

## 6. Utilization and Survival of Trout in Indiana

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### ABSTRACT

In a series of northern Indiana trout streams voluntary returns of tags from hatchery-reared rainbow trout of large size varied from 0 up to 42 percent during the year of planting. Corrected second-year recoveries in one stream amounted to 18 percent of those of the first year, giving some idea of the total mortality for a year. The great majority of recaptures were from within a mile of the point of release.

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### INTRODUCTION

There are apparently no accounts extant of the occurrence of native trout in Indiana, except for the lake trout of Lake Michigan. Early in the history of fish culture in the state the possibility of introducing trout populations in certain northern streams was recognized. The time and place of the first trout stocking in Indiana could probably not be ascertained now, but it was only after about 1920 that plants began to be made on any large scale, many of them frankly on an experimental basis. Three species of trout were used : brook (*Salvelinus fontinalis*), rainbow (*Salmo gairdneri*) and brown (*Salmo trutta*). The first-mentioned has become established in only a few small streams, but the rainbows and browns now occur in many places through the northern tier of counties.

The desirability of having definite information concerning actual and potential trout streams led to a survey made in 1931 and 1932 by M. J. MURRAY, whose summary reports have been published (MURRAY, 1938a,b) . Using limits of tolerance of environmental factors (temperature principally) recommended in New York and other states, MURRAY separated 17 miles of good trout waters and 34 miles of doubtful ones from the streams visited by him—and he visited the greater part of the waters which might be even remotely suspected of maintaining trout. Experience now shows that MURRAY'S criteria were too severe. The northern Indiana streams which currently provide fair to good trout fishing run to several hundreds of miles, including some that are of moderate size. Some of the best of them, for example the Little Elkhart and its tributaries, were entirely rejected by MURRAY. The reasons for this discrepancy are not altogether clear. MURRAY conscientiously applied the criteria then available. He recognized a possibility that "genetic strains of trout . . . which

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could survive higher temperatures" might conceivably be developed, but of course could not allow for such a possibility in his recommendations. Whether any such strains have really been developed is still unknown, but it does not seem probable that, in only 25 years or so of Indiana existence, better adaptation to high temperatures would be secured than in warm streams elsewhere where the same species of trout have existed for a much longer period. An interesting and possibly critical observation is that even the larger of the Indiana streams which now support good trout populations (Little Kankakee, Little Elkhart, Solomon's Creek, etc.) apparently have always lacked any significant number of predacious fishes of large size, such as northern pike (*Esox lucius*), perch (*Perca flavescens*), smallmouth and largemouth bass (*Micropterus dolomieu* and *M. salmoides*), rock bass (*Ambloplites rupestris*) and centrarchids generally. Prior to being stocked with trout they would yield the angler principally an abundance of creek chubs (*Semotilus atromaculatus*) and some suckers (*Catostomus commersonnii*), which of course are still there. Streams in which trout stocking has been generally unsuccessful, like Fawn River, Pigeon River, Elkhart River, etc., afford good fishing for some or all of the predacious species just mentioned. Just why these warm-water species did not and do not frequent such streams as the Little Elkhart is not at all clear. Certainly these streams seem to be neither too cold nor too small for them, particularly for the ubiquitous rock bass.

#### PROCEDURE

Prior to 1943 most trout stocking in Indiana was done with fingerling fish. In 1943 the opportunity of obtaining a rather large number of adult rainbow trout presented itself. These came from the U. S. Fish and Wildlife Service hatchery at Neosho, Missouri. They were transported to Indiana by a special truck having built-in circulation and cooling system, and there were very few losses. A thousand of them were tagged on April 14 by SHETTER'S method, using a No. 3 tag clamped about the lower jaw. Losses from this operation too were light, and the following day the trout were distributed into selected streams. Planting was done by the "spot" method, the whole of each group being liberated at a convenient bridge. Trout of this series, liberated in Judy Creek, the Little Elkhart and the Little Kankakee, averaged 9.7 to 10.1 inches in different lots, fork length ; the grand average was 9.9 inches (252 millimeters), the extreme range 6.7 to 14.8 inches (170-375 millimeters), and the standard deviation 1.3 inches (32 millimeters). The lot put into the Pigeon River the same year was a little smaller, averaging 9.3 inches (235 millimeters), with a standard deviation of 0.8 inches (20 millimeters). In spite of their large size, all these fish were only about a year old when stocked : i.e. the progeny of the 1942 spring spawning.

In 1944 similar fish were available, from the same place. They were divided into smaller lots for more widespread distribution, the range

of average length in these lots being 9.3 to 9.7 inches. The grand average was 9.5 inches (241 millimeters), the extreme range 7.3 to 12.2 inches (185 to 310 millimeters), and the standard deviation 0.67 inches (16.9 millimeters). Some adult brown trout from Northville, Michigan, were also tagged in 1944. The three lots ranged from 12.2 to 12.5 inches in average (fork) length; the grand average was 12.4 inches (314 millimeters), the extreme range 10.0 to 15.2 inches (255 to 385 millimeters), and the standard deviation 1.28 inches (32.4 millimeters).

The streams in which trout were planted are listed below. For ready identification, the county, township and section number is given of the exact site where the fish were put in, also the air-line distance from the center of a nearby municipality. The main rivers into which these streams flow are the Kankakee, which is a tributary of the Illinois and hence of the Mississippi River; and the St. Joseph, which flows into Lake Michigan. A few of the streams flow more directly into Lake Michigan.

#### STREAMS STOCKED WITH RAINBOW TROUT IN 1943

Judy Creek (also called State Ditch; tributary of St. Joseph River). St. Joseph County, Clay Twp., N part of Section 32; 4 miles NE of South Bend.

Little Elkhart River—site No. 1 (tributary of St. Joseph River; the Little Elkhart at this point is locally called Emma creek, and is so labelled at U. S. road 20). Elkhart County, Middlebury Twp., S side Section 12; at U. S. road 20, 2½ miles SE of Middlebury.

Little Elkhart River—site No. 3. Elkhart County, York Twp., N side Section 33, 3 miles NNE of Middlebury.

Little Elkhart River—site No. 4. Elkhart County, Washington Twp., NE corner of Section 26; 1 mile E of Bristol.

Little Kankakee River (upper). Laporte County, Kankakee Twp., south edge Section 35; 6 miles E of Laporte.

Little Kankakee River (lower). LaPorte County, Lincoln Twp., middle of Section 18; 9 miles SE of Laporte.

Pigeon River (tributary of St. Joseph River). Steuben County, Jackson Twp., middle of Section 20; at state road 327, 5½ miles S of Orland.

#### STREAMS STOCKED WITH RAINBOW TROUT IN 1944

Bloody run (tributary of Pigeon River). Lagrange County, Springfield Twp., middle of Section 15; 2 miles SE of Mongo.

Buck creek (tributary of Pigeon River). Lagrange County, Clay Twp., SW corner Section 23; 2 miles W of Lagrange.

Cobus creek (tributary of St. Joseph River). Elkhart County, Cleveland Twp., Sections 22 and 34; 5-6 miles NW of Elkhart.

Coffee creek (tributary of Little Calumet River), Porter County, Liberty Twp., middle of Section 7; 2 miles SSE of Chesterton.

Crooked creek (upper) (tributary of Kankakee River). Porter County, Washington Twp., middle of Section 26 and S part of Section 23; 5½ miles E of Valparaiso.

Crooked creek (lower), Porter County, Morgan Twp., Section 2; 6 miles ESE of Valparaiso.

Dutch creek (tributary of Trail creek), Laporte County, Michigan Twp., Section 23; 3 miles ENE of Michigan City.

Emma creek (tributary of Little Elkhart River). Lagrange County, Newbury Twp., W side of Section 35, at state road 5; 2 miles WNW of Emma.

Fly creek (tributary of Pigeon River). Lagrange County, Bloomfield Twp., S side of Section 14; 4 miles ENE of Lagrange.

Judy creek. St. Joseph County, Clay Twp., N part Section 32, E side Section 25, SE corner and middle of Section 23; 3 miles N to NE of South Bend.

Little Elkhart River (main branch). Lagrange County, Newbury Twp., SW corner Section 28; 4 miles WNW of Emma.

West Branch Little Elkhart River (named "State Ditch" on maps; sometimes wrongly called the "Little Elkhart" and so labelled at U. S. road 20). Lagrange County, Newbury Twp., SW corner Section 32; 5 miles W of Emma.

Little Kankakee River (upper). Laporte County, Pleasant Twp., or side Section 2 and N side Section 12; 6-7 miles E of Laporte.

Little Kankakee River (lower). Laporte County, Lincoln Twp., middle of Section 19;  $2\frac{1}{4}$  miles E of Stilwell, 1 mile W of Fish Lake. This is about 1 mile below the lower section of 1943.

Pigeon River (tributary of St. Joseph River). Steuben County, Jackson Twp. One plant made above and below the dam near the boundary of Sections 20 and 21; another made at E border of Section 22, at a dam on the outskirts of Flint.

Potato creek (tributary of Kankakee River). St. Joseph County, Liberty Twp., SW corner of Section 28; at North Liberty.

Snake creek (tributary of Trail creek). LaPorte County, Michigan Twp., Section 24; 4 miles E of Michigan City.

Solomon's creek (tributary of Elkhart River), Elkhart County, Benton Twp., Sections 17, 20 and 28; 4-6 miles SE of New Paris.

Trail creek (tributary of Lake Michigan), Laporte County, Springfield Twp., SW side Section 31; 4 miles ESE of Michigan City.

Turkey creek (tributary of Pigeon River), Lagrange County, Springfield Twp., NE corner of Section 28, at U. S. road 20;  $8\frac{1}{2}$  miles E of Lagrange.

Willow creek (tributary of St. Joseph River). St. Joseph County, Penn Twp., S half of Section 1 and N half of Section 12; 3 miles E of Mishawaka.

#### STREAMS STOCKED WITH BROWN TROUT IN 1944

Crooked creek (lower). Porter County, Morgan Twp., Section 2; 6 Miles ESE of Valparaiso.

Little Kankakee River (lower). Laporte County, Lincoln Twp., Section 19.

Massaruga or Rattlebridge creek (tributary of Little Calumet River), Laporte County, Cool Spring Twp., Section 32.

## RESULTS

In interpreting the returns from these plantings several things must be borne in mind. (1) The recaptures tabulated represent a minimum number, since there is little question that some tags were taken but not turned in. While no direct estimate of losses of this sort is available, they are believed to be relatively moderate because of the large amount of local interest taken in the experiments, particularly in 1943. Possibly the unreturned tags amount to from a quarter as many up to as many as were returned, on different streams. (2) The returns, even if complete, would not necessarily represent the rate of exploitation of native fish in the same streams. (3) Absence or scarcity of recaptures from certain streams does not *necessarily* indicate that they are poor as trout streams. It does suggest of course that planting of adult rainbow trout in them is of little value under present fishing conditions, though it may be that some of them would be entitled to a second trial. This is particularly true where the number of fish planted was small. (4) The years 1943 and 1944 were unfavorable ones for obtaining an estimate of the normal rate of exploitation on these streams. Various effects of the war combined to restrict fishing effort, so that the results obtained must be regarded as considerably less than a representative value for recent years, even apart from the incompleteness of returns.

RECOVERY OF RAINBOW TROUT. The streams planted with rainbow trout **may** be grouped into three classes. Streams in which less than 5 percent recaptures were returned include Bloody run, Cobus creek, Coffee creek,


TABLE 1. Rainbow trout planted and recaptures made in 1943.

	Date of plant	No. plant- ed	Mean fork length		May	June	July	A.	Not classi- fied	Total	Per- cent- age
			<i>inches</i>	<i>mm.</i>							
Judy creek	Apr. 14	91	9.7	247	14	5				29	32
Little Elkhart (1)	"	243	10.1	256	18	6	5		35	99	42
Little Elkhart (3)	"	104	10.0	254	1			8		9	9
Little Elkhart (4)	"	127	9.9	251	5	2	1			8	6
Little Kankakee (upper)	"	238	9.8	249	10	3			9	22	9
Little Kankakee (lower)		241	9.9	252						48	20
Pigeon River	Apr. 30	35	9.3	235						0	0

Fly creek, Pigeon River (lower site), Potato creek and Snake creek. All of these streams except Potato creek are said to have produced at least fair trout fishing in recent years, the fish caught being either from earlier plants or from naturally-hatched fry. We conclude however that, whether because of inadequate fishing or an unfavorable environment, adult rainbows are not being recaptured sufficiently frequently to justify the expense of planting them.

Another group of streams returned 6 to 15 percent of the rainbows planted, in at least one of the years. These include the upper part of the Little Kankakee, the lower part of the Little Elkhart (below Middlebury), Buck creek, Crooked creek, Pigeon River (upper site), Solomon's creek, Turkey creek and Willow creek. These streams are much better prospects than the last group, and with more intensive fishing might yield a respectable number of returns.

TABLE 2. Rainbow and brown trout planted and recaptures made in 1944.

	Date of plant	Number planted	Mean fork length		Recaptures	
			<i>inches</i>	<i>mm.</i>	<i>no.</i>	
<b>A. Rainbow trout</b>						
Crooked creek (upper)	Apr. 21	49	9.5	240	6	12
Coffee creek	"	25	9.6	243	1	4
Little Kankakee River (upper)	"	73	9.4	239	1	1
Dutch creek	"	21	9.5	241	4	19
Trail creek	"	25	9.6	243	5	20
Snake creek	"	25	9.5	242	1	4
Judy creek	Apr. 15	50	9.5	240	6	12
Potato creek	"	24	9.5	242	0	0
Willow creek	"	101	9.6	244	15	15
Solomon's creek	"	75	9.5	240	10	13
Cobus creek	"	98	9.6	244	1	1
Little Elkhart River West branch	"	47	9.5	242	1	2
Little Elkhart	"	23	9.4	238	6	26
Emma creek	"	23	9.6	244	5	22
Bloody run 	"	23	9.4	238	0	
Fly creek	"	23	9.5	240	1	4
Turkey creek	"	24	9.3	235	3	12
Pigeon River (lower)	"	25	9.6	245	1	4
Pigeon River (upper)	"	25	9.7	246	2	8
Buck creek	"	20	9.5	242	3	15
<b>B. Brown trout</b>						
Little Kankakee River (lower)	Apr. 21	25	12.5	318	2	8
Massarauga creek	"	25	12.4	315	1	4
Crooked creek (lower)	"	24	12.2	309	0	0



The third group, from which 16 percent or more were returned in at least one year, includes Dutch creek, Emma creek, Judy creek, the Little Elkhart above Middlebury, the West Branch of the Little Elkhart, the lower plant on the Little Kankakee, and Trail creek. These streams mostly yielded 20 to 25 percent recoveries, the greatest figure being 42 percent for the Little Elkhart River in 1943.

For comparison with results in other states, reference can be made to the paper of SHETTER and HAZZARD 1941, and to several earlier works which they review. SHETTER and HAZZARD'S work was done by direct creel census on the stream site, so would be expected to yield more nearly complete returns than our experiments. They found rates of recapture of rainbow trout, planted from April to June, to range from 10 to 62 percent in several first-class trout streams; the average of 6 plants was 34 percent. Considering their more efficient method of recovery, these results are of the same order as the returns from the best group of Indiana streams. Hence we must regard these Indiana streams too as good trout streams—at least from the point of view of survival of hatchery-reared fish.

**RECOVERY OF BROWN TROUT.** The number of plantings of brown trout made in Indiana is too small to be very informative. However, the three trials to date have proved disappointing, considering the large size of the fish used—12 1/2 inches. Only 3 tags were sent in from 74 put out. Two of these were from the 25 fish put into the Little Kankakee—the only instance where the percentage return reached the "intermediate" class described for rainbows.

This small rate of recapture of our browns is in line with the results of SHETTER and HAZZARD, who obtained 7 to 19 percent return from brown trout released from April to June. The average of their three plants were 14 percent, or less than half what was obtained from their rainbows.

**SURVIVAL RATE AND NATURAL MORTALITY.** Only from the Little Elkhart River have second-year recoveries of tags been made. Ten rainbows were caught in May of 1944, from the No. 1 plant of 1943, and 2 others were reported that had lost their tags. There was also 1 from the No. 3 plant, and 1 from the No. 4 plant. Since no tagged trout were planted in these sections in 1944, there is no direct measure of the rate of exploitation in 1944, though we know that there was considerable fishing activity. If the search for tags be considered equal in the two years, the ratio of the recoveries of 1944 to those of 1943 will give an estimate of the survival rate of the fish, viz. 12/99 12 percent for the No. 1 plant, and 2/17 12 percent for the No. 3 and No. 4 plants together. These figures may be low because apparently less fishing was done in 1944, by some anglers at least; also some tags may have become lost from the fish, though experience elsewhere seems to be that large trout retain jaw tags fairly well. If the survival rate were increased by half to take care of these factors, it would mean that there is about 82 percent total mor-

tality in a year's time. Compared to the 42 percent minimum rate of exploitation, this leaves 40 percent of the fish which disappeared from other causes. Because the efficiency of recovery of tags on this stream seems to have been quite high, and wandering seems to be negligible, most of the loss must be ascribed to natural mortality (including predation).

In other streams natural mortality may be even higher, since no second-year recoveries were made from them. This was also the common finding of SHETTER and HAZZARD (1942) in Michigan. Their best over-winter survival from rainbow trout planted in April and May was on the Pine River, where 8 were returned in 1939 from 1500 marked in 1938, as compared with 633 returned in 1938. This suggests a survival rate of only 1.3 percent.

WANDERING. The great majority of recaptures were made from the same stream as the plantings, and usually not far from the exact spot. For example, the No. 1 plant of 1943 on the Little Elkhart was made at U. S. road 20. Of 99 recaptures in 1943, 3 were made upstream not more than half a mile, the remainder were downstream, usually about half a mile, and only 1 was farther off than Middlebury, which is 2 miles away on the map. Of 12 1944 recaptures 8 were  $\frac{1}{2}$  to 1 mile downstream, while 4 were  $\frac{1}{2}$  to 1 mile upstream. This is typical of the other plants, though there are several instances of trout having ascended a tributary of the stream in which they were planted, for a short distance.

Three trout undertook longer journeys. One individual of the No. 4 Little Elkhart plant in 1943 moved out into the St. Joseph River, down it and up the (big) Elkhart to Elkhart City, where it was captured July 10. One of the trout from the West Branch of the Little Elkhart in 1944 arrived at the same place, having made a longer journey (19 miles on the map); while another of the same plant was taken almost as far away, in a small tributary of the St. Joseph north of Elkhart. These three individuals are the only ones which are known to have moved more than 2 or 3 map miles from the planting site. It may be that there is more wandering than this suggests, since in some of the larger streams to which they might move no fishing is done directed specifically at trout. Nevertheless it seems clear that wandering represents exceptional rather than typical behaviour, as has been found elsewhere (*cf.* SHETTER and HAZZARD).

NATIVE TROUT. A few of the fishermen who returned tags from the Little Elkhart River were sent a brief questionnaire regarding what non-tagged trout they had taken on the same section of the stream that the tagged ones were caught in. Returns from 4 of them (reporting the catch of 10 fishermen) showed 230 rainbow trout caught in 1943, of which 88 were tagged. Thus the "native" rainbow trout taken were considerably more numerous than the tagged ones. However they were of smaller size, on the average, so that the total bulk of native fish taken was

probably no greater than that of the planted ones. Fourteen brown trout were reported by the same group of fishermen, these mostly of large size.

The same group of men reported their 1944 catches to be much smaller : 43 rainbows and 6 browns. This was partly the result of less fishing by them, which in turn was said to be partly the result of poor success.

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