

A PRELIMINARY REPORT ON THE TOTAL POPULATION MANIPULATION  
OF A WARM-WATER STREAM

by

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Abstract

The upper 46 miles of the North Fork of Licking River in Mason County, Kentucky, were treated in July, 1952, with 5-percent powdered rotenone to eradicate the entire fish population. This experimental section was then left open at all times to rough fish movement and recruitment. North Fork was selected as being typical of the many warm-water streams in the state having a high rough fish population which once offered better than average game fish angling.

Five random population samples totaling 2.88 acres in area were taken prior to the eradication operation. They yielded 2,662 fish weighing 466.49 pounds. Game fish species occupied only 4.51 percent by number and 6.54 percent by weight of the total population. These samples revealed the stream was supporting an average of 161.98 pounds of fish per acre.

Restocking of game and pan fishes was begun one week after eradication. A total of 18,717 game fish (largemouth bass, black crappie, and white crappie) were released at 14 different locations. At these same locations 12,540 bluegill and longear sunfish were restocked.

Population studies conducted in the original five areas one year after eradication showed that game fish species occupied 5.81 percent by number and 6.90 by weight of the total population. The standing crop of all species of fish combined was only 81.52 pounds per acre. This figure is approximately one-half of the previously determined carrying capacity.

This investigation is being continued and the changes in species composition and stream production will be closely followed.

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<sup>1</sup>Contribution from Dingell-Johnson Project No. F-4-R, Kentucky.

## INTRODUCTION

There is at present not enough information on hand regarding the dynamics of warm-water stream populations to use as a basis for the management or renovation of small streams in Kentucky. During the past two decades erosion, pollution, and, possibly, fishing pressure, have reduced the game fish populations in most of the small streams that have been under the observation of this department, while the rough fish populations have increased. There is a real need for warm-water stream research in this section of the country and the lack of such has often been lamented by fisheries workers in the southeast. The interrelationships of populations in warm-water streams cannot be interpreted on the basis of facts derived from trout stream investigations. Neither can sound management practices be evolved from observations and work done on small or restricted stream areas. The need is for studies on streams over which the researcher has reasonable control of an area that includes the upper watershed and tributaries as well as a fairly long stretch of the stream itself. Two streams, North Fork of Licking River and Whip-poorwill Creek, were selected early in 1952 for such experimental work. An additional stream, Fleming Creek, was selected this past summer. This report deals only with the first-mentioned stream, North Fork River, which was selected as being typical of the many warm-water streams in the state now having a high rough fish population (Carter, 1953), but which reportedly once offered better than average game fish angling.

The three main objectives of this stream investigation project, as outlined in the work plans, are:

- (1) To determine whether population manipulation can be successfully accomplished on warm-water streams now sup-

porting heavy rough fish populations for the benefit of the game fish species.

- (2) To determine whether game fish populations can be established and maintained in stream sections open to rough fish pressure and recruitment.
- (3) To determine whether it is economically and biologically sound to attempt population manipulation in streams now supporting heavy rough fish populations prior to upper watershed management and stream improvement.

#### DESCRIPTION OF THE RIVER

North Fork River rises in the northeastern corner of Fleming County and flows in a generally westward direction through Mason County, ultimately entering the Licking River near the southeastern corner of Pendleton County. The upper 46 miles of North Fork were designated as the experimental section and 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 averages 27.5 feet wide and 2.1 feet deep. Pools are interrupted by frequent riffles of varying lengths which are covered with a dense growth of water willow (Dianthera americana). Within this area are found many curves and meanders and the stream in many places is choked by log and brush barriers.

Pools predominate in the middle third of the experimental section. Very few log and brush barriers are present and the widest and deepest water of the entire experimental area occurs here. The area averages 44.6 feet wide and 3.7 feet deep.

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

#### METHODS AND MATERIALS

Leases. --- All persons owning land bordering North Fork River were personally contacted and written agreements were obtained granting the Department of Fish and Wildlife Resources permission to use North Fork as an experimental stream. In a few instances some difficulty was encountered in signing up certain individuals because of personal resentment against the law enforcement arm of the department. These persons were in the minority, however.

Chemical and Biological Data. --- Routine chemical and bottom sample analyses performed early in 1952 revealed nothing out of the ordinary and are not included since they are beyond the scope of this report.

One instance of an oxygen deficiency was brought to our attention late in the summer when fallen leaves were beginning to accumulate on the stream bottom. Tests revealed that the dissolved oxygen content of the water in the area where distressed fish were observed was 3.1 parts per million. Subsequent rainfall apparently corrected this condition since no other cases were noted or reported.

Pre-eradication Population Studies. --- The results of five random population studies made prior to the eradication of the total popula-

tion during the summer of 1952 are presented below in Table 1. These five studies, totaling 2.88 acres, yielded 2,662 fish of various species which weighed 466.49 pounds. On the basis of these population studies it was determined that North Fork River was supporting an average of 161.98 pounds of fish per acre. Game fish species, represented by largemouth bass, spotted bass, and white crappie, occupied 4.51 percent by number and 6.54 percent by weight of the total population. Pan fish (bluegill, longear sunfish, green sunfish, and warmouth) made up 33.29 percent by number but only 10.80 percent by weight of the total population. The remaining 62.20 percent of the total number was made up of various rough and forage fish. By weight this last-named group made up 82.66 percent of the total stream population.

Eradication Operation. --- One week prior to the eradication operation on North Fork a conference was held to brief all participating fishery personnel. The previous project leader (Harold Barber) outlined a tentative procedure plan based upon extensive physical surveys of the stream. The 46-mile section to be eradicated was divided into 10 areas which varied from 2 to 7 miles each. A map and copy of the procedure plan was provided each crew chief. It was planned to completely eradicate the section in one week but subsequent weather conditions prolonged the work into a two-week operation.

The first day (July 14, 1952) equipment, materials, and personnel were moved to Maysville. In the afternoon the five crew chiefs, accompanied by their crews, inspected and familiarized themselves with their respective areas. The crew was composed of five Fisheries Biologists, five Field Assistants, two Chemists, eight Fishery Aides, and eight Con-

TABLE 1. - Pre-eradication (1952) and Post-eradication (1953) Population Study Comparison.

| SPECIES          | 1952           |                 |                         |                         | 1953           |                 |                         |                         |
|------------------|----------------|-----------------|-------------------------|-------------------------|----------------|-----------------|-------------------------|-------------------------|
|                  | Number of Fish | Weight (Pounds) | Percentage of Total No. | Percentage of Total Wt. | Number of Fish | Weight (Pounds) | Percentage of Total No. | Percentage of Total Wt. |
| Largemouth Bass  | 18             | 6.33            | 0.68                    | 1.36                    | 56             | 12.29           | 3.70                    | 5.23                    |
| Spotted Bass     | 34             | 10.92           | 1.28                    | 2.34                    |                |                 |                         |                         |
| White Crappie    | 68             | 13.22           | 2.55                    | 2.84                    | 32             | 3.92            | 2.11                    | 1.67                    |
| Bluegill         | 13             | 1.07            | 0.49                    | 0.23                    | 117            | 10.70           | 7.73                    | 4.56                    |
| Longear Sunfish  | 748            | 38.54           | 28.10                   | 8.26                    | 141            | 9.15            | 9.31                    | 3.90                    |
| Warmouth         | 22             | 2.95            | 0.83                    | 0.63                    |                |                 |                         |                         |
| Green Sunfish    | 103            | 7.83            | 3.87                    | 1.68                    | 112            | 3.96            | 7.40                    | 1.69                    |
| Redhorse Sucker  | 151            | 39.69           | 5.67                    | 8.51                    | 20             | 5.08            | 1.32                    | 2.16                    |
| White Sucker     | 308            | 61.07           | 11.57                   | 13.09                   | 238            | 36.65           | 15.72                   | 15.61                   |
| Spotted Sucker   | 32             | 9.39            | 1.20                    | 2.01                    | 5              | 2.15            | 0.33                    | 0.92                    |
| Channel Catfish  | 7              | 11.64           | 0.26                    | 2.50                    |                |                 |                         |                         |
| Flathead Catfish | 46             | 23.75           | 1.73                    | 5.09                    |                |                 |                         |                         |
| Stonecat         | 2              | 0.10            | 0.07                    | 0.02                    |                |                 |                         |                         |
| Black Bullhead   | 115            | 4.86            | 4.32                    | 1.04                    | 89             | 16.42           | 5.88                    | 6.99                    |
| Yellow Bullhead  | 61             | 8.18            | 2.29                    | 1.75                    | 14             | 3.19            | 0.92                    | 1.36                    |
| Carp             | 21             | 34.97           | 0.79                    | 7.50                    | 23             | 99.46           | 1.52                    | 42.36                   |
| Bigmouth Buffalo | 53             | 131.80          | 1.99                    | 28.25                   |                |                 |                         |                         |
| Drum             | 1              | 1.20            | 0.04                    | 0.26                    | 1              | 1.63            | 0.06                    | 0.69                    |
| Gizzard Shad     | 256            | 49.27           | 9.62                    | 10.56                   | 135            | 23.83           | 8.92                    | 10.15                   |
| Darters          | 17             | 0.24            | 0.64                    | 0.05                    | 19             | 0.17            | 1.25                    | 0.07                    |
| Creek Chubs      | 93             | 6.60            | 3.49                    | 1.42                    | 36             | 1.64            | 2.38                    | 0.70                    |
| Misc. Minnows    | 493            | 2.87            | 18.52                   | 0.61                    | 476            | 4.54            | 31.44                   | 1.93                    |
| <b>Totals:</b>   | <b>2,662</b>   | <b>466.49</b>   | <b>100.00</b>           | <b>100.00</b>           | <b>1,514</b>   | <b>234.78</b>   | <b>99.99</b>            | <b>99.99</b>            |

servation Officers.

The second day areas I through V were eradicated by the five crews. This was a total of 21 miles. Each crew was provided a vehicle, a predetermined amount of 5-percent powdered rotenone, and other necessary equipment. The upper two areas did not require the use of a boat or spray pump. Here the crews carried the rotenone in feed sacks, mixing it as needed and dispersing it by hand. The minimum dosage was calculated at two pounds of cube powder per acre foot. A heavier concentration than was actually needed resulted, however, since it was difficult for the crews to estimate stream distances while walking and working. All crews used more cube powder than the original predetermined amounts. In addition, greatly lowered water levels prevailed at the time of eradication. 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 cube powder was used to treat the 46-mile section. The use of boats in Areas III, IV, and V, aided in transporting the rotenone since each area was approximately five miles long. At the end point of Area V a barrier of 1-inch mesh wire netting was erected to prevent any possible fish movement from the untreated downstream areas into the upstream treated sections. The third day was spent picking up and burying all fish not utilized by local citizens. It was estimated that a crowd of from 200 to 400 people was following closely behind each crew and picking up fish as soon as they showed signs of distress. During the night of the third day an extremely hard rain washed out the barrier at Area V.

On the fourth day three crews were sent one-half, one, and one and one-half miles, respectively, above the washed-out barrier site. Each

crew laid down a heavy curtain of rotenone at these points. Observers stationed below and between these curtain release points reported that no fish were seen during several hours of observation. This check showed that no fish had moved upstream past the barrier site and it also demonstrated that the kill success in this area was adequate. Crews continued poisoning down-stream in the afternoon and a new barrier was erected at the end point of Area VII.

The fifth day was spent picking up fish from the previous day's nine miles of eradicated section. Again the barrier was washed out by a hard rain and subsequent high water. A two-man crew stayed over the weekend, laying down a curtain of rotenone at six-hour intervals, until the high water subsided and a new barrier could be erected. The first day of the second week was devoted to making six spot checks at various stream intervals to determine kill success. Particular attention was paid to the area just above the washed-out barrier site. These checks revealed no fish and it is believed that very close to a complete kill resulted. The following three days were spent eradicating and picking up in Areas VIII, IX, and X, a distance of 16 miles. The project leader and his assistant spent an extra day inspecting these lower areas for any additional fish that would have created a sanitary problem. On the basis of the population study data, the 230 eradicated acres of North Fork yielded 37,255 pounds of fish.

All major tributaries 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 and will aid in providing food for the game species that were restocked.

Restocking. ---- Four days after completion of the eradication operation adult bluegill in live-boxes were placed at random locations in the river to check on the toxicity of the water. All the test fish survived, indicating that no residual rotenone remained. High water temperatures and several heavy rains probably hastened this detoxifying action. Three days later the actual restocking began. Our 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 one location the bluegill spawned immediately after being stocked in the river. Of necessity, availability largely determined the numbers and ratio of game to forage species stocked. A total of 18,717 game fish (largemouth bass, black crappie, and white crappie) were released at 14 different locations. At these same locations a total of 12,540 bluegill and longear sunfish were restocked.

Netting Studies. ---- As was true with nearly all streams in Kentucky in 1952, due to the extremely dry season, North Fork River was very low most of the summer and fall. Rough fish movement from the downstream untreated area into the eradicated upper area was almost a physical impossibility until the late fall rains began. Very little, and in many places, no water whatsoever was flowing across the riffles connecting the pools. Netting activities were delayed until the stream flow was back to normal. Very little rough fish movement was anticipated at this time of the year. This belief was borne out by the results of the few attempts made at netting. Three separate weeks of netting immediately above the untreated area yielded only stocked fish and small numbers of black and yellow bullheads. Continuous netting proved impractical be-

cause of extreme water level fluctuation.

Post-eradication Population Studies. --- Because of natural stream features and obstructions, it was possible to conduct population studies in 1953, one year after eradication, in the same areas that were sampled in 1952. Stream flow and depth were, for all practical purposes, approximately the same as they were in 1952 when the initial studies were made. The results of these studies are presented in Table 1 to facilitate comparison with the pre-eradication population studies. Largemouth bass and white crappie occupied 5.81 percent by number and 6.90 percent by weight of the total population in 1953. Pan fish (bluegill, longear sunfish, and green sunfish) made up 24.44 percent by number, but only 10.15 percent by weight of the total. Four of the original fifteen rough and forage fish species were absent in these follow-up studies. These were channel catfish, flathead catfish, stonecat, and bigmouth buffalo. Those species that did reenter the eradicated section made up 69.74 percent by number and 82.94 percent by weight. The standing crop one year after eradication, combining all species present, was found to be 81.52 pounds per acre. This figure is approximately one-half of the previously determined carrying capacity.

Age and Growth. --- Scale samples were taken from all game fish species and some pan fish during the course of the pre-eradication population studies. It was hoped that additional scale samples could be secured during the eradication operation to supplement the meager number resulting from these studies, but this aim was not realized since the game fish species were so weakly represented in the total population. Only 24 spotted bass, 16 largemouth bass, and 5 white crappie were available for age and growth analysis.

The average total length of largemouth bass at the end of their first year of life as determined from the pre-eradication scale samples was ~~3.8~~<sup>4.2</sup> inches. The average total length of 51 largemouth bass stocked as fingerlings after eradication, and recovered in the 1953 population studies, was 6.8 inches. At the end of their first year of life these fish averaged 4.1 inches. It must be remembered that these latter fish were stocked late in the summer of 1952 after being held in hatchery ponds and handled several times.

#### DISCUSSION

It is readily apparent from the foregoing data that no significant changes in the desirable species composition have resulted from this attempt at total population manipulation. Definite changes have occurred, however, among the rough fish species. Bigmouth buffalo formerly occupied 28.25 percent of the total weight, but now this species is completely absent from the population. This percentage loss was more than matched by the increase of carp weight from 7.50 percent in 1952 to 42.36 percent in the 1953 population. It must be remembered that the standing crop in 1953 was only 50.3 percent of the previously determined carrying capacity. No <sup>final</sup> evaluation of the degree of success or failure of total population manipulation can be made until the present population approximates the normal carrying capacity of 161.98 pounds per acre.

In view of the above findings it is believed that some kind of barrier to rough fish movement will be necessary before attempting to establish and maintain game fish populations in streams now supporting

heavy rough fish populations. An electrical barrier of the type employed by the Fish and Wildlife Service in the Great Lakes region for the control of sea lamprey migration is being considered. It is hoped that such a barrier can be put into operation on Fleming Creek in 1954.

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#### LITERATURE CITED

Carter, Bernard T.  
1953. The status of legalized gigging and snagging in Kentucky. Department of Fish and Wildlife Resources, Division of Fisheries,  
7 p.