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DIVISION OF FISHERIES
MICHIGAN DEPARTMENT OF CONSERVATION
COOPERATING WITH THE
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THE ELEVENTH ANNUAL CREEL CENSUS

PIGEON RIVER TROUT RESEARCH STATION, 1959

By William C. Latta

The Pigeon River Trout Research Station was established in 1949, on the site of the former Pigeon River Forest Headquarters, 13 miles east of Vanderbilt, in Otsego County. 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 in length (Fig. 1). In 1953, a fifth experimental section (E), also about 1.2 miles long, was added at the upstream end of the controlled area. This addition increased the total length of the experimental area to about 6 miles. Table 1 presents the physical features of the experimental stream sections.

Since 1949, a compulsory permit system has been in effect on the experimental waters. Each angler is required to obtain a free, one-day permit before proceeding to his selected water, whether experimental section of the stream or individual lake, and is also required to report on his trip and to allow examination of his catch by station personnel. He may fish each day in as many sections of the river or individual lakes as he desires, so long as he reports back to the checking station after fishing in each water.

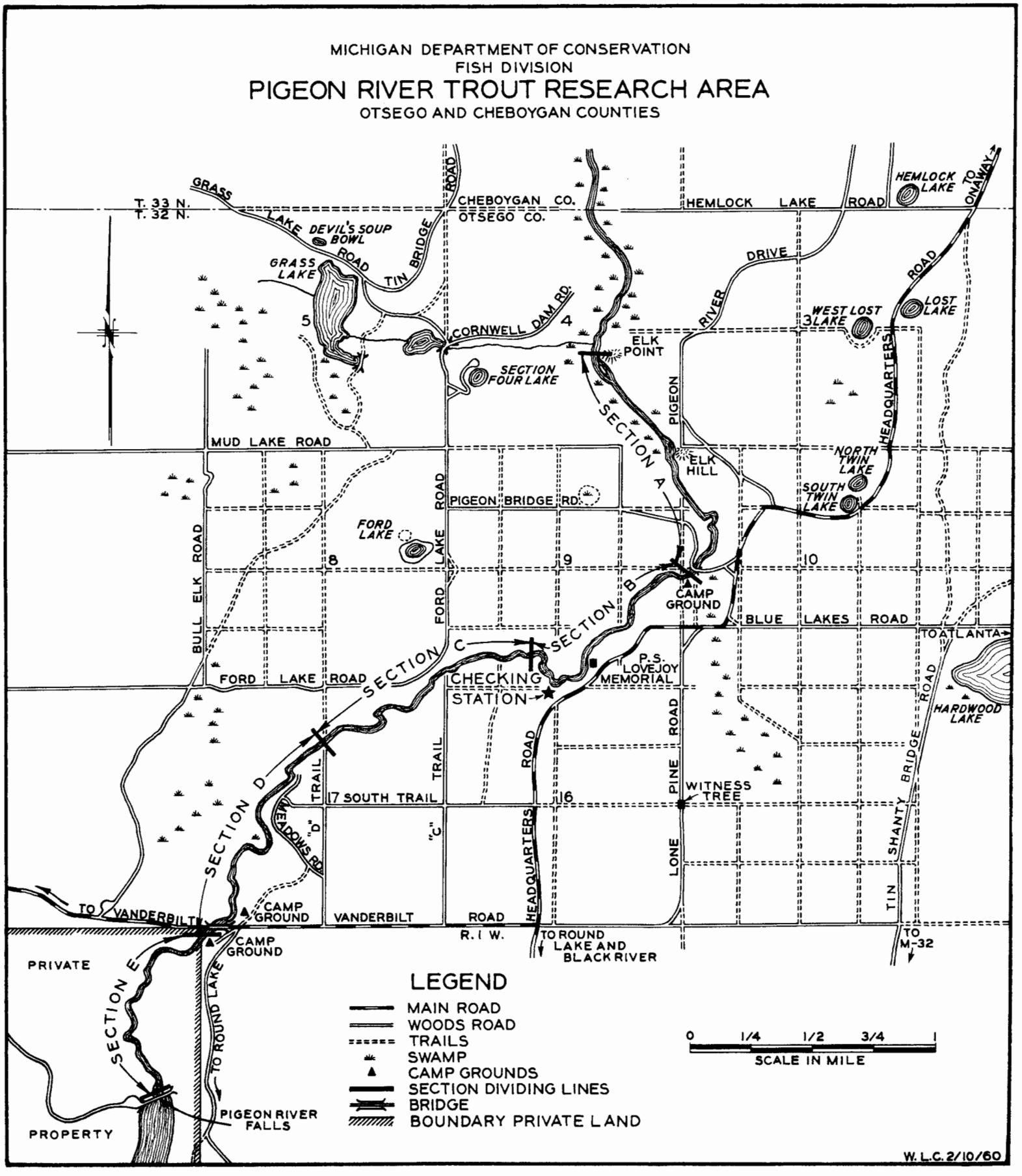
MICHIGAN DEPARTMENT OF CONSERVATION
FISH DIVISION
PIGEON RIVER TROUT RESEARCH AREA
OTSEGO AND CHEBOYGAN COUNTIES
T. 33 N.
T. 32 N.
CHEBOYGAN CO.
OTSEGO CO.
GRASS LAKE ROAD
TIN BRIDGE ROAD
DEVIL'S SOUP BOWL
GRASS LAKE
CORNWELL DAM RD.
SECTION FOUR LAKE
HEMLOCK LAKE ROAD
HEMLOCK LAKE
TO ONAWAY
RIVER DRIVE
WEST LOST LAKE
LOST LAKE
HEADQUARTERS ROAD
ELK POINT
PIGEON
SECTION A
ELK HILL
NORTH TWIN LAKE
SOUTH TWIN LAKE
MUD LAKE ROAD
PIGEON BRIDGE RD.
FORD LAKE
FORD LAKE ROAD
BULL ELK ROAD
8
9
10
CAMP GROUND
SECTION B
BLUE LAKES ROAD
TO ATLANTA
SECTION C
FORD LAKE ROAD
CHECKING STATION
P.S. LOVEJOY MEMORIAL
HARDWOOD LAKE
SHANTY BRIDGE ROAD
PINE ROAD
TRAIL
17 SOUTH TRAIL
16
WITNESS TREE
SECTION D
MEADOWS RD.
"D"
"C"
HEADQUARTERS
LONE
TIN
TO VANDERBILT
CAMP GROUND
VANDERBILT ROAD
R. 1 W.
TO ROUND LAKE AND BLACK RIVER
TO M-32
PRIVATE
SECTION E
TO ROUND LAKE
PIGEON RIVER FALLS
PROPERTY
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 estimated by Waters (1957a).

The creel census serves as a tool in evaluation of experimental methods of trout management, such as special regulations, methods of planting, manipulation of the environment, etc., as well as providing information concerning the basic biology of trout. Because a compulsory permit system was in effect, insuring a complete, or nearly complete, census, information was secured which could not otherwise be obtained. Previous annual creel census reports have appeared as Institute for Fisheries Research Reports Numbers 1250, 1288 (Cooper, 1950, 1951); 1512, 1521, 1527 (Waters, 1957a, 1957b, 1957c); 1544 (Bacon, Shetter and Cooper, 1958); and 1560 and 1568 (Latta, 1959a, 1959b).

It is the primary purpose of this report to record data on certain features of the trout fishing in the research area which may have a significant bearing on trout fisheries in other Michigan waters. Data are presented on fishing success in relation to experimental section of the stream or individual lake fished, lure used and time of season; a comparison of fishing quality during the different years since the establishment of the research station; the age composition of the catch; types of fishing rods used; the various classes of anglers using the area; and the residence of anglers. Postseason fall population estimates made in the experimental area of the stream are also given in order to show the degree of exploitation by anglers.

In addition to the creel census, the activities of the research station personnel are concerned with several research projects, some of which utilize the creel census as a research tool, and some of which are conducted on waters outside the area under creel census. The results of these research projects are given in separate reports, inasmuch as the projects often continue over a number of years. Since no trout have

been planted in the experimental sections of the stream since 1957, the data for the stream fishery are for wild trout only. However, the data recorded in this report for the lakes are for hatchery trout only, since the entire fishery in the lakes is the result of hatchery plantings. Only certain features of general interest, in the lake fisheries, are included here; the overall results of the research projects on the lakes have been reserved for special reports.

During 1959, 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. During the first two days of the fishing season, Gayle D. Betts and Kiyoshi G. Fukano provided additional help. Mr. Betts also assisted during the postseason fall population estimate. Supervisory assistance was provided by Gerald P. Cooper and David S. Shetter.

Creel census

Since the establishment of the research station, certain special fishing regulations have been in effect. The regulations have been, or will be, evaluated in separate reports; however, they are summarized in Table 2, to aid in an interpretation of the creel census results.

Table 3 presents the catch statistics for 1959 for the stream sections.[1] The total catch of 342 trout was the lowest recorded since the establishment of the station in 1949. It was a drop of 66.5 percent below the catch in 1958. The total hours of fishing (fishing pressure) dropped 34.4 percent from 1958.

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[1] 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 2.--Experimental regulations, in waters of the Pigeon River Research Station, 1949-1959

Years	Water and regulations[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
1955-59	5	7	5	9	10	7	5	7

[1] Lure was restricted to artificial flies only in Sections C and D of the river in 1958-59 and in Ford Lake in 1955-59. The use of minnows was prohibited in the lakes (state-wide restriction on all designated trout lakes).

[2] Section E was added in 1953.

Table 3.--Results of creel census on experimental stream sections, Pigeon River Trout Research Station, 1959

Stream sections	Fishing trips		Total hours fished	Average number of trout caught per hour per trip
	Number	Percentage successful		
A	168	14.3	342.5	0.11
B	444	14.2	894.5	0.10
C	133	7.5	321.0	0.05
D	162	7.4	382.5	0.04
E	299	23.4	819.5	0.18
Total	1,206	14.8	2,760.0	0.11

Stream sections	Anglers' catch					
	Brook trout		Brown trout		Total	
	Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)
A	40	7.23	4	1.01	45[1]	8.37[1]
B	89	16.84	18	5.98	107	22.82
C	8	2.50	5	2.04	13	4.54
D	12	3.84	2	0.52	14	4.36
E	140	27.67	23	5.86	163	33.53
Total	289	58.08	52	15.41	342[1]	73.62[1]

[1] Totals include 1 rainbow trout (weight, 0.13 pound) caught in Section A.

The primary reason for the decline in catch is unknown. The population estimate for the fall of 1958 indicated a large population in comparison with previous years, and the estimate of the number of legal size fish remaining in the fall of 1959 (1,345) was slightly greater than the estimate in the fall of 1958 (1,220). There was no evidence that excessive sand in the river, from the 1957 flood (Waters, 1960) caused any major decline in the fall population in 1957 and 1958 (Latta, 1959a, 1959b). One contributing cause of decline in catch was the work that the Lake and Stream Improvement Section of the Fish Division was doing in Section A. As part of the evaluation of the effect of stream improvement on the catch and population of trout in Section A, all man-made improvement structures and most natural cover were removed from the section during the summer of 1959. In addition, all holes created by deflectors were filled with sand. The turbid conditions caused by the dumping of sand and the work of removing the natural and man-made cover discouraged many anglers from fishing this section. Fishing pressure (in hours) was reduced 65 percent and catch 76 percent, from 1958. The fishing pressure for Section A comprised 24 percent of the total fishing pressure in 1958 but only 12 percent in 1959. The catch in Section A made up 18 percent of the total in 1958 but only 13 percent in 1959. The difference was a minor but definite contribution to the decline in catch in 1959.

Table 4 presents the catch statistics for the Pigeon River lakes. The fishery consists entirely of hatchery brook trout planted as fingerlings in the fall, with the exception of Section 4 Lake where brook trout fry are planted in the spring. Fishing success, as measured by the average catch per hour per trip, was lower for all lakes in 1959 than in 1958. The exception was Ford Lake. At Ford Lake, with a flies-only restriction, the catch increased from 0.83 trout per hour in 1958 to 1.15 trout per hour in 1959.

Table 4.--Results of creel census on lakes of the Pigeon River Trout Research Station, 1959

[Only brook trout were caught]

Lake	Fishing trips		Brook trout caught		Hours fished	Average number of fish caught
	Number	Percentage successful	Number	Pounds		per hour per trip
Ford	232	61.6	554	115.99	510.5	1.15
Section 4	147	10.9	45	12.56	297.5	0.11
Hemlock	256	41.8	297	74.56	745.5	0.37
Lost	278	33.1	213	36.33	651.0	0.34
West Lost	401	31.7	268	101.64	1,108.0	0.23
North Twin	432	33.3	395	133.92	1,097.0	0.32
South Twin	325	22.8	177	42.64	735.0	0.21
Total	2,071	33.9	1,949	517.64	5,144.5	0.37

With regard to fishing success according to lure used, stream anglers using flies had a slightly lower total catch and catch per hour per trip than anglers using worms (Table 5). Flies were used most frequently, with worms and worms-spinner combination following in that order. In the lakes, worms were used most frequently and accounted for the greatest part of the catch.

Table 6 gives the fishing success and total weight of the anglers' catch by weekly periods. Fishing was extremely poor during the first week of the season, and during the weeks of August 15-21 and September 5-11; the fishing quality was highest during the three-week period of May 9-29. As in previous years, there was a general decline in fishing success in July.

Table 7 lists the types of fishing rods used by anglers. In the sections of the stream where there was a flies-only restriction (Sections C and D), 96.3 percent of the anglers used a fly rod. In the other sections only 57.7 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).

Table 8 gives the number of fishing trips made by licensed and non-licensed anglers, i.e., wives or minors, to the experimental waters. Licensed anglers accounted for 74 percent of the fishing on the stream and 64 percent of the fishing on the lakes. Eighty-six percent of the stream fishermen and 97 percent of the lake fishermen were Michigan residents. (The above percentages have shown little annual variation during the 11 years of creel census.)

Most of the anglers fishing the Pigeon River came from Wayne County, with local residents from Otsego County placing second (Table 9). Of the

Table 5.--Fishing success according to lure used, Pigeon River Trout Research Station, 1959

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	369	14.1	91	8	99	727.5	0.10
Worms and spinner	155	18.1	65	2	67	386.0	0.14
Flies	490	12.0	58	36	95[1]	1,110.5	0.09
Minnows	3	...	...	...	...	6.0	...
Insects	13	...	...	...	...	14.0	...
Artificial[2]	22	9.1	2	1	3	38.0	0.11
Natural[3]	2	...	...	...	...	2.5	...
Other[4]	152	25.0	73	5	78	475.0	0.13
Unknown	...	...	...	...	...	...	...
Total for stream	1,206	14.8	289	52	342[1]	2,760.0	0.11
LAKES							
Worms	1,212	33.3	1,037	...	...	2,987.5	0.32
Worms and spinner	293	31.1	247	...	...	755.5	0.26
Flies	37	10.8	5	...	...	76.0	0.05
Insects	14	21.4	4	...	...	26.5	0.14
Artificials[2]	23	13.0	4	...	...	35.5	0.11
Naturals[3]	24	41.7	19	...	...	87.0	0.22
Other[4]	236	19.5	79	...	...	666.0	0.10
Unknown	...	...	...	...	...	...	...
Ford Lake (Flies only)	232	61.6	554	...	...	510.5	1.15
Total for lakes	2,071	33.9	1,949	...	...	5,144.5	0.37

[1] Total includes one 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.

Table 6.--Fishing success, and total weight of anglers' catch during weekly periods, Pigeon River, 1959

Dates	Fishing trips		Trout caught						Hours fished	Average number of fish caught per hour per trip
			Brook		Brown		Total catch			
	Number	Percentage successful	Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)		
April 25-May 1	112	2.7	2	0.53	1	0.18	3	0.71	209.5	0.01
May 2-May 8	46	13.0	10	1.85	...	...	10	1.85	84.0	0.12
May 9-May 15	33	39.4	36	6.52	1	0.41	37	6.93	93.0	0.29
May 16-May 22	82	24.4	38	7.66	2	0.38	40	8.04	182.5	0.21
May 23-May 29	62	27.4	47	8.38	1	0.32	48	8.70	188.0	0.20
May 30-June 5	91	13.2	20	3.91	2	1.89	22	5.80	224.5	0.09
June 6-June 12	38	18.4	12	2.93	2	0.82	14	3.75	98.0	0.18
June 13-June 19	55	16.4	12	2.26	4	1.90	16	4.16	140.0	0.10
June 20-June 26	41	26.8	13	2.49	2	0.50	15	2.99	102.0	0.13
June 27-July 3	50	30.0	22	5.24	3	0.64	25	5.88	121.5	0.16
July 4-July 10	94	9.6	13	2.36	4	0.96	17	3.32	182.5	0.07
July 11-July 17	91	14.3	11	2.41	5	0.78	16	3.19	181.0	0.09
July 18-July 24	66	7.6	10	2.61	2	1.14	12	3.75	124.5	0.07
July 25-July 31	61	9.8	6	0.96	2	0.26	8	1.22	118.0	0.05
Aug. 1-Aug. 7	71	12.7	19	4.08	9	2.59	28	6.67	147.5	0.15
Aug. 8-Aug. 14	49	18.4	10	1.73	1	0.38	11	2.11	114.5	0.15
Aug. 15-Aug. 21	29	3.4	...	...	...	...	1[1]	0.13[1]	75.5	0.01
Aug. 22-Aug. 28	23	17.4	2	0.38	4	0.74	6	1.12	55.0	0.10
Aug. 29-Sept. 4	37	10.8	1	0.26	3	0.50	4	0.76	100.5	0.06
Sept. 5-Sept. 11	53	3.8	1	0.24	1	0.15	2	0.39	167.0	0.01
Sept. 12-Sept. 13	22	18.2	4	1.28	3	0.86	7	2.14	51.0	0.09
Total	1,206	14.8	289	58.08	52	15.40	342[1]	73.61[1]	2,760.0	0.11

[1] The one fish caught during the period Aug. 15-Aug. 21 was a rainbow trout.

Table 7.--Number of anglers using each type of fishing rod, Pigeon River Trout Research Station, 1959[1]

Stream section or lake	Type of rod						Total
	Fly	Spinning	Casting	Other	Combination	No record	
STREAM							
A	91	57	9	8	1	2	168
B	277	114	36	7	2	8	444
E	158	104	18	3	3	13	299
Total	526	275	63	18	6	23	911
Percentage	57.7	30.2	6.9	2.0	0.7	2.5	...
C	133	...	...	...	...	...	133
D	151	6	3	1	...	1	162
Total	284	6	3	1	...	1	295
Percentage	96.3	2.0	1.0	0.3	...	0.3	...
LAKES							
Ford	188	29	...	...	5	10	232
Percentage	81.0	12.5	...	...	2.2	4.3	...
Section 4	67	58	16	2	3	1	147
Hemlock	82	128	29	3	6	8	256
Lost	73	150	30	5	7	13	278
West Lost	117	210	34	7	14	19	401
North Twin	155	177	76	7	9	8	432
South Twin	100	148	40	9	11	17	325
Total	594	871	225	33	50	66	1,839
Percentage	32.3	47.4	12.2	1.8	2.7	3.6	...

[1] Data for stream sections C and D and for Ford Lake are shown separately because lures were restricted to flies only in 1959.

Table 8.--Number of anglers of different classes who fished in experimental waters of the Pigeon River in 1959

[Percentages in parentheses]

Residence	Licensed males	Licensed females	Wives	Minor males	Minor females	Total
STREAM						
Resident	752	4	86	172	23	1,037 (86.0)
Nonresident	120	16	...	28	5	169 (14.0)
Stream total	872 (72.3)	20 (1.7)	86 (7.1)	200 (16.6)	28 (2.3)	1,206 ...
LAKES						
Resident	1,280	6	283	347	90	2,006 (96.9)
Nonresident	44	...	3	15	3	65 (3.1)
Lakes total	1,324 (63.9)	6 (0.3)	286 (13.8)	362 (17.5)	93 (4.5)	2,071 ...

Table 9.--Residence of anglers who fished the experimental sections of the Pigeon River in 1959

County	Number of fishing trips	County	Number of fishing trips	County, state or province	Number of fishing trips
Wayne	260	Sanilac	8	Crawford	1
Otsego	125	Calhoun	7	Iosco	1
Oakland	99	Emmet	7	Isabella	1
Genesee	71	Gratiot	7	Lapeer	1
Ingham	68	St. Clair	7	Michigan (total)	1,037
Washtenaw	45	Hillsdale	6	Ohio	120
Kent	40	Clare	4	Indiana	18
Bay	38	Jackson	4	Illinois	11
Alpena	32	Monroe	4	Kentucky	4
Midland	27	Montmorency	4	New York	3
Macomb	22	Roscommon	4	Missouri	2
Muskegon	18	Arenac	3	Wisconsin	2
Branch	16	Livingston	3	Ontario (Canada)	2
Charlevoix	14	Gladwin	2	Iowa	1
Cheboygan	14	Grand Traverse	2	Massachusetts	1
Saginaw	13	Huron	2	Minnesota	1
Eaton	11	Ionia	2	New Hampshire	1
Ottawa	10	Mecosta	2	New Jersey	1
Shiawassee	10	Oceana	2	Pennsylvania	1
Kalamazoo	9	Tuscola	2	Texas	1
Presque Isle	8	Benzie	1	Total	1,206

83 counties in Michigan, 46 were represented by at least one angler; 14 other states and Ontario were represented. Ohio supplied most of the non-resident anglers.

On the lakes the Otsego County anglers outnumbered the Wayne County anglers (Table 10). Fifty counties of Michigan and 6 states contributed at least one angler.

Table 11 gives the annual totals of fishing pressure and fishing success for the experimental sections of the Pigeon River since 1949. Because various experimental management methods have been tested during these years, a meaningful interpretation of these data is somewhat complicated. Fishing pressure has declined steadily since 1954 and fishing success (wild trout caught per hour per trip) has had a similar trend. The coefficient of correlation, r, for fishing pressure and fishing success, since 1954, was 0.834; r was significantly different from 0 (t = 5.487, 4 d.f., P greater than 0.01).

Table 12 gives the age composition of the anglers' catch in 1959 and average total length and weight of each age group for each experimental section of the Pigeon River. As in past years, two-year-olds predominated in the catch.

Postseason fall population estimate

In previous annual reports of the Pigeon River Trout Research Station, the population size was calculated (by the Petersen method of mark and recapture) for four length categories--0-3.9 inches; 4.0-6.9; 7.0-9.9; and 10.0 inches and larger--for all species combined and for the entire 6 miles of experimental water as a unit. The estimate for each size category was then proportioned, on the basis of number of fish caught in the two trips through the experimental water with the direct-current shocker (one

Table 10.--Residence of anglers who fished Pigeon River lakes in 1959

County	Number of fishing trips	County	Number of fishing trips	County or state	Number of fishing trips
Otsego	312	Jackson	23	Oceana	4
Wayne	221	Eaton	18	Livingston	3
Muskegon	164	Arenac	17	Hillsdale	2
Genesee	117	Ottawa	16	Newaygo	2
Oakland	100	Isabella	11	Barry	1
Bay	97	Clare	8	Iosco	1
Ingham	90	Alpena	7	Mackinac	1
Shiawassee	81	Berrien	7	Ogemaw	1
Saginaw	73	Lapeer	7	Osceola	1
Washtenaw	70	Calhoun	6	Tuscola	1
Gratiot	64	Montcalm	6		
Presque Isle	64	St. Joseph	6	Michigan (total)	2,006
Cheboygan	62	Benzie	5	Ohio	47
Charlevoix	59	Gladwin	5	Indiana	9
Midland	58	Manistee	5	Illinois	3
St. Clair	58	Emmet	4	Florida	2
Kent	39	Grand Traverse	4	Iowa	2
Macomb	38	Huron	4	New York	2
Kalamazoo	28	Ionia	4		
Sanilac	27	Mecosta	4	Total	2,071

Table 11.--Results of creel census in experimental sections of the Pigeon River, 1949-59

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	0.15
1950	2,160	27.3	917	255	18	1,190	6,195.0	0.18
1951	2,846	15.4	453	228	10	691	7,076.0	0.10
1952	1,450	24.5	464	127	47	638	3,957.5	0.16
1953	1,943	24.9	742	203	88	1,033	5,689.0	0.23
1954	2,427	32.8	1,435	437	66	1,938	6,584.5	0.30
1955	2,039	25.3	959	250	33	1,242	5,775.5	0.20
1956	1,979	24.8	869	266	15	1,150	5,527.0	0.19
1957	1,699	23.2	721	120	17	858	4,490.0	0.18
1958	1,599	25.8	894	116	11	1,021	4,205.0	0.22
1959	1,206	14.8	289	52	1	342	2,760.0	0.11

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

Table 12.--Age composition of the anglers' catch and average length and weight of age groups for each experimental section, Pigeon River, 1959

Stream section	Species	Age group	Number	Average total length (inches)	Average weight (pounds)
A	Brook	I	4	7.3	0.14
		II	34	7.9	0.18
		III	2	8.5	0.24
	Brown	I	1	7.1	0.12
		II	3	9.2	0.30
	Rainbow	I	1	7.4	0.13
B	Brook[1]	I	12	7.3	0.14
		II	70	8.1	0.19
		III	6	9.1	0.28
	Brown	I	11	7.6	0.14
		II	6	10.7	0.48
		III	1	15.5	1.50
C	Brook	II	8	9.5	0.31
	Brown	II	5	10.3	0.41
D	Brook	II	9	9.3	0.29
		III	3	10.3	0.40
	Brown	II	2	9.2	0.26
E	Brook	I	19	7.5	0.15
		II	115	8.1	0.20
		III	6	9.3	0.30
	Brown	I	15	7.4	0.14
		II	8	10.6	0.47

[1] No scales were taken from one brook trout, 8.0 inches in length and 0.16 pound in weight.

trip to mark, the second to recapture), into number of fish in each section of stream; the estimate was further stratified according to number of each species in each 1-inch length group (Waters, 1957a). This method does not give enough weight to the difference in catchability among species and the difference in catchability of fish among the different sections, and is therefore less accurate than estimates based on calculations made separately for each 1-inch group of each species for each section (the procedure followed for the present report).[2]

In order to compute the pounds of trout in the fall population estimate, the average weight of each 1-inch group of each species (based on the calculated weight at each 0.1 inch) was found, by referring to the established length-weight relationships for Pigeon River trout (Cooper and Benson, 1951).

Table 13 presents the results of the 1959 fall population estimate, 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 estimate). The total population for the six miles of river was 12,467 brook, 3,241 brown and 12 rainbow trout, or 22.91 pounds of trout per acre. The total of 15,720 trout of all sizes was somewhat below the 1958 total of 18,165. The decrease was primarily in the number of brown trout, which declined from 6,531 in 1958 to 3,241 in 1959. (Most of the decrease was in young-of-the-year fish.)

Table 14 gives the annual expectations of death for brook and brown trout in the experimental sections of the river for the year beginning fall, 1958, and ending fall, 1959.

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[2] The previous population estimates, 1949-58, have been recalculated by this method and will be summarized in a future report.

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 1959 (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	1	4	0.01	...	...	...	...	4	0.01
	2	280	1.68	84	0.50	...	...	364	2.18
	3	79	1.18	113	1.81	...	...	192	2.99
	4	15	0.48	2	0.07	...	...	17	0.55
	5	98	5.68	13	0.78	...	...	111	6.46
	6	75	7.20	77	7.55	5	0.49	157	15.24
	7	21	3.07	74	11.10	1	0.15	96	14.32
	8	10	2.11	35	7.60	2	0.43	47	10.14
	9	2	0.59	9	2.72	...	...	11	3.31
	10	...	...	4	1.63	...	...	4	1.63
	11	...	...	2	1.07	...	...	2	1.07
	12+	...	...	3	5.42	...	...	3	5.42
Total		584	22.00	416	40.25	8	1.07	1,008	63.32
Pounds per acre			3.07		5.62		0.15		8.84
B	1	3	0.01	...	...	...	...	3	0.01
	2	961	5.77	213	1.28	...	...	1,174	7.05
	3	348	5.22	518	8.29	...	...	866	13.51
	4	47	1.50	36	1.22	...	...	83	2.72
	5	245	14.21	28	1.68	...	...	273	15.89
	6	186	17.86	117	11.47	...	...	303	29.33
	7	35	5.11	166	24.90	1	0.15	202	30.16
	8	7	1.48	26	5.64	...	...	33	7.12
	9	5	1.46	7	2.11	...	...	12	3.57
	10	1	0.39	2	0.81	...	...	3	1.20
	11	...	...	4	2.13	...	...	4	2.13
	12+	...	...	9	7.13	...	...	9	7.13
Total		1,838	53.01	1,126	66.66	1	0.15	2,965	119.82
Pounds per acre			8.98		11.30		0.03		20.31
C	1	9	0.02	...	...	...	...	9	0.02
	2	1,879	11.27	72	0.43	...	...	1,951	11.70
	3	621	9.32	301	4.82	...	...	922	14.14
	4	224	7.17	50	1.70	...	....	274	8.87
	5	449	26.04	56	3.36	...	...	505	29.40
	6	202	19.39	196	19.21	2	0.20	400	38.80
	7	53	7.74	125	18.75	1	0.15	179	26.64
	8	47	9.92	13	2.82	...	...	60	12.74
	9	10	2.93	6	1.81	...	...	16	4.74
	10	3	1.18	3	1.22	...	...	6	2.40
	11	...	...	4	2.13	...	...	4	2.13
	12+	...	...	9	13.32	...	...	9	13.32
Total		3,497	94.98	835	69.57	3	0.35	4,335	164.90
Pounds per acre			17.62		12.91		0.06		30.59

(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	1	6	0.01	...	...	...	...	6	0.01
	2	1,648	9.89	8	0.05	...	...	1,656	9.94
	3	638	9.57	44	0.70	...	...	682	10.27
	4	284	9.09	6	0.20	...	...	290	9.29
	5	455	26.39	64	3.84	...	...	519	30.23
	6	176	16.90	178	17.44	...	...	354	34.34
	7	59	8.61	142	21.30	...	...	201	29.91
	8	54	11.39	36	7.81	...	...	90	19.20
	9	18	5.27	5	1.51	...	...	23	6.78
	10	5	1.97	2	0.81	...	...	7	2.78
	11	3	1.54	4	2.13	...	...	7	3.67
	12+	...	...	17	30.46	...	...	17	30.46
Total		3,346	100.63	506	86.25	...	...	3,852	186.88
Pounds per acre			17.81		15.27		...		33.08
E	1	2	T[2]	...	...	...	...	2	T
	2	1,645	9.87	9	0.05	...	...	1,654	9.92
	3	625	9.38	8	0.13	...	...	633	9.51
	4	205	6.56	3	0.10	...	...	208	6.66
	5	448	25.98	2	0.12	...	...	450	26.10
	6	199	19.10	113	11.07	...	...	312	30.17
	7	38	5.55	169	25.35	...	...	207	30.90
	8	17	3.59	30	6.51	...	...	47	10.10
	9	14	4.10	3	0.91	...	...	17	5.01
	10	6	2.36	5	2.04	...	...	11	4.40
	11	2	1.03	5	2.66	...	...	7	3.69
	12+	1	0.66	11	10.24	...	...	12	10.90
Total		3,202	88.18	358	59.18	...	...	3,560	147.36
Pounds per acre			15.55		10.44		...		25.99
All sections	1	24	0.05	...	...	...	...	24	0.05
	2	6,413	38.48	386	2.31	...	...	6,799	40.79
	3	2,311	34.67	984	15.75	...	...	3,295	50.42
	4	775	24.80	97	3.29	...	...	872	28.09
	5	1,695	98.30	163	9.78	...	...	1,858	108.08
	6	838	80.45	681	66.74	7	0.69	1,526	147.88
	7	206	30.08	676	101.40	3	0.45	885	131.93
	8	135	28.49	140	30.38	2	0.43	277	59.30
	9	49	14.35	30	9.06	...	...	79	23.41
	10	15	5.90	16	6.51	...	...	31	12.41
	11	5	2.57	19	10.12	...	...	24	12.69
	12+	1	0.66	49	66.57	...	...	50	67.23
Total		12,467	358.80	3,241	321.91	12	1.57	15,720	682.38
Pounds per acre			12.05		10.81		0.05		22.91

[1] Length groups range from 1.0 to 1.9 inches, 2.0-2.9, 3.0-3.9 inches, etc.

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

Table 14.--Annual expectations of death for brook and brown trout in the experimental sections of the Pigeon River, 1959

Species, and section	Age group I			Age group II+		
	Total mortality a	Rate of exploitation u	Natural mortality v	Total mortality a	Rate of exploitation u	Natural mortality v
Brook trout						
A	0.38	0.01	0.37	0.96	0.15	0.81
B	0.60	0.01	0.59	0.91	0.37	0.54
C	0.58	...	0.58	0.87	0.01	0.86
D	0.65	...	0.65	0.89	0.01	0.88
E	0.59	0.01	0.58	0.87	0.17	0.70
Brown trout						
A	0.79	<0.01	0.79	0.94	0.02	0.92
B	0.74	0.01	0.73	0.91	0.04	0.87
C	0.74	...	0.74	0.87	0.03	0.84
D	0.73	...	0.73	0.79	0.01	0.78
E	0.34	0.03	0.31	0.52	0.10	0.42

Total mortality, a, natural mortality, v, and rate of exploitation, u, are defined by Ricker, 1958. Total survival, s, is the complement of total mortality, $s = 1 - a$. Total survival for age-group I was determined by $s = 1 - a = \frac{\text{age-group I}}{\text{age-group 0}}$; and for age-group II+, $s = 1 - a = \frac{\text{age-group II + III + . . .}}{\text{age-group I + II + . . .}}$. During the fall population estimates an attempt was made to obtain 15 scale samples for each 1-inch group of each species. Then the estimated number of fish in each 1-inch group was proportioned among the age groups found in each 1-inch group.

The rate of exploitation, u, is the number of fish caught during the year (age-group I or age-group II+) divided by the number available to be caught (age-group 0 or age-group I+) as determined in the fall population estimate for the previous year.

Natural mortality, v, is the difference between total mortality and rate of exploitation ($v = a - u$).

It was assumed for these calculations that there was no movement of fish from one section of stream to another.

These figures (Table 14) point out the low rate of exploitation in Sections C and D (under a 9-inch size limit and a flies-only regulation) as compared to the other sections (7-inch size limit and no restriction as to lure). Furthermore, if one averages the total mortality and natural mortality figures for the two sections (C, D) under a flies-only order and for the three sections (A, B, E) not under flies only, total mortality on brown trout was higher in the flies-only water, higher on one-year-old brook trout in the flies-only water, and only slightly lower on two-year-old+ brook trout in the flies-only water. Also, natural mortality of both brook trout and brown trout was higher, on the average, in the flies-only sections than in other sections. Apparently the flies-only regulation did not significantly reduce either total mortality or natural mortality during 1959.

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