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RESULTS OF INVESTIGATIONS DURING 1947 ON THE RELATIVE EFFICIENCY
OF THE "SPOT" AND "BOAT" (OR SCATTER) METHOD OF PLANTING
LEGAL-SIZED TROUT DURING THE OPEN SEASON

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Previous research, involving spring and fall plantings of legal-sized trout in Michigan streams demonstrated there was a negligible difference in efficiency between "spot" and "boat"[↓] planting, with regard to the ultimate number of anglers benefited by either method. If the data on all three species of trout planted by both methods are combined it is found that 82 anglers recovered 101 boat-planted trout from 1,050 jaw-tagged fish released, a recovery percentage of 9.6, and a catch per angler of 1.2. From 1,175 spot-planted trout 100 anglers recaptured 122 tagged fish, a recovery percentage of 10.3, and a catch per angler of 1.2. A similar combination of the data for fall plantings by the

↓ "Spot" planting is the release of relatively large numbers of trout within 1/4 mile or less of a planting site. "Boat" or "scatter" planting involves the release of one or two fish from a drifting boat or from pails carried along the bank.

two methods indicates that 45 anglers caught 50 of the 1,050 boat-planted trout for a recovery percentage of 4.7, and a catch per angler of 1.1, while 40 fishermen reported taking 47 of 1,175 spot-planted tagged legal trout at the rate of 1.2 fish per angler and a recovery of 4.0 percent (Shetter, 1947).

However, the relative efficiency of the two methods of planting during the open season had not been tested previously. Therefore a series of planting experiments was conducted during the 1947 trout season involving legal-sized brook, brown and rainbow trout to determine, if possible, which method of release produced the best distribution of the artificially-bred stock among the fishing public.

Briefly, the design of the experiment was as follows: Jaw-tagged trout in varying numbers (depending on the size of the stream) were planted at several intervals during the 1947 season in several streams. One-half of each lot was released at a bridgehead, camp site, or fishing site in the more or less standard procedure in common use by the planting crews. The remainder were stocked from a planting boat or from pails carried along the banks from 3/4 mile to 2 miles above and below the spot planting site.

The streams chosen for experimental plantings of tagged brook trout were the Middle Branch of the Ontonagon River (Gogebic County) and Slagle Creek (Wexford County). Tagged brown trout were released in Thompson Creek (Schoolcraft County), the Main Au Sable (Crawford County), and Gamble Creek and Rifle River (Ogemaw County). Tagged rainbow trout were planted in the Sturgeon River (Cheboygan County) and also in the Main Au Sable River (Crawford County). The experimental fish were placed in

portions of these streams relatively close to hatcheries where District Biologists were able to carry on the periodic tagging of the trout and to take part in the planting operations with the assistance of the various hatchery crews, or in the case of the Rifle River and Gamble Creek, to receive aid from personnel of the Rifle River Area.

Recovery data were obtained by two methods. One was by advertising the experiment through numerous posters along the stream banks requesting reports on tagged fish and other fish caught along with the pertinent creel census data. The other method was through direct contacts with anglers by district biologists, other Fish Division personnel or conservation officers.

More concise data might have been assembled had it been possible to operate intensive creel censuses on the experimental portions of the streams mentioned above. Complete recovery data are available only for the Gamble Creek and Rifle River experiments involving brown trout since all fish taken on the Rifle River Area are examined at the checking station. The creel census records and the lists of tags reported from the other streams are incomplete because none of the district fisheries biologists could devote more than a small portion of his time to creel census work.

The fact that all reports on recaptures of tagged trout were not sent in or observed (except on the Rifle River Area) makes interpretation of the data difficult, since the total number of recoveries and the total number of anglers making those recoveries are necessary to fully evaluate the efficiency of either method of planting. It is not known whether the data obtained were random in nature with regard to anglers fishing over

both spot and boat plantings.^{2/} If the records were unwittingly taken from one group more than the other, the resulting calculations could be biased. The 1947 results are summarized with these objections in mind.

Criteria which are of importance in judging the efficiency of the two methods of planting are the percentage of recovery obtained and the number of individuals benefiting from both types of release in a given stream. The method of release of trout of legal size which yields a high rate of recovery well distributed among the anglers is to be desired. Perhaps the best index figure for comparing one method with the other is found by dividing the number of individual anglers making recoveries from a given method of planting by the number of fish planted by that method. The resulting figure (multiplied by 100) indicates how many anglers would benefit by the planting of 100 fish under the percentage of recovery obtained in that experiment. Table 1 presents the data from which index figures of this type were obtained for the spot and boat plantings, and the data are summarized by stream, by species, and for all species combined.

Results with brook trout

Tagged hatchery brook trout of legal size were released in the Middle Branch of the Ontonagon River and Slagle Creek. In the Middle Branch

^{2/} Under ideal experimental conditions, all anglers would fish over the entire portion of water covered by the spot and boat plantings. Because of stream access conditions, anglers' personal likes and dislikes concerning stream sections, and planting site choices by the district biologists, these ideal conditions were not met.

Table 1.--A comparison of the results from spot and boat (or scatter) planting on seven Michigan trout streams during the 1947 trout season. All averages are weighted averages.

Stream and species	Scatter or boat planting				Spot planting			
	Number of tagged trout released	Number of recoveries (and percent of recovery)	Number of anglers (and catch per angler)	Anglers sharing in recoveries from 100 fish planted	Number of tagged trout released	Number of recoveries (and percent of recovery)	Number of anglers (and catch per angler)	Anglers sharing in recoveries from 100 fish planted
Middle Br. Ontonagon - brook (Gogebie)	400	78(19.5)	32(2.43)	8.0	400	109(27.2)	47(2.34)	11.6
Slagle Creek ¹ - brook (Wexford)	200	24(12.0)	20(1.20)	10.0	200	50(25.0)	13(3.84)	6.5
Totals, averages for brook trout	600	102(17.0)	52(1.96)	8.7	600	159(26.5)	60(2.65)	10.0
Thompson Creek - brown (Schoolcraft)	193	20(10.4)	6(3.33)	3.1	200	21(10.5)	11(1.89)	5.6
Main Au Sable - brown (Crawford)	150	2(1.3)	2(1.00)	1.3	150	7(4.7)	4(1.75)	2.7
Gamble Creek - brown (Ogemaw)	150	1(0.7)	1(1.00)	0.7	150	3(2.0)	2(1.50)	1.3
Rifle River - brown (Ogemaw)	300	44(14.7)	36(1.21)	12.0	300	47(15.7)	27(1.74)	9.0
Totals, averages for brown trout	793	67(8.4)	45(1.48)	5.7	800	78(9.7)	44(1.77)	5.5
Main Au Sable - rainbow (Crawford)	150	5(3.3)	5(1.00)	3.3	150	4(2.7)	4(1.00)	2.7
Sturgeon River - rainbow (Cheboygan)	391	88(22.5)	32(2.75)	8.2	407	103(25.3)	42(2.45)	10.3
Totals, averages for rainbow trout	541	93(17.2)	37(2.51)	6.9	557	107(19.2)	46(2.32)	8.3
Totals, averages for all species	1,934	262(13.5)	134(1.95)	6.9	1,957	344(17.6)	150(2.29)	7.7

¹ Actual creel census data indicate 11 known individuals took 15 scatter-planted brook trout and 11 known individuals took 48 spot-planted trout. Further study of the data suggests that it is likely that the remainder were single recoveries made by individual anglers.

experiment 400 were planted by the spot method in the vicinity of the old Ontonagon Rearing Station and 400 were released one mile above and below the spot stocking point from a floating live crate. Random creel census and anglers' volunteer reports show that 78 (19.5 percent return) recoveries were obtained from the boat plantings by 32 individuals, and 109 tag recoveries (27.2 percent of the plantings) were reported from the spot releases by 47 individuals. The catch per angler from boat plantings thus was 2.43 fish, while the catch per angler from the spot releases was 2.34 tagged fish. In this stream spot releases were 31.1 percent more efficient than were boat plantings, since only 8.0 anglers made recoveries from 100 fish planted by boat as compared with 11.6 anglers making recoveries from 100 fish planted by the spot method.

The opposite results were obtained in the Slagle Creek experiment, where the planting rate was halved (to 100 fish monthly) because of the small size of the stream. More anglers reported catching tagged trout from the scatter plantings even though twice as many spot-planted trout were recovered. From the season's total of 200 tagged trout planted by the scatter method over approximately 1-1/2 miles of Slagle Creek immediately below the Harrietta Hatchery, 24 tagged fish (12.0 percent recovery) were reported by 20 individuals, or an average catch per angler of 1.20 tagged fish. The 200 spot-planted brook trout yielded a recovery of 50 tagged fish (25.0 percent recovery) to 13 individuals, or 3.84 tagged fish per angler. On this stream, one individual accounted for 29 of the tag recoveries from the spot plantings. The scatter plantings were 35 percent more efficient in distributing the fish among the anglers on Slagle Creek, as 10.0 fishermen were able to share in the recoveries from 100 fish planted by the scatter method, whereas only 6.5 anglers captured recoveries from plantings of 100 fish by the spot method of release.

Combining the results from the two brook trout experiments there were records for 52 individual anglers who caught 102 tagged brook trout from 600 fish planted by the boat or scatter method, a recovery of 17.0 percent, and an average catch per angler of 1.96 scatter-planted fish. From 600 spot-planted fish 60 individuals reported the capture of 159 tagged fish (26.5 percent recovery), or an average catch per angler of 2.65 fish. For all brook trout combined spot planting was 13.0 percent more efficient than scatter or boat planting in distributing the fish among the anglers, since the average number of anglers benefited per 100 boat-planted fish was 8.7, whereas the average number of anglers sharing in the recoveries from 100 spot-planted fish was 10.0.

Results with brown trout

Jaw-tagged brown trout were released in four streams in varying numbers, depending on the size of the stream.

On Thompson Creek, six different anglers reported the recovery of 20 tagged fish from a total scatter release of 193 brown trout, or a catch per angler of 3.33 brown trout (10.4 percent recovery), while 11 individuals reported recapture of 21 tagged brown trout from a total of 200 spot-planted fish, or 1.89 fish per fisherman (10.5 percent recovery). On the basis of the available data, spot planting was 44.6 percent more efficient, as 5.6 anglers shared in the recoveries from 100 spot-planted brown trout as compared with 3.1 anglers removing the recaptures from 100 scatter-planted brown trout.

On the Main Au Sable River the planting of 150 tagged brown trout by boat resulted in the report of recovery of only two tagged fish by two anglers. Release of a like number of tagged brown trout at the "Pull-over" by the spot method provided seven tagged fish for four

different anglers, or 1.75 fish per fisherman. Much higher returns might have been expected from this heavily fished water for both types of planting, since previous tagging experiments in this same water have yielded percentages of recovery on a similar voluntary report basis varying from 12.8 to 15.2 percent for spring plantings of 250 and 500 fish (Shetter, 1947).

The Gamble Creek experiment, where 150 tagged brown trout were planted by the spot method at the Lodge Trail Bridge, and 150 fish scattered from pails approximately 1/2 mile above and below the bridge, yielded the following results: one angler captured one of the scatter-planted tagged fish (0.7 percent recovery) and two other anglers caught three of the spot-planted brown trout (2.0 percent recovery, 1.50 fish per angler). Two of the recoveries, one from a spot planting, one from a scatter planting, were made in a tributary, Fontinalis Creek.

Spot planting was more efficient than scatter planting on Thompson Creek, the Main Au Sable, and on Gamble Creek as can be determined by comparing the numbers of anglers sharing in the recoveries from 100 fish planted by the two methods by margins varying from about 44 to 50 percent. However, the number of recoveries from the Main Au Sable and Gamble Creek were too few to make a good comparison between the two methods of planting brown trout in these streams.

On the Rifle River 300 tagged brown trout were released by spot planting about midway between the Ranch Bridge and the south boundary, and 300 tagged brown trout were stocked at intervals from pails carried on foot approximately two miles above and below the spot planting site. From the scatter release, 36 individuals caught 44 tagged fish, a recovery of 14.7 percent, at the rate of 1.21 tagged fish per angler. Recaptures from the spot plantings were made by 27 different anglers who

caught 47 of the spot-planted trout (15.7 percent recovery) at the rate of 1.74 tagged fish per angler. On this stream, scatter planting was 25 percent more efficient in parceling the hatchery product among the license holders, as 12.0 anglers captured the recoveries from 100 boat-planted fish while only 9.0 fishermen took tagged brown trout from 100 spot-planted brown trout.

The combined data from all brown trout experiments suggest that boat planting was slightly more efficient for this species, as 3.6 percent more anglers were benefited per 100 fish stocked by the boat or scatter method (5.7 anglers shared in the recoveries from 100 boat-planted fish as compared with 5.5 anglers who shared in recaptures from 100 spot-planted fish).

Results with rainbow trout

Experimental plantings similar to those already described were carried out with rainbow trout in the Main Au Sable River in the vicinity of the Pull-over and in the Sturgeon River south of the town of Indian River. On the Main Au Sable River five anglers took five of the boat-planted fish (3.3 percent recovery), and 4 anglers captured four of the tagged rainbow trout from spot plantings (2.7 percent recovery). Boat planting, on the basis of the limited number of recaptures available, was 18.2 percent more effective at distributing these fish than was the spot planting.

A total of 391 tagged rainbow trout were planted in the Sturgeon River by the scatter method, and a minimum of 32 different anglers recaptured 88 of the fish planted in this manner (22.5 percent recovery), or 2.75 tagged fish per angler. From 407 tagged rainbow trout released by the spot method, a minimum of 42 individuals reported the capture of

103 tagged rainbow trout (25.3 percent recovery) at the rate of 2.45 fish per angler. Analysis of the Sturgeon River data was complicated by the fact that 64 of the 191 recoveries were turned in to conservation officers or resort operators without the names of the anglers who caught them. Sorting was performed on this group of fish by the use of dates and localities, but because of the unknown factor the numbers of anglers participating in the recaptures from each type of planting is given as "minimum" in each instance. The available data indicate that spot planting of the tagged rainbow trout on the Sturgeon River was 20.4 more efficient in distributing the fish among the anglers, as 100 scatter-planted fish furnished sport for only 8.2 anglers whereas 100 spot-planted fish gave recoveries to 10.3 fishermen.

The combined figures for the two rainbow trout experiments show that a minimum of 37 fishermen recaptured 93 of 541 tagged rainbow trout released by the boat or scatter method of planting (a recovery percentage of 17.2), or 2.51 fish per angler. From the spot planting of 557 tagged rainbow trout, 107 recoveries (or, 19.2 percent) were retaken by 46 anglers, or an average catch per individual of 2.32 fish. Based on the average number of anglers sharing in the recoveries from 100 boat-planted rainbow trout (6.9) as compared with the average number of fishermen benefiting from 100 spot-planted rainbow trout (8.3) an advantage of 16.9 percent more fishermen serviced is indicated for spot plantings of this species.

If the results from all species on all of the streams are brought together and averaged we find that 134 different anglers caught 262 boat-planted trout from a total planting of 1,934 tagged fish, or a recovery

of 13.5 percent at the rate of 1.95 tagged fish per angler. From spot plantings totalling 1,957 tagged trout 150 anglers caught 344 tagged fish, effecting a recovery percentage of 17.6 percent of the total planted at the rate of 2.29 fish per fisherman. Therefore an average of 6.9 anglers benefited from plantings of 100 trout by the boat method, and an average of 7.7 anglers shared in the recoveries from 100 fish planted by the spot method, an advantage of 10.4 percent in the efficiency of distribution in favor of the spot method of planting.

Average length of time between planting and recovery

For six of the eight streams studied, the average time between planting and recovery by the anglers is available for the recoveries from both types of planting (Table 2). These data are given by monthly periods.

The data from seven brook trout plantings on which recoveries were made from both types of plantings indicate that the average period of freedom is from one to 26 days longer for scatter-planted fish than for those which were spot planted. Only one exception was noted -- the July planting in Slagle Creek. From this particular release, spot-planted fish had an average period of freedom 2.1 days longer in the stream than did fish from the scatter planting. Averaging all brook trout data together, spot plantings were free an average time of 14.4 days before recovery, while the scatter plantings were in the streams an average time of 19.7 days before capture.

Four brown trout plantings were noted in which recoveries were reported for both types of plantings. In three of them the scatter-planted fish were free for average periods of 34.3, 66.0, and 65.0 days, whereas the spot plantings had average periods of freedom of 28.7, 66.0, and

Table 2.--The average number of days between planting and recovery for tagged brook, brown, and rainbow trout released by two different methods during the 1947 trout season. (Numbers of tagged fish recovered are given in parentheses).

Stream and month of planting	Brook trout		Brown trout		Rainbow trout	
	Spot	Boat	Spot	Boat	Spot	Boat
Middle Br. Ontonagon - May	19.2(38)	20.3(42)	...	...	...	...
June	15.0(37)	18.4(16)	...	...	...	...
July	13.2(24)	17.2(17)	...	...	...	...
August	8.6(10)	11.7(3)	...	...	...	...
Slagle Creek - May	14.4(16)	41.0(4)	...	...	...	...
June	8.3(23)	26.6(9)	...	...	...	...
July	16.5(11)	12.4(11)	...	...	...	...
August	...	...	...	...	...	...
Brook trout averages	14.4(159)	19.7(102)	...	...	...	...
Rifle River - May	...	...	39.9(41)	37.8(37)	...	...
July	...	...	28.7(6)	34.3(7)	...	...
August	...	...	...	...	...	...
Gamble Creek - May	...	...	66.0(1)	66.0(1)	...	...
July	...	...	60.0(2)	...	...	...
August	...	...	...	...	...	...
Main Au Sable - May	...	...	49.0(7)	65.0(1)	51.2(4)	58.5(2)
June	...	...	...	33.0(1)	...	19.0(2)
August	...	...	...	...	...	2.0(1)
Brown, rainbow trout averages ¹	...	...	40.3(55)	38.4(46)	51.2(4)	58.5(2)

¹ Only those data used where recoveries were made from both types of planting. Averages are weighted averages.

49.0 days. In the one instance where spot plantings were in the stream longer, the recovered fish were free an average period of 39.9 days compared with an average period of freedom of 37.8 days for boat plantings made at the same time. The average periods of freedom for the brown trout recoveries were: spot plantings, 40.3 days; scatter plantings, 38.4 days.

The one set of rainbow trout plantings from the Main Au Sable River indicated that the boat-planted fish were free in the stream a greater average length of time than was its experimental counterpart -- 58.5 days compared with 51.2 days for spot planting.

The average for all plantings where recoveries were made from both types of planting were as follows: scatter plantings, 26.0 days; spot plantings, 21.6 days. The fact that most boat-planted fish stay in the stream somewhat longer than do those released by the spot method is a factor to be considered in their ultimate dispersal among the anglers.

It should be mentioned that in general the August, 1947, plantings by either method were failures when compared with recovery results obtained from the plantings in May, June and July. This suggests that the releases late in the season are very likely wasted in most streams as far as the anglers are concerned. Extension of the trout season to the second Sunday in September should result in somewhat better recoveries of August-planted trout.

Migration of tagged fish

The migrations of the planted brook trout, as indicated by the tagged fish recovered, were not extensive. On Slagle Creek, the longest movement noted was two miles downstream. No upstream travel was traceable from the recoveries reported. From the Middle Branch of the Ontonagon,

1-1/2 miles upstream and 2-1/2 miles downstream were the extremes of movement which could be traced from the tag recoveries. District Biologist Anderson's data indicated that 41 percent of all returns were caught at the point of planting, 43 percent below the planting site, and 12 percent upstream from the site of release; 4 percent had no recapture locality data.

The brown trout released in the Rifle River appear to have stayed within the confines of the stream section planted except for one tagged fish which moved to the Devoe Lake Dam from the May spot planting site, a distance of about 2-1/2 miles upstream. Two tagged fish from the Gamble Creek brown trout releases moved out of Gamble Creek and up Fontinalis Creek about 1/2 mile. In the Main Au Sable River, the tagged brown trout reported were all caught within one mile of the point of release.

The longest migrations were noted for the rainbow trout tagged and released in the Main Au Sable River. Only three fish were recovered at the point of release. The remainder of those recaptured were taken anywhere from 1/2 mile to 16 sections (approximately 25 miles) downstream. No recovery reports came from above the planting site at the Pull-over. In the Sturgeon River experiments with rainbow trout, the maximum movements noted were 8 miles upstream to the West Branch of the Sturgeon River, and one mile downstream. The latter recovery was taken in the form of a tag from the stomach of a walleye three days after the rainbow trout had been planted.

From the incomplete data collected during the summer of 1947, it is observed that boat or scatter plantings effected a better distribution of the hatchery fish in three of the eight experiments, while spot

plantings were more efficient in the remaining five. Among the three species of trout, spot plantings were determined to be 13.0 percent and 16.9 percent more efficient in distributing brook trout and rainbow trout respectively among the angling public than were boat or scatter plantings. Scatter planting of brown trout, however, was noted to be 3.6 percent more efficient in the distribution of this species among the anglers than was spot planting. For all species combined the average spot planting benefited 10.4 more anglers than did the boat plantings.

In general, boat-planted trout were free in the stream a longer period of time than were the spot-planted fish. The average time between release and recovery for boat-planted fish was 26.0 days, for spot-planted fish, 21.6 days. Possibly this is a factor to be considered in their ultimate dispersal among the anglers.

Recoveries from this series of experiments indicated that there was comparatively little migration by the planted fish. The maximum distances noted for brook trout were 1-1/2 miles upstream and 2-1/2 miles downstream. For brown trout, the greatest distances travelled by the recovered fish were 1 mile downstream and 2 miles upstream. The rainbow trout, as usual, moved further than the others. One recovery from the Main Au Sable moved approximately 25 miles downstream, and one recovery from the Sturgeon River was caught 8 miles upstream from the planting site.

Inspection of Tables 1 and 2 indicates that different results may be anticipated on different streams, and that there is a variation among the different species involved. Other factors which probably influenced the results are: stream size and drainage pattern, number of points of access to the streams for both anglers and Fish Division planting

units, the population of native trout in the stream areas planted, and the general fishing pattern on the streams involved. On the one stream where we had complete data and a fairly large number of recoveries (Rifle River), boat planting was superior to spot planting of brown trout in distributing hatchery fish among the anglers. On the other streams where the data was either incomplete or not adequate, boat planting was more efficient on two, and spot planting was more efficient on five streams. It is suggested that if it is desirable to have a more accurate answer to this general problem, similar experiments be initiated on stream areas where we can obtain complete recovery on planted fish and record the complete fishing effort. The Rifle River on the Rifle River Area might be utilized to test spot and boat plantings of brown and rainbow trout, and brook trout plantings could be investigated in the experimental waters of the Hunt Creek Fisheries Experiment Station.

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