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Inst. for Fish. Res.
Pigeon River Station
Hunt Creek Station
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DIVISION OF FISHERIES
MICHIGAN DEPARTMENT OF CONSERVATION
COOPERATING WITH THE
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THE TWELFTH ANNUAL CREEL CENSUS AND PROGRESS REPORT, PIGEON RIVER TROUT RESEARCH STATION, 1960[1]

By William C. Latta

The Pigeon River Trout Research Station, 13 miles east of Vanderbilt in Otsego County, was established in 1949 on the site of the former Pigeon River Forest Headquarters. The experimental waters of the station include seven small limestone sinks or lakes (Ford, Section 4, Hemlock, Lost, West Lost, North Twin, and South Twin) and, at the time of the station's establishment, included 4.8 miles of the Pigeon River. This portion of the Pigeon River was divided into four experimental sections (A, B, C, and D), each approximately 1.2 miles long (Fig. 1). In 1953, a fifth experimental section (E), of about equal length, was added at the upstream end of the controlled area, increasing the length of the experimental area to about 6 miles. The physical features of the experimental stream sections are presented in Table 1.

Since 1949, fishing on the experimental waters has been by permit. Each angler is required to obtain a free, one-day permit before proceeding

[1] Starting with July 1, 1960, studies at this station are under Dingell-Johnson Project F-17-R-1.

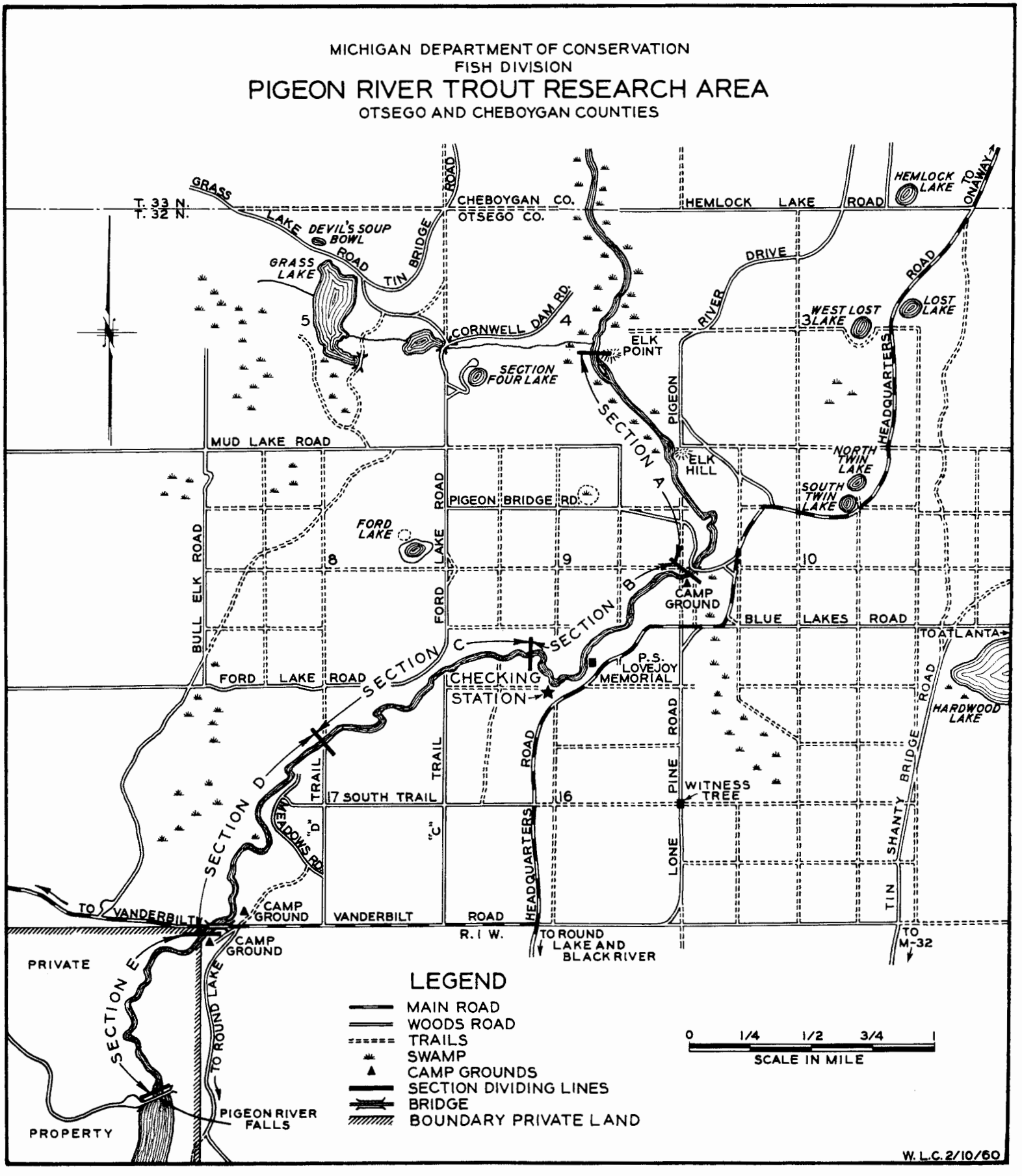
MICHIGAN DEPARTMENT OF CONSERVATION
FISH DIVISION
PIGEON RIVER TROUT RESEARCH AREA
OTSEGO AND CHEBOYGAN COUNTIES
T. 33 N.
T. 32 N.
CHEBOYGAN CO.
OTSEGO CO.
GRASS LAKE ROAD
DEVIL'S SOUP BOWL
GRASS LAKE
TIN BRIDGE ROAD
CORNWELL DAM RD.
SECTION FOUR LAKE
ELK POINT
HEMLOCK LAKE ROAD
HEMLOCK LAKE
TO ONAWAY
RIVER DRIVE
WEST LOST LAKE
LOST LAKE
HEADQUARTERS ROAD
MUD LAKE ROAD
ELK HILL
NORTH TWIN LAKE
SOUTH TWIN LAKE
PIGEON BRIDGE RD.
FORD LAKE
FORD LAKE ROAD
BULL ELK ROAD
CAMP GROUND
BLUE LAKES ROAD
TO ATLANTA
SECTION A
SECTION B
SECTION C
SECTION D
SECTION E
FORD LAKE ROAD
CHECKING STATION
P.S. "LOVEJOY MEMORIAL
HARDWOOD LAKE
17 SOUTH TRAIL
WITNESS TREE
PINE ROAD
SHANTY BRIDGE ROAD
MEADOWS ROAD
HEADQUARTERS
LONE TREE
TIN
TO VANDERBILT
CAMP GROUND
VANDERBILT ROAD
R. 1 W.
TO ROUND LAKE AND BLACK RIVER
TO M-32
PRIVATE
PROPERTY
TO ROUND LAKE
PIGEON RIVER FALLS
LEGEND
MAIN ROAD
WOODS ROAD
TRAILS
SWAMP
CAMP GROUNDS
SECTION DIVIDING LINES
BRIDGE
BOUNDARY PRIVATE LAND
0 1/4 1/2 3/4 1
SCALE IN MILE
W. L. C. 2/10/60

Figure 1

THE PIGEON RIVER TROUT RESEARCH AREA

This research and experimental area is located in the northeastern corner of Otsego County and in a small portion of Cheboygan County in the Pigeon River State Forest. Here six miles of the Pigeon River and seven trout lakes have been designated as experimental waters for studies on brook, brown, and rainbow trout. This program, as is also true with other functions of the Fish Division, is financed solely from the sale of fishing licenses and trout stamps. Its success depends to a large extent on the cooperation of the fishing public in supplying the information needed to maintain and improve trout fishing.

The Pigeon River in this experimental area is divided into five convenient fishing sections as indicated on the reverse side of this sheet. Seven trout lakes of unusual character are included in the trout research program. These lakes are believed to have been formed geologically through the solution of underlying limestone by ground water, and a settling of the surface layer of sand and gravel, producing cone-shaped pot holes, some with nearly vertical banks 50 to 60 feet high.

In order to obtain a complete record of the fishing in this area, each fisherman is required to register daily at the checking station, obtain a free permit to fish in any lake or portion of the stream and report back to the checking station before fishing in another lake or stream section or before leaving the area. Some experimental changes in the usual regulations governing trout fishing in Michigan are made from time to time in order to learn how necessary such restrictions are and whether changes may improve the angling quality. The special regulations are stated on the fishing permit.

In addition to the information on fishing success collected from anglers using the area, periodic estimates are made of the size of the trout populations and the rates of growth and mortality of the fish are determined. All of these factors—fishing success, total catch, population size, growth, mortality and any others that are pertinent—are used in the evaluation of research projects.

Research projects include the evaluation of various changes in the fishing regulations, the correct stocking programs for the lakes and stream, and the effects of stream improvement, as well as studies of the basic biology of trout.

The research station also provides a base for studies on waters outside of the experimental area.

Table 1. --Morphometry of experimental stream sections, Pigeon River Trout Research Station[1]

Section	Length (miles)	Average width (feet)	Area (acres)
A	1.31	45	7.16
B	1.19	41	5.90
C	1.13	40	5.39
D	1.18	40	5.65
E	1.17	40	5.67

[1] Data for Sections A, B, C and D from Cooper, 1953. Length of Section E from Bacon, Shetter and Cooper, 1958. Width of Section E was measured July 28, 1961.

to his selected water, whether experimental section of the stream or particular lake, and is also required to report on his trip and to allow examination of his catch by station personnel. On any day, he may fish in as many sections of the river or in as many lakes as he desires, so long as he reports back to the checking station after fishing in each separate water.

The creel census is used to evaluate experimental methods of trout management, such as special regulations, methods of planting, manipulation of the environment, as well as providing information concerning the basic biology of trout. The compulsory permit system assured a complete, or nearly complete, census and information was secured which could not be obtained otherwise. Previous annual creel census reports have appeared in the Institute report series.[2]

No trout have been planted in the experimental sections of the stream since 1957; the data for the stream fishing are for wild trout only. Trout do not reproduce in the lakes, so for lakes all data are derived from plants of hatchery trout.

During 1960, the station was under the supervision of the author. The rest of the permanent staff included Gerald F. Myers, Harold H. Brado and Doyle E. Edson. Mr. Kiyoshi G. Fukano and Keith R. Sammons assisted during the preseason population estimate. Mr. Fukano and Gayle D. Betts helped with the creel census during the first two days of the fishing season. Mr. Betts helped during the postseason population

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[2] For report numbers, refer to "Literature cited."

estimate. Supervisory assistance was provided by Gerald P. Cooper and David S. Shetter.

Since July 1, 1960, the station has been under the Federal Aid in Fish Restoration Act. The name of the project (F-17-R-1) is: Development and Evaluation of Trout Management Techniques. The primary purposes in previous reports were to record creel census data which might have significant bearing on trout fisheries in other Michigan waters and, from postseason population estimates, ascertain the degree of exploitation by anglers. The present report includes data on creel census and exploitation rates and also indicates progress on all "jobs" considered under the Federal Aid Project.

Job No. 1.--Station clerical work, record keeping and library maintenance.

The routine clerical work included bookkeeping on supplies purchased, utilities, vehicles, time and attendance, and so forth. Daily weather readings were taken; weekly and monthly reports were submitted to the U. S. Weather Bureau. A stream gauge was checked weekly for U. S. Geological Survey. Some progress was made on assembling and maintaining station library.

Job No. 2.--Complete creel census of six miles of stream.

Certain special fishing regulations have been in effect since the establishment of the research station. They have been, or will be, evaluated in separate reports but to aid in an interpretation of the creel census results, the regulations are summarized in Table 2.

Table 2.--Experimental regulations, in waters of the Pigeon River Trout Research Station, 1949-1960

Years	Water and regulation[1]							
	Stream sections						Lakes	
	A, B		C, D		E[2]			
	Creel limit (trout per day)	Minimum legal length (inches)	Creel limit (trout per day)	Minimum legal length (inches)	Creel limit (trout per day)	Minimum legal length (inches)	Creel limit (trout per day)	Minimum legal length (inches)
1949-50	5	7	15	7	..	..	5	7
1951-52	5	7	2	9	..	..	5	7
1953-54	5	7	2	9	10	7	5	7
1955-60	5	7	5	9	10	7	5	7

[1] Lure was restricted to artificial flies only in Section C and D in 1958-60 and in Ford Lake in 1955-60. The use of minnows was prohibited in the lakes (state-wide restriction on all designated trout lakes).

[2] Section E was added in 1953.

Catch statistics for 1960 for the stream sections are presented in Table 3.[3] The catch of 915 trout was considerably better than the low of 342 recorded in 1959 and approached the average catch (since 1953) of about 1,000 fish per year. Section E continued to produce the bulk of the catch (544 of the 915 trout). Sections C and D, with the higher size limit and flies-only regulation, produced the fewest trout (25 and 42 trout, respectively). Total number of fishing trips was about the same as in 1959 but total hours fished increased from 2,760 to 3,197 hours. The average number of trout caught per hour per trip increased from 0.11 trout, in 1959, to 0.27 trout, in 1960.

Fishing success during weekly periods is given in Table 4; it was best in early June and was poorest in mid-August.

Annual totals of fishing pressure and fishing success for the experimental waters of the Pigeon River since 1949 are given in Table 5. Fishing pressure (hours fished) increased some during 1960, after a steady decline from 1954 to 1959. Fishing success, as measured by percentage of successful fishing trips and average number of trout caught per trip, increased to 29.2 percent and 0.27 trout for the highest figures recorded since 1954.

Most of the anglers fishing the Pigeon River came from Wayne County, with local residents from Otsego County placing second (Table 6). Of the 83 counties in Michigan, 46 were represented by at least one angler; 11 other states were represented. Most of the nonresident anglers came from Ohio.

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[3] In Table 3 and subsequent tables, catch per hour per trip was determined by taking a simple average of the catch per hour for each fishing trip.

Table 3.--Results of creel census on experimental stream sections, Pigeon River Trout Research Station, 1960

Stream sections	Fishing trips		Total hours fished	Average number of trout caught per hour per trip
	Number	Percentage successful		
A	199	31.2	489.5	0.23
B	372	24.7	891.0	0.18
C	134	16.4	358.0	0.06
D	183	14.8	447.5	0.10
E	348	45.4	1,011.0	0.56
Total	1,236	29.2	3,197.0	0.27

Stream sections	Anglers' catch							
	Brook trout		Brown trout		Rainbow trout		Total	
	Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)
A	94	21.34	26	8.70	...	...	120	30.04
B	145	27.10	39	16.65	...	...	184	43.75
C	15	5.57	10	3.24	...	...	25	8.81
D	18	6.60	23	10.90	1	0.27	42	17.77
E	420	99.62	122	53.84	2	0.48	544	153.94
Total	692	160.23	220	93.33	3	0.75	915	254.31

Table 4.--Fishing success, and total weight of anglers' catch during weekly periods, Pigeon River, 1960

Dates	Fishing trips		Trout caught						Hours fished	Average number of trout caught per hour per trip
			Brook		Brown		Total catch			
	Number	Percentage successful	Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)		
April 30-May 6	74	28.4	57	19.52	15	4.05	72	23.57	186.5	0.29
May 7-May 13	36	11.1	5	1.42	3	1.54	8	2.96	67.0	0.08
May 14-May 20	47	36.2	34	8.43	6	2.94	40	11.37	118.0	0.33
May 21-May 27	73	45.2	89	20.00	20	6.92	109	26.92	196.0	0.43
May 28-June 3	103	30.1	75	18.12	11	6.82	86	24.94	266.5	0.24
June 4-June 10	52	34.6	58	15.60	22	8.74	80	24.34	125.0	0.74
June 11-June 17	53	54.7	67	15.60	20	8.38	87	23.98	160.5	0.51
June 18-June 24	62	33.9	24	6.18	23	9.54	48[1]	15.99[1]	165.0	0.29
June 25-July 1	73	37.0	33	6.89	26	10.27	59	17.16	174.0	0.37
July 2-July 8	68	29.4	31	6.06	12	4.52	43	10.58	176.0	0.21
July 9-July 15	64	42.2	39	7.82	17	7.45	57[1]	15.41[1]	149.5	0.36
July 16-July 22	89	21.3	27	4.74	7	1.93	34	6.67	219.0	0.14
July 23-July 29	53	34.0	35	6.81	17	9.64	52	16.45	123.0	0.55
July 30-Aug. 5	71	31.0	29	6.35	11	6.61	41[1]	13.30[1]	196.5	0.20
Aug. 6-Aug. 12	55	16.4	14	2.51	1	0.16	15	2.67	122.0	0.10
Aug. 13-Aug. 19	59	8.5	4	0.90	1	0.17	5	1.07	161.5	0.03
Aug. 20-Aug. 26	44	29.5	23	4.06	3	0.48	26	4.54	146.5	0.18
Aug. 27-Sept. 2	83	16.9	25	5.22	4	2.80	29	8.02	245.5	0.10
Sept. 3-Sept. 9	60	16.7	16	2.88	1	0.34	17	3.22	159.5	0.10
Sept. 10-Sept. 11	17	17.6	7	1.10	...	...	7	1.10	39.5	0.22
Total	1,236	29.2	692	160.21	220	93.30	915	254.26	3,197.0	0.27

[1] In addition to the trout listed, three rainbow trout were caught: one during the period June 18-June 24, weight 0.27; one July 9-July 15, weight 0.14; and one July 30-Aug. 5, weight 0.34.

Table 5.--Results of creel census in experimental waters of the Pigeon River, 1949-60

Year[1]	Fishing trips		Trout caught				Hours fished	Average number of fish caught per hour per trip
	Number	Percentage successful	Brook	Brown	Rainbow	Total		
1949	2,233	26.2	793	198	57	1,048	6,817	0.15
1950	2,160	27.3	917	255	18	1,190	6,195	0.18
1951	2,846	15.4	453	228	10	691	7,076	0.10
1952	1,450	24.5	464	127	47	638	3,957	0.16
1953	1,943	24.9	742	203	88	1,033	5,689	0.23
1954	2,427	32.8	1,435	437	66	1,938	6,584	0.30
1955	2,039	25.3	959	250	33	1,242	5,775	0.20
1956	1,979	24.8	869	266	15	1,150	5,527	0.19
1957	1,699	23.2	721	120	17	858	4,490	0.18
1958	1,599	25.8	894	116	11	1,021	4,205	0.22
1959	1,206	14.8	289	52	1	342	2,760	0.11
1960	1,236	29.2	692	220	3	915	3,197	0.27

[1] Section E was added to the experimental waters in 1953.

Table 6.--Residence of anglers who fished the experimental sections of the Pigeon River in 1960

County	Number of fishing trips	County	Number of fishing trips	County or state	Number of fishing trips
Wayne	229	Lenawee	9	Gladwin	1
Otsego	149	Ottawa	8	Isabella	1
Oakland	133	Charlevoix	6	Lapeer	1
Genesee	97	Iosco	6	Livingston	1
Ingham	77	Roscommon	5	Ogemaw	1
Bay	52	Presque Isle	4	Van Buren	1
Washtenaw	40	St. Clair	4	Michigan	
Saginaw	34	Wexford	4	(total)	1,078
Kalamazoo	27	Cheboygan	3	Ohio	107
Kent	21	Emmet	3	Indiana	26
Macomb	21	Gratiot	3	New York	7
Alpena	20	Ionia	3	Illinois	5
Branch	20	Montcalm	3	Wisconsin	3
Tuscola	19	Barry	2	Colorado	2
Calhoun	15	Mecosta	2	Massachusetts	2
Midland	14	Montmorency	2	Missouri	2
Shiawassee	14	Newaygo	2	New Mexico	2
Muskegon	10	Clinton	1	California	1
Jackson	9	Eaton	1	Maryland	1
				Total	1,236

Job No. 3.--Complete creel census of seven trout lakes.

Catch statistics for the lakes are presented in Table 7. The fishery consists entirely of hatchery brook trout planted as fingerlings (average total length 5.5 inches) in the fall, with the exception of Section 4 Lake where brook trout fry are planted in the spring. The planting rate approximates 100 fingerlings per acre per year. Numbers of fingerlings planted in each lake annually are: Ford, 1,170; Hemlock, 600; Lost, 460; West Lost, 400; North Twin, 550; South Twin, 430. Section 4 Lake receives 3,000 fry per year (1,090 per acre). Fishing success for all of the lakes combined, as measured by the average number of fish caught per hour per trip, was 0.35 trout. In 1959, it was 0.37 trout. Total fishing trips and hours fished decreased from 2,071 trips and 5,144.5 hours in 1959, to 1,649 trips and 4,386 hours in 1960.

On Ford Lake under a flies-only regulation the catch per hour decreased from a high of 1.15 trout in 1959 to 0.82 trout in 1960.

Residence of anglers who fished the lakes in 1960 is given in Table 8. Otsego County contributed the most anglers; Muskegon County was second. Fifty-one counties of Michigan and eight states contributed at least one angler.

Data from the river and the lakes are combined in tables 9, 10 and 11.

Stream anglers who used flies were more successful, in terms of total catch and catch per hour per trip, than those who used worms (Table 9). In 1959, on the other hand, worm fishermen were more successful. In both

Table 7.--Results of creel census on lakes of the Pigeon River Trout Research Station, 1960

[only brook trout were caught]

Lake	Fishing trips		Trout caught		Hours fished	Average number of fish caught per hour per trip
	Number	Percentage successful	Number	Pounds		
Ford	204	60.3	416	87.25	503.0	0.82
Section 4	101	15.8	33	6.36	243.5	0.10
Hemlock	219	37.4	235	66.84	670.5	0.29
Lost	171	38.0	189	32.28	397.5	0.47
West Lost	292	37.7	275	85.74	892.0	0.29
North Twin	379	33.0	303	120.42	1,067.5	0.25
South Twin	283	28.3	179	40.56	612.0	0.27
Total	1,649	36.4	1,630	439.45	4,386.0	0.35

Table 8.--Residence of anglers who fished Pigeon River lakes in 1960

County	Number of fishing trips	County	Number of fishing trips	County or state	Number of fishing trips
Otsego	217	Benzie	11	Ogemaw	2
Muskegon	199	Ottawa	11	St. Joseph	2
Wayne	118	Monroe	10	Berrien	1
Ingham	101	Montcalm	10	Calhoun	1
Genesee	87	Montmorency	9	Emmet	1
Oakland	83	Wexford	8	Gladwin	1
Kent	78	Branch	7	Hillsdale	1
Saginaw	75	Livingston	7	Kalkaska	1
Presque Isle	72	Allegan	6	Mackinac	1
Cheboygan	67	Grand Traverse	6		
Washtenaw	62	Jackson	6	Michigan	
Shiawassee	56	Arenac	5	(total)	1,608
Bay	53	Alpena	4	Ohio	23
Midland	49	Antrim	4	Indiana	7
Charlevoix	46	Ionia	4	California	3
Gratiot	31	Lenawee	4	Illinois	2
Macomb	24	Tuscola	4	Maryland	2
St. Clair	17	Eaton	3	Pennsylvania	2
Roscommon	13	Isabella	2	Minnesota	1
Kalamazoo	12	Manistee	2	Texas	1
Sanilac	12	Newaygo	2		
				Total	1,649

Table 9.--Fishing success according to lure used, Pigeon River Trout Research Station, 1960

Lure	Fishing trips		Number of trout caught			Hours fished	Average number of trout caught per hour per trip
	Number	Percentage successful	Brook	Brown	Total		
STREAM							
Worms	361	31.0	249	49	298	902.0	0.26
Worms and spinner	128	29.7	85	4	89	348.5	0.22
Flies	581	27.7	235	141	379[1]	1,456.5	0.28
Minnows	3	...	...	...	...	8.0	...
Insects	11	36.4	7	4	11	17.5	0.43
Artificial[2]	23	17.4	7	3	10	56.5	0.24
Natural[3]	2	...	...	...	...	7.0	...
Other[4]	127	33.1	109	19	128	401.0	0.31
Unknown	...	...	...	...	...	...	...
Total for stream	1,236	29.2	692	220	915	3,197.0	0.27
LAKES							
Worms	916	37.3	867	...	...	2,416.5	0.32
Worms and spinner	218	27.5	144	...	...	590.0	0.26
Flies	38	23.7	13	...	...	77.5	0.16
Insects	14	42.9	20	...	...	29.0	0.47
Artificial[2]	24	25.0	9	...	...	48.0	0.13
Natural[3]	8	12.5	3	...	...	14.5	0.19
Other[4]	228	24.1	159	...	...	708.5	0.19
Unknown	...	...	...	...	...	...	...
Ford Lake (flies only)	203[5]	60.1	415	...	...	502.0	0.82
Total for lakes	1,649	36.4	1,630	...	...	4,386.0	0.35

[1] Total includes three rainbow trout.

[2] Artificial lures other than flies.

[3] Natural baits other than worms, minnows or insects.

[4] Other refers to a combination of the above lures, two or more lures used successively on same trip or a lure other than listed above.

[5] One angler fished with worms for one hour and caught one fish. The trip was added to the worms category.

years, flies were used most frequently, with worms and worms-spinner combinations following in that order. In the lakes, worms were used most frequently and accounted for most of the catch.

Types of fishing rods used by anglers are listed in Table 10. In the sections of the stream where there was a flies-only regulation (Sections C and D), 96.8 percent of the anglers used a fly rod. In the other sections only 58.8 percent used a fly rod. On the lakes, a spinning rod was used more often than a fly rod (except at Ford Lake where there was a flies-only restriction).

Number of fishing trips made to the experimental waters by licensed and non-licensed anglers, i.e., wives and minors, are given in Table 11. Licensed anglers accounted for 77.5 percent of the fishing on the stream and 68.7 percent of the fishing on the lakes. Michigan residents did 87.2 percent of the stream fishing and 97.5 percent of the lake fishing.

Job No. 4.--Estimate number of trout in stream during spring and fall.

The mark-and-recapture (Petersen) method was used to estimate the number of trout present in each experimental section of the river. Two trips were made through each section using a direct-current shocker to take samples of trout (one trip to mark trout, and the second to recapture, with an interval of a week between trips). The number of fish in each 1-inch group of each species for each section was calculated.

In order to compute the pounds of trout in the population estimates, the average weight of each 1-inch group of each species (based on the

Table 10.--Number of anglers using each type of fishing rod, Pigeon River Trout Research Station, 1960[1]

Stream section or lake	Type of rod						Total
	Fly	Spinning	Casting	Other	Combination	No record	
STREAM							
A	118	66	8	5	...	2	199
B	220	132	15	2	...	3	372
E	202	135	5	2	1	3	348
Total	540	333	28	9	1	8	919
Percentage	58.8	36.2	3.0	1.0	0.1	0.9	...
C	133	1	...	...	...	...	134
D	174	4	4	...	...	1	183
Total	307	5	4	...	...	1	317
Percentage	96.8	1.6	1.3	...	...	0.3	...
LAKES							
Ford	165	17	3	...	5	14	204
Percentage	80.9	8.3	1.5	...	2.4	6.9	...
Section 4	30	56	9	...	2	4	101
Hemlock	67	138	9	...	2	3	219
Lost	29	113	19	3	3	4	171
West Lost	66	173	18	19	11	5	292
North Twin	112	202	30	7	9	19	379
South Twin	74	162	28	4	4	11	283
Total	378	844	113	33	31	46	1,445
Percentage	26.2	58.4	7.8	2.3	2.1	3.2	...

[1] Data for stream sections C and D and for Ford Lake are shown separately because lures were restricted to flies only in 1960.

Table 11.--Number of anglers of different classes who fished in experimental waters of the Pigeon River in 1960

[Percentages in parentheses]

Residence	Licensed males	Licensed females	Wives	Minor males	Minor females	Total
STREAM						
Resident	828	...	97	136	17	1,078 (87.2)
Nonresident	111	19	...	21	7	158 (12.8)
Total	939 (76.0)	19 (1.5)	97 (7.8)	157 (12.7)	24 (1.9)	1,236 ...
LAKES						
Resident	1,092	6	200	262	48	1,608 (97.5)
Nonresident	33	2	...	3	3	41 (2.5)
Total	1,125 (68.2)	8 (0.5)	200 (12.1)	265 (16.1)	51 (3.1)	1,649 ...

calculated weight at each 0.1 inch) was found by referring to a graph of the length-weight relationships for Pigeon River trout (Cooper and Benson, 1951).

Results of the 1960 spring population estimates, by stream section, species, and 1-inch groups of trout (fish 12 inches long and longer were grouped in the table but not in the estimates) are presented in Table 12. The total population for the six miles of river was 5,124 trout (4,301 brook, 821 brown and 2 rainbow trout) or 8.58 pounds of trout per acre.

Results of the 1960 fall population estimate are presented in Table 13. The total population was 12,342 trout (10,563 brook, 1,778 brown and 1 rainbow trout) or 22.32 pounds of trout per acre.

Job No. 5.--Estimate number of trout in two lakes during spring and fall.

Estimated numbers of brook trout present in Ford and Hemlock lakes in October, 1960 and April, 1961 are presented in Table 14. The Bailey modification of the Petersen formula for mark-and-recapture estimates was used (Ricker, 1958). Confidence limits (95 percent) were calculated from Clopper and Pearson's (1934) chart. Samples of trout were taken by fishing with flies, shocking with a direct-current shocker and underwater lights at night, and by examination of the anglers' catch.

In Hemlock Lake in October of 1960, there remained 180 of the trout planted in 1959. By April of 1961 the number had decreased by only four, to 176. In Ford Lake, during the same period, the decrease was from 325 to 215 trout. During the winter of 1960-61, Ford Lake was

Table 12.--Estimated numbers and weight of trout of different species and lengths in the experimental sections of the Pigeon River in the spring of 1960 (before opening of the trout fishing season)

Stream section	Inch groups[1]	Brook trout		Brown trout		Rainbow trout		Total	
		Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)
A	2	24	0.14	3	0.02	...	...	27	0.16
	3	171	2.56	46	0.74	...	...	217	3.30
	4	93	2.98	23	0.78	1	0.03	117	3.79
	5	8	0.46	9	0.54	...	...	17	1.00
	6	22	2.11	4	0.39	...	...	26	2.50
	7	13	1.90	6	0.90	...	...	19	2.80
	8	1	0.21	16	3.47	...	...	17	3.68
	9	1	0.29	12	3.62	...	...	13	3.91
	10	...	...	...	...	...	...	...	...
	11	...	...	...	...	...	...	...	...
	12+	...	...	...	...	...	...	...	...
Total		333	10.65	119	10.46	1	0.03	453	21.14
Pounds per acre			1.49		1.46		T[2]		2.95
B	2	60	0.36	5	0.03	...	...	65	0.39
	3	384	5.76	42	0.67	...	...	426	6.43
	4	122	3.90	52	1.77	...	...	174	5.67
	5	23	1.33	...	...	...	...	23	1.33
	6	28	2.69	6	0.59	...	...	34	3.28
	7	4	0.58	12	1.80	...	...	16	2.38
	8	4	0.84	12	2.60	...	...	16	3.44
	9	...	...	...	...	1	0.30	1	0.30
	10	...	...	3	1.22	...	...	3	1.22
	11	...	...	...	...	...	...	...	...
	12+	...	...	3	4.66	...	...	3	4.66
Total		625	15.46	135	13.34	1	0.30	761	29.10
Pounds per acre			2.62		2.26		0.05		4.93
C	2	184	1.10	3	0.02	...	...	187	1.12
	3	663	9.94	44	0.70	...	...	707	10.64
	4	176	5.63	88	2.99	...	...	264	8.62
	5	42	2.44	12	0.72	...	...	54	3.16
	6	72	6.91	4	0.39	...	...	76	7.30
	7	19	2.77	18	2.70	...	...	37	5.47
	8	6	1.27	14	3.04	...	...	20	4.31
	9	12	3.52	11	3.32	...	...	23	6.84
	10	5	1.97	5	2.04	...	...	10	4.01
	11	...	...	...	...	...	...	...	...
	12+	...	...	7	5.12	...	...	7	5.12
Total		1,179	35.55	206	21.04	...	...	1,385	56.59
Pounds per acre			6.60		3.90				10.50

(continued)

Table 12, continued

Stream section	Inch groups[1]	Brook trout Number	Brook trout Weight (pounds)	Brown trout Number	Brown trout Weight (pounds)	Rainbow trout Number	Rainbow trout Weight (pounds)	Total Number	Total Weight (pounds)
D	2	80	0.48	...	...	...	...	80	0.48
	3	609	9.14	16	0.26	...	...	625	9.40
	4	223	7.14	23	0.78	...	...	246	7.92
	5	78	4.52	5	0.30	...	...	83	4.82
	6	68	6.53	5	0.49	...	...	73	7.02
	7	40	5.84	40	6.00	...	...	80	11.84
	8	20	4.22	14	3.04	...	...	34	7.26
	9	9	2.64	4	1.21	...	...	13	3.85
	10	4	1.58	4	1.63	...	...	8	3.21
	11	...	...	...	...	...	...	...	...
	12+	...	...	2	1.36	...	...	2	1.36
Total		1,131	42.09	113	15.07	...	...	1,244	57.16
Pounds per acre			7.45		2.67				10.12
E	2	76	0.46	...	...	...	...	76	0.46
	3	488	7.32	10	0.16	...	...	498	7.48
	4	289	9.25	42	1.43	...	...	331	10.68
	5	65	3.77	3	0.18	...	...	68	3.95
	6	55	5.28	...	...	...	...	55	5.28
	7	46	6.72	48	7.20	...	...	94	13.92
	8	6	1.27	77	16.71	...	...	83	17.98
	9	8	2.34	53	16.01	...	...	61	18.35
	10	...	...	6	2.44	...	...	6	2.44
	11	...	...	...	...	...	...	...	...
	12+	...	...	9	11.02	...	...	9	11.02
Total		1,033	36.41	248	55.15	...	...	1,281	91.56
Pounds per acre			6.42		9.73				16.15
All sections	2	424	2.54	11	0.07	...	...	435	2.61
	3	2,315	34.72	158	2.53	...	...	2,473	37.25
	4	903	28.90	228	7.75	1	0.03	1,132	36.68
	5	216	12.52	29	1.74	...	...	245	14.26
	6	245	23.52	19	1.86	...	...	264	25.38
	7	122	17.81	124	18.60	...	...	246	36.41
	8	37	7.81	133	28.86	...	...	170	36.67
	9	30	8.79	80	24.16	1	0.30	111	33.25
	10	9	3.55	18	7.33	...	...	27	10.88
	11	...	...	...	...	...	...	...	...
	12+	...	...	21	22.16	...	...	21	22.16
Total		4,301	140.16	821	115.06	2	0.33	5,124	255.55
Pounds per acre			4.71		3.86		0.01		8.58

[1] Length groups range from 2.0 to 2.9 inches, 3.0-3.9, 4.0-4.9 inches, etc.

[2] T indicates a weight of 0.005 pound or less.

Table 13.--Estimated numbers and weight of trout of different species and lengths in the experimental sections of the Pigeon River in the fall of 1960 (after close of the trout fishing season)

Stream section	Inch groups[1]	Brook trout		Brown trout		Rainbow trout		Total	
		Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)
A	2	117	0.70	5	0.03	...	...	122	0.73
	3	226	3.39	87	1.39	...	...	313	4.78
	4	43	1.38	4	0.14	...	...	47	1.52
	5	38	2.20	1	0.06	...	...	39	2.26
	6	69	6.62	11	1.08	...	...	80	7.70
	7	43	6.28	45	6.75	...	...	88	13.03
	8	18	3.80	26	5.64	...	...	44	9.44
	9	9	2.64	5	1.51	...	...	14	4.15
	10	1	0.39	3	1.22	...	...	4	1.61
	11	1	0.52	7	3.73	...	...	8	4.25
	12+	1	0.66	16	15.72	1	0.86	18	17.24
Total		566	28.58	210	37.27	1	0.86	777	66.71
Pounds per acre			3.99		5.21		0.12		9.32
B	2	435	2.61	60	0.36	...	...	495	2.97
	3	823	12.34	248	3.97	...	...	1,071	16.31
	4	211	6.75	40	1.36	...	...	251	8.11
	5	164	9.51	12	0.72	...	...	176	10.23
	6	154	14.78	18	1.76	...	...	172	16.54
	7	36	5.26	67	10.05	...	...	103	15.31
	8	2	0.42	48	10.42	...	...	50	10.84
	9	4	1.17	7	2.11	...	...	11	3.28
	10	1	0.39	8	3.26	...	...	9	3.65
	11	1	0.52	10	5.33	...	...	11	5,85
	12+	...	...	22	21.57	...	...	22	21.57
Total		1,831	53.75	540	60.91	...	...	2,371	114.66
Pounds per acre			9.11		10.32	...	...		19.43
C	2	503	3.02	18	0.11	...	...	521	3.13
	3	1,619	24.28	312	4.99	...	...	1,931	29.27
	4	331	10.59	42	1.43	...	...	373	12.02
	5	331	19.20	...	...	...	...	331	19.20
	6	262	25.15	24	2.35	...	...	286	27.50
	7	103	15.04	50	7.50	...	...	153	22.54
	8	34	7.17	23	4.99	...	...	57	12.16
	9	20	5.86	7	2.11	...	...	27	7.97
	10	10	3.94	11	4.48	...	...	21	8.42
	11	3	1.54	6	3.20	...	...	9	4.74
	12+	1	0.66	26	31.05	...	...	27	31.71
Total		3,217	116.45	519	62.21	...	...	3,736	178.66
Pounds per acre			21.61		11.54				33.15

(continued)

Table 13, continued

Stream section	Inch groups[1]	Brook trout Number	Brook trout Weight (pounds)	Brown trout Number	Brown trout Weight (pounds)	Rainbow trout Number	Rainbow trout Weight (pounds)	Total Number	Total Weight (pounds)
D	2	416	2.50	16	0.10	...	...	432	2.60
	3	1,374	20.61	160	2.56	...	...	1,534	23.17
	4	278	8.90	5	0.17	...	...	283	9.07
	5	295	17.11	7	0.42	...	...	302	17.53
	6	307	29.47	17	1.67	...	...	324	31.14
	7	115	16.79	29	4.35	...	...	144	21.14
	8	44	9.28	13	2.82	...	...	57	12.10
	9	18	5.27	12	3.62	...	...	30	8.89
	10	7	2.76	12	4.88	...	...	19	7.64
	11	5	2.58	8	4.26	...	...	13	6.84
	12+	1	0.66	35	31.20	...	...	36	31.86
Total		2,860	115.93	314	56.05	...	...	3,174	171.98
Pounds per acre			20.52		9.92				30.44
E	2	257	1.54	2	0.01	...	...	259	1.55
	3	979	14.68	83	1.33	...	...	1,062	16.01
	4	218	6.98	20	0.68	...	...	238	7.66
	5	221	12.82	...	...	...	...	221	12.82
	6	290	27.84	1	0.10	...	...	291	27.94
	7	90	13.14	17	2.55	...	...	107	15.69
	8	22	4.64	11	2.39	...	...	33	7.03
	9	6	1.76	5	1.51	...	...	11	3.27
	10	5	1.97	10	4.07	...	...	15	6.04
	11	1	0.52	18	9.59	...	...	19	10.11
	12+	...	...	28	24.36	...	...	28	24.36
Total		2,089	85.89	195	46.59	...	...	2,284	132.48
Pounds per acre			15.15		8.22				23.37
All sections	2	1,728	10.37	101	0.61	...	...	1,829	10.98
	3	5,021	75.30	890	14.24	...	...	5,911	89.54
	4	1,081	34.60	111	3.78	...	...	1,192	38.38
	5	1,049	60.84	20	1.20	...	...	1,069	62.04
	6	1,082	103.86	71	6.96	...	...	1,153	110.82
	7	387	56.51	208	31.20	...	...	595	87.71
	8	120	25.31	121	26.26	...	...	241	51.57
	9	57	16.70	36	10.86	...	...	93	27.56
	10	24	9.45	44	17.91	...	...	68	27.36
	11	11	5.68	49	26.11	...	...	60	31.79
	12+	3	1.98	127	123.90	1	0.86	131	126.74
Total		10,563	400.60	1,778	263.03	1	0.86	12,342	664.49
Pounds per acre			13.46		8.83		0.03		22.32

[1] Length groups range from 2.0-2.9 inches, 3.0-3.9, 4.0-4.9 inches, etc.

Table 14.--Estimated numbers of brook trout in Ford and Hemlock lakes in October, 1960 and April, 1961

Lake	Date of population estimate	Method of Marking	Method of Recapture	Year class	Population estimate	95 percent confidence limits
Ford	Oct. 1960	Fishing[1]	Shocking 2x[2]	1959	325	268-404
	Oct. 1960	Fishing	Shocking 2x	1958	21	none
	April 1961	Shocking 2x, fishing	Shocking 1x	1960	638	508-857
	April 1961	Shocking 2x	Creel census[3]	1959	215	154-316
Hemlock	Oct. 1960	Fishing	Shocking 2x	1959	180	146-231
	April 1961	Shocking 1x	Shocking 1x	1960	512	397-682
	April 1961	Shocking 2x	Creel census	1959	176	144-234

[1] Station personnel fishing with flies.

[2] Direct-current shocker used at night with underwater lights; 2x indicates number of times or trips to the lake.

[3] Anglers' catch examined for ratio of marked to total number of fish caught.

fished illegally at least twice. There was a known loss of 8 trout (violators were caught with 34 trout, 8 of which were dead) and a rumor of a previous catch of 65 trout. The estimates indicate a loss of at least 100 trout. In other years, the loss over winter has been small in both lakes.

The November, 1960 plant in Ford Lake was 1,170 fingerling brook trout (average total length 5.5 inches). The estimate in April, 1961, indicated 638 trout present. This is an over-winter loss of 45 percent; much higher than usual. The over-winter loss in Hemlock Lake from 600 fingerling brook trout planted in November, 1960 was only 15 percent. The larger than usual over-winter loss in Ford Lake cannot be explained.

Job No. 6.--Calculate growth and mortality rates for the trout from the stream.

Age composition of the anglers' catch in 1960 and average total length and weight of each age group for each experimental section of the Pigeon River are given in Table 15. As in past years, two-year-olds predominated in the catch.

Annual expectations of death (mortality rates) for brook and brown trout in the experimental sections of the Pigeon River, from the fall of 1959 to the fall of 1960, are given in Table 16.

These mortality rates were obtained by a study of survival of a "known" population of marked (fin-clipped) fish. For this known population, all trout collected during the first shocker run in the fall of 1959 were marked (and released) with a fin clip, distinctive for each experimental section of

Table 15.--Age composition of the anglers' catch and average length and weight of age groups for each experimental section, Pigeon River, 1960

Stream section	Species	Age group	Number	Average total length (inches)	Average weight (pounds)
A	Brook	I	35	7.7	0.17
		II	52	8.5	0.24
		III	7	10.0	0.42
	Brown	I	7	7.6	0.16
		II	19	10.2	0.40
B	Brook[1]	I	62	7.5	0.15
		II	77	8.0	0.20
		III	4	10.5	0.44
		IV	1	11.5	0.59
	Brown	I	11	7.6	0.16
		II	26	10.5	0.43
		III	1	11.2	0.60
		V	1	19.5	3.12
C	Brook	II	10	9.6	0.34
		III	5	10.4	0.44
	Brown	II	10	9.6	0.32
D	Brook	II	13	9.6	0.32
		III	4	10.6	0.47
		IV	1	11.4	0.56
	Brown	II	22	10.6	0.45
		III	1	14.2	1.05
	Rainbow	II	1	9.1	0.27
E	Brook[1]	I	79	7.4	0.15
		II	303	8.4	0.23
		III	31	10.9	0.50
		IV	6	11.2	0.56
	Brown	I	11	7.8	0.18
		II	102	10.1	0.39
		III	8	14.3	1.21
		IV	1	18.1	2.25
	Rainbow	I	1	7.3	0.14
		II	1	9.9	0.34

[1] No scales were taken from one brook trout, 7.5 inches in length and 0.15 pound in weight, from Section B, and one brook trout, 11.7 inches and 0.52 pound, from Section E.

Table 16.--Annual expectations of death for marked brook and brown trout in the experimental sections of the Pigeon River, fall, 1959 to fall, 1960

Species	Stream section	Number marked fall, 1959	Estimate, spring, 1960	Catch, summer, 1960	Estimate, fall, 1960	Total mortality, winter, 1959-60	Total mortality, summer, 1960	Rate of exploitation summer, 1960	Natural mortality summer, 1960
Brook trout	A	272	72	17	25	0.74	0.65	0.24	0.41
	B	730	159	30	47	0.78	0.70	0.19	0.51
	C	1,349	389	32	179	0.71	0.54	0.08	0.46
	D	1,196	264	31	127	0.78	0.52	0.12	0.40
	E	1,106	257	91	129	0.77	0.50	0.35	0.15
Brown trout	A	211	32	6	16	0.85	0.50	0.19	0.31
	B	403	54	16	36	0.87	0.33	0.30	0.03
	C	400	84	12	36	0.79	0.57	0.14	0.43
	D	290	48	15	36	0.83	0.25	0.31	0.00
	E	234	96	33	39	0.59	0.59	0.34	0.25

the river, and records were kept of the number of brook trout and brown trout in each 1-inch size group.

Survival of this known population of marked fish, from the fall of 1959 to the spring of 1960, and to the fall of 1960, was computed during the 1960 spring and fall population estimates. Estimates of the total population (survivors of the 1959 known population plus all other trout) during the spring of 1960, and the fall of 1960, were made by the usual mark-and-recapture procedure. Then, the survival of the 1959-marked, known population, by species and inch group, was computed from the proportion of 1959-marked fish to total fish taken in both runs of the shocker, and this proportion multiplied by the estimated total population for each inch group. Data for inch groups were then summed for stream sections.

In the above procedure, migrations of marked fish between sections could be recorded and such fish were regarded as recaptures within their home sections. Because of the amount of movement of fish between sections (see Job No. 9, below), calculations of mortality based on a known population of marked fish are regarded as better than calculations based on populations of unmarked fish with which it is more difficult to allow for migration.

An attempt to use the estimates of all fish (rather than estimates of marked fish) and age distributions from scale collections made at time of estimates, to compute mortality figures by age groups was unsuccessful. Particularly among fish II years of age and older, it appeared that more fish were caught during the 1960 season than were estimated to be present at the

start of the season. The preliminary analysis indicated that the preseason estimate was low and/or there was recruitment from outside of the experimental area. Movement between sections can be appraised, and the age determinations of fish in the catch or in the populations were not in error. Further analysis may reveal the source of error and possible correction. Until further work can be done on these data, the mortality figures presented in Table 16 are the best available. The most obvious discrepancy in Table 16 is that the rate of exploitation of the brown trout from Section D is greater than the total mortality for the summer of 1960. But giving due consideration to sampling errors, the most impressive fact is the magnitude of the mortality from the fall of 1959 to the spring of 1960. For the brook trout the mean over-winter mortality for all sections was 0.76, and for the brown trout it was 0.79. Assuming that the spring population estimate was low, it is still apparent that loss over winter was considerable.

Job No. 7.--Map segments of the stream.

In 1953, Section A was improved by the addition of log cover, deflectors, and so forth. At the end of 5 years, the effects of the improvement on angling and on the trout population were evaluated, but results were inconclusive (Latta, 1960). Maps of Sections A and B were made in 1958. In 1959, as a continuation of the experiment, stream improvement devices and much of the natural cover were removed from Section A, and sand was deposited in the holes which had been created by the deflectors. The intent was to restore in Section A the conditions which

prevailed prior to improvement in 1953. Section B remained in its natural state to serve as a control. In 1960, sample 100-foot segments of Section A (13 segments) and Section B (10 segments) were mapped by the plane-table method to record bottom soil types, water depths and amount of cover. A final mapping will be made before the completion of the experiment (probably in 1964).

Square feet of bottom soil types, water depths and cover in the sample segments of Sections A and B, in 1958 and 1960, are given in tables 17, 18 and 19. It appears from these data that the "deimprovement" of Section A has brought about an increase in the area of sand, a decrease in the areas of gravel and sand-gravel mixture, a decrease in the area of water deeper than 2 feet, and a decided decrease in the square feet of cover. During the two years parallel changes of similar magnitude have occurred in the areas of sand, gravel and sand-gravel mixture in Section B, doubtlessly caused by the sand brought into the river during the 1957 flood (see below) and which has been slowly moving downstream since then.

Job No. 8.--Record water and air temperatures at six locations on the stream during the summer.

Average monthly water and air temperatures for the summer of 1960 are given in Table 20.

In 1958, a new dam was built on private property at the upstream end of Section E of the experimental water. An impoundment of about 70 acres was formed. The previous dam was destroyed by a flood in 1957 (Waters, 1960). In the new dam, most of the water from the impoundment is released

Table 17.--Square feet of bottom soil types in sample 100-foot segments in Sections A and B, Pigeon River, 1958 and 1960

[Percentages in parentheses]

Section and year	Categories of bottom type							Total
	Silt or organic	Sand	Sand and gravel	Gravel	Gravel and cobble	Cobble	Clay	
Section A								
1958	5,227 (9.1)	12,429 (21.7)	14,877 (26.0)	15,467 (27.0)	8,957 (15.6)	142 (0.2)	201 (0.4)	57,300
1960	3,844 (6.6)	22,102 (37.8)	10,534 (18.0)	11,065 (18.9)	10,033 (17.1)	722 (1.2)	247 (0.4)	58,547
Section B								
1958	7,473 (17.9)	6,951 (16.7)	10,429 (25.0)	9,265 (22.2)	6,466 (15.5)	529 (1.3)	619 (1.5)	41,732
1960	3,948 (10.0)	11,798 (30.0)	9,037 (23.0)	5,680 (14.4)	8,444 (21.5)	346 (0.9)	94 (0.2)	39,347

Table 18.--Square feet of water depths in sample 100-foot segments in Sections A and B, Pigeon River, 1958 and 1960

[Percentages in parentheses]

Section and year	Water depth (feet)				Total
	0 to 1	1 to 2	2 to 3	3 plus	
Section A					
1958	34,455 (60.1)	18,766 (32.8)	3,442 (6.0)	637 (1.1)	57,300
1960	35,763 (61.1)	20,180 (34.5)	2,497 (4.3)	107 (0.2)	58,547
Section B					
1958	21,438 (51.4)	17,924 (43.0)	2,087 (5.0)	283 (0.7)	41,732
1960	20,535 (52.2)	16,075 (40.9)	2,328 (5.9)	409 (1.0)	39,347

Table 19.--Square feet of cover in sample 100-foot segments in Sections A and B, Pigeon River with percentage of increase or decrease from 1958 to 1960 in parentheses

Section and year	Categories of cover			
	Logs, stumps, etc.	Undercut bank	Shade	Turbulent water
Section A				
1958	3,645	444	4,321	7,171
	(-51.5)	(-53.4)	(+51.8)	(-17.7)
1960	1,769	207	6,558	5,900
Section B				
1958	2,418	235	5,545	3,079
	(+6.0)	(-34.0)	(+28.6)	(+51.0)
1960	2,563	155	7,131	4,650

Table 20.--Average monthly water and air temperatures taken each week at six stations[1] on the Pigeon River, 1960

Month	Station											
	I		II		III		IV		V		VI	
	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water	Air	Water
May	67.7	53.7	67.3	54.0	66.7	54.3	66.7	56.0	67.7	58.3	67.3	59.3
June	70.8	57.5	71.5	58.8	71.8	62.0	71.0	63.8	70.8	65.8	70.5	65.3
July	69.4	58.6	70.6	60.4	70.8	62.6	70.6	65.8	71.2	68.6	71.8	67.8
August	74.4	59.2	74.6	60.6	75.2	64.0	76.0	66.4	76.2	68.8	75.6	67.0

[1] Station I is 7 miles and station II is 2 miles above the dam which is at the upstream end of the experimental water. Station III is immediately below the dam and stations IV and V are 2 miles and 5.5 miles, respectively, below the dam; all are within the experimental water. Station VI is 8 miles below the dam, 2 miles below the experimental water.

near the bottom, whereas in the old structure the flow was over spill logs at the top. Temperatures (pocket thermometer) were taken once a week at six locations on the Pigeon River, two above, three within, and one below the experimental water. Similar temperature records were secured in the summers of 1957, 1958 and 1959. The readings for 1957, with the dam out, will be compared with readings for 1958-60, after installation of the new dam. It is hoped that these temperature readings will give some measure of the effect of the new dam on water temperatures in the experimental sections of the river.

Job No. 9.--Mark hatchery and native trout to facilitate recognition.

The lakes were stocked with 3,610 fin-clipped (dorsal and left pectoral) brook trout in November, 1960. The planted trout were from 5 to 6 inches long (mean length, 5.5 inches).

All of the trout taken during the first run with the direct-current shocker through the experimental sections of the river in the fall of 1959 were given a fin clip distinctive for each section. The numbers of fish marked are given in Table 16. It was decided that marking another large group of fish in the fall of 1960 might cause some confusion in the identification of fin clips from both years and that it would be better to wait until most of the fish marked in 1959 were gone from the population, thus no native trout were marked in 1960.

The estimated numbers of marked brook and brown trout remaining from the fall of 1959, found in each experimental section of the river in the spring of 1960 are given in tables 21 and 22, respectively. The estimates were obtained by proportion as described in Job No. 6 above.

Table 21.--Estimated number of marked brook trout in each experimental section of the Pigeon River, spring, 1960

Stream section	Fin clip					Total
	Right pelvic	Left pelvic	Left pectoral	Dorsal	Right pectoral	
A	62	18	26	4	...	110
B	6	125	27	3	5	166
C	...	14	297	12	...	323
D	2	2	36	230	31	301
E	2	...	3	15	221	241
Total	72	159	389	264	257	1,141
Percent moved out of section	14	21	24	13	14	

Table 22.--Estimated number of marked brown trout in each experimental section of the Pigeon River, spring, 1960

Stream section	Fin clip					Total
	Right pelvic	Left pelvic	Left pectoral	Dorsal	Right pectoral	
A	32	2	2	2	...	38
B	...	41	...	...	...	41
C	...	3	67	...	10	80
D	...	2	6	41	...	49
E	...	6	9	5	86	106
Total	32	54	84	48	96	314
Percent moved out of section	...	24	20	15	10	

From the fall of 1959 to the spring of 1960 the movement appears to have been at random with as many trout moving upstream as downstream. The percentage that moved out of a section in which they were marked varied from 13 to 24 for the brook trout and from 10 to 24 for the brown trout.

The numbers of marked brook and brown trout estimated to be present in the fall of 1960 and, in addition, the numbers of marked trout caught in each experimental section during the 1960 fishing season are given in tables 23 and 24. Again the movement appears to have been at random, but movement from the "home" section was more extensive than in the spring. For the brook trout, the percentage that moved varied from 16 to 35, and for the brown trout, it varied from 17 to 35.

In order to check upon movement of marked fish out of the experimental area, a run was made in the fall of 1960 with the direct-current shocker through 1.5 miles of the Pigeon River immediately below Section A. Of the 343 brook trout captured, 4 were marked fish from the experimental sections, one each from Section A through D and, in addition, 4 trout had a caudal nick indicating they had been handled in the previous two weeks during the annual fall population estimate in the experimental sections. Of the 342 brown trout captured, 4 were marked fish, 1 from Section B, 2 from Section C and 1 from Section E, and 1 had been marked in the population estimate. All of the unmarked fish were given a fin clip (adipose, left pectoral) to check upon movement into the experimental sections.

Table 23.--Number of marked brook trout caught during the fishing season and estimated to be present in the fall, in each experimental section, Pigeon River, 1960

Stream section	Fin clip										Total
	Right pelvic		Left pelvic		Left pectoral		Dorsal		Right pectoral		
	Catch	Estimate	Catch	Estimate	Catch	Estimate	Catch	Estimate	Catch	Estimate	
A	14	18	2	6	7	9	5	...	3	2	66
B	...	5	24	26	12	8	7	3	3	3	91
C	...	...	...	8	4	136	1	12	...	4	165
D	1	1	...	7	...	21	6	109	...	20	165
E	2	1	4	...	9	5	12	3	85	100	221
Total	17	25	30	47	32	179	31	127	91	129	708
Percent moved out of section	24		35		34		27		16		...

Table 24.--Number of marked brown trout caught during the fishing season and estimated to be present in the fall, in each experimental section, Pigeon River, 1960

Stream section	Fin clip										Total
	Right pelvic		Left pelvic		Left pectoral		Dorsal		Right pectoral		
	Catch	Estimate	Catch	Estimate	Catch	Estimate	Catch	Estimate	Catch	Estimate	
A	6	11	...	...	1	5	2	...	...	...	25
B	...	2	10	30	3	2	1	1	1	2	52
C	...	1	...	2	4	27	...	...	...	2	36
D	...	...	1	2	1	2	4	34	3	4	51
E	...	2	5	2	3	...	8	1	29	31	81
Total	6	16	16	36	12	36	15	36	33	39	245
Percent moved out of section	23		23		35		25		17		...

To learn if the dam at the upstream end of Section E constitutes a barrier to downstream migration, an attempt was made in the fall of 1960 to collect trout from the impoundment. Underwater lights and a direct-current shocker were used at night, but no trout were seen or captured. As an alternative, 1,168 brook trout and 1 brown trout were collected, marked (adipose and left ventral fins clipped) and released in 0.5 mile of stream above the impoundment.[4] Their migration (if any) into the experimental waters will be noted in the continuing creel census and population study.

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[4] One marked brook trout (left pectoral, Section C) was captured, but in all likelihood it was a natural anomaly for it does not seem possible that a trout could move up through the dam.

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