Original: Research and Development
cc: Hunt Creek Station
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Pigeon River files
Fish Section
Educ.-Game
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Federal Aid (2)

MICHIGAN DEPARTMENT OF CONSERVATION
Research and Development Report No. 45*

October 28, 1965

THE SIXTEENTH ANNUAL CREEL CENSUS AND PROGRESS REPORT, PIGEON RIVER TROUT RESEARCH STATION, 1964

By William C. Latta

* Institute for Fisheries Research Report No. 1707

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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 (Figure 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 experimental stream to about 6 miles. The physical features of the stream sections are given in Table 1.

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* Institute for Fisheries Research Report No. 1707.

1 Contribution from Dingell-Johnson Project F-27-R, Work Plan 7, Michigan.

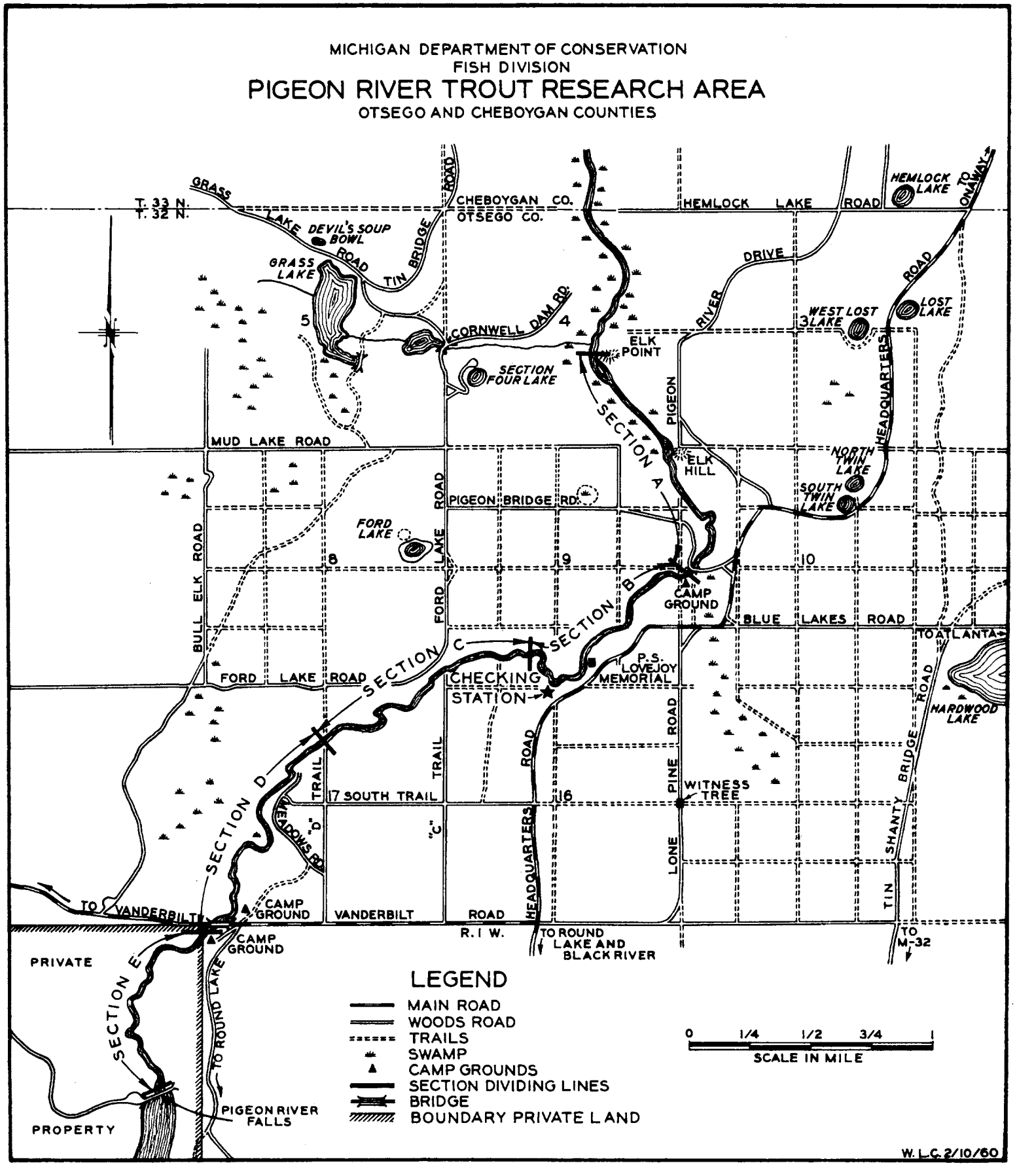
MICHIGAN DEPARTMENT OF CONSERVATION
FISH DIVISION
PIGEON RIVER TROUT RESEARCH AREA
OTSEGO AND CHEBOYGAN COUNTIES
T. 33 N.
T. 32 N.
CHEBOYGAN CO.
OTSEGO CO.
GRASS LAKE ROAD
DEVIL'S SOUP BOWL
GRASS LAKE
TIN BRIDGE ROAD
CORNWELL DAM RD.
SECTION FOUR LAKE
ELK POINT
HEMLOCK LAKE ROAD
HEMLOCK LAKE
TO ONAWAY
RIVER DRIVE
WEST LOST LAKE
LOST LAKE
HEADQUARTERS ROAD
PIGEON
SECTION A
MUD LAKE ROAD
ELK HILL
NORTH TWIN LAKE
SOUTH TWIN LAKE
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"
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

Do Not
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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.

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. The success of the program depends to a large extent on the cooperation of the fishing public in supplying the information needed.

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.

Since 1949, fishing on the experimental waters has been by permit. Each angler is required to obtain a free, one-day permit before proceeding to his selected water, whether an experimental section of the stream or a lake, and is also required to report on his trip and 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, and manipulation of the environment, as well as to provide information concerning the basic biology of trout. The compulsory permit system assures a virtually complete census, and provides information which could not be obtained otherwise. All the previous annual creel census and progress reports are included 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 all the fishing in them is for hatchery trout.

During 1964 the station was under the supervision of the author. Other permanent staff included Gerald F. Myers, Harold H. Brado and Doyle E. Edson. Supervisory assistance was provided by Gerald P. Cooper and David S. Shetter.

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[2] Numbers 1250, 1288, 1512, 1521, 1527, 1544, 1560, 1568, 1611, 1632, 1647, 1676, and 1695 (or Research & Development Report No. 10).

Since July 1, 1960, work at the station has been supported largely by funds provided by the Federal Aid in Fish Restoration Act. The name of the station's current Work Plan under the Dingell-Johnson project is Development and Evaluation of Trout Management Techniques. The general objective is to evaluate the effects on the catches and standing crops of trout of (1) physical changes in a trout-stream environment, (2) changes in fishing regulations, and (3) variations in number, size, and time of planting of trout in lakes. Seven procedures (mainly involving creel census and population studies) are used to collect data for the evaluations. The data collected under each procedure will be presented first; then progress on the jobs under the D-J project will be summarized, with further references to the data.

(1) Complete creel census of 6 miles of stream

Special fishing regulations have been in effect since the establishment of the research station in 1949. The regulations for the river and the lakes are summarized in Table 2 to aid in interpretation of the creel census and the population estimates.

Catch statistics for 1964 for the stream sections appear in Table 3.[3] The catch of 958 trout was close to the average catch (since 1953) of about 1,000 fish per year. Section E, with the general fishing regulations, produced the most fish: 547 of the 958 trout caught. Sections

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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.

C and D, with the higher size limit and flies-only regulations, produced the fewest fish: 31 and 25 trout, respectively. Total number of fishing trips increased from 1,890 in 1963 to 2,049 in 1964, and the total hours fished increased from 5,094.5 to 5,179.0. The rate of catch increased from 0.13 trout per hour in 1963 to 0.17 trout in 1964.

Fishing success during weekly periods is given in Table 4; it was best during the middle two weeks of May and poorest during late July and early August, which corresponded identically to the extremes of the 1963 season.

Most of the anglers fishing the Pigeon River came from Wayne County (Table 5). Of the 83 counties in Michigan 57 were represented by at least one angler; 10 other states were represented also. Most of the nonresident anglers came from Ohio.

(2) Complete creel census of seven trout lakes

Catch statistics for the lakes are presented in Table 6. In six of the lakes, the fishery consists entirely of hatchery brook trout planted as fingerlings (average total length, 5.5 inches) in the fall; the planting rate approximates 100 fingerlings per acre per year. Section 4 Lake received about 1,000 brook trout fry per acre (a total of 3,000) each spring through 1961. In July 1962, this lake was planted with 400 fish exceeding 7 inches to compare survival of two strains (Michigan and Pennsylvania) and inter-strain crosses of brook trout. No plantings were

made in 1963. In April 1964, 70 rainbow trout exceeding 7 inches and 3,000 fry were planted in Section 4 to duplicate the original brook trout plantings. A comparison will be made between returns from the two species.

On Ford Lake, under a flies-only regulation, the average catch per hour per trip in 1964 was 0.37 trout--slightly lower than the 0.40 trout recorded in 1963. Fishing success for all the lakes combined, as measured by average catch per hour per trip, was 0.20 trout, almost identical to the rate of 0.21 trout for 1963. Total fishing effort decreased from 1,553 trips and 4,195.0 hours in 1963 to 1,475 trips and 3,952.5 hours in 1964.

Residence of anglers who fished the lakes in 1964 is given in Table 7. Most of these anglers were from Muskegon and Ingham counties. Fifty counties of Michigan and nine states contributed at least one angler.

Numbers of trips made to the experimental waters by licensed and non-licensed anglers, i.e., wives and minors, are given in Table 8. Licensed anglers accounted for 69.7% of the fishing on the stream and 67.9% of the fishing on the lakes. Michigan residents did 83.8% of the stream fishing and 93.8% of the lake fishing.

(3) Estimate of number of trout in the stream in 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 with 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 numbers of fish in 1-inch groups of each species were calculated for each section.

In order to compute the pounds of trout in the estimated populations, the average weight of each 1-inch group of each species was determined from the calculated weight at each 0.1 inch. The calculations were based on the length-weight relationships of Pigeon River trout as described by Cooper and Benson (1951).

Results of the 1964 spring population estimates are presented in Table 9. Inch groups above 12 inches were kept separate for population estimates, but are combined in the table. The total population for the 6 miles of river was computed to be 9,170 trout (7,906 brook trout and 1,264 brown trout) or 15.05 pounds of trout per acre. For comparison, the figures of the 1963 spring estimates were 11,237 trout (10,341 brook, 896 brown) and 15.55 pounds per acre.

Results of the 1964 fall population estimates are presented in Table 10. The total population was determined as 24,347 trout (20,876 brook trout and 3,471 brown trout) or 31.20 pounds per acre. The 1963 fall estimates were 18,937 trout (16,656 brook, 2,281 brown) and 30.05 pounds per acre.

(4) Estimate of number of trout in two lakes in spring and fall

April and October population estimates of the number of brook trout in each year class in Ford and Hemlock lakes, and the catch of trout by anglers, are presented in Table 11. Samples of trout for the estimates were taken by fishing with flies, shocking with a direct-current shocker at night with underwater lights, seine, and creel census. The Bailey modification of the Petersen formula for mark-and-recapture estimates was used (Ricker, 1958). Confidence limits (95%) were calculated from Clopper and Pearson's (1934) chart.

(5) Calculate growth and mortality rates for the trout from the stream

Age composition of the anglers' catch in 1964 and average total length and weight of each age group for each experimental section of the Pigeon River are given in Table 12. As in past years, two-year-old fish predominated in the catch.

There has been poor agreement in past years between the estimates and the number of fish in the catch, for in many instances more fish were caught during the fishing season than were estimated to be present at the start of the season. Possible reasons for these discrepancies include movement of fish between sections, recruitment from outside the experimental area, inaccurate estimates of population size in the spring because of high water and other physical difficulties. Several of such conditions have been checked, other possibilities will be considered, and correction factors will be sought.

In 1964, age distributions of the spring and fall population estimates were determined from scale collections; 15 scale samples were obtained from each inch group of each species at the time of the estimates. However, annual expectations of death (total mortality, rate of exploitation, and natural mortality) were not calculated; these figures will be determined when correction factors have been devised.

(6) Calculate growth and mortality rates for trout from Ford and Hemlock lakes

Average length and weight for each year class of brook trout in the anglers' catch from Ford and Hemlock lakes are given in Table 13.

Expectations of death (mortality rates) for brook trout in Ford and Hemlock lakes, April to October 1964, are presented in Table 14. These figures are based on estimates of population size and creel census (Table 11).

(7) Mark hatchery trout for planting in lakes

The lakes were stocked with 3,610 brook trout in November 1964. The fish were from 5 to 6 inches long, and had been marked by clipping the dorsal and left ventral fins.

Following is a review of the progress made on each job under the D-J Work Plan (No. 7) assigned to the station:

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

Research and all other activities of the station were administered. The routine clerical work included bookkeeping on supplies purchased, utilities, 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 the U. S. Geological Survey. Progress continued on assembling and maintaining the station's library.

Job No. 2.--Construction and maintenance of equipment.

Equipment used was built, modified, or repaired as needed.

Job No. 3.--Evaluation of stream improvement upon anglers' catch and standing crop of trout in Pigeon River.

In 1953, Section A of the Pigeon River was improved for trout by the addition of log cover, deflectors, and so forth (30 structures); Section B--unimproved--was designated as the control section. In 1958, at the end of 5 years, the effects of the improvement on angling and on the trout population were evaluated but results were inconclusive because of large year-to-year variations in the data and greater fishing pressure on the control section (Latta, 1960). In 1959, as a continuation of the experiment, all the improvement devices and most of the natural cover were removed from Section A, and sand was deposited in the stream to fill the holes created by the deflectors. The intent was to recreate in Section A the conditions which prevailed prior to improvement in 1953. Section B was left in its natural state to continue as a control.

In 1958, before Section A was de-improved, and again in 1960, sample 100-foot segments of Section A (13) and Section B (10) were mapped by the plane-table method to record square feet of bottom soil types, water depths, and cover (Latta, 1961). The sample areas were mapped again in August 1964. A final report will be prepared in 1965; the study was completed in 1964.

Job No. 4.--Evaluation of special regulations (fly-fishing only and increased size limit) upon anglers' catch and standing crop of trout in Pigeon River.

The special-fishing regulations on Sections C and D in 1955-57 were a 9-inch minimum length and a daily creel limit of 5 trout. In 1958, a flies-only restriction was added. Section B, which has regulations of 7-inch minimum length and a creel limit of 5 trout, but no restriction as to lure, is considered the control area. From the creel census, the following data have been tabulated for each year: total hours of fishing, number of fishing trips, percentage of successful anglers, average number of trout caught per hour per trip, and numbers of brook trout and brown trout 9 inches or larger captured by anglers. From the annual fall population estimates, the following data were obtained: standing crop in pounds of brook and brown trout; number of young-of-year brook and brown trout; number of brook and brown trout 9 inches or larger; and number of brook and brown trout 7 inches or larger. For each annual measurement, the ratio of Section B to Sections C and D will be calculated,

and the mean ratios for the years 1955-57 (with any lure) will be compared statistically with that for the years 1958-64 (artificial flies only). A considerable amount of work has been done already on these phases of the job. A final report will be prepared in 1965; 1964 was the last year of the study.

Job No. 5.--Evaluation of fly-fishing-only regulation upon the population and anglers' catch of brook trout in a lake.

In Ford Lake since 1955, lures have been restricted to artificial flies. Hemlock Lake, where anglers could use any bait except minnows, was used as a control. The effects of the special regulation on angling and on the trout population have been evaluated through 1962 (Latta, 1963). With the data for 1963 and 1964 included, conclusions are essentially the same as those drawn in the reference just cited. A final report will be prepared in 1965; 1964 was the final year of the study.

Job No. 6.--Evaluation, from anglers' catch, of changes in number, size and time of stocking of brook trout in lakes.

The experiment with rainbow trout in Section 4 Lake (mentioned earlier) was the only work done on this job in 1964. The other lakes were used for the study of the biology of the gill louse (Salmincola edwardsii) (Job No. 8).

Job No. 7. --Determination of causes of natural mortality of trout in lakes and stream.

In order to determine some of the causes of the natural mortality of brook trout planted in lakes and of wild populations of brook and brown trout in the river, the following procedures were taken:

(1) Again during the 1964 fishing season, the sex was determined of most of the trout caught from the river and examined in the creel census in order to determine further if natural mortality was greater for one sex than the other (Table 15). Apparently the brook trout and brown trout in the catch do not vary from a 1:1 ratio of males to females.

(2) In order to measure the effects of merganser predation on brook trout populations in lakes and on the fishing quality, six American Mergansers were wing-clipped and released in 1963, three each on North Twin Lake and South Twin Lake. West Lost and Lost lakes were designated as controls. Mark-and-recapture estimates of the trout population size were made in the spring before the mergansers were released, and again in the fall. The mergansers were released April 17 before the fishing season and removed 19 days later on May 6. An attempt to estimate the population immediately after the mergansers were removed was unsuccessful. A detailed report has been prepared.

(3) Before the mergansers were released on the lakes, they were held in captivity at the Oden State Fish Hatchery from 49 to 69 days for observations on their feeding behavior. The mergansers consumed

small trout before they took larger ones. The tests indicated that the largest size of trout eaten is determined by the size of the bird and the girth of the prey, and that there is no preference between minnows and trout. The mergansers consumed 15.3% to 19.5% of their body weight per day. A detailed report has been prepared (Latta and Sharkey, 1964).

(4) Mortality of newly emerged brook trout fry is high (Latta, 1962). To measure the effects of starvation on very young brook trout fry, collections were taken from the Pigeon River in 1962, 1964 and 1965, as soon as the fry emerged and then were held in aquaria at various water temperatures and without food. The experimental conditions were kept as uniform as possible from year to year. On the average, 50% mortality was reached in 27 days at a water temperature of 50 F, in 30 days at 45 F, in 43 days at 42 F, and in 70 days at 39 F. A detailed report will be prepared.

Job No. 8.--Evaluate the effects of the gill louse on the brook trout in lakes.

Brook trout in the Pigeon River lakes are infested with the gill louse (Salmincola edwardsii). The gill louse is a common source of mortality among brook trout when the fish are crowded in hatcheries. Little is known of the biology of this parasite in natural environments. Because it may be an important factor in the unexplained natural loss of trout in the lakes, an investigation was begun on its biology, its effect on the host, and its relationship to environmental factors. The study is being made in cooperation with L. N. Allison, Fish Pathologist.

About the middle of each month for 12 months a sample of at least 10 brook trout was taken from each of six lakes--South Twin, North Twin, West Lost, Lost, Ford and Hemlock. Condition of each fish was recorded with the number of gill lice present. The incidence of gill lice on brook trout of the 1963 year class is given in Table 16. As to development, the parasites were recorded as very young, immature, early-mature, late-mature, and senescent. Densities of the trout populations were estimated in April and October. Dissolved oxygen and temperatures were measured in each lake during the critical summer months. A report will be prepared after the data have been analyzed.

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INSTITUTE FOR FISHERIES RESEARCH

William C. Latta

Report approved by G. P. Cooper

Typed by M. S. McClure

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, 1952. Length of Section E, from Bacon, Shetter and Cooper, 1958. Width of Section E was measured on July 28, 1961.

Table 2.--Experimental regulations, in waters of the Pigeon River Trout Research Station, 1949-1964

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
1955-64	5	7	5	9	10	7	5	7

[1] Lure was restricted to artificial flies only in Sections C and D in 1958-64 and in Ford Lake in 1955-64. The use of minnows as bait was prohibited in the lakes (state-wide regulation 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, 1964

Stream sections	Fishing trips		Total hours fished	Average number of trout caught per hour per trip
	Number	Percentage successful		
A	569	15.5	1,257.0	0.11
B	463	21.4	1,073.5	0.17
C	193	10.9	510.0	0.07
D	247	8.1	709.0	0.03
E	577	29.8	1,629.5	0.30
Total	2,049	19.5	5,179.0	0.17

Stream sections	Anglers' catch					
	Brook trout		Brown trout		Total	
	Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)
A	140	37.32	14	5.64	154	42.96
B	165	31.52	35	24.42	201[1]	56.08[1]
C	17	5.12	14	7.76	31	12.88
D	16	5.35	9	4.64	25	9.99
E	496	101.56	51	23.63	547	125.19
Total	834	180.87	123	66.09	958[1]	247.10[1]

[1] One rainbow (0.14 pound) included.

Table 4.--Fishing success, and total weight of anglers' catch during weekly periods, Pigeon River, 1964

Dates	Fishing trips		Trout caught						Hours fished	Average number of trout caught per hour per trip
			Brook		Brown		Total			
	Number	Percentage successful	Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)		
April 25 - May 1	167	22.2	113	23.26	14	4.76	127	28.02	433.5	0.24
May 2 - May 8	90	34.4	68	13.30	4	1.92	72	15.22	230.0	0.29
May 9 - May 15	67	34.3	62	12.80	5	1.95	67	14.75	165.0	0.44
May 16 - May 22	100	44.0	149	28.08	7	2.60	156	30.68	295.0	0.55
May 23 - May 29	56	19.6	17	3.54	4	1.92	21	5.46	113.5	0.15
May 30 - June 5	100	27.0	59	13.16	8	2.56	67	15.72	253.0	0.27
June 6 - June 12	68	35.3	52	11.84	14	9.56	66	21.40	192.5	0.26
June 13 - June 19	125	22.4	47	9.96	3	2.11	50	12.07	357.5	0.14
June 20 - June 26	76	22.4	19	4.36	6	4.01	25	8.37	217.0	0.11
June 27 - July 3	120	11.7	20	5.56	8	4.44	28	10.00	280.5	0.11
July 4 - July 10	134	14.2	27	5.95	4	8.70	31	14.65	306.5	0.11
July 11 - July 17	95	8.4	12	2.16	5	1.46	17	3.62	237.0	0.04
July 18 - July 24	126	18.3	37	13.62	5	3.46	42	17.08	319.0	0.13
July 25 - July 31	145	6.2	12	5.48	2	0.72	15[1]	6.34[1]	307.0	0.05
Aug. 1 - Aug. 7	102	9.8	6	1.29	5	4.26	11	5.55	223.5	0.05
Aug. 8 - Aug. 14	106	17.0	25	4.76	3	1.08	28	5.84	325.5	0.06
Aug. 15 - Aug. 21	91	12.1	29	5.46	1	0.19	30	5.65	223.5	0.08
Aug. 22 - Aug. 28	86	29.1	50	9.65	8	5.32	58	14.97	227.5	0.22
Aug. 29 - Sept. 4	80	11.2	12	2.68	7	2.50	19	5.18	225.5	0.09
Sept. 5 - Sept. 11	106	10.4	15	3.04	9	2.34	24	5.38	213.5	0.07
Sept. 12 - Sept. 13	9	11.1	3	0.88	1	0.20	4	1.08	33.0	0.11
Total	2,049	19.5	834	180.83	123	66.06	958[1]	247.03[1]	5,179.0	0.17

[1] One rainbow trout (0.14 pound) included.

Table 5.--Residence of anglers who fished the experimental sections of the Pigeon River in 1964

County	Number of fishing trips	County	Number of fishing trips	County or state	Number of fishing trips
Wayne	338	St. Clair	11	Marquette	2
Ingham	231	Barry	10	Oceana	2
Oakland	206	Ottawa	9	Roscommon	2
Genesee	133	Lenawee	7	St. Joseph	2
Otsego	83	Clinton	6	Sanilac	2
Bay	74	Eaton	6	Antrim	1
Washtenaw	72	Ionia	6	Cass	1
Saginaw	51	Isabella	6	Crawford	1
Kent	42	Lapeer	6	Gladwin	1
Macomb	40	Emmet	5	Houghton	1
Alpena	34	Mason	5	Mecosta	1
Gratiot	32	Osceola	5	Michigan total	1,718
Midland	32	Tuscola	5	Ohio	255
Muskegon	32	Wexford	5	Indiana	41
Kalamazoo	27	Arenac	4	Illinois	21
Calhoun	25	Montcalm	4	Maryland	5
Jackson	23	Montmorency	4	California	2
Cheboygan	22	Charlevoix	3	Iowa	2
Presque Isle	21	Iosco	3	Pennsylvania	2
Branch	19	Iron	3	Colorado	1
Shiawassee	17	Benzie	2	Kansas	1
Livingston	16	Berrien	2	New York	1
Huron	13	Clare	2	Non-resident total	331
				Grand total	2,049

Table 6.--Results of creel census on lakes of the Pigeon River Trout Research Station, 1964

(Only brook trout were caught except in Section 4 Lake)

Lake	Fishing trips		Trout caught		Hours fished	Average number of fish caught per hour per trip
	Number	Percentage successful	Number	Weight (pounds)		
Ford	194	38.7	202	69.40	468.5	0.37
Section 4	161	19.9	69[1]	27.34[1]	480.5	0.11
Hemlock	202	39.1	196	58.46	684.0	0.28
Lost	180	15.6	49	9.18	383.5	0.11
West Lost	242	28.5	165	54.64	650.0	0.18
North Twin	239	26.4	142	58.92	668.5	0.19
South Twin	257	21.8	141	63.47	617.5	0.18
Total	1,475	27.3	964	341.40	3,952.5	0.20

[1] Summation of 46 brook trout (16.70 pounds) and 23 rainbow trout (10.64 pounds).

Table 7.--Residence of anglers who fished the Pigeon River lakes in 1964

County	Number of fishing trips	County	Number of fishing trips	County or state	Number of fishing trips
Muskegon	133	Calhoun	11	Oceana	2
Ingham	130	Huron	11	Osceola	2
Otsego	107	Roscommon	11	Tuscola	2
Wayne	98	Alpena	9	Barry	1
Kent	92	Eaton	9	Clare	1
Genesee	88	Lapeer	9	Iron	1
Saginaw	87	Berrien	7	Michigan total	1,384
Oakland	82	Sanilac	7	Ohio	53
Bay	70	Arenac	6	Indiana	15
Shiawassee	63	Emmet	6	Florida	12
Cheboygan	38	Ogemaw	6	Maryland	4
Gratiot	37	Hillsdale	5	Arizona	2
Washtenaw	37	Montcalm	5	Connecticut	2
Presque Isle	36	Montmorency	5	California	1
Jackson	28	Crawford	3	Illinois	1
Midland	27	Kalamazoo	3	Missouri	1
Charlevoix	20	Monroe	3	Nonresident	
Clinton	17	St. Clair	3	total	91
Isabella	16	Allegan	2	Grand total	1,475
Ottawa	15	Gladwin	2		
Macomb	14	Ionia	2		
Lenawee	13	Livingston	2		

Table 8. --Number of anglers of different classes who fished in experimental waters of the Pigeon River in 1964

(Percentages in parentheses)

Residence	Licensed males	Licensed females	Wives	Minor males	Minor females	Total
STREAM						
Resident	1,166	10	154	350	38	1,718 (83.8)
Nonresident	236	16	...	65	14	331 (16.2)
Total	1,402 (68.4)	26 (1.3)	154 (7.5)	415 (20.3)	52 (2.5)	2,049
LAKES						
Resident	920	9	202	213	40	1,384 (93.8)
Nonresident	66	7	...	16	2	91 (6.2)
Total	986 (66.8)	16 (1.1)	202 (13.7)	229 (15.5)	42 (2.8)	1,475

Table 9.--Estimated numbers and weights of trout, by species and lengths, in the experimental sections of the Pigeon River in the spring of 1964 (before opening of the trout fishing season)

Stream section	Inch group[1]	Brook trout		Brown trout		Total	
		Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)
A	2	60	0.36	6	0.04	66	0.40
	3	436	6.54	51	0.82	487	7.36
	4	261	8.35	139	4.73	400	13.08
	5	74	4.29	27	1.62	101	5.91
	6	72	6.91	5	0.49	77	7.40
	7	72	10.51	17	2.55	89	13.06
	8	8	1.69	20	4.34	28	6.03
	9	...	...	3	0.91	3	0.91
	10	1	0.39	4	1.63	5	2.02
	11	...	...	5	2.67	5	2.67
	12	...	...	2	1.36	2	1.36
	13+	...	...	4	4.62	4	4.62
Total		984	39.04	283	25.78	1,267	64.82
Pounds per acre			5.45		3.60		9.05
B	2	102	0.61	...	...	102	0.61
	3	684	10.26	78	1.25	762	11.51
	4	225	7.20	137	4.66	362	11.86
	5	88	5.10	24	1.44	112	6.54
	6	110	10.56	1	0.10	111	10.66
	7	28	4.09	21	3.15	49	7.24
	8	9	1.90	19	4.12	28	6.02
	9	1	0.29	4	1.21	5	1.50
	10	...	...	4	1.63	4	1.63
	11	...	...	2	1.07	2	1.07
	12	...	...	2	1.36	2	1.36
	13+	...	...	5	7.30	5	7.30
Total		1,247	40.01	297	27.29	1,544	67.30
Pounds per acre			6.78		4.63		11.41
C	2	214	1.28	8	0.05	222	1.33
	3	955	14.32	41	0.66	996	14.98
	4	464	14.85	136	4.62	600	19.47
	5	175	10.15	28	1.68	203	11.83
	6	147	14.11	22	2.16	169	16.27
	7	75	10.95	34	5.10	109	16.05
	8	20	4.22	25	5.42	45	9.64
	9	4	1.17	6	1.81	10	2.98
	10	...	...	9	3.66	9	3.66
	11	...	...	4	2.13	4	2.13
	12	...	...	1	0.68	1	0.68
	13+	...	...	5	5.10	5	5.10
Total		2,054	71.05	319	33.07	2,373	104.12
Pounds per acre			13.18		6.13		19.31

(continued)

Table 9.--concluded

Stream section	Inch group[1]	Brook trout		Brown trout		Total	
		Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)
D	2	49	0.29	...	...	49	0.29
	3	873	13.10	16	0.26	889	13.36
	4	427	13.66	113	3.84	540	17.50
	5	204	11.83	22	1.32	226	13.15
	6	177	16.99	1	0.10	178	17.09
	7	48	7.01	9	1.35	57	8.36
	8	36	7.60	11	2.39	47	9.99
	9	4	1.17	18	5.44	22	6.61
	10	2	0.79	6	2.44	8	3.23
	11	...	...	2	1.07	2	1.07
	12	...	...	1	0.68	1	0.68
	13+	...	...	4	6.15	4	6.15
Total		1,820	72.44	203	25.04	2,023	97.48
Pounds per acre			12.82		4.64		17.46
E	2	43	0.26	...	...	43	0.26
	3	773	11.60	4	0.06	777	11.66
	4	471	15.07	77	2.62	548	17.69
	5	136	7.89	23	1.38	159	9.27
	6	229	21.98	4	0.39	233	22.37
	7	112	16.35	4	0.60	116	16.95
	8	31	6.54	9	1.95	40	8.49
	9	4	1.17	13	3.93	17	5.10
	10	2	0.79	7	2.85	9	3.64
	11	...	...	9	4.80	9	4.80
	12	...	...	2	1.36	2	1.36
	13+	...	...	10	12.70	10	12.70
Total		1,801	81.65	162	32.64	1,963	114.29
Pounds per acre			14.40		5.76		20.16
All sections	2	468	2.80	14	0.09	482	2.89
	3	3,721	55.82	190	3.05	3,911	58.87
	4	1,848	59.13	602	20.47	2,450	79.60
	5	677	39.26	124	7.44	801	46.70
	6	735	70.55	33	3.24	768	73.79
	7	335	48.91	85	12.75	420	61.66
	8	104	21.95	84	18.22	188	40.17
	9	13	3.80	44	13.30	57	17.10
	10	5	1.97	30	12.21	35	14.18
	11	...	...	22	11.74	22	11.74
	12	...	...	8	5.44	8	5.44
	13+	...	...	28	35.87	28	35.87
Total		7,906	304.19	1,264	143.82	9,170	448.01
Pounds per acre			10.22		4.83		15.05

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

Table 10.--Estimated numbers and weights of trout, by species and lengths, in the experimental sections of the Pigeon River in the fall of 1964 (after close of the trout fishing season)

Stream section	Inch group[1]	Brook trout		Brown trout		Total	
		Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)
A	1	1	tr[2]	...	...	1	tr[2]
	2	892	5.35	153	0.92	1,045	6.27
	3	868	13.02	469	7.50	1,337	20.52
	4	51	1.63	65	2.21	116	3.84
	5	177	10.27	5	0.30	182	10.57
	6	131	12.58	35	3.43	166	16.01
	7	41	5.99	43	6.45	84	12.44
	8	18	3.80	18	3.91	36	7.71
	9	4	1.17	16	4.83	20	6.00
	10	10	3.94	11	4.48	21	8.42
	11	1	0.52	8	4.26	9	4.78
	12	...	...	6	4.09	6	4.09
	13+	...	...	22	30.57	22	30.57
Total		2,194	58.27	851	72.95	3,045	131.22
Pounds per acre			8.14		10.19		18.33
B	1	5	0.01	...	...	5	0.01
	2	2,135	12.81	238	1.43	2,373	14.24
	3	2,122	31.83	576	9.22	2,698	41.05
	4	208	6.66	46	1.56	254	8.22
	5	277	16.07	2	0.12	279	16.19
	6	169	16.22	30	2.94	199	19.16
	7	32	4.67	58	8.70	90	13.37
	8	14	2.95	18	3.91	32	6.86
	9	4	1.17	10	3.02	14	4.19
	10	2	0.79	4	1.63	6	2.42
	11	2	1.03	18	9.59	20	10.62
	12	1	0.66	6	4.09	7	4.75
	13+	1	0.83	23	34.40	24	35.23
Total		4,972	95.70	1,029	80.61	6,001	176.31
Pounds per acre			16.22		13.66		29.88
C	1	...	...	...	...	...	...
	2	2,372	14.23	70	0.42	2,442	14.65
	3	2,946	44.19	611	9.78	3,557	53.97
	4	254	8.13	216	7.34	470	15.47
	5	487	28.25	7	0.42	494	28.67
	6	278	26.69	29	2.84	307	29.53
	7	143	20.88	84	12.60	227	33.48
	8	76	16.04	21	4.56	97	20.60
	9	17	4.98	6	1.81	23	6.79
	10	5	1.97	14	5.70	19	7.67
	11	1	0.52	4	2.13	5	2.65
	12	2	1.32	3	2.05	5	3.37
	13+	1	1.02	18	26.85	19	27.87
Total		6,582	168.22	1,083	76.50	7,665	244.72
Pounds per acre			31.20		14.19		45.39

(continued)

Table 10.--concluded

Stream section	Inch group[1]	Brook trout Number	Brook trout Weight (pounds)	Brown trout Number	Brown trout Weight (pounds)	Total Number	Total Weight (pounds)
D	1	...	...	...	...	...	...
	2	977	5.86	12	0.07	989	5.93
	3	2,109	31.64	90	1.44	2,199	33.08
	4	224	7.17	76	2.58	300	9.75
	5	503	29.17	2	0.12	505	29.29
	6	380	36.48	17	1.67	397	38.15
	7	175	25.55	55	8.25	230	33.80
	8	70	14.77	23	4.99	93	19.76
	9	38	11.13	7	2.11	45	13.24
	10	12	4.73	4	1.63	16	6.36
	11	8	4.12	4	2.13	12	6.25
	12	5	3.30	10	6.82	15	10.12
	13+	1	1.56	13	22.85	14	24.41
Total		4,502	175.48	313	54.66	4,815	230.14
Pounds per acre			31.06		9.67		40.73
E	1	...	...	...	...	...	...
	2	553	3.32	1	0.01	554	3.33
	3	1,152	17.28	24	0.38	1,176	17.66
	4	174	5.57	38	1.29	212	6.86
	5	307	17.81	...	...	307	17.81
	6	327	31.39	8	0.78	335	32.17
	7	78	11.38	25	3.75	103	15.13
	8	18	3.80	52	11.28	70	15.08
	9	6	1.76	11	3.32	17	5.08
	10	9	3.55	1	0.41	10	3.96
	11	2	1.03	4	2.13	6	3.16
	12	...	...	16	10.91	16	10.91
	13+	...	...	15	15.29	15	15.29
Total		2,626	96.89	195	49.55	2,821	146.44
Pounds per acre			17.09		8.74		25.83
All sections	1	6	0.01	...	...	6	0.01
	2	6,929	41.57	474	2.85	7,403	44.42
	3	9,197	137.96	1,770	28.32	10,967	166.28
	4	911	29.16	441	14.98	1,352	44.14
	5	1,751	101.57	16	0.96	1,767	102.53
	6	1,285	123.36	119	11.66	1,404	135.02
	7	469	68.47	265	39.75	734	108.22
	8	196	41.36	132	28.65	328	70.01
	9	69	20.21	50	15.09	119	35.30
	10	38	14.98	34	13.85	72	28.83
	11	14	7.22	38	20.24	52	27.46
	12	8	5.28	41	27.96	49	33.24
	13+	3	3.41	91	129.96	94	133.37
Total		20,876	594.56	3,471	334.27	24,347	928.83
Pounds per acre			19.97		11.23		31.20

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

[2] tr indicates weight less than 0.006 pound.

Table 11.--Anglers' catches, and spring and fall population estimates of brook trout in Ford and Hemlock lakes, 1964

[The 95-per cent confidence limits for population estimates are given in parentheses]

Year class	Population estimates and catches[1]					
	Ford Lake			Hemlock Lake		
	N_1	C	N_2	N_1	C	N_2
1961	53 (23-160)	32	4 ...	2[2] ...	3	... ...
1962	152 (89-533)	91	19 ...	43 ...	23	6 ...
1963	792 (590-1,152)	79	137 (114-176)	606 (476-781)	169	179 (151-234)
Totals	997	202	160	651	195	185

[1] N_1 = April population estimate, C = catch, N_2 = October population estimate.

[2] Population assumed to have been at least 3.

Table 12.--Age composition of the anglers' catch and average length and weight of age groups for each experimental section, Pigeon River, 1964

Stream section	Species	Age group	Number	Average total length (inches)	Average total weight (pounds)
A	Brook[1]	I	11	7.6	0.16
		II	115	8.4	0.24
		III	12	11.6	0.66
	Brown	I	6	7.7	0.17
		II	6	11.2	0.56
		III	2	12.0	0.64
B	Brook[2]	I	22	7.5	0.15
		II	137	8.0	0.19
		III	5	9.1	0.28
	Brown	I	9	8.1	0.18
		II	18	9.5	0.34
		III	6	13.7	1.10
		VI	1	19.5	3.25
		VIII	1	26.8	6.81
C	Brook	II	10	9.3	0.29
		III	7	9.4	0.32
	Brown[1]	I	1	9.0	0.25
		II	9	9.9	0.36
		III	3	14.7	1.24
D	Brook	II	12	9.4	0.33
		III	4	9.7	0.34
	Brown	II	9	11.1	0.52
E	Brook[1]	I	62	7.5	0.14
		II	390	8.0	0.20
		III	36	9.6	0.34
		IV	2	12.4	0.68
	Brown	I	12	8.0	0.18
		II	29	10.3	0.44
		III	9	12.8	0.84
		IV	1	15.3	1.28

[1] Age was not determined for two brook trout in Section A, one brown trout in Section C, and six brook trout in Section E.

[2] One rainbow trout (age I, 7.4 inches, 0.14 pound) was caught in Section B.

Table 13.--Average length and weight for each year class of brook trout in the anglers' catch from Ford and Hemlock lakes, 1964

Lake	Year class	Number of fish	Average total length (inches)	Average total weight (pounds)
Ford	1961	32	10.9	0.50
	1962	91	10.0	0.37
	1963	79	8.2	0.25
Hemlock	1960	1	13.6	1.12
	1961	3	11.7	0.40
	1962	23	11.0	0.56
	1963	169	8.5	0.25

Table 14.--Expectations of death for brook trout in Ford and Hemlock lakes, April to October 1964

Lake	Year class	Total mortality	Rate of exploitation	Natural mortality
Ford	1961	0.92	0.60	0.32
	1962	0.88	0.60	0.28
	1963	0.83	0.10	0.73
Hemlock	1961	1.00	1.00	0.00
	1962	0.86	0.53	0.33
	1963	0.60	0.28	0.32

Table 15.--Number of male and female brook and brown trout in the anglers' catch from each experimental section, Pigeon River, 1964

Section	Age group	Brook trout		Brown trout	
		Male	Female	Male	Female
A	I	6	5	4	2
	II	55	57	1	5
	III	8	4	1	1
	Total	69	66	6	8
B	I	17	7	6	2
	II	67	60	10	8
	III	1	2	4	2
	VI	...	...	...	1
	VIII	...	...	...	1
	Total	85	69	20	14
C	I	...	...	...	1
	II	6	5	4	4
	III	1	4	3	...
	Total	7	9	7	5
D	I	...	...	...	...
	II	6	9	2	7
	III	3	1	...	...
	Total	9	10	2	7
E	I	55	23	8	4
	II	195	199	16	13
	III	16	20	5	4
	IV	...	2	...	1
	Total	266	244	29	22

Table 16.--Mean number of gill lice per brook trout of the 1963 year class from Pigeon River lakes, 1964

Month	Lakes					
	Ford	Hemlock	Lost	West Lost	North Twin	South Twin
January	0.7	2.8	3.5	12.3	18.4	2.0
February	0.8	5.4	2.6	11.8	24.2	3.3
March	1.0	3.9	4.0	16.2	25.4	4.8
April	1.4	6.5	1.8	21.4	23.8	5.8
May	4.0	7.7	4.2	25.9	33.2	10.5
June	6.0	9.3	2.8	34.0	43.1	24.2
July	4.5	17.8	3.1	51.4	50.4	35.5
August	0.0	34.7	3.5	66.2	48.0	52.5
September	0.0	38.2	1.5	53.2	52.8	27.5
October	0.0	43.3	5.7	64.1	72.9	46.3
November	0.0	51.1	14.1	84.4	83.3	84.9
December	0.0	56.8	10.7	117.7	86.0	98.2