

Prepared for
Mich. Acad. of Science, Arts & Letters
March 17-19, 1938

Original: Mich. Academy
cc: Mr. Ruhl
Dr. Shetter
Fish Division

REPORT NO. 460

SPECIES COMPOSITION BY AGE GROUPS AND STABILITY OF
FISH POPULATIONS IN SECTIONS OF THREE MICHIGAN TROUT
STREAMS DURING THE SUMMER OF 1937*

David S. Shetter and Albert S. Hazzard

Introduction

Management of trout waters to maintain dependably good angling is being discussed by fisheries biologists and fisheries administrators, but at present such management would be difficult because of the lack of basic data. For example, almost no information is available as to the composition of typical trout stream populations, the variation in such populations in different habitats, the seasonal changes to which they are subject and the effects upon the populations of angling and artificial plantings of hatchery-reared trout. Although a number of studies have been made of the fish food supply and the feeding habits of trout, no one has satisfactorily correlated these investigations so as to demonstrate selectivity or non-selectivity in feeding or the influence of a given number of fish upon the abundance of bottom food organisms.

* Contribution from the Institute for Fisheries Research, Michigan Department of Conservation and the University of Michigan.

Embrey (1929) determined the number, species and size of fish in a New York trout stream by temporarily diverting the flow of a short section into an old channel. Greeley (1933) developed the procedure of blocking sections of stream for seining and has sampled a number of New York streams in this way. Further results of this method have been reported by Moore et al (1934) in New York and by Trippensee (1937) in New Hampshire. The latter critically evaluated the method for different bottom types.

Purposes and Methods

This investigation of sample sections of Michigan trout streams was made:

1. To determine the number of trout present.
2. To learn the proportion of other fishes found in association with trout.
3. To find out the changes in numbers and species occurring during the summer.
4. To determine age and coefficient of condition of the trout from scale samples, weights and measurements of the fish taken.
5. To learn the degree of stability of the various species by marking captured fish and by removing the entire population in one section each month.

The three streams investigated were the South Branch of the Pine River (Alcona County), the Little Manistee River (Lake County), and the North Branch of the Boardman River (Grand Traverse County). Three portions of the South Branch of the Pine and two of the Little Manistee were studied in June, July, August, and September; on the North Branch of the Boardman two sections were sampled on July 1 and 2, whereas three were studied during late July and mid-August. The sections were chosen

at random, but the wildlife technicians who located them were instructed to select a variety of seizable habitats on each stream. The physical data and habitat characteristics of the several stream portions under consideration are presented in Table 1.

The field methods used in the census work have been described by Greeley (1933). These methods were followed except for certain additions and refinements. Chicken-wire was found to be the most suitable material for supporting the blocking seines, as shown in Figure 1. Specially constructed J-shaped iron stakes approximately two feet long were used to hold the lead lines of the blocking seines to the stream bottom. Plane table maps were prepared for each census area (scale 1 inch = 10 feet). Depths and bottom types were plotted on these charts. Areas were determined by use of a planimeter, and lineal distances were calculated with a map measurer. Stream velocities were obtained by determining the time required for a match to move 30 feet (measured distance).

Before any section was seined, a bottom-food sample was collected with a one square foot sampling net from the dominant bottom type of that particular section so that some measure of availability of food might be obtained ~~late~~ for comparison later with the food found in the stomachs of fish taken from that particular section.

The fish of each species were counted, weighed, scale-sampled, and measured alive in the field. Weights were taken in grams; standard and total lengths were recorded in millimeters. Live weights of the fish were readily obtained through the use of a Chatillon spring balance (500 gram capacity) equipped with an adjustable dial. A small pan of fresh water was placed on the balance to keep the fish alive; the additional weight was automatically corrected with the movable dial.

census

In all but one section of each stream the fish were released alive after the pertinent data had been recorded. Before release they were marked by fin-clipping, different fins being removed each month so that when recaptured it was possible to tell when they had first entered the catch. The total population from one section of each stream was preserved each month for a detailed stomach analysis. These fish were counted, weighed and measured before initial preservation in ten per cent formalin.

The efficiency of the general method of stream census was not tested as extensively as might be desired, but results from one test on the lower census area of the South Branch of the Pine River, considered the most difficult to seine, indicated that with the probable exception of the muddlers,* a very small percentage of fish (all species of minor importance) escaped the original count. On August 13, 1937, the lower census section was blocked and was seined in the usual manner (Figure 2) until no fish was caught or only an occasional muddler was taken, at which time seining efforts normally would have been stopped. After a period of four hours, during which the section was left undisturbed with blocking nets in place, seining was resumed. The fish captured in the check seining consisted of: 6 black-nosed dace, 6 common suckers, and 4 muddlers. These fish represented a total weight of 9 grams.

After this additional seining, the entire crew of seven men lined up at the bottom blocking seine and walked slowly upstream, probing all places where fish might be concealed. Only one fish was observed, a black-nosed dace so small that it could escape through the meshes of a fine-meshed common sense minnow seine.

*

Scientific names are given in Table 2.

During the course of the regular seining, 131 fish (see Table 3) were captured, representing 89.1 per cent of the total number of fish taken in both regular and check seinings. It should be noted that no trout were caught in the second seining, and as none was observed by the careful scrutiny of the crew at the conclusion of the efficiency test, it was assumed that the entire trout population of this particular section had been captured by the regular procedure. If 89.1 per cent efficiency could be obtained on the most difficult section to seine, probably the figures given for other sections closely approach 100 per cent.

Other tests of the efficiency of this particular method of stream census were conducted during the past summer by Trippensee (1937) in New Hampshire trout streams. All of the sections studied by us were similar to those classed by him as "relatively easy to seine." In this class he estimates the efficiency of the method as between 90 per cent and 100 per cent.

No corrections have been made in the calculated populations per acre and per mile as given in this discussion, inasmuch as the test on the Pine suggests that for trout the error in this method is negligible.

Density of Fish Populations*

The species of fish, and the crayfish, which were encountered during the population studies are listed in Table 2. Brook, brown and rainbow trout were present in both the South Branch of the Pine River and in the Little Manistee River, but only brook and brown trout were taken in the North Branch of the Boardman River. Common suckers, mud-
dlers, black-nosed daces, and crayfish occurred consistently in all

* No artificial plantings of fish were made during the period of census.

three streams. Creek chubs, sticklebacks, and lampreys were caught in two of the three streams. Johnny darters were taken consistently only in the Little Manistee River. The remaining species (golden shiners, mud minnows, yellow perch, bullheads, and bluegills) were seined in sections of only one stream.

Numerical results of the population studies on the various stream sections will be found in Tables 3 to 10, and consist of the monthly total of the several species of fish found in each section, the calculated number and weight of fish per mile and per acre of stream, based on the actual number and weight of fish determined for each section. The computations of the number of fish and weight per acre provide the best figures for comparing population densities in different sections of the same stream and other streams.

No calculations of populations have been made for entire streams on the basis of the sections sampled as in most instances the censuses were conducted in portions of streams representing particular trout habitats which could be studied by this method. Reliable estimates of the population of entire streams cannot be computed unless the proportion of the various habitats are accurately known for the entire stream. The calculations per mile and per acre are representative only for the particular habitats studied, and even these figures must be considered tentative because of the extreme variation encountered in similar environments in different months (Tables 3 to 10).

To determine what relationship, if any, exists between trout stream habitat and calculated populations of fish per acre, the salient habitat characteristics of the various sections are given in Table 11 together with the average number of fish and calculated average weight of fish per acre. A numerical rating has also been used to facilitate comparison.

On the basis of the available data, the most productive stream, in pounds per acre of fish and number of trout, is the Little Manistee, followed by the South Branch of the Pine. The North Branch of the Boardman was poorest in calculated numbers, pounds of fish and pounds of trout per acre. From the fisherman's standpoint, the Little Manistee River was also the best, since it produced more legal trout per acre than the South Branch of the Pine or the North Branch of the Boardman. One section of the latter showed no legal trout at any time during the investigations.

The most productive sections were those which, according to past standards, had a relatively unproductive bottom type--chiefly sand. Those sampled areas which were dominantly of gravel were comparatively low in fish production (Table 11). The one characteristic common to the three most productive sections encountered during the course of the study was a greater average depth than was found in the remaining five sections; the average depth of these three sections (lower, South Branch of the Pine; upper and middle, Little Manistee) average between 14 and 18 inches, while the remainder averaged between 9 and 11 inches in depth. The greater depth of the water may very possibly be an important limiting factor in determining the carrying capacity of ~~th~~ a stream, since this was the only favorable habitat characteristic present in two sections of the Little Manistee River, both of which led, in general, in production of trout and other fish.

Stability of Fish Populations

Some measure of the stability or motility of the fish population of the sections investigated may be calculated from the recaptures of fish marked during the course of the work. In the South Branch of

the Pine River and in the North Branch of the Boardman River all fish seined in both upper and lower census sections were fin-clipped and released after all pertinent data had been recorded. This procedure was also followed on the upper section of the Little Manistee River. A different fin was removed each month (except in the case of the muddlers); thus in succeeding months fish which had been captured previously were readily separated from more recent inhabitants of the census section.

Analysis of recaptures has been made by considering the total number of trout (all species combined to obtain a sufficient number of individuals), suckers, and muddlers, in the stream sections where recaptures were made. The percentage of marked fish which remained from month to month in the section are shown in the horizontal columns of Tables 12 to 17 and are calculated from the number of fish recovered bearing marks of the preceding months. The net percentage loss (which may have been due to migration, capture by fishermen, predation or other causes of death) is calculated by subtracting the total number of marked fish recovered in any month from the number of marked fish released during the previous month, and dividing the result by the number of such fish released in that month.

Tables 12 to 14 indicate that the net percentage loss of the trout population from month to month may be anywhere from 44 to 94 per cent. The suckers and the muddlers suffered a similarly high loss from month to month, varying from 69 to 100 per cent. In the North Branch of the Boardman River and in the Little Manistee River none of the marked minnows or coarse fish were ever recovered in successive months, indicating that a completely new population had

moved in between the dates of sampling. Evidence of migration, probably of a minor nature, may be inferred from the results of the monthly removal of the fish from the middle sections of each of the streams. Tables 4, 6 and 9 conclusively demonstrate that these sections were repopulated within thirty days.

These data, which definitely suggest that populations of stream fish, both trout and associated species, are relatively unstable in specific areas of stream during the summer months, indicate that calculations of stream populations from counts on one or two short sections of stream at only one period during the year are unreliable.

Age Groups Represented in Populations

The trout scales collected during the investigation were cleaned, mounted in glycerin-gelatin and read by the use of a micro-projector. Scale samples were taken from all trout of legal size (7 inches, total length) encountered in the census sections, and from all the smaller trout, except where it was obvious from length measurements that they were in their first summer of life.

The results of the age study are presented in Tables 18, 19, and 20, in which the total number of trout of each species in each age group by months are given for the three streams. The more significant facts are also shown in Figures 3, 4, and 5.

It appears that the trout population in the censused portion of the North Branch of the Boardman is somewhat abnormal in the distribution of the age groups, since the population consisted almost entirely of brook trout of the 0 group and brown trout of the 0 group. The distribution of the age groups of the trout population in the South Branch of the Pine River and the Little Manistee River were more normal

in that older age groups were represented. The South Branch of the Pine River, however, had no brown trout of the 0 group, although two adults were taken.

Rainbows decidedly predominated in the trout population in the Little Manistee (see Figure 3). This predominance prevailed despite the fact that almost 50,000 brown trout, and no rainbow trout, were planted in this area in the last 4 years.

Although the rainbows are by far the most numerous of the trout in the Little Manistee, and make up the major part of the anglers' catch in this stream (Shetter MS.), this species is not as available to the fishermen as the brooks and browns since according to Greeley (1933) a large proportion of the young descend to Lake Michigan before reaching the legal size of 7 inches. Greeley also reports that only 26.2 per cent of the rainbow trout collected on the Little Manistee in August, 1930 were of legal size in their second growing season. If they had migrated to the lake before the next fishing season, very few would have been taken by anglers. Migratory habits of the rainbow in the South Branch of the Pine River have not been determined.

As will be noted by comparison of data in Table 11 with information in Tables 18, 19 and 20, the shallower, shaded sections which had some submerged cover present generally produced the greatest number of 0 group trout.

Figures 3 to 5 indicate that there is little similarity between any of the streams in the proportion of age groups of different species. But the relationship between the total numbers in each age group of all species combined in each stream was more constant throughout the investigation. Just what constitutes a normal distribution of age groups in trout will be known only when we have gathered more data

of a similar type from more trout streams of the state and when we are able to compare these figures with similar censuses in unfished streams.

Summary

1. Intensive studies of the fish populations in three sections of the South Branch of the Pine River, two sections of the Little Manistee River, and three sections of the North Branch of the Boardman River were carried out monthly from June to September, 1937. The same sections were blocked and seined each month and the fish found there enumerated by species, and were weighed and measured. Scale samples were collected from all trout above the 0 group.

2. The efficiency of the block-and-seining method of stream census was tested in the most difficult section to seine (lower census section on the South Branch of the Pine River). It was found to be 89.1 per cent effective, comparing favorably with results of similar tests conducted in New Hampshire trout streams. As far as could be determined, the method was 100 per cent efficient on the trout population. Only the very small minnows, muddlers and suckers escaped the original seining.

3. From the results of the above seinings and from accurate maps of the census sections, monthly estimates were made of the per acre and per mile populations in the censused portions of each stream. No computations for entire streams have been made because the proportion of the habitats censused is not known for any of the streams in question. The estimates for various habitats must be considered as tentative in the light of the extreme variation found in the same section in different months.

4. Recaptures of marked fish in subsequent months indicate that neither the trout nor the "coarse fish" tend to remain in the census areas. Calculations of stream populations on the basis of one or two counts in limited sections at any one time will therefore be inaccurate.

5. A study of the age of the trout collected in the census sections of the North Branch of the Boardman indicates an abnormal number of trout of the 0 group. In the South Branch of the Pine and in the Little Manistee the older age groups are present. The oldest trout represented by a few individuals were in the fourth year of life.

Acknowledgments

The authors wish to thank the U. S. Forest Service and the Michigan Civilian Conservation Corps for their continued interest and cooperation throughout the investigations. Man-power for installing blocking nets and seining and transportation was furnished by these agencies. On the Huron National Forest the work was aided by Don Gray, Wildlife Technician, and on the Manistee Purchase Unit by Wildlife Technicians Eugene Kuhne and William Hopkins. Lee Mauer, Supervisor of the Fife Lake CCC Camp, cooperated in the work on the North Branch of the Boardman River.

Thanks are due to Mr. Edwin Cooper of the University of Michigan for his able assistance in the field, and to Mrs. Dorothy Woodbury for her skill and patience in preparing and mounting the trout scales used in age determinations. We are indebted to Dr. F. S. Welch of the Zoology Department of the University of Michigan for the loan of equipment used in areal determinations.

To Dr. Ralph Hile of the U. S. Bureau of Fisheries, and Dr. Carl L. Hubbs, Curator of Fishes at the Museum of Zoology, University of Michigan, we wish to express our thanks for advice and aid in the preparation of certain data.

Literature Cited

- EMBODY, G. C. 1929. I. Stocking Policy for the Streams, Lakes and Ponds of the Erie-Niagara Watershed, Exclusive of Lake Erie. A Biological Survey of the Erie-Niagara System. Supplemental to Eighteenth Annual Report: 23-24.
- GREBLEY, J. R. 1933. II. Fishes of the Upper Hudson Watershed with Annotated List. A Biological Survey of the Upper Hudson Watershed. Supplemental to Twenty-Second Annual Report. 7:77-83.
- _____, _____. 1933. The Growth of Rainbow Trout from Some Michigan Waters. Trans. Am. Fish. Soc. 63:361-378.
- MOORE, EMELINE, and others. 1934. A Problem in Trout Stream Management. Trans. Am. Fish. Soc. 64:68-80.
- SHETTER, DAVID S. 1936. Shrinkage of Trout At Death And On Preservation. Copeia, No. 1; 60-61.
- TRIPPENSEE, R. E. 1937. Fish Population Studies on Some New Hampshire Trout Streams. Biol. Survey of the Androscoggin, Saco and Coastal Watersheds. New Hampshire Fish and Game Department. Survey Report 2, 119-124.

Checked against original references. - A.S.H.

TABLE 1

CHARACTERISTICS OF STREAM SECTIONS EXAMINED FOR POPULATION DENSITIES,

SUMMER OF 1937

Stream	Section	Length (ft.)	Av. width (ft.)	Av. depth (in.)	Area (sq. ft.)	Calculated volume (cu. ft.)	Calculated velocity (ft./sec.)	Calculated flow (cu. ft./sec.)	Shade ²	Submerged cover ²	Number of improvement devices	Bottom soils (in per cent) ³				
												Peat	Clay	Organic Muck	Gravel	Sand
South Branch of Pine	Upper	96.9	24.9	9.8	2429	1984	0.75	15.3	Partly	Excellent	...	...	...	17	81	2
	Middle	95.0	17.7	10.9	1674	1521	0.86	13.8	Densely	Excellent	3	...	74	1	25	...
	Lower	93.3	21.9	13.7	2211	2524	0.68	16.6	Partly	Excellent	...	2	...	90	3	5
Little Manistee	Upper	106.6	27.9	17.2	2845	4078	1.37	52.4	Partly	Average	2	...	...	2	33	65
	Middle	153.7	36.7	17.4	5291	7672	...	68.4 ¹	Exposed	Poor	...	...	...	9	37	54
North Branch of Boardman	Upper	139.9	24.5	10.1	2966	2479	3.10	55.3	Partly	Excellent	1	...	...	5	65	20
	Middle	95.0	27.8	11.4	2722	2586	1.52	41.4	Exposed	Poor	4	...	...	2	8	90
	Lower	121.3	29.7	9.1	3612	2740	1.69	38.2	Partly	Poor	4	...	...	1	4	95

¹ Calculated by using velocity found in upper section.

² These categories based on observation and fishing experience.

³ Percentages of different types of bottom soils were estimated for the North Branch of the Boardman. For all others, determinations were made from maps of the sections by means of a planimeter.

TABLE 2

SPECIES OF FISH AND CRAYFISH

ENCOUNTERED IN POPULATION STUDIES, SUMMER OF 1937

Species	Stream		
	South Branch of Pine	Little Manistee	North Branch of Boardman
Brook trout (<u>Salvelinus fontinalis</u>)	x	x	x
Brown trout (<u>Salmo trutta</u>)	x	x	x
Rainbow trout (<u>Salmo gairdnerii irideus</u>)	x	x	...
Common sucker (<u>Catostomus c. commersonii</u>)	x	x	x
Muddler (<u>Cottus cognatus bairdii</u>)	x	x	x
Black-nosed dace (<u>Rhinichthys atratulus</u>)	x	x	x
Creek chub (<u>Semotilus atromaculatus</u>)	...	x	x
Mud minnow (<u>Umbra limi</u>)	x	...	...
Stickleback (<u>Eucalia inconstans</u>)	x	x	...
Johnny darter (<u>Boleosoma n. nigrum</u>)	...	x	...
Golden shiner (<u>Notemigonus c. crysoleucas</u>)	x	...	...
Yellow perch (<u>Perca flavescens</u>)	x	...	...
Bluegill (<u>Helioperca macrochira</u>)	...	...	x
Lamprey (<u>Entosphenus lamnoteni</u>)	x	x	...
Bullhead (<u>Ameiurus sp.</u>)	x	...	...
Crayfish (<u>Cambarus virilis, c. propinquus</u>)	x	x	x

TABLE 3

FISH POPULATION IN SOUTH BRANCH OF PINE RIVER, LOWER CENSUS SECTION.

Actual weights in grams, calculated weights in pounds.

Legal trout are 7 inches and over.

Species	Actual number and weight of fish in section in month					Calculated number and weight of fish per mile of stream in month					Calculated number and weight of fish per acre of stream in month					
	June	July	August	September	Mean	June	July	August	September	Mean	June	July	August	September	Mean	
Brook trout	Legal	2	5	2	2	2.75	100	250	100	100	137.5	39	99	39	39	54.00
	Sub-legal	9	8	3	4	6.0	450	400	150	200	300.0	177	158	59	79	118.25
	Total weight	500	623	428	441	498.0	55.0	68.5	47.1	48.5	54.78	21.5	26.8	18.4	19.0	21.43
Brown trout	Legal	...	...	1	...	0.25	...	...	50	...	12.5	...	...	20	...	5.00
	Sub-legal	1	...	...	...	0.25	50	...	...	12.5	20	...	...	...	...	5.00
	Total weight	25	...	195	...	55.0	2.7	...	21.5	...	6.05	1.1	...	8.4	...	2.38
Rainbow trout	Legal	...	1	2	3	1.50	...	50	100	150	75.00	...	20	39	59	29.50
	Sub-legal	10	10	10	24	13.50	500	500	500	1200	675.0	197	197	79	473	236.50
	Total weight	376	385	244	504	377.25	41.4	42.3	26.8	55.4	41.48	16.2	16.6	10.5	21.7	16.25
Common sucker		51	44	56	86	59.25	2550	2200	2800	4300	2962.5	1005	867	1103	1694	1167.25
	Total weight	3607	3150	3640	1287	2921.0	396.7	346.5	400.4	141.6	321.3	155.1	135.4	156.5	55.3	125.58
Muddler		111	48	53	84	74.0	5550	2400	2650	4200	3700.0	2187	946	1044	1655	1458.00
	Total weight	380	175	197	148	225.0	41.8	19.3	21.7	16.3	24.78	16.3	7.5	8.5	6.4	9.68
Black-nosed dace		1	...	7	19	6.75	50	...	350	950	337.50	20	...	138	374	133.00
	Total weight	1	...	3	12	4.00	0.1	...	0.3	1.3	0.43	0.04	...	0.1	0.5	0.16
Stickleback		...	1	...	1	0.50	...	50	...	50	0.25	...	20	...	20	10.00
	Total weight	...	1	...	0.5	0.38	...	0.1	...	0.05	0.04	...	0.04	...	0.04	0.02
Perch		...	...	...	1	0.25	...	...	...	50	12.50	...	...	...	20	5.0
	Total weight	...	...	...	1	0.25	...	...	...	0.1	0.03	...	...	...	0.04	0.01
Golden shiner		...	...	...	1	0.25	...	...	...	50	12.50	...	...	...	20	5.0
	Total weight	...	...	...	2	0.50	...	...	...	0.2	0.05	...	...	...	0.1	0.03
Crayfish		5	1	3	2	2.75	250	50	150	100	137.50	99	20	59	39	54.25
	Total weight	83	23	59	56	9.1	9.1	2.5	6.5	6.2	6.08	3.6	1.0	2.5	2.4	2.38
Lamprey		1	...	...	...	0.25	50	...	...	...	12.50	20	...	...	...	5.00
	Total weight	4	...	...	...	1.00	0.4	...	...	...	0.1	0.2	...	...	...	0.05
Total number	191	118	131	227	166.75	9550	5990	6850	11350	8412.5	3764	2327	2580	4472	3285.75	
Total weight	4976	4357	4766	2451.5	4137.63	547.2	479.2	524.3	269.6	455.08	214.04	187.34	204.9	105.5	177.95	

TABLE 4

FISH POPULATION IN SOUTH BRANCH OF THE PINE RIVER, MIDDLE CENSUS SECTION.

Actual weights are given in grams, calculated weights in pounds.

Legal trout are 7 inches (178 mm.) or over.

Species	Actual number and weight of fish in section in month					Calculated number and weight of fish per mile of stream in month					Calculated number of fish and weight per acre of stream in month					
	June	July	August	September	Mean	June	July	August	September	Mean	June	July	August	September	Mean	
Brook trout	Legal	1	...	...	...	0.25	56	...	...	...	14.0	26	...	...	...	6.5
	Sub-legal	15	5	3	6	7.25	723	278	167	334	375.50	342	132	79	158	177.75
	Total weight	290	132	63	54	134.75	35.7	16.2	7.7	6.6	16.55	16.8	7.7	3.6	3.1	7.8
Rainbow trout	Legal	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sub-legal	10	61	6	11	22.0	667	3392	334	612	1251.25	316	1604	158	289	591.75
	Total weight	192	45	17.5	72	81.63	23.6	5.5	2.2	8.9	10.05	11.1	2.6	1.1	4.2	4.75
Common sucker	Legal	1	...	1	...	0.5	56	...	56	...	28.00	26	...	26	...	13.0
	Total weight	2	...	1	...	0.75	0.2	...	0.1	...	0.08	0.1	...	0.06	...	0.04
Muddler	Legal	49 ¹	13	43	25	32.50	2780	723	2391	1390	1821.0	1289	342	1130	658	854.75
	Total weight	175	40	49	42	76.50	21.5	4.9	6.0	5.2	9.4	10.1	2.3	2.8	2.4	4.4
Mud minnow	Legal	...	1	...	...	0.25	...	56	...	...	14.0	...	26	...	...	6.50
	Total weight	...	3	...	...	0.75	...	0.4	...	...	0.1	...	0.2	...	...	0.05
Lamprey	Legal	1	...	...	...	0.25	56	...	...	...	14.0	26	...	...	...	6.50
	Total weight	5	...	...	...	1.25	0.6	...	...	...	0.15	0.3	...	...	...	0.075
Crayfish	Legal	3	...	2	...	1.25	167	...	111	...	69.5	79	...	53	...	33.00
	Total weight	80	...	50	...	32.50	9.8	...	6.2	...	4.0	4.6	...	2.9	...	1.88
Total number	80	80	55	42 ²	64.25	4455	4449	3059	2503 ³	3616.50	2104	2104	1446	1184 ³	1709.50	
Total weight	744	220	180.5	168	328.13	91.4	27.0	22.2	20.7	40.33	43.0	12.8	10.46	9.7	18.99	

¹ One muddler escaped; not included in weight.² Three black-nosed dace, too small to weigh not included.³ 167 black-nosed dace included in population calculation but not in weight calculation.

TABLE 5

FISH POPULATION IN SOUTH BRANCH OF THE PINE RIVER, UPPER CENSUS SECTION

Actual weights are given in grams, calculated weights in pounds.

Legal trout are 7 inches (178 mm.) or over.

Species	Actual number and weight of fish in section in month					Calculated number and weight of fish per mile of stream in month					Calculated number and weight of fish per acre of stream in month				
	June	July	August	September	Mean	June	July	August	September	Mean	June	July	August	September	Mean
Brook trout															
Legal	1	...	...	2	0.75	56	...	...	111	41.75	18	...	...	36	13.50
Sub-legal	8	12	19	27	16.50	445	723	1056	1501	931.25	142	214	338	481	293.75
Total weight	248	73	180	322	205.75	30.5	9.0	22.1	45.1	26.68	9.7	2.8	7.0	14.5	8.5
Rainbow trout															
Legal	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sub-legal	3	19	22	21	16.25	167	1056	1223	1167	903.25	53	338	392	374	289.25
Total weight	29	23	96	175	80.75	3.6	2.8	11.8	21.5	9.93	1.1	0.9	3.7	6.8	3.13
Common sucker															
Total weight	...	...	2	33	8.75	...	...	111	1835	486.50	...	...	36	587	155.75
	...	...	1	319	80.0	...	...	0.1	39.2	9.83	...	...	0.1	12.4	3.13
Muddler															
Total weight	43	11	20	46	30.0	2391	612	1112	2558	1668.25	765	196	356	819	534.0
	150	22	106	146	106	18.5	2.7	13.0	18.0	13.05	5.8	0.9	4.1	5.7	4.13
Black-nosed dace															
Total weight	...	...	...	1	0.25	...	...	...	56	14.0	...	...	...	18	4.5
	...	...	...	2	0.50	...	...	...	0.3	0.08	...	...	...	0.1	0.03
Mud minnow															
Total weight	1	...	...	...	0.25	56	...	...	...	14.0	18	...	...	...	4.5
	4	...	...	...	1.0	0.5	...	...	...	0.13	0.2	...	...	...	0.05
Bullhead															
Total weight	1	...	...	...	0.25	56	...	...	...	14.0	18	...	...	...	4.5
	24	...	...	...	6.0	2.9	...	...	...	0.73	0.9	...	...	...	0.23
Perch															
Total weight	...	...	...	1	0.25	...	...	...	56	14.0	...	...	...	18	4.5
	...	...	...	1	0.25	...	...	...	0.1	0.025	...	...	...	0.04	0.01
Crayfish															
Total weight	5	2	6	5	4.5	278	111	334	278	250.25	89	36	107	89	80.25
	86	23	126	87	80.50	10.5	2.8	15.5	10.7	9.88	3.3	0.9	4.9	3.4	3.13
Total number	62	44	69	136	77.75	3449	2502	3836	7562	4337.25	1103	784	1229	2422	1384.50
Total weight	541	141	509	1052	560.75	66.5	17.3	62.5	134.7	70.25	21.0	5.5	19.9	42.94	22.34

TABLE 6

FISH POPULATION IN LITTLE MANISTEE RIVER, MIDDLE CENSUS SECTION

Actual weights are given in grams, calculated weights in pounds.

Legal trout are 7 inches (178 mm.) and over.

Species	Actual number and weight of fish in section in month					Calculated number and weight of fish per mile of stream in month					Calculated number of fish and weight per acre of stream in month				
	June	July	August	September	Mean	June	July	August	September	Mean	June	July	August	September	Mean
Brook trout	Legal	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sub-legal	10	8	3	3	6	345	276	104	104	207.25	83	66	25	25
	Total weight	88.5	104	19	26	59.38	6.7	7.9	1.4	2.0	4.5	1.6	1.9	0.3	0.5
Brown trout	Legal	3	3	...	...	1.50	104	104	...	...	52	25	25	...	...
	Sub-legal	25	60	16	3	26	863	2070	552	104	897.25	208	500	133	25
	Total weight	511	693	194	45	360.75	38.8	52.7	14.7	3.4	2.74	9.2	12.5	3.5	0.8
Rainbow trout	Legal	1	3	4	...	2	35	104	138	...	69.25	8	25	33	...
	Sub-legal	205	240	283	111	209.75	7073	8280	9763	3795	7227.75	1702	1992	2349	921
	Total weight	2157	890	1320	669	1259	163.9	67.6	100.3	50.8	95.65	38.8	16.0	23.8	12.0
Muddler		41	76	118	89	81	1415	2622	4071	3070	2794.50	340	631	979	739
	Total weight	43.5	56	114	152	91.38	3.3	4.3	8.7	11.5	6.95	0.8	1.0	2.0	2.7
Common sucker		...	42	53	13	27	...	1449	1829	449	931.75	...	349	440	50
	Total weight	...	12	59	24	23.75	...	0.9	4.5	1.8	1.8	...	0.2	1.1	0.4
Black-nosed dace		40	27	102	6	43.75	1380	933	3519	207	1509.75	332	224	847	108
	Total weight	36	22	40	3	25.25	2.7	1.7	3.0	0.20	1.9	0.6	0.4	0.7	0.1
Johnny darter		...	3	2	1	1.50	...	104	69	35	52	...	25	17	8
	Total weight	...	7	3	0.5	2.63	...	0.5	0.2	0.04	0.19	...	0.1	...	...
Creek chub		...	...	...	1	0.25	...	...	...	35	8.75	...	...	...	8
	Total weight	...	...	...	0.5	0.13	...	...	...	0.04	0.01	...	...	...	...
Lamprey		1	15	2	...	4.5	35	517	69	...	155.25	8	125	17	...
	Total weight	5	40	2	...	11.75	0.4	3.0	0.1	...	0.2	0.1	0.7	...	...
Crayfish		3	9	27	4	10.75	104	310	934	138	371.5	25	75	224	33
	Total weight	17	26	34	3	20.00	1.3	2.0	2.6	0.20	1.53	0.3	0.5	0.6	0.1
Total number	329	486	610	231	414	11354	16769	21048	7937	14277	2731	4037	5064	1917	
Total weight	2858	1850	1785	923	1854	217.1	140.6	135.5	70.0	140.8	51.4	33.3	32.0	16.6	

TABLE 7

FISH POPULATION IN LITTLE MANISTEE RIVER, UPPER CENSUS SECTION.

Actual weights are given in grams, calculated weights in pounds.

Legal trout are 7 inches (178 mm.) and over.

Species	Actual number and weight of fish in section in month					Calculated number and weight of fish per mile of stream in month					Calculated number of fish and weight per acre of stream in month				
	June	July	August	September	Mean	June	July	August	September	Mean	June	July	August	September	Mean
Brook trout	Legal	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Sub-legal	1	3	2 (1)	2	2	50	150	100	100	100	15	46	31	31
	Total weight	40	84	37	55	54	4.4	9.2	4.0	6.1	5.93	1.4	2.9	1.3 ¹	1.9
Brown trout	Legal	7	7	4	1	4.75	350	350	200	50	237.5	108	108	62	15
	Sub-legal	8	9	6	6	7.75	400	450	300	300	362.5	123	139	92	92
	Total weight	874	656	301	182	502.6	96.1	72.2	33.0	20.0	55.33	29.7	22.3	10.2	6.2
Rainbow trout	Legal	1	4	5	1	2.75	50	200	250	50	137.5	15	62	77	15
	Sub-legal	16	24	9	5	13.50	800	1200	450	250	675.0	246	370	139	77
	Total weight	624	636	489	97	461.50	68.6	70.0	53.9	10.7	50.8	21.2	21.6	16.6	3.3
Common sucker	Legal	6	27	7	9	12.25	300	1350	350	450	612.5	92	416	108	139
	Total weight	739	4	465	480	422	81.3	0.4	51.2	52.8	46.43	25.1	0.1	15.8	16.3
Muddler	Legal	14	49	34	63	40	700	2450	1700	3150	2000	216	755	524	970
	Total weight	30	65	17	109	55.25	3.3	7.2	1.8	12.0	6.75	1.0	2.2	0.6	3.7
Black-nosed dace	Legal	14	69	19	23	31.25	700	3450	950	1150	1562.5	216	1063	293	354
	Total weight	0.5	12	5	13	7.63	0.06	1.3	0.6	1.4	0.84	...	0.4	0.2	0.4
Johnny darter	Legal	...	1	...	...	0.25	...	50	...	...	12.5	...	15	...	...
	Total weight	...	2	...	...	0.5	...	0.2	...	...	0.05	...	0.1	...	...
Creek chub	Legal	...	...	...	3	0.75	...	...	...	150	375	...	...	...	46
	Total weight	...	...	...	1	0.25	...	...	...	0.1	0.03	...	...	...	...
Stickleback	Legal	...	...	...	1	0.25	...	...	...	50	12.5	...	...	...	15
	Total weight	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Lamprey	Legal	...	2	...	...	0.50	...	100	...	...	25	...	31	...	...
	Total weight	...	5	...	...	0.80	...	0.6	...	...	0.15	...	0.2	...	...
Crayfish	Legal	15	16	16	39	21.50	750	800	800	1950	1075	231	246	246	601
	Total weight	90	53	108	198	112.25	9.9	5.8	11.8	21.8	12.33	3.1	1.8	3.7	6.4
Total number	82	211	102	153	137	1100	10550	5100	7650	6850	1262	3251	1572	2355	2110
Total weight	2397	1517	1422	1135	1617.75	263.7	166.7	156.3	124.9	177.9	81.5	51.6	48.4	38.2	54.95

¹ One sub-legal trout observed but not captured for weighing; not included in calculations.

(1) One sub-legal brook trout escaped before measuring and weighing. Included in population calculation but not in weight calculation.

TABLE 8

FISH POPULATION IN THE NORTH BRANCH OF
THE BOARDMAN RIVER, LOWER CENSUS SECTION.

Actual weights are given in grams,

calculated weights in pounds.

Legal trout are 7 inches (178 mm.) and over.

Species	Actual number and weight of fish in section in month				Calculated number and weight of fish per mile of stream in month				Calculated number of fish and weight per acre of stream in month				
	July 1	July 22	August	Mean	July 1	July 22	August	Mean	July 1	July 22	August	Mean	
Brook trout	Legal	...	...	...	...	...	...	...	...	...	...	...
	Sub-legal	3	3	1	2.33	131	131	44	1020	36	24	12	24
	Total weight	3.5	6	1	3.5	0.3	0.6	0.1	0.33	0.9	0.1	0.03	0.43
Brown trout	Legal	1 ¹	1 ²	...	0.67	44 ¹	44	...	29.33	12 ¹	12	...	8.0
	Sub-legal	...	1 ²	6	2.33	...	44 ²	261	101.67	...	12 ²	72	28.0
	Total weight	...	66	41	35.67	...	6.3	3.9	3.4	...	1.7	1.1	0.93
Common sucker		2	14	11	9.0	37	609	479	391.67	24	168	132	1030
	Total weight	1	8	15	8.0	0.1	0.8	1.4	0.77	0.03	0.2	0.4	0.3
Muddler		7	72	138	72.33	305	3132	6003	3146.67	84	864	1356	868.0
	Total weight	13	26	71	36.67	1.1	2.5	6.8	3.47	0.3	0.7	1.8	0.93
Black-nosed dace		...	16	...	5.3	...	696	...	2320	...	192	...	64.0
	Total weight	...	3	...	1.0	...	0.3	...	0.1	...	0.1	...	0.03
Creek chub		...	...	26	8.67	...	...	1131	377.0	...	...	312	104.0
	Total weight	...	...	9	3.00	...	...	0.9	0.3	...	...	0.2	0.06
Crayfish		10	26	74	36.67	435	2439	3219	2031.0	120	312	838	400.0
	Total weight	31	37	110	59.33	1.0	6.0	10.6	5.87	0.8	1.0	2.9	1.3
Total number	23 ¹	133 ²	256	137.33	1002	7095	11137	6411.33	276	1584	3072	1644	
Total weight	48.5	146	247	147.00	2.5	16.5	23.7	14.23	2.03	3.8	6.43	4.09	

¹ One legal brown trout observed but not captured forms the basis for this calculation.

² One sub-legal trout (species ?) observed but not captured included in population calculations but not in weight calculations.

TABLE 9

FISH POPULATION IN THE NORTH BRANCH OF
THE BOARDMAN RIVER, MIDDLE CENSUS SECTION.

Actual weights are given in grams,

calculated weights in pounds.

Legal trout are 7 inches (178 mm.) and over.

Species	Actual number and weight of fish in section in month				Calculated number and weight of fish per mile of stream in month				Calculated number of fish and weight per acre of stream in month				
	July 1	July 23	August	Mean	July 1	July 23	August	Mean	July 1	July 23	August	Mean	
Brook trout	Legal	...	...	...	...	...	...	...	...	...	...	...
	Sub-legal	3	4	2	3	167	222	111	166.67	48	64	32	48.0
	Total weight	10	9	11	10	1.2	1.1	1.3	1.2	0.4	0.3	0.4	0.37
Brown trout	Legal	...	...	...	...	...	...	...	...	...	...	...
	Sub-legal	4	2	2	2.67	334	111	111	148.0	76	32	32	42.67
	Total weight	11	3	12	8.67	9.7	1.3	0.4	1.5	0.4	0.1	0.4	0.3
Muddler		19	44	119	60.67	1056	2446	6616	3372.67	306	708	1916	976.67
	Total weight	61	20	79	53.33	7.5	2.5	9.7	6.56	2.1	0.7	2.8	1.87
Common sucker		...	5	11	5.33	...	278	612	29.67	...	81	177	86.0
	Total weight	...	...	15	5.0	...	0.1	1.8	0.63	...	...	0.5	0.17
Black-nosed dace		...	2	6	2.67	...	111	334	148.33	...	32	97	43.0
	Total weight	...	1	0.5	0.5	...	0.1	0.1	0.07	...	0.04	0.02	0.2
Creek chub		...	18	101	39.67	...	1000	5616	2205.33	...	290	1626	638.67
	Total weight	...	4	34.5	12.83	...	0.4	4.2	1.53	...	0.1	1.2	0.43
Crayfish		13	14	22	16.33	723	778	1223	908.0	209	225	354	193.0
	Total weight	51	29	34	38.0	6.3	3.7	4.2	3.73	1.8	1.0	1.2	0.73
Total number	11 89	89	263	130.33	2168 2168	4946	14623	7245.67	627 627	1432	4234	3097.67	
Total weight	201 133	66	186	129.33	157.0 16.3	8.3	22.8	18.6	7.1 4.7	2.24	6.52	4.49	

TABLE 10
FISH POPULATION IN NORTH BRANCH OF
THE BOARDMAN RIVER, UPPER CENSUS SECTION.

Actual weights in grams,

calculated weights in pounds.

Legal trout are 7 inches (178 mm.) and over.

Species	Actual number and weight of fish in section in month			Calculated number and weight of fish per mile of stream in month			Calculated number of fish and weight per acre of stream in month		
	July	August	Mean	July	August	Mean	July	August	Mean
Brook trout	...	...	...	...	...	...	...	...	...
Legal	1	1	1	39	39	39	15	15	15
Sub-legal	2	11	6.5	0.2	0.9	0.55	0.1	0.4	0.25
Total weight									
Brown trout	1 ¹	...	1	78 ¹	...	39	29 ¹	...	14.5
Legal	27 ¹	18	23	1117 ¹	693	905	412 ¹	265	338.5
Sub-legal	368	99	233.5	31.3 ²	8.4	19.7	11.8 ²	3.2	7.5
Total weight									
Common sucker	7	11	9	270	424	347	103	162	132.5
Total weight	3	15	9	0.2	1.3	0.75	0.1	0.5	0.3
Muddler	18	65	41.5	693	2503	1598	265	956	610.5
Total weight	34	50	42	2.9	4.2	3.55	1.1	1.6	1.35
Black-nosed dace	5	42	23.5	193	1617	905	74	617	345.5
Total weight	1	15	8	0.1	1.3	0.7	0.03	0.5	0.26
Creek chub	...	49	24.5	...	1887	943.5	...	720	360
Total weight	...	15	7.5	...	1.3	0.65	...	0.5	0.25
Bluegill	...	1	0.5	...	39	17.5	...	15	7.5
Total weight	...	5	2.5	...	0.4	0.2	...	0.2	0.1
Crayfish	7	18	12.5	270	693	481.5	103	265	184
Total weight	44	26	35	3.7	2.2	2.95	1.4	0.8	1.1
Total number	66 (68)	205	136.5	2660	7895	5277.5	1001	3015	2008
Total weight	452	236	344	38.4	20.0	29.2	14.5	7.7	11.1

¹ One brown trout in each category escaped, but included in calculations of population.

² Calculated poundage for 28 brown trout weighed. Does not include possible poundage of escaped fish.

TABLE 11

RELATION OF CERTAIN ENVIRONMENTAL CHARACTERISTICS
AND CALCULATED AVERAGE NUMBERS AND POUNDS OF FISH PER ACRE.

Order of data determined from Tables 1 to 10 inclusive.

Stream and Section	Average depth (inches)	Shade	Submerged cover	No. pounds of all fish	No. pounds of trout	Per cent of trout	No. of trout	No. legal trout	Dominant bottom type ¹	
South Branch of Pine	Upper	9.8 (7)	Partly	Excellent	22 (4)	11 (5)	43.0 (2)	597 (4)	13 (7)	Gravel
	Middle	10.9 (5)	Densely	Excellent	19 (5)	12.5 (4)	42.5 (3)	776 (2)	20 (4)	Clay
	Lower	13.7 (3)	Partly	Excellent	178 (1)	40 (1)	13.6 (6)	448 (5)	100 (2)	Muck and detritus
Little Manistee	Upper	17.2 (2)	Partly	Average	55 (2)	35 (2)	24.5 (5)	466 (4)	115 (1)	Sand
	Middle	17.4 (1)	Exposed	Poor	33 (3)	30 (3)	60.0 (1)	2036 (1)	29 (3)	Sand
North Branch of Boardman	Upper	10.1 (6)	Partly	Excellent	11 (6)	8 (6)	27.3 (4)	30 (8)	15 (5)	Gravel
	Middle	11.4 (4)	Exposed	Poor	5 (7)	1.6 (8)	9.0 (8)	101 (6)	0 (8)	Sand
	Lower	9.1 (8)	Partly	Poor	4 (8)	1.4 (7)	11.5 (7)	60 (7)	8 (7)	Sand

¹ Fifty per cent or more.

TABLE 12

PERCENTAGE OF TROUT POPULATION REMAINING
 IN LOWER CENSUS SECTION, SOUTH BRANCH OF THE PINE RIVER,
 FROM MONTH TO MONTH.

Inferior figures give numbers of marked fish recovered.

Month Marked	Total number of trout in section in month	Number of unmarked trout in section in month	Percentage of trout marked for month recovered in month		
			July	August	September
June	17 ¹	17 ¹	53.0 ₉	18.1 ₄	13.6 ₃
July	24	15	...	20.0 ₃	13.3 ₂
August	18	11	...	...	27.3 ₃
September	33	25	...	...	...
Net percentage loss of marked trout			47.0 ₉	70.8 ₇	55.6 ₈

¹ Represents number actually released with fins clipped. Five others escaped.

TABLE 13

PERCENTAGE OF TROUT POPULATION REMAINING
 IN UPPER CENSUS SECTION, SOUTH BRANCH OF THE PINE RIVER,
 FROM MONTH TO MONTH.

Inferior figures give numbers of marked fish recovered.

Month Marked	Total number of trout in section in month	Number of unmarked trout in section in month	Percentage of trout marked for month recovered in month		
			July	August	September
June	12	12	8.33 ₁ [^]	16.7 ₂ [^]	0.0 ₀ [^]
July	31	30	...	0.0 ₀ [^]	3.3 ₁ [^]
August	41	39	...	...	28.2 ₁₁ [^]
September	50	38	...	...	...
Net percentage loss of marked trout			91.7 ₁ [^]	93.6 ₂ [^]	70.7 ₁₂ [^]

TABLE 14

PERCENTAGE OF TROUT POPULATION REMAINING
 IN UPPER CENSUS SECTION, LITTLE MANISTEE RIVER,
 FROM MONTH TO MONTH.

Inferior figures give numbers of marked fish recovered.

Month Marked	Total number of trout in section in month	Number of unmarked trout in section in month	Percentage of trout marked in month recovered in month		
			July	August	September
June	33	33	33.0 ¹ / ₁₁	18.1 ⁶ / ₈	6.1 ² / ₂
July	47	36	...	22.2 ⁸ / ₈	16.7 ⁶ / ₆
August	18	12 ¹	...	...	50.0 ² / ₂
September	15	5	...	...	...
Net percentage loss of marked trout			67.0 ¹ / ₁₁	70.2 ¹⁴ / ₁₄	44.4 ¹⁰ / ₁₀

¹ 8 of these died, leaving 4 to be added to the total number of marked fish recovered.

TABLE 15

PERCENTAGE OF SUCKER POPULATION REMAINING
 IN LOWER CENSUS SECTION, SOUTH BRANCH OF THE PINE RIVER,
 FROM MONTH TO MONTH.

Inferior figures give numbers of marked fish recovered.

Month Marked	Total number of fish in section in month	Number of unmarked fish in section	Percentage of fish marked in month recovered in month		
			July	August	September
June	51	51	21.5 ¹¹ / ₁₁	17.6 ⁹ / ₉	1.9 ¹ / ₁
July	44	33	...	15.1 ⁸ / ₈	0
August	56	44	...	...	0
September	86	85	...	...	...
Net percentage loss of marked fish			78.5 ¹¹ / ₁₁	68.1 ¹⁴ / ₁₄	98.2 ¹ / ₁

TABLE 16

PERCENTAGE OF MUDDLER POPULATION REMAINING
 IN LOWER CENSUS SECTION, SOUTH BRANCH OF THE PINE RIVER,
 FROM MONTH TO MONTH.

Inferior figures give the number of marked fish recovered.

Month Marked	Total number of fish in section in month	Total number of unmarked fish in section in month	Percentage of fish marked in month recovered in month		
			July	August	September
June	111	111	13.6 ¹ / ₁₅	11.8 ¹ / ₁₇	...
July	48	33	...	...	...
August	53	36	...	...	...
September	84	84	...	...	...
Net percentage loss of marked fish			86.4 ¹ / ₁₅	88.2 ¹ / ₁₇	100

¹ Calculated on the basis of the total number marked up to this month, since muddlers from months after July could not be recognized as they did not have enough fins suitable for clipping.

TABLE 17

PERCENTAGE OF MUDDLER POPULATION REMAINING
 IN UPPER CENSUS SECTION, SOUTH BRANCH OF THE PINE RIVER,
 FROM MONTH TO MONTH.

Inferior figures give number of marked fish recovered.

Month marked	Total number of fish in section in month	Total number of unmarked fish in section in month	Percentage of fish marked in month recovered in month		
			July	August	September
June	43	43	6 $\frac{3}{4}$	7.8 $\frac{1}{4}$	
July	11	8	...		7.5 $\frac{1}{5}$
August	20	16	...	...
September	46	41	...	...	...
Net percentage loss of marked fish			93	92.2	92.5

¹ Calculated on the basis of the total number of fish marked up to each month since muddlers after the month of July could not be recognized as there were not enough fins suitable for clipping.

TABLE 19

TOTAL NUMBER OF TROUT BY SPECIES IN EACH AGE GROUP
BY MONTHS IN CENSUS SECTIONS OF THE SOUTH BRANCH OF THE PINE RIVER.

Inferior figures under "Number" indicate number of legal fish,
under "Av. total length" number of specimens on which the average
length is based where the average does not represent all specimens
counted.

Month	Species	Number and average total length (mm.) in age groups								Total number
		0		I		II		III		
		Number	Av. total length	Number	Av. total length	Number	Av. total length	Number	Total length	
June	Brook	9	54	24 ₄	156	3 ₃	192	...	...	36 ₇
	Brown	...	...	1	137	...	...	...	...	1 ₀
	Rainbow ¹	8	43	12	143	...	...	...	...	20 ₀
July	Brook	13	72	12 ₂	149	5 ₃	183	...	...	30 ₅
	Brown	...	...	...	...	...	...	...	...	...
	Rainbow ²	80	42 ₅₉	6	156	5 ₂	169	...	...	91 ₂
August	Brook	18	81	8 ₁	153	...	...	1 ₁	285	27 ₂
	Brown	...	...	...	...	...	...	1 ₁	264	1 ₁
	Rainbow	32	78 ₁₀	6 ₁	147	2 ₁	177	...	...	40 ₂
September	Brook	31	96	7 ₂	160	2 ₁	167	1 ₁	291	41 ₄
	Brown	...	...	...	...	...	...	...	...	...
	Rainbow	48	83	8 ₂	152	3 ₁	174	...	...	59 ₃

¹ 3 sub-legal fish escaped before scales were taken.

² 0-group rainbow from July collections measured on March 22, 1938 and corrected for shrinkage by a factor of 1.054 as previously determined by Shetter (1936).

TABLE 20

TOTAL NUMBER OF TROUT BY SPECIES IN EACH AGE GROUP
BY MONTHS IN CENSUS SECTIONS OF THE LITTLE MANISTEE RIVER.

Inferior figures under "Number" indicate number of legal fish, under "Av. total length," number of specimens on which the average is based, where the average is not made from all the specimens counted.

Month	Species	Number and average total length (mm.) in age groups								Total number
		0		I		II		III		
		Number	Av. total length	Number	Av. total length	Number	Av. total length	Number	Av. total length	
June ¹	Brook	9	77 ⁷	2	163	...	...	...	...	11 ⁰
	Brown ²	25	71 ²³	12 ⁴	170	3 ³	199	2 ²	220	42 ¹⁰
	Rainbow	148	38	67 ²	149	6	165	2 (?)	158	223 ²
July	Brook	7	74	3	168	...	...	...	...	10 ⁰
	Brown ³	64	81 ⁵⁵	10 ⁶	179	3 ²	186	...	...	77 ¹⁰
	Rainbow	250	54 ²¹	25 ⁶	164	5 ³	182	...	...	280 ⁹
August	Brook	4	81 ³	1	164	...	...	...	...	5
	Brown	22	102	3 ³	180	1 ¹	200	...	...	26 ⁴
	Rainbow	288	73 ¹³⁶	8 ⁴	172	5 ⁵	191	...	...	301 ⁹
September	Brook	4	105	1	168	...	...	...	...	5
	Brown	8	114	2 ¹	185	...	...	...	...	10 ¹
	Rainbow	116	84	1 ¹	185	...	...	...	...	117 ¹

¹ All 0-group fish were measured on March 22, 1938 and corrected for shrinkage by a factor of 1.054, as previously determined by Shetter (1936).

² One legal brown trout, age not determinable, included in total of legal fish.

³ Two legal brown trout, age not determinable, included in total of legal fish.



Fig. 1. CCC crew cleaning lower blocking seine during removal of fish from section of South Branch of Pine River.



Fig. 2. Seining the lower section of the South Branch of the Pine. The upper blocking seine is upstream, just around the bend. Note the amount of shade and depth of water in this especially productive section.

FIG. 3. TOTAL NUMBER OF TROUT BY SPECIES IN EACH AGE GROUP BY MONTHS
 IN CENSUS SECTIONS OF THE NORTH BRANCH OF THE BOARDMAN RIVER.
 AVERAGE SIZE (TOTAL LENGTH IN INCHES) OF AGE GROUP SHOWN AT
 RIGHT OF BAR.

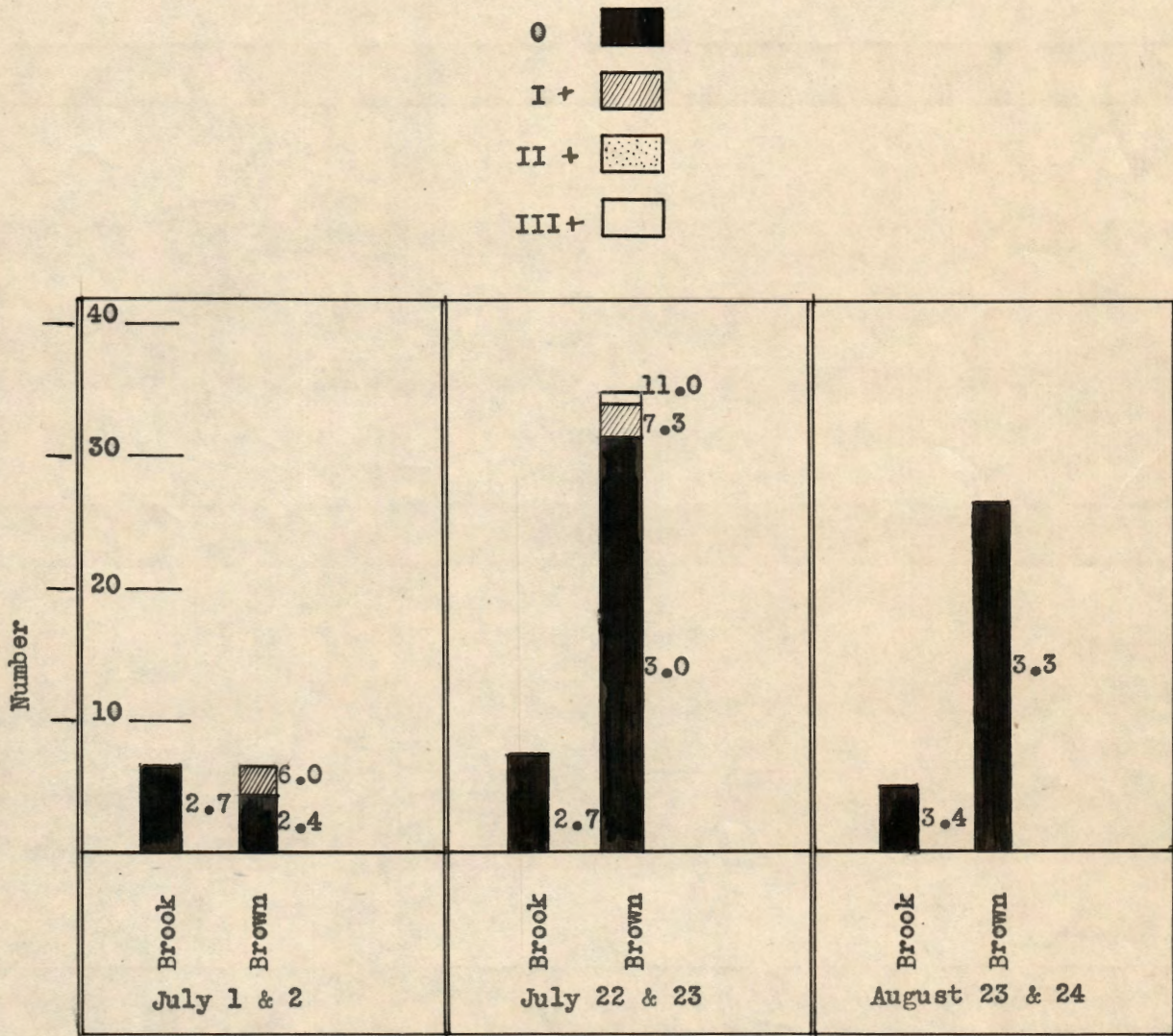


FIG. 4. TOTAL NUMBER OF TROUT BY SPECIES IN EACH AGE GROUP BY MONTHS
IN CENSUS SECTIONS OF THE SOUTH BRANCH OF THE PINE RIVER.

AVERAGE SIZE (TOTAL LENGTH IN INCHES) OF AGE GROUP SHOWN AT
RIGHT OF BAR.

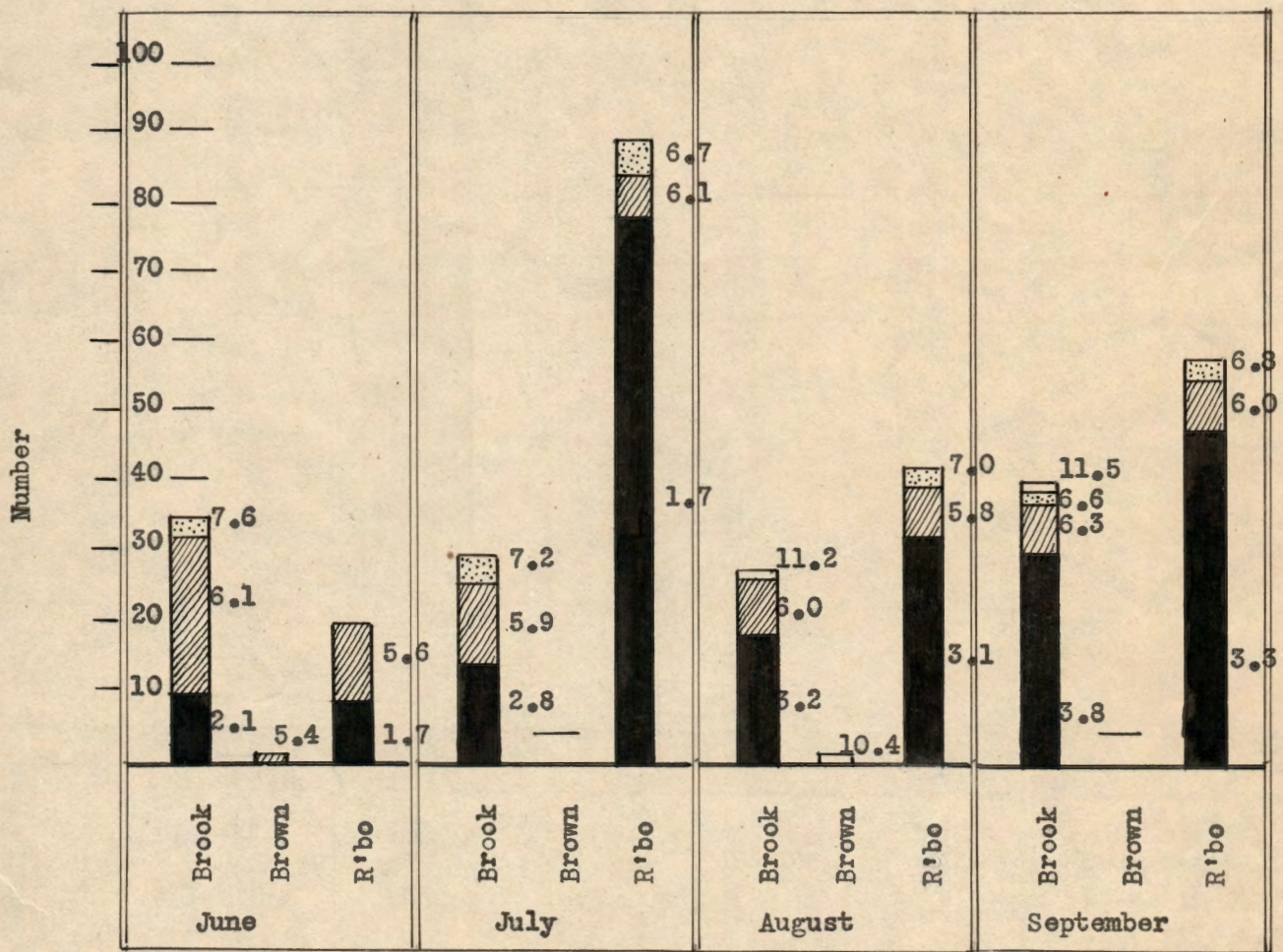
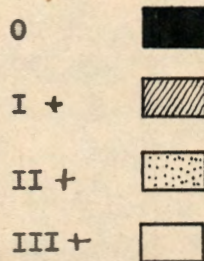


FIG. 5. TOTAL NUMBER OF TROUT BY SPECIES IN EACH AGE GROUP BY MONTHS
IN CENSUS SECTIONS OF THE LITTLE MANISTEE RIVER.

AVERAGE SIZE (TOTAL LENGTH IN INCHES) OF AGE GROUP SHOWN
AT RIGHT OF BAR.

