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 MICHIGAN DEPARTMENT OF CONSERVATION  
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 UNIVERSITY OF MICHIGAN

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December 3, 1957

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Report No. 1533

**PROGRESS REPORT ON THE TROUT POPULATION IN THE SPECIAL-REGULATION WATER  
 OF THE SOUTH BRANCH OF THE AU SABLE RIVER, CRAWFORD COUNTY, 1952-1956**

by David S. Shetter

Since 1952, fishing on the South Branch of the Au Sable River, from 300 feet below Steckert Bridge to the mouth, has been under the following restrictions set by the Conservation Commission:

Stream area	Years	Regulations in force		
		Lure	Minimum size (inches)	Daily creel limit
300 feet below Steckert Bridge to Smith Bridge ("middle" area, Fig. 1) .....	1952-1954	Flies only	10	10
300 feet below Steckert Bridge to Smith Bridge ("middle" area, Fig. 1) .....	1955-1956	Flies only	10	5
Smith Bridge to the mouth ("lower" area, Fig. 1) .....	1952-1954	Any lure	10	10
Smith Bridge to the mouth ("lower" area, Fig. 1) .....	1955-1956	Flies only	10	5

The purpose of these restrictions is to perpetuate the excellent trout fishing which this river affords.

Some measure of the effect of the regulations on the brook trout and brown trout populations has been obtained by annual fall sampling with a direct-current

Figure 1.--South Branch Au Sable River,  
showing the three stream sections of  
special interest in this study.

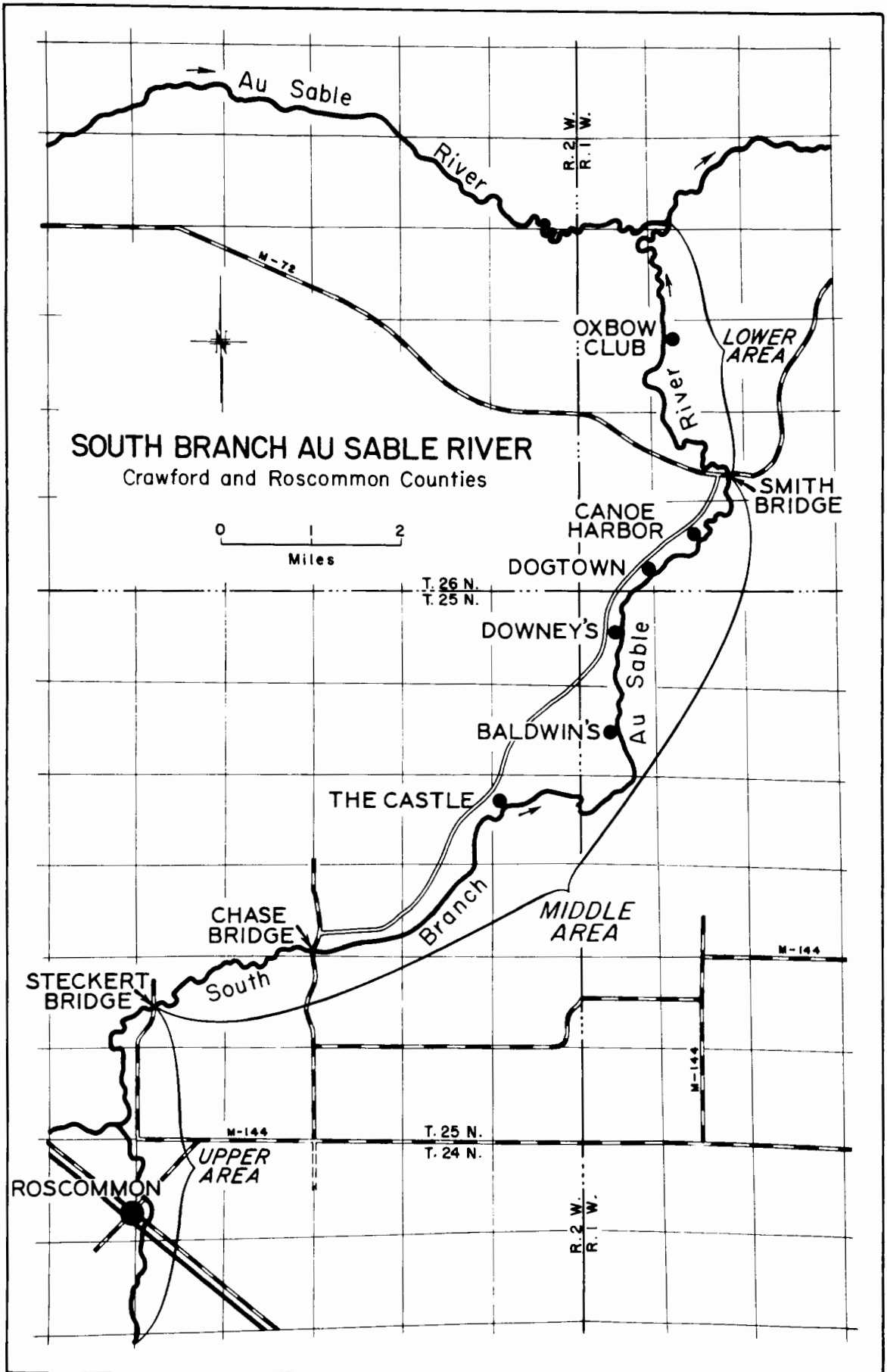


Figure 1

shocker. Adequate creel census data for the South Branch are not available for recent years. More creel census effort would have been required than could be assigned to this project, because of the road pattern and cottage ownership at the lower end, use of canoes and the high fraction of night fishing.

#### Fall sampling with DC shocker

A DC shocker was operated by a three-man crew at 10 to 22 sampling sites each fall. The length of time spent shocking was recorded, along with the catch of fish. The catch per hour by shocker was computed for three stream sections (lower, middle and upper, see Fig. 1). All fish were measured individually, and a large series of scale samples from both brook and brown trout were taken each year.

A summary of the more important results of the electrofishing is presented in Table 1. The lower area refers to the river from the mouth up to Smith Bridge; the middle, from Smith Bridge to a point 300 feet below Steckert Bridge; and the upper, from the latter point upstream. The lower and middle areas have had special fishing regulations; the upper serves somewhat as a control area for the present study.

Trout captured were mostly browns and brooks, in a ratio of about 2 to 1. A very few naturally spawned rainbow trout were taken. The catch per hour by shocker, of trout of all sizes, varied from 52 to 154 for brown trout and from 30 to 112 for brook trout (annual averages), with considerable variation between the lower, middle and upper sections (Table 1). The upper area was not sampled in 1956.

In analyzing the catch-per-hour indices it should be remembered that we have no knowledge of the numbers of fish removed from any part of the stream by angling in any year, nor do we have available from the lower or middle areas

Table 1.--Summary of DC shocker catches, South Branch of the Au Sable River, Crawford County, 1952-1956

Year	Area <sup>1</sup>	Minutes of shocking	Brook trout			Brown trout			Total trout collected <sup>3</sup>	Total catch per hour	Ratio, <sup>4</sup> small: large trout
			Number <sup>2</sup>	Catch per hour	Size range (inches)	Number <sup>2</sup>	Catch per hour	Size range (inches)			
1952	Lower	95	59	37	3.2- 9.4	147	93	2.8-18.8	211 (5)	133	32:21
	Middle	189	140	44	2.6- 9.4	377	120	2.8-21.9	518 (1)	164	47:120
	Upper	78	9	7	3.6-10.1	83(16)	64	4.1-19.9	92	71	15:16
	Total	362	208	34	...	607	101	...	821	136	94:157
1953	Lower	148	87	35	3.6-10.7	165	67	3.0-19.3	253 (1)	103	46:44
	Middle	304	173	34	2.4- 9.0	373	74	3.0-24.0	548 (2)	108	153:181
	Upper	78	4	3	4.5- 8.1	40(11)	31	3.6-19.1	44	34	18:18
	Total	530	264	30	...	578	65	...	845	96	217:243
1954	Lower	89	177	119	2.7- 9.3	123	83	2.7-15.4	300	202	24:23
	Middle	289	217	45	2.2- 9.1	215(5)	45	2.7-20.7	432	90	82:93
	Upper	22	3	8	4.1- 6.2	10(2)	27	3.7-21.9	13	35	0:7
	Total	400	397	60	...	348	52	...	745	112	106:123
1955	Lower	150	144	58	2.7- 8.0	371	148	3.3-18.7	515	206	118:99
	Middle	434	648	90	2.5-10.5	918	127	3.2-23.1	1,586 (20)	225	228:231
	Upper	66	6	5	4.1- 7.4	81	74	3.7-20.4	87	79	14:16
	Total	650	798	74	...	1,370	126	...	2,188	200	360:346
1956	Lower	119	134	68	2.7- 9.7	332	167	3.1-19.5	466	235	88:132
	Middle	275	604(2)	132	2.6-11.2	682	149	2.9-22.0	1,288 (2)	280	229:187
	Upper	..	..	..	...	..	..	...	..	..	...
	Total	394	738	112	...	1,014	154	...	1,754	267	317:319

<sup>1</sup>See text for description of areas.

<sup>2</sup>Number of hatchery fish in parentheses.

<sup>3</sup>Number of rainbow trout included in total shown in parentheses.

<sup>4</sup>Ratio of 7.0- to 9.9-inch trout to trout 10 inches long or longer.

any shocker collections following a season of fishing under state-wide regulations (7-inch minimum size, 10-fish creel limit, any lure). High, discolored water, which decreased electrical conductivity and increased the difficulty of netting stunned fish because of poor visibility, probably lowered collecting efficiency during the 1953 and 1954 sampling. This factor should be considered in making comparisons among the different years.

The data for brook trout indicate a trend toward an increase in the population between 1952 and 1956 in the areas where restrictions have been in force (Table 1, Fig. 2). In the upper section, fished under state-wide regulations, the catch per hour with a DC shocker has remained consistently low--between three and eight brook trout per hour. However, this may be the end result of comparatively poor brook trout habitat in this section of stream. The collections in the upper section consistently included numerous northern pike, rock bass, yellow perch, bullheads, white suckers, and other warm-water species which would compete with trout for food and space, or prey on small trout.

The catch of brown trout per hour in the different years also suggests some increase in the population of the lower and middle sections in 1955 and 1956, as compared to 1952 (Table 1, Fig. 2). The indices noted for brown trout in the upper section were consistently lower than in the restricted areas. This situation could result from a greater angling harvest of brown trout in the upper section, or could be the result of poorer habitat.

Unmarked, and presumably native rainbow trout were found on relatively few occasions (Table 1). This species obviously plays a negligible role in the waters of the South Branch, in so far as naturally spawned fish are concerned.

It is obvious that an excellent spawning population of brook and brown trout remained at the conclusion of the fishing seasons of 1952-1956. If the length distribution of trout in samples collected by shocking in the different years was representative of the size distribution of fish in the population,

Figure 2.--Numbers of brook and brown trout  
collected per hour with a DC shocker, South  
Branch Au Sable River, 1952-1956.

(Data from Table 1)

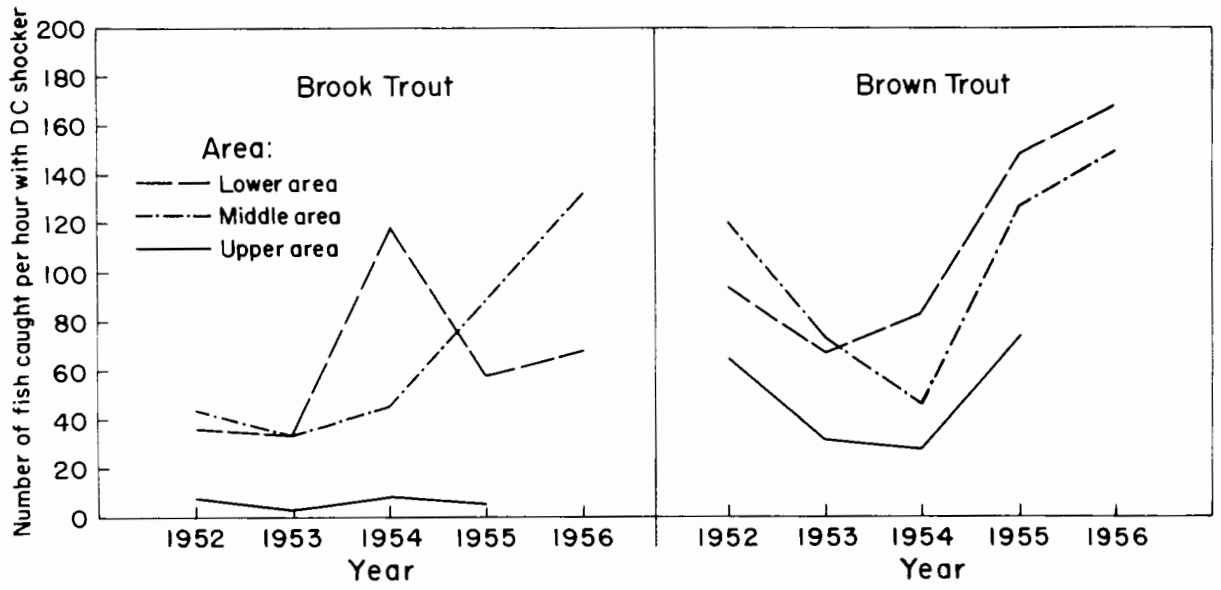


Figure 2



then about one-third of the trout present in the fall of the year exceeded 7 inches in length and about one-fifth were between 10 and 24 inches long.

#### Hatchery fish observed

Since the inception of the special regulations, no hatchery-reared trout have been planted in the restricted waters except for the annual "gift plantings" received from the George Mason estate in 1954 (1,500 brown trout), 1955 (1,200 rainbow trout) and 1956 (742 brook trout). Trout planted by the State in the upper section or in the tributaries were fin-clipped; the Mason fish were tagged or fin-clipped each year so they might be identified by anglers or the investigators. Numbers of hatchery-reared fish found in the fall shocking were as follows:

<u>Year</u>	<u>Brown trout</u>	<u>Rainbow trout</u>	<u>Brook trout</u>
1952	16	1	..
1953	11	2	..
1954	7	..	..
1955	..	20	..
1956	..	..	2

Most of the brown trout were captured by shocker in the upper section near the planting site, and the rainbow and brook trout were collected from the middle section, also in the general locality of release.

#### Size composition

The size composition of wild brook and brown trout collected in 1952-1956 is shown in Table 2. The 2.0- to 4.9-inch and 5.0- to 9.9-inch size classes were found by Chi-square tests to constitute a significantly higher fraction of the brook trout population in each of the years since 1952 except 1955.

Table 2.--Length-frequency distribution of brook trout and brown trout collected by DC shocker,  
 South Branch Au Sable River, Crawford County, 1952-1956 ↓

Length group (inches)	Number of brook trout					Number of brown trout				
	1952	1953	1954	1955	1956	1952	1953	1954	1955	1956
2.0 - 2.9	2	12	20	57	33	5	..	8	11	20
3.0 - 3.9	96	88	179	387	296	95	53	71	315	219
4.0 - 4.9	75	87	94	178	230	200	81	71	367	185
5.0 - 5.9	12	15	25	36	39	41	10	4	34	15
6.0 - 6.9	10	37	36	49	41	16	29	8	28	37
7.0 - 7.9	9	18	27	43	45	23(1)	70(2)	31	108	85
8.0 - 8.9	1	4	14	24	30	38(9)	88(4)	23	117	76
9.0 - 9.9	2	2	2	19	17	32(2)	50(2)	9	49	64
10.0 - 10.9	1	1	..	5	4	31(3)	32(2)	27(3)	65	65
11.0 - 11.9	..	..	..	..	1	37(1)	37	31(1)	64	60
12.0 - 12.9	..	..	..	..	..	25	25	19(2)	62	55
13.0 - 13.9	..	..	..	..	..	13	35	10(1)	54	37
14.0 - 14.9	..	..	..	..	1(1)	12	26(1)	9	37	45
15.0 - 15.9	..	..	..	..	1(1)	10	11	12	23	17
16.0 - 16.9	..	..	..	..	..	10	12	5	9	9
17.0 - 17.9	..	..	..	..	..	5	6	3	7	10
18.0 - 18.9	..	..	..	..	..	7	4	3	12	4
19.0 - 19.9	..	..	..	..	..	3	4	..	1	5
20.0 - 20.9	..	..	..	..	..	2	3	3	3	2
21.0 - 21.9	..	..	..	..	..	1	..	1	2	2
22.0 - 22.9	..	..	..	..	..	..	1	..	1	2
23.0 - 23.9	..	..	..	..	..	1	..	..	1	..
24.0 - 24.9	..	..	..	..	..	..	1	..	..	..
Totals	208	264	397	798	738(2)	607(16)	578(11)	348(7)	1,370	1,014

Numbers of hatchery-reared fish (identifiable by tags or fin-clips) indicated in parentheses.

Apparently the angler harvest and natural mortality of brook trout larger than 10 inches is of such proportions that relatively few such fish are left in the fall, although they increased slightly in numbers in the 1955 and 1956 collections.

Among brown trout, 2.0- to 4.9-inch fish have contributed a significantly smaller fraction of the total fish collected each year since 1952, except for 1955. If the aberrant 1953 and 1954 collections are excluded, the 5.0- to 9.9-inch size class has shown relatively little change. A comparison of the annual collections suggests that a significantly higher fraction of the population was 10 inches long or longer in 1956 than in 1952. Apparently brown trout were less vulnerable than brook trout to fly fishing.

#### Age distribution

The scales collected each year were impressed on plastic, read, and measured (from the focus to each annulus). Brook trout scales presented little difficulty, but scales of certain of the older, larger brown trout were rejected because of regeneration. The age distribution data for brook and brown trout for each year are given in Tables 3 and 4. The calculations for each table were made as follows: Scales were removed from trout larger than 2.0 inches (brook trout) or 3.0 inches (brown trout), with 15 fish in each inch-class as a goal. Nearly all fish larger than 12 inches were scale-sampled. After the scales were read, the percentage of fish of different ages in each inch-class was determined. These percentages were then applied to the total number of fish in each inch-class in the collections to estimate the number of fish of each age group in the annual samples.

Age-groups 0, I, II and III were found among the brook trout collected. Approximately 3/4 of the fish in the fall sample were young of the year. Age-group I made up 16 to 24 percent, and age-group II contributed 1 to 4 percent of the total sample. No III-group fish were found in three of the five annual brook trout samples. No significant difference was found in the fraction of

Table 3.--Estimated age distribution of South Branch Au Sable brook trout,  
1952-1956

(Percentages of each age group in the annual samples  
are given in parentheses.)

Year	Estimated number of fish in age group				Total number of fish captured	Number of fish aged <sup>1</sup>
	0	I	II	III		
1952	172 (83)	33 (16)	3 (1)	...	208	137
1953	192 (73)	67 (25)	4 (1)	1 (tr)	264	117
1954	295 (74)	95 (24)	7 (2)	...	397	95
1955	617 (78)	163 (20)	18 (2)	...	798	192
1956	578 (78)	124 (17)	26 (4)	8 (1)	736	100

<sup>1</sup>Numbers of fish larger than 2.0 inches for which age was determined by  
scale examination.

Table 4.--Estimated age distribution of wild brown trout in the South Branch of the Au Sable River, Crawford County, 1952-1956

(Percentages of each age group in the yearly samples are given in parentheses.)

Year	Estimated number of fish in age group								Total number of fish captured	Number of fish aged <sup>1</sup>
	0	I	II	III	IV	V	VI	VII		
1952	287 (49)	131 (22)	119 (20)	32 (5)	12 (2)	7 (1)	1 (tr)	1 (tr)	590 <sup>2</sup>	334
1953	115 (20)	220 (39)	158 (28)	49 (9)	15 (3)	9 (1)	..	..	566 <sup>2</sup>	33 <sup>3</sup>
1954	152 (45)	62 (18)	76 (22)	29 (9)	14 (4)	4 (1)	4 (1)	..	341	177
1955	700 (51)	254 (18)	238 (17)	132 (10)	38 (3)	8 (1)	..	..	1,370	249
1956	434 (43)	234 (23)	164 (16)	128 (12)	41 (4)	11 (1)	2 (tr)	..	1,014	206

<sup>1</sup>Numbers of fish larger than 3.0 inches for which age was determined by scale examination.

<sup>2</sup>Scales of one 23-inch fish in 1952 and a 24-inch fish in 1953 could not be read.

<sup>3</sup>Only fish larger than 14 inches were sampled in 1953. For fish smaller than 14 inches the age distribution was determined from the percentage distribution in the 1952 sample.

the total shocker catch contributed by the 0-group in 1956 as compared to 1952. Age-group-I fish were about equally abundant in both years. The fraction of fish in age-groups II and III had increased by 1956 almost to the point of statistical significance (Chi-square, 3.54; P, 93.9 percent).

Eight age-groups (0-VII) were found among the brown trout collected. In contrast to the brook trout, 0-group fish made up only 20 to 51 percent of the sample (the value of 20 percent in 1953 is probably biased because of poor collecting conditions). Age-group I made up 18 to 23 percent of the sample in all years except 1953; age-group II contributed 16 to 23 percent; age-group III, 5 to 12 percent; and age-group IV and older fish, 3 to 6 percent.

#### Growth

Data on the growth of brook and brown trout in the South Branch of the Au Sable River are summarized in Table 5. Both the average total lengths at the time of collection and calculated lengths are given for the combined collections (1952-1956). The body-scale relationship was determined for both species and nomographs constructed as described by Hile (1950) were utilized to calculate total length at the end of various years of life.↓

Most empirical lengths were measured in October and November each year whereas calculated lengths were based on the time of annulus formation, which usually takes place sometime between March and June. Thus the two types of length data are not strictly comparable.

Two factors are believed to distort the brook trout growth picture; (1) biased sampling of the young of the year (tendency of the electrofishing gear

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↓The body-scale relationship for brook trout was expressed by the formula:  $ASR = CL^n = 1.1092 L^{0.67117}$ , where ASR = anterior scale radius, C and n = constants, and L = measured total length of the fish. This body-scale relationship was determined from length and scale measurements of 654 brook trout collected in 1952-1956.

The brown trout body-scale relationship, as determined from scale and length measurements of 341 fish collected in 1954 was:  $ASR = 1.1818 L^{0.92761}$ .

Table 5.--The average measured and calculated lengths (in inches)  
of wild brook trout and wild brown trout in the South  
Branch of the Au Sable River

(The numbers of specimens on which the averages are based are shown in parentheses.)

Length at end of:	Brook trout		Brown trout	
	Meas.	Calc.	Meas.	Calc.
1st summer	4.1 (253)	...	4.3 (201)	...
1st year	...	3.2 (382)	...	3.9 (793)
2nd summer	6.8 (311)	...	7.4 (252)	...
2nd year	...	6.2 (71)	...	8.4 (541)
3rd summer	9.0 (66)	...	11.0 (270)	...
3rd year	...	6.9 (5)	...	12.1 (271)
4th summer	9.2 (5)	...	14.2 (164)	...
4th year	...	...	...	14.9 (107)
5th summer	...	...	16.5 (87)	...
5th year	...	...	...	17.5 (20)
6th summer	...	...	19.1 (16)	...
6th year	...	...	...	19.7 (4)
7th summer	...	...	21.0 (3)	...
7th year	...	...	...	20.1 (1)
8th summer	...	...	21.7 (1)	...

and the operators to take a smaller fraction of the 2.0- to 3.0-inch brook trout than actually were present), and (2) the harvest by angling of a high fraction of brook trout larger than 10 inches. Together these factors appear to produce the phenomenon of "apparent change in growth rate," as described by Lee (1912). When scales from the older fish in the collections were used to calculate lengths at earlier ages, the calculated lengths were noticeably shorter than the lengths measured at the time of collection. This presumably resulted from the removal by anglers of the faster-growing fish in age groups II and III, leaving mainly slowly growing brook trout to be collected by the shocker. Attention has been called to similar situations among brook trout populations in Gangle Lake and Pigeon River (Cooper, 1949; 1953) and in the North Branch of the Au Sable River (Shetter, 1954), where the calculated lengths of angler-caught fish were greater at most ages than the calculated lengths of fish collected by poisoning or electrofishing gear.

For brown trout, as for brook trout, it is believed that biased sampling of the 0-group in the fall yielded average measured lengths which were larger than the true average because of inefficiency of the gear in taking 2.0- to 3.0-inch brown trout. The growth data for older brown trout from the South Branch suggest strongly that the situation after the first year of life was exactly the reverse of that for brook trout. For age groups II-VI, calculated lengths at the end of each year of growth consistently exceeded the measured lengths of the same age group at the time of collection in the preceding fall. It appears, therefore, that some growth is made by South Branch brown trout during the period between October and the following spring. Tody (1949, Table V) reported that calculated lengths of brown trout from the North Branch of the Au Sable also exceeded the measured lengths of fish in the same age group caught in the fall. He called attention to the fact



that the outer edges of scales of brown trout collected in October and November exhibited widely spaced circuli, suggesting that the fish were still growing.

From information in Tables 3, 4 and 5 it would appear that South Branch brook trout require three summers of growth to reach the present legal length of 10 inches, whereas a few of the South Branch brown trout may reach the 10-inch size as early as the second summer. Most three-summer-old brown trout exceed 10 inches in length.

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