Original: Fish Division
cc: Education - Game
Institute for Fisheries Research
D. S. Shetter
J. A. Scully
C. T. Yoder
R. S. Marks
E. L. Cooper

June 15, 1951

Report No. 1288

PIGEON RIVER TROUT RESEARCH AREA

SECOND ANNUAL REPORT OF FISHING

1950

By

Edwin L. Cooper

Pigeon River Trout Research Area

Second Annual Report of Fishing

1950

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INSTITUTE FOR FISHERIES RESEARCH
DIVISION OF FISHERIES
MICHIGAN DEPARTMENT OF CONSERVATION
COOPERATING WITH THE
UNIVERSITY OF MICHIGAN

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Abstract

A permit system creel census was in operation on 4.8 miles of the Pigeon River during the season of 1950. Total fishing intensity in 1950 was 2,160 fishing trips compared with 2,233 in 1949. The records for both years indicate a relatively heavy use of this portion of the stream.

Fishing success in 1950 was considerably better than in 1949. This was attributed to more efficient utilization in 1950 of the 4,500 legal-sized trout planted in each of the two years. In both years, about half of the fishing trips were unsuccessful.

There was no evidence to indicate that either fishing calendars or the barometer could be relied on in predicting fishing success. One of the most important factors determining angling quality was the planting of hatchery trout. Cold water in the spring (below 54° F.) appeared to adversely affect fishing quality, as did warm water on days in which the temperature rose to above 74° F.

Fishing with worms was more popular than flies during the early part and the latter part of the season. Persons fishing with worms took more hatchery trout per trip than did persons fishing with flies. Fly fishermen were more successful in catching wild trout.

A comparison of the merits of spot planting and scatter planting indicated little or no differences between the two methods.

In 1950, a relatively few fishing trips (or anglers) accounted for a large proportion of the total catch. In general, the more skilled fishermen go fishing more times than the lesser skilled ones. Fisherman's luck plays a minor role in determining success in trout fishing.

Fishing success may be maintained at nearly any desired level by planting legal-sized trout frequently in appropriate numbers. The catch per hour of hatchery fish for the week June 1 to June 7, 1951, averaged 2.27 legal trout; 107 of 123 fishing trips (87 percent) were successful in catching at least one trout. This was the week following a planting of 2,000 hatchery trout. Three weeks later, the catch per hour of hatchery fish was only 0.40 legal trout; 42 percent of the trips were successful.

Plantings of rainbow trout influenced the catch for longer periods of time than did equal numbers of brook trout. Over-winter recoveries of brown and rainbow trout averaged 2.3 percent of 3,000 fish planted during the previous trout season. No brook trout were recovered in 1950 from 1,500 fish planted during the 1949 season.

Movement of hatchery trout following planting was slight, except for one early season planting. A marked downstream movement of the April planting occurred coincident with low water temperatures.

No relationship could be demonstrated between planting large numbers of hatchery trout and the catch of wild trout in the stream. More information is desirable concerning competition for food and space and their effects on growth, condition and survival for a proper understanding of trout population dynamics.

Production of wild trout in the 4.8 miles of the Pigeon River averaged 8.57 pounds per acre in 1950 compared with 8.41 pounds per acre in 1949. In no instance did individual production rates of the four sections in 1950 differ by more than 17 percent from the 1949 values. As to species, brook trout predominate both in numbers and in total weight.

The brook trout population appears to be heavily exploited in comparison to the brown trout in the Pigeon River. This is indicated by the smaller average size of the brook trout taken by anglers and by the smaller number of legal-sized fish remaining after the season has closed.

The average trout fisherman cannot readily identify the three species of trout commonly found in Michigan. He believes that we are not doing enough environmental improvement, but is undecided about planting more legal-sized trout. He favors higher license fees by a majority of about 3 to 1.

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Introduction

In April, 1949, the Pigeon River Trout Research Area was established on the site of the old Pigeon River Forest Headquarters, 13 miles east of Vanderbilt in Otsego County. In this area, a series of lakes suitable for trout and 4.8 miles of the Pigeon River make possible detailed studies of the management of the three species of trout common to Michigan. The present report deals principally with the results of the second annual creel census taken on the stream in connection with the permit system of fishing in the area. A report covering the analysis of fishing results of the lakes will be embodied in the study of the fertilization experiments on these lakes being undertaken by Mr. Howard A. Tanner under the supervision of Dr. Robert C. Ball.

Fishing regulations for the different fishing sections (A, B, C, and D) of the 4.8 miles of the Pigeon River (Table 1) remained unchanged from the season of 1949. Sections A and B had a 5-trout daily limit; sections C and D had the 15-trout daily limit in general effect in trout streams in Michigan. The minimum size limit remained at 7 inches for

Table 1.--Morphometry of the experimental portion of the Pigeon River, Survey of 1949-50

Item	Section A	Section B	Section C	Section D	Total
Length - miles	1.31	1.19	1.13	1.18	4.80
Average width - feet	45	41	40	40	41
Area - acres	7.16	5.90	5.39	5.65	24.10
Gradient - feet					
Per section	12.61	11.34	13.72	9.07	46.74
Per mile	9.63	9.53	12.20	7.69	9.74
Percent	0.18	0.18	0.23	0.15	0.18

both the 1949 and 1950 seasons on all sections. No fish were planted in Sections A and D; equal numbers of the trout planted were distributed between the two middle sections, B and C (Figure 1). This policy is the same as that of 1949 and permits an evaluation of the amount of movement of the hatchery fish following planting.

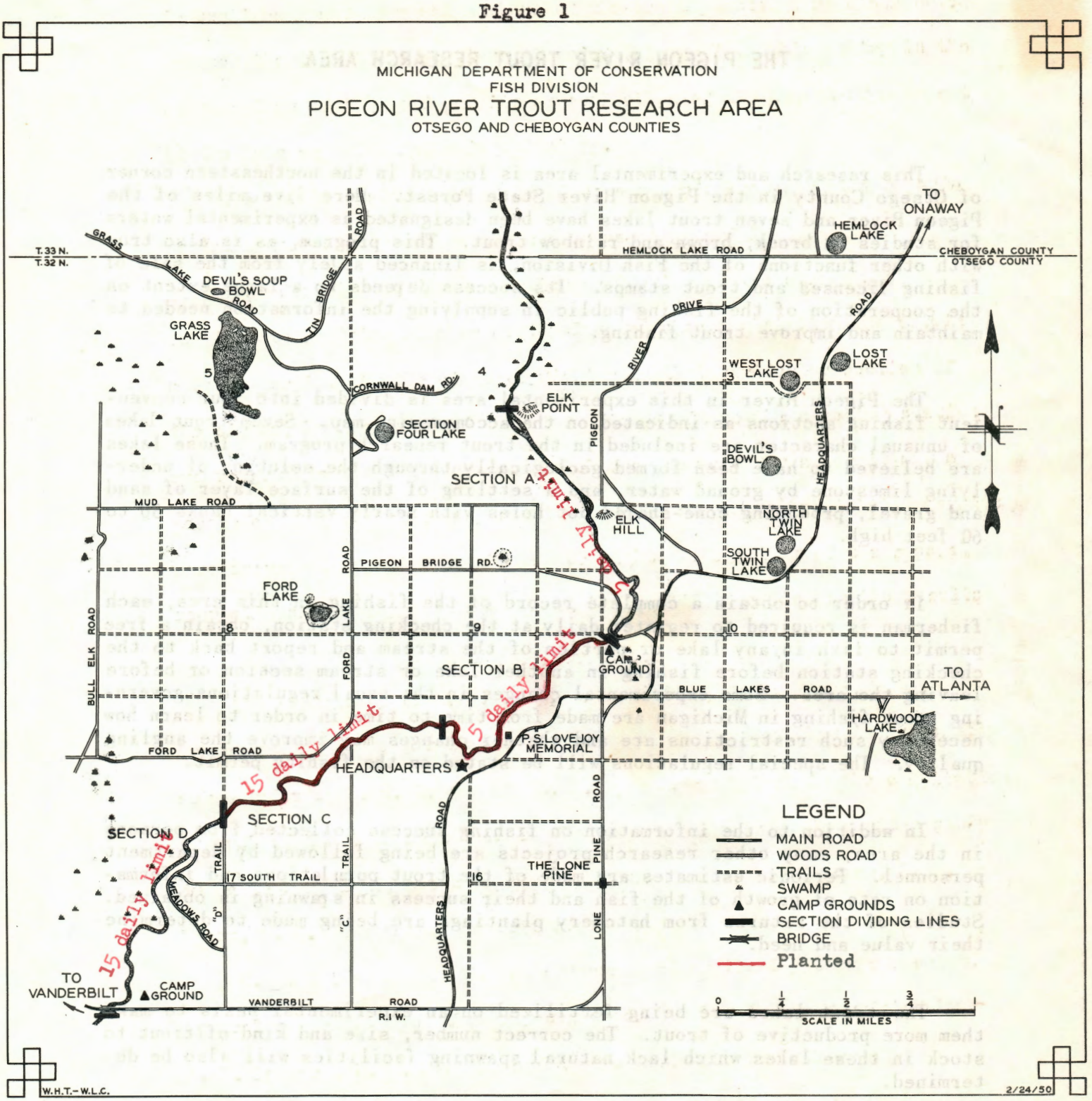
The permit system type of creel census was operated on the experimental waters during the past two seasons (1949 and 1950). Each fisherman desiring to fish a particular portion of the stream was required to register at a centrally-located checking station and obtain a daily permit. At the close of fishing in that particular section of the stream, he was required to return his permit to the checking station and report his fishing success. No charge was made for a permit and a person could fish in as many sections of the stream as he wished. Permits were issued at any time of the day or night. Violations of the special regulations were very few and minor, having little effect on the results.

Acknowledgment

The assistance of W. H. Tody, N. G. Benson, G. F. Myers, D. G. Tesman and W. C. Wagner in securing data on anglers catches is gratefully acknowledged. N. G. Benson and G. F. Myers also helped in the compilation of much of the data contained in the report. The trout population study in September, 1950, was conducted by K. G. Fukano, E. Andersen, G. F. Myers, N. G. Benson and the writer.

G. P. Cooper and A. S. Hazzard examined critically the manuscript. General supervision of the projects described herein was furnished by A. S. Hazzard, R. S. Shetter and the writer. The assistance of Conservation Officers Henry Holds and Leo Marlatt in securing public acceptance to the experimental program is also acknowledged.

Figure 1


MICHIGAN DEPARTMENT OF CONSERVATION
FISH DIVISION
PIGEON RIVER TROUT RESEARCH AREA
OTSEGO AND CHEBOYGAN COUNTIES
T. 33 N.
T. 32 N.
GRASS LAKE ROAD
DEVIL'S SOUP BOWL
TIN BRIDGE ROAD
GRASS LAKE
CORNWALL DAM RD.
SECTION FOUR LAKE
HEMLOCK LAKE ROAD
HEMLOCK LAKE
TO ONAWAY
CHEBOYGAN COUNTY
OTSEGO COUNTY
RIVER DRIVE
PIGEON
ELK POINT
WEST LOST LAKE
LOST LAKE
HEADQUARTERS ROAD
DEVIL'S BOWL
SECTION A
5 daily limit
ELK HILL
NORTH TWIN LAKE
SOUTH TWIN LAKE
MUD LAKE ROAD
PIGEON BRIDGE RD.
FORD LAKE
FORD LAKE ROAD
BULL ELK ROAD
SECTION B
CAMP GROUND
BLUE LAKES ROAD
TO ATLANTA
HARDWOOD LAKE
P.S. LOVEJOY MEMORIAL
HEADQUARTERS
15 daily limit
SECTION C
SECTION D
17 SOUTH TRAIL
MEADOWS ROAD
"D" TRAIL
"C" TRAIL
THE LONE PINE
PINE LONE ROAD
HEADQUARTERS ROAD
TO VANDERBILT
CAMP GROUND
VANDERBILT ROAD
R.I W.
LEGEND
MAIN ROAD
WOODS ROAD
TRAILS
SWAMP
CAMP GROUNDS
SECTION DIVIDING LINES
BRIDGE
Planted
0 1/4 1/2 3/4 1
SCALE IN MILES
W.H.T.-W.L.C.
2/24/50

Fishing Intensity

During the trout season of 1950 (April 29 to September 10, inclusive) 2,160 fishing trips were made in the experimental portion of the Pigeon River. These fishing trips amounted to 6,195 hours of fishing (2.87 hours per trip), which is equivalent to 1,291 hours of fishing per mile of stream or 257 hours per acre (Table 2). The two sections that were stocked with hatchery fish accounted for about two-thirds of the fishing effort.

The entire pattern of fishing intensity on the different sections of the Pigeon River in 1950 was very similar to that in 1949. Total fishing was about 3 percent less in 1950. The bulk of the fishing trips were made on week ends and holidays, with Saturdays and Sundays alone accounting for 48 percent of the fishing trips. July and August averaged fewer fishermen per day than did May, June and September (Table 3). The cold weather on opening week end had such an adverse effect on fishing quality in the stream (101 fishing trips produced only 2 fish) that many fishermen chose to fish in the pot-hole lakes where limit catches of 5 trout were common.

The 2,160 fishing trips were made by 1,199 individual fishermen. About two-thirds of the anglers fished only once in the Pigeon River during the season and 96 percent made less than 6 fishing trips on this portion of the stream. Only one person in a hundred fished there 10 times or more during the season (Table 4).

Residence of Anglers

The residence of anglers fishing the Pigeon River in 1950 has been tabulated both as to the number of fishing trips and by individuals (Tables 5 and 6). The distribution of the anglers according to residence follows the distribution of the population of the state to a large extent; large numbers of fishermen came from areas of high population density (Table 7). An exception to this trend is noted for

Table 2.--General results of fishing, Pigeon River, season of 1950

Item	Section A	Section B	Section C	Section D	Total
Number of fishing trips	333	814	616	397	2,160
Number of hours fished	898	2,130.5	1,890	1,276.5	6,195
Percent of total hours	14.5	34.4	30.5	20.6	
Number of trout taken					
Hatchery	291	1,064	905	43	2,303
Wild	123	251	402	414	1,190
Number of trout per successful fishing trip	2.8	3.1	4.0	2.8	3.3
Number of fishing trips successful	153	430	325	164	1,072
Percent successful	45.9	52.8	52.8	41.3	49.6

Table 3.--Distribution of angling pressure throughout the season, Pigeon River, 1950

Week of season	Number of fishing trips	Period	Number of fishing trips	Average fishing trips per day
April 29 - May 5	114 W	April 29-30	101	...
May 6 - May 12	63	May 1-31	570	18
May 13 - May 19	154	June 1-30	536	18
May 20 - May 26	127	July 1-31	396	13
May 27 - June 2	230 W	August 1-31	390	13
June 3 - June 9	166	September 1-10	167	17
June 10 - June 16	134			
June 17 - June 23	123			
June 24 - June 30	96			
July 1 - July 7	175 W			
July 8 - July 14	64			
July 15 - July 21	83			
July 22 - July 28	53			
July 29 - August 4	56			
August 5 - August 11	106			
August 12 - August 18	104			
August 19 - August 25	91			
August 26 - September 1	71			
September 2 - September 8	128 W			
September 9 - September 10	22			
Total	2,160			

W Includes opening week end, Decoration Day, Fourth of July, and Labor Day, respectively.

Table 4.--Distribution of the number of fishing trips per angler, Pigeon River, 1950

Number of fishing trips	Number of anglers	Percent of total anglers	Cumulative percent of total anglers
1	815	68.0	68.0
2	181	15.1	83.1
3	86	7.2	90.2
4	46	3.8	94.1
5	25	2.1	96.2
6	11	0.9	
7	8	0.7	
8	6	0.5	
9	8	0.7	
10	1	0.1	99.0
11	4	0.3	
12	3	0.3	
..	...	...	
14	1	0.1	
15	2	0.2	
..	...	...	
19	1	0.1	
..	...	...	
21	1	0.1	

Table 5.--Residence of anglers fishing Pigeon River in 1950. Tabulated by fishing trips.

County of residence	Population of county in thousands	Number of fishing trips
Allegan	42	4
Alpena	21	11
Antrim	11	2
Barry	23	1
Bay	75	80
Benzie	8	3
Berrien	89	1
Branch	26	20
Calhoun	94	25
Charlevoix	13	5
Cheboygan	14	32
Chippewa	28	2
Clare	9	6
Clinton	27	6
Crawford	4	3
Eaton	34	4
Emmet	16	7
Genesee	228	139
Gladwin	9	11
Grand Traverse	23	16
Gratiot	32	2
Hillsdale	29	23
Ingham	130	110
Ionia	36	1
Isabella	26	6
Jackson	93	15
Kalamazoo	100	12
Kent	246	33
Lapeer	32	10
Leelanau	8	1
Lenawee	53	5
Livingston	21	7
Macomb	107	41
Mecosta	17	20
Midland	27	35
Monroe	59	47
Montcalm	29	15
Montmorency	4	6
Muskegon	95	26
Newaygo	19	4
Oakland	254	142
Oceana	15	4
Ogemaw	9	1
Otsego	6	331
Ottawa	60	5
Presque Isle	12	12
Roscommon	4	38
Saginaw	130	46
St. Clair	76	6
St. Joseph	32	1
Shiawassee	41	36
Tuscola	36	14
Washtenaw	81	73
Wayne	2,015	451
Wexford	18	2

State of residence	Number of fishing trips
Ohio	140
Illinois	10
California	4
New York	8
Pennsylvania	19
Oklahoma	2
W. Virginia	4
Virginia	1
Wisconsin	1
Indiana	6
Texas	1
Georgia	1
Minnesota	1
Tennessee	2
Manitoba	1

Table 6.--Residence of anglers fishing Pigeon River in 1950. Tabulated by individual anglers.

County	Population of county in thousands	Number of fishermen
Allegan	42	4
Alpena	21	6
Antrim	11	1
Barry	23	1
Bay	75	45
Benzie	8	1
Berrien	89	1
Branch	26	11
Calhoun	94	19
Charlevoix	13	5
Cheboygan	14	26
Chippewa	28	2
Clare	9	3
Clinton	27	5
Crawford	4	3
Eaton	34	2
Emmet	16	5
Genesee	228	89
Gladwin	9	2
Grand Traverse	23	11
Gratiot	32	2
Hillsdale	29	10
Ingham	130	69
Ionia	36	1
Isabella	26	3
Jackson	93	14
Kalamazoo	100	9
Kent	246	29
Lapeer	32	6
Leelanau	8	1
Lenawee	53	3
Livingston	21	5
Macomb	107	14
Mecosta	17	13
Midland	27	25
Monroe	59	13
Montcalm	29	9
Montmorency	4	5
Muskegon	95	16
Newaygo	19	2
Oakland	254	90
Oceana	15	4
Ogemaw	9	1
Otsego	6	119
Ottawa	60	5
Presque Isle	12	12
Roscommon	4	13
Saginaw	130	32
St. Clair	76	4
St. Joseph	32	1
Shiawassee	41	16
Tuscola	36	8
Washtenaw	81	35
Wayne	2,015	259
Wexford	18	1

Sub-total = 1,091 (91 percent)

State	Number of fishermen
Ohio	66
Illinois	8
California	4
New York	5
Pennsylvania	7
Oklahoma	3
W. Virginia	2
Wisconsin	1
Indiana	5
Texas	1
Georgia	1
Virginia	1
Minnesota	1
Tennessee	2
Manitoba	1

Sub-total = 108 (9 percent)

Total 1,199

Table 7.--Number and percent of total fishing trips coming from major population centers in Michigan, Pigeon River, 1949 & 1950

County	1949 Population of county in thousands	1949 Number of fishing trips	1949 Percent of total	1950 Number of fishing trips	1950 Percent of total
Wayne	2,015	517	23.1	451	20.9
Oakland	254	111	5.0	142	6.6
Genesee	228	154	6.9	139	6.4
Ingham	130	113	5.1	110	5.1
Kent	246	43	1.9	33	1.5
Calhoun	94	13	0.6	25	1.2
Kalamazoo	100	39	1.7	12	0.6

counties lying on the western side of the state (Kalamazoo, Kent, and Calhoun). The pattern of major trunk highways apparently determines to some extent the distribution of anglers from cities such as Grand Rapids, Kalamazoo and Battle Creek. This also could explain the preponderance of Ohio fishermen among out-of-state anglers compared with the few anglers coming from Indiana and Illinois.

As was noted in 1949, the counties immediately adjacent to Otsego County were represented by relatively few anglers (Table 8). The ready accessibility of trout streams in most of these counties provides fishing for the residents without having to look elsewhere. This also applies to residents of the Upper Peninsula of Michigan.

Indices of Fishing Quality

The index of fishing quality used in this report is based on the catch-per-hour-per-angler as described in Institute for Fisheries Research Report No. 1250. The statistical tools employed have been limited to the mean, the standard error of the mean and the t-test for determining the significance of differences between means. All the fishing trips have been used in the computation of these statistics, even though the inclusion of the unsuccessful trips maintains a highly skewed distribution of catch-per-hour-per-angler values.

An additional index of fishing quality used in this report is the percent of fishermen who were successful in catching at least one legal trout; i.e., the successful fishing trips. These figures are usually given in conjunction with the mean catch per hour.

The Effect of Barometric Pressure on Fishing Quality

The popular notion that fishing is affected by changes in the barometric pressure was examined again by means of records obtained in 1950. For trout fishing on the Pigeon River, individual days were classified as to

Table 8.--Number of anglers fishing Pigeon River from Otsego County Area, 1950

County	Number of fishing trips
Otsego	331
Cheboygan	32
Presque Isle	12
Emmet	7
Montmorency	7
Charlevoix	5
Antrim	3
Crawford	3
Kalkaska	0
Oseoda	0

falling barometer (33 days in which barometric pressure fell more than 0.1 mm. mercury), rising barometer (32 days) and steady barometer (70 days). All fishing trips were combined in each category and their fishing statistics compared (Table 9). In 1950, the catch per hour for both rising and falling categories was better than for days in which the barometer was steady. Likewise, the percent of successful anglers was higher for rising and falling days than for steady days. In comparing these data with what we observed in 1949 we find that the results are contradictory; in 1949, fishing was better when the barometer was steady. In neither year were we able to demonstrate any difference in catch per hour between a rising barometer and a falling barometer. Before drawing any conclusions concerning the relationship between barometric pressure changes and fishing quality, it seems wise to consider other factors which can be shown to exert a tremendous effect on angling success. One of these is the occurrence of a large planting of hatchery trout. Another possible factor is low water temperatures which were coincident with poor fishing. A more detailed account of these will be given in a later section but some of the data are presented here to partially explain the results of the tabulations on barometric pressure. If we consider the distribution of angling days classified as to barometric pressure in the light of the pattern of fishing quality as influenced by hatchery plantings and cold weather, we find that there is little probability that changes in barometric pressure had much to do with determining angler success (Table 10). For instance, only 23 percent of the days when the barometer was steady occurred during periods when fishing was better than average. For rising and falling barometer, these percentages were 41 and 39, respectively.

Table 9.--Relationship between change in atmospheric pressure and fishing quality, Pigeon River, 1950

Item	Number of days	Number of fishing trips	Mean	Standard error of mean	Percent fishing trips successful
Steady barometer (less than 0.1 mm. change in 24 hours.)	70	1,098	0.55	0.035	45.2
Rising barometer	32	508	0.68	0.047	55.7
Falling barometer	33	554	0.70	0.051	52.9

Rising vs. steady

Difference of means = 0.13
Standard error of difference = 0.059
t = 2.2 = 97%

Falling vs. steady

Difference of means = 0.15
Standard error of difference = 0.062
t = 2.4 = 98%

Table 10.--Prediction of angling success by barometer compared with pattern of fishing quality as determined by other factors.

Period	Mean catch per hour	Percentage of days falling within different periods in column 1.		
		Barometer steady	Barometer rising	Barometer falling
April 29 - May 11 (cold weather with heavy planting)	0.02	7	9	15
May 12 - May 31 (No planting)	0.58	16	16	12
June 1 - June 21 (3 weeks following heavy planting)	1.48	9	25	21
June 22 - August 7 (No planting)	0.32	40	28	31
August 8 - August 28 (3 weeks following light planting)	0.63	14	16	18
August 29 - September 10 (No planting)	0.38	14	6	3
		23 percent of days above average.	41 percent of days above average.	39 percent of days above average.

The Effect of Lunar Cycles on Angling Quality

In a discussion concerning the effects of the full moon on rainbow trout fishing, Mottley (1938, page 212) states: "No doubt the belief that the moon has an effect on the fishing has been borrowed from marine fishermen. In the sea, however, the situation may be related to the effect of the tides, which are definitely associated with the phases of the moon. In fresh water, no such explanation is possible."[1] However, most anglers are aware of fishing calendars based on lunar cycles that claim to predict angling success. Such a calendar is distributed by the Shakespeare Company under the authority of Joe Godfrey. This calendar lists the days as either best, good, or fair. From a fishing tackle manufacturer's viewpoint, naturally there are no bad days to go fishing.

The predictions of this calendar were tested with the data available for both the 1949 and 1950 seasons. In 1950, trout fishing in the Pigeon River was better on the fair days than it was on the best days (Table 11). In 1949, no significant differences were observed between the best and fair days. Before drawing any conclusions concerning the possible cause and effect relationship between lunar cycles and fishing quality we should consider other factors which are known to exert a noticeable effect on angling success, such as mentioned in the preceding section. If we superimpose the distribution of angling days predicted as best, good and fair on the pattern of fishing quality as influenced by cold temperatures and hatchery plantings (Table 12), we find there is also little probability that lunar cycles

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[1] Mottley, C. McC., 1938
Does the full moon affect rainbow trout fishing?, Trans. Amer. Fish. Soc. Vol. 67 (1937), pp. 212-214.

Table 11.--Relationship between fishing quality and phase of the moon, Pigeon River, 1950.

Item	Number of days	Number of fishing trips	Mean catch per hour	Standard error of mean	Percent fishing trips successful
Joe Godfrey's Guide					
Best days	38	642	0.52	0.049	38.6
Good days	75	1,184	0.65	0.033	52.7
Fair days	22	334	0.71	0.056	59.9
	Best vs. good	Best vs. fair	Good vs. fair		
	t = 2.2 97%	t = 2.6 99%	t = 0.9 63%		

Table 12.--Prediction of angling success by fishing calendars compared with pattern of fishing quality as determined by other factors.

Period	Mean catch per hour	Percentage of days falling within different periods in column 1.		
		Best days	Good days	Fair days
April 29 - May 11 (cold weather with heavy planting)	0.02	18	8	0
May 12 - May 31 (No planting)	0.58	11	15	23
June 1 - June 21 (3 weeks following heavy planting)	1.48	8	17	23
June 22 - August 7 (No planting)	0.32	42	34	23
August 8 - August 28 (3 weeks following light planting)	0.63	13	15	23
August 29 - September 10 (No planting)	0.38	8	11	8
		21 percent of days above average.	32 percent of days above average.	46 percent of days above average.

had much to do with determining angler success. For instance, 60 percent of what should have been the best days, according to the clendar, fell during the periods of poor angling quality (0.02 and 0.32), and only 21 percent of the best days fell within the periods of good angling quality (0.63 and 1.48). For the fair days, only 23 percent fell within periods of poor angling and 46 percent were included in periods of good angling.

Flies vs. Worms in Trout Fishing

The angling quality has also been compared with the different types of lure used. The three principal categories, worms, flies and spinner with worms were numerous enough to justify separate tabulations. In the miscellaneous classification are included lures such as that popular wooden plug the Flatfish, minnows, grasshoppers, spinners or other combinations of different types of lures such as flies and worms. Spinners with worms seemed to be a little more effective in taking fish than the other baits used. There was little difference between the other types (Table 13).

Some idea of the seasonal changes in the type of lure used was gained by tabulating results by 5-week intervals (Table 14). Worms predominate in the fishing early in the season and again late in the season while flies are more in use during June and July. The effectiveness of different types of bait in taking hatchery fish or wild fish was tabulated, since from casual observation it appeared that worm fishermen were catching predominantly the hatchery fish (Table 15). This observation was substantiated by the fishing records and indicates that either the hatchery fish are easier to catch with worms than they are with flies or that fly fishermen caught and released more hatchery fish than did the worm fishermen. No accurate accounting was possible of the number of legal sized trout caught and released by fishermen; the records indicate only those fish that were kept by the anglers.

Table 13.--Relationship between type of lure used and fishing quality, Pigeon River, 1950.

Type of lure	Number of fishing trips	Mean catch per hour	Standard error of mean	Percent fishing trips successful
Worms	878	0.64	0.042	48.9
Flies	696	0.58	0.039	52.2
Worms & spinner	276	0.75	0.074	56.5
Miscellaneous	310	0.53	0.060	40.0

Probability that means are different

	Worms	Flies	Spinner worms
Flies	84		
Spinner & worms	81	95	
Miscellaneous	87	52	98

Table 14.--Ratio between numbers of fishing trips of different types of lure used, Pigeon River, 1950.

5-week period	Type of lure used			
	Worms	Flies	Spinner & worms	Miscellaneous
April 29 - June 2	4.69	1.81	2.06	1.00
June 3 - July 7	2.94	3.53	1.00	1.32
July 8 - August 11	8.93	11.42	1.00	4.50
August 12 - September 10	5.23	3.63	1.00	2.03
Season total	3.18	2.52	1.00	1.12

Table 15.--Relationship between number of hatchery trout and wild trout taken and the type of lure used, Pigeon River, 1950

Type of lure used	Number of fishing trips	Number of fish caught per 100 trips	
		Hatchery	Wild
Worms	878	116	37
Flies	696	68	86
Spinners & worms	276	159	53
Miscellaneous	310	119	40
Total		106	55

Fishing Quality and Temperature of the Water

Portions of the Pigeon River would be classified by some biologists as marginal trout water because of the rather high summer water temperatures. In June, July and August the water often goes above 70° F. and occasionally reaches 80° F. The relationship of high water temperatures to the density of trout populations is being investigated by Norman G. Benson as part of a doctoral problem. However, some information on the effects of high water temperatures on fishing quality is available and will be discussed at the present time.

On a basis of the 1949 records (I.F.R. Report No. 1250), it was stated that there was a slump in fishing quality in late June, July and early August, apparently caused by high water temperatures. During this period, the daily maximum water temperatures were consistently over 70° F. Before and after this period, temperatures were somewhat lower. All fishing records for the period April 30 to June 20 were grouped together, likewise for the periods June 21 to August 15 and August 16 to September 11. Details concerning the catch per hour and water temperatures for these periods are given in Institute for Fisheries Research Report No. 1250.

In 1950, the individual days were classified into four categories on a basis of the maximum water temperature recorded for that day, and fishing records were tabulated accordingly (Table 16). The four categories were as follows:

(1) Days in which the maximum water temperature did not exceed 54° F. These were confined to the first 13 days of the season.

(2) Maximum daily water temperatures from 55° F. to 68° F. inclusive. A total of 68 days; 20 in May, 13 in June, 9 in July, 16 in August and 10 in September.

Table 16.--Daily water temperature records of Pigeon River, April 29 - September 10, 1950.

Temperatures were recorded near the upper end of Section B.

Date	Maximum water temp.	Minimum water temp.
April 29	42	36
30	42	39
May 1	46	38
2	46	38
3	45	37
4	42	39
5	49	42
6	54	45
7	51	43
8	51	42
9	46	42
10	45	43
11	50	43
12	55	43
13	58	47
14	61	49
15	61	50
16	62	51
17	62	50
18	56	51
19	59	48
20	63	47
21	65	50
22	65	52
23	65	53
24	66	54
25	65	55
26	66	57
27	68	55
28	67	54
29	64	48
30	64	53
31	67	56
June 1	67	56
2	66	56
3	60	52
4	64	50
5	65	53
6	66	56
7	68	56
8	68	60
9	76	63
10	74	62
11	72	58
12	69	57
13	71	58
14	72	60
15	74	59
16	70	62
17	72	57
18	67	54
19	64	54
20	62	54
21	67	54
22	68	52
23	72	58
24	74	63
25	78	64
26	79	65
27	77	61
28	70	56
29	70	57
30	70	59
July 1	66	56
2	66	56
3	60	56
4	64	55
5	64	58
6	65	56
7	69	57
8	72	58
9	74	60
10	75	60
11	75	61
12	76	62
13	75	63
14	68	62
15	64	56
16	70	56
17	71	59
18	71	60
19	73	60
20	65	62
21	70	60
22	72	58
23	74	59
24	73	60
25	70	60
26	73	61
27	74	60
28	76	60
29	75	62
30	77	63
31	73	63
August 1	67	60
2	64	61
3	62	57
4	61	55
5	65	55
6	70	55
7	72	58
8	75	62
9	72	61
10	72	59
11	72	59
12	70	56
13	72	55
14	72	56
15	71	57
16	72	59
17	72	59
18	72	58
19	70	58
20	68	54
21	67	53
22	64	52
23	65	53
24	64	55
25	69	56
26	63	56
27	..	..
28	64	56
29	60	55
30	..	..
31	58	50
September 1	63	56
2	65	55
3	64	54
4	59	51
5	61	51
6	63	52
7	65	58
8	64	53
9	..	..
10	64	54

(3) Days in which maximum water temperatures were from 69° F. to 74° F. inclusive. A total of 42 days, 13 in June, 15 in July and 14 in August.

(4) Days in which maximum water temperatures were from 75° F. to 79° F. inclusive. A total of 12 days, 4 in June, 7 in July and 1 in August.

The mean catch per hour was then computed for each of these classifications, both for wild fish and for wild and hatchery fish combined. Fishing quality was much lower for the cold spring period of 1950, when water temperatures did not exceed 54° F. The wild fish also showed a disinclination to bite when water temperatures exceeded 74° F., although this effect could not be demonstrated for the hatchery fish for the 1950 data (Table 17).

The apparent contradiction between the 1949 data and the 1950 data was resolved by re-examining the 1949 data on a daily basis as described above. When compared in this manner, there appears to be no correlation between warm days, as measured by the daily maximum water temperature and catch per hour until water temperatures exceed 74° F. For the 1949 data, both the hatchery fish and wild fish were disinterested in angler's lures when daily maximum water temperatures exceeded 74° F. (Table 18).

The slump in fishing observed in 1949 in the middle of the season was also duplicated in 1950. This midsummer decline in fishing in 1950 is attributed to three probable causes: (1) The lack of hatchery plantings during this period and the resultant lack of stimulation of the catch due to the plantings (Table 19 and Figure 2); (2) a decline in availability of the legal-sized wild fish through a high rate of exploitation and a slackening of growth rate; and (3) effects of high water temperatures on feeding activity of the fish since most of the hot days occur during this period.

Table 17.--Relationship between catch per hour and water temperature, Pigeon River, 1950.

Temperature classification	Number of days	Number of fishing trips	Mean catch per hour	Value of "t"	Percent successful
Wild and Hatchery Fish Combined					
Daily maximum water temperature.					
54° F or below	13	170	0.02	--	4.7
55° to 68°	68	1,278	0.67	--	55.9
69° to 74°	42	570	0.65	--	55.7
			) ------	0.6	
75° to 79°	12	142	0.73	--	40.1
Wild Fish Only					
54° or below	13	170	0.01	--	2.4
55° to 68°	68	1,278	0.19	--	30.0
69° to 74°	42	570	0.21	--	30.8
			) ------	2.7	
75° to 79°	12	142	0.13	--	19.0

Table 18.--Relationship between catch per hour and water temperature, Pigeon River, 1949

Temperature classification	Number of days	Number of fishing trips	Mean catch per hour	Value of "t"	Percent successful
Wild and Hatchery Fish Combined					
Daily maximum water temperature					
51° F. or below	0	--	--	--	--
55° to 68°	49	874	0.42	--	51.9
69° to 74°	60	820	0.41	2.95	47.3
75° to 80°	15	214	0.28	--	31.8
Wild Fish Only					
51° or below	0	--	--	--	--
52° to 68°	49	874	0.15	--	27.5
69° to 74°	60	820	0.19	4.8	28.4
75° to 80°	15	214	0.09	--	16.4

Table 19.--Relationship between time of planting and catch per hour of hatchery fish, Pigeon River for Sections B and C combined.

1949				1950			
Period	Number of fishing trips	Percent successful	Mean catch per hour (all species)	Period	Number of fishing trips	Percent successful	Mean catch per hour (all species)
April 28, 1949 1/				April 26, 1950 1/			
April 30 - May 6	198	33.3	0.30	April 29 - May 5	87	1.1	0.01
May 7 - 13	79	48.1	0.38	May 6 - 12	42	16.7	0.17
May 14 - 20	81	34.6	0.21	May 13 - 19	89	61.8	0.50
May 21 - 24	70	32.9	0.18	May 20 - 26	73	47.9	0.41
				May 27 - 31	117	32.5	0.21
May 25, 1949 1/				June 1, 1950 1/			
May 25 - 31	180	52.8	0.46	June 1 - 7	123	87.0	2.27
June 1 - 7	52	48.1	0.33	June 8 - 14	112	71.4	1.34
June 8 - 14	56	53.6	0.37	June 15 - 21	76	67.1	0.65
June 15 - 21	105	39.0	0.26	June 22 - 28	76	42.1	0.40
June 22 - 28	60	20.0	0.08	June 29 - July 5	107	32.7	0.23
				July 6 - 12	50	28.0	0.21
June 29, 1949 1/				July 13 - 19	54	20.4	0.09
June 29 - July 5	115	35.7	0.28	July 20 - 26	26	19.2	0.13
July 6 - 12	80	28.8	0.15	July 27 - August 2	33	18.2	0.11
July 13 - 19	38	23.7	0.09	August 3 - 7	25	28.0	0.18
July 20 - 26	35	17.1	0.08				
				August 8, 1950 1/			
July 27, 1949 1/				August 8 - 14	98	59.2	0.98
July 27 - August 2	71	25.4	0.29	August 15 - 21	53	50.9	0.35
August 3 - 9	40	37.5	0.18	August 22 - 28	72	41.7	0.29
August 10 - 16	52	28.8	0.15	August 29-Sept. 4	79	27.8	0.19
				September 5 - 10	37	43.2	0.29
August 17, 1949 1/							
August 17 - 23	78	64.1	0.80				
August 24 - 30	67	41.8	0.34				
August 31 - Sept. 6	122	51.6	0.37				
September 7 - 11	42	50.0	0.42				
All Plantings							
1st week	642	42.1	0.40				
2nd week	318	40.6	0.28				
3rd week	349	41.5	0.27				

1/ Planting dates.

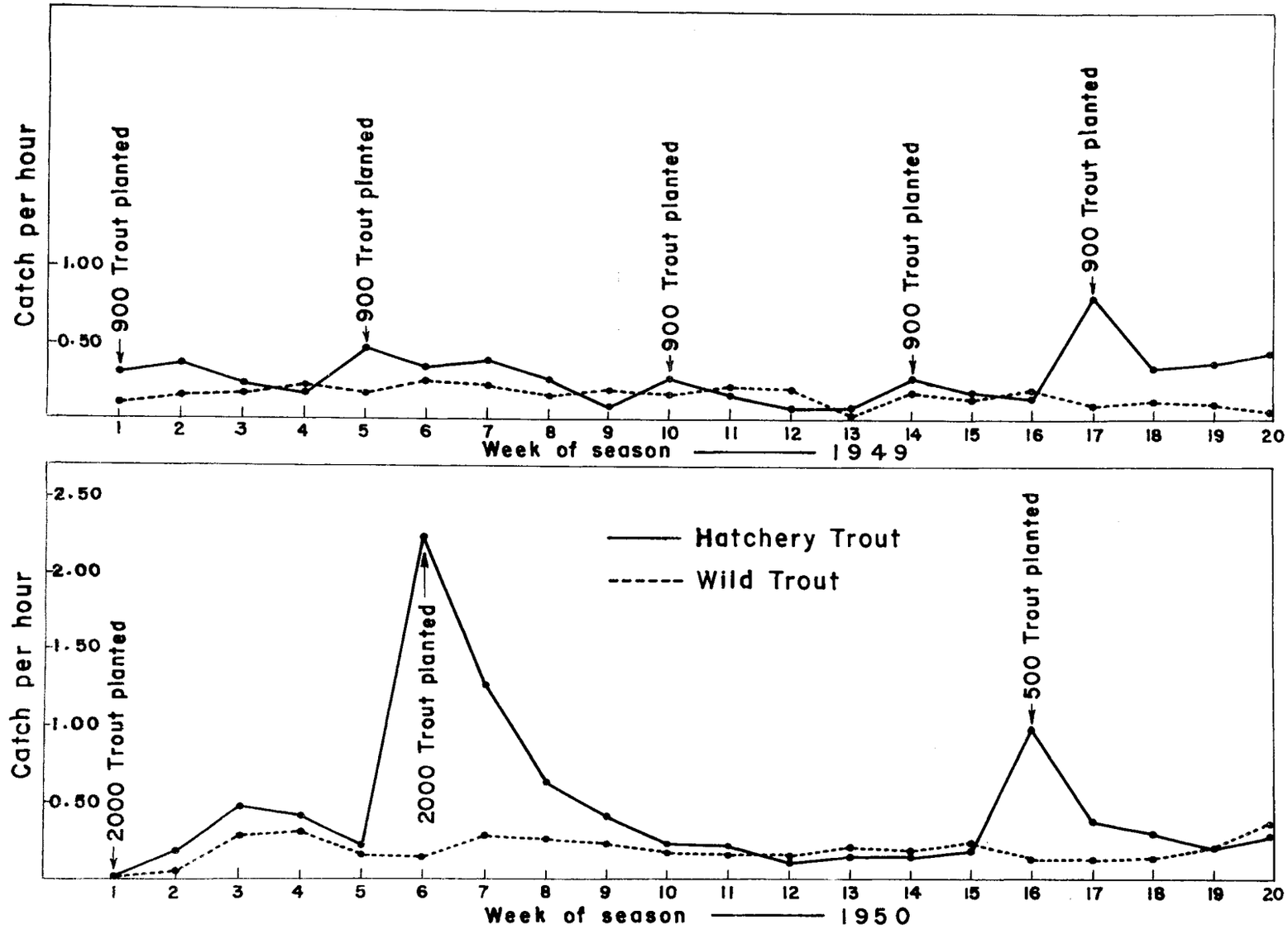

Figure 2.--The relationship between time of planting and catch per hour of hatchery trout planted in the Pigeon River and wild trout, seasons of 1949 and 1950.

In 1949, despite equal plantings of hatchery fish in each month of the season, the decline in fishing quality appeared coincident with a very poor showing of the two plantings made on June 29 and July 27. A possible explanation of the poor survival and recovery of these two plantings is suggested by the extremely high water temperatures following the June and July plantings of 1949 compared with the other plantings made:

Planting date	Maximum water temperatures for subsequent days
April 28, 1949	No data (temperatures from May 11 in 50's)
May 25, 1949	58, 54, 52, 52, 56, 59
June 29, 1949	73, 74, 74, 75, 78, 76
July 27, 1949	79, 79, 80, 79, 79, 69
August 17, 1949	73, 70, 72, 70, 69, 70
April 26, 1950	43, 44, 41, 42, 42, 46
June 1, 1950	67, 66, 60, 64, 65, 66
August 8, 1950	75, 72, 72, 72, 70, 72

It appears from the foregoing discussion that stream temperatures below 55° F. may inhibit the feeding activity of fish to a marked degree. It is also indicated that a similar effect may result at extremely high temperatures although the data obtained from the Pigeon River during 1949 and 1950 suggest that maximum daily water temperatures may reach 70° to 74° F. for many days at a time without any appreciable effect on the mean catch per hour for those days. In the Pigeon River, the daily fluctuation in temperature during the hot part of the summer averages about 14 degrees, which provides a relatively cool period (night and early morning) for each 24 hours.

Comparison of Planting Record

Plantings of hatchery trout made during the season of 1950 made possible further evaluation of the merits of spot planting and scatter planting. The numbers in individual plantings in 1950 were increased somewhat over those of 1949 but the total number of fish planted remained the same for the season (Table 20). In several different approaches to the subject, comparisons between spot and scatter plantings indicated little difference in results from the two methods (Table 21). Of the number of successful fishing trips recorded, spot planted fish contributed to 466, scatter planted fish 445. Of the number of different fishermen benefitting, scatter plants exceeded spot plants 283 to 273. Comparing total fish recovered, spot plants were better than scatter plants 1,049 to 933. There was little difference between the two methods as to the number of fish taken per successful trip; spot planted fish averaged 2.26, scatter planted fish averaged 2.11. Comparing the total number of days of the season in which fish from the two planting methods were caught by fishermen, spot plants contributed on 186 days, scatter plants on 185 days. Some additional observations made on the area may explain in part the little differences noted between the two methods. The fishing area of the stream which was planted is easily accessible at many points. It would seem logical that, even though the fish were evenly dispersed over the entire stream in scatter planting, many fishermen could readily fish over them. Also, fish planted in a group tended to disperse rather quickly over adjacent portions of the stream. This was noted on several occasions in connection with attempts to take large samples of hatchery fish with a shocker a few days following spot plantings. It appears that the majority of the fish in a planting are available to the angler for a short time only and it matters little whether the fish be concentrated

Table 20.--List of hatchery trout planted in experimental sections of Pigeon River, season of 1950. Brook trout were from Oden Hatchery, Rainbow trout were from Wolverine Rearing Ponds.

	Spot planting					Scatter planting		
Date	How marked	Number	Species	Section planted	Range in size in inches	Number	species	Section planted
April 26, 1950	tagged	250	brook	C	7.0-11.4	250	brook	C
	tagged	250	brook	B	7.0-11.4	250	brook	B
	tagged	250	rainbow	C	7.0-11.5	250	rainbow	C
	tagged	250	rainbow	B	7.0-11.5	250	rainbow	B
June 1, 1950	tagged	250	brook	C	6.9-10.7	250	brook	B
	fin-clipped	250	brook	C	6.9-10.7	250	brook	B
	tagged	250	rainbow	B	7.0-10.2	250	rainbow	C
	fin-clipped	250	rainbow	B	7.0-10.2	250	rainbow	C
August 8, 1950	tagged	125	brook	B	7.0-11.0			
	fin-clipped	125	brook	B	7.0-11.0			
	tagged	125	brook	C	7.0-11.0			
	fin-clipped	125	brook	C	7.0-11.0			

Table 21.--Spot planting versus scatter planting - returns to anglers. Pigeon River 1950.

Species and month of planting	Number of successful fishing trips		Number of different fishermen sharing the catch		Total fish recovered		Number of fish per successful fishing trip		Number of fish per successful angler		Number of days in season in which fish were caught		Number of days required take varying percentages of total recovery					
	Spot	Scatter	Spot	Scatter	Spot	Scatter	Spot	Scatter	Spot	Scatter	Spot	Scatter	Spot			Scatter		
													25	50	75	25	50	75
Rainbow																		
April	..	..	..	..	108 92	94 71	..	..	..	..	58	56	26	32	48	28	33	51
June	..	..	..	..	203 164	207 137	..	..	..	..	64	62	7	11	31	5	14	24
Brook																		
April	..	..	..	..	98 82	105 73	..	..	..	..	36	27	15	17	29	15	16	24
June	..	..	..	..	127 175	101 145	..	..	..	..	28	40	3	4	5	3	7	16
Total	466	445	273	283	1,049	933	2.26	2.11	3.86	3.32	186	185						

in one spot or spread uniformly over a mile or two of easily accessible water. Experiments seem to indicate that if the fish are not caught within a relatively short time after planting they do not contribute much to the catch. This is especially true of brook trout, where the majority of the recoveries are made within the first three weeks following planting, and in some cases within the first few days (Table 21). Plantings of hatchery trout should be scheduled to fit the pattern of fishing intensity and if it is thought necessary to combat the evils of "meat-fishing," frequent plantings of small numbers of fish in accessible portions of the streams seem to be desirable, although this would add to the expense in at least some cases.

Distribution of Catch Among Fishing Trips

The planting schedule in 1950 was quite different from that in 1949. In 1949, 1,500 trout of each species (brook, brown and rainbow) were stocked at the rate of 300 in each of 5 monthly plantings. Half of each group were spot planted, the other half scatter planted. The area planted was Sections B and C at the monthly rate of approximately 80 fish per acre or 400 per acre per season for all species combined. In 1950, the total season planting was the same as for 1949. However, no brown trout were planted and the total was divided between three individual plantings: April 26 - 1,000 brook and 1,000 rainbow (178 per acre); June 1 - 1,000 brook and 1,000 rainbow (178 per acre); and August 8 - 500 brook (44 per acre).

With an increase in the monthly stocking rate from 80 trout per acre in 1949 to 178 trout per acre in 1950 there was a corresponding increase in the catch per hour immediately following planting (Table 19 and Figure 4). There was also a greater percentage of fishing trips successful in taking limit catches in 1950 over that in 1949; however, the bulk of this increase did not come from the formerly

unsuccessful angler class but rather from those anglers that took less than the limit the previous year. Planting trout does not seem to equalize the effects of fishing ability very much, rather it allows those expert fishermen who can catch fish to take more of them, and increasing the size of the planting simply favors this trend (Table 22). Planting a few fish at a time at frequent intervals spreads the fish over more fishing trips and over more anglers to a greater extent than the scatter planting method involving larger numbers of trout stocked less frequently (Table 21, 1950; and Table 15, 1949). Such a system would increase the cost of stocking but it is believed that the additional cost would be justified in more efficient and more equitable utilization of the present hatchery production. This better utilization would have the same effect as increasing the present production of legal-sized trout.

Differences in Catch per Hour Between Sections

As was the case in 1949, the catch per hour in Sections B and C in 1950 was higher than in A and D. This was primarily the result of the stocking program (Table 23). The catch per hour of wild fish was best in Section D although Section C probably would have been much better if the fishing pressure caused in part by planting hatchery fish had not been so heavy. Sections B and C induced the greatest fishing pressure although the downstream movement of many fish from the April planting resulted in a larger proportion of anglers choosing Section A to fish in than was the case in 1949. As a rule, anglers tend to concentrate in areas where it has been better than average fishing. This tendency is also apparent as to the time of the year when most angling is done. May, June and September have higher fishing pressures than July and August; the fishing quality also shows the same pattern, being somewhat poorer in July and August than at other times.

Table 22.--Number of trout per fishing trip, Pigeon River, 1950

	Number of trout per trip							
	0	1	2	3	4	5	6-10	11-15
Section A								
Number of fishing trips	180	47	36	24	12	33	1	-
Fishing trips by percent	54.1	14.1	10.8	7.2	3.6	9.9	0.3	-
Cumulative percent of fishing trips	-	45.9	31.8	21.0	13.8	10.2	0.3	-
Percent of total fish caught	-	11.3	17.4	17.4	11.6	39.9	2.4	-
Cumulative percent of total fish caught	-	100.0	88.7	71.3	53.9	42.3	2.4	-
Section B								
Number of fishing trips	384	124	72	41	45	146	2	-
Fishing trips by percent	473	15.2	8.8	5.0	5.5	18.0	0.2	-
Cumulative percent of fishing trips	-	52.7	37.5	28.7	23.7	18.2	0.2	-
Percent of total fish caught	-	9.4	11.0	9.4	13.7	55.4	1.1	-
Cumulative percent of total fish caught.	-	100.0	90.6	79.6	70.2	56.5	1.1	-
Section C								
Number of fishing trips	291	91	66	41	28	24	51	24
Fishing trips by percent	47.2	14.8	10.7	6.7	4.5	3.9	8.3	3.9
Cumulative percent of fishing trips	-	52.8	38.0	27.3	20.6	16.1	12.2	3.9
Percent of total fish caught	-	7.0	10.1	9.4	8.6	9.2	30.1	25.6
Cumulative percent of total fish caught.	-	100.0	93.0	82.9	73.5	64.9	55.7	25.6
Section D								
Number of fishing trips	233	68	31	24	16	7	15	3
Fishing trips by percent	58.7	17.1	7.8	6.0	4.0	1.8	3.8	0.8
Cumulative percent of fishing trips	-	41.3	24.2	16.4	10.4	6.4	4.6	0.8
Percent of total fish caught	-	14.9	13.6	15.8	14.0	7.7	24.6	9.4
Cumulative percent of total fish caught.	-	100.0	85.1	71.5	55.7	41.7	34.0	9.4

Table 23.--Quality of fishing in different sections of Pigeon River, 1950.

Section	Number of fishing trips	Mean catch per hour	Standard deviation, σ	Standard error of mean, σ_m	Percent of fishing trips successful	Number of fish caught	Total hours fished
			Wild Fish Only				
A	333	0.13	0.30	0.016	24.6	123	898
B	814	0.12	0.35	0.012	20.5	251	2,130 1/2
C	616	0.18	0.35	0.014	30.5	402	1,890
D	397	0.33	0.60	0.030	38.5	414	1,276 1/2
Total	2,160	0.18	0.41	0.008	27.3	1,190	6,195
			Hatchery Fish Only				
A	333	0.33	0.59	0.032	36.9	291	898
B	814	0.65	1.35	0.047	46.9	1,064	2,130 1/2
C	616	0.49	1.03	0.042	41.4	905	1,890
D	397	0.03	0.016	0.0008	7.5	43	1,276 1/2
Total	2,160	0.44	1.09	0.073	36.6	2,303	6,195
			Wild and Hatchery Fish Combined				
A	333	0.47	0.48	0.026	45.9	414	898
B	814	0.77	1.45	0.051	52.8	1,315	2,130 1/2
C	616	0.67	1.11	0.045	52.8	1,307	1,890
D	397	0.36	0.64	0.032	41.3	457	1,276 1/2
Total	2,160	0.62	1.15	0.025	49.6	3,493	6,195

The percentage of successful fishing trips does not fluctuate as widely as the catch per hour, suggesting that this index may not be so indicative of angling quality as catch per hour. Increases in the total catch are reflected to a larger degree in catch per hour than in the percent of successful anglers, as revealed by the following summaries:

Year	1949	1950
Number of wild fish caught	1,048	1,190
Catch per hour	0.15	0.18
Percentage of successful anglers	26.2	27.3
Number of hatchery fish caught	1,670	2,303
Catch per hour	0.24	0.44
Percentage of successful anglers	32.9	36.6
Total hours fished	6,817	6,195

Frequency Distribution of Trout in Catch

The one experimental change in the general regulations for trout that was made at the Pigeon River during the 1949 and 1950 seasons involved a reduction in the daily limit from 15 to 5 trout per day. This was done in Sections A and B (Figure 1) to find out what effect the lower daily limit would have in redistributing the catch over more fishermen.

For 1950, as in 1949, the records have been summarized on a basis of the number of fish caught per fishing trip (Table 22). Table 24 summarizes the number of hatchery fish, wild fish, and total fish taken by individual anglers. Certain trends are noticeable in these tabulations which are almost identical with the information reported in 1949. Some of these are the following:

Table 24.--Number of trout in season catch of individual anglers. Pigeon River, 1950.

Number of fish caught	Number of anglers taking hatchery fish	Number of anglers taking wild fish	Number of anglers taking hatchery and wild fish	Number of fish caught Range	Percent of anglers taking hatchery fish	Percent of total catch	Percent of anglers taking wild fish	Percent of total catch	Percent of anglers taking hatchery and wild fish	Percent of total catch
0	753	830	623							
1	148	175	168							
2	80	69	87	0 - 5	90.4	31.2	95.8	49.7	85.8	26.8
3	34	42	59							
4	42	12	39							
5	28	21	52							
6	12	10	23	6 - 10	4.8	18.6	2.6	19.2	7.3	20.0
7	19	8	13							
8	14	6	17							
9	8	6	16							
10	4	1	19	More than 10	4.8	50.2	1.6	31.1	6.9	53.2
11	5	1	5							
12	4	3	5							
13	3	2	7							
14	4	1	5							
15	7	..	10							
16	5	1	5							
17	3	1	5							
183	3	1	2							
19	1	2	4							
20	..	..	2							
21	4	..	..							
22	3	..	3							
23	1	..	3							
24	1	2	3							
25	2	1	3							
26	1	1	1							
27	..	1	1							
28	1	..	..							
29	3	..	..							
30	1	1	6							
..	..	..	..							
32	1	..	1							
..	..	..	..							
36	..	..	1							
37	..	..	1							
38	..	1	1							
..	..	..	..							
40	1	..	..							
41	..	..	1							
..	..	...	..							
44	..	..	1							
45	1	..	1							
47	..	..	2							
54	..	..	1							
55	1	..	..							
59	1	..	1							
60	..	..	1							
61	..	..	1							

(1) Roughly half of the fishing trips are unsuccessful in producing a single legal-sized trout. The addition of large numbers of hatchery fish to a stream reduces this figure about 10 percent.

(2) Relatively few fishing trips account for a lion's share of the total catch. In Section A (unplanted) 21.0 percent of the trips took 71.3 percent of the fish; Section D (unplanted) 16.4 percent of the trips took 71.5 percent of the fish; Section B (planted) 23.7 percent of the trips took 70.2 percent of the fish; and Section C (planted) 20.6 percent of the trips took 73.5 percent of the fish. Planting fish does not change this pattern very much either.

(3) Limiting the daily creel to 5 trout per day theoretically would have affected 12.2 percent of fishing trips in Section C (planted) and 4.6 percent of the fishing trips in Section D (not planted). If these limits were further reduced to 2 fish per day, 27.3 percent of the fishing trips in Section C would have been affected, 16.4 percent in Section D.

(4) The 5-fish limit in Section B had practically no effect in redistributing the catch compared with the 15-fish limit in Section C. Note that the percentage of anglers taking 5 fish per trip in Section B (18.2) was similar to the percentage of anglers taking 5 or more fish per trip in Section C (16.1), and that the percentages of anglers taking 0, 1, 2, 3, and 4 fish per trip in the two sections were much the same (Table 22). Sections A and D may be compared in like manner.

(5) Considering the total catch for the season, the greater share is taken by only a few anglers. This is true for both hatchery and wild fish.

Differences in the angling ability of individual fishermen accounts for most of the trends noted here. The better anglers go fishing more often than the dubs; the catch per hour of the anglers who fished more than 10 times in the Pigeon River in 1950 was twice as high as the average of all the fishermen (Table 25). Because of their superior angling skill,

Table 25.--Fishing statistics for individual anglers who fished 10 or more times in the Pigeon River, 1950. In parentheses are percentages of totals of entire season

Number of anglers	Residence-county or state	Number of fishing trips	Number successful trips	Wild trout	Hatchery trout	Total trout	Mean catch per hour
1	Otsego	21	18	2	59	61	2.60
2	Otsego	19	17	5	55	60	1.57
3	Ohio	15	9	16	8	24	0.76
4	Wayne	15	13	24	21	45	0.89
5	Washtenaw	14	10	24	3	27	1.01
6	Otsego	12	8	0	32	32	1.25
7	Ohio	12	7	12	7	19	0.73
8	Roscommon	12	9	9	29	38	0.58
9	Otsego	11	7	2	45	47	2.22
10	Hillsdale	11	9	30	24	54	1.41
11	Ohio	11	4	9	4	13	0.33
12	Wayne	11	8	3	21	24	0.58
13	Otsego	10	8	7	40	47	2.12
Total 13(1.3)		174(8.1)	127(11.9)	143(12.3)	348(15.0)	491(14.1)	

Percent fishing trips successful = 73.0 Mean catch per hour = 1.29

and also because of fishing more times, these fishermen account for a large proportion of the total catch. Any restriction on daily limits will be generally discriminatory against the more skillful and more persistent angler.

Length of Time Planted Trout Influence the Catch

The planting program for 1950 has been summarized in an earlier section (Table 20). Each trout was either tagged individually or marked in groups by fin-clipping, making it possible to trace movement, recovery, etc., from individual plantings. Brook trout do not influence the catch for so long a period as similar plantings of rainbow trout, although the total percentage of recovery was about the same for both species (Tables 26 and 27). For all brook trout plantings combined, 80 percent of the recoveries were made in the first 20 days after planting and 97 percent were made in the first 40 days. For the rainbows, these values were 29 percent and 77 percent respectively. Scatter planted trout do not contribute to the catch for longer periods than do spot planted fish (Table 27). These observations are very similar to the results of the 1949 experiments.

Some additional information was obtained on the carry-over of hatchery fish from one season to the next (Tables 26 and 28). Of 1,500 brook trout planted in 1949, none were recovered in 1950; of equal numbers of brown and rainbow trout planted in 1949, 2.3 percent were taken the following season. These same fish amounted to 7.3 percent and 8.9 percent respectively of the estimated population of planted and rainbow trout remaining in the stream in September 1949 from plantings made that season (Table 28). The 33 brown trout recovered in 1950 from plantings made in 1949 averaged 9.9 inches long and had grown an average of 0.7 inches. The 34 rainbows averaged 9.3 inches long and had grown 1.0 inches. This average growth rate of planted trout is much below that of the wild trout for the same period in the Pigeon River.

Table 26.--Summary of returns from brook, brown and rainbow trout planted in the Pigeon River, 1949 and 1950. Recoveries made in 1950 season only tabulated.

Includes voluntary returns from fish recovered outside experimental area.

Date	Rainbow trout		Brook trout			Number of fisherman days	Fish recovered from 1949 planting	
	Month in which planting occurred							
	April	June	April	June	August		Brown	Rainbow
	1,000#		1,000#					
April 29	..		1			80	..	..
30	..		..			21	..	..
May 1	..		..			..	..	..
2	..		..			2	..	..
3	..		..			7	..	..
4	..		..			2	..	..
5	..		..			2	..	..
6	..		3			18	..	1
7	..		..			21	..	..
8	1		2			5	..	..
9	..		..			4	..	..
10	..		..			4	..	..
11	..		..			4	..	..
12	2		13			7	2	..
13	6		94			45	4	4
14	12		77			51	1	1
15	8		17			13	..	..
16	5		11			10	2	..
17	..		1			9	3	..
18	1		1			7	1	..
19	9		6			19	2	1
20	9		11			31	2	2
21	16		13			38	..	2
22	13		11			23	..	2
23	2		7			10	1	..
24	4		2			5	..	..
25	4		1			7	..	..
26	7		8			13	..	..
27	17		16			47	..	1
28	20		11			77	1	2
29	36		8			57	1	5
30	15		8			25	1	..
31	4	1,000#	..	1,000#		7	..	1
June 1	2	18	..	13		6	..	..
2	2	4	3	58		11	1	1
3	7	56	1	117		30	..	..
4	15	52	2	108		43	..	1
5	6	29	1	28		16	..	..
6	2	22	1	18		16	..	1
7	7	37	2	25		20	1	..
8	8	28	1	13		17	..	..
9	2	26	2	34		24	..	..
10	7	33	7	14		36	..	..
11	9	41	1	9		30	2	3
12	5	3	..	2		11	..	..
13	1	4	..	3		9	..	..
14	5	41	1	7		20	2	..
15	4	7	2	8		14	..	..

	16	1	23	1	3		14	..	1
	17	2	16	4	10		25	..	..
	18	9	15	1	7		26	..	..
	19	1	10	..	6		13	..	..
	20	..	4	1	8		6	..	..
	21	7	4	2	9		16	..	..
	22	3	22	..	9		19	..	..
	23	2	10	1	1		18	..	..
	24	3	12	..	3		22	..	..
	25	..	..	..	1		16	..	..
	26	1	..	..	..		16	..	..
	27	..	5	..	1		7	1	..
	28	..	5	..	1		10	..	1
	29	3	5	..	1		9	..	..
	30	3	2	..	3		16	..	..
July	1	2	11	..	2		35	..	..
	2	5	11	..	5		45	1	..
	3	1	17	..	4		33	..	..
	4	3	9	..	3		38	..	..
	5	1	..	..	1		5	..	..
	6	..	7	..	..		11	1	..
	7	1	3	..	..		8	..	1
	8	3	4	..	1		17	1	..
	9	..	..	..	..		7	..	..
	10	..	1	..	..		6	..	..
	11	1	2	..	..		13	..	..
	12	..	3	..	1		13	..	..
	13	..	..	..	..		5	..	..
	14	..	..	..	..		3	..	..
	15	..	..	..	2		27	..	1
	16	..	4	..	1		14	..	..
	17	..	2	..	1		12	..	1
	18	..	4	..	..		14	..	..
	19	..	..	..	..		5	..	..
	20	1	..	..	..		1	..	..
	21	..	4	..	..		10	..	..
	22	1	..	..	..		8	..	..
	23	..	3	1	..		8	..	..
	24	..	3	..	..		7	..	..
	25	..	..	..	..		5	..	..
	26	..	..	..	..		8	..	..
	27	..	2	..	..		13	..	..
	28	..	2	..	..		4	..	..
	29	..	..	..	..		4	..	..
	30	4	2	..	1		12	..	..
	31	..	1	..	..		5	..	..
August	1	..	..	..	..		5	..	..
	2	..	..	..	..		9	..	..
	3	..	..	..	..		4	..	..
	4	..	4	..	..		17	1	..
	5	..	1	..	..		14	..	..
	6	1	1	..	..		10	..	..
	7	..	3	..	..	500✓	9	..	..
	8	2	4	..	..	78	22	1	..
	9	1	..	..	..	15	23	..	..
	10	..	3	..	..	16	12	..	..
	11	2	5	..	1	29	16	..	..
	12	1	1	..	..	30	23	..	..
	13	1	1	..	..	10	14	..	1
	14	..	7	1	1	13	17	..	..
	15	..	4	..	..	5	9	..	..
	16	1	2	..	2	15	16	..	..

	17	..	1	..	..	1	12	..	..
	18	1	3	..	..	9	13	..	..
	19	1	1	..	..	8	10	..	..
	20	..	..	..	..	3	10	..	..
	21	..	1	..	..	1	7	..	..
	22	..	..	..	..	1	16	..	..
	23	3	6	..	..	6	14	..	..
	24	1	4	..	..	16	23	..	..
	25	..	1	..	..	14	11	..	..
	26	5	3	..	1	6	22	..	..
	27	3	..	..	..	4	7	..	..
	28	..	..	..	..	2	9	..	..
	29	..	..	..	..	..	1	..	..
	30	..	..	..	..	..	7	..	..
	31	..	..	..	..	..	8	..	..
September	1	..	6	..	..	6	17	..	..
	2	2	3	..	..	13	37	..	..
	3	4	4	..	..	12	35	..	..
	4	1	4	..	..	7	25	..	..
	5	..	..	..	..	2	6	..	..
	6	..	..	..	1	..	1	..	..
	7	..	1	..	..	..	11	..	..
	8	3	5	..	..	3	13	..	..
	9	..	..	..	..	3	6	..	..
	10	1	3	..	..	3	16	..	..
Total -		365	711	358	548	331	2,160	33	34
Percent of recovery		36.5	71.1	35.8	54.8	66.2		2.2	2.3

Total trout recovered (1950 planting)

	Number	Percent
Brook	1,237	49.5
Rainbow	1,076	53.8
Total	2,313	51.4

Total trout recovered (1949 planting)

		Number	Percent
Brook	1949	600	40.0
	1950	0	0
Brown	1949	384	25.6
	1950	33	2.2
Rainbow	1949	671	44.7
	1950	34	2.3
Total		1,722	38.3

√ Fish planted.

Table 27.--Length of time plantings of brook and rainbow trout influence the catch, Pigeon River, 1950.

Planting date	Section planted	How marked	Number planted	Number of trout recovered in different periods following planting: 1st 20 days	2nd 20 days	3rd 20 days	4th 20 days	5th 20 days	6th 20 days	7th 20 days
Brook trout - Spot plantings										
April 26, 1950	B	tagged	250	44	32	6	0	0	0	0(15 days)
April 26, 1950	C	tagged	250	59	33	6	0	0	0	0(15 days)
June 1, 1950	C	fin clip	250	168	6	1	0	0	0(2 days)	
June 1, 1950	C	tagged	250	119	4	2	1	1	0(2 days)	
Total				390	75	15	1	1	0	0
Percent of total				80.9	15.6	3.1	0.2	0.2	0	0
August 8, 1950	B	fin clip	125	74	6(13 days)					
August 8, 1950	B	tagged	125	60	17(13 days)					
August 8, 1950	C	fin clip	125	91	10(13 days)					
August 8, 1950	C	tagged	125	57	16(13 days)					
Brook trout - Scatter plantings										
April 26, 1950	B	tagged	250	41	25	7	0	0	0	0(15 days)
April 26, 1950	C	tagged	250	76	22	5	0	1	1	0(15 days)
June 1, 1950	B	fin clip	250	123	17	3	2	0	0(2 days)	
June 1, 1950	B	tagged	250	81	18	0	1	1	0(2 days)	
Total				321	82	15	3	2	1	0
Percent of total				75.8	19.3	3.5	0.7	0.5	0.2	0
Rainbow trout - Spot plantings										
April 26, 1950	B	tagged	250	11	46	20	6	1	4	4(15 days)
April 26, 1950	C	tagged	250	12	59	20	4	2	9	2(15 days)
June 1, 1950	B	fin clip	250	143	46	5	6	3	0(2 days)	
June 1, 1950	B	tagged	250	89	35	4	20	16	0(2 days)	
Total				255	186	49	36	22	13	6
Percent of total				45.0	32.8	8.6	6.3	3.9	2.3	1.1
Rainbow trout - Scatter plantings										
April 26, 1950	B	tagged	250	6	33	15	6	2	3	6(15 days)
April 26, 1950	C	tagged	250	6	59	15	7	2	3	2(15 days)
June 1, 1950	C	fin clip	250	156	25	14	5	6	1(2 days)	
June 1, 1950	C	fin clip	250	81	22	8	11	13	2(2 days)	
Total				249	139	52	29	23	9	8
Percent of total				48.9	27.3	10.2	5.7	4.5	1.8	1.6

Table 28.--Hatchery trout recovered from plantings made in Pigeon River during 1949 and 1950

Date of planting	Number of fish recovered by anglers in 1950		
	Brook	Brown	Rainbow
April 28, 1949	0	4	2
May 25, 1949	0	2	0
June 29, 1949	0	6	6
July 27, 1949	0	8	9
August 17, 1949	0	13	17
Total recovered in 1950	0	33	34
Percent of total planted	0.0	2.2	2.3
Number planted in 1949	1500	1500	1500
Number recovered by anglers in 1949	600	384	671
Population estimate, September, 1949	80	452	380
Number recovered by anglers in 1950	0	33	34
Percent recovered of estimate in September, 1949	0	7.3	8.9
Population estimate, September, 1950	0	31	2
Number planted in 1950	2500	...	2000
Number recovered by anglers in 1950	1237	...	1076
Population estimate September, 1950	75	...	151

The recovery from the April, 1950, planting of brooks and rainbows is not believed to be very complete because of the marked tendency shown by this planting to move downstream. The number of voluntary returns of fish recovered below the research area in 1950 was much greater than in 1949, but these fish almost entirely came from the April planting (Table 29). The percentage of recovery therefore for this planting is presumably somewhat below the actual number of fish taken by anglers. For the June planting and August planting, the percentage of recovery represents nearly the complete catch by anglers, since few recaptures were reported outside of the sections planted or downstream from the experimental area.

Rainbow trout furnished a little better fishing than did brook trout, and their effect on the catch was more prolonged than that of the brook trout. For both brook and rainbow trout, a greater average recovery rate was obtained in 1950 than in 1949. This was brought about principally by eliminating the plantings during the hot part of the summer and concentrating the fish during the early part of the season.

During 1949 and 1950 we have accumulated some data on the relationship between percentage return of planted trout and the numbers of fish planted at one time. In 1949, plantings were made more frequently at a lower individual rate than in 1950. The percent of recovery from different plantings for brook and rainbow trout have been summarized from earlier tables for convenience (Table 30). Except for the April, 1950, planting which we have shown to be minimal as far as complete recoveries are concerned, the rates of recovery of plantings made at comparable dates are quite similar, despite the great difference in rate of planting. The fishing intensity and stream conditions in the two- to three-week period immediately following planting probably influences the percentage of recovery much more than the numbers of fish planted.

Table 29.--Movement of hatchery fish following planting in Pigeon River, 1950. Recoveries outside research area, tabulated from voluntary returns by anglers. Mileage based on two miles of stream for each land section traversed.

Miles downstream	Rainbow		Brook		
	April	June	April	June	August
2 (Elk Point)	12	..	29	2	3
3 (County line)	5	..	9	..	..
5	1	..	..	..	..
6	1	..	..	..	..
7 (Tin Bridge)	4	..	5	1	1
9	1	..	1	..	..
10 (Pine Grove)	1	..	2	..	..
14 (Red Bridge)	5	..	3	..	..
16	1	..	..	..	..
25 (Beebe Bridge)	2	..	..	..	..
35 (I-Beam below Afton)	2	..	3	..	..
60 (Paper Mill Dam, Cheboygan)	1	..	..	..	..

Table 30.---Relationship between percent of recovery and number of fish planted, Pigeon River 1949 and 1950. Stream averages 40 feet wide in the 2.32 miles of stream planted.

Planting date	Species	Number of fish planted per mile of stream	Percent of total recovery
April 28, 1949	Brook	129	71
April 26, 1950	Brook	431	36
April 28, 1949	Rainbow	129	74
April 26, 1950	Rainbow	431	37
May 25, 1949	Brook	129	41
June 1, 1950	Brook	431	55
May 25, 1949	Rainbow	129	70
June 1, 1950	Rainbow	431	71
June 29, 1949	Brook	129	10
June 29, 1949	Rainbow	129	20
July 27, 1949	Brook	129	18
July 27, 1949	Rainbow	129	26
August 17, 1949	Brook	129	60
August 8, 1950	Brook	216	66
August 17, 1949	Rainbow	129	34

Movement of Hatchery Fish Following Planting

The complete record of fishing intensity and of the catch from the four experimental fishing sections makes possible the calculation of accurate indices of movement of fish planted in these sections. Briefly, this movement index is based on adjusting the number of fish recovered in any section to the amount of fishing effort expended in that section in the period of time to which the planting was exposed to capture. The numbers of fish recovered during equal hours of fishing in the different sections should represent the relative numerical distribution of fish in the sections and thus indicate the degree of movement from the planting site. Except for the planting made on April 26, 1950, the great majority of the fish were recaptured within half a mile of the place where they had been planted (Table 31). This observation is very similar to the 1949 results. The large-scale downstream movement noted for the April, 1950, planting is further substantiated by the number of voluntary returns of fish from outside the experimental area from this planting (Table 29). No such downstream movement was recorded for the fish planted on April 28, 1949, and the only evident difference between the conditions in 1949 and 1950 was the water temperature. In both instances, the spring run-off had occurred prior to planting. Although we have no water temperature records for the period April 20 to May 10, 1949, the difference in weather for the last 11 days in April and the first 17 days in May of 1949 and 1950 is well shown by air temperature records maintained by the cooperative observer of the U. S. Weather Bureau at the station (Table 32). Annulus formation of scales of brook trout and changes in condition of brook and brown trout also indicated that the spring of 1950 was about two or three weeks behind 1949 in warming up. Fishing in 1950 was very poor for the first 10 days of the season compared with 1949. All available evidence indicates that it was the cold weather that accounted for the downstream movement

Table 31.--Movement of hatchery fish following planting, based on recoveries made by anglers, Pigeon River, 1950. Movement indices have been computed on a basis of fishing intensity for individual plantings.

Date of planting	How marked	Movement indices = Number fish caught / Fishing intensity				
		Down two sections	Down one section	No movement	Up one section	Up two sections
		Brook trout - Spot planting				
April 26, 1950	tagged	16	14	15	2	..
April 26, 1950	tagged	..	32	12	1	0
June 1, 1950	fin clip	1	4	57	1	..
June 1, 1950	tagged	4	4	39	1	..
August 8, 1950	tagged	6	5	14	1	..
August 8, 1950	fin clip	4	7	23	0	..
August 8, 1950	tagged	..	10	15	1	1
August 8, 1950	fin clip	..	6	16	2	0
		Brook trout - Scatter planting				
April 26, 1950	tagged	19	17	17	1	..
April 26, 1950	tagged	..	32	11	2	0
June 1, 1950	tagged	..	14	22	4	3
June 1, 1950	fin clip	..	19	36	5	1
		Rainbow trout - Spot planting				
April 26, 1950	tagged	23	16	19	0	..
April 26, 1950	tagged	..	26	21	1	1
June 1, 1950	tagged	..	2	50	3	0
June 1, 1950	fin clip	..	3	58	6	2
		Rainbow trout - Scatter planting				
April 26, 1950	tagged	26	14	11	0	..
April 26, 1950	tagged	..	40	11	1	0
June 1, 1950	tagged	0	2	45	2	..
June 1, 1950	fin clip	3	6	65	4	..

Table 32.--Temperature records of air and water for the period April 20 to May 17, 1949 and 1950, Pigeon River.

Date	1949				1950			
	Air temperature		Water temperature		Air temperature		Water temperature	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
April 20	68	26			50	31	46	38
21	76	52			38	20	42	37
22	71	45			42	18	43	40
23	60	36			50	23	42	40
24	49	28			48	24	44	37
25	60	23			52	34	48	38
26	67	35			41	32	43	37
27	61	28			39	24	44	37
28	65	19			36	26	41	37
29	73	36			40	20	42	36
30	84	24			47	23	42	39
May 1	72	49			49	33	46	38
2	74	48			45	19	46	38
3	87	39			55	35	45	37
4	87	64			..	..	42	39
5	88	60			56	34	49	42
6	82	50			81	47	54	45
7	70	29			52	32	51	43
8	72	30			48	15	51	42
9	72	33			65	43	46	42
10	55	24			65	48	45	43
11	56	17	57	47	53	23	50	43
12	66	24	53	44	68	41	55	43
13	80	34	56	48	75	42	58	47
14	69	34	58	50	60	27	61	49
15	70	28	61	50	79	31	61	50
16	82	27	58	50	79	33	62	51
17	76	41	63	52	77	37	62	50

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of the trout planted in April, 1950, although the actual relationship of water temperatures and fish movement is not definitely known.

Possible Applications of Data to Future Planting Programs

If the April, 1950, planting is disregarded and only the plantings that exhibited very little movement from the experimental area are considered, one can arrive at some mortality figures for these plantings for the period in which they were in the stream (Table 33). A population estimate made in September, 1950, furnishes information on how many of these fish were present at that time. These estimates indicate a rapid disappearance of hatchery fish from the stream following planting.

To maintain high recovery rates of planted trout, the plantings should be subjected to heavy fishing pressures soon after release. High water temperatures may result in low recovery rates to anglers. To obtain best results, plantings should be avoided during periods of hot weather in streams where maximum water temperatures may exceed 75° F. There is also a little evidence that suggests a rapid dispersal of recently planted trout when water temperatures are below 50° F. If these observations are considered when planting schedules are being prepared, it is reasonable to expect recovery rates of from 50 to 75 percent for brook and rainbow trout and 25 to 50 percent for brown trout on readily accessible and heavily fished streams. These values are substantiated by results for legal-sized trout plantings in 1949 and 1950 and by many experiments carried on by other states on heavily fished waters stocked at the most favorable periods.

The inability of the average fisherman to catch brown trout makes this species a poor investiment for any type of put-and-take fishing. Also, there is no apparent superiority to the rainbow in being able to survive the winter and thus contribute to future seasons' catch. Evidence obtained for streams that have abundant brown trout populations indicates that they

Table 33.--Approximate mortality of hatchery fish during the season in which planted. Pigeon River, 1950.

Species	Planting date	Number planted	Percent caught by anglers	Percent remaining at end of season	Percent mortality through season [1]
Brook	April 26, 1950	1,000	35.8	0.0	64.2
	June 1, 1950	1,000	54.8	0.4	44.8
	August 8, 1950	500	66.2	14.2	19.6
Rainbow	April 26, 1950	1,000	36.5	5.7	57.8
	June 1, 1950	1,000	71.1	9.4	19.5

[1] The percent mortality includes the fish which moved out of the experimental area and whose recapture was not reported voluntarily. In the case of the April 26 planting, this movement was high although the exact number cannot be determined from the data available.

are not being fully exploited even under heavy fishing intensity. Stocking of this species because of depletion of native stocks therefore is seldom warranted. The argument that the sportsmen want brown trout rather than rainbows can hardly be substantiated by the results of our identification questionnaire. It was apparent that half or more of the persons who answered the questionnaire could not even identify the brown trout (Table 45). The fact that people generally would prefer to catch fish than not catch them and the inability of the brown trout to furnish this return would suggest that the angler's preference, if any, would be for brook or rainbow trout.

Effect of Planting Hatchery Fish on Catch of Wild Fish

As a result of previous experiments in Michigan involving plantings of brook and rainbow trout, Hazzard and Shetter (1939) concluded that planting legal-sized hatchery fish markedly increases the catch of wild fish. The cause and effect relationship cited was operative only for individual species, i.e., plantings of brook trout would affect the catch of wild brook trout and not of the other two species, etc. In a later paper (1941) the same authors further limited the cause and effect relationship described above to those instances in which individual plantings were at the rate of more than 160 legal trout per mile of stream because of the failure to demonstrate this result in plantings in which the stocking rate was from 100 to 160 legal trout per mile.

The stocking program for the Pigeon River for 1949 and 1950 in conjunction with the permit system of fishing affords an opportunity to check the effects of similar plantings of hatchery trout upon the catch of wild trout. However, we much limit our discussion to the brook trout for the following reasons: (1) The catch of native rainbow trout is too small to show fluctuations of such a nature. (2) Brown trout plantings

made in 1949 were at the monthly rate of 130 trout per mile of stream. According to Hazzard and Shetter (1941) this stocking rate should have no effect on the catch of wild trout. No brown trout were planted in 1950.

In 1949, brook trout plantings were made on five different dates through the trout season at the rate of 130 trout per mile of stream. In 1950, on April 26 and June 1, brook trout were planted at the rate of 431 trout per mile of stream and on August 8, one planting was made at the rate of 216 trout per mile of stream. The Pigeon River averages about 40 feet wide in the portion stocked and contains a fair population of native brook trout. All hatchery fish stocked were marked in a distinctive manner and all fish caught by anglers were examined by department employees.

In order that our results might be more comparable with those reported by Hazzard and Shetter, their methods for computing catch per hour for the periods in question have been adopted. This consists simply of dividing the total trout caught in any interval of time by the total number of hours fished. The records comparing catch per hour of hatchery brook trout with the catch per hour of wild brook trout have been limited to Sections B and C, the two sections in which hatchery fish were stocked. As a control section, we have used Section D, in which practically no hatchery fish were caught by anglers but which does contain a fairly abundant brook trout population. Section A has been omitted for two reasons: (1) Movement downstream of the hatchery trout at times was considerable, and (2) Very few native brook trout were caught in this section.

The 1949 data for Sections B and C have been examined for weekly periods following each planting of brook trout (Table 34). The data on catch per hour of hatchery brook trout only show a high degree of correlation with the planting dates, the highest catch per hour always

Table 34.--Effect of planting hatchery fish on the catch of wild fish. Brook trout - Pigeon River, 1949.

Period ∀	Section B			Section C			Section B & C				
	Hours fished	Hatchery fish	Wild fish	Hours fished	Hatchery fish	Wild fish	Hours fished	Hatchery fish		Wild fish	
								Number	Catch per hour	Number	Catch per hour
April 30 - May 6	254	46	15	342	58	30	596	104	0.17	45	0.08
May 7 - 13	136	25	7	110	10	10	246	35	0.14	17	0.07
May 14 - 24	182	10	17	304 1/2	25	57	486 1/2	35	0.07	74	0.15
May 25 - 31	276 1/2	51	17	263	55	22	539 1/2	106	0.20	39	0.07
June 1 - 7	87 1/2	3	16	82 1/2	7	11	170	10	0.06	27	0.16
June 8 - 14	84	4	6	111	2	21	195	6	0.03	27	0.14
June 15 - 21	209 1/2	3	13	118	4	22	327 1/2	7	0.02	35	0.11
June 22 - 28	101 1/2	0	1	75	2	12	176 1/2	2	0.01	13	0.07
June 29 - July 5	182 1/2	12	12	138 1/2	3	18	321	15	0.05	30	0.09
July 6 - 12	121 1/2	1	11	85	3	18	206 1/2	4	0.02	29	0.14
July 13 - 19	28 1/2	0	2	92 1/2	1	10	121	1	0.01	12	0.10
July 20 - 26	54 1/2	0	2	50	1	5	104 1/2	1	0.01	7	0.07
July 27 - August 2	78 1/2	4	1	96	8	3	174 1/2	12	0.07	4	0.02
August 3 - 9	68 1/2	6	4	67	1	11	135 1/2	7	0.05	15	0.11
August 10 - 16	47	1	4	91	0	5	138	1	0.01	9	0.07
August 17 - 23	92 1/2	22	4	200 1/2	83	14	293	105	0.36	18	0.06
August 24 - 30	82	14	3	112	8	5	194	22	0.11	8	0.04
August 31 - Sept. 11	298 1/2	42	14	211	22	10	509 1/2	64	0.13	24	0.05
Total	2,385	244	149	2,549 1/2	293	284	4,934 1/2	537	0.11	433	0.09
Sections B & C combined											
1st week after planting							1,924	342	0.18	136	0.07
2nd week after planting							952	78	0.08	96	0.10
3rd week after planting							1,450	107	0.07	146	0.10

∀ Planting dates include April 28, May 25, June 29, July 27, and August 17, 1949.

occurring during the week following a planting and each week thereafter exhibits a declining catch per hour. The effect of the planting of hatchery fish on the catch of wild fish is somewhat obscure, but in three instances out of four, the planting of hatchery trout was followed by a decline in the catch per hour of wild trout from the previous week. This general trend of the catch of both hatchery fish and wild fish is substantiated by adding together the data for corresponding weeks following each planting. The catch per hour of the hatchery fish exhibits a declining series, but the catch per hour of wild fish is lower the first week than the following two weeks. From these data alone it appears that the planting of hatchery trout may have influenced adversely the catch of wild trout during the first week (Table 34). For confirmation of these results we have examined the results of fishing in Section D where the almost complete lack of hatchery brook trout could exert little influence on the catch of wild fish (Table 35). Here we also see that the catch per hour for the first week following the plantings is consistently less than the succeeding two weeks. The obvious conclusion is that the factors responsible for the variation in catch per hour of wild fish were operative in all three sections and the presence of hatchery fish in Sections B and C probably had no influence on the catch of wild fish. The planting rate for 1949 was approximately 130 fish per mile of stream. It would seem that we are in complete accord with Hazzard and Shetter (1941) in that plantings of this intensity have no effect on the catch of wild fish of the same species.

Turning to the data for 1950, brook trout were planted during April and June at the rate of 431 trout per mile of stream and in August at the rate of 216 per mile, both rates which according to Hazzard and Shetter

Table 35.--Effect of planting hatchery fish on the catch of wild fish.

Brook trout - Pigeon River, 1949.

Period ✓	Section D (not planted) Hours fished	Hatchery fish	Wild fish	Catch per hour
April 28 - May 6	90 1/2	1	8	0.09
May 7 - 13	52 1/2	1	17	0.32
May 14 - 24	124 1/2	0	20	0.16
May 25 - 31	94 1/2	2	36	0.38
June 1 - 7	53 1/2	0	23	0.43
June 8 - 14	36	0	17	0.47
June 15 - 21	30	0	18	0.60
June 22 - 28	19	0	5	0.26
June 29 - July 5	59	0	15	0.25
July 6 - 12	33	1	15	0.45
July 13 - 19	86	0	33	0.38
July 20 - 26	67 1/2	1	3	0.04
July 27 - August 2	29 1/2	0	2	0.07
August 3 - 9	31 1/2	0	8	0.25
August 10 - 16	55 1/2	0	17	0.31
August 17 - 23	63	1	8	0.13
August 24 - 30	46	1	2	0.04
August 31 - September 11	85	6	21	0.25
Total	1,056 1/2	14	268	0.25
1st week after planting	336 1/2	4	69	0.21
2nd week after planting	216 1/2	3	65	0.30
3rd week after planting	387	6	108	0.28

✓ Planting dates include April 28, May 25, June 29, July 27 and August 17, 1949.

should be sufficient to produce a definite increase in the catch of wild trout of the same species. The results are summarized in a manner similar to those of 1949 giving two sections in which hatchery fish were abundantly planted and one in which no hatchery fish were planted and in which practically no hatchery fish were caught by anglers (Tables 36 and 37). In Sections B and C, although the catch per hour of the planted trout increased greatly at the time of planting (0.06 to 0.79, 0.00 to 0.93, 0.02 to 1.25 and 0.00 to 0.67), the corresponding weekly catch per hour data for the wild trout showed no such correlation (0.08 to 0.07, 0.10 to 0.03, 0.19 to 0.12 and 0.27 to 0.11). Again it appeared that the planting of hatchery fish adversely affected the catch of wild fish from the data for Sections B and C. However, this drop in the catch per hour of wild fish might have been caused by the increase in the fishing intensity brought about by the hatchery plantings.

It might be argued that the increased fishing pressure induced by planting trout would increase the exploitation of wild fish so that the end result would be the same, i.e., a smaller proportion of wild fish left at the end of the season in planted sections. Again citing figures obtained from Sections B, C and D of the Pigeon River, we are unable to demonstrate increased exploitation of the wild brook trout populations as being due to increased fishing pressure (Table 38). It should be explained that in all three sections, the rate of exploitation is high, approaching 75 percent of all brook trout that become of legal size during the season. The relationship between fishing intensity and rate of exploitation is not well known for this species or many other species of fish. For the brook trout, it appears that a comparatively few fishing trips may materially reduce the numbers of trout of any legal size, and that additional fishing trips are consequently less successful in catching fish.

Table 36.--Effect of planting hatchery fish on the catch of wild fish, brook trout, Pigeon River, 1950.

Period ⩛	Section B					Section C					Sections B & C				
	Hours fished	Hatchery fish		Wild fish		Hours fished	Hatchery fish		Wild fish		Hours fished	Hatchery fish		Wild fish	
		Number	Catch per hour	Number	Catch per hour		Number	Catch per hour	Number	Catch per hour		Number	Catch per hour	Number	Catch per hour
April 29 - May 5	92	0	0.00	0	0.00	105 1/2	1	0.01	0	0.00	197 1/2	1	0.01	0	0.00
May 6 - 12	43 1/2	9	0.21	3	0.07	48	6	0.13	2	0.04	91 1/2	15	0.16	5	0.05
May 13 - 19	183	78	0.43	13	0.07	136 1/2	33	0.24	29	0.21	319 1/2	111	0.35	42	0.13
May 20 - 26	85	15	0.18	6	0.07	132 1/2	19	0.14	48	0.36	217 1/2	34	0.16	54	0.25
May 27 - 31	232	14	0.06	18	0.08	140 1/2	3	0.02	26	0.19	372 1/2	17	0.05	44	0.12
June 1 - 7	140 1/2	111	0.79	10	0.07	193 1/2	242	1.25	24	0.12	334	353	1.06	34	0.10
June 8 - 14	180 1/2	48	0.27	19	0.11	133 1/2	36	0.27	22	0.16	314	84	0.27	41	0.13
June 15 - 21	116 1/2	33	0.28	9	0.08	124 1/2	17	0.14	24	0.19	241	50	0.21	33	0.14
June 22-28	116 1/2	14	0.12	7	0.06	74 1/2	2	0.03	15	0.20	191	16	0.08	22	0.12
June 29 - July 5	169 1/2	8	0.05	9	0.05	109 1/2	3	0.03	26	0.24	279	11	0.04	35	0.13
July 6 - 12	69	1	0.01	13	0.19	81 1/2	1	0.01	15	0.18	150 1/2	2	0.01	28	0.19
July 13 - 19	64 1/2	2	0.03	3	0.05	84 1/2	1	0.01	7	0.08	149	3	0.02	10	0.07
July 20 - 26	47	0	0.00	3	0.06	27	1	0.04	6	0.22	74	1	0.01	9	0.12
July 27 - August 2	24	0	0.00	0	0.00	68	1	0.01	5	0.07	92	1	0.01	5	0.05
August 3 - 7	20	0	0.00	2	0.10	47 1/2	0	0.00	13	0.27	67 1/2	0	0.00	15	0.22
August 8 - 14	89 1/2	83	0.93	3	0.03	142	95	0.67	16	0.11	231 1/2	178	0.77	19	0.08
August 15 - 21	79	30	0.38	3	0.04	66 1/2	11	0.17	7	0.11	145 1/2	41	0.28	10	0.07
August 22 - 28	160	44	0.28	5	0.03	74 1/2	1	0.01	12	0.16	234 1/2	45	0.19	17	0.07
August 29 - Sept. 4	166	21	0.13	18	0.11	55 1/2	8	0.14	8	0.14	221 1/2	29	0.13	26	0.12
September 5 - 10	52 1/2	7	0.13	8	0.15	44 1/2	4	0.09	6	0.13	97	11	0.11	14	0.14
Total	2,130 1/2	518	0.24	152	0.07	1,890	485	0.26	311	0.16	4,020 1/2	1,003	0.25	463	0.12

⩛ Planting dates are April 26, June 1, and August 8, 1950.

Table 37.--Effect of planting hatchery fish on the catch of wild fish, brook trout, Pigeon River, 1950.

Period ✓	Section D (not planted)				
	Hours fished	Hatchery fish		Wild fish	
		Number	Catch per hour	Number	Catch per hour
April 26 - May 5	20	0		0	0.00
May 6 - 12	21 1/2	0		0	0.00
May 13 - 19	126	2		69	0.55
May 20 - 26	57	0		15	0.26
May 27 - 31	132	0		38	0.29
June 1 - 7	31 1/2	2		9	0.29
June 8 - 14	64	0		40	0.63
June 15 - 21	62 1/2	5		28	0.45
June 22 - 28	81 1/2	1		29	0.36
June 29 - July 5	116	4		24	0.21
July 6 - 12	72 1/2	0		8	0.11
July 13 - 19	73	0		10	0.14
July 20 - 26	37 1/2	0		12	0.32
July 27 - August 2	23 1/2	0		0	0.00
August 3 - 7	33	0		4	0.12
August 8 - 14	54	1		22	0.41
August 15 - 21	35	0		8	0.23
August 22 - 28	69	0		8	0.12
August 29 - Sept. 4	116 1/2	3		21	0.18
September 5 - 10	50 1/2	1		18	0.36
Total	1,276 1/2	19		363	0.28

✓ Planting dates are April 26, June 1, and August 8, 1950.

Table 38.--Comparison of escapement of wild brook trout in planted sections and unplanted sections, Pigeon River, 1949 and 1950.

Item	Total	Section D	Section C	Section B	Section A
1949 - stocking rate at 130 trout per mile.					
Total anglers' catch	795	268	284	149	94
Population estimate of legal-size trout, September, 1949.	290	91	76	86	37
Percent escapement	26.7	25.3	21.1	36.6	28.2
1950 - stocking rate at 216 to 431 trout per mile					
Total anglers' catch	919	363	311	152	93
Population estimate of legal-size trout, September, 1950.	309	127	63	64	55
Percent escapement	25.2	25.9	16.8	29.6	37.2

Some other data lend themselves to an evaluation of this cause and effect relationship cited by Hazzard and Shetter. If heavy plantings of hatchery trout cause increased competition for food and shelter to the point where wild fish are forced to forage more extensively and are caught more readily than normal, it is also logical to assume that the exploitation of wild fish in planted sections would be greater than in sections that had not been stocked. Also, the exploitation of the wild brook trout population in 1950 should have been greater than in 1949 because of the increase in stocking rate from 130 fish per mile in 1949 to 216 and 431 fish per mile in 1950. There is no good evidence from the 1949 and 1950 data on the Pigeon River to support these assumptions (Table 38). The rate of exploitation between the seasons 1949 and 1950 was not much different and there was no agreement between individual sections. In both years, Section B (planted section with high fishing intensity) had a greater escapement of wild brook trout than did Section D (unplanted), and also in both years Section C (planted) had the lowest rate of escapement of any of the sections. Factors other than stocking hatchery fish apparently are more effective in determining the rate of exploitation of the wild trout populations.

Wild Fish Production

The ratio of abundance of the three species of native trout in the anglers' catch did not change a great deal from 1949 to 1950. Brook trout furnished the most fish to the angler followed by brown and rainbow trout (Table 39). For 1950, total trout production for the 4.8 miles of stream averaged 8.57 pounds per surface acre, ranging from 3.14 pounds per acre in Section A to 12.66 pounds per acre in Section C. The production per acre for the three species and for the

Table 39.--Number and weight of wild trout caught by anglers from Pigeon River, 1950.

	Brook trout		Brown trout		Rainbow trout		All species	
	Number	Pounds per acre	Number	Pounds per acre	Number	Pounds per acre	Number	Pounds per acre
Section A	93	2.01	27	0.93	3	0.20	123	3.14
Section B	152	4.31	91	3.66	8	0.21	251	8.18
Section C	311	8.61	88	3.98	3	0.07	402	12.66
Section D	363	9.55	49	2.35	2	0.04	414	11.94
All Sections	919	5.82	255	2.61	18	0.14	1,190	8.57

Total weight by species		Average weight by species
Brook trout	140.2 pounds	.154 pounds
Brown trout	62.9 pounds	.247 pounds
Rainbow trout	3.3 pounds	.183 pounds
Total	206.4 pounds	.173 pounds

different sections of the stream in 1950 were remarkably similar to 1949. This was due in part to the nearly equal fishing intensity on this portion of the river for the two seasons but also reflects no large change in the abundance of the fish stocks. On this basis, we might predict somewhat of an increase in production for 1951 because of the noticeable increase in the sub-legal trout populations indicated in the fall population estimates of 1950 (Table 40). The similarity in the production for different sections of the stream for the two years agrees with observations made with the use of electrical shockers on the abundance of the trout in the different sections and substantiates these population estimates. The tremendous variation in production of small adjacent portions of the stream indicates that the effect of limiting factors is operative within rather narrow limits. The determination and evaluation of these factors is the object of a special study by N. G. Benson being carried on at the present time. From preliminary information on four selected areas of the Pigeon River, the amount of ground water (springs, seepage, etc.) in the immediate vicinity of these selected areas appears to be correlated with the abundance and distribution of the trout populations. It is known that sources of ground water are necessary for successful spawning of trout. Also, the warming effect of ground water in the winter in reducing ice formation would lessen the adverse effects of ice-scouring on gravel riffles, underwater cover, etc. Whatever the relationship, this correlation between abundant ground water, lack of ice in the winter and good trout production furnishes a possible index to be used in a winter survey of trout streams (Figures 3, 4, 5).

Table 40.--Estimates of populations of wild trout and hatchery trout in 4.8 miles of the Pigeon River, 1949 and 1950.

September, 1949

Species	Wild fish			Hatchery fish
	2.0" - 4.9"	5.0" - 6.9"	7.0" & over	Over 7"
Brook	4,131	1,511	290	80
Brown	1,082	221	602	452
Rainbow	...	...	...	380

September, 1950

Species	Wild fish				Hatchery fish
	2.0" - 4.9"	5.0" - 6.9"	7.0" - 9.9"	10.0" & over	Over 7"
Brook	5,444	1,623	308	2	75
Brown	1,552	310	514	116	31
Rainbow	291	27	13	0	153

Figure 3.--Experimental Section D of Pigeon River, Otsego County, Michigan, looking downstream from road bridge on Section 17-20 line, T. 32 N., R. 1 W. February 9, 1951. Minimum air temperatures for February 8, 1951 was -30° F.; for February 9, 1951, -30° F. Production of trout to anglers from this section in 1949 was 10.42 pounds per acre; in 1950, 11.94 pounds per acre.

Figure 4.--Experimental Section B of Pigeon River, Otsego County, Michigan, looking upstream from staff house building in Section 9, T. 32 N., R. 1 W. February 9, 1951. Weather data same as for Figure 3. Production of trout to anglers from this section in 1949 was 8.03 pounds per acre; in 1950, 8.18 pounds per acre.

Figure 5.--Experimental Section A of Pigeon River, Otsego County, Michigan, looking downstream from Elk Hill in Section 9, T. 32 N., R. 1 W. February 9, 1951. Weather data same as for Figure 3. Production of trout to anglers from this section in 1949 was 3.79 pounds per acre; in 1950, 2.98 pounds per acre.

During the summer of 1949, the Lansing Club, now owned and operated by the heirs of Mr. Jackson, rebuilt the dam located on the river about one mile above the research area. As a part of this construction a water-wheel, spillway and separate race-way were installed along the west bank of the stream. In this race-way, which was screened off from the main river, a planting of brook trout was made sometime during the fall or early winter of 1949. To our knowledge, no permit was obtained for this planting and the fish were not marked in any manner enabling easy identification. This planting came to our attention as a result of the appearance of what looked like unmarked hatchery fish in the catch of anglers fishing in the research area. These fish had apparently escaped the rather inadequately screened race-way on the Lansing Club property. Special care was taken to sort these fish from wild-appearing brook trout, as a routine matter scale samples were taken from all unmarked trout observed at the checking station. It was possible to separate these fish from native trout on a basis of the appearance of the scales, and the fish derived from this single planting have been tabulated separately from the native trout (Table 41). The distribution of these hatchery trout in the anglers' catch both as to the time of capture and the section in which caught substantiates the identification made from their general appearance and the examination of their scales. Most of the catch came from sections D and C, and nearly all the fish were caught before the first of July.

Rate of Exploitation of Wild Trout

One of the most important items of information of use in the management of fish populations is the number of fish caught by anglers in relation to the total fish of legal size that are available for

Table 41.--Recoveries from Lansing Club brook trout, Pigeon River, 1950.

Section in which recovered, size and date, 1950							
Date recovered	Section A	Date recovered	Section B	Date recovered	Section C	Date recovered	Section D
May 14	8.1	July 1	7.1	May 13	8.8	May 18	9.1
May 27	7.0	July 1	9.6	May 24	8.6	May 28	9.2
May 29	8.3			May 26	8.8	May 28	8.4
July 3	7.8			May 26	8.2	May 28	8.1
				May 26	7.9	May 28	9.5
				May 27	8.0	May 28	9.0
				May 28	8.6	May 29	8.1
				May 28	8.5	May 29	8.3
				May 28	8.3	May 30	8.4
				June 2	9.2	May 31	8.2
				June 13	9.4	June 4	8.5
				June 15	9.3	June 6	8.4
				June 17	8.1	June 6	8.8
				June 22	9.1	June 6	9.4
				June 30	8.7	June 14	9.1
				July 1	8.8	June 14	9.2
				July 21	8.8	June 16	10.0
				August 11	8.3	June 17	8.8
						June 18	8.6
						June 19	8.5
						June 21	9.2
						June 21	8.2
						June 21	8.9
						June 22	9.0
						August 14	8.1

capture. This has been identified by some workers as the rate of exploitation. Due to the time at which the trout season opens and to the lack of confidence in fish population estimates made in the spring before water temperatures have warmed up, we have calculated a "rate of exploitation" index on a basis of the numbers of fish still present in the stream after the season has closed compared with the total catch of that species for the season (Table 42). These values indicate that the brook trout are being heavily exploited in comparison to the brown trout. The value given for the rainbow trout is based on small numbers of fish and may not be representative of areas where the population density is greater.

Age-group Composition of the Catch

Another way to show the effects of fishing on the stocks of native fish present is to tabulate the catch on a basis of the age of the fish. When this is done for four-week periods of the trout season, a better idea of the rate of exploitation and recruitment of individual age groups is obtained. For the major part of the season, the bulk of the catch of brook trout comes from age-group II, fish that are in their third summer of life. For the last four weeks, age-group I is most important in the catch. (Table 43) However, age-group I contributes heavily to the catch from about July 1. It is well to realize that females of age-group I will not have spawned for the first time and thus cannot contribute to the native reproduction of the stream. Fish older than age-group II are rare in the catch of brook trout due to the high rate of exploitation of this species.

Size Distribution of Wild Trout in the Catch

The size distribution of the wild trout in the catch naturally follows the same pattern shown by the distribution of age-groups of fish. However, some additional information is derived from an

Table 42.--Exploitation of wild trout, Pigeon River, 1949 and 1950.

Item	Brook trout	Brown trout	Rainbow trout
1950			
Number caught	901	241	47
Population estimate - September	310	630	13
Percent exploitation	74.4	27.7	78.3
1949			
Number caught	793	198	
Population estimate - September	290	602	
Percent exploitation	73.2	24.8	

Table 43.--Age composition of the catch of wild brook and brown trout taken from the Pigeon River during the 1949 and 1950 seasons. Percentages are given in parentheses.

Period [V]	Brook trout								
	1949			1950			1949 and 1950		
	Number of fish in age group:			Number of fish in age group:			Number of fish in age group:		
	I	II	III	I	II	III	I	II	III
1st (April 30-May 27)	7	101	5	1	182	28	8 (2.5)	283 (87.3)	33 (10.2)
2nd (May 28-June 24)	11	48	1	3	269	7	14 (4.1)	317 (93.5)	8 (2.4)
3rd (June 25-July 22)	45	43	0	10	138	1	55 (23.2)	181 (76.4)	1 (0.4)
4th (July 23-August 19)	22	26	0	34	70	2	56 (36.4)	96 (62.3)	2 (1.3)
5th (August 20-Sept. 11)	32	21	0	62	49	1	94 (57.0)	70 (42.4)	1 (0.6)
	Number of trout in catch = 793			Number of trout in catch = 919			Number of trout in catch = 1,712		
	Number sampled = 362			Number sampled = 857			Number sampled = 1,219		

Period [V]	Brown trout								
	1949			1950			1949 and 1950		
	Number of fish in age groups			Number of fish in age groups			Number of fish in age group:		
	I	II	III	I	II	III	I	II	III
1st (April 30-May 27)	0	20	0	0	57	3	0 (0.0)	77 (96.3)	3 (3.7)
2nd (May 28-June 24)	6	26	2	2	64	0	8 (8.0)	90 (90.0)	2 (2.0)
3rd (June 25-July 22)	21	15	2	0	45	4	21 (24.1)	60 (69.0)	6 (6.9)
4th (July 23-August 19)	17	11	1	23	14	3	40 (58.0)	25 (36.2)	4 (5.8)
5th (August 20-Sept. 11)	28	7	0	24	12	1	52 (72.2)	19 (26.4)	1 (1.4)
	Number of trout in catch = 198			Number of trout in catch = 255			Number of trout in catch = 453		
	Number sampled = 156			Number sampled = 252			Number sampled = 408		

[V] The periods are four weeks except for the last period which is only 23 days due to the season closing on the second Sunday in September. Dates given are for the 1949 season. For the 1950 season, each date would be advanced one day, because of opening day falling on April 29.

examination of these data (Table 44 and Figure 6). With heavy fishing intensity it is natural to expect that most fish caught will be close to the minimum size limit. However, the number of larger sized trout taken reflects the degree of exploitation of the population. The difference in exploitation between brook and brown trout is well shown by the size distribution of the total catch. If we consider the total catch of wild brook and brown trout for 1949 and 1950 combined, the number of trout and percentage of total catch that were larger than 10 inches is as follows: brook trout, 22 of 1,593 or 1.4 percent; brown trout, 71 of 446 or 15.9 percent. Preliminary investigation of the growth of the two species indicates that they are growing at similar rates. When it is realized that these data for 10-inch brook and brown trout represent the total catch from 4.8 miles of stream for two complete trout seasons, one can readily see that the chances of catching a wild brook trout or brown trout worth bragging about seem to be slim indeed.

Questionnaire on Trout Management Policies

During the 1950 trout season an attempt was made to determine the percentage of trout fishermen that could readily identify the three species of trout common to Michigan. There is abundant evidence to justify different fishing restrictions on the three species of trout. However, such regulations presuppose at least a passing acquaintance with the three species of trout by the anglers concerned. In order to get this information and at the same time to determine public sentiment on other policies concerning trout management, a questionnaire was submitted on a voluntary basis to each angler when he applied for a fishing permit. (Figure 7.) This questionnaire was used at Hunt Creek Fisheries Experiment Station, Rifle River Area (Grousehaven) and at the Pigeon River Trout Research Area. The addition of other questions

Table 44.--Length-distribution of wild brook and brown trout caught by anglers in Pigeon River, seasons of 1949 and 1950.

Length in inches	Brook trout				Brown trout			
	Number of trout in catch			Percent of total	Number of trout in catch			Percent of total
	1949	1950	1949 & 1950	1949 & 1950	1949	1950	1949 & 1950	1949 & 1950
5.5 - 5.9	..	1	1		..	..	..	
6.0 - 6.4	..	3	3		..	1	1	
6.5 - 6.9	56	54	110	76.0	3	6	9	39.0
7.0 - 7.4	250	361	611		55	31	86	
7.5 - 7.9	208	277	485		26	52	78	
8.0 - 8.4	103	99	202		12	50	62	
8.5 - 8.9	56	48	104		20	34	54	
9.0 - 9.4	16	15	31	22.6	18	40	58	45.1
9.5 - 9.9	15	9	24		17	10	27	
10.0 - 10.4	7	12	19		16	15	31	
10.5 - 10.9	2	1	3		8	5	13	
11.0 - 11.4	..	..	..		5	2	7	
11.5 - 11.9	..	..	..		5	2	7	
12.0 - 12.4	..	..	..		1	1	2	
12.5 - 12.9	..	..	..	1.4	3	3	6	15.9
13.0 - 13.4	..	..	..		..	1	1	
13.5 - 13.9	..	..	..		..	..	..	
14.0 - 14.4	..	..	..		..	1	1	
14.5 - 14.9	..	..	..		..	..	..	
15.0 - 15.4	..	..	..		..	..	..	
15.5 - 15.9	..	..	..		..	..	..	
16.0 - 16.4	..	..	..		..	..	..	
16.5 - 16.9	..	..	..		1	2	3	
Total	713	880	1,593		190	256	446	

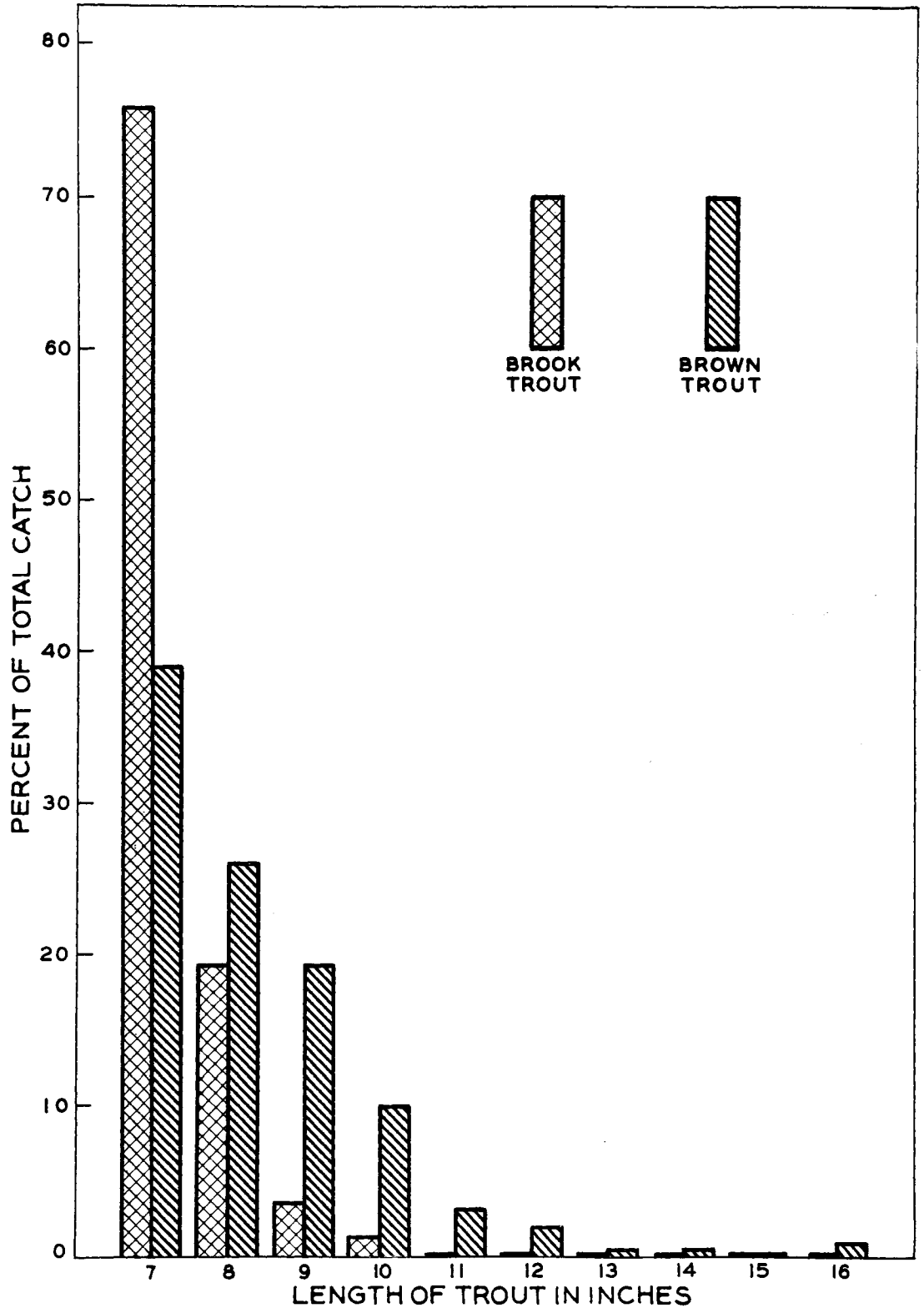

Figure 6.--Length-distribution of trout in anglers' catch, Pigeon River, 1949 and 1950

QUESTIONNAIRE ON TROUT MANAGEMENT
(1950)

The Fish Division of the Michigan Department of Conservation is anxious to determine public opinion on some questions of vital importance to future policies of planting trout. You are cordially invited to express your opinion on the following questions if you desire to do so. Please underline the answer that best expresses your opinion.

1. I believe that the Department is planting (too many - enough - not enough) legal-sized trout in Michigan's lakes and streams.

2. I (would - would not) favor an increase in trout license fees if the money were to be spent for raising and planting more legal-sized trout.

3. I think the Department is doing (too much - enough - not enough) stream improvement.

4. I (would - would not) favor an increase in trout license fees if the money were to be spent for more trout stream improvement.

5. Please identify the three kinds of trout displayed by writing the number of the bottle under the correct name as listed below:

Brook or Speckled Trout Brown Trout Rainbow Trout

_____

Signature
(Not obligatory)

Figure 7

to the trout identification test had the advantage of camouflaging somewhat the intent of the experiment, for it was thought that in a voluntary poll of this kind, a highly biased sample would result if only the identification question was used. This belief was at least partially correct, judging from the number of persons who refrained from answering the identification question (Table 45). It was apparent from the beginning that the question concerning the identification of the three species of trout was embarrassing to a great many fishermen and undoubtedly resulted in fewer people participating in the poll than otherwise. Also, parties of fishermen frequently would rely on the "expert" of the group for correct answers. Any compilation of correct scores would therefore be biased compared with a strictly random sample and fewer trout fishermen could be expected to be able to identify the three species correctly than judged by the results of the questionnaire.

The predominance of opinion in favor of more environmental improvement may be the result of recent emphasis of department thinking and publicity in favor of this type of work. It is a little surprising to note that about half of the fishermen believe that the department is planting enough trout, and also to observe that they are generally in favor of higher license fees if the money is to be spent either for planting trout or stream improvement.

INSTITUTE FOR FISHERIES RESEARCH

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Report approved by A. S. Hazzard

Report typed by B. A. Lowell

Table 45.--Results of the voluntary poll of anglers concerning trout identification, planting of hatchery fish, environmental improvement and license fees.

	Pigeon River	Hunt Creek	Rifle River
Question 1. I believe that the Department is planting (too many - enough - not enough) legal-sized trout in Michigan's lakes and streams.			
Number of answers	125	111	68
Too many	2 percent	7 percent	16 percent
Enough	48 percent	38 percent	41 percent
Not enough	50 percent	55 percent	43 percent
Question 2. I (would - would not) favor an increase in trout license fees if the money were to be spend for raising and planting more legal-sized trout.			
Number of answers	130	116	70
Would	77 percent	70 percent	57 percent
Would not	23 percent	30 percent	43 percent
Question 3. I think the Department is doing (too much - enough - not enough) stream improvement.			
Number of answers	133	114	70
Too much	3 percent	0 percent	1 percent
Enough	36 percent	34 percent	41 percent
Not enough	61 percent	66 percent	58 percent
Question 4. I (would - would not) favor an increase in trout license fees if the money were to be spent for more trout stream improvement.			
Number of answers	130	118	68
Would	75 percent	81 percent	73 percent
Would not	25 percent	19 percent	27 percent
Question 5. Please identify the three kinds of trout displayed (brook, brown and rainbow trout displayed).			
Number of questionnaires	102	126	80
Did not answer	18 percent	4 percent	33 percent
All correct	62 percent	56 percent	54 percent
Brook trout misidentified	19 percent	25 percent	10 percent
Brown trout misidentified	15 percent	38 percent	11 percent
Rainbow trout misidentified	17 percent	34 percent	9 percent