

A DYNAMITE SAMPLING STUDY ON THE HIWASSEE AND OCOEE RIVERS IN EAST TENNESSEE

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Presented Before

THE 18th ANNUAL CONFERENCE

of

Southeastern Association of Game and Fish Commissioners

October 18, 19, 20, 21, 1964

Clearwater, Florida

ABSTRACT

In the winter of 1960 and 1961 the Tennessee Game and Fish Commission received reports that fish kills had occurred on the Hiwassee River. During the month of March, 1961 a study was developed on the Hiwassee and Ocoee Rivers to determine the fish population and to locate as accurately as possible the area or areas of adverse conditions relative to fish survival.

Six stations were selected in cooperation with the Tennessee Stream Pollution Control Board. Due to the large volume of water the percussion method was employed as a sampling technique. At two of the six stations carp were tethered to try to determine the effect of the explosive on fish.

While this report is primarily concerned with the fish population, attention is given to the use of dynamite as a sampling technique in the hope that it may be of aid in future studies of this type.

A DYNAMITE SAMPLING STUDY ON THE HIWASSEE AND OCOEE RIVERS IN EAST TENNESSEE

During the month of March, 1961, a population study on the Hiwassee and Ocoee rivers was conducted in southeast Tennessee. The purpose of this investigation was to determine the fish population and to locate as accurately as possible the area or areas of adverse conditions from the standpoint of fish survival.

Six stations were selected in cooperation with the Tennessee Stream Pollution Control Board. Due to the large volume of water, dynamite was employed as the sampling method.

While this report is primarily concerned with the population investigation outlined above, attention is given to the use of dynamite as a sampling technique in the hope that it may be of aid in future studies of this type.

In the winter of 1960-61, the Tennessee Game and Fish Commission received reports that fish kills had occurred on the Hiwassee River. The reported fish kills concerned the water flowing below the Bowater Paper Corporation, at Calhoun, Tennessee, River Mile 20. The dead fish were of drum and shad species, with the former being most abundant. A study was developed by personnel of the Game and Fish Commission to determine the fish population and to locate as accurately as possible the area or areas of adverse condition relative to fish survival.

The Hiwassee River is a tributary of the Tennessee River and flows westward from North Carolina into Tennessee. The river is of economic importance for transportation, fishing, hydro-electric power, water supply, flood protection, recreation and industrial use.

Sampling stations were proposed with the cooperation of the Stream Pollution Control Board. These stations were set up between tributary streams such as Oostanaula Creek which contains domestic sewage from the town of Athens and is thought to have an influencing factor on the river. The following are the stations and their locations which were selected by this department and the Stream Pollution Control Board.

- Station 1*—Ocoee River, about one-half mile upstream from the mouth of Ocoee River, main channel.
- Station 2*—Ocoee River, about one-half mile upstream from the mouth, main channel.
- Station 3*—Hiwassee River, River Mile 24, one-half mile upstream from the Chattata Creek, main channel.
- Station 4*—Hiwassee River, River Mile 16.2, between South Mouse Creek and the Bowaters Paper Corporation effluent.
- Station 5*—Hiwassee River, River Mile 9, between Price Creek and Agency Creek. This station was in a backwater area due to high and swift water in the main channel.
- Station 6*—Hiwassee River, River Mile 3.2, downstream from Lick Branch in a backwater area which was flooded from high waters. A map of the stations is shown in Figure 1.

The percussion method was used as the sampling technique, and the terms dynamite, explosives and percussion will be used synonymously below. This method was employed because of the large volume of water and rapid flow, and it was the author's belief that the sampling area could be best controlled by this method. When the stations were located, several sites were a short distance from influencing factors such as polluted streams and tributaries, and rotenone was therefore impractical to use. It was desirable that the sample be restricted to a definite area, and this factor made the use of rotenone and similar toxic substances impractical.

At stations 5 and 6 a control situation was set up to measure the effect of the dynamite on fish. Carp were tethered at 5-foot intervals, and after the charge was detonated, they were retrieved and dissected for visual inspection. The charge at each station was set in different levels of water, and the number of charges used varied according to water depths. Carp were tethered at intervals of 5 feet at Station 5, starting at 10 feet from the charge and ranging to 30 feet, and at Station 6, 5-foot intervals ranging to 20 feet. Due to the limited number of fish available at the time these were the only stations where fish were tethered.

Each station was sounded for depth before the charge was set, and weighted line with float attached was placed in the water. The line on which the fish were tethered was attached to a float line weight and was set in a straight line away from the center of the explosion. The charge was prepared on the shore and attached to a line which was cut to measure 2-feet short of the total water depth. This placed the measured line 2 feet above the bottom. Placing the charge at this level was believed to promote greater efficiency in view of bottom material present. The charge was carried to the station by boat, tied to the float, lighted and dropped over the side of the boat. Persons handling the explosives then retired to a safe distance. Immediately after the explosion occurred, a crew of men in boats converged on the area and collected dead and dying fish present on the surface of the water. The total weight, numbers and length for each individual size class was made of species collected. Table 1 gives a condensed synopsis of the

information taken at each station. Table II gives the number and species collected at each station.

An examination of tethered fish at Stations 5 and 6 was made to try to determine the effect of the blast on fish. All of the fish at Station 6 were dead when retrieved. These fish had been at 5-foot intervals ranging to 20 feet. A visual autopsy of the internal organs showed the air bladder to be ruptured in all fish. The intestines were ruptured and macerated. On three of the four fish tethered at this station, the backbones and ribs were exposed. These fish had been tethered at distances of 5, 10 and 15 feet from the center of the blast.

Fish tethered at Station 5 were examined the same as those at Station 6. There were five tethered at this station starting at 10 feet and ending at 30 feet in intervals of 5 feet. None of these fish were dead upon removal from the water, but internal examination showed those at distances 10, 15 and 20 feet had the intestines ruptured and macerated. These fish would have died in a short period. The fish tethered at 25 and 30 feet were not damaged to the extent that death would be inevitable. The reason for this was because of the water depth in which the sample was taken. Too large a charge was used, and the greatest amount of concussion was directed into the air, instead of being distributed through the water.

A pilot study had been conducted February 28, 1961, to try another type of explosive, 40 per cent dynamite. This type of dynamite was found to be unsatisfactory for work in water because of its tendency to absorb water. During the course of using the 40 per cent dynamite, a "dud" occurred. This is a charge that when detonated fails to explode. One hour after the "dud" occurred, it was retrieved from the water and examined. The examination showed that the cap, or primer, had gone off, and therefore the fuse and cap were not at fault. The sticks of dynamite had already started to disintegrate in the water and when held in the hand had a mushy consistency. The practice of retrieving a "dud" is not recommended unless it is absolutely necessary. In this case it was considered vital to remove the "dud" since the charge was located in the main channel where there is motor boat and barge traffic. After the "dud" had occurred, a similar charge was prepared and axle grease was used to seal the hole where the cap and fuse enter the stick of dynamite. This method of waterproofing was found to be efficient in further testing.

The type of fuse used was orange safety fuse. Tests of burning speed were run, and a difference in the speed of burning in water and dry land was discovered. On dry land the fuse burned at a rate of $1/39$ sec.; in water the fuse burned at a rate of $1/36$ sec.; this difference is considerable when using 4 or 5' of fuse and can thus promote safety. A safety manual recommends using at least a 2-foot fuse, and this would burn at a rate of $2/78$ sec. on dry land, and $2/72$ sec. in water. On all occasions we used a 5-foot fuse, allowing the persons setting the charge three minutes to retreat to safety. This time was found to be sufficient. A man was appointed timer, and as soon as the fuse was lighted, he shouted, "Fire in the hole," and the timer was then able to calculate the exact time of the explosion. This procedure was employed for the benefit of all persons participating in the study.

The following procedures are set forth for the promotion of safety and efficiency in the use of dynamite as a fish sampling technique.

The prevention of accidents in the use of explosives is a result of careful planning and observance of the best known practices. The person using explosives must remember that he is dealing with a powerful force, and that various devices and methods have been developed to assist him in directing this force. He should realize that this force, if misdirected, may either kill or injure both him and his fellow workers.

All explosives are dangerous and must be handled and used with care either by or under the direction of competent experienced persons. It is the responsibility of all persons who handle explosives to know and to follow all approved safety procedures.

It is obviously impossible to include warnings or approved methods for every conceivable situation. A list of suggestions to aid in avoiding the more common cause of accidents is available in the Institute of Makers of Explosives publications listed:

“American Table of Distance” (Pamphlet No. 2).

“Standard Storage Magazines” (Pamphlet No. 1).

“Safety First Rules for Handling, Storing, Delivering and Shipping Explosives” (Pamphlet No. 5).

“Safety in the Handling and Use of Explosives” (Pamphlet No. 17).

When in doubt, consult the manufacturer.

Definitions

1. The term “explosives” as used herein includes the following: Dynamite blasing caps and orange safety fuse.
2. The term “primer” as used herein means a cartridge of explosives in combination with a blasting cap.

How to Make a Primer

When Using Cap and Fuse:

Priming—When blasting caps are used, the proper length of fuse should be cut from the roll and the blasting cap crimped to the fresh cut end of the fuse with a cap crimper, not with a knife or with teeth. Be sure that the fuse is cut squarely across and that the end is pushed gently against the explosive material in the blasting cap. Do not twist the fuse inside the cap. The crimp in the blasting cap should be made near the end through which the fuse enters. In wet work, use a waterproof crimp or waterproof the joints between the fuse and cap. In this project, both waterproofing of the joints and waterproof crimp were employed.

In making up primers by the side priming method, punch a hole about the size of a lead pencil in the side of the cartridge. This hole should be a little deeper than the length of the blasting cap, and should be directed downward rather than across the cartridge. Insert the blasting cap and fasten the fuse securely to the dynamite cartridge to prevent the cap and fuse being pulled out of the cartridge. The side priming method was used in this study.

Conclusions

Although there were several positive results gained from this study, it was not considered a success as a whole. The small quantity of fish taken in the sampling prohibited any definite conclusions.

Several factors were felt to be responsible for the insufficiency of specimens. The stations generally were not located in areas conducive to the congregation of fish; i.e., areas of creek influence and below shoals. On future surveys of this type, it is recommended that sampling stations be located in the areas of quiet waters where tributary streams flow into the main river.

It is further recommended that a follow-up study be undertaken during the late winter and early spring when fish kills have occurred. Appalachia and Ocoee power dams influence the level of water in these areas, and therefore have an effect on the sites of greatest fish concentration. The lower water level during shut-down periods will create

more pools and riffles where fish tend to concentrate, and sampling in these areas would yield more specimens on which definite conclusions could be based. The strong current present during the recent survey reduced the efficiency of the dynamite, and it is felt that this factor could, and would, be remedied by the slower water flow during the winter season.

Cost of Items Used in Project

Amount	Item	Bulk Price	Cost of Amount Used
1 case—50%	ditching powder	\$14.65 case	\$ 5.20
1 box—100	caps	2.80 /100	.60
1 roll—100'	orange wax covered fuse	1.20 /100'	1.20
1 pair—cap	crimpers	3.65	3.65
1 lb.—#48	seine twine	1.04	1.04
100 yds.—#20	nylon fish line	1.98	1.98
1 doz.—Hills	shoat rings	.15	.15
1 box—Hills	hog ringers	.45	.45
22½ lbs.—carp		.10 /lb.	2.25
Total			\$16.52

The excess dynamite and caps were turned over to Mr. Lee Price, Access Area Supervisor, to be used in his work.

Acknowledgments

The writer is indebted to Officers of the Law Enforcement Division who provided both data and assistance in the field, and to David Murrian, Public Relations Representative, for the pictures. Biologists who participated in the project were Ed Manges, District No. 3 Biologist; Edward Lyles, District No. 4 Biologist; Ray Hoffarth, Junior Commercial Fisheries Biologist; and Gene Ruhr, Federal Aid Coordinator for Fisheries. The suggestions and criticisms of Mr. Ruhr and Sam J. Sullivan, Jr., Pollution Control Chemist for Bowater Paper Corporation, were of great value in the success of this project.

Station 1

Location: Hiwassee River, 10 feet from south bank, one-half mile upstream from mouth of Ocoee River.

Date: March 24, 1961

Time: 3:30 P. M.

Depth: 12 feet

Temperature: 52° F.

Bottom: Unknown

Boats: Two boats with seven men—Flow: 3756 c.f.s.

Charge: Two 4-stick charges of 50 per cent ditching powder set off simultaneously. Fish were noted to jump out of water when charge went off on the opposite side of river where water was shallow.

Fish Collected: (All lengths in inches; weight in pounds).

Length	<i>Mooneye</i>		Length	<i>Carp sucker</i>	
	Number	Weight		Number	Weight
11	9	4.0	13	1	1.1
12	9	4.9	14	1	1.5
			16	1	2.3
			17	3	7.3

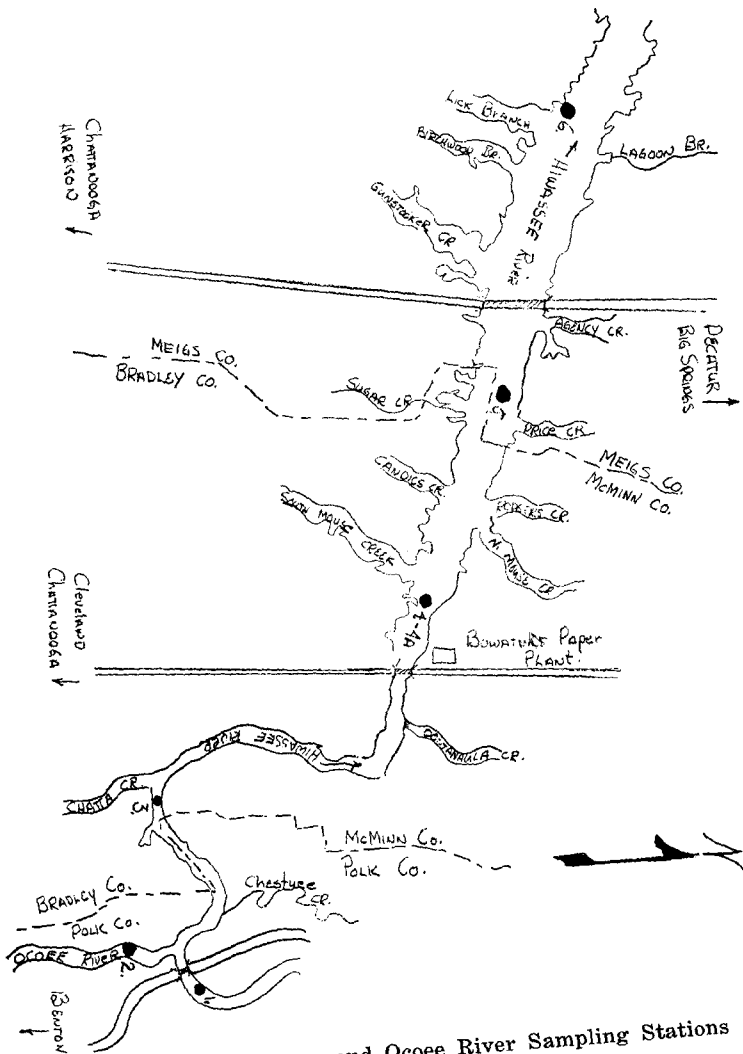


Figure 1.—Hiwassee and Ocoee River Sampling Stations

<i>Gizzard Shad</i>			<i>Buffalo</i>		
Length	Number	Weight	Length	Number	Weight
10	2	0.6	16	1	2.2

<i>Channel Catfish</i>			<i>White Bass</i>		
Length	Number	Weight	Length	Number	Weight
16	1	1.0	9	1	0.3

Number of Fish Taken	29
Total Weight	25.2

Station 2

Location: Ocoee River, one-fourth mile upstream from mouth, ten feet from the west bank.

Date: March 24, 1961

Time: 2:30 P. M.

Depth: 12 feet

Temperature: 52° F.

Bottom: Unknown

Boats: Two boats with seven men—Flow: 1878 c.f.s.

Charge: Two 3-stick charges of 50 per cent ditching powder set off simultaneously. Two fish were noted to jump out of water during the explosion about 50-75 yards downstream from charge.

Fish Collected: (All lengths in inches; weight in pounds).

Gizzard Shad

Number of Fish Taken	1
Total Weight	0.2

Station 3

Location: Mile 24, Hiwassee River, thirty feet from south bank.

Date: March 24, 1961

Time: 11:30 A. M.

Depth: 15 feet

Temperature: 52° F.

Bottom: Unknown

Boats: Three boats with seven men—Flow: 2100c.f.s.

Charge: One 5-stick charge of 50 per cent ditching powder.

Fish Collected: (All lengths in inches; weight in pounds).

<i>Channel Catfish</i>			<i>Carp sucker</i>		
Length	Number	Weight	Length	Number	Weight
10	2	0.5	11	1	0.4
11	2	0.6			
15	1	0.7			

<i>Gizzard Shad</i>			<i>Buffalo</i>		
Length	Number	Weight	Length	Number	Weight
8	2	0.3	17	1	2.2
9	1	0.3			

Number of Fish Taken	10
Total Weight	5.0

Station 4-A

Location: Hiwassee River, Mile 16.2, forty feet from the south bank.
 Date: March 8, 1961 Time: 2:30 P. M.
 Depth: 30 feet Temperature: 55° F.
 Bottom: 4 inches of clay, firm.
 Boats: Five boats, two men per boat—Flow: 19,562 c.f.s.
 Charge: One 5-stick charge of 50 per cent ditching powder.
 The bottom was checked by David Murrian, who assisted in study by skin diving in the area where charge was to be placed.
 Fish Collected: (All lengths in inches; weight in pounds).

Length	<i>Buffalo</i> Number	Weight	Length	<i>Drum</i> Number	Weight
15	2	3.4	9	1	0.3
Number of Fish Taken		3			
Total Weight		3.7			

Station 4-B

Location: Mile 16.2, Hiwassee River, 40 feet from south bank.
 Date: March 24, 1961 Time: 10:15 A. M.
 Depth: 19 feet Temperature: 52° F.
 Bottom: About 4 inches of clay.
 Boats: Three boats with seven men—Flow: 1,561 c.f.s.
 Charge: One 5-stick charge, 50 per cent ditching powder.
 This station is a repeat from March 8 study, due to high and swift water present the first time.
 Fish Collected: (All lengths in inches; weight in pounds).

Length	<i>Channel Catfish</i> Number	Weight	Length	<i>Gizzard Shad</i> Number	Weight
8	1	0.1	9	1	0.3
10	1	0.3	10	1	0.5
11	1	0.3	11	1	0.6
12	1	0.4			
14	1	0.7			

Length	<i>Drum</i> Number	Weight	Length	<i>Mooneye</i> Number	Weight
9	2	0.5	10	1	0.4
			11	1	0.5

Length	<i>Carp</i> Number	Weight	Length	<i>White Bass</i> Number	Weight
16	1	2.3	9	1	0.3
17	1	2.3			

Length	<i>Lampreys*</i> Number	Weight	Length	<i>Minnows</i> Number	Weight
6	1	—	3	30	0.2
Number of Fish Taken		54	4	8	0.1
Total Weight		9.8	*Attached to head region of carp		

Station 5

Location: Hiwassee River, Mile 9.0, back water flood area, due to high and swift water in main channel.

Date: March 8, 1961

Time: 11:30 A. M.

Depth: 4½ feet

Temperature: 56° F.

Bottom :Soft mud and silt, mud 2-3", silt 10" in depth.

Boats: Five boats with at least two men per boat.

Flow: Negligible.

Charge: Three sticks of 50 per cent ditching powder.

Fish were tethered at distance of 10, 15, 20, 25 and 30 feet from center of charge. This station was moved from original site because of high and swift water. The original set with floats and fish were pulled up and placed in new sites described above.

Fish Collected: (All lengths in inches; weight in pounds).

<i>Gizzard Shad</i>			<i>Drum</i>		
Length	Number	Weight	Length	Number	Weight
4	6	—*	6	1	—
5	3	—	8	5	0.8
8	4	0.8	9	3	0.7
9	3	0.8	10	2	0.5
10	5	1.5	11	1	0.2

<i>White Bass</i>			<i>Crappie</i>		
Length	Number	Weight	Length	Number	Weight
4	1	—	9	1	0.3

<i>Green Sunfish</i>		
Length	Number	Weight
2	2	—
Number of Fish Taken		37
Total Weight		5.6

*Less than 0.1

Station 6

Location: Mile 3.2, Hiwassee River. Backwater area caused by high water.

Date: March 8, 1961

Time: 9:30 A. M.

Depth: 10½ feet

Temperature: 55° F.

Bottom: Soft mud and silt; silt 2-3", soft mud 15" in depth.

Boats: Five boats with at least two men per boat.

Flow: Neligible—slight wind action causing few waves; main channel flow 14,365 c.f.s.

Charge: Four sticks of 50 per cent ditching powder.

Fish were tethered at distances of 5, 10, 15 and 20 feet from center of blast area.

Fish Collected: (All lengths in inches; weight in pounds).

Table I
Sampling Stations on Hiwassee and Ocoee Rivers

STATIONS	1	2 ¹	3	4a	4b	5	6
Charges per Station	2-4 ²	2-3	5	5	5	3	4
Depth of Stations	12'	12'	15'	30'	19'	4.5'	10.5'
Number of Fish per Station	29	1	10	3	54	37	181
Number Pounds of Fish per Station	25.2 ³	0.2	5.0	3.7	9.8	5.6	55.1
Water Temperature ⁴	52°	52°	52°	55°	52°	56°	57°
Time Above Taken	3:30 P.M.	2:30 P.M.	11:30 A.M.	2:30 P.M.	10:15 A.M.	11:30 A.M.	9:30 A.M.
Total Number of Fish—	315						
Total Pounds of Fish—	104.6						

¹ Ocoee River

² Two 4-stick charges set off simultaneously at a distance of 20-25 feet apart

³ All weights are in pounds and tenths

⁴ All temperatures are in Fahrenheit

<i>Gizzard Shad</i>			<i>Drum</i>		
Length	Number	Weight	Length	Number	Weight
8	13	2.1	5	1	—*
9	49	10.4	7	1	—
10	70	22.6	8	3	0.4
11	26	10.1	9	1	0.2
12	4	2.1	10	1	0.3
13	1	0.6	11	1	0.4
			12	1	0.5

<i>Crappie</i>			<i>Channel Catfish</i>		
Length	Number	Weight	Length	Number	Weight
8	1	0.2	4	1	—
9	1	0.4	9	1	0.1
10	2	1.1			
11	1	0.6			
12	1	0.8			
15	1	2.2			
Number of Fish Taken		181			
Total Weight		55.1	*Less than 0.1		

Table II
Sampling Stations with Number and
Species of Each Type

STATIONS								
SPECIES	1	2	3	4a	4b	5	6	TOTALS
Shad	2	1	3	0	3	21	163	193
Crappie	0	0	0	0	0	1	7	8
Drum	0	0	0	1	2	12	9	24
Channel Cat	1	0	5	0	5	0	2	13
Buffalo	1	0	1	2	0	0	0	4
White Bass	1	0	0	0	1	1	0	3
Green Sunfish	0	0	0	0	0	2	0	2
Carp	0	0	0	0	2	0	0	2
Mooneye	18	0	0	0	2	0	0	20
Minnows	0	0	0	0	38	0	0	38
Carp sucker	6	0	1	0	0	0	0	7
Lamprey	0	0	0	0	1	0	0	1
TOTALS	29	1	10	3	54	37	181	315