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FURTHER RESULTS FROM THE PLANTINGS OF LEGAL-SIZED, HATCHERY-REARED TROUT IN STREAMS AND LAKES OF MICHIGAN

by

David S. Shetter

Previous experiments described by Shetter and Hazzard (1941, 1942) demonstrated that, in the majority of Michigan trout streams, from two to six times as many hatchery-bred trout were caught from spring plantings as were caught from plantings made in the fall of the year. This conclusion is consistent with the results of other investigations in Michigan (Smith, 1941), and Massachusetts (Nesbit and Kitson, 1937). In lakes where suitable thermal and chemical conditions for trout exist, we found that legal-sized rainbow trout might be planted in the fall of the year with the expectancy that from 20 to 70 per cent would be recovered by anglers in succeeding seasons.

This report will present additional information on the success of planting adult hatchery-reared trout at different seasons in Michigan streams and lakes from data gathered chiefly during the 1942 trout season. Information available on the percentage of marked plantings surviving to the second and third season after release is included, as well as data on the relative merits of "spot" and "boat" planting.

Six streams located in all sections of Michigan were planted with jaw-tagged trout. In the lakes studied, where trout were already present, the plantings were fin-clipped to make the hatchery fish recognizable from those fish already present. In lakes which were planted with trout for the first time, such a procedure was not necessary. Data on the recoveries of marked fish obtained from the streams were furnished voluntarily by co-operative anglers and through the efforts of members of the Fish Division and Field Administration Division. The data on the lakes involved were obtained either through complete creel censuses or censuses limited to the opening weekend or opening day of the trout season.

The experiments could not have been physically carried out without the assistance of numerous individuals. The author wishes to thank the following members of the Conservation Department for their cooperation and interest during the course of the work:

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H. L. Peterson, Supervisor at Grayling Hatchery

Florin Warren, Supervisor at Watersmeet Hatchery

Paul Eschmeyer, District Biologist at the Watersmeet Hatchery.

The author is also indebted to other members of the Institute staff for certain of the creel census data from the trout lakes censused in the season of 1942.

Results from Stream Plantings (Table 1)

Brook Trout

Five hundred (500) jaw-tagged brook trout were released in the fall of 1941, and a similar number in the spring of 1942, in the West Branch of the Sturgeon River just south of the town of Wolverine (Cheboygan County). Of the fall planting, 4 (or 0.8 per cent) were later reported, and of the spring planting, 18 (or 3.6 per cent) were reported as captured by angling. Compared with previous brook trout experiments, this planting was almost a failure, for which no definite reasons can be given. It is possible that there was much lighter angling pressure on this stream in 1942 than in previous seasons, and this may have been an influencing factor.

On the Middle Branch of the Ontonagon River, 150 legal-sized brook trout were tagged and released at each season. Twelve returns, or a recovery of 8.0 per cent, were reported in the 1942 fishing from the 1941 fall planting, while 17 (or 11.3 per cent) were returned from the 1942 spring planting.

For the two streams combined, an average recovery of 2.5 per cent was made on the 1941 fall plantings, and 5.4 per cent on the spring plantings from a release of 650 fish at each season.

Rainbow Trout

Two trout streams in the extreme southern part of the state were included in the experiments of 1941-42, since it seemed possible that the over-the-winter mortality of adult fish might be non-existent, or much lower, than that previously noted in streams farther north where the winters are more severe. Accordingly, fall and spring plantings of legal-sized rainbow trout and brown trout were made in Portage Creek (Kalamazoo County) and Dowagiac Creek (Cass County).

TABLE 1. RESULTS FROM FALL AND SPRING (PRE-SEASON) PLANTINGS OF TAGGED TROUT OF LEGAL SIZE IN STREAMS BASED ON FISH REPORTED DURING THE 1942 TROUT SEASON

Stream	Brook Trout						Rainbow Trout						Brown Trout					
	Number planted		Number recovered		Per cent recovery		Number planted		Number recovered		Per cent recovery		Number planted		Number recovered		Per cent recovery	
	'41 Fall	'42 Spring	'41 Fall	'42 Spring	'41 Fall	'42 Spring	'41 Fall	'42 Spring	'41 Fall	'42 Spring	'41 Fall	'42 Spring	'41 Fall	'42 Spring	'41 Fall	'42 Spring	'41 Fall	'42 Spring
Portage Creek	...	...	...	...	...	...	100	100	2	17	2.0	17.0	25	25	...	3	0.0	12.0
Dowagiac Creek	...	...	...	...	...	...	250	250	3	28	1.2	11.2	50	50	...	2	0.0	4.0
Baldwin Creek	...	...	...	...	...	...	250	250	14	28	5.6	11.2	250	250	18	16	7.2	6.4
Main Au Sable	...	...	...	...	...	...	250	250	23	51	9.2	20.4	250	250	18	32	7.2	12.8
West Branch Sturgeon	500	500	4	18	0.8	3.6	...	...	...	...	...	...	...	...	...	...	...	...
Middle Branch Ontonagon	150	150	12	17	8.0	11.3	150	150	3	11	2.0	7.3	...	...	...	...	...	...
Totals, weighted averages	650	650	16	35	2.5	5.4	1,000	1,000	45	135	4.5	13.5	575	575	36	53	6.3	9.2

In Portage Creek the results from planting 100 tagged rainbow trout at both seasons of the year were as follows: percentage of recovery by anglers on spring-planted fish, 17.0 per cent; on fall-planted fish, 2.0 per cent.

In Dowagiac Creek 250 tagged rainbow trout were planted in the fall of 1941, and a like number in the spring of 1942; during the 1942 trout season three, or 1.2 per cent, were recovered from the 1941 fall planting, and 28 (or 11.2 per cent) were reported as recaptured from the 1942 spring planting.

From similar plantings of 250 tagged rainbow trout in the spring and in the fall in Baldwin Creek (Lake County), twice as many were recovered from the spring planting as from the fall planting during the 1942 trout season (14 [5.6 per cent] from the fall planting, 28 [11.2 per cent] from the spring planting).

Plantings of 250 tagged rainbow trout released both in the spring and the fall in the Main Au Sable River (Crawford County) just below Grayling yielded the following results during the 1942 trout season: from the fall planting of 1941, 23 recoveries (or 9.2 per cent); from the spring planting of 1942, 51 recoveries (or 20.4 per cent).

In the Middle Branch of the Ontonagon River (Gogebic County) 150 tagged rainbow trout were planted at each season. Three recaptures (2.0 per cent) were reported during the 1942 season from the fall planting of 1941, and 11 recoveries from the spring planting of 1942 were captured by 1942 anglers on the Middle Branch (7.3 per cent).

The combined results from the five streams were as follows: 1,000 tagged rainbow trout were planted at each season; 4.5 per cent of the fall planting of 1941 were recovered during the 1942 season, and 13.5 per cent of the spring planting (or three times as many) were recovered during 1942.

Brown Trout

Experiments involving the planting of tagged, legal-sized, hatchery-bred brown trout were conducted on four streams. In the two southernmost streams (Portage Creek and Dowagiac Creek), no recoveries were reported during the 1942 season from the fall plantings of 1941 (25 brown trout planted in each stream). Similar plantings in the spring of 1942 yielded 12.0 and 4.0 per cent respectively to the 1942 anglers reporting on those streams.

In Baldwin Creek 250 tagged brown trout were planted at each season. During 1942 more fall-planted fish were reported than spring-planted fish for the first time in the writer's experience (18 [or 7.2 per cent] from the 1941 fall planting; 16 [or 6.4 per cent] from the spring planting).

Two hundred and fifty tagged brown trout were planted in the Main Au Sable just below the town of Grayling in the fall of 1941 and again in the spring of 1942. During 1942, 18 (or 7.2 per cent) of the fall-planted fish were reported as recaptured, while 32 (or 12.8 per cent) of the spring release of 1942 were recovered.

The combined results of the experiments with brown trout of legal size were as follows: fall plantings of 1941, 36 of 575 fish were recovered, or 6.3 per cent; spring plantings of 1942, 53 of 575 fish were later recaptured, or 9.2 per cent.

"Carry-over" or Survival of Hatchery-reared Trout Through One or More Seasons

A summarization of the results of all of these recent plantings of marked legal-sized hatchery-reared trout is presented in Table 2. Data from the West Branch of the Sturgeon River have not been included as no recoveries of tagged fish other than the few obtained during the 1942 trout season (the first season of availability) have been received. Information from Kinne Creek (a private trout stream on the Wingleton Club in Lake County) has been included.

Table 2. A COMPARISON OF THE RESULTS FROM SPRING AND FALL PLANTINGS OF BROOK, BROWN AND RAINBOW TROUT BY SPOT RELEASES AND SCATTER PLANTINGS. (Figures in parentheses indicate percentages of recovery)

Stream	Species and season when first available	Number planted				Number recovered first season				Number recovered second season				Number recovered third season			
		Spring		Fall		Spring		Fall		Spring		Fall		Spring		Fall	
		Boat	Spot	Boat	Spot	Boat	Spot	Boat	Spot	Boat	Spot	Boat	Spot	Boat	Spot	Boat	Spot
Main Au Sable	Rainbow '41	250	249	239	232	52 (20.8)	46 (18.5)	20 (8.3)	31 (13.3)	1 (0.4)	2 (0.8)	1 (0.4)	... (0.0)	... (0.0)	... (0.0)	... (0.0)	... (0.0)
	Rainbow '42	125	125	125	125	32 (25.6)	19 (15.2)	16 (12.8)	7 (5.6)	1 (0.8)	... (0.0)	... (0.0)	... (0.0)	... ...	... ...	... ...	... ...
	Brown '41	250	250	250	250	34 (13.6)	42 (16.8)	19 (7.6)	21 (8.4)	1 (0.4)	1 (0.4)	1 (0.4)	... (0.0)	... (0.0)	... (0.0)	... (0.0)	2 (0.8)
	Brown '42	125	125	125	125	16 (12.8)	16 (12.8)	8 (6.4)	10 (8.0)	... (0.0)	1 (0.8)	... (0.0)	2 (1.6)	... ...	... ...	... ...	... ...
Baldwin Creek	Rainbow '41	250	250	249	249	25 (10.0)	26 (10.4)	21 (8.4)	17 (6.8)	2 (0.8)	... (0.0)	1 (0.4)	... (0.0)	... (0.0)	... (0.0)	... (0.0)	... (0.0)
	Rainbow '42	125	125	125	125	15 (12.0)	13 (10.4)	6 (4.8)	8 (6.4)	1 (0.8)	... (0.0)	... (0.0)	... (0.0)	... ...	... ...	... ...	... ...
	Brown '41	250	198	250	250	22 (8.8)	32 (16.2)	11 (4.4)	20 (8.0)	3 (1.2)	... (0.0)	1 (0.4)	... (0.0)	... (0.0)	... (0.0)	... (0.0)	... (0.0)
	Brown '42	125	125	125	125	3 (2.4)	13 (10.4)	8 (6.4)	10 (8.0)	... (0.0)	1 (0.8)	... (0.0)	... (0.0)	... ...	... ...	... ...	... ...
Dowagiac Creek	Rainbow '42	125	125	125	125	10 (8.0)	18 (14.4)	3 (2.4)	... (0.0)	1 (0.8)	... (0.0)	... (0.0)	... (0.0)	... ...	... ...	... ...	... ...
	Brown '42	25	25	25	25	2 (8.0)	... (0.0)	... (0.0)	... (0.0)	... (0.0)	1 (4.0)	... (0.0)	... (0.0)	... ...	... ...	... ...	... ...
Middle Branch Ontonagon	Rainbow '42	75	75	75	75	8 (10.7)	3 (4.0)	2 (2.7)	1 (1.3)	... (0.0)	... (0.0)	... (0.0)	... (0.0)	... ...	... ...	... ...	... ...
	Brook '42	75	75	75	75	6 (8.0)	11 (14.7)	6 (8.0)	6 (8.0)	... (0.0)	... (0.0)	... (0.0)	... (0.0)	... ...	... ...	... ...	... ...
Kinne Creek	Brown '39	994	...	...	...	98 (9.6)	... ...	... ...	... ...	10 (1.0)	... ...	... ...	... ...	1 (0.1)	... ...	... ...	... ...
	Brown '41	201	...	...	...	56 (27.8)	... ...	... ...	... ...	5 (2.5)	... ...	... ...	... ...	... ...	... ...	... ...	... ...
	Rainbow '40	250	...	...	...	85 (34.0)	... ...	... ...	... ...	1 (0.4)	... ...	... ...	... ...	... ...	... ...	... ...	... ...
	Rainbow '41	203	...	...	...	77 (37.9)	... ...	... ...	... ...	5 (2.5)	... ...	... ...	... ...	... ...	... ...	... ...	... ...
	Brook '41	100	...	...	...	23 (23.0)	... ...	... ...	... ...	2 (2.0)	... ...	... ...	... ...	1 (1.0)	... ...	... ...	... ...
Totals by species	Rainbow	1403	949	938	931	304 (21.7)	125 (13.2)	68 (7.2)	64 (6.9)	12 (0.8)	2 (0.1)	2 (0.1)	... ...	... ...	... ...	... ...	... ...
	Brown	1970	723	950	950	231 (11.7)	103 (14.2)	46 (4.8)	61 (6.4)	19 (1.0)	4 (0.5)	2 (0.2)	2 (0.2)	1 (0.05)	... ...	... ...	2 (0.2)
	Brook	175	75	75	75	29 (16.6)	11 (14.7)	6 (8.0)	6 (8.0)	2 (1.1)	... ...	... ...	... ...	1 (0.5)	... ...	... ...	... ...
Grand Total	All	3548	1747	1963	1956	564 (15.9)	239 (13.68)	120 (6.1)	131 (6.7)	33 (0.9)	6 (0.3)	4 (0.2)	2 (0.1)	2 (0.1)	... ...	... ...	2 (0.1)

Study of the table indicates that, as might be expected, the largest percentage of the planted fish is recovered during the first season of availability no matter what time of the year they are released. The data from Kinne Creek probably represent the maximum "carry-over" which could be secured. The members of the Wingleton Club are required by their own rules to record each day's catch in a book kept in the ice-house. The stream has been quite efficiently blocked near its confluence with the Pere Marquette River by a self-cleaning rotary screen which keeps all fish planted in Kinne Creek in the stream until removed by club anglers or by natural death. Here significant percentages of recovery in the second season after planting have been noted--from 0.4 per cent of a planting of 250 rainbow trout to 2.5 per cent of a planting of 203 rainbow trout; also 2.5 per cent of a release of 201 brown trout and 2.0 per cent from a planting of 100 brook trout. These percentages of recovery during the second season after planting are for the most part higher than found in the experiments conducted on public waters where the percentages of recovery during the second season after planting have varied between 0.0 and 1.6 per cent (the 4.0 per cent recovery on the 1942 planting of brown trout taken in Dowagiac Creek in 1943 is not considered as representative since only 25 fish were available and only one recovered). This lower percentage of recovery during the second season after planting on public waters is probably due in part to more intensive angling and to the failure of an unknown number of anglers catching tagged trout outside of census areas to report them.

Apparently very few hatchery-reared trout survive to reach the third open season after planting. Of marked hatchery fish planted since the spring of 1939 (approximately 10,000) we have records of only five recoveries which were taken during the third season after release. Three of these

were brown trout and two were brook trout. Two of the brown trout originated from a fall planting in 1940 in the Main Au Sable River, and the other came from a spring planting in Kinne Creek in 1939. Both of the brook trout originated from spring plantings, one from a release in Kinne Creek in 1941, the other from a planting in the Pine River in 1939 (not shown on Table 2). It would appear, from the data at hand, that in general there is more chance for season-to-season survival of spring- or summer-planted trout than for trout placed in the streams in the fall of the year, although the percentage of survival will vary with the species of trout, and from stream to stream.

Comparison of Results of "Spot" Plantings and "Boat" (or Scatter) Planting

At each season of planting approximately one-half of each species of trout involved was released at a single spot, while the other half was distributed by boat drifting above and below the locality of the spot planting. In other words, the fish released from the boat were scattered over from 1 to 3 miles of stream both above and below the locality of the spot planting.

The sorting of the recoveries as to whether they came from "spot" plantings or "boat" plantings yielded no conclusive information. On some streams, and in some seasons, and for certain species, higher percentages of recovery were noted for "boat" plantings. The reverse was also true (Table 3).

Theoretically, the fish distributed by boat should have been somewhat more difficult to recover since they were spread over a much greater stream area originally than were the "spot"-planted fish. It is logical to suppose that a small number of anglers could remove a large number of hatchery trout that were planted by the "spot" method if the fish chose to remain schooled up at the point of planting. However, the 1942 data indicate a

TABLE 3. COMPARISON OF RESULTS FROM "SPOT" PLANTINGS AND "SCATTER" PLANTINGS OF LEGAL TROUT, 1942 TROUT SEASON

(Figures in parentheses show number of anglers reporting indicated numbers of fish)

	Number of recaptures reported from Spring Release						Number of recaptures reported from Fall Release					
	Rainbow Trout		Brown Trout		Brook Trout		Rainbow Trout		Brown Trout		Brook Trout	
Stream	Boat	Spot	Boat	Spot	Boat	Spot	Boat	Spot	Boat	Spot	Boat	Spot
Main Au Sable	32 (24)	19 (17)	16 (9)	16 (13)	...	...	16 (14)	7 (5)	8 (6)	10 (8)	...	...
Baldwin Creek	15 (13)	13 (13)	3 (3)	13 (9)	...	...	6 (6)	8 (7)	8 (6)	10 (8)	...	...
Dowagiac	10 (9)	18 (14)	2 (2)	*/..	...	...	3 (2)	*/...	*/...	*/...	...	...
Portage Creek	...	17 (13)	...	3 (3)	...	...	...	2 (2)	...	*/...	...	...
West Branch Sturgeon	...	...	...	...	9 (8)	9 (9)	...	...	...	...	1 (1)	3 (3)
Middle Branch Ontonagon	8 (8)	3 (3)	...	...	6 (6)	11 (6)	2 (2)	1 (1)	...	...	6 (6)	6 (6)
Totals, averages	65 (54)	70 (60)	21 (14)	32 (25)	15 (14)	20 (15)	27 (24)	18 (15)	16 (11)	20 (16)	7 (7)	9 (9)
Total planted	450	550	275	300	325	325	450	550	275	300	325	325
Percentage recovered	14.4	12.7	7.0	10.7	4.6	6.1	6.0	3.2	5.8	6.6	2.1	2.8
Marked fish caught per angler reporting	1.4	1.1	1.5	1.3	1.1	1.3	1.1	1.2	1.1	1.3	1.0	1.01

*/No fish caught from plantings. Other blanks indicate no plantings.

higher catch per angler reporting recoveries from spring plantings of "boat" planted rainbow and brown trout, but a lower catch per angler reporting recoveries from "boat"-planted brook trout. From the fall releases of 1941, "boat"-planted brown and rainbow trout yielded fewer fish per angler reporting than did "spot" planting, and the yield per angler reporting marked brook trout was the same for the "spot" and the "boat" methods.

One phase of the problem of planting adult trout in streams which has not received a thorough test is a comparison of the results between "spot" and "boat" plantings made during the open trout season. It would be desirable for the hatchery supervisors to know how widely over a stream the stock must be dispersed during the open season so that the maximum number of fishermen might be benefited, rather than having a small number of anglers take more than their share of fish from any one release. Experiments on this problem will be conducted as soon as personnel is available.

Results From Plantings in Trout Lakes

The results from experimental plantings of adult hatchery-reared brook trout in the fall of 1941 in lakes found suitable for the species amplify the findings of Shetter and Hazzard (1942) with regard to rainbow trout of legal size when planted in lakes in the fall. A tabular summary of the lakes on which accurate creel census data (taken during the 1942 trout season) are available is presented in Table 4. Information from six fall plantings indicate that in lakes where conditions are favorable for brook trout, in the season following the fall of release anywhere from 13.9 per cent to 88.1 per cent may be expected to be recovered by the anglers (average survival 56.3 per cent). Individual weights and lengths of fish caught and observations of the census takers showed that these trout had made considerable growth over winter and that they were generally in good condition.

TABLE 4. RECOVERY OF PRECEDING FALL PLANTINGS OF LEGAL-SIZED BROOK TROUT IN MICHIGAN LAKES DURING THE TROUT SEASON OF 1942

(Data for East Fish Lake include 1941 season also)

Lake	Species	Number planted	Number recovered	Percentage of recovery	Total trout opening day	Percentage of total recovery on opening day
South Twin Lake[1]	Brook	590	427	72.3	340	79.6
North Twin Lake[1]	Brook	456	402	88.1	368	91.5
Holland Lake[2]	Brook	200	136	68.0	129	...
Kimes Lake[3]	Brook	1,000	422	42.2	422	...
East Fish Lake '41	Brook	243	34	13.9	32	94.1
East Fish Lake '42	Brook	250	133	53.5	123	92.4

[1] To July 1.

[2] Creel census for first two days of 1942

[3] Creel census records for opening day, 1942, only.

The data obtained in previous years concerning rainbow trout plantings in lakes and the results from brook trout plantings in lakes discussed above demonstrate that a very high percentage of adult fish planted in trout lakes in the fall of the year are available to and are taken by anglers in the season following release. The one unfavorable result of such a planting program has been that from 80 to 94 per cent of the total trout catch for the whole season on lakes where adult brook trout were stocked in the fall of 1941 were taken on the opening day (the average for the lakes on which complete creel censuses were operated was 89.4 recovery on the opening day). Results of a comparable nature were noted in the Pigeon River Forest lakes which were stocked with legal-sized rainbow trout (see Report No. 620). As far as these small "made" trout lakes are concerned, a small percentage of the total anglers using these lakes takes much more than their share of the fish planted in them.

Conclusions

In general, the following conclusions seem warranted concerning the planting of trout seven inches or larger and have been rather definitely proven by repeated experiments:

1. When planting trout in streams, significantly more fish will be available to the anglers from fish released in the spring of the year than from a similar number of fish planted in the fall of the year. This conclusion appears to hold even for trout streams in the southwestern part of the state where winter conditions are not as severe as in the more northerly regions, as demonstrated by the results obtained in the experiments on Dowagiac and Portage Creeks.

As suggested by limited earlier experiments with brown trout, this species appears to survive better over winter than do brook or rainbow trout but, except in one instance, spring plantings of this species also gave appreciably better returns to the angler.

Editorial Comment

The reason for better returns from spring and open season plantings has not yet been definitely determined but since good results come from fall planting in lakes, it must be concluded that the environment in streams is not as favorable for trout in winter as in lakes. It might be inferred that if streams contained more deep, quiet pools (approaching lake conditions) survival would be better. Cannibalism evidently is not a factor since most of these lakes contained at least some large trout when these experimental plantings were made. Predation by merganser ducks is known to account for some losses in streams. Competition from trout already occupying the better pools in the streams may also be an important factor. Creel censuses on the Pine River as well as on other northern Michigan streams have demonstrated large populations of wild trout. Since few trout are left in most small lakes by fall, it is likely that competition for food and shelter is not as keen there as in streams at the time plantings are made. This may explain the more favorable returns from fall plantings now being reported by workers in New York and Pennsylvania.--A.S.H.

2. As far as can be determined from the data at hand, neither "spot" nor "boat" planting has demonstrated any great superiority over the other in plantings made in the fall or in the spring before the season opens. The relative merits of the two methods should be tested on plantings of "keeper" trout in streams during the open season.

3. As shown earlier for rainbow trout, creel census records from lakes stocked with legal-sized brook trout demonstrate that high percentages of fall planted fish survive the winter and are taken by the anglers in the following season. The worst feature of such a management program is that an average of about 90 per cent of the total catch for the season on brook trout lakes is removed by a very small percentage of the total number of anglers who use the lake. Some thought should be given to correcting this situation, whether it be by lowering the creel limit, or by other special regulations for such waters, or by other means.

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