United States Department of the Interior
Fish and Wildlife Service

Fishery Leaflet 137

Chicago 54, Ill. * August 1945

SUMMARY OF TROUT STOCKING EXPERIMENTS

By Ancil D. Holloway, Biologist, Division of Game-fish and Hatcheries

---

This leaflet attempts to summarize and evaluate stocking experiments with trout. Tables showing the results of planting various sizes at different seasons of the year are given. In many waters, when the results expected from the planting of eyed eggs and advanced fry did not materialize, the fry were grown to larger sizes and planted as fingerlings. If stocking with fingerlings failed to satisfy the fishermen, some agencies began to plant legal-size fish. Nearly all the experiments dealing with survival and recovery of planted trout have been done in the last 10 years.

To understand the basic problem in managing trout streams, information on the relative sizes and numbers of the different age groups is necessary. In a first-class trout stream, a few of the trout should reach 7 inches during the second summer and most of them should attain that length not later than the third summer. Hoover (10) determined the age classes of brook trout in a primitive area in New Hampshire where no stocking and little fishing had occurred for a period of 10 years, as noted in the following tabulation. A very large percentage of the waters supporting trout in the eastern United States and in some other sections of the country are small headwater streams with trout populations similar to those found by Hoover.

Percentage of total population:

	Summer of age				
Water	Second	Third	Fourth	Fifth	Total
Nine Brook	66.7	20.1	14.0	0.0	185
Cold Brook	43.1	43.1	12.9	0.9	116
Unknown Pond	28.0	58.3	16.7	3.0	132

The trout in their fourth summer of life ranged from 4-3/4 to 5 inches, while the fifth summer fish were from 5-3/4 to 6-7/8 inches in length. Shetter and Leonard (19) found a similar distribution for trout in Michigan streams with 46.7 percent in the first summer of life and 30.8, 19.8, and 2.7 in each successive age group, and that wild brook trout do not reach the legal length of seven inches until their third or fourth summer. Only 2.3 percent of the trout collected had attained legal size. The results of numerous life history studies show that the life expectancy of nearly all our game fishes is not more than four or five summers for 95 to 98 percent of the individuals. Abundant fish foods are, therefore, important to promote

the rapid growth that is necessary if a body of water is to produce an abundance of fish of satisfactory sizes. Trout streams ordinarily do not have that much food. If only two or three percent of the trout in a stream reach a size that can be utilized for food and sport, as occurs in many trout streams, how can we expect them to withstand intensive fishing pressure unless we manipulate the numbers in the size groups of the population so that the greater proportion of fish foods contribute to the support and production of sizes that are usable and more satisfactory to anglers.

Let us examine the information available on the mortality of trout from the egg to the creel to see what light it throws on the proper sizes to plant.

Smith (21), working in controlled areas in Convict Creek in California, found a survival rate of 16 to 17 percent for cut-throat eggs to the fry stage, and from 0.04 to 5.98 percent to sizes of two to four inches in September of their first year. He stated that the greatest loss occurred after the fry emerged from the gravel. With brook trout the average survival through the first summer after hatching was 16.4 percent. The best results he obtained--"showed the rather remarkable fact that as many as 40 or 50 percent of the eggs may live long enough to grow into two-inch fingerlings--". These experiments show only mortality during the summer months.

Needham and Slater (13) ran 63 experiments over periods from 89 to 151 days to determine the survival of hatchery fingerlings during their first summer when planted in the spring. These experiments were also under controlled conditions in Convict Creek. A gross survival of 63.7 percent was obtained from brown-trout fingerlings ranging in size from 1.25 to 1.56 inches. Rainbow fingerlings of from 2.88 to 3.72 inches, under more severe competition, had a gross survival of 46.6 percent. Other rainbows ranging from 1.32 to 1.69 inches in length had a gross survival of 44.2 percent. The survival rate showed a direct relation to the amount of competition and predation. These experiments indicated that during the growing period, when food competition is a determining factor, the success of trout planting can be anticipated when the weight of the resident trout population is known. This finding would not apply where uncontrolled factors as floods occur, but would apply under normal stream conditions. From the results of these experiments the authors showed the expected initial summer survival of 1.4-inch brown trout stocked at the rate of 5,000 per mile of stream, 10 feet wide, to be as follows:

With	5	pounds	of	wild	trout	present	the	expected	survival	would	be	3,680.
"	25	"	"	"	"	"	"	"	"	"	"	2,690.
"	50	"	"	"	"	"	"	"	"	"	"	2,145.
"	100	"	"	"	"	"	"	"	"	"	"	1,560.

The proper planting rate in relation to available food is not measurable from the data collected. It is well known, however, that an increase in the density of planting usually results in greater survival only up to a certain point beyond which it decreases as intensity of stocking is increased.

If stocking rates were based on the number of trout or competitors already in the waters, we should expect better survival. Needham and Slater (13) state that planting of fingerlings is largely ineffectual in streams containing numerous wild trout, competition and predation preventing any significant survival. These authors also note that heavy over-winter loss of naturally-propagated brown trout in their first year is clearly indicated.

Needham, Moffett, and Slater (14) counted the fish in sections of Convict Creek in August and April from 1940 to 1944, inclusive, to procure data on winter losses. They found the population somewhat cyclic and highly unstable as to both numbers and pounds of fish present at various times. They concluded that "variable survival conditions rather than number of young produced in any season determine the number of fish that later reach a catchable size." Winter losses of all trout, regardless of size, averaged 60 percent, and evidently were correlated with the severity of the winter. From August to April, fish 4 inches and less in length decreased 62 percent and larger trout about 80 percent. Reduction in the weight of trout present usually paralleled the reduction in numbers over winter but there usually was an increase in weight from April to August because of the growth of each new age class. During the years of the study the fish of each yearly brood decreased about 85 percent in their first 18 months of life.

RESULTS FROM FALL PLANTINGS OF RAINBOW AND BROOK-TROUT FINGERLINGS

Table 1 lists the results of planting fingerling brook and rainbow trouts in streams in Michigan, North Carolina, and Virginia. It indicates the recovery that can be expected in such streams from fingerlings that remain in the stream one or more winters before reaching legal size. The best recovery was 3.3 percent and the average recovery from 30,485 individuals planted was less than one percent. Summer plantings showed no advantage over those made in the fall.

From the experiments reported on survival and recovery, it is obvious that "winter kill" is a very important factor that must be considered in trout planting. Observations indicate that it is heavy in wild as well as in planted trout.

The experiments on recoveries of fingerlings were conducted by marking the fish before planting and by examining the catches of fishermen. Needham and Slater (13) and Smith (21) performed their experiments in controlled areas of a stream where the amount of competition could be regulated and all fish removed when desired. The other workers made their experimental plants and checked results without considering the relation of recovery to the amount of fish already present. The reason that food and competition were not considered was that these factors are very difficult to measure accurately unless especially controlled areas are available. Considerable progress has been made in recent years on methods of measuring populations but an accurate evaluation of food conditions is extremely difficult. Since Needham and Slater, and Smith also, showed that the amount of competing fish was an extremely important factor affecting the amount of survival, one must conclude that if fingerling trout are to give satisfactory results they must not be planted in quantities large enough seriously to increase competition.

Table 1.--Results from plantings of fingerling brook and rainbow trout during fall, spring, and summer months

Water	State and Author	Month and year planted	Species	Number planted	Average length	Percentage recovered
North Branch of Au Sable	Mich. (16)	October 1936	Brook	9,778	3.5	0.03
Canada Creek	Mich. (16)	April 1937	do	500	5.5	1.60
Canada Creek	Mich. (16)	October 1937	do	1,000	4.0	0.00
South Branch of Pine	Mich. (16)	October 1936	do	496	5.5	0.60
South Branch of Pine	Mich. (16)	September 1937	do	98	4.6	0.00
Clancey Creek	Mich. (16)	November 1937	Rainbow	468	4.8	1.07
Clancey Creek	Mich. (16)	November 1937	Brook	541	6.0	0.00
French Broad River	N. C. (1)	Summer 1939	do	1,000	3.0	1.2
Little E. F. Pigeon River	N. C. (1)	Summer 1939	do	1,500	3.0	0.4
French Broad River	N. C. (1)	Summer 1939	Rainbow	1,000	3.0	2.0
French Broad River	N. C. (1)	Summer 1938	Rainbow	2,500	3.0	0.0
St. Marys River	Va. (22)	September 1935	Brook	2,841	3.75	0.8
St. Marys River	Va. (22)	November 1936	do	787	5.00	1.2
St. Marys River	Va. (22)	October 1938	do	1,106	5.6	0.86
St. Marys River	Va. (22)	August 1935	Rainbow	2,632	5.0	0.72
St. Marys River	Va. (22)	August) October) November) 1936	Rainbow	3,738	4.2-6.00	3.3

RESULTS FROM LEGAL LENGTH PLANTINGS OF RAINBOW, BROOK, AND CUT-THROAT TROUT

Table 2 lists the results from legal length cut-throat, brook, and rainbow trouts planted at different seasons of the year in Wisconsin, North Carolina, Michigan, Connecticut, New Hampshire, Arizona, and New Mexico. The data in this table indicate that much better recoveries can be attained by planting legal length fish than can be obtained with fingerlings. Also, that legal-length fish planted in the spring can be expected to give better results than those planted in fall or winter. Chamberlain (1) procured an average recovery of 6.4 percent from fall-planted, and 58.8 from spring-planted, brook trout. With rainbows, his recovery from fall plants of legal trout averaged 9.2 percent and from spring and summer plants 44.5 percent. Variable results were obtained by the different workers, but with one or two exceptions, spring or summer plantings gave much better results than those made in fall and winter. Recovery increased with more intensive fishing.

The experiments with legal-length trout were apparently made with little consideration of the number of pounds of fish already present and in some cases with too little consideration of the fishing pressure. From the streams in Wisconsin (23), 71 percent of the catch was made up of native fishes. Gee (4) stated that 42 and 60 percent of the catch from the streams came from native fish. Chamberlain (1) indicated a high percentage of native fish in the catches. Hazzard and Shetter (6) indicate that 54 percent of the brook trout and 79 percent of the rainbows were from other sources than the legal-length plants. Shetter and Hazzard (17) obtained from 69.6 to 98.2 percent of their catch from native fish. Smith (20) stated that native fish contributed 56 percent, 61.4, and 75.1 percent of the total catch in successive years.

Where fishing pressure is heavy in relation to the available numbers of legal-length trout planted and the number of native fish available in the stream, the recovery of legal-length spring and summer-planted trout has been correspondingly higher as shown by Heacox (7) in New York where hatchery fish contributed 85 to 90 percent of the catch. Other plantings, in numbers that related to the need as shown by fishing pressure, gave correspondingly high recovery rates. Some were as high as 70 to 92 precent.

As with fingerlings, the introduction of legal-length trout in streams in sufficient numbers to cause severe competition results in poor recovery. In many eastern streams, trout are on a near starvation diet and the introduction of legal-length trout in the spring and summer greatly overloads the carrying capacity of the streams. Unless fishermen remove a large number of the planted fish within one or two months after the season opens, poor-conditioned fish will begin to occur in the catches and a high percentage of the fish planted will never reach the creel. Two things can be done to prevent planted trout from getting in poor condition. The first is to limit the number planted so that a high percentage will be caught within one or two months, and the second is to plant only well-conditioned fish. A method worked out by the author (8), and used in 16 trout management areas on National Forests in the southeastern States, was to plant about five legal-length trout per fisherman day of effort. More than half of the total fishing effort occurred during the first half of the season and often in the first three weeks. Except in

streams fished heavily throughout the season, this permitted the fish to be planted three or four weeks in advance of the season and gave assurance that 50 percent or more would be removed during the first half of the fishing season. When the number of legal-length trout was increased to 7 to 10 per fisherman day, poor-conditioned fish began to occur in the catches by the middle of the fishing season and poor to mediocre recovery was obtained from the plants. Where fishing was heavy throughout the season it was found desirable to make at least one plant during the season in addition to that made in advance of opening day. These remarks relate primarily to rainbows. Brook trout are caught out rather rapidly and if continuous heavy fishing is anticipated, several small plantings during the season would be more desirable than one or two large plants.

The use of legal-length trout to support fishing pressure has received criticism from the "dry-fly purist" and some worm fishermen. It has been said that hatchery trout show poor fighting and eating qualities, also poor color It may interest those offering these criticisms to know that many excellent fly fishermen have been heard to criticize naturally-reared fish in some of our eastern streams as being small and unable to reach sufficient size (7 to 8 inches) to put up a fight. I am sure, however, that all of us prefer trout fishing from naturally-reared stock where such is possible. However, if we are to have trout fishing provided only by natural stream-reared and planted fingerlings of sizes that have to remain in the stream through at least one winter, then, it will be for only a limited number of people. There has been a number of suggestions on how the take can be limited to distribute the fishing among many. Some "dry-fly purists" have recommended that all fishing be done with barbless hooks and that all trout be returned to the water for the next fisherman. That type of management may be justified in private or fishing-club waters or in limited public waters, but since, most trout fishing is supported by public funds, it should be maintained primarily for general public use, not for the most expert and idealistic anglers.

The country still has many waters to which fishermen cannot drive a car. If satisfactory fishing were provided in accessible areas correspondingly less stocking would be needed in remote waters. The general run of fishermen would be provided for in the readily accessible waters by the use of legal trout. This planting of legal-length trout to distribute fishing pressure is a management tool that should not be overlooked.

We need not be too much concerned with answering the criticism that legal-length planted fish are too easy to catch. If a wild-trout population is present they will make up a high percentage of the total catch during the early part of the season, indicating that they are just as easy to catch as the planted fish. This may not be true with brook trout as they are much easier to hook than are the rainbow or brown trouts.

The most general criticism of legal trout by the angler concerns lack of color and fighting qualities. Holloway and Chamberlain (8) found that fish planted approximately four weeks in advance of the opening date of the fishing season acquired natural color and, except for their being in better condition, resembled wild trout. Legal-length trout were carried through the winter in dirt ponds, or conditioned in such ponds four or five weeks before planting. In these ponds, trout become well-colored, well-conditioned, and essentially like wild fish.

Table 2.--Results of planting legal-size cut-throat, brook, and rainbow trouts in spring, summer, and fall

Water	State and Author	Month and year planted	Species	Number planted	Average length	Percentage recovered
Deerskin River	Wisc. (23)	December 1940	Brook	802	Legal	20.2
Deerskin River	Wisc. (23)	May 1941	do	200	Legal	82.0
Deerskin River	Wisc. (23)	December 1940	Rainbow	450	Legal	48.4
Deerskin River	Wisc. (23)	May 1940	do	1,171	Legal	30.5
West Fk. Pigeon River	N. C. (1)	Fall 1940	Brook	730	7.5	22.6
West Fk. Pigeon River	N. C. (1)	Spring 1941	do	2,720	8.5	82.7
West Fk. Pigeon River	N. C. (1)	Fall 1939	do	1,000	7.5	7.9
West Fk. Pigeon River	N. C. (1)	Spring 1940	do	2,975	8.5	78.9
West Fk. Pigeon River	N. C. (1)	Fall 1938	do	3,000	7.5	2.3
West Fk. Pigeon River	N. C. (1)	Spring 1939	do	900	8.5	49.1
South Mills River	N. C. (1)	Fall 1939	do	500	7.5	7.2
South Mills River	N. C. (1)	Spring 1940	do	1,050	8.5	15.5
South Mills River	N. C. (1)	Spring 1941	do	1,250	8.5	45.4
Davidson River	N. C. (1)	Fall 1937	do	3,000	7.5	5.9
Davidson River	N. C. (1)	Spring 1940	do	743	8.5	52.4
Davidson River	N. C. (1)	Spring 1941	do	830	8.5	62.2
Big E. F. Pigeon River	N. C. (1)	Spring 1941	do	2,520	8.5	45.2
Little E. F. Pigeon River	N.C. (1)	Spring 1941	do	1,200	8.5	36.3
Average Fall Plants	N. C. (1)	Fall -	do	8,230	7.5	6.4
Average Spring Plants	N. C. (1)	Spring -	do	14,188	8.5	57.8
Davidson River	N. C. (1)	Fall 1940	Rainbow	1,000	7.5	26.2
Davidson River	N. C. (1)	Spring 1941	do	3,332	8.5	62.4
Davidson River	N. C. (1)	Fall 1939	do	2,000	7.5	13.4
Davidson River	N. C. (1)	Spring 1940	do	3,066	8.5	44.0
Davidson River	N. C. (1)	Fall 1937	do	6,500	7.5	5.6
Davidson River	N. C. (1)	Fall 1938	do	6,537	9.5	4.8
South Mills River	N. C. (1)	Fall 1940	do	2,000	7.5	19.8
South Mills River	N. C. (1)	Spring 1941	do	2,600	8.5	38.1
South Mills River	N. C. (1)	Fall 1939	do	1,487	7.5	10.6

Table 2.--Results of planting legal-size cut-throat, brook, and rainbow trouts in spring, summer, and fall
Continued

Water	State and author		Month and year planted	Species	Number planted	Average length	Percentage recovered
South Mills River	N. C.	(1)	Spring 1940	Rainbow	1,000	8.5	64.3
North Mills River	N. C.	(1)	Fall 1940	do	1,000	7.5	13.3
North Mills River	N. C.	(1)	Spring 1941	do	1,320	8.5	23.4
French Broad River	N. C.	(1)	Fall 1940	do	1,200	7.5	10.8
French Broad River	N. C.	(1)	Spring 1940	do	2,700	8.5	38.1
Average Fall Plants	N. C.	(1)	Fall -	do	21,722	7.5	9.2
Average Spring Plants	N. C.	(1)	Spring -	do	14,018	8.5	44.5
Wayah Creek	N. C.	(8)	Season planting	Brook	595	7.5	92.0
Salmon Trout River	Mich.	(20)	November 1938	do	1,233	7.9	0.02
Salmon Trout River	Mich.	(20)	May 1938	do	252	7.9	15.5
Salmon Trout River	Mich.	(20)	October 1939	do	600	7.9	1.0
Salmon Trout River	Mich.	(20)	Spring 1940	do	699	7.9	12.01
Two Streams	Mich.	(17)	Fall 1937-39	Rainbow	1,000	Legal	6.9
Two Streams	Mich.	(17)	Spring 1937-39	do	1,000	do	23.2
Three Streams	Mich.	(17)	Fall 1937-39	Brook	2,798	do	4.4
Four Streams	Mich.	(17)	Spring 1937-39 (Seasons plantings)	do	3,300	do	29.2
Four Streams	Mich.	(17)	(1937-39 (Seasons plantings))	Brook	9,501	do	24.7
Two Streams	Mich.	(17)	(1937-39 (Seasons plantings))	Rainbow	7,391	do	23.7
Pine River Drainage	Mich.	(6)	(1937 (Season plantings))	Brook	7,514	do	1/ 19.8
Pine River Drainage	Mich.	(6)	(1937)	Rainbow	4,007	do	1/ 17.5

1/ Returns incomplete.

Table 2.--Results of planting legal-size cut-throat, brook, and rainbow trouts in spring, summer, and fall
Continued

Water	State and author	Month and year planted	Species	Number planted	Average length	Percentage recovered
		(Season plantings)				
Several streams	Conn. (3)	(1932)	Brook	15,875	Legal	2/ 33.0
Bear Creek	N. H. (9)	June 1942	do	500	do	3/ 70.0
Horton Creek	(Ariz. and (New Mex. (4)	May 1940	Rainbow	399	6.8	72.0
Upper Tonto Creek	do	May 1940	do	398	6.8	57.5
Rio La Junta	do	November 1940	(New Mex. natives)	491	6.8	7.7
Rio La Junta	do	July 1941	do	198	9.11	37.5
Rio La Junta	do	August 1941	do	198	9.11	37.3
Rio La Junta	do	April 1940	(Wild fish (New Mex. (natives	84	6.8	54.6
Rio La Junta	do	June 1941	do	141	7.9	42.0
Willow Creek	do	May 1939	Rainbow	2,000	7.9	41.17
Upper Pecos River	do	May 1939	do	799	6.8	61.2
Upper Pecos River	do	January 1940	do	593	6.8	2.2
Upper Pecos River	do	September 1940	do	995	6.8	28.2

1/ Returns incomplete.
2/ Fish marked with belly tags and returns based on voluntary returns from anglers. Actual recovery estimated to be twice as high.
3/ Census for three weeks after planting.

RESULTS FROM LAKE PLANTINGS IN MICHIGAN AND CALIFORNIA

Table 3 gives the results of lake stocking. The returns indicate that very good results can be obtained from fall plantings. The data available are inadequate for broad application, but they agree in general to the satisfactory results obtained from planting fingerlings in lakes.

In a great many trout lakes, fishing has been improved and maintained by planting fry and fingerlings. Mottley (11) by planting one-inch fry in Paul Lake, British Columbia, increased the annual catch in a five-year period from 3,000 to 10,000 and the total weight from 4,500 pounds to 10,000 pounds. The number of fish in the spawning run was increased from 500 to 2,500. The mortality amounted to about 95 percent of the fry planted. Harkness (5) gives data showing that the planting of fry and fingerlings was instrumental in increasing and maintaining the catch in three small lakes in Ontario. Needham and Summer (12) showed that winter-kill was an important factor in survival of planted trout in high western lakes. Shetter and Hazzard (17) demonstrated that excellent recovery can be obtained with legal-length, fall-planted rainbows in certain Michigan lakes. The fact that there have been fewer studies made on recoveries from planted trout in lakes compared to streams is indicative of better success in the maintenance of lake fishing. The data available indicate that the most economical method of maintaining trout fishing in lakes may be different in various regions and even in closely associated lakes.

RESULTS FROM BROWN TROUT PLANTINGS

Table 4 gives the results from a number of brown-trout planting experiments. The recovery records do not indicate that spring or summer plantings have any advantage over fall plants. The author's experience in Forest Service management areas in the southeastern United States indicated that it was as economical to plant fingerlings in the fall as in the spring. With legal-length, brown trout comparatively poor recoveries were experienced, not always due to poor survival, but to the inability of the fishermen to catch them. Brown trout have done rather well in sandy and silted streams in the southeastern National Forests where brook and rainbow trouts were unsuccessful, provided minnow life was adequate to support them. Brown trout, contrary to common belief, do not thrive in warmer waters than do the rainbows.

New York State has done considerable legal-length, brown-trout stocking with satisfactory results. In this program, Heacox (7) found that legal-length brown trout carry through the winter well. Excellent recovery was indicated from his incomplete creel census (table 3), which revealed that 85 to 90 percent of the catch was from hatchery fish and that the most recently stocked trout were not, as a rule, the first to be caught. For example, on Wiscoy Creek, during the first 14 days of the 1943 season, only seven trout were caught from the most recent planting, while 213 trout were recorded as from the planting made the previous fall. After May 1, however, the bulk of the catch was composed of trout from the planting made just before the opening of the season.

Table 3.--Results of trout planting in lakes

Water	State and author	Month and year planted	Species	Number planted	Average length	Percentage recovered
South Twin Lake	Mich. (17)	Fall 1935	Rainbow	100	Legal	1/ 64.0
North Twin Lake	Mich. (17)	Fall 1937	do	100	do	1/ 66.0
Pickerel Lake	Mich. (17)	Fall 1939	do	400	do	2/ 23.3
Hemlock Lake	Mich. (17)	Fall 1939	do	303	do	3/ 37.3
Upper Angora Lake	Calif. (12)	September 1933	Brook	5,028	1,97	4.3
Upper Angora Lake	Calif. (12)	June 1935	do	2,080	5.3	4/ 25.62

1/ One season creel census.
2/ Creel census April 27 to May 5, 1940.
3/ Creel census first 9 days of 1940 season only.
4/ Caught season 1935, 22.7 percent.

Table 4.--Results of brown-trout planting

Water	State and author	Month and year planted	Species	Number planted	Average length	Percentage recovered
One Stream	Mich. (17)	Fall 1937-39	Brown	500	Legal	3.2
One Stream	Mich. (17)	Spring 1937-39	do	500	do	6.8
Two Streams	Mich. (17)	Spring 1937-39	do	1,500	do	13.0
South Mills River	N. C. (1)	Summer 1939	do	4,000	3	0.7
South Mills River	N. C. (1)	Fall 1938	do	1,500	6.5	32.3
South Mills River	N. C. (1)	Fall 1939	do	2,930	6.0	7.3
South Mills River	N. C. (1)	Fall 1940	do	900	7.5	7.1
Average Fall Plants	N. C. (1)	Fall -	do	5,330	6-7.5	14.3
South Mills River	N. C. (1)	Spring 1941	do	820	9	28.2
South Mills River	N. C. (1)	Spring 1940	do	1,870	9	16.0
North Mills River	N. C. (1)	Spring 1941	do	1,000	8.5	4.3
Average Spring plants	N. C. (1)	Spring -	do	3,690	8.9	15.6
Clancey Creek	Mich. (16)	November 1937	do	541	6	0.0
Clancey Creek	Mich. (16)	November 1937	do	506	4	0.0
Wiscoy Creek	N. Y. (7)	Spring 1941	do	7,200	Legal	1/20.4
Wiscoy Creek	N. Y. (7)	Fall 1941	do	2,915	do	1/31.8
Wiscoy Creek	N. Y. (7)	Spring 1942	do	7,200	do	1/33.2
Wiscoy Creek	N. Y. (7)	Fall 1942	do	3,600	do	1/31.4
Wiscoy Creek	N. Y. (7)	Spring 1943	do	7,200	do	1/28.7
East Koy Creek	N. Y. (7)	Spring 1941	do	11,400	do	1/20.9
East Koy Creek	N. Y. (7)	Fall 1941	do	3,020	do	1/32.2
East Koy Creek	N. Y. (7)	Spring 1942	do	6,915	do	1/39.4
East Koy Creek	N. Y. (7)	Fall 1942	do	1,661	do	1/24.5
East Koy Creek	N. Y. (7)	Spring 1943	do	7,000	do	1/47.8

1/ Creel census incomplete--85 to 90 percent of trout caught were of hatchery origin.

Creel Census Records

Records of catches per fisherman day of effort are not abundant. Shetter and Hazzard (17) note catches of from 7 to 15 fish per man-day of effort; Smith (20) 4.3 to 5.2; Chamberlain (1) 5.1 for 11,076 fishermen over a five-year period; and Holloway and Chamberlain (8) 5.9 for 10,200 anglers. Some catch records for southeastern National Forests Wildlife Management Areas are shown in table 5. They represent better than average catches for the region involved, as indicated by the increase each year in the number of anglers that were willing to pay a fee of $1 for the privilege of fishing in the managed areas.

What is considered as satisfactory fishing may vary from one section of the country to another. Average daily catches may be influenced by legal length and creel limit, the species of trout, and other factors.

Table 5.--Some fishing returns from southeastern Forest Service Wildlife Management areas

Management area	Number man-days fishing	Average catch per man-day	Average length (inches)	Percentage catching no trout	Percentage catching limit	Year
Daniel Boone	218	6.1	7.5	-	-	1941
Mt. Mitchell	678	6.0	8.3	-	-	1941
Sherwood	1,230	6.5	8.0	-	-	1941
Santeetlah	640	9.7	7.2	-	-	1941
Standing Indian	316	5.5	7.6	-	-	1941
Fires Creek	321	5.2	8.0	-	-	1941
Wayah Bald	275	8.7	7.3	-	-	1941
Cliffside Lake	359	7.7	7.4	-	-	1941
Tellico 1/	2,016	5.0	8.4	30	25	1940
Jacks River 1/	414	4.8	-	32	27	1941
Rock Creek 1/	655	3.9	-	18	13	1941
16 Areas 2/	10,200	5.1	-	-	-	1941
Pisgah experiments	11,076	5.9	-	-	-	1937-1941

1/ Estimated from creel census of portion of fishermen.

2/ Total creel census on nine areas and partial creel census on seven.

SUMMARY

Studies have shown a survival of approximately 16 percent from egg to fingerling stage during the first summer, an over-winter loss of 62 percent for trout under four inches, 80 percent for larger trout, and about 60 perce for all sizes combined. The fish of each yearly brood decreased about 85 percent during the first 18 months of life. The life expectancy of trout is not more than three or four years for 95 to 98 percent of the individuals. Recoveries from experimental plants in streams of brook, rainbow, and, cut-throat trouts have indicated an average recovery from fall-planted fingerlings of less than one percent; for fall-planted, legal-length trout, 6 to 10 percent; for spring and summer plantings of legal-length, 45 to 60 percent, with some recoveries being as high as 70 to 90 percent when the number planted was correlated closely with fishing pressure. In many trout lakes, the planting of fry and fingerlings has given very good results. Brown trout experiments are inconclusive but indicate that planting fingerlings in the fall may be as satisfactory as stocking legal-length trout in the spring. In considering cost, fall-planted, brown-trout fingerlings would appear advantageous for use in many waters.

The needs for trout stocking may be outlined as follows:

1. No stocking in waters with sufficient reproduction and productivity to accommodate the angler load.

2. Stock waters barren of trout if such waters are needed to support or spread the angling pressure. Advanced fry or fingerlings usually give satisfactory results.

3. Stock waters where natural replacement does not occur or is inadequate to maintain a trout population large enough fully to utilize the food supply, provided the increase in trout is needed to support the fishing load. If advanced fry and fingerlings do not give satisfactory results, a limited number of legal-length trout may be used.

4. Stock legal-length trout in advance of or during the fishing season where the annual productivity of the stream is inadequate to meet the fishing demand. In this case, only enough legal-length fish should be planted to satisfy fishing requirements.

Good trout management, ordinarily, is merely the manipulation of trout populations by the cheapest method available to maintain adequate legal-length fish to supply the fishing demand. In some high western waters that are carrying too large a population for the food supply, fishing could be improved by reducing the fish population and thereby increasing the size of individuals. In other waters, trout fishing has been restored or improved by: controlling the "rough" or competing species; removing barriers to permit fish to reach more extensive and better spawning areas; improving the physical character of streams by the construction of small dams and suitable cover; and limiting the catch and fishing seasons. Waters are not standardized in their biological and physical characteristics and may not be satisfactorily managed by any uniform method of stocking or treatment. Each is a problem in itself and should be so studied and treated.

REFERENCES

1. Chamberlain, Thomas K.
   1942 - Research in stream management in the Pisgah National Forest. Trans. Am. Fish. Soc. 72: 150-176.

2. 1942 - Overstocking fish streams. Trans. 8th No. Am. Wildlife Conf. 350-357.

3. Cobb, Eben W.
   1933 - Results of trout tagging to determine migration and results from plants made. Trans. Am. Fish. Soc. 63: 308-318.

4. Gee, Merle
   1942 - Success of planting legal size trout in the southwest. Trans. 7th No. Am. Wildlife Conf. 238-244.

5. Harkness, William J. K.
   1940 - Catches of speckled trout from the plantings of hatchery-raised fish in private waters of Ontario. Trans. Am. Fish. Soc. Vol. 70: 410-413.

6. Hazzard, Albert S. and David S. Shetter.
   1939 - Results from the planting of legal size brook trout (Salvelinus fontinalis) and rainbow trout (Salmo g. irideus) Trans. Am. Fish. Soc. 68: 196-208.

7. Heacox, Cecil
   1944 - Stocking experiments on Wiscoy and East Koy Creeks. The Empire State Sportsman. Vol. 4, No. 7, April 1944.

8. Holloway, Ancil D. and Thomas K. Chamberlain.
   1942 - Trout management and stocking results in the National Forests of the Southern Appalachians. Trans. 7th No. Am. Wildlife Conf. 245-249.

9. Hoover, Earl E. and M. S. Johnson.
   1938 - Migration and depletion of stocked brook trout. Trans. Am. Fish Soc. 67: 224-227.

10. Hoover, Earl E.
    1939 - Age and growth of brook trout in Northern breeder streams. Jour. Wildlife Mgt. 3.2: 81-91.

11. Mottley, C. McC.
    1940 - The production of rainbow at Paul Lake, British Columbia. Trans. Am. Fish. Soc. Vol. 69. 188-191.

12. Needham, Paul R. and Frank K. Summer.
    1941 - Fish management problems of high western lakes with returns from marked trout planted in upper Angora Lake, California. Trans. Am. Fish. Soc. 71: 249-269.

13. Needham, Paul R. and Daniel W. Slater.
1944 - Survival of hatchery-reared brown and rainbow trout as affected by wild trout populations. Jour. Wildlife Mgt. 8.1: 22-36.

14. Needham, Paul R., James W. Moffett, and Daniel W. Slater.
1945 - Fluctuations in wild brown trout populations in Convict Creek, Calif. Jour. Wildlife Mgt. 9.1: 9-25.

15. Nesbit, Robert A. and J. Arthur Kitson.
1937 - Some results of trout tagging in Massachusetts. Copeia, Nov. 17, 1937. 2: 168-172.

16. Shetter, David S.
1939 - Success of planting fingerling trout in Michigan waters as demonstrated by marking experiments and creel census. Trans. 4th No. Am. Wildlife Conf. 318-325.

17. Shetter, David S. and Albert S. Hazzard.
1941 - Results from planting marked trout of legal size in streams and lakes of Michigan. Trans. Am. Fish. Soc. 70: 446-467.

18. 1942 - Planting "keeper" trout. Mich. Conservation 4: 3-5.

19. Shetter, Daniel S. and Justin W. Leonard.
1942 - A population study of a limited area in a Michigan trout stream, September 1940. Trans. Am. Fish. Soc. 72: 35-51.

20. Smith, Lloyd L.
1940 - The results of planting brook trout of legal length in the Salmon Trout River - Northern Michigan. Trans. Am. Fish. Soc. 70: 249-259.

21. Smith, Osgood R.
1944 - Returns from Natural spawning of cut-throat and eastern brook trout, Fish and Wildlife Service (unpublished).

22. Surber, Eugene W.
1940 - Lost - 10,839 fingerling trout. Progressive Fish Culturist 49: 1-13.

23. Williamson, Lyman O. and Edward Schneberger.
1942 - The results of planting legal-sized trout in the Deerskin River, Vilas County, Wisconsin. Trans. Am. Fish. Soc. 72: 92-96.