

March 23, 1955

Report No. 1441

Migration and Growth of Tagged, Immature  
Rainbow Trout in the Black River,  
Mackinac County, and in Lake Michigan,  
1951-1954<sup>1</sup>

By

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Abstract

This report concerns the migration and subsequent growth of wild rainbow trout and hatchery rainbow trout in the Black River. The wild trout were trapped and tagged as parr while migrating downstream to Lake Michigan; over the 3 years of 1951-1953, 842 parr were tagged with a No. 3 jaw tag. Four plantings of tagged, hatchery, 2-year-old rainbow trout (total of 2,000) were made, two in the Black River and two in Lake Michigan. All wild fish and 10 per cent of each stocking of hatchery fish were scale sampled. Recoveries were made by anglers, by three fish traps on the Black River, and by commercial fishing gear.

Of the 842 wild fish tagged, 145 or 17.2 per cent have been recovered so far. All but 6 recoveries were from the Black River. Three were from other streams and 3 were from Lake Michigan.

The two river plantings of hatchery rainbows (500 fish in each) were made at a point four miles upstream from the mouth on October 20, 1952 and October 26, 1953. To date, recoveries from the 1952 stocking have amounted to 3.2 per cent; and from the 1953 stocking, 1.6 per cent.

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<sup>1</sup> Contribution from the Institute for Fisheries Research

These recoveries have indicated some downstream movement, but none of their scales showed lake growth.

One of the Lake Michigan plantings of hatchery rainbows was 500 fish planted on October 26, 1953, some 200 yards east of the mouth of the Black River. Of these 2-year-olds a total of 54 (10.4 per cent) have been recovered, mostly from the Black River, a few from Lake Michigan.

The second stocking, of 500 2-year-olds, in Lake Michigan was on May 12, 1954, at a point 200 yards east of the mouth of the Black River. A total of 5.2 per cent has been recovered to date, all from the Black River.

The returns from the first growing season of fish showing lake growth are as follows: wild fish (age-group II), 2.5 per cent; hatchery fish of the Lake Michigan stocking during the fall of 1953, 0.6 per cent; and hatchery fish of the Lake Michigan stocking during May of 1954, 2.4 per cent. Percentages are in terms of numbers released.

Hatchery fish showing lake growth demonstrated a more rapid rate of growth than did wild fish of comparable age (age-group II) during the first growing season after release. Hatchery fish stocked in Lake Michigan in the fall of 1953 increased 8.3 inches in length and 1 pound, 14 ounces in weight, and hatchery fish stocked in May of 1954 increased 7.5 inches in length and 1 pound, 9 ounces in weight, while wild fish increased only 6.1 inches in length and 13 ounces in weight.

It is concluded that migratory rainbow trout should be managed to take advantage of the tremendous growth in the Great Lakes. Furthermore, an excellent possibility exists that hatchery rainbow trout can be utilized to supplement runs of wild fish from the Great Lakes.

March 23, 1955

Report No. 1141

Migration and Growth of Tagged, Immature

Rainbow Trout in the Black River,

Mackinac County, and in Lake Michigan,

1951-1954

Thomas M. Stauffer

The Black River, where this study took place, has long been noted as an excellent migratory rainbow trout stream. It also has a heavy spawning run of sea lampreys, American brook lampreys, white suckers, longnose suckers and smelt. There is a moderate to heavy resident population of brown trout and a light population of brook trout. The stream is fairly wide (35'-45') and slow-moving in the lower 1/4 mile. The upper and middle reaches contain a fair amount of gravel which is utilized by most of the aforementioned species for spawning. The water is dark brown in color and generally clear. The average volume of flow is 33.4 c.f.s. (USGS) with extremes of 12-15 1/2 c.f.s. These volumetric figures should be considered minimal because of two tributaries entering the main stream below the gaging station carrying a combined volume estimated as averaging 15-20 c.f.s. The drainage area of the Black River is approximately 28 square miles.

This report concerns the migration and subsequent growth of rainbow trout trapped migrating downstream to Lake Michigan for the first time, and also of 2,000 hatchery trout, half planted in the river and half in Lake Michigan. While practically all downstream-migrating rainbow trout

were tagged, only the immature fish which did not show lake growth (parr) will be considered. These fish were all in age-groups I, II or III. The young rainbows obtained for tagging were secured at a two-way fish trap. Essentially, the trap consisted of a fence of hardware cloth (1/2" mesh) stretched diagonally across the stream with a catch-box at either end. This weir was originally installed to check on the escapement of sea lampreys over a lamprey barrier dam installed downstream from the weir. However, the weir also presented an excellent opportunity for a study of the migration of rainbow trout, inasmuch as the immature rainbow trout were migrating downstream at the same time that the sea lampreys were migrating upstream. Consequently, whenever possible all rainbow trout taken in the downstream trap were tagged and scale sampled before release.

During 1951, the weir was located on the Black River some 3 miles upstream from the mouth; it was in operation from May 8 to July 5. During 1952 and 1953, it was located about 3/4 mile upstream from the mouth, and was operated during 1952 from May 9 to July 22, during and in 1954 from May 9 to July 21, 1953 from May 4 to July 25. It is thought that most fish in the runs each year were trapped. It is apparent, however, that some (believed to be limited) migration took place before the weir was installed. The early migrants were fish of age-groups II and III, judging from fish collected during early, sporadic operation of the weir.

During 1951, 413 of a total of 471 downstream-migrating parr were tagged and 457 were scale sampled, weighed and measured. Parr 5.0" and under were not tagged. The tag used was a No. 3 jaw tag which seemed to be most suitable for the young rainbow trout. The fish were anaesthetized with urethane before tagging. After tagging, the fish

were placed in a live box until they were fully recovered, and they were then released. Observed mortality was very light, and subsequent mortality from tagging was probably negligible.

During 1952, 200 of a total of 629 were tagged and 623 were scale sampled, weighed and measured. All parr 5.5" and over were tagged. Otherwise the tagging procedure remained the same as during 1951.

During 1953, 557 were tagged of a total of 2,346 trapped, and age determinations were made on 2,236. Of the 557 trout tagged, 328 were tagged with a streamer tag and 229 with the No. 3 jaw tag. The streamer tags did not prove satisfactory, because they were lost very readily from the fish. Only a few returns were secured from streamer-tagged fish that had been in Lake Michigan. Therefore, the streamer-tagged fish were not considered. Except for the period from June 12 to 17, all fish 5.5" and over were tagged. (Due to an unexpected heavy run of fish, the tag supply was exhausted on June 12 and no more could be secured until June 17.) Fish were handled as before.

Two stockings of 2-year-old hatchery rainbow trout were made in the Black River and two were made in Lake Michigan. The first stocking was made in the fall of 1952 in the stream. A total of 500 were stocked, all were jaw tagged and a random sample of 50 were scale sampled, weighed and measured. In the fall of 1953, 500 were stocked in the river and 500 in Lake Michigan. All of these were jaw tagged and a random sample of 50 was scale sampled, weighed and measured. In the spring of 1954, 500 were stocked in Lake Michigan. All were jaw tagged and a random sample of 50 was scale sampled, weighed and measured.

The major means of recovery were anglers, the checking weir, an upstream trap in the sea lamprey barrier, and commercial fishing gear.

Generally speaking, the angling pressure was heavy on the lower 1/2 mile of stream during the latter part of April, part of May, September and October of each year. A creel census on the stream was taken from April to July and from September 1 to November 14 of each year. Many tagged fish were recovered from anglers in this manner. Signs stating that tagged fish were present were posted, and angler cooperation was judged to be fair. The fish traps mentioned were in operation during the periods that creel census was taken. Cooperation from commercial fishermen in the immediate area in Lake Michigan was fair to good.

#### Returns From Wild Fish

Over the 3 years of tagging, 842 downstream-migrating immature rainbows were tagged. Of these, 145, or 17.2 per cent, were subsequently recovered. Most recoveries (139, or 95.8 per cent of the total) were from the Black River. Recoveries from other streams totalled 3 (2.1 per cent), and 3 (2.1 per cent) were returned from Lake Michigan. Recoveries from other streams were from the Carp River (Mackinac County), Asylum Creek (Grand Traverse County) and the Manistee River (Manistee County). One of the recoveries from Lake Michigan was at the mouth of the Black River, one was taken at Gravel Island, approximately 2 miles east of the mouth, and one was recaptured in Big Bay De Noc. It would seem that most of the rainbows return to the parent stream. However some straying is indicated.

A total of 132 age-group-I parr were tagged and 15 or 11.4 per cent were recovered; 643 age-group-II fish were tagged of which 111 or 17.1 per cent were recovered; and 62 age-group-III parr were tagged with 19 or 30.6 per cent being recovered. The factor or factors accounting for the higher rate of recovery for age groups II and III is unknown.

Possibly, the larger size of these fish when tagged accounted for the difference. Presumably, the larger the fish, the better chance of survival. Also, they would be able to carry the tag better. A factor partially responsible for the higher recovery of the II's and III's would be their availability to anglers immediately after tagging, since all III's were legal size and many II's were legal. The I's were unavailable to anglers at this time because of their small size but they would have been subject to hooking mortality.

Table I indicates those returns showing lake growth. Lake growth was determined by scale analysis. The returns during the same spring and summer as the tagging occurred indicate that there is little return from Lake Michigan at this time, inasmuch as there was only one recovery showing lake growth. By the first fall and second spring more than half of those recovered showed lake growth, and by the second fall practically all showed lake growth.

Most of the recoveries took place during the first three periods. Only 12 per cent of the recoveries were made thereafter. The percentage of total recovery for the different periods were as follows: first spring, 27 per cent; first fall, 26 per cent; second spring, 35 per cent; second fall, 4 per cent and third spring 6 per cent. However, it should be noted that for the 1953 tagging, the third spring will not occur until 1955. Recoveries which might be made in 1955 should raise the per cent of recoveries obtained during the third spring.

Assuming that the average age group of these fish is II, most of the fish recovered are caught as immature fish. Thirty per cent of the lake-run males are mature at age group II, 67 per cent are mature at age group III and all are mature at age group IV. Females mature at a

later age, with 32 per cent being mature at age group III; all are mature at age group IV (IWR Report No. 1431). While most of the males would mature within the periods (first spring to second spring) when most of the recoveries were made, only 32 per cent of the females could conceivably be mature.

Little growth (Table II) is apparent from fish taken during the first spring. This is due to the fact that most of the recoveries are from fish showing no lake growth. The first-fall column indicates a rapid increase in size. This is due to the rapid growth which occurred in the lake. The second-spring recoveries of lake-run fish also show a large increase in size from the time that the fish were tagged. However, the increase in size over those recovered in the first fall is not great. Presumably this is due to slower growth over the winter. By the third spring, the length of lake-run fish is approximately 3 times the length when tagged and twice the length of those recovered during the second spring. This tremendous growth can only be explained on the basis of highly favorable conditions in Lake Michigan in contrast to conditions in the stream. It is suspected that the more abundant supply of food in Lake Michigan is the cause of the rapid growth. It should be borne in mind that the metal No. 3 jaw tags somewhat inhibit growth; therefore, the gain recorded on Table II would be minimal.

A different rate of lake growth was noted between age group II and III (Table II). The data indicate that age-group-III fish grow more rapidly when they reach the lake than do age-group-II fish.



Table I

Distribution by age group and season of recovery, of wild rainbow trout recovered from the Black River, 1951-1953, with percentages of fish showing lake growth given in parentheses

Season of recovery	Age group			Total I-III
	I	II	III	
First spring <sup>∇</sup>	9 (0)	25 (4)	5 (0)	39 (3)
First fall <sup>‡</sup>	1 (100)	23 (65)	6 (100)	30 (73)
Second spring	3 (33)	34 (76)	5 (60)	42 (71)
Second fall	0 ...	5 (80)	0 ...	5 (80)
Third spring	1 (100)	8 (100)	1 (100)	10 (100)
Total	14 (21)	95 (57)	17 (59)	126 (53)

<sup>∇</sup>Table does not include recoveries for which data are incomplete.

<sup>∇</sup>Same season as tagged; includes regular trout season (spring run).

<sup>‡</sup>Fall special season (fall run).

Table II

Age group	Season of recovery	Number of fish and growth history								Misc.+ fish
		Lake growth				Stream growth only				
		Number of fish	Average days out	Gain in length (in.)	Gain in wt. (oz.)	Number of fish	Average days out	Gain in length (in.)	Gain in wt. (oz.)	
I*	1st spring	0	...	...	...	9	8	0	0	0
	1st fall	1	121	4.4	5	0	...	...	...	0
	2nd spring	1	357	7.5	14	2	314	2.6	2	1
	2nd fall	0	...	...	...	0	...	...	...	0
	3rd spring	0	...	...	...	0	...	...	...	0
II	1st spring	1	105	3.9	1	16	26	0.4	0	8
	1st fall	15	140	6.1	13	4	102	1.6	1	11
	2nd spring	21	333	6.6	14	7	321	1.6	2	14
	2nd fall	0	...	...	...	0	...	...	...	5
	3rd spring	8	702	12.0	33	0	...	...	...	1
III	1st spring	0	...	...	...	2	14	0	0	3
	1st fall	6	147	7.0	19	0	...	...	...	1
	2nd spring	3	361	7.8	21	0	...	...	...	3
	2nd fall	0	...	...	...	0	...	...	...	0
	3rd spring	1	710	15.6	70	0	...	...	...	0

\* One recovery in this age group could not be assigned to a particular period, and therefore is not included in the tabulation.

+ Data on growth history not available.

### Returns from Hatchery Fish

On October 20, 1952, a stocking of 497 tagged hatchery rainbow trout was made in the Black River. The stocking site was about four miles upstream from the mouth of the river and was about one mile above the section open to fall and early spring fishing for migratory rainbows. The fish had two summer's growth and averaged 8.1 inches in length and 92 grams in weight. Only 16 or 3.2 per cent were subsequently recovered. All recoveries were made in 1953, indicating that few survived after that year. Growth shown by the recoveries was very slight. Ten recoveries were made by anglers and 6 were recovered in the downstream trap of the checking weir. Ten recoveries were made at a distance of 3 1/2 miles downstream, two recoveries were made about one mile below the site of stocking, two were recovered at the site of stocking, one was recovered a short distance above the stocking site, and on one the location of recovery was unknown. Generally, it appears as if there is a tendency for downstream movement, although this may be somewhat biased inasmuch as there was no weir above the stocking site and creel census above the site was not so intensive as below.

On October 26, 1953, a stocking of 500 tagged hatchery rainbow trout was made in the Black River. The location was the same as that for 1952. The fish were 2 years old and averaged 9.1 inches in length and 120 grams in weight. Only 8 or 1.6 per cent were subsequently recovered. All recoveries were made in 1954. Six recoveries were by anglers and two were recaptured in the downstream trap of the weir. Three were recovered 3 1/2 miles downstream, four were recovered about a mile below the tagging site, and one was recovered at the site of tagging. The location of recoveries appears to be the same as in 1952.

A stocking of 500 tagged hatchery rainbow trout was made in Lake Michigan about 200 yards east of the mouth of the Black River on October 26, 1953. These fish had 2 summer's growth and averaged 9.1 inches in length and 120 grams in weight. A total of 54 fish (10.8 per cent) were recovered (Table III). Many of the fish migrated into the river shortly after tagging. Seventeen were taken in an upstream trap at the barrier dam within 4 days after stocking; and returns from anglers also indicated an upstream migration. Others of the stocking soon ranged out into Lake Michigan, judging by the returns from Lake Michigan. Those recaptured in the fall of 1953 and in the spring of 1954 showed little growth. However, those returned in the fall of 1954 showed the tremendous increase in length and weight typical of native rainbow trout which have been in Lake Michigan. The average length and weight of two fish on which there are reliable data was 17.4 inches and 2 pounds 2 ounces. This was an average increase of 8.3 inches in length and 1 pound 14 ounces in weight in one year's time. Both fish were males.

The last stocking was in Lake Michigan, 200 yards east of the mouth of the Black River on May 12, 1954. Five hundred tagged hatchery rainbow trout were released. These averaged 9.3 inches in length and 137 grams in weight. Twenty-six (5.2 per cent) have been recovered to date (see Table IV). Many fish of this stocking also migrated into the river shortly after tagging. Apparently, these fish moved out of the river after May 31, since no more were taken after that date until the fall run commenced. Further substantiating the theory that these fish remained in the stream only a short time was the lack of recoveries of fish showing stream growth in the fall.

Fish recaptured May 12 to 31 showed an average loss of weight and length since planting on May 12. The weight loss can be explained by the change of environment, i.e., hatchery to wild conditions. It would hardly seem that these fish would lose in length, however. It is probable that the recoveries were not entirely representative. The increase in size of the recoveries made during the period of September 6 to October 30 was spectacular. These fish almost doubled their length, and increased their weight five-fold—all in a period of less than 5 months (Table VI). This rapid growth is typical of wild rainbow trout in Lake Michigan. Of 8 fish showing lake growth which were sexed, 7 were males.

#### Comparison of Returns from Wild and Hatchery Fish

The returns from the fall stream stocking (1952 and 1953) of hatchery fish do not compare favorably with the returns from wild fish. The return from the stocking of the fall of 1952 was 3.2 per cent, and the return from the fall of 1953 was 1.6 per cent, whereas the return from wild fish of age group II was 17.1 per cent. Further, 53 per cent of the wild fish returned showed lake growth, while none of the hatchery fish exhibited this rapid growth.

The returns from the 1953 fall stocking in Lake Michigan compares more favorably with the returns from wild fish. This stocking produced a return of 10.8 per cent. However, only 6.4 per cent of those returned showed lake growth. These percentages are expected to rise, inasmuch as the period when the most recoveries are to be expected (second spring) will not occur until the spring of 1955. The growth of those showing lake growth compared favorably with that exhibited by wild fish.

Although the single spring stocking was made only last spring (1954) in Lake Michigan, this stocking seems to show the most promise of all. During the short period (first spring and first fall) since these fish have been stocked, 5.2 per cent have been returned; a comparable period for wild fish of the same age shows 3.4 per cent returned (Table V). Of the hatchery fish returned so far, 44 per cent (Table IV) showed lake growth; and 33 per cent of the wild fish returned during a comparable period showed lake growth. Table VI indicates the increase in size of age-group-II wild fish and fish from the stocking of 1954. The hatchery fish at first lose weight in the stream, falling behind wild fish in growth. Upon returning to the stream in the fall from Lake Michigan, their average increase in length (7.5") has exceeded that of wild fish by 1.4 inches. Their increase in weight (1 pound, 9 ounces) is even more amazing. This weight increase exceeds that of the wild fish by 12 ounces.

Those hatchery fish returned showing lake growth were almost impossible to distinguish from wild fish showing lake growth (except by tag numbers). The body shape and color were identical. The only difference that the author could discover was the blunted leading edges of the fins of the hatchery-reared fish which were lacking in the wild fish.

#### Discussion

The data available indicate that the migratory rainbow trout should be managed to take advantage of the rapid growth in Lake Michigan. A 10-inch size limit and fly fishing only (the latter regulation to be in effect from May 15 to the end of the regular season) would protect the immature rainbows until they had spent at least one growing season in Lake Michigan.

The stocking of hatchery rainbow trout suggests that spring stockings in Lake Michigan may be able to supplement natural runs of wild fish in streams in close proximity to the point of release. Further study is necessary before this type of stocking could be put on a management basis.

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Table III

Returns from a planting of 500 hatchery rainbow trout  
made in Lake Michigan on October 26, 1953

Dates of recovery	Location of recovery				Total recoveries	
	Black River			Lake Michigan	Number	Per cent
	Dam trap	Angling	Total			
Fall, 1953 (October 26-November 14)	21✓	9✓	30	1✓	34	6.8
Spring, 1954 (April 10-June 30)	1	13	14	2✓	16	3.2
Fall, 1954 <sup>g</sup> (August 14-November 14)	0	3	3	1✓	4	0.8
Total	21	25	47	7	54	10.8

✓ One recovery made in the East Branch of the Black River with an A.C. shocker.

▽ Six released.

▽ Three recoveries from Gravel Island 3 miles east of Black River, 1 recovery near the town of Brevert, 12 miles away.

✓ One recovered at Beaver Island, one recovered off the mouth of the Boardman River

✓ All showed lake growth.

✓ Recovered in Lake Erie.



Table IV

Returns and growth of rainbow trout from a stocking of 500 in Lake Michigan on May 12, 1954

Dates of recovery	Recoveries from Black River				Average growth			Days out
	Dam trap	Angling	Total recoveries		Number <sup>✓</sup>	Increase in length (inches)	Increase <sup>✓</sup> in weight (ounces)	
			Number	Per cent				
May 12-31	6	8	14	54	12	-0.5	-1	9
September 6-October 30 <sup>✓</sup>	3	9	12	46	9	7.5	25 <sup>✓</sup>	144
Total	9	17	26	100	21	...	...	...

✓ On which lengths and weights were taken.

∇ All fish recorded here showed lake growth, except one on which data were lacking.

∇ One weight was dressed weight.

Table V

A comparison of the recoveries of wild and hatchery rainbow trout, Black River, 1951-1953

Type of fish	Season of recovery									
	First spring <sup>∇</sup>		First fall		Second spring		Second fall		Third spring	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Wild										
Age group IV <sup>∇</sup>	9	6.8	1	0.8	4	3.0	0	0	0	0
Age group II	25	3.8	30	4.5	42	6.5	5	0.8	9	1.4
Age group III	5	8.1	7	12.9	6	9.7	0	0	1	1.6
Total	39	4.6	38	4.5	52	6.2	5	0.6	10	1.2
Hatchery										
Spring, 1954	14	2.8	12	2.4	...	...	...	...	...	...

∇ Per cent of total tagged.

∇ On one, the time of recovery could not be determined and is not included.

Table VI

Comparison of growth of wild and hatchery rainbow trout

Type of growth and growth history	Season of recovery									
	First spring		First fall		Second spring		Second fall		Third spring	
	Wild*	Hatch- <sup>+</sup> ery	Wild	Hatch- ery	Wild	Hatch- ery	Wild	Hatch- ery	Wild	Hatch- ery
<u>Lake growth</u>										
Number	1	0	15	9	21	...	0	...	8	...
Average increase in length (in.)	3.9	0	6.1	7.5	6.6	...	0	...	12.0	...
Average increase in weight (oz.)	1	0	13	25	14	...	0	...	33	...
Average days out	105	0	140	144	333	...	0	...	702	...
<u>No lake growth</u>										
Number	16	12	4	0	7	...	0	...	0	...
Average increase in length (in.)	0.4	-0.5	1.6	0	1.6	...	0	...	0	...
Average increase in weight (oz.)	0	-1	1	0	2	...	0	...	0	...
Average days out	26	9	102	0	321	...	0	...	0	...

\* Age-group-II parr, 1951-53.

+ 1954 stocking.

Literature Cited

Stauffer, Thomas H. 1954. Creel Census on the Black River, Mackinac County in 1953 and a Comparison With Previous Years.  
(Unpublished.) Institute for Fisheries Research Report  
Number 1431.

Date 6/18

Name Bea

### WHILE YOU WERE OUT

Name Wally Beard

~~Called to see~~ Telephoned you at 1 o'clock. Will ~~Come in~~ Telephone again at 1 o'clock

Wants you to phone. Telephone Number is \_\_\_\_\_

Remarks Wally Today is still working on IFR repair 1441; will take good care of it & return it when he's through with it.

Signed Wally