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MICHIGAN DEPARTMENT OF CONSERVATION
Research and Development Report No. 10*

July 28, 1964

THE FIFTEENTH ANNUAL CREEL CENSUS AND
PROGRESS REPORT, PIGEON RIVER TROUT
RESEARCH STATION, 1963

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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 (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 stream section to about 6 miles. The physical features of the stream sections are given 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

* Institute for Fisheries Research Report No. 1695.

¹ Contribution from Dingell-Johnson Project F-27-R Michigan.

MICHIGAN DEPARTMENT OF CONSERVATION
FISH DIVISION
PIGEON RIVER TROUT RESEARCH AREA
OTSEGO AND CHEBOYGAN COUNTIES

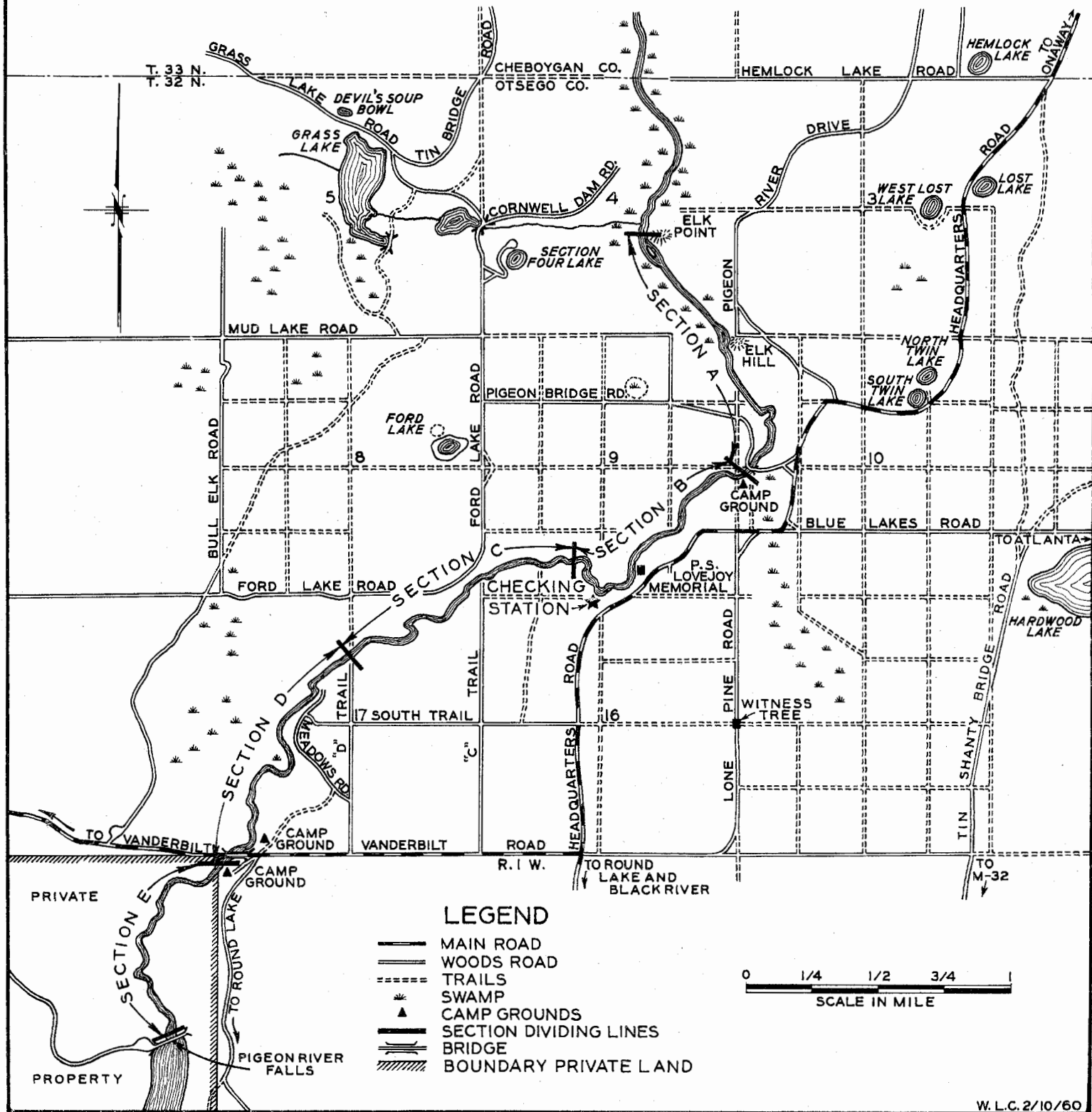


Figure 1

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.

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.

before proceeding 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, and manipulation of the environment, as well as to provide information concerning the basic biology of trout. The compulsory permit system assures a complete, or nearly complete census, and provides information which could not be obtained otherwise. Previous annual creel census and progress 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 all fishing in lakes is for hatchery trout.

During 1963 the station was under the supervision of the author. Other permanent staff included Gerald F. Myers, Harold H. Brado and Doyle E. Edson. Kiyoshi G. Fukano helped with the pre-season population estimates and the creel census during the first 2 days of the fishing season. Several other Institute personnel assisted during

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

the preseason and postseason population estimates. 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-27-R) is: Development and Evaluation of Trout Management Techniques. The general objective is to evaluate the effects on the catch and standing crop of trout which are caused by (1) physical changes in a trout-stream environment, (2) changes in fishing regulations, and (3) changes in number, size and time of planting trout in lakes. Seven techniques (predominantly creel census and population studies) are used to collect data for the evaluations. The data collected under each technique will be presented first and then the various jobs of the project will be reviewed utilizing these data where they are pertinent. The techniques and a summary of the data are as follows:

- (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 lakes are summarized in Table 2 to aid in interpretation of the creel census and the population estimates.

Catch statistics for 1963 for the stream sections are presented in Table 3.³ The catch of 807 trout was considerably lower than the average catch (since 1953) of about 1,000 fish per year. Section E, with

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.

the normal fishing regulations, produced the most fish: 383 of the 807 trout caught. Sections C and D, with the higher size limit and flies-only regulation, produced the fewest fish: 27 and 30 trout, respectively. Total number of fishing trips increased from 1,776 in 1962, to 1,890 in 1963, and total hours fished increased from 4,692.0 to 5,094.5. The average number of trout caught per hour decreased from 0.20 trout in 1962 to 0.13 trout in 1963.

Fishing success during weekly periods is given in Table 4; it was best during the middle 2 weeks of May and poorest during late July and early August.

Most of the anglers fishing the Pigeon River came from Wayne County (Table 5). Of the 83 counties in Michigan, 56 were represented by at least one angler; 8 other states, Ontario and Washington, D. C. 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. 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. 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 fry for the lake) each spring through 1961. In 1962, Section 4

Lake was used in an experiment to measure the food consumption of the Common Merganser (Latta and Sharkey, 1963). The brook trout population was prey for the predatory merganser. In July, 1962, after the merganser experiment, Section 4 Lake was planted with 400 brook trout (longer than 7 inches) to test the comparative survival of two strains (Michigan and Pennsylvania) and inter-strain crosses of brook trout. No plantings were made in Section 4 Lake in 1963; the quality of the fishing decreased markedly. In 1963, North Twin and South Twin lakes were also involved in a merganser-brook trout experiment which probably resulted in a decrease in the quality of the angling on these two lakes (see Job No. 7). On Ford Lake, under a flies-only regulation, the average catch per hour per trip in 1963 was 0.40 trout--slightly higher than the 0.37 trout recorded in 1962. Fishing success for all the lakes combined, as measured by average catch per hour per trip, was 0.21 trout; this was slightly lower than the 0.26 trout caught in 1962. Total fishing trips and hours fished decreased from 1,561 trips and 4,271.5 hours in 1962 to 1,553 trips and 4,195.0 hours in 1963.

Residence of anglers who fished the lakes in 1963 is given in Table 7. Most of the anglers fishing the lakes were local residents from Otsego County; Muskegon County was second. Fifty-one counties of Michigan and six states contributed at least one angler.

Numbers of fishing trips made to the experimental waters, river and lakes, by licensed and non-licensed anglers, i. e., wives and minors, are given in Table 8. Licensed anglers accounted for 68.2%

of the fishing on the stream; 66.7% of the fishing on the lakes. Michigan residents did 84.3% of the stream fishing and 94.8% 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 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 was found (based on the calculated weight at each 0.1 inch). The length-weight relationships of Pigeon River trout as described by Cooper and Benson (1951) was the basis of the calculations.

Results of the 1963 spring population estimates, by stream section, species, and 1-inch groups of trout, are presented in Table 9. Inch groups above 12 inches were kept separate for population estimates, but are grouped in the table. The total population for the 6 miles of river was 11,237 trout (10,341 brook trout and 896 brown trout) or 15.55 pounds of trout per acre.

Results of the 1963 fall population estimates are presented in Table 10. The total population was 18,937 trout (16,656 brook trout and 2,281 brown trout) or 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, 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 1963 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-olds predominated in the catch.

Annual expectations of death (total mortality, rate of exploitation, and natural mortality) for brook trout and brown trout in the experimental sections of the Pigeon River, from fall of 1962 to the fall of 1963, are given in Table 13.

The age distributions of fish in the spring and fall population estimates were determined from scale collections (15 scale samples for each inch group of each species) taken at the time of the estimates.

(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 14.

Annual expectations of death (mortality rates) for brook trout in Ford and Hemlock lakes, April to October, 1963, are presented in Table 15. These figures are based on estimates of population size calculated in (4) and creel census in (2) (Table 11).

(7) Mark hatchery trout for planting in lakes

The lakes were stocked with 3,610 brook trout in November, 1963. The planted trout were from 5 to 6 inches long, and were marked by a clip of the right ventral fin and right maxillary bone.

A brief review of the progress made on each job follows:

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 was made 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 as trout habitat by the addition of log cover, deflectors, and so forth (30 structures); Section B--unimproved--was studied as a control. 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 stream 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 re-create in Section A the conditions which prevailed prior to improvement in 1953. Section B was left in its natural state to serve 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, 1961b). In August, 1964, the sample areas will be mapped again.

Because the de-improvement took place during the fishing season of 1959, the data for this year have been excluded from the evaluation. The data on anglers' catch and fall populations are compared for the three periods: before improvement (1949-53), improved years (1954-58), and de-improved years (1960-63). The data for each year are expressed as an A:B ratio (the value for Section A related to the value for Section B). Based on means of ratios, tentative conclusions are:

- (1) the brook trout catch in the "de-improved" years was similar to the catch in the "before" years but less than in the "improved" years;
- (2) the brook trout fall population in the "de-improved" years was lower than in either the "before" or "improved" years;
- (3) the brown trout catch in the "de-improved" years was higher than in either the "before" or "improved" years;
- (4) the brown trout population in the "de-improved" years was similar to that in the "improved" years, higher than in "before" years.

Fishing pressure and catch per hour per trip (mean ratios) were the same in the "de-improved" years as in the "improved" years. A final report will be prepared at the end of the 1964 season; 1964 is the

final year of the present cycle in the study. For the present progress report, the comparisons of mean ratios, summarized above, have not been tested statistically.

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

for the years 1955-57 (with any lure) was compared statistically with that for the years 1955-62 (artificial flies only). Only in hours of fishing and in number of fishing trips were there significant differences. Under flies-only there was less fishing pressure and fewer fishing trips. It could not be shown that there was a difference in quality of the fishing or in any aspect of the fall standing crop. However, these are tentative conclusions. The final analysis and report will be made in 1964.

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

Since 1955, only the commonly accepted wet or dry fly has been used as lure in Ford Lake. The effects of the regulation on angling and on the trout population in the lake have been evaluated through 1962 (Latta, 1963b). Hemlock Lake was used as a control. In Hemlock Lake anglers could use any bait except minnows. Although the use of artificial fly as a lure reduces mortality from hooking, apparently in Ford Lake mortality from other sources was great enough to offset the survival gained by using only flies. There was no indication of increased survival either in percentage of return from a year class or in a comparison of natural mortality rates for the first summer in the lake (the time when the brook trout are of sublegal size and growing into the catch). The quality of the fishing (in catch per hour) was higher on Ford

Lake than on the control lake (also higher than in the other experimental lakes in the area), but this was a result of the lower fishing pressure. The better fishing on Ford Lake did not attract fishermen from the other lakes. The difference in fishing pressure (hours per acre) between Ford and Hemlock lakes was considerable (48.5 as compared to 147.6 hours).

Conclusions, based on the data for 1963, are essentially the same as for the previous years.

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

The fish populations in all of the experimental lakes in the Pigeon River area were poisoned in the early 1950's. Trout spawning is unsuccessful in these lakes, and the fishery has been maintained by annual fall plantings of brook trout. The initial planting rate was about 500 brook trout per acre (fish in age-group 0, average length about 4 inches). The exception was Section 4 Lake which was planted each spring with about 1,000 brook trout fry per acre (see technique (2) above). In 1957, the fall planting of fingerlings in all lakes except Section 4 was reduced to 100 per acre. In 1956, with an improvement in the hatchery diet, the brook trout averaged more than 4 inches by autumn, and since then 5- to 6-inch trout (average total length about 5.5 inches) have been selected for planting each year.

With the increase in 1956 of size of trout planted and a decrease in 1957 of number planted per acre, there has been an approximate doubling of percentage of a year class caught by anglers--both in numbers and pounds. However, the actual number and weight harvested from a year class is generally less now than under the previous planting program. The total number caught in recent years is about one half as great as in years prior to the changes in planting program; weight is about three quarters as great. A more detailed report on this study will be prepared.

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 leads were investigated:

(1) The relationship of abundance of young-of-the-year trout to mature trout and ground water in the Pigeon River was studied, and a resulting manuscript has been accepted for publication in the Transactions of the American Fisheries Society. For the brook trout, there was little indication that the number of potential spawners influenced the number of young-of-the-year trout present in the fall, but there was good indication that high ground water level was accompanied by larger numbers of young-of-the-year brook trout. Apparently, neither ground water levels

nor number of mature trout influenced the number of young-of-the-year brown trout present each September.

(2) During the 1963 fishing season, as in 1962, the sex was determined of most of the trout examined in the creel census in order to determine if natural mortality was greater for one sex than the other (Table 16). Apparently, the brook trout in the catch do not vary from a 1:1 ratio of males to females. The faster growing males enter the catch in greater numbers than the slower growing females during the second summer of life (age-group I) but the females enter the catch in greater numbers during the third summer of life (age-group II). The brown trout in the catch appear to vary from the expected 1:1 ratio in favor of the males; however, this may have been caused by some mis-identification of immature females as males.

(3) In order to measure the effects of merganser predation on brook trout populations in lakes and on the fishing quality, six Common Mergansers were wing-clipped and released, three on North Twin and three on South Twin lakes. West Lost and Lost lakes were designated as the 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. Samples of trout were taken by fishing and with a direct-current electric shocker. The mergansers were released April 17 before the fishing season and removed 19 days later on May 6. One merganser on South Twin Lake was killed by a predator on May 5. An unsuccessful attempt was made to estimate the population size of

brook trout immediately after the mergansers were removed from the lakes. A summary of the spring and fall population estimates, catch and natural loss of brook trout in the lakes, with and without merganser predation, is provided in Table 17. The creel census and the population data have not been analyzed completely but it appears that merganser predation did adversely affect the fishing quality (Table 6); however, the natural loss in the control lakes was considerable (Table 17). A more detailed report will be prepared.

(4) Because of an unexplained natural loss of trout in the control lakes (no predators were observed on these lakes), other sources of mortality were sought. Brook trout in the Pigeon River lakes are infested with the gill louse (Salmincola edwardsii). In hatcheries, under high population densities of brook trout, the gill louse is a common cause of mortality. Little is known of the biology of this parasite in a natural environment. In cooperation with L. N. Allison, fish pathologist, an investigation was started on the biology of the gill louse in the Pigeon River lakes, its effect on the host, and its relationship to environmental factors (D-J Work Plan No. 10).

(5) After capture, and prior to their release on North Twin and South Twin lakes, the six Common Mergansers were held in captivity at the Oden State Fish Hatchery. Time in captivity ranged from 49 to 69 days. Observations of the feeding behavior of the mergansers in a series of tests indicated that they consume smaller trout before they take larger ones, that the largest size of trout eaten is determined by the size of

the merganser and the girth of the prey, and that they do not choose between minnows and trout as prey. They consumed 15.3 to 19.5% of their body weight per day. A more detailed report on this study has been prepared.

Literature cited

- Bacon, E. H., D. S. Shetter, and G. P. Cooper. 1958. Third, fourth, and fifth annual reports of the Pigeon River Trout Research Station for 1951, 1952 and 1953. Mich. Inst. Fish. Res. Rept. 1544, unpublished, 45 p.
- Clopper, C. J., and E. S. Pearson. 1934. The use of confidence or fiducial limits applied to the case of the binomial. *Biometrika*, 26: 404-413.
- Cooper, Edwin L. 1950. Pigeon River Trout Research Area initial report of fishing, 1949. Mich. Inst. Fish. Res. Rept. 1250, unpublished, 53 p.
- _____. 1951. Pigeon River Trout Research Area second annual report of fishing, 1950. Mich. Inst. Fish. Res. Rept. 1288, unpublished, 81 p.
- _____. 1952. Rate of exploitation of wild eastern brook trout and brown trout populations in the Pigeon River, Otsego County, Michigan. *Trans. Am. Fisheries Soc.*, 81(1951): 224-234.
- Cooper, Edwin L., and Norman G. Benson. 1951. The coefficient of condition of brook, brown and rainbow trout in the Pigeon River, Otsego County, Michigan. *Prog. Fish-Cult.*, 13(4): 181-192.
- Latta, William C. 1959a. The ninth annual creel census, Pigeon River Trout Research Station, 1957. Mich. Inst. Fish. Res. Rept. 1560, unpublished, 29 p.

Latta, William C. 1959b. The tenth annual creel census, Pigeon River Trout Research Station, 1958. Mich. Inst. Fish. Res. Rept. 1568, unpublished, 30 p.

_____. 1960. The effects of stream improvement upon the anglers' catch and standing crop of trout in the Pigeon River, Otsego County, Michigan. Mich. Inst. Fish. Res. Rept. 1608, unpublished, 49 p.

_____. 1961a. The eleventh annual creel census, Pigeon River Trout Research Station, 1959. Mich. Inst. Fish. Res. Rept. 1611, unpublished, 26 p.

_____. 1961b. The twelfth annual creel census and progress report, Pigeon River Trout Research Station, 1960. Mich. Inst. Fish. Res. Rept. 1632, unpublished, 43 p.

_____. 1962. The thirteenth annual creel census and progress report, Pigeon River Trout Research Station, 1961. Mich. Inst. Fish. Res. Rept. 1647, unpublished, 32 p.

_____. 1963a. The fourteenth annual creel census and progress report, Pigeon River Trout Research Station, 1962. Mich. Inst. Fish. Res. Rept. 1676, unpublished, 34 p.

_____. 1963b. Effects of a flies-only regulation on angling and trout populations in Ford Lake, Otsego County, Michigan. Mich. Inst. Fish. Res. Rept. 1678, unpublished, 26 p.

Latta, William C., and Reginald F. Sharkey. 1963. Food consumption of the American Merganser. Mich. Inst. Fish. Res. Rept. 1661, unpublished, 25 p.

Ricker, W. E. 1958. Handbook of computations for biological statistics of fish populations. Fish. Res. Bd. Canada, Bull. 119, 300 p.

Waters, Thomas F. 1957a. Report of sixth annual creel census, Pigeon River Trout Research Station, 1954. Mich. Inst. Fish. Res. Rept. 1512, unpublished, 33 p.

_____. 1957b. The seventh annual creel census, Pigeon River Trout Research Station, 1955. Mich. Inst. Fish. Res. Rept. 1521, unpublished, 27 p.

_____. 1957c. The eighth annual creel census, Pigeon River Trout Research Station, 1956. Mich. Inst. Fish. Res. Rept. 1527, unpublished, 28 p.

INSTITUTE FOR FISHERIES RESEARCH

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Report approved by G. P. Cooper

Typed by M. S. McClure

Table 1. --Morphometry of experimental stream sections,
Pigeon River Trout Research Station¹

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

¹Data 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, 1949-1963

Years	Water and regulation ¹						Lakes	
	Stream sections							
	A, B		C, D		E ²			
	Creel limit (trout per day)	Mini- mum legal length (inches)	Creel limit (trout per day)	Mini- mum legal length (inches)	Creel limit (trout per day)	Mini- mum legal length (inches)	Creel limit (trout per day)	Mini- mum 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
1955-63	5	7	5	9	10	7	5	7

¹ Lure was restricted to artificial flies only in Sections C and D in 1958-63 and in Ford Lake in 1955-63. 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, 1963

Stream sections	Fishing trips		Total hours fished	Average number of trout caught per hour per trip
	Number	Percentage successful		
A	508	17.3	1,222.0	0.13
B	474	23.4	1,169.5	0.15
C	185	11.9	482.0	0.05
D	225	8.9	679.0	0.04
E	498	30.3	1,542.0	0.20
Total	1,890	20.7	5,094.5	0.13

Stream sections	Anglers' catch					
	Brook trout		Brown trout		Total	
	Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)
A	151	36.86	21	10.13	173 [↓]	47.11 [↓]
B	170	32.78	24	7.22	194	40.00
C	14	4.70	13	6.55	27	11.25
D	20	6.86	10	9.24	30	16.10
E	334	73.34	49	21.83	383	95.17
Total	689	154.54	117	54.97	807 [↓]	209.63 [↓]

[↓] One rainbow trout weighing 0.12 pound was added to the totals.

Table 4. --Fishing success, and total weight of anglers' catch during weekly periods, Pigeon River, 1963

Dates	Fishing trips		Trout caught						Hours fished	Average number of trout caught per hour per trip
	Num-ber	Percent- age success- ful	Brook		Brown		Total			
			Num-ber	Weight (pounds)	Num-ber	Weight (pounds)	Num-ber	Weight (pounds)		
April 27-May 3	138	31.9	116	22.23	2	0.54	118	22.77	476.0	0.22
May 4-May 10	60	20.0	22	4.37	2	1.24	24	5.61	149.0	0.14
May 11-May 17	50	26.0	42	8.41	2	0.80	44	9.21	146.0	0.26
May 18-May 24	89	36.0	57	10.12	6	3.96	63	14.08	221.5	0.25
May 25-May 31	130	20.8	38	7.00	1	0.28	39	7.28	341.0	0.12
June 1-June 7	109	17.4	21	3.87	6	2.36	27	6.23	260.0	0.07
June 8-June 14	56	16.1	12	2.28	3	1.18	15	3.46	164.5	0.07
June 15-June 21	113	29.2	59	15.36	6	1.84	65	17.20	319.0	0.21
June 22-June 28	91	35.2	53	16.20	14	13.02	67	29.22	260.0	0.23
June 29-July 5	111	15.3	15	5.58	15	6.30	30	11.88	233.0	0.11
July 6-July 12	114	24.6	43	11.42	11	6.40	54	17.82	311.0	0.16
July 13-July 19	127	10.2	9	2.04	4	1.30	14 [↓]	3.46 [↓]	350.5	0.04
July 20-July 26	107	9.3	12	2.00	5	2.22	17	4.22	212.5	0.08
July 27-Aug. 2	132	12.1	25	6.30	5	2.53	30	8.83	321.0	0.06
Aug. 3-Aug. 9	83	8.4	7	1.92	1	0.59	8	2.51	216.5	0.03
Aug. 10-Aug. 16	78	14.1	14	2.92	4	1.90	18	4.82	228.5	0.06
Aug. 17-Aug. 23	122	26.2	60	13.94	12	3.90	72	17.84	351.0	0.18
Aug. 24-Aug. 30	88	29.5	56	12.38	15	3.42	71	15.80	280.5	0.22
Aug. 31-Sept. 6	80	12.5	23	5.14	3	1.20	26	6.34	217.0	0.07
Sept. 7-Sept. 8	12	8.3	5	1.06	0	0.00	5	1.06	36.0	0.07
Total	1,890	20.7	689	154.54	117	54.98	807 [↓]	209.64 [↓]	5,094.5	0.13

[↓] One rainbow trout weighing 0.12 pound was added to the totals.

Table 5. --Residence of anglers who fished the experimental sections of the Pigeon River in 1963

County	Number of fishing trips	County	Number of fishing trips	County or state	Number of fishing trips
Wayne	302	Lenawee	12	Osceola	2
Oakland	218	Presque Isle	11	Sanilac	2
Ingham	134	St. Clair	11	Wexford	2
Genesee	130	Ottawa	10	Eaton	1
Washtenaw	126	Mecosta	9	Grand Traverse	1
Bay	79	Tuscola	9	Hillsdale	1
Otsego	73	Berrien	8	Leelanau	1
Macomb	37	Emmet	7	Missaukee	1
Saginaw	35	Lapeer	7	Ogemaw	1
Midland	33	Isabella	5	Oscoda	1
Muskegon	33	Montcalm	5	Michigan total	1,593
Kalamazoo	32	Antrim	4	Ohio	206
Calhoun	27	Ionia	4	Indiana	50
Kent	25	Monroe	4	Illinois	16
Branch	24	Montmorency	4	Ontario	9
Alpena	22	Arenac	3	Pennsylvania	5
Livingston	21	Charlevoix	3	Florida	4
Cheboygan	19	Iosco	3	Kentucky	2
Barry	18	Clare	2	New York	2
Shiawassee	18	Clinton	2	Washington, D. C.	2
Gratiot	16	Crawford	2	California	1
Jackson	15	Gladwin	2	Nonresident	
Roscommon	14	Mason	2	Total	297
				Total	1,890

Table 6. --Results of creel census on lakes of the Pigeon River Trout
 Research Station, 1963
 (Only brook trout were caught)

Lake	Fishing trips		Trout caught		Hours fished	Average number of fish caught per hour per trip
	Num- ber	Percent- age success- ful	Num- ber (pounds)	Weight		
Ford	238	38.2	226	66.26	572.5	0.40
Section 4	191	18.3	78	25.76	446.5	0.14
Hemlock	320	39.7	346	105.68	1,170.0	0.24
Lost	129	35.7	91	14.91	348.0	0.20
West Lost	264	25.0	132	42.36	705.0	0.17
North Twin	190	16.3	65	34.40	492.5	0.12
South Twin	221	15.8	89	38.18	460.5	0.13
Total	1,553	27.8	1,027	327.56	4,195.0	0.21

Table 7. --Residence of anglers who fished the Pigeon River lakes in 1963

County	Number of fishing trips	County	Number of fishing trips	County or state	Number of fishing trips
Otsego	144	Huron	11	Mecosta	3
Muskegon	141	Arenac	10	Barry	2
Ingham	112	Calhoun	10	Berrien	2
Oakland	110	Ottawa	9	Grand Traverse	2
Wayne	100	Roscommon	9	Oscoda	2
Kent	72	Clare	8	St. Joseph	2
Gratiot	65	Eaton	8	Antrim	1
Washtenaw	63	Ionia	7	Branch	1
Saginaw	61	Montcalm	7	Marquette	1
Genesee	60	Tuscola	7	Van Buren	1
Shiawassee	57	Emmet	6	Wexford	1
Bay	56	Livingston	6	Michigan total	1,472
Cheboygan	56	Ogemaw	6	Ohio	63
Alpena	49	St. Clair	6	Indiana	8
Charlevoix	37	Clinton	5	Pennsylvania	5
Midland	37	Jackson	5	Kansas	2
Presque Isle	34	Kalamazoo	5	Tennessee	2
Macomb	24	Montmorency	5	Florida	1
Isabella	20	Oceana	5	Nonresident total	81
Lenawee	17	Monroe	4	Total	1,553

Table 8. --Number of anglers of different classes who fished in
experimental waters of the Pigeon River in 1963

(Percentages in parentheses)

Residence	Licensed males	Licensed females	Wives	Minor males	Minor females	Total
<u>STREAM</u>						
Resident	1,056	5	140	317	75	1,593 (84.3)
Nonresident	197	30	...	49	21	297 (15.7)
Total	1,253 (66.3)	35 (1.9)	140 (7.4)	366 (19.4)	96 (5.1)	1,890
<u>LAKES</u>						
Resident	970	4	187	267	44	1,472 (94.8)
Nonresident	60	2	1	13	5	81 (5.2)
Total	1,030 (66.3)	6 (0.4)	188 (12.1)	280 (18.0)	49 (3.2)	1,553

Table 9. --Estimated numbers and weights of trout of different species and lengths in the experimental sections of the Pigeon River in the spring of 1963

(Before opening of the trout fishing season)							
Stream section	Inch group ↓	Brook trout		Brown trout		Total	
		Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)
A	2	15	0.09	...	...	15	0.09
	3	436	6.54	39	0.62	475	7.16
	4	687	21.98	150	5.10	837	27.08
	5	189	10.96	24	1.44	213	12.40
	6	98	9.41	15	1.47	113	10.88
	7	51	7.45	21	3.15	72	10.60
	8	5	1.06	17	3.69	22	4.75
	9	1	0.29	6	1.81	7	2.10
	10	1	0.39	3	1.22	4	1.61
	11	...	...	1	0.53	1	0.53
	12+	...	...	11	12.30	11	12.30
	Total		1,483	58.17	287	31.33	1,770	89.50
Pounds per acre			8.13		4.38		12.51
B	2	43	0.26	2	0.01	45	0.27
	3	884	13.26	28	0.45	912	13.71
	4	780	24.96	107	3.64	887	28.60
	5	195	11.31	52	3.12	247	14.43
	6	81	7.78	7	0.69	88	8.47
	7	50	7.30	37	5.55	87	12.85
	8	5	1.06	12	2.60	17	3.66
	9	1	0.29	7	2.11	8	2.40
	10	1	0.39	4	1.63	5	2.02
	11	1	0.52	...	...	1	0.52
	12+	...	...	6	7.85	6	7.85
	Total		2,041	67.13	262	27.65	2,303	94.78
Pounds per acre			11.38		4.69		16.07
C	2	27	0.16	...	...	27	0.16
	3	1,129	16.94	9	0.14	1,138	17.08
	4	1,035	33.12	79	2.69	1,114	35.81
	5	201	11.66	35	2.10	236	13.76
	6	127	12.19	5	0.49	132	12.68
	7	67	9.78	14	2.10	81	11.88
	8	10	2.11	16	3.47	26	5.58
	9	2	0.59	7	2.11	9	2.70
	10	...	...	...	...	...	...
	11	...	...	1	0.53	1	0.53
	12+	...	...	2	1.36	2	1.36
	Total		2,598	86.55	168	14.99	2,766	101.54
Pounds per acre			16.06		2.78		18.84

Table 9. --continued

Stream section	Inch groups ¹	Brook trout		Brown trout		Total	
		Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)
D	2	8	0.05	...	...	8	0.05
	3	852	12.78	5	0.08	857	12.86
	4	1,172	37.50	79	2.69	1,251	40.19
	5	230	13.34	19	1.14	249	14.48
	6	148	14.21	...	...	148	14.21
	7	39	5.69	8	1.20	47	6.89
	8	7	1.48	6	1.30	13	2.78
	9	1	0.29	3	0.91	4	1.20
	10	2	0.79	2	0.81	4	1.60
	11	...	...	1	0.53	1	0.53
	12+	...	...	1	2.18	1	2.18
	Total		2,459	86.13	124	10.84	2,583	96.97
Pounds per acre			15.25		1.92		17.17
E	2	5	0.03	...	...	5	0.03
	3	441	6.62	2	0.03	443	6.65
	4	929	29.73	34	1.16	963	30.89
	5	196	11.37	10	0.60	206	11.97
	6	113	10.85	1	0.10	114	10.95
	7	60	8.76	1	0.15	61	8.91
	8	14	2.95	1	0.22	15	3.17
	9	1	0.29	2	0.60	3	0.89
	10	1	0.39	...	...	1	0.39
	11	...	...	...	...	...	...
	12+	...	...	4	6.12	4	6.12
	Total		1,760	70.99	55	8.98	1,815	79.97
Pounds per acre			12.52		1.58		14.10
All sections	2	98	0.59	2	0.01	100	0.60
	3	3,742	56.14	83	1.32	3,825	57.46
	4	4,603	147.29	449	15.28	5,052	162.57
	5	1,011	58.64	140	8.40	1,151	67.04
	6	567	54.44	28	2.75	595	57.19
	7	267	38.98	81	12.15	348	51.13
	8	41	8.66	52	11.28	93	19.94
	9	6	1.75	25	7.54	31	9.29
	10	5	1.96	9	3.66	14	5.62
	11	1	0.52	3	1.59	4	2.11
	12+	...	...	24	29.81	24	29.81
	Total		10,341	368.97	896	93.79	11,237	462.76
Pounds per acre			12.40		3.15		15.55

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

Table 10. --Estimated numbers and weights of trout of different species and lengths in the experimental sections of the Pigeon River in the fall of 1963

(After close of the trout fishing season)

Stream section	Inch groups ¹ ↓	Brook trout		Brown trout		Total	
		Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)
A	1	2	tr ²	...	...	2	tr ²
	2	529	3.17	40	0.24	569	3.41
	3	361	5.42	414	6.62	775	12.04
	4	64	2.05	59	2.01	123	4.06
	5	208	12.06	5	0.30	213	12.36
	6	173	16.61	38	3.72	211	20.33
	7	39	5.69	47	7.05	86	12.74
	8	15	3.16	16	3.47	31	6.63
	9	4	1.17	8	2.42	12	3.59
	10	11	4.33	15	6.10	26	10.43
	11	...	...	10	5.33	10	5.33
	12+	1	0.83	22	20.22	23	21.05
Total		1,407	54.49	674	57.48	2,081	111.97
Pounds per acre			7.61		8.03		15.64
B	1	3	0.01	...	...	3	0.01
	2	928	5.57	47	0.28	975	5.85
	3	997	14.96	296	4.74	1,293	19.70
	4	148	4.74	73	2.48	221	7.22
	5	461	26.74	9	0.54	470	27.28
	6	254	24.38	32	3.14	286	27.52
	7	40	5.84	53	7.95	93	13.79
	8	15	3.16	13	2.82	28	5.98
	9	4	1.17	14	4.23	18	5.40
	10	3	1.18	5	2.04	8	3.22
	11	...	...	7	3.73	7	3.73
	12+	3	2.32	11	10.86	14	13.18
Total		2,856	90.07	560	42.81	3,416	132.88
Pounds per acre			15.27		7.26		22.53
C	1	8	0.02	...	...	8	0.02
	2	1,367	8.20	82	0.49	1,449	8.69
	3	2,252	33.78	287	4.59	2,539	38.37
	4	293	9.38	72	2.45	365	11.83
	5	811	47.04	6	0.36	817	47.40
	6	444	42.62	26	2.55	470	45.17
	7	106	15.48	49	7.35	155	22.83
	8	37	7.81	13	2.82	50	10.63
	9	18	5.27	11	3.32	29	8.59
	10	5	1.97	10	4.07	15	6.04
	11	4	2.06	4	2.13	8	4.19
	12+	1	1.02	24	42.06	25	43.08
Total		5,346	174.65	584	72.19	5,930	246.84
Pounds per acre			32.40		13.39		45.79

(continued, next page)

Table 10. --continued

Stream section	Inch groups ¹	Brook trout		Brown trout		Total	
		Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)
D	1	2	tr ²	...	...	2	tr ²
	2	753	4.52	6	0.04	759	4.56
	3	1,446	21.69	71	1.14	1,517	22.83
	4	316	10.11	15	0.51	331	10.62
	5	972	56.38	2	0.12	974	56.50
	6	567	54.43	31	3.04	598	57.47
	7	183	26.72	30	4.50	213	31.22
	8	60	12.66	21	4.56	81	17.22
	9	28	8.20	4	1.21	32	9.41
	10	13	5.12	2	0.81	15	5.93
	11	4	2.06	15	8.00	19	10.06
	12+	3	2.51	19	24.70	22	27.21
Total		4,347	204.40	216	48.63	4,563	253.03
Pounds per acre			36.18		8.61		44.79
E	1	...	...	...	...	...	...
	2	531	3.19	4	0.02	535	3.21
	3	1,015	15.22	85	1.36	1,100	16.58
	4	154	4.93	42	1.43	196	6.36
	5	450	26.10	1	0.06	451	26.16
	6	425	40.80	10	0.98	435	41.78
	7	102	14.89	41	6.15	143	21.04
	8	10	2.11	32	6.94	42	9.05
	9	7	2.05	6	1.81	13	3.86
	10	2	0.79	6	2.44	8	3.23
	11	2	1.03	4	2.13	6	3.16
	12+	2	1.32	16	13.88	18	15.20
Total		2,700	112.43	247	37.20	2,947	149.63
Pounds per acre			19.83		6.56		26.39
All sections	1	15	0.03	...	...	15	0.03
	2	4,108	24.65	179	1.07	4,287	25.72
	3	6,071	91.07	1,153	18.45	7,224	109.52
	4	975	31.21	261	8.88	1,236	40.09
	5	2,902	168.32	23	1.38	2,925	169.70
	6	1,863	178.84	137	13.43	2,000	192.27
	7	470	68.62	220	33.00	690	101.62
	8	137	28.90	95	20.61	232	49.51
	9	61	17.86	43	12.99	104	30.85
	10	34	13.39	38	15.46	72	28.85
	11	10	5.15	40	21.32	50	26.47
	12+	10	8.00	92	111.72	102	119.72
Total		16,656	636.04	2,281	258.31	18,937	894.35
Pounds per acre			21.37		8.68		30.05

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, 1963
 [The 95-percent 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
1959	... ²	3	1	...	...	...
			...			
1960	1 ³	12	...	1 ⁴	5	1
		
1961	329 (244-535)	142	75 (55-133)	173 (136-237)	124	6 ...
1962	846 (696-1,078)	69	259 (208-328)	541 (435-729)	217	124 (94-210)
Totals			335			131

¹ N₁ = April population estimate, C = catch, N₂ = October population estimate.

² Minimum estimate; number of fish handled. N₁ assumed to be 4.

³ Minimum estimate; number of fish handled. N₁ assumed to be 12.

⁴ Minimum estimate; number of fish handled. N₁ assumed to be 6.

Table 12. --Age composition of the anglers' catch and average length and weight of age groups for each experimental section, Pigeon River, 1963

Stream section	Species	Age group	Number	Average total length (inches)	Average total weight (pounds)
A	Brook ¹ ²	I	15	7.6	0.16
		II	126	8.5	0.24
		III	9	10.8	0.52
	Brown	I	2	7.4	0.14
		II	17	9.7	0.32
		IV	2	18.0	2.16
B	Brook	I	21	7.5	0.14
		II	147	8.1	0.20
		III	2	9.6	0.35
	Brown	I	7	7.3	0.14
		II	17	9.8	0.37
	C	Brook	II	13	9.7	0.34
III			1	9.8	0.35
Brown		II	12	10.3	0.45
		III	1	14.8	1.19
D		Brook ¹	II	17	9.6	0.33
	III		2	11.0	0.54
	Brown	II	8	11.0	0.52
		IV	1	21.6	3.75
		V	1	15.3	1.34
	E	Brook ¹	I	62	7.3	0.14
II			254	8.4	0.23
III			17	10.3	0.42
Brown		I	21	7.8	0.17
		II	24	11.0	0.51
		III	2	13.4	1.06
		IV	1	15.2	1.06
		V	1	19.9	2.75

¹ Age was not determined for one brook trout in Section A, Section D and Section E.

² One rainbow trout age I, length 7.0 inches and weight 0.12 pound was caught in Section A.

Table 13. --Annual expectations of death for brook trout and brown trout in the experimental sections of the Pigeon River, fall of 1962 to fall of 1963

Section	Total mortality winter, 1962-63		Total mortality, summer, 1963		Rate of exploitation, summer, 1963		Natural mortality, summer, 1963	
	<u>Age group</u>		<u>Age group</u>		<u>Age group</u>		<u>Age group</u>	
	I	II+	I	II+	I	II+	I	II+
BROOK TROUT								
A	... [↓]	0.40	0.63	0.83	0.01	0.53	0.62	0.30
B	0.40	0.60	0.52	0.85	0.01	0.59	0.51	0.26
C	0.51	0.78	0.34	0.44	0.00 ²	0.04	0.34	0.40
D	0.40	0.79	0.21	0.23	0.00 ²	0.06	0.21	0.17
E	0.42	0.79	0.29	... [↓]	0.04	... [↓]	0.25	... [↓]
BROWN TROUT								
A	0.55	0.64	0.52	... [↓]	0.01	... [↓]	0.51	... [↓]
B	0.60	0.61	0.42	0.48	0.04	0.23	0.38	0.25
C	0.78	0.81	0.24	... [↓]	0.00 ²	... [↓]	0.24	... [↓]
D	0.50	0.85	0.16	... [↓]	0.00 ²	... [↓]	0.16	... [↓]
E	0.81	0.94	... [↓]	... [↓]	... ¹	... [↓]	... ¹	... [↓]

[↓] No estimate made because of lack of agreement between size of population and/or catch.

² Under 9-inch minimum size regulation no fish from age-group I are caught.

Table 14. --Average length and weight for each year class
of brook trout in the anglers' catch from Ford and
Hemlock lakes, 1963

Lake	Year class	Number of fish	Average total length (inches)	Average total weight (pounds)
Ford	1959	3	13.1	0.92
	1960	12	11.1	0.53
	1961	142	9.4	0.31
	1962	69	8.1	0.20
Hemlock	1960	5	12.1	0.71
	1961	124	10.0	0.40
	1962	217	8.3	0.24

Table 15. --Annual expectations of death for brook trout
in Ford and Hemlock lakes, April to October, 1963

Lake	Year class	Total mortality	Rate of exploitation	Natural mortality
Ford	1960	1.00	1.00	0.00
	1961	0.77	0.43	0.34
	1962	0.69	0.08	0.61
Hemlock	1960	0.83	0.83	0.00
	1961	0.97	0.72	0.25
	1962	0.77	0.40	0.37

Table 16. --Number of male and female brook and brown trout in the anglers' catch from each experimental section, Pigeon River, 1963

Section	Age group	Brook trout		Brown trout	
		Male	Female	Male	Female
A	I	10	5	1	...
	II	55	68	8	8
	III	4	5	...	...
	IV	...	...	1	1
	Total	69	78	10	9
B	I	13	8	5	2
	II	77	64	8	7
	III	1	1	...	...
	Total	91	73	13	9
C	I	...	...	...	1
	II	11	2	5	6
	III	...	1	...	1
	Total	11	3	5	8
D	I	...	...	...	...
	II	8	10	2	6
	III	2	...	...	...
	IV	...	...	1	...
	V	...	...	...	1
	Total	10	10	3	7
E	I	38	23	13	5
	II	101	149	13	11
	III	5	12	2	...
	IV	...	...	1	...
	V	...	...	1	...
	Total	144	184	30	16

Table 17. --Summary of population estimates, catch, and natural loss of brook trout in lakes with (North Twin, South Twin) and without (West Lost, Lost) Common Merganser predation

Year class	Estimated spring population	Catch	Estimated fall population	Natural loss	Total natural loss per acre
<u>NORTH TWIN LAKE</u>					
1962	478	24	164	290	
1961	219	38	50	131	
1960	20	3	1	16	
Total	717	65	215	437	91
<u>SOUTH TWIN LAKE</u>					
1962	333	30	89	214	
1961	208	50	52	106	
1960	19	6	1	12	
1959	5	2	3	0	
Total	564	88	145	331	85
<u>WEST LOST LAKE</u>					
1962	349	75	124	150	
1961	122	46	37	39	
1960	15	9	3	3	
1959	2	0	0	2	
Total	488	130	164	194	56
<u>LOST LAKE</u>					
1962	441	46	127	268	
1961	91	45	3	43	
1960	1	0	0	1	
Total	533	91	130	312	84