FINAL REPORT ON POPULATION MANIPULATION STUDIES IN THREE KENTUCKY STREAMS*

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ABSTRACT

Perhaps the most universal problem in many of Kentucky's streams, from the angler's viewpoint, is that of excessive numbers of rough fish in proportion to the numbers of game fish. This paper presents the findings of a Dingell-Johnson project that has been concerned since 1952 with the manipulation of populations in 3 streams typical of types found in the state. The upper 46 miles of North Fork River in Mason County and 12 miles of Whippoorwill Creek in Logan County were treated with 5-percent powdered rotenone in 1952 to eradicate their entire fish populations. Both streams were immediately restocked with game and panfish species. Annual sampling of the population of both streams revealed a gradual reversion to the original population composition in each stream. It was concluded that total population manipulation could be accomplished, and at no more prohibitive cost than other comparable management techniques, but that any benefit to the game fish species was of questionable value and of short duration. Similar findings resulted from removing undesirable species from 11.5 miles of Floyd's Fork Creek (Bullitt County) with an electric seine during 1955.

All available evidence indicates that partial or total population manipulation alone (without environmental alteration or improvement) holds little promise as a management tool for improving the population composition of the average Kentucky stream.

INTRODUCTION

During the paet 2 decades erosion, siltation, pollution, and possibly fishing pressure, have caused the reduction of game fish populations in many of the streams under the observation of this Department, while the rough fish populations have increased. Since information on hand regarding the dynamics of warm-water stream populations was insufficient for management or renovation of such streams, Kentucky initiated a Dingell-Johnson stream investigation project early in 1952. The original objectives of this project were threefold: (1) to determine whether total population eradication could be successfully accomplished in warm-water streams supporting heavy rough fish populations; (2) to determine whether game fish populations could then be established and maintained at a level above their former abundance in stream sections open to rough fish pressure; (3) to determine whether it was economically and biologically sound to attempt population manipulation prior to upper watershed management and/or stream improvement. A fourth objective was added later during the life of the project: to determine if partial population manipulation could achieve the aims of the aforementioned objectives.

Two streams, North Fork of Licking River and Whippoorwill Creek, were selected early in 1952 as being typical of 2 different types of streams in the state having heavy rough fish populations but which reportedly once offered better than average game fish angling. A third experimental stream, Floyd's Fork Creek, was selected in 1955. Total population manipulation techniques (complete eradication and restocking) were employed on the first 2 streams. Partial population manipulation (rough fish removal only) was tested on Floyd's Fork.

DESCRIPTIONS OF THE STUDY STREAMS

North Fork of Licking River

This stream (hereinafter referred to as North Fork River) rises in the northeastern corner of Fleming County and flows in a generally westward direction through Mason County, ultimately entering the main stem of the Licking River near the southeastern corner of Pendleton County. The uppermost 46 miles of North Fork were designated as the experimental section and

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the downstream termination point was arbitrarily chosen at U. S. 68 highway bridge between Maysville and Paris.

The upper one-third of the experimental section averaged 27.5 feet wide and 2.1 feet deep. Pools were interrupted by frequent riffles of varying lengths which were covered with a dense growth of water willow, *Dianthera americana*. Within this area were found many curves and meanders, and the stream in many places was choked by log and brush barriers.

Pools predominated throughout the middle third of the experimental section. Very few log and brush barriers were present and the widest and deepest water of the entire study section occurred here. This area averaged 44.6 feet wide and 3.7 feet deep.

The lower third of the section was a mixture of pools and riffles. One stretch resembled the Everglades, being choked with bars and islands, all covered with a dense growth of water willow. In some areas there was no clearly defined stream channel, only a few inches of water hidden by weeds. Long pools occurred toward the lower end of the area with few bars and islands present. The average width for this lower third was 45.3 feet and the depth averaged 3.4 feet.

Whippoorwill Creek

This stream rises near the geographical center of Todd County and flows in a southeasterly direction into Logan County, where its course then takes a more southerly direction. Whippoorwill enters the Red River only a few miles above the Kentucky-Tennessee border. A 12-mile section in the middle part of this stream was arbitrarily chosen for population manipulation studies. The upper end of the study area began at U. S. 79 highway bridge and the downstream termination point was an old mill dam near the town of Lickskillet.

Whippoorwill Creek is typical of streams found in the south-central part of Kentucky. These streams are usually clear most of the year, with relatively cool waters and rocky bottoms. Many of the streams in this general area have a characteristic smallmouth-rock bass population, accompanied by the usual rough and forage species found elsewhere in the state.

The upper 3 miles of the 12-mile study section of Whippoorwill averaged about 32 feet in width with an average depth of 2 feet. The middle 6 miles had an average width of 40 feet and was also 2 feet deep. The lower 3 miles averaged 56 feet in width with an average depth of 5.5 feet. Bedrock and broken rock (from boulders to sand) were the predominant bottom types found throughout the entire 12-mile section. Some detritus occurred but very little mud was found overlying the bottom. Aquatic vegetation was sparse; small patches of *Dianthera americana* were sometimes found on or near riffle areas. Whippoorwill Creek flows through an essentially rural area, hence no pollution other than a small amount of domestic sewage was present. Stock watering and recreation were the only significant uses made of the water in this creek. As far as known, no water was used for irrigation purposes during the course of the study.

Floyd's Fork Creek

The main stem of Floyd's Fork, from the junction of the North and East Forks to its confluence with the Salt River, was found to be 60.9 miles long. The average width was 55.4 feet and the average depth was 2.11 feet. There were 408 surface acres and 864 acre feet of water contained in this main section.

The main stem is formed in Oldham County at an elevation of 700 feet and enters the Salt River in Bullitt County at an elevation of 400 feet. There is an average gradient of 4.9 feet per mile. The stream follows generally a southwesterly course across Oldham, Jefferson, and Bullitt Counties. There are 16.1 miles of stream in Oldham County proper (the stream forms a portion of the boundary line between Oldham and Shelby Counties). Jefferson County has 30.3 miles and there are 14.5 miles in Bullitt County.

For reporting purposes, the stream was arbitrarily divided into 6 sections. The first 5, from the headwaters downstream, measured 10 miles each. The remaining section, to the mouth, measured 10.8 miles. Physical data were averaged separately for each section and then combined to obtain total averages. Stock watering and recreation (fishing, swimming, boating, etc.) were found to be the only significant uses of the water. Amounts of water removed for irrigation purposes are probably insignificant. Only 1 industrial user of water, a whiskey distillery in Jefferson County, is known to be located on this stream. Behind this distillery is the only true dam. It is constructed of concrete but does not block fish movement except during the low-water periods.

Pollution is rarely a problem in this watershed. The above-mentioned distillery has, in the past, reportedly been responsible for several fish kills. As far as could be determined, however, these were local in nature, of short duration, and very infrequent. Some pollution of domestic orgin exists but is considered to be relatively insignificant.

Illegal and unlawful activities such as seining, dynamiting, and poisoning are occasionally reported by the landowners, but it is difficult to evaluate the effects of these practices since so many unknown factors are involved.

Section No. 1

The uppermost 10 miles of Floyd's Fork Creek averaged 40.0 feet in width and 1.34 feet in depth. Approximately 48.5 surface acres and 64.9 acre feet of water were contained in this upper section. The pool-to-riffle ratio was estimated to be 70:30. All major bottom types occurred but rubble, gravel, and sand predominated. Pools in this section, on the basis of quality, received a rating of "medium" to "poor". Riffles received a rating of "good". Fish shelter was evaluated as medium to poor in quality and quantity. Aquatic vegetation was common in occurrence and consisted of water willow (*Dianthera americana*) and various grasses. No major tributaries enter this section.

Section No. 2

The second 10 miles of creek averaged 39.0 feet wide and 1.19 feet deep. Approximately 47.3 surface acres and 56.3 acre feet of water were contained in this section. Pool-to-riffle ratio was an estimated 78:12. All types of bottom occurred, and the first extensive deposits of mud were found within this section. Pools were rated medium in grade; riffles received a rating of good. Fish shelter was found to average between medium and poor in amount. Aquatic vegetation ranged from sparse to common. Riffles in Floyd's Fork are invariably grown up in water willow. The low percentage of riffle areas in this section accounts for the sparseness of vegetation. One major tributary, Curry's Fork, enters this section.

Section No. 3

The third 10 miles of stream averaged 60.0 feet in width, 1.83 feet in depth, and had 72.7 surface acres with 133.1 acre feet of water. A pool-to-riffle ratio of 61:39 was found. All major bottom types existed but bedrock and boulders composed only a minor portion of the bottom throughout this section. Pools were evaluated as good; riffles likewise were rated good. Fish shelter, however, ranged from medium to poor in amount and quality. Aquatic vegetation was sparse to common in occurrence and was, for the most part, *Dianthera americana*. Three major tributaries empty into this section. They are Long Run, Brush Run, and Pope Lick.

Section No. 4

The fourth 10 miles averaged 47.2 feet wide and 2.03 feet deep. Surface acreage was calculated to be 57.2 acres with 116.1 acre feet of water. An estimated pool-to-riffle ratio of 72:28 existed. Few areas within this section had a bottom of bedrock although all the other major types were represented. Pools received a rating of medium quality; riffles ranged from poor to good. The latter rating was accorded to riffles flowing over boulder, rubble, or gravel. The former rating was given to riffles flowing over bedrock or sand. Fish shelter averaged from medium to poor in amount and quality. Aquatic vegetation was sparsely distributed. There were 4 major tributaries to this section. There were Cane Run, Brush Run, Chenoweth Run, and Broad Run.

Section No. 5

The fifth 10 miles had an average width of 68.5 feet. The depth averaged 2.08 feet. Surface acreage was tabulated to be 83.0 acres and 17.7 acre feet of water. A pool-to-riffle ratio of 78:22 was estimated for this section. Pools

received an evaluation rating of good; riffles were considered to rate only medium in quality. Aquatic vegetation was common throughout the section. Fish shelter was abundant and of good quality. The 4 major tributaries were Big Run, Long Run, Wells Run, and Bethel Branch.

Section No. 6

This section contained 10.8 miles from the end of Section No. 5 to the mouth at Salt River. It averaged 76.0 feet in width and 3.23 feet in depth. Surface acreage was calculated to be 99.5 acres with 321.4 acre feet of water. A poolto-riffle ratio of 83:17 existed in this section. Bedrock was the only major bottom type not well represented in this section. Pools were of medium quality. Sparse amounts of aquatic vegetation occurred in this last section of stream. Cedar Creek, Brooks Run, and Bluelick Creek were the major tributaries.

MATERIALS AND METHODS

Leases

All persons owning land bordering North Fork River and Whippoorwill Creek were personally contacted in 1952. Written agreements were obtained granting the Department of Fish and Wildlife Resources permission to use these streams for experimental purposes. In a few instances some difficulty was encountered in signing up certain landowners because of personal resentment against the law enforcement division of the Department. These individuals were in the minority, however. Three years later, in 1955, when Floyd's Fork Creek was selected for partial population manipulation studies, it was believed that leases were no longer required as a public relations gesture since this stream flows through an essentially metropolitan area of the state, where the sportsmen are better informed and the proposed experimental methods were not as drastic as total eradication.

Population Sampling Methods

The methods used to determine the undisturbed species composition of all 3 experimental streams, and all subsequent population sampling methods, were standardized insofar as possible. Rotenone alone was used throughout the life of the project to sample the populations of North Fork and Whippoorwill. The electric seine was sometimes employed on Floyd's Fork but was always backed up with an application of rotenone. Block nets were used at each station at both the upstream and downstream limits of the study area regardless of the sampling method. The nets were stretched from bank to bank and were of sufficient depth to adequately block mets was $\frac{1}{4}$ inch. The nets were left in the stream overnight at each station since rotenone studies require at least 2 days' observation to recover all fish. Those stations having deeper than average (2 to 3 feet) depths were checked the third day to insure that any additional fish would be recovered.

The same sampling procedure was followed at each station. The area was first blocked at each end to prevent escape of the normal population that might have been disturbed by subsequent operations. A steel tape was used to measure the length, width, and depth of the study area. All measurements and observations were recorded on a standardized form. A standard brand of 5% rotenone-content cube powder was used at the rate of 2.5 pounds per acre foot of water. The powder was mixed to a thick paste consistency and then applied as "mud balls" in the deeper parts of the area or further diluted with water and applied to the surface with a coffee can. Fish in distress were netted as soon as they surfaced since it has been learned by experience that many species, especially those lacking air bladders, sink to the bottom after their initial distress and surface again only after bloating. While lying on the bottom many of the smaller fish are devoured by crayfish and other scavengers and are not recovered in the sample. In clear streams with a dense crayfish population it has been observed that the loss of small fish can be significant.

A brief description of the electric seine used in Kentucky and the techniques employed in its use should suffice for the purposes of this report. The electric seine consists of a heavy-duty (14 gauge) 3-conductor neoprene-insulated cable stretched between 2 bamboo poles which are much like ordinary seine brailles. At 4-foot intervals alternate horizontal (floating) and vertical (hanging) electrodes are tapped into the 3-conductor cable. The hanging electrodes are made of heavy stiff copper wire to insure their trailing near the stream bottom in a straight path, even in swift water. Small bamboo poles, with flexible electrical cable taped along their lengths and then suspended from the downstream ends, act as floating "pigtails", thereby creating an electrical field as wide (parallel to the stream flow) as the poles are long. The poles are usually about 4 feet long. The wide field tends to prevent fish from darting up to the seine, being stunned, and then quickly recovering because only a thin "wall" of electricity existed. The momentum of a darting fish is often enough to propel it through a narrow electrical field and on out of reach of the waiting dip netters. Current is supplied for the seine by a portable A.C.-D.C. Homelite generator (see the *Progressive Fish Culturist*, January, 1954, issue for an article that pictures and describes this generator). When the current is applied all fish in the electrically energized field are stunned and become helpless. Dip nets are used to recover these fish and they are placed in floating live-boxes until a stream section is completely electroseined.

Eradication and Restocking Operations North Fork River

The 46-mile section to be treated with rotenone was divided into 10 areas which varied from 2 to 7 miles each. It was planned to completely eradicate the entire section in 1 week but heavy rainfall prolonged the work into a 2-week operation. The minimum dosage required was calculated to be 2 pounds of powdered rotenone per acre foot. A heavier concentration resulted, however, since it was difficult for the crews to estimate stream distances while walking and working. All crews used more rotenone than the predetermined amounts. Also, greatly lowered water levels prevailed at the time of eradication, compared to the levels prevailing at the time the stream measurements were made. Because of the above facts and others to be mentioned later, it is believed that very close to a complete kill was achieved. A total of 1,250 pounds of rotenone was used to treat the 46-mile section.

In those areas shallow enough to wade, the crews carried the rotenone in feed sacks, mixing it as needed and dispersing it by hand. Boats and spray pumps were used in the deeper areas. A barrier of 1-inch mesh wire netting was erected at the end of each day to prevent fish movement from untreated downstream areas into the eradicated areas. Several times during the eradication operation these barriers were washed out by extremely heavy rainfall. When this occurred, the following morning a heavy curtain of rotenone would be released at $\frac{1}{2}$ -mile intervals above the barrier-washout site. Observers stationed below and between these curtain release points reported that no fish were seen during several hours' observation. These checks showed that no fish had moved upstream while the barrier was down and they also demonstrated that the previous day's rotenone treatment in these areas was adequate. Every other day was spent picking up and burying dead fish that otherwise might have created a sanitary problem. It was estimated that a crowd of 200 to 400 people was following behind the crews, picking up edible fish as soon as those species showed signs of distress. Based on the previous population study data, it was estimated that the 230 eradicated acres contained some 37,000 pounds of fish.

All major tributaries to North Fork were treated from their mouths upstream to a point where they no longer contained enough water to support sizeable fish of any species. It is believed that these small tributaries acted as reservoirs for forage minnows that aided in providing immediate forage for the restocked game species.

Four days after completion of the eradication operation adult bluegill in liveboxes were placed at random locations in the river to check on the toxicity of the water. All the test fish survived, indicating no residual rotenone remained. High water temperatures and several hard rains probably hastened this detoxifying action. Three days later the actual restocking began. Departmental hatcheries provided largemouth bass fingerlings, "cannibals", and adults. Farm ponds and city reservoirs were seined to obtain black crappie, white crappie, bluegill, and longear sunfish. Many of this last-named group were sexually mature and it is known that in at least 1 location the bluegill spawned soon after being stocked in the river. Of necessity, availability largely determined the numbers and ratio of game to forage species stocked. Only a minimum number of the desired species were available in the late summer of 1952 after the eradication work was completed. A reduced hatch, coupled with an extended holding period, resulted in only 11,250 largemouth bass fingerlings and cannibals being available that year for the 46 miles of North Fork. In 1953, 8,700 additional largemouth fingerlings were stocked. North Fork received 71,000 advanced fry and 6,200 fingerling largemouth bass in 1954. These bass were released at 14 separate locations. At these same locations 7,750 black and white crappie and 12,500 bluegill and longear sunfish were released in 1952.

Whippoorwill Creek

The entire 12-mile experimental section of Whippoorwill Creek was eradicated with 5% powdered rotenone in 1 day. Three hundred pounds of rotenone were used to treat the 36 surface acres. It was estimated that 537 pounds of fish were removed from the 12 miles of stream. The same operational techniques used on North Fork were employed on Whippoorwill Creek in eradicating the population.

Very soon after eradication the restocking of desired species was begun. Four game fish species (largemouth, smallmouth, and rock bass; white crappie) and 3 forage fish species (warmouth, bluegill, and golden shiner) were reintroduced. Slightly more than 4,000 game fish and about 3,000 forage fish were stocked during the early fall of 1952. Two hundred smallmouth bass fingerlings were planted in Whippoorwill in 1953. In 1954, 1,000 rock bass fingerlings and 75 adult black crappie were released at several locations in this stream.

Rough Fish Removal Operation Floyd's Fork Creek

Rough fish removal operations were initiated on Floyd's Fork during the late summer of 1955. Beginning at the mouth and working upstream, 11.5 miles were covered with the electric seine during the time alloted to this phase of the project. The basic crew consisted of the project leader and 3 assistants; however, landowners and interested fishermen often assisted in netting operations, boat handling, unloading equipment, and similar tasks. Their aid in the lower areas where the stream was wide and deep was very helpful and appreciated.

The electric seine used to remove rough fish is described above in this report. Nearly all species seemed susceptible to stunning with the seine, although certain ones exhibited varying degrees of tolerance. This was especially true of blackstripe topminnows which are ordinarily found on or near the surface. They usually darted through the energized field unaffected. Most fish 4 inches or longer of all species are immobilized by the Kentucky seine. Thus the major rough fish species we were most interested in removing from this stream were ordinarily stunned since they averaged considerably more than 4 inches in length.

Floating live-boxes enabled the crew to safely hold desirable species until a pool could be completely seined. Game fish were processed first and then returned unharmed to their native pool. Those species slated for removal were the last to be weighed and measured. Very few desirable fish were killed during this operation, either from handling or as a result of being electrically shocked. Edible rough fish were given the landowner whose property bordered the section being seined or to fishermen that were usually on hand watching our work. Very few pounds of fish were wasted during the removal operation. Gizzard shad were oftentimes desired by catfish anglers for use as trotline bait. This approach to the disposal problem was well received by the local people and sportsmen in this area.

A total of 2,065 fish representing 39 separate species and weighing 1,535 pounds was taken. Sixteen of these species were returned unharmed to the stream. There were 231 individual fish weighing 79.7 pounds in the group designated desirable. The remaining 23 undesirable species numbered 1,834 fish and weighed 1,455.3 pounds. Coupled with those fish necessarily removed during the prior rotenone and electrofishing population sampling studies, a grand total of 5,445 fish weighing 2,181.4 pounds were permanently removed during 1955. Eight of the 63 species identified from Floyd's Fork that year were discovered during the rough fish removal operations and were not represented in the previous population studies. Longear sunfish were found to be the most abundant

species, while fresh-water drum accounted for the greatest weight percentage of any single species.

COMPOSITION OF THE UNDISTURBED POPULATIONS

North Fork River

Five population studies were conducted at random locations on North Fork early in 1952 prior to eradication of the entire population. These five studies, totalling 2.88 acres in area, yielded 2,662 fish which weighed 466 pounds (Table I; Figs. 1, 2). Twenty major species, plus several miscellaneous small species, were represented in the original, undisturbed population. On the basis of these studies it was determined that North Fork was supporting an average of 162 pounds of fish per acre. Game fish species, represented by largemouth bass, Kentucky bass, and white crappie, occupied 4.5 percent of the total number and 6.5 percent of the total weight of the combined samples. Panfish species (bluegill, longear sunfish, green sunfish, and warmouth) made up 33.3 percent by number but only 10.8 percent by weight of the sampled population. Ten species, arbitrarily classed as "rough fish", accounted for 29.9 percent and 70.0 percent of the total number and total weight, respectively. The remaining 32.3 percent of the total number was composed of the various forage fish species. By weight this last-named group made up 12.7 percent of the sampled population.

Whippoorwill Creek

Three population studies were conducted at random locations on Whippoorwill during the summer of 1952 prior to eradication of 12 miles of its fish population. These 3 studies, totalling 1.50 acres in area, yielded 302 fish which weighed 22.4 pounds (Table II; Figs. 3 and 4). Nine major species, plus miscellaneous small species, were represented in the original, undisturbed population. On the basis of these studies it was determined that Whippoorwill was supporting an average of 15 pounds of fish per acre. Game fish species, represented by Kentucky bass and rock bass, occupied 6.3 percent of the total number and 12.3 percent of the total weight of the combined samples. Panfish species (longear sunfish and green sunfish) made up 7.6 percent by number but only 3.2 percent by weight of the sampled population. Redhorse and hog sucker were the only rough fish species encountered. They accounted for 16.6 percent and 69.8 percent of the total number and total weight, respectively. The remaining 69.5 percent of the total number was composed of the various forage fish species. By weight this last-named group made up 14.6 percent of the sampled population.

Floyd's Fork Creek

Eight population studies, approximately 8 miles apart, were conducted on Floyd's Fork during the summer of 1955 prior to rough fish removal work described in another section of this report. A total of 3,611 fish weighing 726 pounds was taken from the 10.7 acres sampled (Table III; Fig. 7). This represents a standing crop value of 68 pounds per acre. The 5 game fish species encountered made up 4.2 percent by number and 7.5 percent by weight of the sampled population. Five species of panfish accounted for 45.2 percent and 61.9 percent, respectively, of the total number and weight. Rough fish, represented by 14 species, occupied 23.9 percent by number and 66.8 percent by weight of the population. The remaining 31 species composed the forage fish group, which accounted for 26.7 percent of the total number and 17.1 percent of the total weight.

TABLE I

NORTH FORK RIVER, 1952. COMPOSITION OF THE UNDISTURBED POPULATION PRIOR TO ERADICATION AS DETERMINED BY SAMPLING 5 AREAS TOTALLING 2.88 ACRES

Species	Number of Fish	% Total Number	Length	Weight	% Total Weight
Largemouth Bass	18 34 68	0.68 1.28 2.55	4.3–13.5 5.0–12.0 4.0–10.5	6.33 10.92 13.22	1.36 2.34 2.84
GAME FISH	. 120	4.51		30.47	6.54

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d . 1	Number	% Total	.	*** * * .	% Total
Species	of Fish	Number	Length	Weight	W eight
Bluegill	. 13	0.49	2.0- 6.0	1.07	0.23
Longear Sunfish	. 748	28.10	2.0- 6.0	38.54	8.26
Warmouth	. 22	0.83	3.0- 7.0	2.95	0.63
Green Sunfish	. 103	3.87	3.0- 6.0	7.83	1.68
Panfish	. 886	33.29	•••••	50.39	10.80
Redhorse	. 151	5.67	2.0-14.0	39.69	8.51
White Sucker	. 308	11.57	3.0-13.0	61.07	13.09
Spotted Sucker	. 32	1.20	3.0-14.0	9.39	2.01
Channel Catfish	. 7	0.26	15.0-20.0	11.64	2.50
Flathead Catfish	. 46	1.73	2.0-22.0	23.75	5.09
Black Bullhead	. 115	4.32	3.0- 9.0	4.86	1.04
Yellow Bullhead	. 61	2.29	3.0-10.0	8.18	1.75
Carp	. 21	0.79	7.0-23.0	34.97	7.50
Bigmouth Buffalo	. 53	1.99	7.0-21.0	131.80	28.25
Drum	. 1	0.04	14.0	1.20	0.26
Rough Fish	. 795	29.86		326.55	70.00
Gizzard Shad	256	9.62	6.0-14.0	49.27	10.56
Stonecat	. 2	0.07	7.0	0.10	0.02
Darters	. 17	0.64	2.0- 6.0	0.24	0.05
Creek Chubs	. 93	3.49	3.0- 8.0	6.60	1.42
Misc. Minnows	. 493	18.52	2.0- 6.0	2.87	0.61
FORAGE FISH	. 861	32.34		59.08	12.66
GRAND TOTALS	. 2,662	100.00		466.49	100.00

TABLE II

Whippoorwill Creek, 1952. Composition of the Undisturbed Population Prior to Eradication as Determined by Sampling 3 Areas Totalling 1.50 Acres

Species	Number of Fish	% Total Number	Lenath	Weiaht	% Totai Weight
Kentucky Bass Rock Bass	1 18	0.33 5.96	4.5 1.0–10.4	0.02 2.74	0.09 12.23
GAME FISH	. 19	6.29		2.76	12.32
Longear Sunfish	. 1 . 22	0.33 7.28	5.0 3.0- 5.0	0.06 0.66	0.27 2.95
PANFISH	. 23	7.61	. <i></i>	0.72	3.22
Redhorse	. 41 . 9	13.58 2.98	2.015.0 5.011.5	13.04 2.60	58.21 11.61
Rough Fish	. 50	16.56	· · · · · · · ·	15.64	69.82
Slender Madtom Cottus sp Creek Chub Misc. Minnows	. 10 . 14 . 2 . 184	3.31 4.64 0.66 60.92	2.0- 6.0 1.0- 5.0 6.0- 8.0 2.0- 4.0	0.23 0.25 0.40 2.40	1.03 1.12 1.78 10.71
Forage Fish	. 210	69.53	<u>.</u>	3.28	14.64
GRAND TOTALS	. 302	99.99	•••••	22.40	100.00
		162			

TABLE III

FLOYD'S FORK CREEK, 1955. COMPOSITION OF THE UNDISTURBED POPULATION PRIOR TO ROUGH FISH REMOVAL AS DETERMINED BY SAMPLING 8 AREAS TOTALLING 10.7 ACRES

	Number	% Total			% Total
Species	of Fish	Number	Length	Weight	Weight
Largemouth Bass	. 12	0.33	4.6-16.8	8.94	1.23
Smallmouth Bass	. 8	0.22	8.2-12.9	5.17	0.71
Kentucky Bass	. 85	2.35	4.114.5	30.94	4.26
Rock Bass	. 4	0.11	4.5- 7.0	0.77	0.10
White Crappie	. 43	1.19	3.7-12.0	8.91	1.23
	150	4.00		<u> </u>	
GAME FISH	. 152	4.20	• • • • • • •	54.73	7.53
Warmouth	. 3	0.08	5.2- 8.1	0.78	0.10
Bluegill	. 244	6.76	2.0- 7.0	9.02	1.24
Longear Sunfish	. 619	17.14	1.0- 6.0	32.08	4.42
Green Sunfish	. 169	4.68	2.0- 7.0	13.91	1.92
Orangespotted Sunfish	. 596	16.51	1.0- 5.0	6.08	0.84
D	1 (11	45.15		(1.07	
PANFISH	. 1,631	45.17	• • • • • • •	61.87	8.52
Redhorse	. 327	9.06	3.7-17.0	111.20	15.32
White Sucker	206	5.70	4.0-13.5	34.10	4.70
Spotted Sucker	119	3.30	4.4-14.4	24.68	3.40
Hog Sucker	3	0.08	11.5-12.5	2.34	0.32
Channel Catfish	. 19	0.53	67-16.4	10.63	1.46
Black Bullhead	. 8	0.22	40-87	1 72	0.24
Yellow Bullhead	. 16	0.44	6.0-10.3	4.34	0.60
Flathead Catfish	0	0.19	10.2-26.0	20.01	2.76
Caro	. 20	0.55	8 0-32 0	110.75	15.25
Drum	. 20	0.00	60-180	35.86	4 94
Bigmouth Buffalo	. 55	014	10 5-24 6	18.02	2 48
Smallmouth Buffalo	. 25	0.69	60-320	71.96	0 01
Quillback	. 25	1 01	46_170	38.63	5 32
Diver Corposition	. 05	0.11	58-100	0.03	013
River Carpsucker	. .				
Rough Fish	. 863	23.91		485.17	66.83
Gizzard Shad	. 402	11.13	5.0-16.0	117.99	16.25
Madtoms	. 52	1.44	1.0- 5.0	0.72	0.10
Darters	. 6	0.17	3.0- 4.7	0.14	0.02
Brook Silversides	. 3	0.08	2.0- 3.0	0.03	0.01
Misc. Minnows	. 502	13.90	1.0- 6.7	5.37	0.74
Forage Fish	. 965	26.72		124.25	17.12
GRAND TOTALS	3,611	100.00		726.02	100.00

POST-ERADICATION POPULATION COMPOSITION

Every year after eradicating and restocking the experimental sections in North Fork River and Whippoorwill Creek, the same population study areas (with exceptions *) were sampled employing identical methods and materials. To further check the validity of the annual, original-area population data, supplemental studies at different locations were made during the summer of 1956, the fifth consecutive year these two streams had been under observation and study. It was suspected that biased samples might possibly have resulted from rotenone sampling the same pools every year. Each supplemental study made in 1956 was therefore conducted immediately upstream from the original study pools. Based on findings presented below, it is believed that the annual population studies have been a true index to each year's existing population in both streams.

^{*} Certain areas of Whippoorwill Creek could not be used each year due to drought conditions. Whenever this situation occurred a comparable area was chosen.

Rough fish species began entering the experimental sections during the first winter and spring following eradication. Certain species such as carp, gizzard shad, and white sucker traveled the maximum distance, appearing in the first post-eradication population samples throughout the 46-mile section of North Fork. Other species entered very slowly and a few have never re-entered the experimental areas. The population composition, as well as the standing crop values, has fluctuated from year to year in both streams. Neither stream is now supporting as many pounds of fish per acre as each was prior to eradication in 1952. The accumulated evidence points to a gradual reversion to the original population composition found in each stream.

North Fork River

All 5 years' population composition data are presented together in Figures 1 and 2 to facilitate comparison between each year's findings. It should be noted that the 1952 findings represent the original undisturbed population prior to chemical eradication and restocking. It is readily apparent that the population quickly reverted in 1953 to very near its original species composition and has remained relatively stable with little change during the past 4 years. Nearly every major species in the rough fish category was found throughout the experimental stream section the first summer following eradication. Numerically, the The population composition has undergone greater shifts than it has weightwise. greatest shifting has occurred in the forage fishes from year to year. Undoubtedly a small residual stock of minnows and other forage species was left unharmed in the springs and small branches feeding North Fork. These survivors apparently brought off a tremendous spawn in 1953, since numerically that year they were 12 percent more abundant than they were in the original population of 1952. It is believed that none of the forage species, except gizzard shad, migrate to the extent that the species in the other categories were found to have migrated. Thus the residual stock of forage species more than repopulated the entire section in less than a year.

It appears that the population in North Fork River has become stablized, even though the last 4 years' standing crop values were far below the originally determined carrying capacity. This latter figure was found to be 162 pounds per acre in 1952. The standing crop value in 1953 was 82 pounds per acre; 1954, 48 pounds per acre; 1955, 49 pounds per acre; 1956, 55 pounds per acre. There has been much closer correlation between the species composition of the population each year than there has been between the weight of the population as a whole, as measured annually in terms of standing crop values (Tables IV-VII). This can partially be explained by the continued absence of bigmouth buffalo from the experimental section of the stream. In the undisturbed population, bigmouth buffalo occupied about 28 percent of the total weight. Since then, only 2 specimens of this once abundant species have been taken in the annual sampling. Channel catfish, flathead catfish, and stonecat are the only species originally present that have remained absent to date from the experimental section. Combined, the above 4 species would have significantly increased the standing crop poundages had they been present in post-eradication population samples at the level of their former abundance.

The 4 supplemental population studies conducted on North Fork during 1956 as a check on the validity of the annual studies totalled 5.02 acres in area, about 134 times the size of the annually sampled areas. A comparison of the annual and supplemental population study data reveals fairly close agreement between the population composition of the annually sampled areas and the supplemental areas, especially in the game fish category (Table VIII; Fig 5). Based on this comparison, it is believed that each year's findings since 1952 have been a true index to the existing population in North Fork River.

Whippoorwill Creek

All 5 years' population composition data are shown together in Figures 3 and 4 as an aid in comparing each year's findings. The 1952 findings represent the original undisturbed population prior to chemical eradication and restocking. After exhibiting an upsurge in 1953, the game fish species as a group gradually decreased weightwise in their relation to the total population (1952, 12.3 percent; 1953, 26.4 percent; 1954, 24.0 percent; 1955, 18.2 percent; 1956, 8.3 percent). Panfish as a group showed the reverse of that trend and weightwise, with the



exception of 1956, have been on the increase (1952, 3.2 percent; 1953, 2.7 percent; 1954, 5.1 percent; 1955, 12.9 percent; 1956, 7.2 percent).

Rough fish species decreased weightwise in 1953 and 1954, only to reverse that trend in 1955 and continue upward in 1956 (1952, 69.8 percent; 1953, 53.5 percent; 1954, 61.1 percent; 1955, 60.3 percent; 1956, 79.6 percent). The forage fish group has followed the pattern of the game firsh species. Weightwise, they entered into the population composition with decreasing strength after 1953 (1952, 14.6 percent; 1953, 17.3 percent; 1954, 9.7 percent; 1955, 8.4 percent; 1956, 5.0 percent).

TABLE IV

North	FORK RIVER	, 1953. Composition of the Population 1 Year aft	ER
	ERADICATION	AND RESTOCKING AS DETERMINED BY SAMPLING	
	THE	Original 5 Study Areas (2.88 Acres)	

THE ORIGIN	Numher	% Total	5 (2.00 men	40)	% Total
Species	of Fish	Number	Length	Weight	Weight
Largemouth Bass	56 32	3.70 2.11	4.2–12.4 1.6–11.8	12.29 3.92	5.23 1.67
Game Fish	88	5.81		16.21	6.90
Bluegill Longear Sunfish Green Sunfish	117 141 112	7.73 9.31 7.40	1.0- 6.8 1.3- 6.7 1.0- 7.0	10.70 9.15 3.96	4.56 3.90 1.69
PANFISH	370	24.44		23.81	10.14
Redhorse White Sucker Spotted Sucker Black Bullhead Yellow Bullhead Carp Drum	20 238 5 89 14 23 1	$1.32 \\ 15.72 \\ 0.33 \\ 5.88 \\ 0.92 \\ 1.52 \\ 0.06$	7.0-14.0 2.0-14.5 7.0-14.3 1.0-12.0 3.5- 9.5 5.5-32.5 15.0	5.08 36.65 2.15 16.42 3.19 99.46 1.63	2.16 15.61 0.92 6.99 1.36 42.36 0.69
Rough Fish	390	25.75	,	164.58	70.10
Gizzard Shad Darters Creek Chub Misc. Minnows	135 19 36 476	8.92 1.25 2.38 31.44	1.9-13.4 1.0- 4.4 2.1- 7.4 1.0- 6.5	23.83 0.17 1.64 4.54	10.15 0.07 0.70 1.93
FORAGE FISH	666	43.99		30.18	12.85
GRAND TOTALS	1,514	99.99		234.78	99.99

TABLE V

North Fork River, 1954. Composition of the Population 2 Years after Eradication and Restocking as Determined by Sampling the Original 5 Study Areas (2.88 Acres)

	37 7	d /1 . 1		- /	al Tracel
Species	of Fish	% I otal Number	Length	Weight	Weight
Largemouth Bass	. 27	1.14	4.9-11.0	9.95	7.22
White Crappie	30	0.08 1.27	7.7- 8.4 3.8- 8.7	0.56 3.04	2.21
GAME FISH	. 59	2.49		13.55	9.84
Bluegill	. 54	2.28	1.0- 7.6	8.51	6.18
Longear Sunfish	. 340	14.35	1.0- 7.0	11.24	8.16
Green Sunfish	. 191	8.06	1.0- 7.0	6.33	4.60
Panfish	. 585	24.69		26.08	18.94
White Sucker	. 123	5.19	3.8-13.1	26.54	19.27
Spotted Sucker	. 17	0.72	3.3 4.8	0.32	0.23
Black Bullhead	. 152	6.41	1.0-11.5	23.31	16.92
Yellow Bullhead	. 110	4.64	1.0-11.4	1.69	1.23
Carp	. 19	0.80	6.4-24.0	26.37	19.15
Rigmonth Buffalo	· -1	0.04	21.5	6.34	4.60
Drum	2	0.08	6.2- 7.0	0.25	0.18
Rouch Fish	. 424	17.88		84.82	61.58

	Table	V—Continu	ued		
Species	Number of Fish	% Total Number	Length	Weight	% Total Weight
Gizzard Shad	. 17	0.72	5.0-10.2	2.47	1.79
Darters	10	0.42	2.0- 3.0	0.07	0.05
Creek Chub	. 92	3.88	2.0- 7.0	3.26	2.37
Misc. Minnows	1,183	49.92	2.0- 3.0	7.48	5.43
FORAGE FISH	. 1,302	54.94		13.28	9.64
GRAND TOTALS	. 2,370	100.00		137.73	100.00

TABLE VI

North Fork River, 1955. Composition of the Population 3 Years after Eradication and Restocking as Determined by Sampling the Original 5 Study Areas (2.88 Acres)

Charles	Number	% Total	T and t		% Total
Species	of Fish	1vumber	Length	w eight	w eight
Largemouth Bass	. 20	1.23	4.0-12.6	7.25	5.10
White Crappie	. 44	2.70	2.0- 9.5	5.44	3.83
GAME FISH	. 64	3.93		12.69	8.93
Warmouth	. 4	0.25	3.5- 6.3	0.83	0.58
Bluegill	. 115	7.06	2.0- 8.0	9.03	6.35
Longear Sunfish	. 159	9.77	2.0- 7.0	7.47	5.25
Green Sunfish	. 103	6.33	2.0- 7.1	5.41	3.81
Panfish	. 381	23.41		22.74	15.99
Redhorse	. 1	0.06	16.9	2.08	1.46
White Sucker	. 468	28.75	2.0-14.0	52.43	36.88
Spotted Sucker	. 14	0.86	8.7-15.0	8.54	6.01
Black Bullhead	. 307	18.86	1.5- 9.5	11.06	7.78
Yellow Bullhead	. 70	4.30	2.010.0	5.30	3.73
Carp	. 15	0.92	6.5–19.3	18.49	13.00
Drum	. 2	0.12	7.5–12.6	1.16	0.82
Bigmouth Buffalo	. 1	0.06	9.2	0.41	0.29
Rough Fish	. 878	53.93		99.47	69.97
Gizzard Shad	. 5	0.31	8.0-11.8	1.49	1.05
Darters	. 7	0.43	2.0- 3.9	0.03	0.02
Creek Chub	. 69	4.24	1.7 7.0	4.16	2.93
Misc. Minnows	. 224	13.76	2.0- 6.5	1.60	1.13
Forage Fish	. 305	18.74		7.28	5.13
GRAND TOTALS	1,628	100.01		142.18	100.02

TABLE VII

North Fork River, 1956. Composition of the Population 4 Years after Eradication and Restocking as Determined by Sampling the Original 5 Study Areas (2.88 Acres)

Species	Number of Fish	% Total Number	Length	Weight	% Total Weight
Largemouth Bass	2 35	0.16 2.71	7.9–13.3 5.0–10.9	1.46 5.16	0.92 3.27
Game Fish	. 37	2.87	·····	6.62	4.19

TABLE VII-Continued

C	Number	% Total	T	117	% Total
Species	of rish	lvumber	Length	w eight	w eight
Warmouth	. 6	0.47	5.0- 7.0	0.96	0.61
Bluegill	. 112	8.68	1.0- 8.0	8.39	5.31
Longear Sunfish	. 216	16.74	2.0 7.0	17.39	11.01
Green Sunfish	. 72	5.58	2.0- 7.0	5.32	3.37
PANFISH	. 406	31.47		32.06	20.31
White Sucker	. 411	31.86	2.014.0	64.42	40.80
Spotted Sucker	. 4	0.31	5.0-15.3	3.11	1.97
Black Bullhead	. 69	5.35	4.0-10.0	13.44	8.51
Yellow Bullhead	. 52	4.03	1.0- 8.0	3.21	2.03
Carp	. 8	0.62	2.8-17.9	13.44	8.51
Drum	. 5	0.39	12.9-21.5	10.06	6.37
Rough Fish	. 549	42.56		107.68	68.20
Gizzard Shad	. 16	1.24	7.0–15.0	6.87	4.35
Creek Chub	95	7.29	1.0- 8.0	3.04	1.93
Common Shiner	. 15	1.16	3.0-7.0	0.92	0.58
Emerald Shiner	. 5	0.39	3.0- 4.0	0.06	0.04
Redfin Shiner	. 4	0.31	1.0- 3.0	0.03	0.02
Bluntnose Minnow	. 128	9.92	2.0- 3.0	0.51	0.32
Notropis spp.	. 22	1.71	2.0- 3.0	0.05	0.03
Darters	. 14	1.09	1.9- 3.0	0.04	0.03
Forage Fish	. 398	23.10		11.52	7.30
GRAND TOTALS	1,290	100.00		157.88	100.00

TABLE VIII

North Fork River, Supplemental Area	1956. Co s (5.02 A	omposition Acres) Sam	OF THE PO	PULATION O	of 4 Me
Species	Number of Fish	% Total Number	Length	Weight	% Total Weight
Largemouth Bass Kentucky Bass White Crappie	. 7 . 2 . 37	0.39 0.11 2.04	5.2–11.6 9.0– 9.5 4.0–13.0	2.07 0.79 6.35	0.96 0.37 2.94
Game Fish	. 46	2.54		9.21	4.27
Warmouth Bluegill Longear Sunfish Green Sunfish	. 11 . 95 . 509 . 196	0.61 5.24 28.08 10.81	3.4 7.0 2.0 8.0 2.0 7.0 2.0 7.0	1.69 7.09 35.03 10.54	0.78 3.29 16.24 4.89
PANFISH	. 811	44.73		54.35	25.20
White Sucker Black Bullhead Yellow Bullhead Carp Drum	. 376 . 98 . 92 . 4 . 1	20.74 5.41 5.07 0.22 0.06	2.0–16.0 2.0–11.0 2.0–10.0 8.0–22.0 15.1	100.91 20.12 8.18 7.57 1.76	46.79 9.33 3.79 3.51 0.82
Rough Fish	. 571	31.49		138.54	64.24

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TABLE VIII-Continued

Species	Number of Fish	% Total Number	Length	Weight	% Total Weight
Gizzard Shad	. 19	1.05	7.0-14.0	6.04	2.80
Stoneroller	. 31	1.71	3.0- 6.0	0.96	0.44
Creek Chub	. 51	2.81	2.0- 9.0	3.64	1.69
Common Shiner	. 18	0.99	3.0- 8.0	1.56	0.72
Emerald Shiner	. 8	0.44	2.0- 5.0	0.09	0.04
Redfin Shiner	. 4	0.22	2.0- 3.0	0.02	0.01
Sand Shiner	. 1	0.06	2.0- 3.0	0.01	
Bluntnose Minnow	. 215	11.86	1.0- 4.0	1.07	0.50
Fathead Minnow	. 4	0.22	2.6- 4.0	0.05	0.02
Darters	. 34	1.88	1.0- 4.0	0.13	0.06
Forage Fish	. 385	21.24		13.57	6.29
GRAND TOTALS	. 1,813	100.00		215.67	100.00

Although the population composition of Whippoorwill Creek has undergone greater relative changes than that of North Fork, for all practical purposes, it also appears to have reverted to near its original species composition (Tables IX-XII). All species found in the undisturbed population appeared in the samples taken 1 year later. In fact, species unknown to the original samples appeared from year to year in the studies. The population composition of Whippoorwill experienced relatively greater shifting weightwise than numerically. Standing crop values fluctuated greatly during the course of the project. The originally determined carrying capacity in 1952 was calculated to be about 15 pounds per acre. This figure fell in 1953 to 8 pounds per acre but rose to 26 pounds per acre in 1954. A figure of 13 pounds per acre was recorded for 1955 and, unaccountably, a standing crop of 47 pounds per acre was found in 1956. No explanation can be offered for this drastic fluctuation in standing crop values from year to year, other than the apparently obvious reason for the 8 pounds per acre in 1953, the first year following eradication. The restocked fish and immigrating native species failed to repopulate the eradicated section within 1 year to the level of the original population.

Table XIII and Figure 6 present the findings that resulted from the 3 supplemental population studies made during 1956 on Whippoorwill. These 3 studies, totalling 2.0 acres in area, were 1 1/3 times the size of the annually sampled areas. Comparison of data reveals close agreement between the population composition of the annually sampled areas and the supplemental areas, in all species categories. It is believed that each year's findings on Whippoorwill Creek have been a valid index to the existing population.

Floyd's Fork Creek

Only 3 of the 6 study areas sampled in 1956 were located within the section of Floyd's Fork from which rough fish had been electroseined the previous summer. The other 3 study areas were located upstream from the rough fish removal termination point. The population composition data from the 3 sampled areas before (1955) and after (1956) rough fish removal are summarized in Tables XIV and XV. These 3 areas totalled 2.91 surface acres and were located approximately 8 miles apart. Prior to rough fish removal, game fish species made up 4.1 percent of the total number and 4.3 percent of the total weight in these 3 study areas. One year later game fish made up 3.7 percent by number and 2.9 percent by weight. Panfish in 1955 occupied 49.6 percent numerically and 5.6 percent weightwise of the population. In 1956 panfish were found to occupy only 13.3 percent numerically and 1.7 percent of the total weight. Rough fish species accounted for 24.3 percent and 80.2 percent, respectively, of the total number and weight in 1955. This group 1 year later accounted for 9.3 percent and 20.2 percent of the total number and weight. Forage species in 1955 were found to make up 21.9 percent numerically and 10.0 percent weightwise of the sampled population. After removal work, forage species had increased numerically to 73.8 percent of the sampled population.



year. Shad poundage also caused the forage group to shift to 75.1 percent of the total weight of the sampled population. Figure 7 graphically depicts these above data as an aid to visual comparison.

It is readily apparent that no improvement has resulted in the game fish population of Floyd's Fork as a result of rough fish removal work. The other arbitrary species groupings shifted to a greater degree, but game fish did not benefit from these changes in the overall population composition. All available population data collected during 1956 were combined to produce Table XVI. In this table the species are listed in relative order of their numerical abundance and also by weight percentage rank. Gizzard shad were found to be the most abundant species, both numerically and weightwise, throughout the entire length of Floyd's Fork.

AGE AND GROWTH OF GAME FISH SPECIES

Scale samples were taken from all game fish species during the course of the pre-eradication population studies on North Fork and Whippoorwill. It was hoped that additional scale samples could be secured during the eradication operations to supplement the small number resulting from these aforementioned studies, but this aim was not realized since the game fish species were so weakly represented in the original populations. Only 16 largemouth bass, 24 Kentucky bass, and 5 white crappie from North Fork; and 3 rock bass from Whippoorwill, became available for age and growth analysis during 1952. More fish for scale sampling could probably have been obtained the first 2 or 3 years after restocking, but because the populations of these 2 streams were just becoming well established, it was felt more harm than good would result from additional rotenone sampling. During this period our electric seine had not been developed to the point that it was functioning satisfactorily.

A fairly satisfactory number (133) of Kentucky bass scale samples was available from Floyd's Fork for age and growth analysis in 1955. Only 24 largemouth bass, 16 rock bass, and 48 white crappie scale samples were taken this same year, however. The following year, after partial population manipulation, there were 42 largemouth bass, 29 Kentucky bass, 52 rock bass, and 19 white crappie scale samples available for age and growth calculations.

A precise interpretation could not be made from these age and growth data since so few fish were available for scale sampling. Consequently, the direct proportion method of age and growth analysis was used for all species from all 3 streams.

Τ	ABLE	IX
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WHIPPOORWILL CREEK, 1953. COMPOSITION OF THE POPULATION 1 YEAR AFTER ERADICATION AND RESTOCKING AS DETERMINED BY SAMPLING THE ORIGINAL 3 STUDY AREAS* (1.50 ACRES)

a . 1	Number	% Total			% Total
Species	of Fish	Numbe r	Length	Weight	Weight
Largemouth Bass	. 1	0.33	6.8	0.17	1.42
Smallmouth Bass	7	2.28	2.6-15.2	1.83	15.29
Rock Bass	45	14.66	1.0 - 6.1	1.04	8.69
White Crappie	. 1	0.33	6.7	0.12	1.00
GAME FISH	. 54	17.59		3.16	26.40
Bluegill	. 7	2.28	1.0- 2.0	0.01	0.08
Longear Sunfish	5	1.63	1.0- 4.0	0.09	0.75
Green Sunfish	. 10	3.26	1.5- 5.3	0.23	1.92
PANFISH	. 22	7.17		0.33	2.76
Redhorse	. 17	5.54	4.3-13.1	2.36	19.72
White Sucker	18	5.86	2.6 - 10.5	2.17	18.13
Spotted Sucker	. 4	1.30	2.5- 7.0	0.25	2.09
Hog Sucker	. 9	2.93	5.0- 9.1	1.63	13.62
Rough Fish	. 48	15.64	· · · · · · · · · ·	6.41	53.55

* Certain areas of Whippoorwill Creek could not be used each year due to drought conditions. Whenever this situation occurred a comparable area was chosen.

TABLE IX-Continued

Species	Number of Fish	% Total Number	Length	Weight	% Total Weight
Creek Chub	. 20	6.51	1.0- 6.9	0.24	2.01
Common Shiner	. 7	2.28	6.0 7.0	0.87	7.27
Sculpin	. 32	10.42	1.0- 4.0	0.30	2.51
Madtoms	. 1	0.33	2.0	0.01	0.08
Pirateperch	. 2	0.65	3.0	0.04	0.33
Darters	. 55	17.92	1.0- 4.0	0.43	3.59
Misc. Minnows	. 66	21.50	1.7- 3.0	0.18	1.50
Forage Fish	. 183	59.61		2.07	17.29
GRAND TOTALS	. 307	100.01	· · · · · · · ·	11.97	100.00

TABLE X

Whippoorwill Creek, 1954. Composition of the Population 2 Years after Eradication and Restocking as Determined by Sampling the Original 3 Study Areas (1.50 Acres)

	Number	% Total			% Total
Species	of Fish	Number	Length	Weight	Weight
Largemouth Bass	. 5	0.72	1.5- 9.5	0.52	1.34
Smallmouth Bass	. 7	1.01	7.7-10.3	2.33	6.03
Rock Bass	. 48	6.94	1.0-10.0	6.45	16.68
GAME FISH	. 60	8.67		9.30	24.05
Bluegill	. 16	2.31	0.5- 4.1	0.21	0.54
Longear Sunfish	. 24	3.47	1.0- 5.2	0.92	2.38
Green Sunfish	. 24	3.47	1.0- 5.8	0.86	2.22
PANFISH	. 64	9.25	•••••	1.99	5.15
Redhorse	. 34	4.91	3.4-15.0	10.98	28.39
White Sucker	. 36	5.20	3.2-14.5	10.22	26.43
Spotted Sucker	. 2	0.29	3.0-4.0	0.03	0.08
Hog Sucker	. 9	1.30	6.0-10.1	2.35	6.08
Black Bullhead	. 8	1.16	2.0 - 3.0	0.04	0.10
Yellow Bullhead	. 1	0.14	1.6	0.01	0.03
Rough Fish	. 90	13.01		23.63	61.11
Common Shiner	. 1	0.14	8.9	0.28	0.72
Creek Chub	. 17	2.46	4.2 8.0	1.79	11.87
Stoneroller	. 1	0.14	4.7	0.03	0.08
Sculpin	. 8	1.16	1.7- 3.9	0.08	0.21
Madtoms	. 7	1.01	3.4- 5.1	0.24	0.62
Pirateperch	. 2	0.29	3.3- 3.7	0.05	0.13
Darters	. 22	3.18	2.0- 4.0	0.16	0.41
Fundulus sp.	. 9	1.30	2.0 4.0	0.04	0.10
Misc. Minnows	. 411	59.39	0.5- 4.0	1.08	2.79
Forage Fish	. 478	69.08		3.75	9.70
GRAND TOTALS	. 692	100.01		38.67	100.01

TABLE XI

WHIPPOORWILL CREEK, 1955. C	COMPOSITION OF	THE POPULATION	3 YEARS AFTER
ERADICATION AND RES	TOCKING AS DE	termined by Sam	PLING
THE ORIGINAL	3 STUDY AREA	as (1.50 Acres)	

	Number	% Total			% Total
Species	of Fish	Number	Length	Weight	Weight
Largemouth Bass	. 8	2.14	1.0 7.4	0.21	1.04
Smallmouth Bass	. 6	1.61	1.5- 3.0	0.01	0.05
Rock Bass	. 25	6.70	0.9- 8.4	3.25	16.17
White Crappie	. 1	0.27	7.7	0.19	0.95
• ••					
GAME FISH	. 40	10.72		3.66	18.21
Bluegill	. 20	5.36	2.5- 6.0	1.11	5.52
Longear Sunfish	. 13	3.49	2.2- 5.0	0.70	3.48
Green Sunfish	. 39	10.46	1.0- 6.0	0.80	3.98
Panfish	. 72	19.31		2.61	12.99
Redhorse	23	617	54-144	7.20	35 82
White Sucker	11	295	60-130	3 4 5	17 16
Spotted Sucker	3	0.80	7.1-13.5	1.34	6.66
Yellow Bullhead	. 3	0.80	1.0- 6.7	0.15	0.75
	<u> </u>				
Rough Fish	. 40	10.72		12.14	60.40
Creek Chub	. 7	1.88	1.0- 3.0	0.02	0.10
Common Shiner	. 1	0.27	7.4	0.20	1.00
Stoneroller	. 4	1.07	2.8- 6.0	0.16	0.80
Sculpin	. 11	2.95	1.1- 4.7	0.16	0.80
Madtoms	. 20	5.36	1.1- 7.0	0.42	2.09
Pirateperch	. 5	1.34	1.7- 4.4	0.14	0.70
Darters	. 15	4.02	1.0- 4.1	0.12	0.60
Fundulus sp.	. 3	0.80	1.0- 3.0		
Gambusia	. 1	0.27	1.0		
Misc. Minnows	. 154	41.29	0.8- 4.0	0.47	2.34
Forage Fish	. 221	59.25		1.69	8.41
GRAND TOTALS	. 373	100.00		20.10	100.01

TABLE XII

Whippoorwill Creek, 1956. Composition of the Population 4 Years after Eradication and Restocking as Determined by Sampling the Original, 3 Study Areas* (1.50 Acres)

			(,	
Species	Number of Fish	% Total Numbe r	Length	Weight	% Total Weight
Largemouth Bass Smallmouth Bass Rock Bass	2 2 30	0.22 0.22 3.31	7.4- 9.8 5.8- 5.9 2.8- 8.7	0.64 0.19 5.02	0.91 0.27 7.13
GAME FISH	34	3.75	•••••	5.85	8.31
Bluegill Longear Sunfish Green Sunfish	25 47 44	2.76 5.19 4.86	1.0- 6.0 1.0- 6.0 2.0- 5.8	1.23 2.82 0.99	1.75 4.01 1.41
Panfish	116	12.80		5.04	7.16

TABLE XII-Continued

Species	Number of Fish	% Total Numbe r	Length	Weight	% Total Weight
Redhorse	. 11	1.21	2.5-12.0	3.65	5.19
White Sucker	. 81	8.94	5.0-17.0	50.72	72.09
Spotted Sucker	. 3	0.33	8.011.0	1.00	1.42
Hog Sucker	. 1	0.11	3.9	0.02	0.03
Yellow Bullhead	. 3	0.33	6.0 9.0	0.60	0.85
Rouch Fish	. 99	10.93		55.99	79.58
Creek Chub	. 18	1.99	1.0- 5.2	0.07	0.10
Common Shiner	. 2	0.22	7.0- 8.0	0.33	0.47
Stoneroller	. 4	0.44	4.0 7.0	0.33	0.47
Sculpin	. 6	0.66	3.0- 4.0	0.11	0.16
Madtoms	. 11	1.21	1.0- 7.0	0.18	0.26
Pirateperch	. 2	0.22	2.2- 4.2	0.11	0.16
Darters	. 6	0.66	1.0- 4.7	0.04	0.06
Fundulus spp	. 3	0.33	2.0- 3.0	0.02	0.03
Lampetra sp	. 10	1.10	4.0 7.0	0.07	0.10
Misc. Minnows	. 595	65.67	1.0- 4.1	2.22	3.16
Forace Fish	. 657	72.52		3.48	4.95
GRAND TOTALS	. 906	100.00		70.36	100.00

* Certain areas of Whippoorwill Creek could not be used each year due to drought conditions. Whenever this situation occurred a comparable area was chosen.

TABLE XIII

WHIPPOORWILL CREEK,	1956.	Composition	N OF THE PO	PULATION	OF 3
SUPPLEMENTAL AREA	s (2.00 /	Acres) San		E FIRST TI	ME
Species	Number of Fish	% Total Number	Length	Weight	% Total Weight
Largemouth Bass	2	0.14	7.4 9. 8	0.64	0.63
Smallmouth Bass	9	0.65	2.913.0	4.19	4.11
Rock Bass	31	2.24	1.0- 8.6	3.95	3.8 8
White Crappie	1	0.07	5.4	0.05	0.05
Game Fish	43	3.10	·····	8.83	8.66
Bluegill	20	1.44	3.0- 6.0	1.09	1.07
Longear Sunfish	78	5.63	2.0- 6.0	3.41	3.35
Green Sunfish	41	2.96	1.0- 6.0	1.21	1.19
PANFISH	139	10.04		5.71	5.60
Redhorse	45	3.25	1.0-14.0	12.05	11.82
White Sucker	119	8.59	5.0-17.0	66.71	65.45
Spotted Sucker	8	0.58	2.0-11.0	1.88	1.84
Hog Sucker	7	0.51	2.0-11.1	0.95	0.93
Yellow Bullhead	3	0.22	6.0- 9.0	0.65	0.64
Rough Fish	182	13.14		82.24	80.68

TABLE	XIII-	-Continued
-------	-------	------------

Species	Number of Fish	% Tot al Number	Length	Weight	% Total Weight
Creek Chub	. 23	1.66	1.0- 3.0	0.06	0.06
Common Shiner	. 2	0.14	7.0- 8.0	0.46	0.45
Stoneroller	. 5	0.36	3.5- 7.0	0.34	0.33
Sculpin	. 19	1.37	1.0 4.0	0.21	0.21
Madtoms	. 3	0.22	2.0- 7.0	0.08	0.08
Pirateperch	. 4	0.29	1.5- 3.0	0.01	0.01
Darters	. 18	1.30	1.0- 5.5	0.13	0.13
Fundulus spp.	. 3	0.22	1.0- 4.0	0.03	0.03
Misc. Minnows	. 944	68.16	1.0- 4.0	3.83	3.76
FORAGE FISH	1,021	73.72		5.15	5.06
GRAND TOTALS	. 1,385	100.00		101.93	100.00

TABLE XIV

FLOYD'S FORK CREEK, 1955. POPULATION COMPOSITION SUMMARY OF 3 AREAS (2.91 ACRES) PRIOR TO ROUGH FISH REMOVAL WORK

	T HIOK TO	ICOCOIL I	LOIN ICHINOVILL	11 OKK	
	Number	% Total			% Total
Species	of Fish	Number	Length	Weight	Weight
Largemouth Bass	. 1	0.15	6.9	0.14	0.07
Kentucky Bass	. 21	3.08	4.611.5	6.98	3.68
Rock Bass	. 4	0.59	4.5 7.0	0.77	0.41
White Crappie	. 2	0.29	4.6- 7.2	0.18	0.09
Game Fish	. 28	4.11	····	8.07	4.26
Bluegill	. 14	2.05	2.0- 5.9	0.47	0.25
Longear Sunfish	. 195	28.59	1.0- 6.0	7.02	3.70
Green Sunfish	. 14	2.05	2.0- 7.0	1.22	0.64
Orangespotted Sunfish	. 112	16.42	1.0- 4.0	1.06	0.56
Warmouth	. 3	0.44	5.2- 8.1	0.78	0.41
Panfish	. 338	49.56	· · · · · · · · ·	10.55	5.57
Redhorse	. 79	11.58	3.7-14.2	25.13	13.26
Spotted Sucker	. 21	3.08	4.4-11.0	3.00	1.58
Hog Sucker	. 2	0.29	11.5-12.5	1.62	0.85
Channel Catfish	. 6	0.88	6.716.4	5.25	2.77
Yellow Bullhead	. 4	0.59	6.6- 8.0	0.78	0.41
Bigmouth Buffalo	. 2	0.29	22.4-24.6	14.10	7.44
Smallmouth Buffalo	. 22	3.23	12.8-32.0	70.57	37.23
Carp	. 1	0.15	24.5	7.00	3.69
Drum	. 29	4.25	6.0–17.9	24.55	12.95
Rough Fish	. 166	24.34		152.00	80.19
Gizzard Shad	. 48	7.04	6.5-15.3	18.00	9.50
Madtoms	. 13	1.91	1.0- 5.0	0.12	0.06
Troutperch	. 1	0.15	4.7	0.05	0.03
Notropis sp.	. 2	0.29	2.0	0.01	0.01
Misc. Minnows	. 86	12.61	1.0- 6.0	0.76	0.40
Forage Fish	. 150	21.99		18.94	9.99
GRAND TOTALS	. 682	100.00		189.56	100.01



TABLE XV

FLOYD'S FC	ork Cree	к, 1956.	POPULAT	TON COM	POSITION	SUMMARY	OF 3 AI	LEAS
(2.91	Acres)	LOCATED	WITHIN	SECTION	OF STRE	AM FROM	Wнісн	
	Rough	FISH HAI	d Been 1	Removed	1 Year	PREVIOUSLY	Y	

	Number	% Total		100041	0 Total
Species	of Fish	Number	Lenath	Weight	Weight
Largemouth Bass	7	0.46	25 147	2 22	0.40
Kentucky Base	21	1 39	43-126	2.23	0.40
Rock Base	11	0.72	58-05	3 08	0.71
White Crannie	17	1 12	65-128	5 04	1.06
white chapple		1.12	0.0-12.0		1.00
GAME FISH	56	3.68		16.12	2.88
		0100			
Bluegill	. 39	2.56	2.0- 7.2	3.14	0.56
Longear Sunfish	. 90	5.91	1.0- 6.0	4.35	0.78
Green Sunfish	. 8	0.53	2.0- 7.0	0.83	0.15
Orangespotted Sunfish	. 62	4.07	2.0- 4.0	1.03	0.18
Hybrid Sunfish	. 2	0.13	6.0	0.32	0.06
Warmouth	. 1	0.07	4.9	0.10	0.02
-					
PANFISH	. 202	13.27	•••••	9.77	1.74
Redhorse	46	3 02	1.0-16.3	26.54	4 74
White Sucker	ĭ	0.07	6.5	0.10	0.02
Spotted Sucker	9	0.59	7.0-12.5	3.37	0.60
Hog Sucker	3	0.20	8.2-12.7	1.84	0.33
Channel Catfish	12	0.79	6.2-17.3	6.06	1.08
Flathead Catfish	8	0.53	4.5-12.8	2.41	0.43
Black Bullhead	2	0.13	5.0- 8.0	0.29	0.05
Yellow Bullhead	3	0.20	5.1- 8.0	0.48	0.09
Carp	2	0.13	8.2-18.8	3.58	0.64
Drum	. 36	2.37	5.8-20.0	38.51	6.88
Bigmouth Buffalo	. 4	0.26	15.0-19.0	11.15	1.99
Smallmouth Buffalo	. 4	0.26	12.0-19.5	7.87	1.41
Highfin Sucker	. 4	0.26	8.0-14.6	3.06	0.55
Quillback	. 5	0.33	9.6-17.1	7.04	1.26
Longnose Gar	. 2	0.13	1.5-23.8	1.00	0.18
		<u> </u>	<u> </u>		
Rough Fish	. 141	9.26		113.30	20.24
Gizzard Shad	810	53 22	50-170	416.82	74 45
Skiniack	5	0.33	95-120	1 42	0.25
Brindled Madtom	35	2.30	2.0 - 4.0	0.36	0.06
Tadpole Madtom	22	1.45	2.0 - 4.0	0.40	0.07
Stonecat		0.07	68	0.12	0.02
Lognerch	ī	0.07	4.5	0.03	0.01
Greenside Darter	. ī	0.07	3.5	0.01	
Fantail Darter	15	0.99	2.0- 3.0	0.04	0.01
Starhead Topminnow	5	0.33	2.0- 3.0	0.02	
Fathead Minnow	25	1.64	2.0- 4.0	0.35	0.06
Bluntnose Minnow	. 149	9.79	1.0- 4.0	0.58	0.10
Silver Chub	. 2	0.13	4.0- 5.0	0.03	0.01
Common Shiner	. 3	0.20	3.0- 7.1	0.20	0.04
Rosyface Shiner	. 1	0.07	3.9	0.01	• • •
Notropis sp.	. 48	3.15	2.0- 3.0	0.31	0.06
FORAGE FISH	1,123	73.78		420.70	75.14
GRAND TOTALS	. 1,522	99.99	<u> </u>	559.89	100.00





RELATIVE NUMERICAL ABUNDANCE AND WEIGHT COMPOSITION (Based Upon All Population Sampling Studies and Rough Fish Removal Work) FLOYD'S FORK CREEK SUMMER, 1956

		No. of	% Total			% Total
Ra	nk Species	Fish	Numbe r	Species	Weight	Weight
1.	Gizzard Shad	.1,250	29.43	Gizzard Shad	557.18	46.28
2.	White Sucker	. 560	13.19	Redhorse	169.98	14.11
3.	Longear Sunfish	. 393	9.25	Carp	120.44	10.00
4.	Bluntnose Minnow	. 332	7.82	Drum	70.53	5.86
5.	Redhorse	. 305	7.18	White Sucker	43.60	3.62
6.	Orangespotted Sunfis	sh 167	3.93	Rock Bass	25.92	2.15
7.	Green Sunfish	. 142	3.34	Longear Sunfish	23.35	1.94
8.	Common Shiner	. 124	2.92	Longnose Gar	22.71	1.89
9.	Creek Chub	. 111	2.61	Spotted Sucker	14.69	1.22
10.	Madtoms	94	2.21	Kentucky Bass	14.48	1.20
11.	Black Bullhead	92	2.17	Quillback	13.62	1.13
12.	Bluegill	83	1.95	Bigmouth Buffalo	13.42	1.11
13.	Rock Bass	. 76	1.79	Black Bullhead	12.29	1.02
14.	Notropis spp	. 75	1.77	Smallmouth Buffalo.	9.98	0.83
15.	Spotted Sucker	. 56	1.32	Largemouth Bass	9.93	0.82
16.	Drum	. 56	1.32	Flathead Catfish	9.45	0.78
17.	Kentucky Bass	. 47	1.11	White Crappie	8.82	0.73
18.	Largemouth Bass	46	1.08	Green Sunfish	8.02	0.67
	Others (18 + Species) 238	5.62	Others (18+Species)	56.09	4.64
	TOTALS	4,247	100.01	- 1	,204.50	100.00

North Fork River

Table XVII (1952) shows that age group I largemouth bass averaged 4.2 inches total length at the end of their first growing season. Age group I largemouth from all subsequent years' collections have failed to match this growth rate, although those from the 1953 collection averaged 4.1 inches. Largemouth from the 1953, 1954, and 1955 population studies have shown a second-

year growth rate that has averaged consistently higher than the corresponding age group sampled in 1952 (Tables XVIII-XX). This pattern was disrupted when age group II largemouth from the 1956 samples averaged less than the 1952 age group II largemouth (Table XXI). Older age groups were so few each year that it is impossible to attempt any comparisons.

Table XXII (1952) indicates white crappie reached an average total length of 2.9 inches by the end of their first growing season in the undisturbed population. Each year after eradication the stocked crappie and their offspring (all age group I crappie in 1953 were hatched in North Fork since all stocked fish were either adults or sub-adults) have averaged less than 2.9 inches as age group I fish (Tables XXIII-XXVI).

Whippoorwill Creek

The rates of growth of rock bass collected during 1952-1956 are shown in Tables XXVII-XXXI. Rock bass in the undisturbed 1952 population were found to average 1.0 inches total length at the end of their first growing season. Age group I rock bass from subsequent years' collections have averaged from 1.8 (1953) to 1.3 (1956) inches total length. This spurt of growth the first year following eradication may have resulted from absence or severe reduction of competing species in the population. As the population expanded and the standing crop poundages increased, the growth rate decreased.

Floyd's Fork Creek

Tables XXXII-XXXIX show the growth rates for largemouth bass, Kentucky bass, rock bass, and white crappie prior to (1955) and after (1956) partial population manipulation. Those tables dealing with the 1955 samples reveal that an average of three years was required for largemouth bass to reach 10 inches total length. Kentucky bass required slightly more than four years to reach the same length. By the end of their third year, rock bass averaged 5.9 inches. White crappie grew to 9.0 inches by the end of their fourth year.

Largemouth bass from the 1956 collection showed an increased growth rate over those of the previous year in all age groups. The same held true for the three other game species in practically all age groups. The inadequate number of scale samples available for analysis prevented drawing definite conclusions whether to attribute these increased growth rates to removal of rough fish or to other factors.

TABLE XVII

THE AVERAGE CALCULATED (DIRECT PROPORTION) TOTAL LENGTH OF LARGEMOUTH BASS FROM NORTH FORK RIVER, 1952

Ye ar Class	No. of Fish	Avg. Total Length at Capture	Calculated 1	Length 2	at End of 3	Year 4
1951	13	7.4	4.4			
1950	1	8.2	3.3	5.4		
1949	1	13.0	4.2	8.8	12.2	
1948	1	12.3	3.2	6.0	8.8	10.7
Average	Length (]	[nches]	4.2	6.7	10.5	10.7
Average	Increment		4.2	2.5	3.8	0.2
Number	of Fish		16	3	2	1

TABLE XVIII

THE AVERAGE CALCULATED (DIRECT PROPORTION) TOTAL LENGTH OF LARGEMOUTH BASS FROM NORTH FORK RIVER, 1953

Year Class	No. of Fish	Avg. Total Length at Capture	Calculated 1	Length 2	at End of 3	Year 4
1952	51	6.8	4.1			
1951	2	11.5	4.4	8.5		
1950	1	12.4	3.1	5.2	11.4	
Average	Length (]	[nches]	4.1	7.4	11.4	
Average	Increment		4.1	3.3	4.0	
Number	of Fish		54	3	1	

TABLE XIX

THE AVERAGE CALCULATED (DIRECT PROPORTION) TOTAL LENGTH OF LARGEMOUTH BASS FROM NORTH FORK RIVER, 1954

Year Class	No. of Fish	Avg. Total Length at Capture	Calculated 1	Length 2	at	End 3	of	Year 4
1953 1952	7 19	5.7 9.5	4.0 3.3			•••		1
Average Average	Length ()	Inches)	3.5 3.5	7.8 4.3		•••		• •
Number	of Fish		26	19				

TABLE XX

Тн	e Average	CALCULATED (DIREC	T PROPORTION) TOTAL	, LENGTH OF	7
	Largi	EMOUTH BASS FROM	North Fork	River, 1	1955	
Year	No.	Avg. Total Length	Calculated	Length	at End of	Year
Class	of Fish	at Capture	1	2	3	4
1954	5	7.1	4.6			
1953	9	10.1	3.3	7.2		
Average	Length ()	[nches]	. 3.8	7.2	• •	
Average	Increment		. 3.8	3.4		
Number	of Fish		. 14	9		• •

TABLE XXI

Тн	e Average Largi	CALCULATED (DIREC MOUTH BASS FROM	t Proportion North Fork) Total River, 1	LENGTH OF 956	ŧ.
Year	No.	Avg. Total Length	Calculated	Length	at End of	Year
Class	of Fish	at Capture	1	2	3	4
1955	2	6.8	3.2			
1954	2	9.3	3.7	6.0		
1953	2	11.4	3.1	7.1	8.6	
Average	Length (1	nches)	. 3.3	6.6	8.6	
Average	Increment		. 3.3	3.3	2.0	
Number	of Fish		. 6	4	2	

TABLE XXII

THE AVERAGE CALCULATED (DIRECT PROPORTION) TOTAL LENGTH OF WHITE CRAPPIE FROM NORTH FORK RIVER, 1952 Year Avg. Total Length Calculated Length at End of Year No. Class of Fish at Capture 2 3 1 4 1951 0 8.2 9.7 2.0 3.5 2.1 7.1 5.7 5.4 5.9 1950 1 3 1949 8.6 1948 1 9.0 7.5 8.6 2.9 8.1 8.6 Average Length (Inches) 2.9 5 Average Increment 3.0 2.2 0.5 . . . 5 Number of Fish..... л 1

TABLE XXIII

Т	he Average Wh	CALCULATED (DIREC ITE CRAPPIE FROM N	t Proportion orth Fork F) Totai River, 19	, Length 53	OF
Year	No.	Avg. Total Length	Calculated	Length	at End o	f Year
Class	of Fish	at Capture	1	2	3	4
1952	19	4.7	2.7			
1951	2	6.5	2.9	5.2		
1950	4	9.0	2.3	5.0	7.7	
1949	2	11.6	2.0	6.0	9.1	10.9
Averag	e Length (I	nches)	. 2.6	5.3	8.2	10.9
Averag	e Increment		. 2.6	2.7	2.9	2.7
Numbe	r of Fish		. 27	8	6	2

TABLE XXIV

THE AVERAGE CALCULATED (DIRECT PROPORTION) TOTAL LENGTH OF WHITE CRAPPIE FROM NORTH FORK RIVER, 1954

Year Class	No. of Fish	Avg. Total Length at Capture	Calculated 1	Length 2	at End of 3	Year 4
1953	12	4.7	2.6		•••	
1952	12	7.1	2.6	5.7		
Average	Length (]	[nches]	2.6	5.7	••	
Average	Increment		2.6	3.1	۰.	
Number	of Fish.		24 1	12		••

TABLE XXV

THE AVERAGE CALCULATED (DIRECT PROPORTION) TOTAL LENGTH OF WHITE CRAPPIE FROM NORTH FORK RIVER, 1955 Year No. Avg. Total Length Calculated Length at End of Year Class of Fish at Capture 1 2 ŝ 4 1954 5 5.4 2.8 • • . . 1953 3 7.6 2.3 5.7 • • 7.7 2.2 1952 4.3 7.5 4 1.7 5.7 7.7 1951 2 8.4 4.0 7.7 2.4 6.9 Average Length (Inches)..... 4.7 2.4 Average Increment 2.3 2.2 0.8 . . . Number of Fish..... 14 9 6 2

TABLE XXVI

THE AVERAGE CALCULATED (DIRECT PROPORTION) TOTAL LENGTH OF White Crappie from North Fork River, 1956

Year	No.	Avg. Total Length	Calci	alated Let	ngth at	End of	Year
Class	of Fish	at Capture	1	2	3	4	5
1955	3	5.4	2.5				
1954	16	6.2	1.8	4.4			
1953	7	8.2	2.0	5.1	7.3		
1952	1	10.9	2.2	6.0	8.2	10.4	
1951	1	13.0	3.8	6.4	8.2	10.7	12.1
Average	Length (Inches)	2.0	4.7	7.5	10.6	12.1
Average	Increment	t	2.0	2.7	1.8	3.1	1.5
Number	of Fish.		28	25	9	2	1

TABLE XXVII

THE AVERAGE CALCULATED (DIRECT PROPORTION) TOTAL LENGTH OF ROCK BASS FROM WHIPPOORWILL CREEK, 1952

Year	No.	Avg. Total Length	Calc	ulated	Leng	th at	End	of 1	l ear
Class	of Fish	at Capture	1	2	3	4	5	6	7
1946	1	8.2	0.9	1.9	2.8	4.1	5.7	7.1	
1945	2	10.2	1.1	2.4	3.3	4.9	6.9	8.3	9.6
Average	Length (Inches)	1.0	2.2	3.1	4.6	6.5	7.9	9.6
Average	Increment		1.0	1.2	0.9	1.5	1.9	1.4	1.7
Number	of Fish.		3	3	3	3	3	3	2
									1

TABLE XXVIII

THE AVERAGE CALCULATED (DIRECT PROPORTION) TOTAL LENGTH OF ROCK BASS FROM WHIPPOORWILL CREEK, 1953

Year	No.	Avg. Total Length	Calculated	Length o	t End of	Year
Class	of Fish	at Capture	1	2	3.	4
1952	11	4.9	1.8			
Average	Length (Inches)	1.8			
Average	Increment		1.8	• •		۰.
Number	of Fish.	· · · · · · · · · · · · · · · · · · ·	11	• •		• •

TABLE XXIX

THE AVERAGE CALCULATED (DIRECT PROPORTION) TOTAL LENGTH OF ROCK BASS FROM WHIPPOORWILL CREEK, 1954

	***		00					•••				
Year	No.	Avg. Total Length	Cai	cula	ited	Let	igth	at	En	t of	Ye	ar
Class	of Fish	at Capture	1	2	3	4	5	6	7	8	9	10
1953	5	2.7	1.5									• •
1952	10	5.5	1.2	3.3							• •	• •
1951	3	7.4	1.5	3.6	6.5				• •		• •	• •
1950	0		· · ·	• •	• •		::		• •			• •
1949	1	8.0	2.1	2.8	4.3	6.2	7.2					•
1948	0	· ·	• •	• •	• •	• •	<u>.</u> .		: :			•
1947	1	8.9	0.9	1.6	3.0	4.3	5.7	6.9	7.8			• •
1946	0	. : :	::	• •	::		·. :	<u>· ·</u>	<u>.</u> .	::	• •	•
1945	1	10.0	0.8	2.3	4.0	5.6	6.2	7.0	7.7	8.3	9.2	•
1944	1	9.7	1.0	2.5	3.9	4.9	5.8	6.2	7.6	8.2	8.7	9.1
Average	Length (Inches)	1.2	3.1	5.0	5.3	6.2	6.7	7.7	8.3	9.0	9.1
Average	Incremen	t	1.2	1.9	1.9	0.3	0.9	0.5	1.0	0.6	0.7	0.1
Number	of Fish		22	17	7	4	4	3	3	2	2	1

TABLE XXX

THE AVERAGE CALCULATED (DIRECT PROPORTION) TOTAL LENGTH OF ROCK BASS FROM WHIPPOORWILL CREEK, 1955

Year Class	No. of Fish	Avg. Total Length at Capture	Calculated 1	Length 2	at End o 3	of Year 4
1954	0				· .	
1953	6	5.6	1.6	3.7		
1952	3	8.0	1.4	4.6	7.1	
Average	Length (]	(nches)	1.5	4.0	7.1	
Average	Increment	••••••	1.5	2.5	3.1	•
Number	of Fish		9	9	3	• •

TABLE XXXI

THE AVERAGE CALCULATED (DIRECT PROPORTION) TOTAL LENGTH OF ROCK BASS FROM WHIPPOORWILL CREEK, 1956

Year	No.	Avg. Total Length	Calculated	Length	at End of	Year
Class	of Fish	at Capture	1	2	3.	4
1955	4	2.9	1.3			
1954	6	5.0	1.6	3.3		• •
1953	6	7.4	1.6	3.8	6.2	
1952	5	6.7	1.0	2.4	3.9	5.9
Average	Length (]	[nches]	1.4	3.2	5.1	5.9
Average	Increment		1.4	1.8	1.9	0. 8
Numbér	of Fish		21	17	11	5

TABLE XXXII

THE AVERAGE CALCULATED (DIRECT PROPORTION) TOTAL LENGTH OF LARGEMOUTH BASS FROM FLOYD'S FORK CREEK, 1955

Year	No.	Avg. Total Length	Cal	culated	Length	at Er	ud of	Year
Class	of Fish	at Capture	1	2	3	4	5	6
1954	4	7.3	4.2					
1953	12	9.4	4.3	. 7.4				
1952	2	11.0	3.4	6.5	8.7			
1951	3	14.4	3.2	7.1	10.5	12.6		
1950	2	17.5	4.2	8.1	11.4	13.8	16.4	
1949	1	17.3	3.5	6.4	9.4	12.1	13.7	15.9
Average	Length ()	Inches)	3.9	7.3	10.2	12.9	15.5	15.9
Incremen	t of Grow	rth	3.9	3.4	2.9	2.7	2.6	0.4
Total Nu	imber		24	20	8	6	3	1

TABLE XXXIII

THE AVERAGE CALCULATED (DIRECT PROPORTION) TOTAL LENGTH OF LARGEMOUTH BASS FROM FLOYD'S FORK CREEK, 1956

Year No. Avg. Total Length at Capture Calculated 1 Length 2 at End of Year 1955 34 6.5 4.5 1955 34 6.5 4.5 1953 1 14.7 5.0 8.3 12.1 1953 1 14.7 5.0 8.3 12.1 Average Length (Inches) 4.5 7.5 12.1 Increment of Growth 4.5 3.0 4.6 Total Number					Q		
Class of Fish at Capture 1 2 3 4 1955 34 6.5 4.5 1954 7 9.6 4.4 7.4 1953 1 14.7 5.0 8.3 12.1 Average Length (Inches) 4.5 7.5 12.1 Increment of Growth 4.5 3.0 4.6 Total Number 42 8 1	Year	No.	Avg. Total Length	Calculated	Length	at End of	Year
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	Class	of Fish	at Capture	1	2	3	4
1954 7 9.6 4.4 7.4 1953 1 14.7 5.0 8.3 12.1 Average Length (Inches) 4.5 7.5 12.1 Increment of Growth 4.5 3.0 4.6 Total Number 42 8 1	1955	34	6.5	4.5			
1953 1 14.7 5.0 8.3 12.1 . Average Length (Inches) 4.5 7.5 12.1 . Increment of Growth 4.5 3.0 4.6 . Total Number 42 8 1 .	1954	7	9.6	4.4	7.4		
Average Length (Inches) 4.5 7.5 12.1 . Increment of Growth 4.5 3.0 4.6 . Total Number 42 8 1 .	195 3	1	14.7	5.0	8.3	12.1	
Increment of Growth 4.5 3.0 4.6 . Total Number 42 8 1 .	Average	Length (1	Inches)	4.5	7.5	12.1	
Total Number	Increment	t of Growt	h	4.5	3.0	4.6	
	Total Nu	mber		42	8	1	

TABLE XXXIV

THE AVERAGE CALCULATED (DIRECT PROPORTION) TOTAL LENGTH OF KENTUCKY BASS FROM FLOYD'S FORK CREEK, 1955

							•		
Year	No.	Avg. Total Length	Cal	culated	Len	gth al	End	of	Year
Class	of Fish	at Capture	1	2	3	4	5	6	7
1954	12	4.7	3.5						
195 3	54	7.1	2.8	5.4					
1952	50	9.6	3.0	5.8	8.2				
1951	11	11.1	3.1	5.7	7.9	9.9	. : :.		••
195 0	4	12.8	3.4	6.1	8.5	10.1	11.6		••
1949	1	13.6	1.7	4.1	6.9	8.9	10.2	12.2	.:::
1948	1	13.6	3.3	6.0	7.7	9.5	10.7	11.4	12.7
Average	Length (I	Inches)	2.7	5.6	8.1	9.8	11.3	11.8	12.7
Increment	: of Grov	vth	2.7	2.9	2.5	1.7	1.5	0.5	0.9
Total Nu	mber		133	121	67	17	6	2	1

TABLE XXXV

THE AVERAGE CALCULATED (DIRECT PROPORTION) TOTAL LENGTH OF KENTUCKY BASS FROM FLOYD'S FORK CREEK, 1956

Year	No.	Avg. Total Length	Calcu	lated Le	ngth at	End of	Year
Class	of Fish	at Capture	1	2	3	4	5
195 5	11	6.5	3.8				
1954	8	8.2	3.6	6.7			
195 3	7	11.1	4.5	7.4	9.6		
1952	2	10.8	2.3	5.2	7.7	9.6	
1951	1	13.7	2.8	5.6	8.4	10.9	12.3
Average 1	Length (]	[nches]	. 3.8	6.7	9.1	10.0	12.3
Increment	of Grow	th	. 3.8	2.9	2.4	0.9	2.3
Total Nu	mber		. 29	18	10	3	1

TABLE XXXVI

THE AVERAGE CALCULATED (DIRECT PROPORTION) TOTAL LENGTH OF ROCK BASS FROM FLOYD'S FORK CREEK, 1955

Year	No.	Avg. Total Length	Calcu	lated Le	ngth at	End of	Year
Class	of Fish	at Capture	1	2	3	4	5
1954	0						
195 3	9	5.9	1.2	3.6			
1952	6	7.8	1.1	3.6	6.0		
1951	0			••	• •		• •
1950	1	9.6	1.0	3.2	5.0	7.1	8.5
Average	Length (]	[nches]	. 1.2	3.6	5.9	7.1	8.5
Increment	f of Grow	th	. 1.2	2.4	2.3	1.2	1.4
Total Nu	mber		. 16	16	7	1	1

TABLE XXXVII

THE AVERAGE CALCULATED (DIRECT PROPORTION) TOTAL LENGTH OF ROCK BASS FROM FLOYD'S FORK CREEK, 1956 Avg. Total Length Year No. Calculated Length at End of Year Class of Fish at Capture 3 4 1 2 5 1955 0 1954 2 6.0 4.5 1.6 $3\overline{2}$ 5.8 1953 6.7 1.2 3.4 1952 16 8.1 1.6 3.9 6.3 7.4 3.3 5.9 7.6 7.4 1951 9.3 1.2 8.9 2 3.5 2.2 1.3 Average Length (Inches)..... 6.0 8.9 2.5 1.3 1.4 1.5 Increment of Growth 52 50 Total Number 52 18 2

TABLE XXXVIII

THE AVERAGE CALCULATED (DIRECT PROPORTION) TOTAL LENGTH OF WHITE CRAPPIE FROM FLOYD'S FORK CREEK, 1955

Year	No.	Avg. Total Length	Calcı	ilated Le	ngth at	End of	Year
Class	of Fish	at Capture	1	2	3	4	5
1954	3	5.0	2.7				
1953	11	6.7	1.8	4.5			
1952	20	8.2	1.9	4.3	6.7		
1951	11	10.2	2.0	4.3	6.7	9.0	· · · ·
1950	3	11.7	2.0	4.1	6.8	9.1	11.0
Average	Length (]	[nches]	2.0	4.3	6.7	9.0	11.0
Increment	of Grow	th	2.0	2.3	2.4	2.3	2.0
Total Nu	mber		48	45	34	14	3

TABLE XXXIX

THE AVERAGE CALCULATED (DIRECT PROPORTION) TOTAL LENGTH OF WHITE CRAPPIE FROM FLOYD'S FORK CREEK, 1956

Year Class	No. of Fish	Avg. Total Length at Capture	Calculated 1	Length 2	at End of 3	Year 4
1955	0					
1954	11	7.2	3.4	6.2		
1953	6	9.3	2.5	4.5	8.1	
1952	2	10.5	1.2	5.1	7.5	9. 9
Average Length (Inches) 2.9				5.5	8.0	9. 9
Increment of Growth 2.9				2.6	2.5	1.9
Total Nu	mber		19	19	8	2

CONCLUSIONS

North Fork River and Whippoorwill Creek

It is believed that the first 3 objectives, pertaining to total population manipulation, have been attained and that the findings of this project are applicable to the typical warm-water stream in Kentucky. Population manipulation can be accomplished at costs no more prohibitive than other comparable management techniques. It is concluded, however, that any benefit to the game fish species is of questionable value, and is of short duration, at best. Results from stream sections having a positive fish barrier, thereby isolating the section from rough fish pressure, might have proved differently; but costs for barriers, such as electric fish screens, were found to be positively prohibitive. The first 3 objectives of the project must be answered in the negative. Therefore, total population manipulation is not recommended for stream sections subject to unrestricted fish movement, or prior to watershed management and/or stream improvement.

Floyd's Fork Creek

It is believed that the principle of rough fish removal has been demonstrated to be ineffective as a single means of improving the population composition of the average Kentucky stream. It is therefore recommended that this technique no longer be considered as a potential management tool for improving stream populations prior to watershed and/or stream rehabilitation and improvement. There is reason to believe that population manipulation might not be needed if environmental conditions were near optimum in the average Kentucky stream. This remains to be demonstrated, however.

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Question: Was a barrier considered? Answer: Yes, but was rejected because of cost. Question: Was fishing pressure heavy? Answer: No. It was considered medium on Floyd's Fork. Question: Was a creel census used to check results? Answer: No. Question: Would not the low game fish population be responsible for poor

guesnow: would not the low game han population be responsible for poor fishing interest?

Answer: That is a good point but one stream had Kentucky bass available in favorable numbers.

Question: How large are the streams? Answer: This is covered in the paper.

INTRODUCTION AND SUCCESS OF WHITE BASS (Roccus chrysops) IN NORTH CAROLINA WATERS

By BUFORD L. TATUM

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North Carolina is divided into three well-defined physiographic regions: the mountains, piedmont, and coastal plains. In the piedmont, which is the region of highest population, the major fishing waters are main stream hydro-electric reservoirs that are heavily silted and subject to frequent water level fluctuations. Before the introduction of white bass, *Roccus chrysops* (Rafinesque), the fishing in these waters was good in early spring and late fall, but during other seasons of the year the fishing was poor.

It was apparent in these reservoirs that little could be done to improve the physical habitat. In some cases, however, certain over populations of fish or unbalanced fish populations could be changed or corrected. Naturally, the sportsmen desired better fishing and it was decided that the introduction of white bass, a predator species, and one which is tolerant of fluctuating water levels, might produce better fishing. Introductions of white bass were made in both major chains of reservoirs in the piedmont, with notable successes and failures.

The purpose of this paper is to outline the introductions of the white bass and point out some of the apparent reasons for their success and failure.

DESCRIPTION OF WATERS

Yadkin River Basin

The upper part of the Yadkin River Basin (Figure 1) lines in the mountain region, which consists of rugged foothills and mountain reaches. The tributaries