 46216	Heart ruptured by hook.	.....	Rupture of heart by hook.
✓ 46221	General internal hemor- rhages noted.	Kidney section normal. (Ehc11)	Possible rough handling.
✓ 46222	Heart ruptured by hook.	.....	Rupture of heart by hook.
✓ 46223	Fish appeared normal.	Kidney decomposed. No sections possible.	No cause found.
✓ 46226	Heart ruptured by hook.	.....	Rupture of heart by hook
✓ 46229	Badly decomposed.	.....	No cause found.
✓ 46231	Fish appeared normal.	Kidney section. Necrotic tissue. Diagnosis obscured. (Ehc8)	Not determined.
✓ 46234	Saddle of fungus across dorsal fin and back.	.....	Fungus may have contri- buted to death. Cause of fungus not found.
✓ 46238	Saddle of fungus across dorsal fin and back.	Kidney section normal. (Ehc9)	Fungus may have con- tributed to death. Cause of fungus not found.
✓ 46241	Fish appeared normal. No marks found.	.....	No cause found.

Tag Number	Condition of Specimen	Section Study	Probable Cause of Death
V46246	Fish appeared normal.	Kidney section normal. (Hhc20)	No cause found.
V46251	Gill lice. Fish appeared normal.	. . . . .	No cause found.
V46252	Fish appeared normal.	. . . . .	No cause found.
V46259	Fish appeared normal.	. . . . .	No cause found.
V46260	Hook wound posterior to last gill arch, right side. No vital organs damaged.	Kidney section normal. (Hhc23)	Not determined.
V46262	Heart ruptured by hook.	Kidney section normal. (Hhc14)	Rupture of heart by hook.
V46263	Badly decomposed.	. . . . .	No cause found.
V46264	Heart ruptured by hook.	. . . . .	Rupture of heart by hook.
V46265	Saddle of fungus across dorsal fin and back.	Kidney section normal. (Hhc21)	Fungus may have contributed to death. Cause of fungus not found.
V46266	Injury to gills resulting in fungus.	Kidney section normal. (Hhc10)	Fungus on gills resulting from injury probably caused death.
V46268	Fish appeared normal.	Kidney section. Necrotic tissue. Diagnosis obscured. (Hhc22)	No cause found.
V46272	Deep cut in roof of mouth in region of right gill arches.	. . . . .	Death caused by hook injury to roof of mouth and gill arches.
V46276	Injury caused hemorrhage in left orbit.	Kidney section normal. (Hhc12)	Hemorrhage of left orbit possible cause of death.
V46278	Lesion in roof of mouth extending to brain.	. . . . .	Death caused by brain injury.
V46282	Blind and in poor condition. Orbit of eye pierced by hook.	. . . . .	Cause not definite. Shock of hooking plus weak condition may be cause.

Tag Number	Condition of Specimen	Section Study	Probable Cause of Death
✓46287	Roof of mouth pierced by hook.	Kidney section normal. (Hhc7)	Hook may have pierced brain.
✓46292	Hook pierced right orbit. One gill arch broken. Hemorrhage of heart.	. . . . .	Multiple injuries caused death.
✓46293	Gill lice.	. . . . .	No cause found.
✓46297	Badly decomposed. Fungus on dorsal fin.	. . . . .	Not determined.
✓46298	Left eye destroyed by hook.	. . . . .	Damage to left eye possible cause.
✓46299	Blind, fish in very poor condition.	. . . . .	Starvation possible cause.
✓48202	Injury in roof of mouth region of left eye.	. . . . .	No cause found.
✓48216	No injury found.	. . . . .	No cause found.
✓48227	Heart ruptured by hook.	. . . . .	Rupture of heart by hook.
✓48245	Heart ruptured by hook.	. . . . .	Rupture of heart by hook.
✓48251	Heart ruptured by hook.	. . . . .	Rupture of heart by hook.
✓48277	Specimen not found	. . . . .	. . . . .
Wild Fish	Heart ruptured by hook.	. . . . .	Rupture of heart by hook.
Wild Fish	Fish appeared normal.	. . . . .	No cause found.
Wild Fish	Roof of mouth pierced by hook.	. . . . .	Not determined.

Table 2

FLY SECTION

✓ Died before hooking

✓ Died after hooking

Micro Slide Code - Hhc

Tag Number	Condition of Specimen	Section Study	Probable Cause of Death
✓ 46305	Fish appeared normal.	. . . . .	No cause found.
✓ 46308	Gill lice. Fish appeared normal.	. . . . .	No cause found.
✓ 46311	Badly decomposed. Body completely covered with fungus.	. . . . .	Not determined.
✓ 46312	Fish appeared normal.	. . . . .	No cause found.
✓ 46313	Specimen not found.	. . . . .	. . . . .
✓ 46314	Hooked through right cheek.	. . . . .	Not determined.
✓ 46316	Badly decomposed. Head covered with fungus.	. . . . .	No cause found.
✓ 46319	Fish appeared normal.	. . . . .	No cause found.
✓ 46320	Fish blind. Emaciated.	. . . . .	Possible starvation.
✓ 46326	Egg bound.	. . . . .	Possibly caused by egg- bound condition.
✓ 46328	Hook pierced orbit. Fungus on gills.	. . . . .	Not determined.
✓ 46329	Left cheek pierced and eroded.	. . . . .	Necrotic tissue in cheek probable cause of death through hemorrhage.
✓ 46331	Fish appeared normal.	. . . . .	No cause found.
✓ 46332	Fish appeared normal.	. . . . .	No cause found.
✓ 46334	Blind. Emaciated.	. . . . .	Possible starvation.
✓ 46336	Fish appeared normal.	. . . . .	No cause found.

Tag Number	Condition of Specimen	Section Study	Probable Cause of Death
V46339	Saddle of fungus across dorsal fin and body.	. . . . .	Fungus may have contributed to death. Cause of fungus not found.
V46341	Fish appeared normal.	. . . . .	No cause found.
V46344	Gill lice. Hemorrhage beneath skin in area of vent.	. . . . .	Not determined. Injury indicated.
V46345	Small hemorrhages in fat around caeca.	Kidney section. Necrotic tissue. Diagnosis obscured. (Hhc3)	Furunculosis possible although kidney section not conclusive.
V46349	Slight damage to mouth, by hook. Fish appeared normal.	Kidney section. Necrotic tissue. Diagnosis obscured. (Hhc4)	Not determined.
V46351	Fish appeared normal.	. . . . .	No cause found.
V46352	Right maxillary missing. No other damage found.	. . . . .	Not determined.
V46354	Hook penetrated orbit. No other damage found.	. . . . .	Not determined.
V46356	Fish appeared normal.	. . . . .	No cause found.
V46357	Badly decomposed.	. . . . .	No cause found.
V46359	Hooked through left maxillary. Fish appeared normal.	. . . . .	No cause found.
V46363	Fish appeared normal.	. . . . .	No cause found.
V46366	Hook pierced right cheek.	. . . . .	Not determined.
V46368	Fish appeared normal.	. . . . .	No cause found.
V46372	Small hemorrhages in fat around caeca.	. . . . .	Not determined. Hemorrhages suggest furunculosis.
V46373	Fish appeared normal.	Kidney section. Necrotic tissue. Diagnosis obscured. (Hhc18)	Not determined.

Tag Number	Condition of Specimen	Section Study	Probable Cause of Death
✓46375	Fish appeared normal.	Kidney section. Necrotic tissue. Diagnosis obscured. (Hhc1)	Not determined.
✓46379	Fish appeared normal.	. . . . .	No cause found.
✓46383	Hook pierced right cheek.	. . . . .	Not determined.
✓44245	Fish appeared normal.	Kidney and liver section. Necrotic tissue. Diagnosis obscured. (Hhc2)	Not determined.
✓46385	Fish appeared normal.	. . . . .	No cause found.
✓46387	Fungus on gills.	Kidney and liver section. Normal. (Hhc5)	Not determined.
✓46388	Fish appeared normal.	. . . . .	No cause found.
✓46389	Right eye destroyed by hook.	. . . . .	Not determined. Injury to right eye may have caused death.
✓46390	Small hemorrhages in fat around caeca. Kidney decomposed - used heart for section study.	Section of heart. Necrotic tissue. Diagnosis obscured. (Hhc19)	Not determined. Possibly furunculosis.
✓48101	Specimen not found.	. . . . .	. . . . .
✓48103	Fish appeared normal.	. . . . .	No cause found.
✓48108	Fish appeared normal.	. . . . .	No cause found.
✓48119	General internal hemorrhage areas.	Kidney section. Necrotic tissue. Diagnosis obscured. (Hhc16)	Furunculosis possible cause. Not determined.
✓48128	Fish appeared normal	. . . . .	No cause found.
✓48140	Fish appeared normal.	Kidney section. Necrotic tissue. Diagnosis obscured. (Hhc17)	Not determined.
✓48142	Right eye pierced by hook. Right palatine bone missing.	. . . . .	Hooking injuries caused death.

Tag Number	Condition of Specimen	Section Study	Probable Cause of Death
✓48151	Lower jaw eroded by tag. Fish appeared normal.	. . . . .	No cause found.
✓48152	Hook pierced right cheek.	. . . . .	Not determined.
✓48157	Left cheek pierced. Small hemorrhages in swim bladder.	. . . . .	Not determined. Furunculosis possible cause.
✓48159	Hook pierced brain.	Liver section. Necrotic tissue. Diagnosis obscured. (Hhc6)	Injury to brain by hook.
✓48189	Hook pierced right cheek.	. . . . .	Not determined.
✓48192	Fish appeared normal.	Kidney section. Necrotic tissue. Diagnosis obscured. (Hhc15)	Not determined.
✓48200	Fish appeared normal.	. . . . .	No cause found.

Table 3

FLY TEST

BAIT TEST

Slide Number	Tag Number	Diagnosis	Slide Number	Tag Number	Diagnosis
1.	V46375	Kidney. Necrotic. Clumps of Bacteria.	7.	V46287	Kidney. Normal.
2.	V44245	Liver. Necrotic? Bacteria in clumps.	8.	V46231	Kidney. Necrotic. Clumps of Bacteria.
2a.	V44245	Kidney. Necrotic. Clumps of Bacteria.	9.	V46238	Kidney. Normal.
3.	V46345	Kidney. Necrotic. Clumps of Bacteria.	10.	V46266	Kidney. Normal.
4.	V46349	Kidney. Necrotic. Clumps of Bacteria.	11.	V46221	Kidney. Normal
5.	V46387	Liver. Normal. Kidney. Normal	12.	V46276	Kidney. Normal.
6.	V48159	Liver. Necrotic? Bacteria in clumps.	13.	V46212	Kidney. Necrotic. Clumps of Bacteria.
15.	V48192	Kidney. Necrotic. Clumps of Bacteria.	14.	V46262	Kidney. Normal.
16.	V48119	Kidney. Necrotic. Clumps of Bacteria.	20.	V46246	Kidney. Normal.
17.	V48140	Kidney. Necrotic. Clumps of Bacteria.	21.	V46265	Kidney. Normal.
18.	V46373	Kidney. Necrotic. Clumps of Bacteria.	22.	V46268	Kidney. Necrotic. Clumps of Bacteria.
19.	V46390	Heart. Necrotic? Bacteria in clumps.	23.	V46260	Kidney. Normal.