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TROUT STREAM POPULATION STUDY ON HUNT CREEK

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by

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In the course of the construction of the diversions in Section C of the Experimental area, it was necessary to divert the flowage of the main stream through the newly-dug race so that wooden forms could be erected in the main channel, in which to pour concrete for the screen supports. The diversion of the water from its old channel presented an excellent opportunity to study the entire fish population of the section of stream which was cut off.

Procedure

On the morning of September 25, 1940, at 7:30 A.M. blocking seines (3/8 inch bar measurement) were placed across the stream at points X and Y (see Figure 1), while the stream flow was in the process of being blocked and diverted through II and III-B by a tight sand-bag dam at point Z. The lead lines of both blocking nets were held tightly to the bottom and to the banks by a row of large boulders placed on each lead line. The entire fish population of II-A and III-A, consisting of 580.5 feet of stream (0.130 acres of water), was trapped off. In about 45 minutes, almost all of the normal water content had drained out of the cut-off area, and the fish were concentrated

in some twenty to thirty scattered, and more or less isolated, small pools.

At this time seining was begun; a 4 ft. x 4 ft. common-sense minnow seine was used. All parts of the main channel containing any water were thoroughly netted, and most of the fish found were caught by seining. The few fish taken by hand or with the aid of a scap net were mostly muddlers. All fish captured were placed in a tub of fresh water, and then counted and weighed by species. All legal trout (7 inches or larger) were weighed and measured individually, and measurements and scale samples from a representative series were taken from trout of less than legal size. After weights and measurements were taken, all fish were then released alive downstream from the lower blocking net. The entire day of September 25 was spent in the seining and the recording of the captured fish.

Despite the fact that approximately six hours of intensive seining effort had been expended on less than 600 feet of stream, a small, but nevertheless observable, percentage of trout and muddlers still remained in the blocked-off area of the stream (II-A and III-A). It was decided to leave the blocking nets in place overnight and apply poison to the pools on the following morning. Accordingly at 7:15 A.M. on September 26 (with the air at 38° F. and the water at 44° F.), powdered Derris Root (5% rotenone content) was introduced into the scattered pools. Two hundred grams of the powder were mixed with 5 quarts of water, and a small portion of this mixture was sprinkled over the surface of each pool in the diversion III-A. After about ten minutes, the remaining trout and muddlers began to show signs of distress, and could be collected either by hand or with the aid of a scap net.

Some of the poisoned water was draining from diversion III-A into diversion II-A (see diagram), because of a small amount of spring seepage

present in diversion III-A. Previously undiscovered trout in diversion II-A began to show signs of distress about 9:30 A.M., although none of the poison mixture had been spread by hand in this part of the stream. To force the already poisoned water into diversion II-A, water from above the sand-bag dam at Z was piped through the dam, using a 4-inch and a 5-inch pipe with screened ends.

After allowing about one-half hour of flow through the pipes, the water was diverted again, and collection of the remaining fish in diversion II-A was continued. At this time, only about one-half of the aqueous mixture of the poison (2½ quarts) had been used. No more was added, since the poisoned water from the uppermost area sufficed to kill all the remaining fish in the lower section.

As there was no accurate means of determining the volume of water in the respective pools, the actions of the fish indicated that we might have applied an extremely toxic solution of rotenone. The lethal action of the poison-bearing water did not seem to diminish on being forced into the lower portion of the stream, so it was decided that the poisoned water should be pumped out of the stream and thrown onto the banks, so that no fish further downstream would be endangered. Accordingly, a sand-and-gravel dike was thrown across the stream channel below the stop-net at Point Y, and a Stewart forest fire pump (65 gal. per min. capacity) was set up for operation at 1:00 P.M. This pump did not throw enough water to keep ahead of the seepage, so a pitcher pump of 100 gallons per minute capacity was placed in operation at 4:00 P.M., and ran until 8:00 P.M. that night. By this hour, all the water had been removed except that entering the blocked off stream by spring seepage. There was at this time

little or no drainage between pools. A small notch was cut in the dike at C, and the remaining water was allowed to drain off slowly. A careful inspection of the stream below the scene of the poisoning on the morning of September 27 revealed that no fish had been killed.

Fish population of the drained area

The fish present in the part of the stream from which the water was diverted were of two species; most of them were brook trout (Salvelinus fontinalis), and the remainder were muddlers (Cottus bairdii bairdii). From diversion III-A which is 298 feet long, and averages 9.2 feet wide, and which is 0.063 acres in area, a total of 345 brook trout, and 90 muddlers were captured (Table 1). In the lower section (diversion II-A), which is 282.5 feet long by 10.5 feet wide, and which is 0.068 acres in area, muddlers removed amounted to 98, while 260 brook trout were found (Table 2). The total number of trout removed from the 580.5 feet of stream (0.13 acres) was 605, along with 188 muddlers (Table 3). On the basis of the measurements and figures this section of the experimental stream was supporting a minimum of 4,619 brook trout and 1,435 muddlers per acre, or, expressed in pounds per acre, 94.23 pounds of brook trout and 9.68 pounds of muddlers. (It should be remembered that an unknown, but probably small number of legal trout were removed from this part of the stream during the 1940 trout season, which closed on September 4, 1940).

Of the 605 trout captured (diversions II-A and III-A), 40 fish were of hatchery origin. Thirty-nine of the hatchery fish were marked fingerlings released in Section C in August, 1940, while one fish originated from the October, 1939, planting. These hatchery trout made up 6.7 per cent of the total trout population, and all were considerably less than legal length at the time of the census. By weight, the hatchery trout made up 2.7 per

cent of the calculated total weight of trout per acre (2.57 of 94.23 pounds). Obviously, the great majority of the trout population is of natural origin in this particular section of Hunt Creek. Judging from measurements on the marked hatchery fish, very few of the hand-reared brook trout will enter the legal catch during the 1941 trout season.

Size distribution of the trout population

All specimens obtained in diversions II-A and III-A were combined to draw up a size-frequency table (Table 4 and Figure 2). This table and chart show that the great majority of the brook trout present were fingerlings (less than 100 mm. total length). Of the total number of trout captured (605), 2.3 per cent (14) were 7 inches or larger, 22.0 per cent (133) were sub-legal (between 100 and 176 mm. total length), and 75.7 per cent (458) were fingerlings. By weight, legal trout made up 19.4 per cent, sub-legal trout made up 48 per cent, and fingerling trout made up 32.6 per cent, of the total weight of trout captured.

Comparison of the populations of the two diversions

The populations of the two areas have been calculated separately to determine what differences existed in the components of the total population. Diversion II-A (lower section) was slightly larger and had more pools and larger pools (average depth 1.2 feet as compared with 1.0 feet in Diversion III-A), and the underwater cover was of better character. The largest number of wild, legal-sized brook trout were found here (10 as compared with 4) and also the largest number of sub-legal brook trout (76 as compared with 57). However, the number of wild fingerlings were considerably fewer (161 as compared with 251) than were found in the shallower and slightly smaller diversion III-A. The corresponding calculations of

number and pounds per acre were of the same magnitude (Tables 1 and 2). The marked trout both of wild and hatchery origin, which were in general of fingerling size, or only slightly larger, were over twice as numerous in diversion III-A as in II-A. The total poundage of fish removed from diversion III-A was 101.57 as compared with 106.33 pounds from diversion II-A.

An analysis of the difficulty of capture of the fish

Of some interest was the difficulty with which the various sized brook trout and muddlers were captured. Seining activities were initiated as soon as the water level had dropped, and were continued all morning (approximately 3½ hours), at which time it was thought that more than half of the fish present had been removed. In both diversions, exactly 50 per cent of the legal-sized brook trout were taken in the morning seining, roughly one-half of the sub-legal brook trout, and approximately 63 per cent of the fingerling brook trout. Capture of the muddlers varied considerably; in diversion III-A, some 41 per cent were taken in the morning seining, while in diversion II-A, only 3.1 per cent were captured (tables 5 and 6).

In diversion III-A, the percentage of trout removed by seining (both afternoon and morning) was 91.9, while poison accounted for 8.1 per cent (27 fingerlings, 1 sub-legal fish). The percentage of all fish removed by seining was 81.4, by poison, 18.6. The derris root powder was extremely efficient on the small muddlers which were difficult to capture with the common-sense minnow seine, as this species was able to escape the lead line by burrowing in gravel and rubble.

In diversion II-A, the percentage of brook trout taken by seining was 86.2, the percentage removed by poison was 13.8 (24 fingerlings, 12

sub-legal fish). The percentage of all fish taken by seining was 72.6, by poison, 27.4.

To further demonstrate how much error would be introduced by consideration of results obtained by seining only, the percentage of the weights removed from the two sections by the seining and by poisoning are given also in Tables 5 and 6.

For example, seining alone accounted for only 84.3 per cent of the total weight of fish taken from Diversion II-A. Seining appears to have been more efficient, however, in Diversion III-A, where almost 93 per cent of the total weight of fish captured were taken by this method.

On the basis of the percentage of the number of trout removed by seining (Table 6), Diversion II-A might be classed as moderately difficult to seine, and Diversion III-A (Table 5) as easy to seine, if data presented by Trippensee (1937) on New Hampshire streams are regarded as applicable to Michigan trout waters.

The discrepancies that can be noted in Tables 5 and 6 between the populations found by seining, and those found by seining plus poisoning, demonstrate conclusively that seining alone cannot remove all the fish from even a small area of stream unless conditions are extremely favorable, and these conditions (such as gently sloping shore, smooth bottom with no rocks or snags, gentle current, etc.) seldom occur in an average trout stream. It should be remembered, too, that seining in these sections was conducted with a lowered water level, which was so low as to almost isolate the deeper pools, and with no interference in the seining operations from effects of the water currents. Had the water level and current been of normal proportions, we probably could not have taken as many fish by seining as shown on the tables. In the future, in order to place less dependence on seining operations to secure the fish, the use of a small, electrically-operated pump is planned so that pools may be drained still further, and their fish contents more easily and accurately removed. The

staff of the experimental station also hopes to try out electrical methods of population study, involving the use of a shocker which stuns the fish momentarily, enabling the investigator to collect the population with scap nets after the fish lose bodily control over their movements. Experimentors in New York have used such a device quite extensively (Haskell, 1939) and have reported favorably on its use.

Age and Growth Study

From the 605 brook trout enumerated in the total population of the two blocked-off stream areas, a more or less random series of scale samples were studied from 97 fish. This series was augmented further by a study of the scales from 27 brook trout collected from the same general stream area in the course of the September seining operations for marked trout. The growth history of the brook trout in Section C was determined from body-length measurements and scale measurements from 71 wild fish of the 124 fish whose ages were determined. All scales (except for 33 small trout of the 0 age-group and 19 from the I age-group) were mounted on slides in glycerin-gelatin and studied on the micro-projector under a magnification of 90 x. The fish noted in the exception were water mounts viewed under a binocular microscope or on the micro-projector, and were examined to determine as closely as possible the upper and lower limits of the size ranges of the 0 and I age-groups respectively.

The data demonstrate that the brook trout in the upper reaches of Hunt Creek are relatively slow-growing. From Table 7 and Figure 3 it will be noted that the average calculated total length of brook trout in this stream area does not reach the legal size of 7 inches until some time during the fourth summer of life (age-group III). According to the length

measurements and the growth calculations from scale measurements, the average total length of the wild brook trout in Section C at the end of one year is slightly more than 3 inches; at the end of two years, 5 inches; at the end of three years, just under 6 and 7/8 inches; at the end of about 3 and 3/4 years, 8 inches. (The average total length of 9 fish showing 3 annuli at the time of the census was 8 inches.)

Some comparative data on the average size of brook trout are available from the writings of Hazzard (1932) concerning the rate of growth of brook trout in New York. Studying rate of growth of brook trout in 13 streams of that state, Hazzard found the average calculated total length at the first annulus to be 94 mm.; at the second annulus, 135 mm.; and at the third annulus, 168 mm. Apparently, the brook trout from the New York streams studied grew at a slightly faster rate during the first two years of life than do the brook trout of Hunt Creek, but exhibited a diminished rate of growth during the third year. The curve for the New York averages is presented also on Figure 3.

The average total length of young of the year (spawned the previous fall and showing no annuli on their scales) was 68 millimeters (about 2 and 5/8 inches). The size range of the fish in the 0 age-group was from 57 to 81 mm. (2 1/4 - 3 1/4 inches total length). An overlap in the size ranges of the several age-groups was noted (Table 7 and Figure 2). Fish in age-group I ranged in size from 71 to 148 mm.; those in age-group II were found to measure from 120 to 218 mm; and fish in the oldest age-group, III, were found to range in size from 168 mm. to 240 mm. total length. Such an overlap as noted here makes it impossible to accurately predict the age of Hunt Creek brook trout from their size.

Although the growth curve drawn up from the average calculated total

lengths at the end of the various years of life indicate that the brook trout of Section C do not reach legal size until the fourth summer of life, actually a portion of the population does grow to the size of 7 inches or larger during the third summer of life (age-group II). It should also be noted that not all of the fish found to be in their fourth summer of life (age-group III) were of legal size.

Since the population study was conducted after the close of the 1940 trout season, the anglers' catch in section C very likely reduced the number and average size of the brook trout in Age-groups II and III, as the law permits the angler to keep only those fish captured which are above 7 inches in length.

Comparison of the growth of brook trout in Hunt Creek with available data from other Michigan streams, and also with averages from Ontario (Canada) brook trout

Comparisons of average total length of brook trout at various ages can be made between the brook trout of Hunt Creek, the White River, the Maple River, and the South Branch of the Pine River (Alcona County). Data from the work of Ricker (1932) is also available. These comparisons will be found in Table 8 and Figure 4. Scale samples and lengths from the above mentioned streams were obtained between June and October in three different years (1937, 1938, 1940). Average total lengths of brook trout in their first summer of life (age-group 0) are also included. From both the figure and the table it will be observed that the brook trout of Hunt Creek grow the slowest of any of the streams listed, and at all points in their lives are smaller than the brook trout from any other stream. The comparative data suggest that the legal size (7 inches) is reached in the other streams usually during the third summer of life, rather than in the fourth summer,

as has been found for the brook trout of Hunt Creek. Ricker's data suggests that the average size of Ontario brook trout is greater than 7 inches by the third summer of life. Since most Canadian investigators refer to fork length as total length, the greatest possible length (length to tip of longest tail rays) given in Table 8 and Figure 4 for the Ontario brook trout probably would be in actuality 1/8 to 1/2 inch longer. From the curves in Figure 4, it appears that the Ontario brook trout grow somewhat less rapidly than Hunt Creek brook trout during their first summer of life, but exhibit a more rapid growth after that time.

Distribution of fish among the various age-groups

The distribution of the brook trout population among the various age-groups is of considerable interest. If it is assumed that the sample of fish which was studied for ages is random, the percentage of the total population of wild brook trout of the two diversions (565, i.e., 605 fish less 40 fish known to be of hatchery origin by their missing fins) in the various age-groups may be calculated from the percentages obtained from a study of the scale samples.

Table 9 presents the number and percentage of fish found in the various size ranges of the series of scales which were studied for ages. The percentages obtained were then applied to the known length-frequency distribution to calculate the total number of wild fish of the several ages in the various size groupings (Table 10). Where fish of the same age occurred in more than one size grouping, the sum was determined. The percentage of the total population of wild fish (565) in the age groups was found by dividing the number in each age-group by 565. According to this latter calculation, 46.7 per cent of the wild brook trout population were young of the year (no annulus), 30.8 per cent were two summers old (one annulus),

19.8 per cent were three summers old (two annuli), and 2.7 per cent were four summers old (three annuli).

Assuming that the population count in Diversions II-A plus III-A is representative of Section C of Hunt Creek, the age composition of the wild brook trout population of Section C in September, 1940, was as follows:

Age-group	0	2,153 fish
" "	1	1,425 "
" "	II	918 "
" "	III	119 "
Total population of wild brook trout	.....	4,615 "

The above figures were determined by applying the percentages obtained in Table 11 to the calculated number of wild fish per acre determined in Table 3 and then multiplying the results by 1.07, the measured water acreage of Section C.

It is interesting to note that if the calculated population of wild fish of legal size (114, i.e., 107 times 1.07) is correct, the anglers during the 1940 trout season removed approximately 50 per cent of the brook trout which were of legal size, or which grew to legal size during the summer of 1940, since the creel census recorded a catch of 113 legal brook trout in this section during the 1940 trout season.

Brook trout in the various age-groups as indicators of the percentage of survival from year to year

From the data available through the calculations demonstrated in Tables 9 and 10, the percentage of the calculated total population of Section C in the various size ranges and age-groups may be estimated. The number of fish surviving from one age-group to the next may be regarded as an index of the mortality from year to year, if it is assumed that mortality

between the several age-groups is the same each year. A survival of 66.2 per cent was found to exist between the first and second summers; between the second and third summers, 64.4 per cent; between the third and fourth summers, 13.0 per cent (Table 11). The number of fish surviving to the second, third, and fourth summers from 1,000 young of the year would then be 661, 426 (of which 19, or 4.3 per cent, would be of legal size), and 55 (of which 35, or 63.1 per cent, would be of legal size). In other words, in Hunt Creek only 54 brook trout out of 1,000 fingerlings reach legal size by the end of the fourth summer, or 5.4 per cent. As stated previously, only about 50 per cent of the total number of legal trout available to the angler were caught, so that the return per 1,000 fingerlings was only 2.7 per cent.

Condition of the population

Knowledge concerning the condition of the fish, that is, whether the fish are heavy or light for their respective lengths, is of interest in connection with their rate of growth. Since measurements and weights were available from 144 specimens from the population, the coefficient of condition was calculated for these fish. This series of coefficients is almost entirely for fish larger than 100 mm. total length. Neither time nor facilities for the accurate measurement of weights of fingerling fish was available during the population study. The coefficient of condition (K) was calculated from the formula

$$K = \frac{\text{weight in grams} \times 10{,}000}{\text{standard length in mm.}^3}$$

The average K for the 144 specimens (size range, 98-240 mm. total length) was found to be 1.469, and the K's ranged from 0.970 to 2.029. (Table 12).

The fish on which the K's were studied were separated into 10 mm. size

groupings starting at 90 mm. and running to 249 mm. The average K for each 10 mm. group was determined and plotted against the average total length (Table 12 and Figure 5). The table and the chart appear to demonstrate that the larger fish were in better condition (were heavier for their lengths), than were the smaller fish. Since the larger brook trout, particularly those above 150 mm. (6 inches) were approaching sexual maturity, or were mature and preparing for the spawning season, this latter factor probably accounts for the higher values of K recorded for the larger fish.

The average values of K found for the Hunt Creek brook trout are somewhat higher than the values of K published by Hazzard (1932) for 18 New York trout streams, and by Klak (1941) for 3 West Virginia trout streams.

Summary

1. The methods used to conduct an exact population study on a 580.5-foot stretch of Section C of Hunt Creek were described. To the best of our knowledge, the figures obtained represent a capture of 100 per cent of the fish present in the blocked-off area.

2. A total population of 605 brook trout and 188 muddlers were found. The calculated number of trout and muddlers per acre of stream was found to be 4,619 and 1,435, respectively, or, expressed in pounds per acre, 94.23 pounds of trout and 9.68 pounds of muddlers. Hatchery trout, recognizable by the fin combinations which had been clipped on release, made up 6.7 per cent of the trout population, and 2.7 per cent of the calculated total weight of trout.

3. Of the total number of trout captured (605), some 2.3 per cent were of legal size, 22.0 per cent were between 100 and 176 mm. total length,

and 75.7 per cent were between 55 and 99 mm. long.

4. More legal trout and trout of sub-legal size were taken from Diversion II-A, where the pools were slightly deeper than from Diversion III-A, which was relatively shallow. However, more small trout were found in Diversion III-A than in Diversion II-A.

5. An analysis of the rapidity with which the fish were captured from the blocked-off areas indicates that population studies conducted with the use of the seine as the sole method of capture cannot be expected to yield all the fish present even in a small area.

6. Age determinations on a series of scale samples from brook trout in the population demonstrate that the brook trout of Section C do not reach the legal length of 7 inches until their third summer, when about 4.4 per cent of the fish of that age are longer than 177 mm. Growth of brook trout in three other Michigan trout streams appeared to be more rapid.

7. The percentage distribution of the population among the various age groups was as follows:

0	I	II	III
46.7	30.8	19.8	2.7

8. Data on the coefficient of condition (K) for the brook trout of Section C of Hunt Creek demonstrate that the fish were rather heavy for their length, since the average values obtained were somewhat higher than K's already published for brook trout. The high values obtained may have been influenced by the approach of the spawning season.

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Figure 1

SKETCH MAP OF STREAM DIVERSIONS HUNT CREEK EXPERIMENT STATION

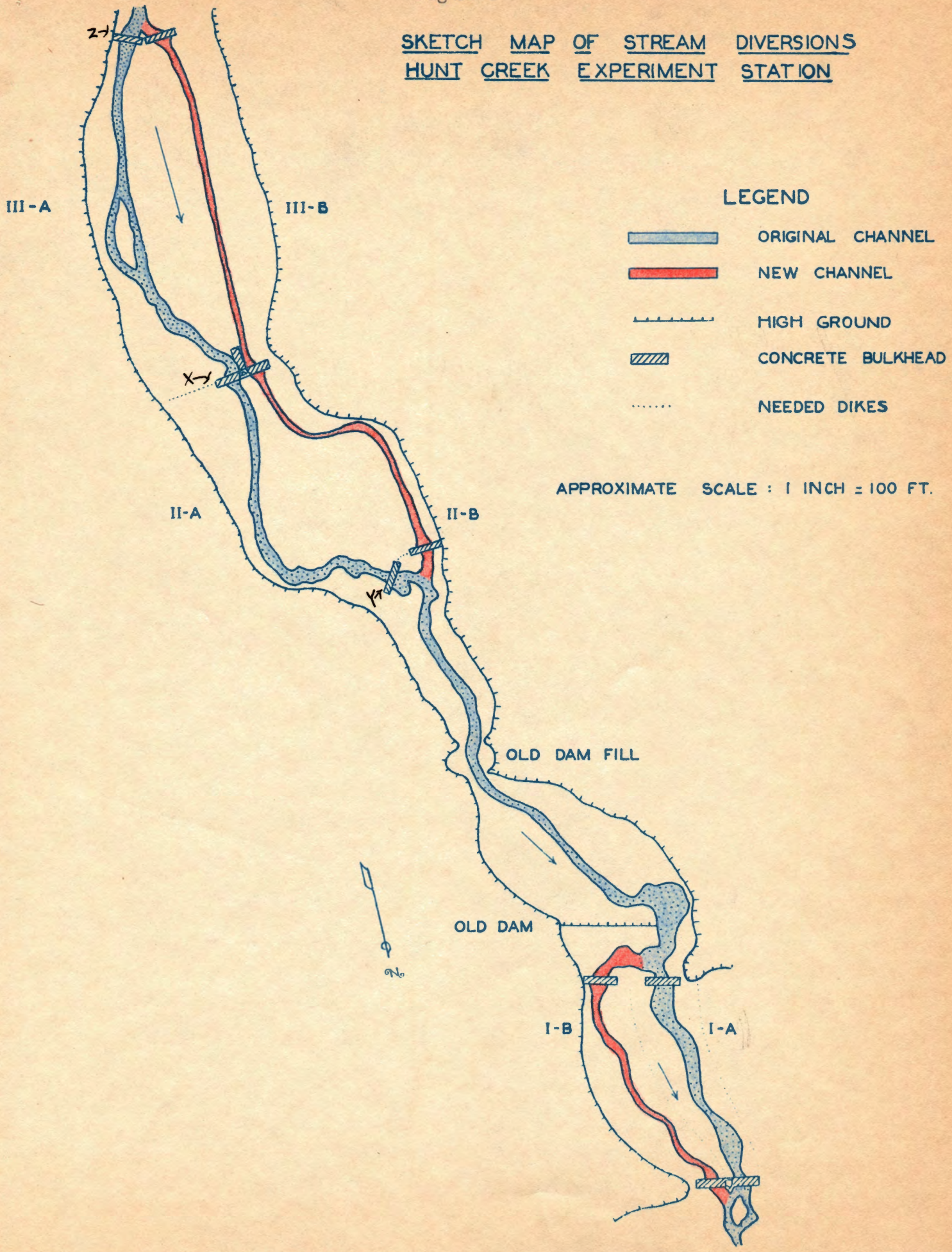

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Figure 2. Length-frequency histogram of total brook trout population of Diversions II-A and III-A (including 40 marked trout of hatchery origin), with size ranges of age-groups. Data taken from Table 4 and Table 8.

Figure 3. Average calculated total length of wild brook trout at various ages from Section C, Hunt Creek, Sept. 25, 26, 1940, with comparative data from 13 New York St. trout streams (Hazzard, 1932),(Hunt Creek data from Table 7).

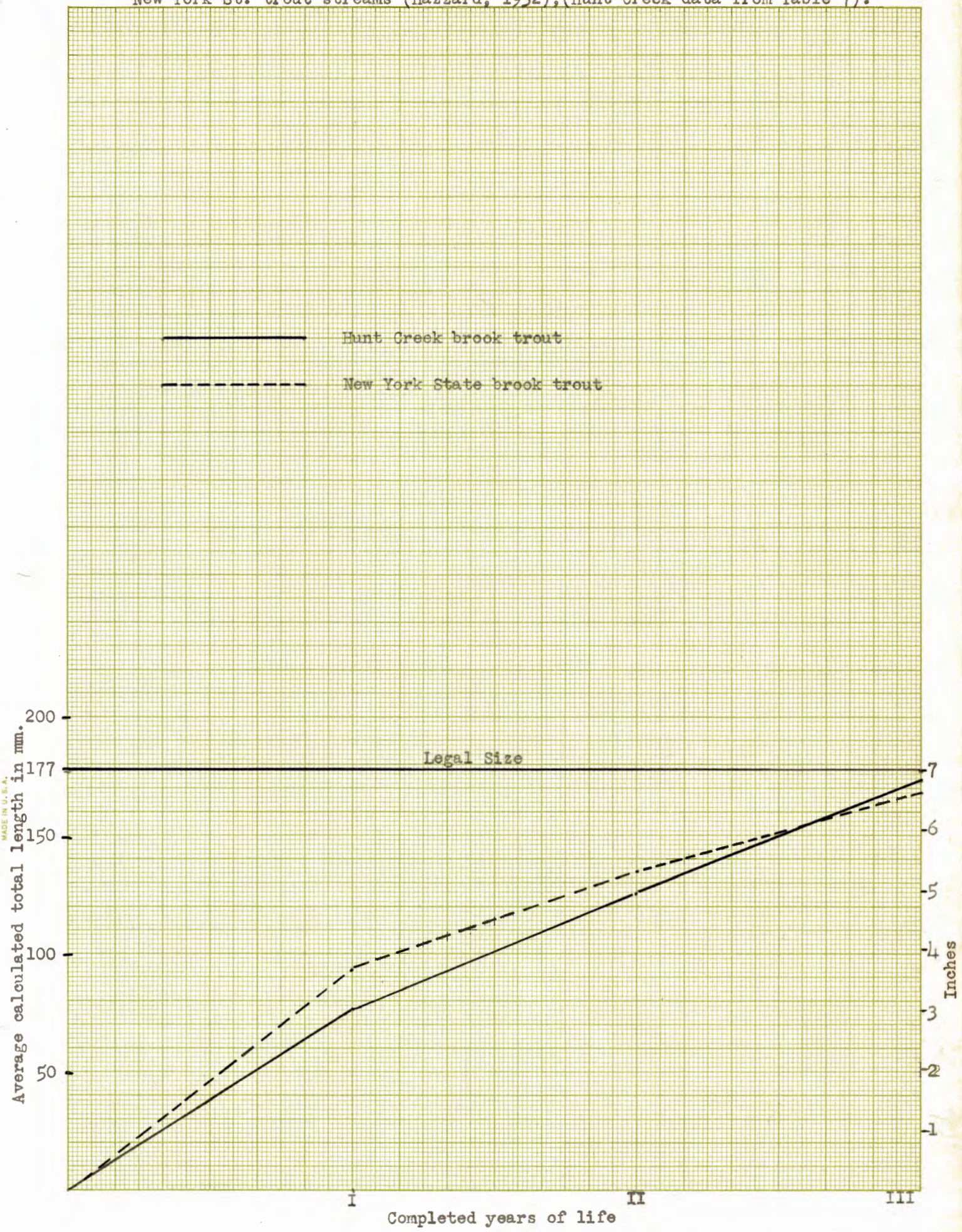

Figure 4. Growth curves of brook trout from 4 Michigan trout streams compared with average growth curve of Ontario (Canada) brook trout (Data taken from Table 8).

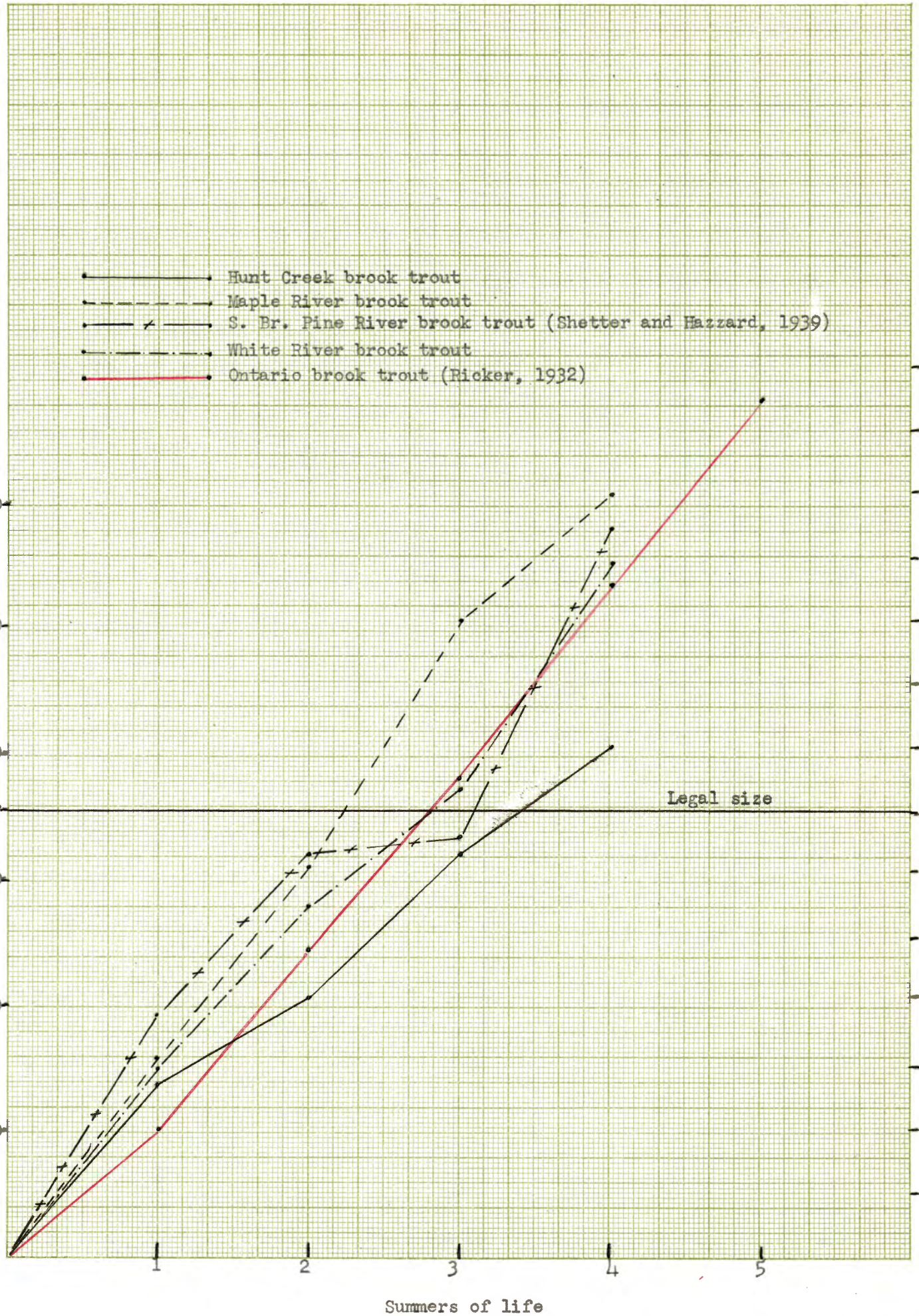

Figure 5. Average coefficient of condition (K) plotted against average total length for brook trout of Section C, Hunt Creek, Sept. 25, 26, 1940, determined by 10 mm. groupings. (Data taken from Table 12).

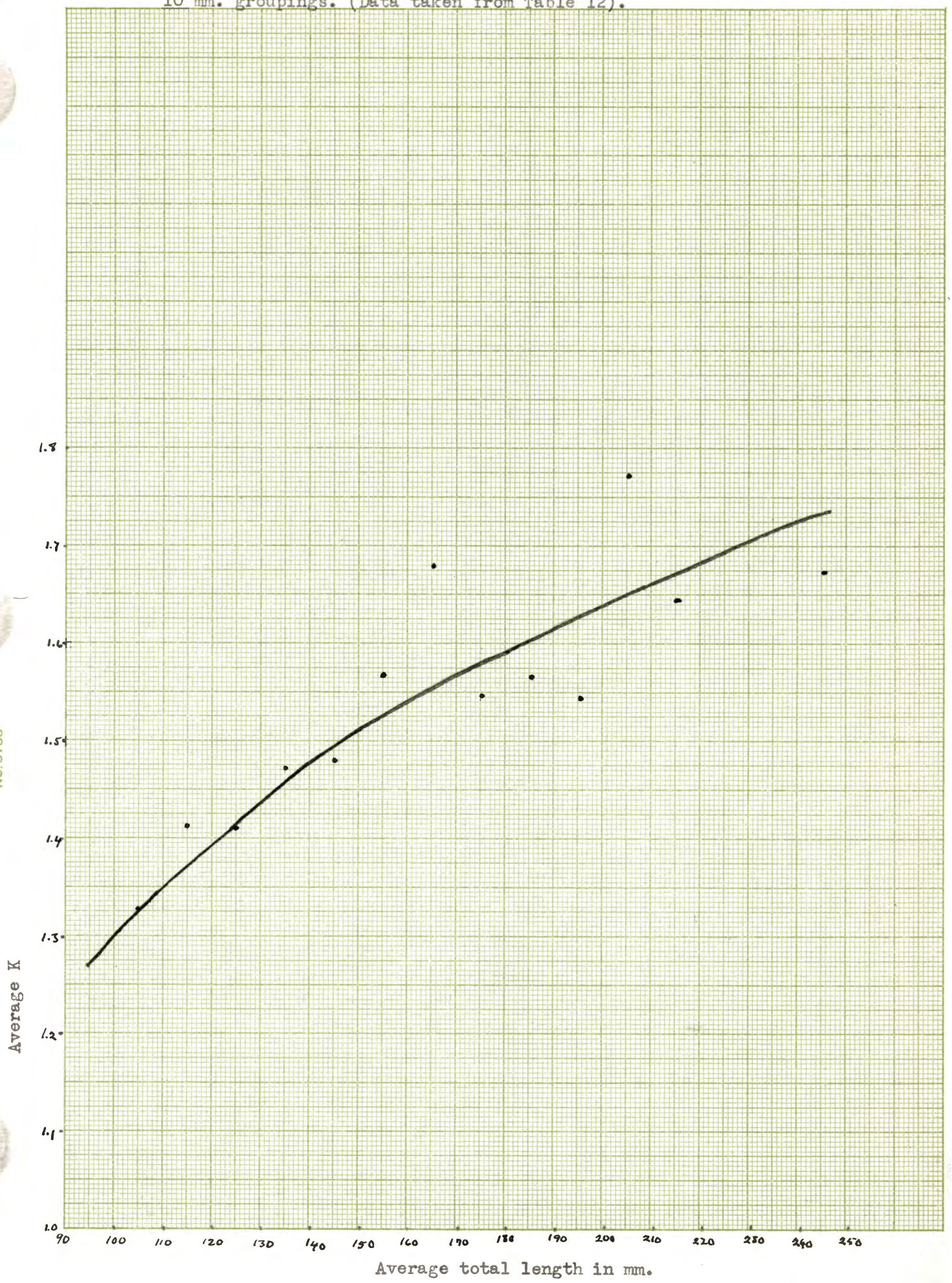

Table 1. Population data from Diversion III-A, Section C, Hunt Creek, Sept. 25, 26, 1940 (Area 0.063 acres).

Item	Number captured	Total weight (grams)	Calculated number per acre	Calculated pounds per acre
Unmarked trout				
legal size	4	342	63	11.97
sub-legal	57	1,145	905	40.06
fingerlings	251	1,004	3,984	35.13
Wild fingerlings (marked)				
Aug., 1939	1	11	16	0.38
Aug., 1940	2	4	32	0.14
Hatchery fingerlings (marked)				
Oct., 1939	-	-	-	-
Aug., 1940	30	113	476	3.95
Cottus	90	284	1,429	9.94
Totals	435	2,903	6,905	101.57

Table 2. Population data from Diversion II-A, Section C, Hunt Creek Sept. 25, 26, 1940 (Area - 0.068 acres).

Item	Number captured	Total weight (grams)	Calculated number per acre	Calculated pounds per acre
Unmarked trout				
legal size	10	743	147	24.08
sub-legal	76	1542	1,118	49.98
fingerlings	162	624	2,382	20.22
Wild fingerlings (marked)				
Aug., 1939	2	33	29	1.07
Aug., 1940	-	-	-	-
Hatchery fingerlings (marked)				
Oct., 1939	1	22	15	0.71
Aug., 1940	9	26	132	0.84
Cottus	98	291	1,441	9.43
Totals	358	3,281	5,264	106.33

Table 3. Population data from Diversion II-A and III-A, Section C, Hunt Creek, Sept. 25, 26, 1940 (Total area - 0.131 acres).

Item	Number captured	Average total length (mm.)	Total weight (grams)	Calculated number per acre	Calculated weight per acre (lbs.)
Unmarked trout (wild)					
legal size	14	198.4	1,085	107	18.26
sub-legal	133	130.0	2,687	1,015	45.22
fingerlings	413	47 72.0	1,628	3,153	27.40
Wild fingerlings (marked)					
Aug., 1939	3	117.0	44	23	0.74
Aug., 1940	2	-	4	15	0.07
Hatchery fingerlings (marked)					
Oct., 1939	1	137.0	22	8	0.37
Aug., 1940	39	4 72.0	129	298	2.17
Cottus	188	-	575	1,435	9.68
Totals	793	-	6,174	6,054	103.91

Table 4. Length-frequency distribution of brook trout found in Diversions II-A and III-A, Section C, Hunt Creek, September 25, 26, 1940 (Includes 40 marked hatchery trout).

Range in total length (mm.)	Number of specimens in group	Range in total length (mm.)	Number of specimens in group
55-59	10	155-159	6
60-64	37	160-164	4
65-69	71	165-169	4
70-74	60	170-174	3
75-79	100	175-179	4
80-84	100	180-184	2
85-89	37	185-189	1
90-94	34	190-194	1
*95-99	9	195-199	1
100-104	3	200-204	1
105-109	11	205-209	-
110-114	9	210-214	-
115-119	26	215-219	4
120-124	13	220-224	-
125-129	8	225-229	-
130-134	13	230-234	-
135-139	13	235-239	-
140-144	10	240-244	1
145-149	3		
150-154	6	Total	605

* The length-frequency distribution of brook trout less than 100 mm. total length was determined from a sample of 174 fish from Section C measured on Sept. 24, 1940. The percentages of fish in each size range of the latter sample was applied to the total number of fish classed as "fingerlings" in the population count. This procedure was followed because of lack of time to measure all trout captured.

Table 5. Analysis of difficulty of capture of fish from Diversion III-A Sept. 25, 26, 1940, Hunt Creek

	Number	Weight (grams)	Percentage of total number	Percentage of total weight
9/25-A.M. seining-Trout				
legal	2	143	50.0	41.8
sub-legal	33	716	56.8	61.9
fingerlings	184	706	65.0	62.9
cottus	37	157	41.2	55.2
9/25-P.M. seining-Trout				
legal	2	199	50.0	58.2
sub-legal	24	429	41.5	37.1
fingerling	72	327	25.4	29.1
cottus	-	-	0.0	0.0
9/26-Rotenone-Trout				
legal	-	-	0.0	0.0
sub-legal	1	11	1.7	1.0
fingerling	27	88	9.6	8.0
cottus	53	127	58.8	44.8
Total population removed by all methods-Trout				
legal	4	342	100.0	100.0
sub-legal	58	1,156	100.0	100.0
fingerling	283	1,121	100.0	100.0
cottus	90	284	100.0	100.0
All fish	435	2,903	100.0	100.0
Trout removed by seining	317	2,520	91.9	96.2
Trout removed by poisoning	28	99	8.1	3.8
All fish removed by seining	354	2,677	81.4	92.8
All fish removed by poisoning	81	226	18.6	7.8

Table 6. Analysis of difficulty of capture of fish from Diversion II-A Sept. 25, 26, 1940 - Hunt Creek.

	Total number	Weight (grams)	Percentage of total number	Percentage of total weight
9/25-A.M. seining-Trout				
legal	5	387	50.0	52.0
sub-legal	35	713	44.3	44.6
fingerlings	102	395	59.6	60.7
cottus	3	17	3.1	5.8
9/25-P.M. seining-Trout				
legal	5	356	50.0	48.0
sub-legal	32	662	40.5	41.5
fingerling	45	174	26.3	26.8
cottus	23	63	23.4	21.7
9/26 - Rotenone-Trout				
legal	-	-	0.0	0.0
sub-legal	12	222	15.5	13.9
fingerling	24	81	14.1	12.5
cottus	72	211	73.5	72.5
Total population removed by all methods-Trout				
legal	10	743	100.0	100.0
sub-legal	79	1,597	100.0	100.0
fingerling	171	650	100.0	100.0
cottus	98	291	100.0	100.0
All fish	358	3,281	100.0	100.0
Trout removed by seining	224	2,687	86.2	89.9
Trout removed by poisoning	36	303	13.8	10.1
All fish removed by seining	260	2,767	72.6	84.3
All fish removed by poisoning	98	514	27.4	15.7

Table 7. Actual and calculated total lengths of wild brook trout of various ages in Section C of Hunt Creek, Sept. 24-26, 1940. (measurements are given in millimeters).

Age group	Number of fish aged	Average total length (measured)	Average calculated total length of fish at annulus 1	2	3	Range in measured total lengths
I	25 44	103	77	-	-	71-148
II	37	161	78	129	-	120-218
III	9	203	73	121	173	168-240
Totals or averages	71 90	-	77	127	173	71-240

- indicates total number of specimens on which scale measurements were made when scale measurements were not made on all fish whose ages were determined.

Table 8. Average total length (mm.) for brook trout of four Michigan trout streams at various ages (Figures in parentheses indicate number of specimens in each age-group), and for average Ontario (Canada) brook trout.[1]

Item	Stream				
	Hunt Creek	Maple River	White River	S. Br. Pine	Ontario Av.
Age-group 0	68 (33)	78 (31)	75 (190)	96 (31)	51
" " I	103 (44)	155 (49)	140 (16)	160 (7)	122
" " II	161 (37)	254 (4)	187 (16)	167 (2)	190
" " III	203 (9)	304 (2)	277 (6)	291 (1)	268
" " IV	-	-	-	-	343
Sampling date	Sept. 1940	July, 1938	July, 1938	Sept. 1937	August 1

[1] Ricker's (1932) figures for average size are for fork length and not total length, so his fish actually were slightly larger than the sizes given.

Table 9. Age and size distribution among 95 wild brook trout from Diversions II-A and III-A, Section C, Hunt Creek, Sept. 25, 26, 1940.

Size range	Number of wild fish from II-A and III-A whose ages were determined	Number and percentage of fish in sample in each size-group			
		0	I	II	III
55-100	52	33 (63.5)	19 (36.5)	-	-
101-176	29	-	5 (17.0)	23 (79.0)	1 (4.0)
177-240	14	-	-	5 (35.7)	9 (64.3)

Table 10. Calculated age and size distribution of wild brook trout in the population of Diversions II-A and III-A, Section C, Hunt Creek as determined from data in Table 9.

Size range	Actual number of fish in II-A and III-A in size range	Calculated number of fish in age group 0	I	II	III	Totals
55-100	415	264	151	-	-	415
101-176	136	-	23	107	6	136
177-240	14	-	-	5	9	14
Totals	565	264	174	112	15	565
Calculated percentage of fish in II-A and III-A in each age-group		46.7	30.8	19.8	2.7	100

Table 11. Calculated age and size distribution of wild brook trout in the total estimated wild population of Section C, Hunt Creek, Sept. 25,26, 1940, with an estimate of survival from year to year. (Figures in parenthesis indicate percentage of age-group in size ranges).

Item	Age-group 0	I	II	III	Totals
Calculated number of fish in size range 55-100 mm.	2,153 (100.0)	1,237 (86.8)	-	-	3,390 (73.4)
Calculated number of fish in size range 101-176 mm.	-	188 (13.2)	879 (95.7)	44 (36.9)	1,111 (24.1)
Calculated number of fish in size range 177-240 mm.	-	-	39 (4.3)	75 (63.1)	114 (2.5)
Distribution of calculated total population of Sec. C among age-groups	2,153 (100.0)	1,425 (100.0)	918 (100.0)	119 (100.0)	4,615 (100.0)
Percentage of fish surviving from previous age-group	100	66.2	64.4	13.0	-
Calculated survival from 1,000 young brook trout	1,000	662	426	55	-

Table 12. Summary of coefficient of condition of brook trout population of Diversions II-A and III-A, Section C, Hunt Creek, September 25, 26, 1940.

Size range in total length (mm.)	Number of specimens	Range in coefficient of condition	Average K
90-99	1	1.270	1.270
100-109	14	1.135-1.729	1.340
110-119	33	1.205-1.686	1.413
120-129	21	0.970-1.700	1.410
130-139	24	1.158-2.029	1.471
140-149	13	1.206-1.826	1.479
150-159	12	1.331-1.806	1.566
160-169	8	1.385-1.891	1.679
170-179	7	1.285-1.799	1.547
180-189	3	1.480-1.731	1.564
190-199	2	1.497-1.593	1.545
200-209	1	1.771	1.771
210-219	4	1.577-1.726	1.643
220-229	-	-	-
230-239	-	-	-
240-249	1	1.672	1.672
Totals or averages	144	0.970-2.029	1.469

INSTITUTE FOR FISHERIES RESEARCH

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