

# Planting "Keeper" Trout

## *Fall, Spring and Open Season Stocking Results Compared*



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SINCE 1930 the angling pressure on Michigan waters has increased tremendously, as borne out by the rising curve of fishing license sales. The reasons for the increased amount of angling are a combination of economic, recreational and social factors, such as shorter working periods, better roads and automobiles, and expanded development of the northern Michigan areas to service fishermen.

Just how great this angling pressure is may be illustrated by a few figures. Intensive creel census records from sections of seven Michigan trout streams show that an average of about 150 man-hours per acre per season were spent in angling on those streams during the 1937, 1938, and 1939 trout seasons. Compare this with an average of 53.7 man-hours per acre per season on six lakes censused in 1941, and remember that the season for lake fishing (exclusive of most trout lakes) is about twice as long as that for most trout streams. On the Hunt Creek Experimental Area, the angling pressure has never been lower than 180 man-hours per acre of stream per season since the start of the creel census in 1939. The pheasant hunter thinks the hunting pressures of late years in southern Michigan have been heavy, but the figures given out by the Rose Lake Experimental Station (reported to be a hunting area that is consistently productive of pheasants, and more heavily hunted than the average farm) indicate that it has never been more than 2.45 man-hours per acre per season.<sup>1</sup>

Under such conditions, good trout streams near centers of population or

near resort towns receive a terrific churning from the ever-growing number of trout fishermen. In several other states, particularly in the east, an even larger number of fishermen are said to take to the streams during the open season, and in order to satisfy the demands of the anglers for fish in the creel, a good share of the trout planted in those states (such as New Jersey, Connecticut, Massachusetts) are of legal size, and almost the entire trout population presumably are hatchery-reared fish.

### Three Per Cent "Keepers"

During the past ten years the Michigan Fish Division has also released legal-sized trout (seven inches or longer) *more as an experiment than as a definite policy*, in an effort to learn what the effects of such plantings might be.<sup>2</sup> Such plantings have never exceeded three per cent of the total number of brook, brown and rainbow trout released (which annually amount to six-to-eight millions).

Since the inception of this comparatively limited program of planting "ready-to-catch" trout, there have been many arguments pro and con on the various phases of the operations involving large, hatchery-reared trout. Certain of our older, experienced trout fishermen look with scorn on any such practices; however, others who are not so experienced nor so discriminating have

<sup>1</sup>Allen, Durward L., 1942. That Season Limit. Michigan Conservation, Vol. 12, No. 2, January 1942, pp. 4-5.

<sup>2</sup>Shetter, David S. and Albert S. Hazzard, 1941. Results from plantings of marked trout of legal size in streams and lakes of Michigan. Trans. Am. Fish Soc., Vol. 70 (1940), pp. 446-468.

TABLE 1  
Percentages of "legal" trout recaptured by anglers after release at various seasons of the year in Michigan streams, 1937-1941.

Species of trout	Fall planting*			Spring planting†			Open-season planting‡		
	Number of experiments	Number of marked fish planted	Percentage of recovery	Number of experiments	Number of marked fish planted	Percentage of recovery	Number of experiments	Number of marked fish planted	Percentage of recovery
BROOK TROUT (totals for 6 streams) <sup>1</sup>	3	2,798	4.4	5	5,300	25.5	9	9,751	25.4
RAINBOW TROUT (totals for 4 streams) <sup>2</sup>	4	1,979	4.9	4	1,999	19.6	10	7,391	25.7
BROWN TROUT (totals for 4 streams) <sup>3</sup>	3	1,500	5.8	3	1,448	11.3	4	1,000	13.0

<sup>1</sup>Pine River (Lake County), N. Branch Au Sable (Crawford County), Canada Creek (Presque Isle County), Little Manistee River (Lake County), E. Branch Tahquamenon River (Chippewa County), Hunt Creek (Montmorency County).

<sup>2</sup>Pine River (Lake County), Pigeon River (Otsego, Cheboygan Counties), Main Au Sable (Crawford County), Baldwin Creek (Lake County).

<sup>3</sup>Pigeon River (Otsego, Cheboygan Counties), Little Manistee (Lake County), Baldwin Creek (Lake County), Main Au Sable (Crawford County).

With the exception of Baldwin Creek and the Main Au Sable, all data obtained from the streams listed above were collected chiefly by intensive creel census crews.

\*Between Labor Day and January 1.

†From about March 1 to the last Saturday in April.

‡Between the last Saturday in April and Labor Day, the open season for trout fishing

written enthusiastic and favorable comments on their angling for hatchery-reared trout.

Much of the argument concerning the release of "legal" trout has centered around the time of year when these larger fish should be placed in the streams and lakes. From the viewpoint of the hatchery supervisor, release of the fish in the fall of the year is an excellent procedure as far as efficient hatchery management is concerned. In the fall season (September-December) almost all

hand, the contentions seem reasonable.

Considering the various arguments in its favor, the fall season would appear to be the logical time of the year to release these large trout.

The Department of Conservation is concerned, however, with the efficient utilization by the angling public of these adult trout which, according to two of our hatchery supervisors, have cost anywhere from 15 cents to 25 cents each by the time they are released. One important question is, do the fishermen catch a

**TABLE 2**  
**Percentages of fall- and spring-planted trout recovered at various distances and directions from the points of planting in five Michigan trout streams**

Stream	Year recovered	Species	Season planted	Number of recoveries with locality data given	Percentage of recovered fish moving number of miles and direction			
					Upstream		Downstream	
					3-10	0-2	3-10	11-75
Pine River	1938	Brook	Fall	84	10	77	11	2
			Spring	453	1	76	22	1
	1938	Rainbow	Fall	13	15	46	31	8
			Spring	214	0	71	25	4
	1939	Brook	Fall	26	35	19	42	4
			Spring	317	32	26	41	1
Pigeon River	1939	Brown	Fall	16	12	75	13	.....
			Spring	34	6	79	15	.....
	1939	Rainbow	Fall	3	.....	67	33	.....
			Spring	48	.....	51	47	*2
North Branch Au Sable Main Au Sable	1939	Brook	Fall	42	.....	40	60	.....
			Spring	138	2	26	72	.....
Baldwin Creek	1941	Brown	Fall	27	.....	100	.....	.....
			Spring	51	.....	100	.....	.....
	1941	Rainbow	Fall	33	.....	91	6	3
			Spring	76	.....	59	16	25
	1941	Brown	Fall	10	.....	100	.....	.....
			Spring	37	.....	97	3	.....
1941	Rainbow	Fall	12	.....	83	17	.....	
		Spring	18	.....	66	17	17	
All experiments combined		Brook	Fall	152	15.0	45.3	37.6	3.0
			Spring	908	11.4	42.3	45.0	1.3
		Brown	Fall	53	4.0	91.7	4.3	.....
			Spring	122	2.0	92.0	6.0	.....
		Rainbow	Fall	61	3.8	71.7	21.7	3.8
			Spring	356	.....	61.7	26.3	12.0

\*One tagged rainbow trout moved from Vanderbilt Road Bridge on Pigeon River to a point 17 miles off Sarnia, Ontario, in the southern end of Lake Huron. However, this record has not been verified.

roads and trails are passable and in good condition, whereas in the early spring they are not. The large tank trucks used to transport the fish can move to almost any streamside locality. If the fish are planted in the fall, there is no food or labor required for the fish during the winter months, which reduces hatchery costs and overhead. If no fish are to be carried over the winter, less pond space is needed in the general hatchery plan.

Also, many fishermen contend that in order for a hand-reared fish to become "wild" in appearance, action and in eating quality, it should spend at least one winter in its new environment. At present, there is no scientific evidence to prove or disprove these latter claims but, off-

greater percentage of fall- or spring-planted "legal" trout, or a greater percentage of these large trout if they are released during the open season? Other questions are: What percentage of the total number of anglers actually catch any of these large hatchery fish? Do fall-planted trout distribute themselves over a stream system better than fish planted a month to six weeks before the season opens? During the past five years the Institute for Fisheries Research, in cooperation with the various hatchery supervisors, conservation officers, and a host of interested anglers, has conducted a large number of experiments to determine the facts.

Concisely and bluntly stated, the prob-

**TABLE 3**  
**Percentages of "legal" trout recaptured by anglers after**  
**release at various seasons of the year in trout lakes**

Lake, and seasons of recovery	Fall planting		Spring planting		Open-season planting	
	Number of fish planted	Percentage of recovery	Number of fish planted	Percentage of recovery	Number of fish planted	Percentage of recovery
<b>RAINBOW TROUT</b>						
<sup>1</sup> South Twin—1935	100	73.0				
<sup>1</sup> North Twin—1937	100	66.0				
<sup>1</sup> Pickereel—1939	400	*23.3				
<sup>1</sup> Hemlock—1939	303	*37.3			200	48.5
<sup>1</sup> Burt—1939, 1940, 1941	500	16.4			250	13.2
<sup>1</sup> Crooked—1940, 1941					250	24.4
<b>BROOK TROUT</b>						
<sup>1</sup> East Fish—1940			250	51.2		
<sup>1</sup> East Fish—1941	243	13.5	250	55.6		

<sup>1</sup>Results based on intensive creel census alone.

<sup>2</sup>Results based on intensive creel census plus marking experiments.

<sup>3</sup>Results based on marking experiments alone with returns of marked fish voluntary.

\*These lakes were under intensive creel census only for 9 days of the 1940 trout season, so these are minimal figures.

lem is this: Do trout fishermen get more fishing for their money from hatchery-reared trout of legal size that are released in the fall, in the spring, or during the open season? The problem was attacked in this way: Known numbers of marked (either tagged or fin-clipped) hatchery-reared trout of all species were planted in sections of nine streams and seven trout lakes at the various seasons. These plantings represented 51 experiments, and involved the marking of approximately 36,000 trout. On several of the streams and lakes, the entire catch, including the marked fish, was tallied by creel census clerks. On other trout waters, data on recoveries were requested and obtained by voluntary reports of fishermen and through contacts made by conservation officers. Hatchery supervisors and their assistants have aided in planting marked trout or in obtaining information on the recovery of marked fish. Many well-trained creel-census clerks were furnished in past years by the State CCC, or through the cooperation of the United States Forest Service.

The data will be presented under two general headings: (1) streams, and (2) lakes, since the results were very different in the two types of trout water.

### STREAMS

The generalized results of experiments with hatchery-reared brook, brown and rainbow trout of legal size released in Michigan streams at various seasons of the year are presented in Table 1. This table shows the average percentage of recovery made by the anglers on plantings released at the different seasons of the year. A study of the table will be somewhat of a shock to those who favor

and advocate fall planting of trout in streams when they note the uniformly low percentages of returns to the angler in the season immediately following the planting. Average percentages of recovery on hatchery-reared trout planted in the fall were as follows: brook trout, 4.4 per cent; rainbow trout, 4.9 per cent; brown trout, 5.8 per cent.

The average percentage of spring-planted (before the opening day but after the winter) hatchery trout recovered by the anglers was 5.8 times greater for brook trout (25.5 per cent recovery), 4.0 times greater for rainbow trout (19.6 per cent recovery), and 1.9 times greater for brown trout (11.3 per cent recovery). *In other words, from two to six times more legal-sized hatchery trout were caught from releases made in the spring of the year than were caught from releases made in the fall of the year in streams.*

It will also be noted in Table 1 that the average percentages of recovery on "legal" hatchery trout planted during the open season were approximately equal to, or somewhat higher than, those recorded for spring plantings.

It should be mentioned here that we have never received any reports of recovery from brook trout planted in the fall which were captured any later than the first open season after planting. In other words, a small number survive to reach the anglers' creels in the following season, but apparently there is no carry-over to succeeding seasons. On the other hand, a very small, but nevertheless measurable number of legal brown and rainbow trout planted in the spring or during the open season have been recovered as late as the second trout season after their release.

### Few Anglers Catch Marked Fish

The data presented in Table 1 were gathered, with one exception (the E. Branch of the Tahquamenon river in Chippewa county), from public fishing waters lying in the northern half of the lower peninsula. It is possible that results might be different from fall plantings of legal-sized trout in some of the trout waters of southwestern Michigan where milder winters and possibly fewer predators might allow a higher percentage of fall-planted adult fish to survive. Marking experiments with legal-sized hatchery fish are now in progress in two southwestern streams (Dowagiac creek, Cass county, and Portage creek, Kalamazoo county) and in one upper peninsula stream (Middle Branch of the Ontonagon river, Gogebic county).

The exact percentage of the total number of anglers benefited by fall, spring, or open season plantings cannot be stated; *that the percentage of the total number of anglers catching planted legal trout would be very small can be surmised from the following data.* On six different streams, intensive creel censuses during four different years showed that the percentage of the total number of anglers fishing who caught marked hatchery trout varied from a low of 5.7 per cent (North Branch Au Sable, 1939) to a high of 20.6 per cent (Pine river, 1938). These percentages included anglers who had caught hatchery fish planted during the open season as well as hatchery trout planted in the fall and in the spring. Even with the inclusion of the above-mentioned anglers catching hatchery trout planted during the open season, the average percentage of the total number of anglers catching hatchery fish was about 11.5 per cent. More simply stated, about *one angler in nine* caught hatchery trout planted at legal size without regard for the season of planting. When it is considered that the plantings made in the censused streams were, as a rule, larger than could normally be made on all trout streams in the state, this figure is especially significant.

The available data on the movements of artificially-reared trout after release in the fall and in the spring are given in Table 2. Not all recoveries reported were usable, as locality data were not given for some of the reports. From the table it can be seen that the average distribution (as judged by the percentage of the

total number of fish recovered at various distances and directions from the points of planting) of fall-planted trout of any species is either only slightly greater (brook trout), or less (brown and rainbow trout), than that for fish of the same species planted in the spring of the year. Apparently there is a distinct tendency for the majority of brook trout to move downstream from three to 10 miles after release. Brown trout appear to move very little after planting in either season. A strong tendency toward downstream movement can be noted in the rainbow trout, where the highest percentages of recovery were noted for fish moving more than 10 miles. Although fall-planted rainbows distributed themselves somewhat before the open season, those planted in the spring were even more widely scattered when caught by anglers. No upstream movement greater than 10 miles was noted for any species; possibly the presence of dams near the experimental localities on the Pigeon river and the main Au Sable may have influenced these results. Apparently fall-planting of any species has no advantage over spring-planting in assuring a wider distribution of fish by the opening day.

### Recoveries of Fall Fish Few

Confirmatory evidence on the correctness of our general conclusions presented here are available from other sources. Smith<sup>3</sup> tagged legal-length brook trout before releasing them at various seasons in the Salmon Trout river, which runs through Marquette county, mostly on the property of the Huron Mountain Club. A complete creel census of the comparatively limited number of club anglers and their guests was easily carried out. Smith found that from 1,233 tagged brook trout planted in the fall of 1938, only three fish were caught in 1939. From 600 legal brook trout released after tagging in October, 1939, only six were retaken by the club anglers during 1940—*a recovery of only one per cent or less on the fall-planted fish.* Recoveries on the "legal" brook trout tagged and planted during the spring months varied from 16 to 67 per cent in Smith's experiments.

Nesbit and Kitson<sup>4</sup> have reported on experiments involving spring and fall

<sup>3</sup>Smith, Jr., Lloyd L., 1941. The results of planting brook trout of legal length in the Salmon Trout river, Northern Michigan. Trans. Am. Fish. Soc., Vol. 70, 1940, pp. 249-259.

<sup>4</sup>Nesbit, Robert A., and J. Arthur Kitson, 1937. Some results of trout tagging in Massachusetts. Copela, No. 3, November 19, 1937, pp. 168-172.

plantings of tagged legal-sized brown and rainbow trout in streams and ponds of Massachusetts. Their recovery results showed that, on the average, about five times as many spring-planted fish were recovered by the anglers as were fall-planted fish. In certain streams they found that the ratio was about 10 to 1 in favor of spring-planted fish, but that in ponds, spring-planting was only about twice as effective.

Cobb<sup>3</sup> stated that fall plantings of "legal" trout in Connecticut waters had failed to survive in any numbers to the following trout season, but offered no evidence.

### LAKES

Very different results have been obtained from a limited series of experimental plantings of adult rainbow and brook trout in trout lakes at different seasons of the year. Most of the plantings of adult trout on which accurate survival data are available have involved rainbow trout (six lakes), and at present figures are available from only one lake where experimental plantings of legal-sized hatchery brook trout were involved. These data are shown in Table 3, where the recovery percentages obtained from the plantings made at the various seasons are listed for the several lakes.

The striking feature of Table 3 is the high percentages of recovery of fall-planted rainbow trout from trout lakes under 100 acres in size (Pickerel lake, Otsego county; Hemlock lake, Cheboygan county; North Twin lake, South Twin lake, Otsego county). In these lakes the recovery percentage of fall-planted rainbow trout ran from 23 to 73 per cent. Even the late summer planting made in Burt lake in Cheboygan county (area of 27.3 square miles), from which only 16.4 per cent has been reported by the anglers to date, has been at least three times more successful than any similar planting of rainbow trout made in streams at the fall season.

The comparatively low percentage of recovery noted in Table 3 for the plantings made in Burt lake may have been caused by any one of the following factors:

(a) Reports were voluntary as no census was possible.

(b) The comparatively large area of the Burt Lake drainage which must be fished to recover a minute component of

the total fish population of the drainage system.

(c) The date of the open-season planting, which was August 4, 1940—rather late in the season.

Marked rainbow trout planted in Burt lake have been recovered in every stream tributary to and distributary from Burt lake, as well as from the lake itself. Somewhat the same set of circumstances obtained in the instance of the open-season planting made in Crooked lake (approximately 3,000 acres), Emmet county. In both of these lakes the excellent growth of the planted fish (anywhere from one to seven inches yearly) helped toward offsetting the fact that apparently not quite as many were recovered as from some of the other lakes.

*On the basis of the data at hand, adult rainbow trout may be stocked in lakes where suitable temperature and habitat conditions prevail, at any season of the year, with the expectancy of recovering from 20 to 70 per cent of the introduced fish in following seasons.* The number recaptured will depend in part upon the size of the lake, the time of stocking in relation to the open season, and the angling pressure on that particular body of water.

A limited amount of information, all from East Fish lake in Montmorency county, on the relative survival rates of fall- and spring-planted, hatchery-reared brook trout, indicates that returns to the angler are about four times as good from spring-planted as from fall-planted trout. However, it is known that fall stocking of adult brook trout in suitable lakes which have been previously "poisoned out" is successful, and that a worthwhile percentage of the brook trout planted are taken by anglers in the following seasons. Several lakes both in the upper and lower peninsulas were so treated during 1940 and 1941 and subsequently stocked with adult brook trout. The angling results in these lakes will be followed closely during the 1942 season.

Brown trout have not been stocked in lakes very often, since experience in Michigan and in other states has demonstrated that this species does not furnish as much sport to the average fisherman as a similar number of brook or rainbow trout. Apparently if food and habitat conditions favor brown trout in a lake, they will grow and survive, but they will refuse to take a lure except when it is very skillfully and persistently presented.

<sup>3</sup>Cobb, Eben W., 1933. Results of trout tagging to determine migrations and results from plants made. Trans. Am. Fish. Soc., Vol. 63, 1933, pp. 308-318.

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REPORT NO. 744

SHOULD LEGAL-SIZED TROUT BE PLANTED IN FALL,

SPRING OR DURING THE OPEN SEASON?

by

David S. Shetter  
and  
Albert S. Hazzard

Since 1930 the angling pressure on Michigan waters has increased tremendously, as borne out by the rising curve of fishing license sales. The reasons for the increased amount of angling are a combination of economic, recreational and social factors, such as shorter working periods, better roads and automobiles, and expanded development of the northern Michigan areas to service fishermen.

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Streams

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The exact percentage of the total number of anglers benefited by fall, spring, or open season plantings cannot be stated; that the percentage of the total number of anglers catching planted trout would be very small can be surmised from the following data. On six different streams, intensive creel censuses during four different years showed that the percentage of the total number of anglers fishing who caught marked hatchery trout varied from a low of 5.7 per cent (North Branch Au Sable, 1939) to a high of 20.6 per cent (Pine River, 1938). These percentages included anglers who had caught hatchery fish planted during the open season as well as hatchery trout planted in the fall and in the spring. Even with the inclusion of the above-mentioned anglers catching

hatchery trout planted during the open season, the average percentage of the total number of anglers catching hatchery fish was about 11.5 per cent. More simply stated, about one angler in nine caught hatchery trout without regard for the season of planting. When it is considered that the plantings made in the censused streams were, as a rule, larger than could normally be made on all trout streams in the state, this figure is especially significant.

The available data on the movements of artificially-reared trout after release in the fall and in the spring are given in Table 2. Not all recoveries reported were usable, as locality data were not given for some of the reports. From the table it can be seen that the average distribution (as judged by the percentage of the total number of fish recovered at various distances and directions from the points of planting) of fall-planted trout of any species is either only slightly greater (brook trout), or less (brown and rainbow trout), than that for fish of the same species planted in the spring of the year. Apparently there is a distinct tendency for the majority of brook trout to move downstream from 3 to 10 miles after release. Brown trout appear to move very little after planting in either season. A strong tendency toward downstream movement can be noted in the rainbow trout, where the highest percentages of recovery were noted for fish moving more than ten miles. Although fall-planted rainbows distributed themselves somewhat before the open season, those planted in the spring were even more widely scattered when caught by anglers. No upstream movement greater than ten miles was noted for any species; possibly the presence of dams near the experimental localities on the Pigeon River and the Main Au Sable may have influenced these results. Apparently fall-planting of any species

has no advantage over spring-planting in assuring a wider distribution of fish by the opening day.

Confirmatory evidence on the correctness of our general conclusions presented here are available from other sources. Smith<sup>2</sup> tagged legal-length brook trout before releasing them at various seasons in the Salmon Trout River, which runs through Marquette County, mostly on the property of the Huron Mountain Club. A complete creel census of the comparatively limited number of club anglers and their guests was easily carried out. Smith found that from 1,233 tagged brook trout planted in the fall of 1938, only three fish were caught in 1939. From 600 legal brook trout released after tagging in October, 1939, only six were re-taken by the club anglers during 1940--a recovery of only one per cent or less on the fall-planted fish. Recoveries on the "legal" brook trout tagged and planted during the spring months varied from 16 to 67 per cent in Smith's experiments. He also noted a slight tendency toward downstream migration in the planted fish.

Nesbit and Kitson<sup>3</sup> have reported on experiments involving spring and fall plantings of tagged legal-sized brown and rainbow trout in streams and ponds of Massachusetts. Their recovery results showed that, on the average, about five times as many spring-planted fish were recovered by the anglers as were fall-planted fish. In certain streams they found that the ratio was about 10 to 1 in favor of spring-planted

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<sup>2</sup> Smith, Jr., Lloyd L., 1941. The results of planting brook trout of legal length in the Salmon Trout River, Northern Michigan. Trans. Am. Fish. Soc., Vol. 70, 1940, pp. 249-259.

<sup>3</sup> Nesbit, Robert A., and J. Arthur Kitson, 1937. Some results of trout tagging in Massachusetts. Copeia, No. 3, November 19, 1937, pp. 168-172.

fish, but that in ponds, spring-planting was only about twice as effective.

Cobb <sup>4</sup> stated that fall plantings of "legal" trout in Connecticut waters had failed to survive in any numbers to the following trout season, but offered no evidence.

#### Lakes

Very different results have been obtained from a limited series of experimental plantings of adult rainbow and brook trout in trout lakes at different seasons of the year. Most of the plantings of adult trout on which accurate survival data are available have involved rainbow trout (six lakes), and at present figures are available from only one lake where experimental plantings of legal-sized hatchery brook trout were involved. These data are shown in Table 3, where the recovery percentages obtained from the plantings made at the various seasons are listed for the several lakes.

The striking feature of Table 3 is the high percentages of recovery of fall-planted rainbow trout from trout lakes under 100 acres in size (Pickereel Lake, Otsego County; Hemlock Lake, Cheboygan County; North Twin Lake, South Twin Lake, Otsego County). In these lakes the recovery percentage of fall-planted rainbow trout ran from 23 to 73 per cent. Even the late summer planting made in Burt Lake in Cheboygan County (area of 27.3 square miles), from which only 16.4 per cent has been reported by the anglers to date, has been at least three times more successful than any similar planting of rainbow trout made in streams at the fall season.

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<sup>4</sup> Cobb, Eben W., 1933. Results of trout tagging to determine migrations and results from plants made. Trans. Am. Fish. Soc., Vol. 63, 1933, pp. 308-318.

The comparatively low percentage of recovery noted in Table 3 for the plantings made in Burt Lake may have been caused by any one of the following factors:

(a) Reports were voluntary as no census was possible.

(b) The comparatively large area of the Burt Lake drainage which must be fished to recover a minute component of the total fish population of the drainage system.

(c) The date of the open-season planting, which was August 4, 1940-- rather late in the season.

Marked rainbow trout planted in Burt Lake have been recovered in every stream tributary to and distributary from Burt Lake, as well as from the lake itself. Somewhat the same set of circumstances obtained in the instance of the open-season planting made in Crooked Lake (approximately 3,000 acres), Emmet County. In both of these lakes the excellent growth of the planted fish (anywhere from 1 to 7 inches yearly) helped toward offsetting the fact that apparently not quite as many were recovered as from some of the other lakes.

On the basis of the data at hand, adult rainbow trout may be stocked in lakes where suitable temperature and habitat conditions prevail, at any season of the year, with the expectancy of recovering from 20 to 70 per cent of the introduced fish in following seasons. The number recaptured will depend in part upon the size of the lake, the time of stocking in relation to the open season, and the angling pressure on that particular body of water.

A limited amount of information, all from East Fish Lake in Montmorency County, on the relative survival rates of fall- and spring-planted, hatchery-reared brook trout, indicates that returns to the



angler are about 4 times as good from spring-planted as from fall-planted trout. However, it is known that fall stocking of adult brook trout in suitable lakes which have been previously "poisoned out" is successful, and that a worthwhile percentage of the brook trout planted are taken by anglers in the following seasons. Several lakes both in the Upper and Lower Peninsulas were so treated during 1940 and 1941 and subsequently stocked with adult brook trout. The angling results in these lakes will be followed closely during the 1942 season.

Brown trout have not been stocked in lakes very often, since experience in Michigan and in other states has demonstrated that this species does not furnish as much sport to the average fisherman as a similar number of brook or rainbow trout. Apparently if food and habitat conditions favor brown trout in a lake, they will grow and survive, but they will refuse to take a lure except when it is very skillfully and persistently presented.

Some simple arithmetic is now in order. For the purpose of discussion, we will assume that it costs \$150 per thousand fish to raise and plant in the fall of the year trout 7 inches or longer. If these same fish are held in rearing ponds over the winter, let us further assume that it costs \$200 per thousand fish by the time they are planted in the spring or during the open season. If a 100 per cent recovery were to be made on any planting, the cost of these fish to the angler would be as stated above--either 15 cents or 20 cents per fish, depending on when it was planted. Since only about 5 per cent of fall-planted trout released in streams are subsequently recovered, (Table 1), the actual cost to the fishermen of fall-planted trout is twenty times the hypothetical 15 cents per fall-planted fish, or \$3.00 per fall-planted fish. The cost

to the angler of spring-planted fish released in streams (based on the recovery percentages presented in Table 1) would be as follows:

Brook trout - \$0.80 per fish

Brown trout - 2.00 per fish

Rainbow trout - 1.00 per fish

The cost to the anglers of "legal" trout planted in streams during the open season would be somewhat less because there are usually a greater percentage of them recovered after planting.

Similar calculations, involving the assumed costs and the percentages of recovery given for the plantings of legal trout in lakes, will show that rainbow trout planted in the fall of the year in lakes under 100 acres have cost the angling public about 30 cents per fish (since an average minimum of 50 per cent were recovered). In East Fish Lake, fall-planted brook trout cost about \$1.06 each, while spring-planted brook trout cost about 36 cents each, on the basis of the data available at present.

Leaving aside for the present the highly controversial questions of table and sporting quality of the fish planted at the various seasons for which no scientific evidence is available at present, the following conclusions as to when legal trout should be planted seem justified on the basis of the experimental work to date:

1. In streams where hatchery-reared brook and rainbow trout are to be released, more fish are made available to the fishermen at a lower cost per fish through plantings made in the spring of the year or during the open fishing season.

2. The differences in results obtained between fall, spring and open-season plantings of brown trout in streams have not been as great

as in the other two species of trout. However, even with brown trout, spring plantings and plantings during the open season gave returns to the angler that were from two to two and one quarter times larger than fall plantings.

3. No advantage in securing a wider natural distribution of the hatchery-reared trout planted in the streams is gained by fall planting.

4. In lakes where conditions are favorable, fall plantings of legal-sized, hatchery-reared rainbow trout may be economically justified, and can be made successfully with the expectation that a high percentage of recovery will be made, depending in part on the angling pressure and the size of the lake so stocked.

Also, in the larger lakes, these trout will grow and distribute themselves well and will benefit a relatively large number of anglers.

5. Spring planting of legal-sized brook trout in the only lake tested with this species to date yielded  $\frac{1}{4}$  times as many fish to the angler as did fall plantings.

6. Information available from creel census records indicate that only about one out of nine fishermen catches hatchery trout after they are planted, regardless of the season stocked.

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Table 1

Percentages of "legal" trout recaptured by anglers after release at various seasons of the year in Michigan streams, 1937-1941.

Species of trout	Fall Ⓜ planting			Spring Ⓜ planting			Open-season Ⓜ planting		
	Number of experiments	Number of marked fish planted	Percentage of recovery	Number of experiments	Number of marked fish planted	Percentage of recovery	Number of experiments	Number of marked fish planted	Percentage of recovery
BROOK TROUT (totals for 6 streams) Ⓜ	3	2,798	4.4	5	5,300	25.5	9	9,751	25.4
RAINBOW TROUT (totals for 4 streams) Ⓜ	4	1,979	4.9	4	1,999	19.6	10	7,391	25.7
BROWN TROUT (totals for 4 streams) Ⓜ	3	1,500	5.8	3	1,448	11.3	4	1,000	13.0

Ⓜ Pine River (Lake County), N. Branch Au Sable (Crawford County), Canada Creek (Presque Isle County), Little Manistee River (Lake County), E. Branch Tahquamenon River (Chippewa County), Hunt Creek (Montmorency County).

Ⓜ Pine River (Lake County), Pigeon River (Otsego, Cheboygan Counties), Main Au Sable (Crawford County), Baldwin Creek (Lake County).

Ⓜ Pigeon River (Otsego, Cheboygan Counties), Little Manistee (Lake County), Baldwin Creek (Lake County), Main Au Sable (Crawford County).

With the exception of Baldwin Creek and the Main Au Sable, all data obtained from the streams listed above were collected chiefly by intensive creel census crews.

Ⓜ Between Labor Day and January 1.

Ⓜ From about March 1 to the last Saturday in April.

Ⓜ Between the last Saturday in April and Labor Day, the open season for trout fishing.

Table 2

Percentages of fall- and spring-planted trout recovered at various distances and directions from the points of planting in five Michigan trout streams.

Stream	Year recovered	Species	Season planted	Number of recoveries with locality data given	Percentage of recovered fish moving number of miles and direction.			
					Upstream		Downstream	
					3-10	0-2	3-10	11-75
Pine River	1938	Brook	Fall	84	10	77	11	2
			Spring	453	1	76	22	1
	1938	Rainbow	Fall	13	15	46	31	8
			Spring	214	0+	71	25	4
	1939	Brook	Fall	26	35	19	42	4
			Spring	317	32	26	41	1
Pigeon River	1939	Brown	Fall	16	12	75	13	...
			Spring	34	6	79	15	...
	1939	Rainbow	Fall	3	...	67	33	...
			Spring	48	...	51	47	↘ 2
North Branch Au Sable	1939	Brook	Fall	42	...	40	60	...
			Spring	138	2	26	72	...
Main Au Sable	1941	Brown	Fall	27	...	100	...	...
			Spring	51	...	100	...	...
	1941	Rainbow	Fall	33	...	91	6	3
			Spring	76	...	59	16	25
Baldwin Creek	1941	Brown	Fall	10	...	100	...	...
			Spring	37	...	97	3	...
	1941	Rainbow	Fall	12	...	83	17	...
			Spring	18	...	66	17	17
All experiments combined		Brook	Fall	152	15.0	45.3	37.6	3.0
			Spring	908	11.4	42.3	45.0	1.3
		Brown	Fall	53	4.0	91.7	4.3	...
			Spring	122	2.0	92.0	6.0	...
		Rainbow	Fall	61	3.8	71.7	21.7	3.8
			Spring	356	...	61.7	26.3	12.0

↘ One tagged rainbow trout moved from Vanderbilt Road Bridge on Pigeon River to a point 17 miles off Sarnia, Ontario, in the southern end of Lake Huron. However, this record has not been verified.

Table 3

Percentages of "legal" trout recaptured by anglers  
after release at various seasons of the year  
in trout lakes

Lake, and seasons of recovery	Fall planting		Spring planting		Open-season planting	
	Number of fish planted	Percentage of recovery	Number of fish planted	Percentage of recovery	Number of fish planted	Percentage of recovery
<u>RAINBOW TROUT</u>						
↓ South Twin - 1935	100	73.0	...	...	...	...
↓ North Twin - 1937	100	66.0	...	...	...	...
↻ Pickerel - 1939	400	↻ 23.3	...	...	...	...
↻ Hemlock - 1939	303	↻ 37.3	...	...	200	48.5
↻ Burt - 1939, 1940, 1941	500	16.4	...	...	250	13.2
↻ Crooked - 1940, 1941	...	...	...	...	250	24.4
<u>BROOK TROUT</u>						
↻ East Fish - 1940	...	...	250	51.2	...	...
↻ East Fish - 1941	243	13.5	250	55.6	...	...

↓ Results based on intensive creel census alone.

↻ Results based on intensive creel census plus marking experiments.

↻ Results based on marking experiments alone with returns of marked fish voluntary.

↻ These lakes were under intensive creel census only for 9 days of the 1940 trout season, so these are minimal figures.