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REPORT NO. 396

TROUT CENSUS ON A SMALL SECTION OF THE  
LITTLE MANISTEE RIVER, LAKE COUNTY, MICHIGAN

By David S. Shetter

Introduction

This project was a cooperative undertaking planned and executed by the Wild Life Division of the Manistee Purchase Unit of the U. S. Forest Service and the Institute for Fisheries Research of the Michigan Department of Conservation. Supervision of the project and equipment for capturing the trout were furnished by the Institute, while transportation and labor were supplied by the Forest Service. Mr. Eugene Kuhne, Wild Life Technician, represented the Forest Service, and the Institute for Fisheries Research was represented by the author. This report has been prepared by the Institute for Fisheries Research after a careful study of the specimens collected in the census work.

The most important goal which can be set in a management program involving any of our natural resources is (expressed in terms of the forester) a sustained yield. In order that he may obtain this yield, the forester first learns as much as possible about his trees--how old they grow, how fast they grow, sites and soils on which they grow best, what their growth and condition is in various concentrations, and the concentrations which give the greatest yield in board feet of lumber per unit area. With these facts at his command, the forester has been able to manage his plantings and his cuttings to make full use of the timber resource.

Data concerning our fish resources and the conditions under which they thrive best, comparable to information possessed by the forester and the farmer for their respective crops, must become available before adequate stocking policies for different types of water can be formulated. In the case of the fisheries biologist, sustained yield is represented by the crop of legal fish available each year for the fishermen, and efforts should be directed toward making this crop as heavy as the various waters will produce and still leave an adequate brood stock in the waters of the state.

In order to set up a fish management plan on a sustained yield basis, we have at hand, or can obtain facts concerning:

1. Species of fish present.
2. Type of water in which they live.
3. Foods on which they usually feed.
4. Length of life, and rate of growth.
5. Time of spawning and habitat desired for spawning.
6. Types of bottom (at least for trout streams) that produce the most food.
7. Factors that hold down the fish population.

We need to know:

1. In what concentrations (number of fish per unit area) do fish populations occur in the various waters of the state? A small amount of data has been accumulated on this point (Eschmeyer, ~~Cooper~~, Shetter<sup>1936</sup>).
2. What concentrations of fish produce the largest number of legal fish of normal weight for their length? (Very little is known about this question). This point is further complicated by the necessity of learning the suitable combinations of habitats for species living in association, and at the same time providing for the varying needs within the age groups of the fish of a single species.
3. How much natural food does it take to raise a fish to legal size?

How much to sustain it? (Must experiment for this).

4. What constitutes "normal" growth for the various species, and under what conditions is it attained? (Must set up from comparison of fish from various waters).
5. How heavily fished is the particular water in question? (Creel census is answering this in certain lakes and streams. More creel census needed).

When we do have all the desired information assembled, it must then be coordinated into a policy which will give a sustained yield of legal fish. The setting up of this policy will necessarily involve more experimentation, more trial and error, since there are so many interlocking ecological factors to be modified (if possible) by human agency in changing the sequence of events in nature to suit our desires.

In 1930, Dr. John Greeley (Greeley, 1931) made one of the earliest attempts to begin a solution of the problem of population density by censusing a small section of the Little Manistee River and studying in detail the fish collected.

This report presents the results of an effort to duplicate the census of Dr. John R. Greeley (Greeley, 1931) on the Little Manistee River in 1930 in an attempt to discover any changes that might have occurred in the trout population, which at that time was thought to be rather dense. Dr. C. M. Tarzwell, who assisted Dr. Greeley in the original work, marked out the boundaries of that portion of the stream which was censused in 1930, so that both counts were made on the same locality in the stream. Both the 1930 and 1936 censuses were conducted in mid-August (August 14-18).

#### Description of Waters Sampled

The section sampled was estimated to be 50% gravel, 45% sand and 5% muck over sand at the edges. Most of the stream bed is sandy, although there are stretches of gravel interspersed at intervals. Shading is below average for the stream as a whole and consists chiefly of hardwoods (oak, poplar, and alder, a few maples, relatively few pines).

Description of Methods Used

Stout stakes 8 feet long were driven at the upper and lower end of the section 24 hours in advance in order that the fish would not be permanently frightened away from the area. On the following day the stream was thoroughly blocked to passage of fish by stretching seines (60' x 6') across the upper and lower ends of the section to be counted. These were backed up by wire fencing (1" x 4" mesh) which served the purpose of supporting the blocking seines. The section cut off by nets measured 160.4 feet long and 30.6 feet wide. Two CCC enrollees (Camp Irons) were detailed to keep the upper net free of debris, and four enrollees were employed at the lower net for the same purpose.

The portion so blocked was then seined thoroughly with a 30' x 6' seine having a 1/4" mesh. Seining was continued until no more fish could be taken. As the fish were captured they were placed in a tub of water, from which they were counted and measured, then either preserved or released below the lower seine. All legal rainbows, 3 of the legal brown trout, and a majority of the remaining size groups were preserved for stomach analysis and to determine the rate of growth from scale readings.

Results

	Greeley, 1930	Shetter & U.S.F.S., 1936
Length of section	126 feet	160.4 feet*
Width of section	28 feet	30.6 feet
Total trout	534	595 )
Total rainbow	475	478 )
Total brown	27	90 )
Total brook	27	27 ) - See Table 2, App.
Legal Rainbow	5	10 )
Legal Brown	Not given	5 )
Legal Brook	Not given	0 )
Total trout per mile	22,000	19,588 - See Table 3, App.
Total trout per acre	6,500	5,777 ) - See Table 4, App.
Legal rainbow/acre	52	97 )
Legal rainbow/mile	160	329 ) - See Table 3, App.
Total rainbow/mile	20,000	15,736 )
Total brown/mile	1,130	2,963 )

\* See Appendix.

The comparison of these two counts made six years apart show that there has been little change in the components of the August trout population of the Little Manistee River, either as to number or as to length frequency distribution. The population has changed in the following respects:

- (a) Brown trout have almost trebled in number in this particular area;
- (b) The number of legal rainbow trout was found to be twice that found in 1930 by Greeley;
- (c) From Graph 1 it will be seen that the average size of this year's rainbow trout hatch is about  $3/4$  of an inch larger than was the 1930 hatch. This may have been due to more propitious weather and food conditions.
- (d) The number of brook trout in the area is approximately the same as at the time of Greeley's census in 1930.

A length-frequency chart of the specimens collected was drawn up. This followed closely a similar chart drawn up by Greeley in the same manner in 1930, except that the first year fish (age shown by scale readings) were approximately  $3/4$  of an inch larger than at the same time in 1930 (Graph 1, Appendix).

The percentage of the rainbow trout population in the various length groups was also computed. It was found that less than 3% were legal-sized fish. Greeley's curve for the 1930 census is also included for comparison (Graph 2, Appendix).

The length frequency curves for the brown trout and the brook trout were drawn up also. Since Greeley did not make any such charts for the Little Manistee River brook and brown trout, there is nothing with which the present results may be compared (Graphs 3, 4, Appendix).

Production in pounds of trout per acre was also computed from the 1936 census of the Little Manistee, although Greeley had not undertaken this in his 1930 work. Our calculations showed that in this section there were 104.5 pounds of trout per acre of stream divided as follows: rainbow trout, 72.6 pounds per acre; brown trout, 26.1 pounds per acre; brook trout, 5.8 pounds per acre. Of the 104.5 pounds of trout per acre of stream, 21 pounds per acre (20%) are rainbow and brown trout

of legal size (7-10") (See Table 5, Appendix).

#### Age of Fish in Sample

Scale samples from all the larger size classes of trout were taken and the age of the fish determined by the use of the scale projecting machine. All rainbow trout above 5 inches in the census were found to possess only one winter mark on their scales, which indicates that they were in their second year of life. This size group made up only a small portion of the total population. Scale samples from the remainder of the rainbow population showed that the size classes below 5 inches possessed no winter marks--in other words, had not completed their first year of life.

Of the brown trout, only the five legal fish were in their second year of life, the remainder (85) of the browns being in their first summer.

These results on the age readings of rainbow trout parallel those of Greeley, with the exception that he found one rainbow in his samples which was in its third year. Greeley's scale samples collected in 1930 were compared with those collected during August, 1936, in order to be certain that both sets would be interpreted in the same manner. The 1930 work did not include the aging of brook and brown trout taken from the Little Manistee.

#### Food Studies of Specimens Collected

##### Analyses by J. W. Leonard

All the larger fish, with the exception of 3 legal brown trout, were preserved for stomach analysis. The examination on these larger fish has been completed, and the data obtained are presented in Table 6. The results of the stomach analyses of the smaller size classes will be presented as soon as they are completed by Mr. Leonard.

Table 6 indicates (if the number of fish examined is sufficient) that there appears to be relatively little competition between the brown trout and the rainbow trout of this size range (average length brown trout, 7.9"; rainbow trout, 7.2") for food at this season of the year. The three legal brown trout examined evidently

fed most heavily on a common snail (Physa) of the Little Manistee. The rainbows preyed largely on insect life, particularly the nymphal and larval stages of mayflies, stoneflies, caddis flies, and true flies, competing only to a slight extent with the brown trout for Physa.

It should be noted that there was evidently competition between the legal and sub-legal rainbow thus far examined, since both length-groups had eaten practically the same forms of aquatic and land forms of insects (Table 6, Appendix).

Although only four muddlers (1 1/2"-3") (Cottus) and two suckers (Catostomus) (2"-3") were taken in seining, it is felt that this does not represent the true density of the forage fishes. Large schools of 8"-12" suckers were observed the day preceding the census in holes immediately down stream. However, no trout examined had any fish remains in their stomachs.

Although the stomach analyses of the preserved specimens is not yet complete, the results of all that have been so far examined indicate that there is competition between the larger and smaller fish of the same species. This is quite obvious in the case of the legal and sub-legal rainbow trout. Until there is a more thorough examination of the bottom food of the area, it cannot be stated whether or not there is an actual shortage of trout food.

The only other work of a similar nature known to the Institute is that of the New York Biological Survey. This work has been under the direction of Dr. Greeley and Dr. Emmeline Moore (Moore, 1934) and was carried out in the manner described in Greeley's report on stream census methods to the Michigan Department of Conservation in 1930.

A census on Trammel Creek, New York showed the trout production to be 97.5 pounds of brook trout to the acre. However, only 2.1 pounds of this were legal trout (trout over 6 inches). (Moore et al).

Comparing results obtained in the Little Manistee with those obtained by Greeley and Moore in New York, one finds that small New York trout streams present

much the same picture--many sub-legal fish per mile in relation to the number of trout that are of "keeper" size. The average standing crop of trout in pounds per acre in six New York streams is calculated at 53.2 pounds (Table 7, Appendix). The production of the Little Manistee was calculated to be 104.5 pounds of trout per acre. In New York, only 2% (2.1 pounds) of Trammel Creek production (97.5 pounds per acre) was available to anglers (6" size limit). In the Little Manistee, 21 pounds per acre or 20% of the total production in pounds per acre were fair game for the fishermen (7" limit). It is very likely that both Greeley's figures in New York and the percentage of legal trout in the Little Manistee would both be higher earlier in the season, since almost every census has been made during the month of August. It is very probable that fishermen in the earlier months of the trout season have removed an appreciable number of the legal fish, both in New York and Michigan, and that growth has not kept pace with removal.

#### Interpretation of Results

Since both the 1930 and the 1936 censuses indicate what seems to be a high population of fingerling rainbow resulting from natural spawning, any **stocking** of the Little Manistee in the near future appears to be unnecessary. Plantings of any species of trout would only increase or bring about a greater degree of competition for the available food, make for slower growth rate of the fish already present, and in general result in fewer rainbows reaching legal size before migrating to Lake Michigan.

Several methods might be employed to decrease the intensity of the rainbow trout population if this proves necessary and desirable. The three most practical ways are:

- (a) by seining out a portion of the wild fingerlings and planting where needed elsewhere;
- (b) by blocking the spawning run with a weir, or
- (c) by raking over the nests shortly after the spawning season in the spring.



Of these methods proposed, the first is probably the best and the more logical in that it involves the use of something already provided by nature instead of destruction of a natural **product** after its creation.

The results of this report represent a sample from only one section of the Little Manistee which may not present a true picture of conditions throughout the length of the stream. More sections of the Little Manistee should be censused in the same manner and an average population density computed. Scale samples and length measurements from the large adult spawning rainbow of the Little Manistee are also needed in order that the length of these fish when they leave the stream may be determined. Greeley (Greeley, 1933) found 26.2% of 102 1st year rainbow of Little Manistee to be legal at the time they left for the lake.

Census work should also be conducted on other rainbow trout streams so that we may have something with which to compare these results, and thereby learn if more legal fish are produced per mile of stream in waters that are more heavily or more lightly "seeded."

#### Summary

1. A re-census of the area originally studied by Greeley in 1930 showed practically the same conditions as to length-frequency and age of size classes to obtain in 1936 as in 1930. The stream is still heavily populated with small rainbow trout.

2. The only noticeable changes found were:

- (a) slightly fewer total number of fish per mile of stream.
- (b) number of legal rainbow had doubled.
- (c) three times as many brown trout were present compared with results of 1930.

(d) The size of the yearling rainbow trout was larger than in 1930.

3. Although stomach analyses are not complete as yet, data available tend to show competition between large and small fish of the same species rather than between different species--as far as the brown and rainbow trout are concerned. (No legal brook trout taken.)

4. Seining out some of the rainbow fingerlings is suggested as one practical method of thinning the large numbers of that species present in the upper gravel stretches of the Little Manistee River if overpopulation is proven by the investigation suggested.

5. Comparison with trout stream censuses conducted in New York reveal that many of the New York streams are as heavily populated with small stock as is the Little Manistee. However, the Little Manistee on the basis of the last census, has a larger percentage of legal fish to offer the fisherman than do the New York streams censused by Greeley and Moore to date.

6. With the exception of a recommendation that no stocking be done in the Little Manistee, no other interpretation of the results is considered justifiable.

7. Suggestions for further study of the general problem were made.

INSTITUTE FOR FISHERIES RESEARCH

David S. Shetter

A P P E N D I X

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Table 1

Measurements of Section of Stream Censused,  
Little Manistee River, August 18, 1936

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Length.....	243 links (160.4 feet)
Width.....	46.4 links (30.6 feet)
Depth.....	4"-2 $\frac{1}{2}$ " feet, average - 18 inches
Bottom.....	50% gravel, 45% sand, 5% muck over sand at edges (estimated)
Acreage.....	0.103 acres
Mileage.....	0.0304 miles
Temperature.....	Air - 84, Water - 67, Time - noon

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The measurements for length and width differ from those of Greeley in 1930. However, there are two possible sources of error. Tarzwell may have dis-remembered the exact location of the 1930 stakes, or Greeley may have been in error in his measurements by pacing. The 1936 measurements were made with a surveyor's chain.

From a section of stream measuring 160.4 feet by 30.6 feet (Table 1, Appendix), a total of 601 fish comprising five species were taken. This total was made up of the following: 478 rainbow trout, 90 brown trout, 27 brook trout, 4 muddlers, and 2 suckers (~~Table 2, Appendix~~).

Table 2  
Stream Census, Little Manistee River  
Actual Fish Count, August 18, 1936

Species	Size Range				Total
	0-3 7/8"	4"-5 7/8"	6"-6 7/8"	7"-10"	
Rainbow Trout	455	3	10	10	478
Brown Trout	64	21	..	5	90
Brook Trout	26	1	..	..	27
Muddler	4	..	..	..	4
Sucker	2	..	..	..	2
Totals	551	25	10	15	601

Tables 3 and 4 are based on calculations using figures found in Tables 1 and 2. No allowances have been made for a small number of fish which undoubtedly escaped. Calculations for fish per mile and per acre are therefore minimum calculations.

By substituting the figures for total fish and length of section censused in the following equation,  $\frac{\text{number of fish in section}}{\text{length of section}} = \frac{\text{number of fish per mile}}{5,280}$ , the number of fish per mile of water can be computed. This gives the following results for the Little Manistee River:

Table 3

Number of Fish per Mile,  
Little Manistee River, August 18, 1936

Species	Size Range				Total
	0"-3 7/8"	4"-5 7/8"	6"-6 7/8"	7"-10"	
Rainbow Trout	14,979	99	329	329	15,736
Brown Trout	2,107	691	..	165	2,963
Brook Trout	856	33	..	..	889
Muddlers	132	..	..	..	132
Suckers	64	..	..	..	64
<b>Total</b>	<b>18,138</b>	<b>823</b>	<b>329</b>	<b>494</b>	<b>19,784</b>

Total trout per mile = 19,588

Table 4

Number of Fish per Acre  
Little Manistee River, August 18, 1936

Species	Size Range				Total
	0"-3 7/8"	4"-5 7/8"	6"-6 7/8"	7"-10"	
Rainbow Trout	4,418	29	97	97	4,641
Brown Trout	621	204	..	49	874
Brook Trout	252	10	..	..	262
Muddlers	39	..	..	..	39
Suckers	19	..	..	..	19
<b>Total</b>	<b>5,349</b>	<b>243</b>	<b>97</b>	<b>146</b>	<b>5,835</b>

Total trout per acre = 5,777

These tables were computed in the same manner as Table 2.

Table 5  
Calculated Pounds of Trout Per Acre  
According to Size Range

Species	0"-3 7/8"	4"-5 7/8"	6"-6 7/8"	7"-10"	Total
Rainbow Trout	49.6*	1.7	9.0	12.3	72.6
Brown Trout	11.3	6.1	...	8.7	26.1
Brook Trout	5.3	.5	...	...	5.8
Total	66.2	8.3	9.0	21.0	104.5

\* Weight in pounds.

These figures were calculated from Table 4, using number of fish per acre in the various size classes and multiplying those results by the average weights as determined by weighing preserved specimens of the various size classes in the laboratory.

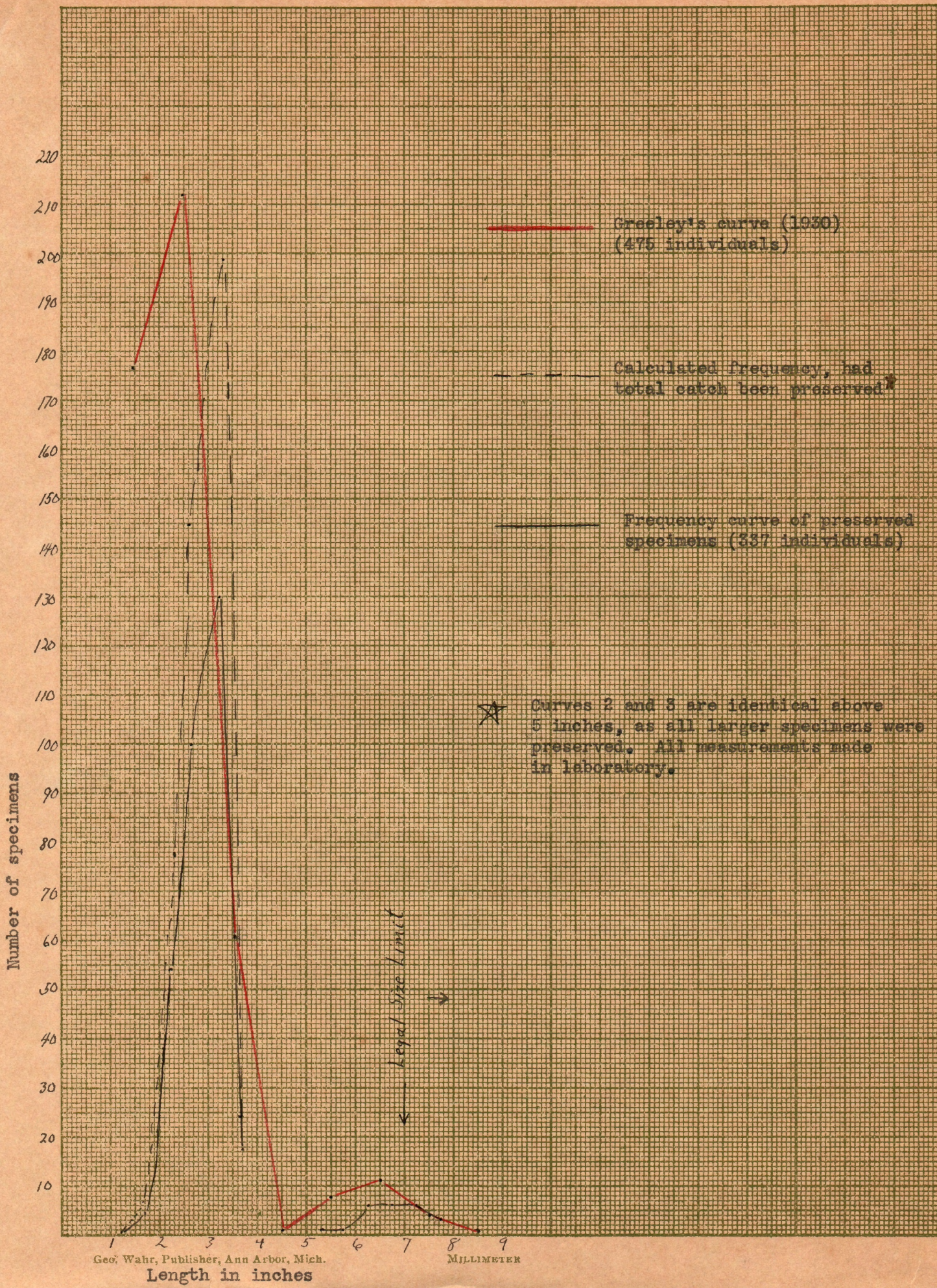




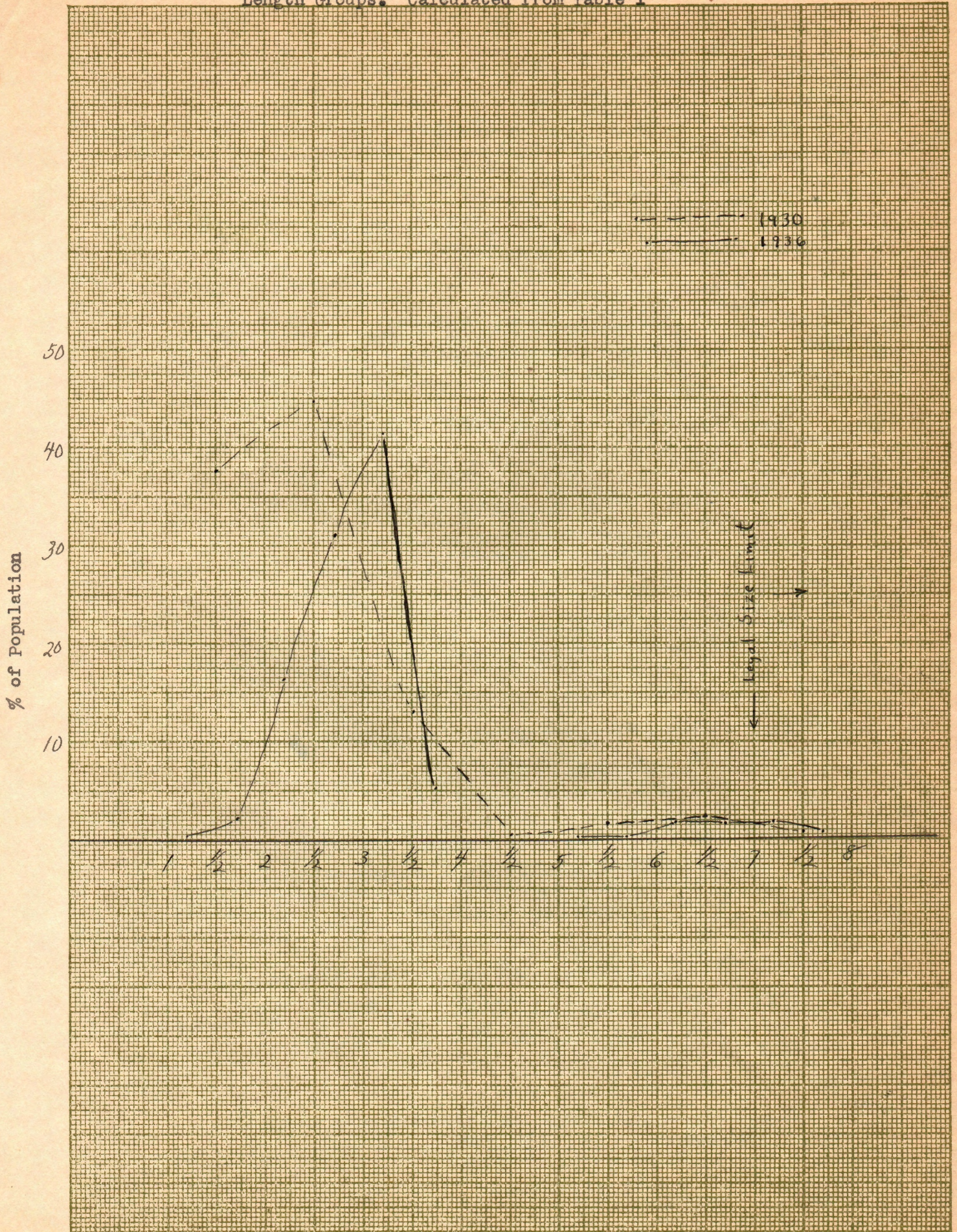
Table 7  
Production of Pounds of Trout per Acre  
In Six New York Streams

	Pounds of Trout Per Acre	No. of Trout Over 6" In Sample
Stafford Brook (average of 2 counts)	17.7	5 in 53
Cold Brook	46.1	5 in 12
Rainbow Brook	146.5	1 in 51
Trib. 10 of Tupper Lake	42.3	0 in 56
Trib. 1 of Clear Pond	93.4	0 in 53
Pine Brook	7.1	0 in 15
Average total lb./acre	58.3	

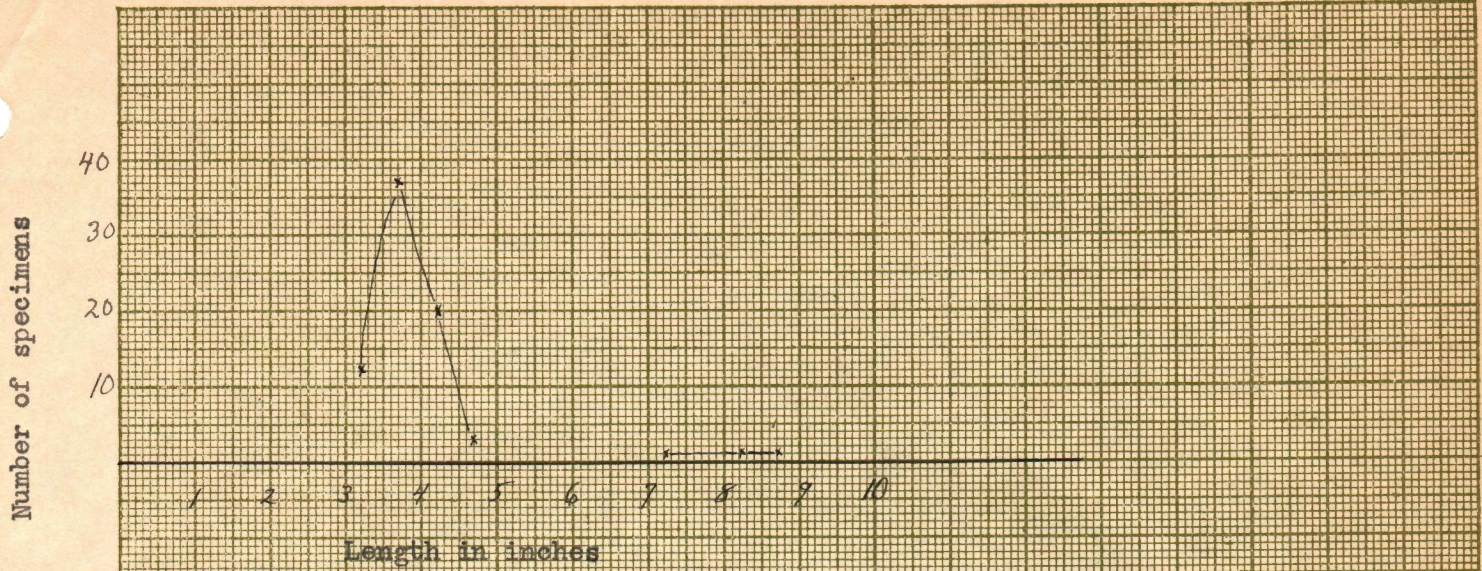
Graph 1 - Length Frequency Distribution of Rainbow Trout



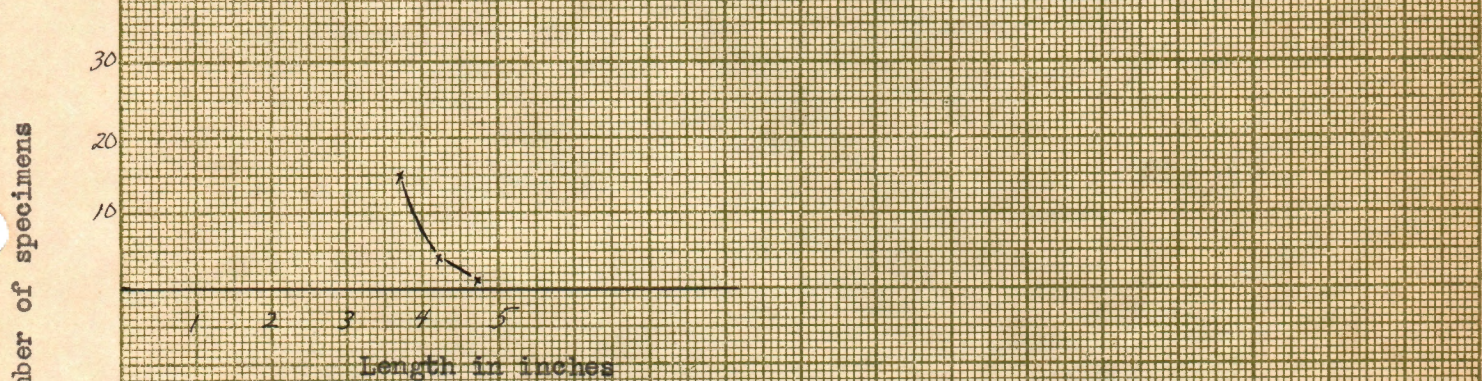
Graph 2 - Percentage of Population of Rainbow Trout in Various Length Groups. Calculated from Table 1.



Graph 3 - Brown Trout--based on 75 specimens



Graph 4 - Brook Trout--based on 20 specimens



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