MICHIGAN DEPARTMENT OF CONSERVATION
Research and Development Report No. 94*

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THE SEVENTEENTH ANNUAL CREEL CENSUS AND PROGRESS REPORT, PIGEON RIVER TROUT RESEARCH STATION, 1965 [1]

By William C. Latta

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

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

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 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 fishing in them is for hatchery trout.

During 1965 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. 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 Work Plan in 1965 under the Dingell-Johnson project was Development and Evaluation of Trout

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[2] Numbers 1250, 1288, 1512, 1521, 1527, 1544, 1560, 1568, 1611, 1632, 1647, 1676, 1695 (Research and Development Report No. 10) and 1707 (Research and Development Report No. 45).

Management Techniques. The general objective was 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) were 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 1965 for the stream sections appear in Table 3.[3] The catch of 1, 218 trout was considerably above the average catch (since 1953) of about 1, 000 fish per year. Section E, with the general fishing regulations, produced the most fish: 384 of the 1, 218 trout caught. Sections C and D produced 254 and 260 trout, respectively, as compared to 31 and 25 trout in 1964. The reason for the large increase

[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.

was a liberalization of fishing regulations in 1965. During 1955-64 in Sections C and D, the lure was restricted to artificial flies only and the minimum size limit was 9 inches. In 1965 the flies-only regulation was revoked and the minimum size was reduced to 7 inches. The creel limit of 5 fish per day was retained (Table 2). Total number of fishing trips increased from 2,049 in 1964 to 2,368 in 1965, and the total hours fished increased from 5,179.0 to 6,339.5. The rate of catch of 0.17 trout in 1964 did not change in 1965.

Fishing success during weekly periods is given in Table 4; it was best during the first two weeks in May and poorest during the middle of August.

More than a third of the anglers fishing the Pigeon River came from Wayne, Oakland and Ingham counties (Table 5). Of the 83 counties in Michigan 57 were represented by at least one angler; 16 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 rainbow fry were planted in Section 4 to duplicate the original brook trout plantings. All of the 182 trout caught in 1965, except one brook trout, were returns from the 1964 planting of rainbow trout.

In 1965, the flies-only regulation on Ford Lake was revoked. The catch increased from 202 brook trout in 1964 to 425 brook trout in 1965. The average catch per hour per trip decreased from 0.37 trout to 0.24 trout.

Fishing success for all lakes combined, as measured by average catch per hour per trip, was 0.24 trout, slightly higher than the rate of 0.20 trout for 1964. Total fishing effort increased from 1,475 trips and 3,952.5 hours in 1964 to 1,762 trips and 4,774.5 hours in 1965.

Residence of anglers who fished the lakes in 1965 is given in Table 7. About a third of these anglers were from Wayne, Muskegon and Ingham counties. Fifty-one counties of Michigan and five states contributed at least one angler.

Number 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 68.4% of the fishing on the stream and 66.3% of the fishing on the lakes. Michigan residents did 86.8% of the stream fishing and 96.1% 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).

There has been poor agreement in past years between the population 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. A possible reason for these discrepancies is inaccurate estimates of population size in the spring because of high water and other physical difficulties. In order to check the accuracy of the spring estimate, in April, 1965, instead of estimating the population in the entire experimental section only 500-yard samples were done, then in early June, 1965, the populations

in the 500-yard sections were again estimated. To date these population data have not been compared so no spring estimates are presented here.

Results of the 1965 fall population estimates are presented in Table 9. Inch groups 12 inches and above were kept separate for population estimates but are combined in the table. The total population was determined as 23,656 trout (20,633 brook trout and 3,023 brown trout) or 33.65 pounds per acre. The 1964 fall estimates were 24,347 trout (20,876 brook, 3,471 brown) and 31.20 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 10. Samples of trout for the estimates were taken by fishing with flies, seine, 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 1965 and average total length and weight of each age group for each experimental section

of the Pigeon River are given in Table 11. As in past years, two-year-old fish predominated in the catch.

In 1965 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 if correction factors are devised for the spring 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 12.

Expectations of death (mortality rates) for brook trout in Ford and Hemlock lakes, April to October 1965 are presented in Table 13. These figures are based on estimates of population size and creel census (Table 10).

(7) Mark hatchery trout for planting in lakes

The lakes were stocked with 8, 145 brook trout in November 1965. The fish were from 5 to 6 inches long, and had been marked by clipping the adipose and left pectoral fins. West Lost Lake received

1,750 trout, South Twin 390, North Twin 240, Hemlock 295, Lost 370, and Ford 5,100.

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, in 1960 after de-improvement, and in 1964 at the completion of the study, 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. The square feet of bottom soil types, water depths and cover in the sample segments of Sections A and B, in 1958, 1960 and 1964, are given in Tables 14, 15 and 16. An analysis of changes in these physical characteristics in relation to the trout populations will be made in the final report.

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 were revoked in 1965. Procedure (1) above, "Complete creel census of 6 miles of stream," contains comments on changes in angling brought about by changes in the regulations. No further work was done on this job. A final report will be prepared.

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

In Ford Lake lures were restricted to artificial flies in 1955-64. The flies-only regulation was dropped in 1965. The effects of the special regulation on angling and on the trout population have been evaluated through 1962 (Latta, 1963). A final report to include the data for 1963-65 will be prepared.

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 terminated with 1965 returns. The catch from Section 4 Lake and the other experimental lakes which contain only brook trout are given in Table 6. In 1966 the lakes will be closed to angling. The change in emphasis of the study is described in F-30-R, Job No. 4. A summary of the anglers' catch from plantings through 1965 will be prepared.

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

In order to measure the effects of merganser predation on brook trout populations in lakes and on 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, 1963 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. The creel census provided a complete record of the catch from each lake.

It was calculated that there were more than enough trout for the maximum food requirements of the mergansers on South Twin (61 pounds needed, 71 pounds available) but not enough for those on North Twin (77 pounds needed, 54 pounds available).

The October standing crop of trout in weight and numbers was not appreciably influenced by the merganser predation. The natural mortality from March to October for the lakes with mergansers was 91.1 and 84.7 trout per acre. For the lakes without mergansers it was 49.1 and 83.6 trout per acre. There was no explanation for the high loss of trout from the control lakes.

From 1962 to 1963 the catch numerically decreased about two thirds in North Twin, increased about a third in South Twin, and remained essentially the same in the control lakes, West Lost and Lost. The 1962 year class, presumed to be the most susceptible to merganser predation, contributed only 5.0 and 7.7 trout per acre to the catch from the experimental lakes. The extent of merganser depredation is dependent upon size structure of the trout population, size and number of mergansers

present, and number of days they remain on the lake. Other causes of natural mortality among brook trout in lakes are still unidentified. A detailed report has been prepared (Latta, 1966).

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 lakes, an investigation was begun on its biology, its effect on the host and its relationship to environmental factors. The study was made in cooperation with L. N. Allison.

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 number of gill lice present. 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.

The analysis of data has been largely completed but the final report has yet to be written. The following is a brief summary of the findings.

In all lakes except Ford and Lost the gill lice populations developed sigmoidally. Reproduction continued throughout the year as illustrated by the percentage in each stage of development for the gill lice from South Twin Lake (Table 17). No relationship was found between parasitism and condition and rate of natural mortality of brook trout (Table 18). Development of gill lice populations was not influenced by a summer decrease in volume of water with suitable temperature and oxygen characteristics for trout (Table 18). Degree of infestation was most influenced by degree of infestation of older fish in each lake (Table 19). Rate of increase was inversely related to number of gill lice on fish (Table 19).

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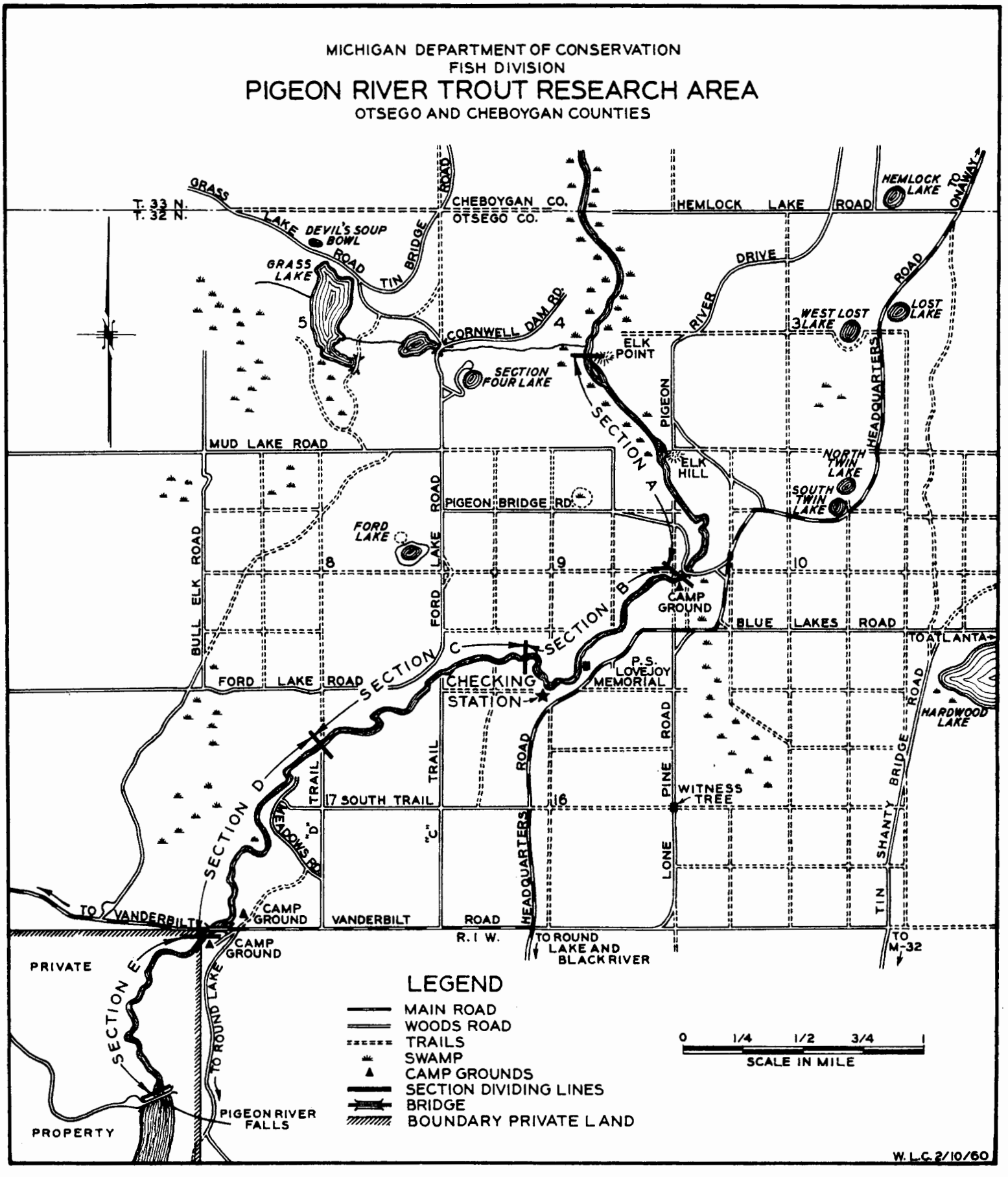
MICHIGAN DEPARTMENT OF CONSERVATION
FISH DIVISION
PIGEON RIVER TROUT RESEARCH AREA
OTSEGO AND CHEBOYGAN COUNTIES
T. 33 N.
T. 32 N.
CHEBOYGAN CO.
OTSEGO CO.
GRASS LAKE ROAD
TIN BRIDGE ROAD
DEVIL'S SOUP BOWL
GRASS LAKE
CORNWELL DAM RD.
SECTION FOUR LAKE
HEMLOCK LAKE ROAD
HEMLOCK LAKE
TO ONAWAY
ELK POINT
PIGEON RIVER DRIVE
WEST LOST LAKE
LOST LAKE
HEADQUARTERS ROAD
SECTION A
MUD LAKE ROAD
ELK HILL
NORTH TWIN LAKE
SOUTH TWIN LAKE
PIGEON BRIDGE RD.
FORD LAKE
FORD LAKE ROAD
BULL ELK ROAD
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
17 SOUTH TRAIL
WITNESS TREE
SECTION D
MEADOWS RD.
"C"
"D"
LONE TREE TRAIL
HEADQUARTERS ROAD
TO VANDERBILT
CAMP GROUND
VANDERBILT ROAD
R. 1 W.
TO ROUND LAKE AND BLACK RIVER
TIN BRIDGE ROAD
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.

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.

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

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, 1949-1965

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
1965	5	7	5	7	10	7	5	7

[1] Lure was restricted to artificial flies only in Sections C and D in 1958-64 and in Ford Lake 1955-64. In 1965 the restriction to artificial flies was revoked. 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, 1965

Stream sections	Fishing trips		Total hours fished	Average number of trout caught per hour per trip
	Number	Percentage successful		
A	378	19.8	925.0	0.13
B	612	17.0	1,456.0	0.11
C	351	31.9	999.0	0.24
D	596	23.0	1,580.5	0.15
E	431	32.9	1,379.0	0.24
Total	2,368	24.1	6,339.5	0.17

Stream sections	Anglers' catch					
	Brook trout		Brown trout		Total	
	Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)
A	102	22.43	36	11.10	138	33.53
B	139	26.35	43	20.91	182	47.26
C	234	49.38	20	8.78	254	58.16
D	233	50.70	27	16.86	260	67.56
E	339	73.35	42	24.56	384	101.09[1]
Total	1,047	222.21	168	82.21	1,218	307.60

[1] Three rainbows weighing 3.18 pounds were added to total.

Table 4.--Fishing success, and total weight of anglers' catch during weekly periods, Pigeon River, 1965

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 24-30	118	13.6	33	6.79	5	1.88	39	10.11[1]	355.0	0.09
May 1-7	75	36.0	80	19.14	7	3.84	87	22.98	216.5	0.46
May 8-14	56	37.5	57	13.36	5	2.72	62	16.08	149.5	0.39
May 15-21	130	35.4	115	23.92	7	2.23	122	26.15	364.5	0.31
May 22-28	65	43.1	59	11.79	7	4.04	67	16.14[2]	252.0	0.27
May 29-June 4	231	22.5	98	23.74	16	8.03	114	31.77	610.5	0.15
June 5-11	82	20.7	24	4.98	5	4.30	29	9.28	227.0	0.09
June 12-18	92	31.5	50	10.90	17	8.24	67	19.14	239.5	0.23
June 19-25	111	32.4	57	12.89	16	7.24	73	20.13	316.5	0.20
June 26-July 2	114	30.7	48	10.56	17	7.96	65	18.52	317.5	0.18
July 3-9	147	20.4	41	8.46	7	3.14	48	11.60	343.0	0.12
July 10-16	126	19.8	36	7.36	2	0.52	38	7.88	363.0	0.09
July 17-23	144	20.8	49	10.26	8	2.08	57	12.34	383.5	0.16
July 24-30	102	15.7	16	3.33	10	3.26	26	6.59	220.5	0.12
July 31-August 6	100	25.0	51	10.79	5	2.50	56	13.29	253.5	0.16
August 7-13	128	17.2	28	5.63	9	6.66	37	12.29	292.0	0.10
August 14-20	132	6.1	10	2.86	1	0.86	11	3.72	312.5	0.04
August 21-27	159	22.0	64	10.58	7	4.60	71	15.18	390.5	0.15
August 28-Sept. 3	115	39.1	97	18.50	13	7.39	110	25.89	358.0	0.26
September 4-10	124	19.4	31	5.94	4	0.72	36	8.10[3]	325.0	0.08
September 11-12	17	17.6	3	0.44	-	-	3	0.44	49.5	0.58
Total	2,368	24.1	1,047	222.22	168	82.21	1,218	307.62	6,339.5	0.17

[1] One rainbow weighing 1.44 pounds was added to totals.

[2] One rainbow weighing 0.31 pound was added to totals.

[3] One rainbow weighing 1.44 pounds was added to totals.

Table 5. --Residence of anglers who fished the experimental sections of the Pigeon River in 1965

County	Number of fishing trips	County	Number of fishing trips	County or state	Number of fishing trips
Wayne	397	Montcalm	16	Grand Traverse	1
Oakland	315	Sanilac	14	Houghton	1
Ingham	276	Branch	12	Isabella	1
Otsego	87	Clinton	11	Marquette	1
Genesee	71	Emmet	11	Mecosta	1
Saginaw	70	Ionia	11	Michigan total	2, 055
Macomb	69	Monroe	11	Ohio	194
Washtenaw	53	Presque Isle	11	Indiana	37
Muskegon	52	St. Joseph	11	Illinois	26
Bay	47	Lapeer	10	Kentucky	9
Shiawassee	40	Berrien	9	Missouri	9
Midland	37	Tuscola	9	California	8
Cheboygan	32	Roscommon	7	Pennsylvania	6
Calhoun	29	Arenac	5	Massachusetts	5
Kent	29	Clare	5	Florida	4
Gratiot	28	Iosco	5	Maine	4
Alpena	27	Barry	4	West Virginia	4
Charlevoix	26	Huron	4	Alabama	2
Ottawa	26	Allegan	3	Minnesota	2
Mason	25	Crawford	3	Georgia	1
Jackson	24	Eaton	3	Kansas	1
St. Clair	23	Missaukee	3	New York	1
Lenawee	22	Ogemaw	3	Non-resident total	313
Livingston	20	Osceola	3		
Gladwin	19	Wexford	3	Grand total	2, 368
Kalamazoo	17	Montmorency	2		

Table 6.--Results of creel census on lakes of the Pigeon River Trout Research Station, 1965

(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	508	33.5	425	152.97	1,453.0	0.24
Section 4	206	35.0	182[1]	42.16	514.0	0.33
Hemlock	155	37.4	146	46.96	572.5	0.24
Lost	194	26.8	132	19.16	474.0	0.24
West Lost	200	16.5	68	24.60	513.5	0.10
North Twin	208	31.7	210	62.37	559.5	0.33
South Twin	291	26.1	189	53.06	688.0	0.21
Total	1,762	29.9	1,352	401.28	4,774.5	0.24

[1] Of 182 trout caught one was a brook trout (0.145 pound); the remainder were rainbow trout.

Table 7.--Residence of anglers who fished the Pigeon River lakes in 1965

County	Number of fishing trips	County	Number of fishing trips	County or state	Number of fishing trips
Wayne	205	Ottawa	15	Arenac	2
Muskegon	201	Barry	14	Ionia	2
Ingham	147	Isabella	13	Iosco	2
Otsego	143	Washtenaw	13	Crawford	1
Oakland	98	Antrim	12	Newaygo	1
Genesee	89	Clinton	12	Michigan total	1,694
Presque Isle	72	Calhoun	11		
Gratiot	68	Clare	11		
Kent	67	St. Joseph	11	Ohio	54
Shiawassee	62	Montcalm	10	Indiana	7
Charlevoix	43	Grand Traverse	9	Missouri	5
Saginaw	42	Allegan	8	Florida	1
Bay	39	Kalamazoo	8	Illinois	1
Macomb	37	Livingston	8		
Cheboygan	32	Montmorency	8	Non-resident total	68
Jackson	22	Huron	7		
Midland	19	Branch	6		
Lenawee	17	Emmet	6	Grand total	1,762
Tuscola	17	Mecosta	5		
Roscommon	16	Sanilac	5		
St. Clair	16	Benzie	4		
Alpena	15	Lapeer	4		
Berrien	15	Ogemaw	4		

Table 8. --Number of anglers of different classes who fished in experimental waters of the Pigeon River in 1965

(Percentages in parentheses)

Residence	Licensed males	Licensed females	Wives	Minor males	Minor females	Total
STREAM						
Resident	1,372	10	201	394	78	2,055 (86.8)
Nonresident	193	45	-	63	12	313 (13.2)
Total	1,565 (66.1)	55 (2.3)	201 (8.5)	457 (19.3)	90 (3.8)	2,368
LAKES						
Resident	1,094	28	229	274	69	1,694 (96.1)
Nonresident	39	7	-	18	4	68 (3.9)
Total	1,133 (64.3)	35 (2.0)	229 (13.0)	292 (16.6)	73 (4.1)	1,762

Table 9.--Estimated numbers and weights of trout of different species and lengths in the experimental sections of the Pigeon River in the fall of 1965 (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	-	-	-	-	-	-
	2	230	1.38	31	0.19	261	1.57
	3	1,001	15.02	572	9.15	1,573	24.17
	4	167	5.34	255	8.67	422	14.01
	5	174	10.09	1	0.06	175	10.15
	6	195	18.72	39	3.82	234	22.54
	7	54	7.88	43	6.45	97	14.33
	8	10	2.11	10	2.17	20	4.28
	9	3	0.88	4	1.21	7	2.09
	10	3	1.18	10	4.07	13	5.25
	11	3	1.54	12	6.40	15	7.94
	12+	1	0.83	19	23.70	20	24.53
Total		1,841	64.97	996	65.89	2,837	130.86
Pounds per acre			9.10		9.22		18.32
B	1	-	-	-	-	-	-
	2	1,260	7.56	33	0.20	1,293	7.76
	3	2,452	36.78	271	4.34	2,723	41.12
	4	512	16.38	224	7.62	736	24.00
	5	443	25.69	5	0.30	448	25.99
	6	331	31.78	54	5.29	385	37.07
	7	92	13.43	57	8.55	149	21.98
	8	4	0.84	17	3.69	21	4.53
	9	8	2.34	5	1.51	13	3.85
	10	1	0.39	16	6.51	17	6.90
	11	-	-	12	6.40	12	6.40
	12+	1	0.83	38	57.40	39	58.23
Total		5,104	136.02	732	101.81	5,836	237.83
Pounds per acre			22.99		17.21		40.20
C	1	3	0.01	-	-	3	0.01
	2	1,139	6.83	43	0.26	1,182	7.09
	3	3,226	48.39	430	6.88	3,656	55.27
	4	848	27.14	134	4.56	982	31.70
	5	463	26.85	9	0.54	472	27.39
	6	358	34.37	13	1.27	371	35.64
	7	86	12.56	42	6.30	128	18.86
	8	27	5.70	23	4.99	50	10.69
	9	6	1.76	15	4.53	21	6.29
	10	1	0.39	15	6.10	16	6.49
	11	6	3.09	17	9.06	23	12.15
	12+	1	0.66	30	43.75	31	44.41
Total		6,164	167.75	771	88.24	6,935	255.99
Pounds per acre			31.20		16.41		47.61

(continued)

Table 9.--continued

Stream section	Inch group[1]	Brook trout		Brown trout		Total	
		Number	Weight (pounds)	Number	Weight (pounds)	Number	Weight (pounds)
D	1	-	-	-	-	-	-
	2	730	4.38	3	0.02	733	4.40
	3	2,229	33.44	144	2.30	2,373	35.74
	4	688	22.02	44	1.50	732	23.52
	5	453	26.27	-	-	453	26.27
	6	428	41.09	4	0.39	432	41.48
	7	107	15.62	20	3.00	127	18.62
	8	11	2.32	26	5.64	37	7.96
	9	7	2.05	1	0.30	8	2.35
	10	4	1.58	6	2.44	10	4.02
	11	2	1.03	12	6.40	14	7.43
	12+	1	0.66	24	32.38	25	33.04
Total		4,660	150.46	284	54.37	4,944	204.83
Pounds per acre			26.63		9.62		36.25
E	1	-	-	-	-	-	-
	2	338	2.03	2	0.01	340	2.04
	3	1,335	20.02	59	0.94	1,394	20.96
	4	604	19.33	84	2.86	688	22.19
	5	189	10.96	-	-	189	10.96
	6	266	25.54	2	0.20	268	25.74
	7	110	16.06	10	1.50	120	17.56
	8	10	2.11	31	6.73	41	8.84
	9	2	0.59	12	3.62	14	4.21
	10	7	2.76	1	0.41	8	3.17
	11	2	1.03	7	3.73	9	4.76
	12+	1	0.66	32	39.09	33	39.75
Total		2,864	101.09	240	59.09	3,104	160.18
Pounds per acre			17.79		10.40		28.19
All sections	1	3	0.01	-	-	3	0.01
	2	3,697	22.18	112	0.68	3,809	22.86
	3	10,243	153.65	1,476	23.61	11,719	177.26
	4	2,819	90.21	741	25.21	3,560	115.42
	5	1,722	99.86	15	0.90	1,737	100.76
	6	1,578	151.50	112	10.97	1,690	162.47
	7	449	65.55	172	25.80	621	91.35
	8	62	13.08	107	23.22	169	36.30
	9	26	7.62	37	11.17	63	18.79
	10	16	6.30	48	19.53	64	25.83
	11	13	6.69	60	31.99	73	38.68
	12+	5	3.64	143	196.32	148	199.96
Total		20,633	620.29	3,023	369.40	23,656	989.69
Pounds per acre			21.09		12.56		33.65

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

Table 10.--Anglers' catches, and spring and fall population estimates of brook trout in Ford and Hemlock lakes, 1965

[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
1962+	10	16	-	-	4	4
1963	103 (78-161)	107	-	105 (79-189)	75	8
1964	642 (542-803)	305	117 (104-147)	462 (401-544)	69	176 (146-241)
Totals	755	428	117	567	148	188

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

Table 11.--Age composition of the anglers' catch and average length and weight of age groups for each experimental section, Pigeon River, 1965

Stream section	Species	Age group	Number	Average total length (inches)	Average total weight (pounds)
A	Brook[1]	I	21	7.3	0.14
		II	73	8.3	0.22
		III	6	10.5	0.46
		IV	1	18.8	0.71
	Brown	I	13	7.8	0.17
		II	21	9.9	0.36
		III	2	12.3	0.68
B	Brook	I	51	7.3	0.14
		II	81	8.2	0.21
		III	7	9.1	0.29
	Brown	I	8	7.6	0.16
		II	27	10.5	0.44
		III	8	14.0	0.98
C	Brook	I	51	7.3	0.14
		II	141	8.1	0.20
		III	42	9.3	0.32
	Brown	I	5	7.7	0.17
		II	12	10.2	0.41
		III	2	12.8	0.76
		IV	1	16.5	1.50
D	Brook[1]	I	54	7.4	0.15
		II	134	8.0	0.20
		III	43	9.3	0.33
	Brown	I	2	7.8	0.16
		II	18	10.6	0.44
		III	6	14.6	1.29
		IV	1	13.2	0.84
E	Brook[1, 2]	I	89	7.4	0.14
		II	227	8.4	0.23
		III	18	9.7	0.37
		IV	2	13.1	0.81
	Brown	I	3	8.0	0.19
		II	34	11.0	0.50
		III	3	13.4	0.98
		IV	2	17.3	2.00

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

[2] Three rainbow trout--age II, length 9.8 inches, weight 0.31 pound, age II, length 15.6 inches, weight 1.44 pounds, and age III, length 15.5 inches, weight 1.44 pounds--were caught in Section E.

Table 12.--Average length and weight for each year class of brook trout in the anglers' catch from Ford and Hemlock lakes, 1965

Lake	Year class	Number of fish	Average total length (inches)	Average total weight (pounds)
Ford	1961	3	12.4	0.77
	1962	13	12.3	0.85
	1963	107	11.1	0.55
	1964	302	8.5	0.27
Hemlock	1962	4	12.1	0.68
	1963	75	10.1	0.40
	1964	67	8.1	0.21

Table 13.--Annual expectations of death for brook trout in Ford and Hemlock lakes, April to October, 1965

Lake	Year class	Total mortality	Rate of exploitation	Natural mortality
Ford	1962+	1.00	1.00	0.00
	1963	1.00	1.00	0.00
	1964	0.82	0.48	0.34
Hemlock	1962+	0.50	0.50	0.00
	1963	0.92	0.71	0.21
	1964	0.62	0.15	0.47

Table 14.--Square feet of bottom soil types in sample 100-foot segments in Sections A and B, Pigeon River, 1958, 1960 and 1964

[Percentages in parentheses]

Section and year	Categories of bottom type							Total
	Silt or organic	Sand	Sand and gravel	Gravel	Gravel and cobble	Cobble	Clay	
Section A								
1958	5, 227 (9.1)	12, 429 (21.7)	14, 877 (26.0)	15, 467 (27.0)	8, 957 (15.6)	142 (0.2)	201 (0.4)	57, 300
1960	3, 844 (6.6)	22, 102 (37.8)	10, 534 (18.0)	11, 065 (18.9)	10, 033 (17.1)	722 (1.2)	247 (0.4)	58, 547
1964	5, 793 (10.0)	17, 266 (29.7)	8, 521 (14.7)	14, 383 (24.8)	8, 722 (15.0)	3, 238 (5.6)	161 (0.2)	58, 084
Section B								
1958	7, 473 (17.9)	6, 951 (16.7)	10, 429 (25.0)	9, 265 (22.2)	6, 466 (15.5)	529 (1.3)	619 (1.5)	41, 732
1960	3, 948 (10.0)	11, 798 (30.0)	9, 037 (23.0)	5, 680 (14.4)	8, 444 (21.5)	346 (0.9)	94 (0.2)	39, 347
1964	5, 527 (13.7)	8, 245 (20.4)	10, 146 (25.1)	8, 798 (21.8)	6, 814 (16.9)	705 (1.7)	178 (0.4)	40, 413

Table 15.--Square feet of water depths in sample 100-foot segments in Sections A and B, Pigeon River, 1958, 1960 and 1964

[Percentages in parentheses]

Section and year	Water depth (feet)				Total
	0 to 1	1 to 2	2 to 3	3 plus	
Section A					
1958	34,455 (60.1)	18,766 (32.8)	3,442 (6.0)	637 (1.1)	57,300
1960	35,763 (61.1)	20,180 (34.5)	2,497 (4.3)	107 (0.2)	58,547
1964	34,050 (58.6)	20,387 (35.1)	3,415 (5.9)	232 (0.4)	58,084
Section B					
1958	21,438 (51.4)	17,924 (43.0)	2,087 (5.0)	283 (0.7)	41,732
1960	20,535 (52.2)	16,075 (40.9)	2,328 (5.9)	409 (1.0)	39,347
1964	19,872 (49.1)	17,407 (43.1)	2,329 (5.8)	805 (2.0)	40,413

Table 16.--Square feet of cover in sample 100-foot segments in Sections A and B, Pigeon River, 1958, 1960 and 1964

Section and year	Categories of cover				Total
	Logs, stumps, etc.	Under-cut bank	Shade	Turbu-lent water	
Section A					
1958	3, 645	444	4, 321	7, 171	15, 581
1960	1, 769	207	6, 558	5, 900	14, 434
1964	1, 413	407	7, 772	3, 339	12, 931
Section B					
1958	2, 418	235	5, 545	3, 079	11, 277
1960	2, 563	155	7, 131	4, 650	14, 499
1964	1, 942	359	8, 469	2, 349	13, 119

Table 17.--Mean number of gill lice per trout and percentage in each stage of development, South Twin Lake, January-December, 1964

Month	Number of gill lice per trout			Stage of development				
	Sample size	Mean	Standard error	Very young	Immature	Early mature	Late mature	Senescent
Jan.	7	1.8	1.6	61	33	6	0	0
Feb.	10	3.3	0.3	76	12	6	3	3
Mar.	10	4.8	1.1	52	40	8	0	0
April	10	5.8	0.7	50	29	14	5	2
May	10	10.5	1.0	18	42	34	6	0
June	10	24.2	1.6	17	33	34	12	4
July	10	35.5	5.8	38	18	27	12	4
Aug.	8	52.6	10.0	6	22	48	13	11
Sept.	10	27.5	6.0	1	11	60	15	13
Oct.	10	46.3	5.0	30	2	42	17	8
Nov.	9	84.9	12.7	41	20	21	14	4
Dec.	10	98.2	17.9	27	33	27	8	4

Table 18. --Comparison of mean number of gill lice per trout with condition, natural mortality rate and environment of trout

Lake	Annual mean number of gill lice per trout[1]	Annual mean condition factor of trout C	Annual instantaneous natural mortality rate of trout q	Thermocline-oxygen strata June-Sept., 1964 (feet^3 x 10^3)
North Twin	46.8	37.5	0.71	3,624
West Lost	46.6	38.2	0.36	2,460
South Twin	33.0	38.2	0.77	2,516
Hemlock	23.1	36.3	0.44	7,161
Lost	4.8	32.9	0.84	6,119
Ford	1.5	37.2	1.76	6,776

[1] Excluding Lost and Ford all means are significantly different at the 95% level except North Twin and West Lost.

Table 19. --Population dynamics of gill lice

Lake	1963 year class			1962 and older year classes
	Annual mean number of gill lice per trout[1]	Log intercept of gill lice population[2] a	Rate of increase of gill lice population[3] b	Estimated number of gill lice on trout Jan., 1963 ($x10^3$)
North Twin	46.8	1.216	0.062	21.6
West Lost	46.6	0.937	0.098	8.6
South Twin	33.0	0.236	0.155	6.7
Hemlock	23.1	0.328	0.128	5.7
Lost	4.8	-	-	1.4
Ford	1.5	-	-	2.4

[1] Excluding Lost and Ford all means are significantly different at the 95% level except North Twin and West Lost.

[2] All intercepts are significantly different at the 95% level.

[3] All slopes are significantly different at the 95% level except South Twin and Hemlock.