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INSTITUTE FOR FISHERIES RESEARCH
DIVISION OF FISHERIES
MICHIGAN DEPARTMENT OF CONSERVATION
COOPERATING WITH THE
UNIVERSITY OF MICHIGAN

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DIRECTOR

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UNIVERSITY MUSEUMS ANNEX
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Report No. 1361

PROGRESS REPORT, BROOK TROUT MANAGEMENT STUDY,
NORTH BRANCH AU SABLE RIVER, 1952 SEASON

By

David S. Shetter

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Abstract

The effect of an increased size limit on the brook trout population of the North Branch of the Au Sable River in northeastern Crawford County, Michigan, has been studied since the spring of 1949. This progress report lists the 1952 data collected and gives some comparisons with information collected in 1950 and 1951.

In 1952 sampling showed 574 anglers on the 10-inch water who fished 1,747.5 hours and caught 52 brook trout (average size, 10.4 inches) and 105 brown trout (average size 12.2 inches). The catch per hour was 0.09 fish. The 1952 data suggest an increase of approximately 60 percent in angling hours and slightly more than a 100 percent increase in the total catch when compared with 1950 figures. From the 7-inch water, sampled an equal number of days, 480 anglers fished 1,743 hours and caught 677 brook trout (average size, 7.7 inches), 166 brown trout (average size, 9.0 inches), and 7 rainbow trout (average size, 9.4 inches). The catch per hour was 0.49 fish. Angling pressure in 1952 in the 7-inch water was 12 percent higher than 1951 (the lowest of the three years), but the total catch of wild trout was only 4 percent greater.

Statistical tests on the creel census data indicate that angling quality as measured by the catch per hour per angler on the 10-inch water has not varied significantly in the period 1950-1952, and has always been poorer than on the 7-inch water. On the 7-inch water, the 1952 angling quality was found to have been significantly better than in 1950, but was ~~littler~~ different than ⁱⁿ 1951.

Studies with the electric shocker (AC) demonstrate that the residual fall brook trout population of fish larger than 5.0 inches in the 10-inch water has increased at least five-fold in the period 1949-1952. This increase is mainly among fish between the sizes of 7.0-9.9 inches. The average size of these fish, which are for the most part two summers old, has increased from 7.1 inches in 1948 to 8.5 inches in 1951.

The regulations now in force on the restricted portion of the North Branch of the Au Sable River should be continued at least through the 1954 trout season for the following reasons:

1. The anglers' catch of 10-inch and larger brook trout has continued to increase each year;
2. The brook trout population as a whole can be shown to be increasing;
3. The brown trout also show a steady increase in the anglers' catch;
4. There appears to be no slowing of the growth rate as determined by studies of the age of the trout taken by angling or by AC shocker;
5. The continued increase in popularity of the restricted water suggests that a relatively larger fraction of the North Branch anglers enjoy fishing for larger brook trout even though they can keep few of them.

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The North Branch of the Au Sable River, in the vicinity of the town of Lovells in Crawford County, has operated under restrictive angling regulations since the 1949 trout season. In that year, by Conservation Commission order, the minimum size limit for brook trout was raised to 10 inches and the creel limit for brook trout was reduced to 5 fish. All other regulations remained the same as state-wide trout stream rules. Following that season, and up to the present, the restrictions have been a 10-inch minimum size limit, possession limits are 10 trout per day not more than 5 of which shall be brook trout. Also at the insistence of the Lovells Hook and Trigger Club starting in 1950 the type of lure was limited to artificial fly. The waters under these regulations extended from the Otsego-Crawford County line downstream to the bridge in Lovells in 1949; since 1950 the restricted water was extended about 3 miles further downstream, i.e., to Eamon's Landing.

The Fish Division, as well as numerous Michigan anglers, have followed the progress of the trout population and the fishing in this water with interest. The river frontage ownership pattern and the road and bridge distribution all mitigated against a complete creel census coverage

because of financial considerations. However, each year since 1950 a good random creel check has been operated on the restricted and non-restricted portions of the North Branch. An equal amount of time has been spent on the 10-inch water and that under normal regulations, and the sampling has been conducted by the same individual at the same locations each year. Although neither the total fishing effort nor the total catch from either type of water is known, it is felt that the records provide an accurate year-to-year comparison of angling in the two types of water because of the manner in which the records have been collected.

The creel census operator, O. M. Corbett, worked on a pre-determined schedule of four 10-hour days each week. The schedule always included Saturday and Sunday, when the bulk of the fishing is done, plus any holiday, and one or two mid-week days. An effort was made to set up the schedule to sample the same number of Wednesdays, etc. also insofar as possible. Alternate Saturdays, Sundays and holidays were spent sampling the restricted stream area first, then normal regulation water. Because of time and distance considerations, the "normal stream" sampled by Corbett ran from about one mile downstream from Dam 2 ("the Ford") in Otsego County to the Otsego-Crawford County Line, and from Eamon's Landing to Kellogg's Bridge.

The changes in the trout population were followed also by sampling with the electric shocker (AC). A measure of the changes taking place as a result of the regulations in force is provided by the number of fish caught per hour of shocking, and also by comparing the size-frequency distribution and the age distribution of the fish collected before and after the establishment of the regulations through scale samples removed from angler-caught fish and from others taken during the shocker studies.

1952 Angling Results

The 1952 creel census operations were the third consecutive year for collection of angling data, and these are summarized in Table 1. A total of 574 angling trips were checked in the restricted water. Of these 103, or 18.1 percent, were successful. A total of 1,747.5 hours were spent during all trips in catching 52 brook trout and 105 brown trout larger than 10 inches. The most anglers were contacted in June (158). The best fishing was experienced in May when 23 brook trout and 45 brown trout were taken in 315.5 hours of fishing (catch per hour = 0.22 fish). For the season as a whole, about 3 brook and 6 brown trout were caught per 100 hours of fishing (catch per hour = 0.09 fish). The average size of the 52 brook trout checked was 10.4 inches and they ranged in total length from 10.0 to 14.0 inches (46 fish 10.0-10.9 inches; 5 fish 11.0-11.9 inches; 1 fish - 14.0 inches)*. The average size of the brown trout observed in the anglers' creel was 12.2 inches. They ranged from 10.0 to 22.4 inches (about 82 percent were between 10.0 and 12.9 inches, about 18 percent between 13.0 and 22.4 inches).

In an equal number of sampling days on the non-restricted (7-inch) waters lying both upstream and downstream, during 1952 Corbett checked 480 angling trips 247 of which were successful (51.5 percent). In all trips a total of 1,743.0 hours were spent fishing. This effort yielded a total catch of 469 wild brook trout, 208 hatchery-reared brook trout (recognizable by the missing right pelvic fin), 166 wild brown trout, and 7 rainbow trout**. The average catch per hour of all trout for the season was 0.49 fish. More anglers were contacted during May than any other month (140). The average total length of the brook trout (both wild and hatchery-reared fish were combined) was 7.7 inches; they

* Four sublegal trout were retained by anglers checked, but were not included in the totals. They measured, 9.9, 9.9, 9.7, and 9.5 inches.

** 2,300 unmarked hatchery rainbow trout were planted downstream from Eamon's in 1952. Presumably the rainbows recorded by the census clerk came from these plantings.

ranged between 7.0 and 10.2 inches. This is the first year since the inception of the restrictions that brook trout larger than 10 inches were observed in the anglers' catches on the 7-inch waters. Brown trout ranged from 7.0 inches to 19.5 inches; their average total length was 9.0 inches (about 76 percent were between 7.0 and 9.9 inches, about 24 percent were between 10.0 and 19.5 inches). The 7 rainbow trout ran from 7.4 to 12.1 inches and their average length was 9.4 inches.

The Progress of the Fishing

No data are available for the angling in 1949, the first year restrictions were in force on the North Branch. The basic data for 1950 and 1951, as well as 1952, are given in Table 2. The "catch per hour per angler" figures are not the same as the "catch per hour". These indices are obtained by calculating the catch per hour for each individual angler, summing them, and dividing by the total number of anglers. The "catch per hour" is calculated by dividing the total catch by the total number of hours of fishing. The catch per hour per angler data have an advantage in that they can be utilized in statistical tests of significance. The results of such tests are usually expressed in percentage chance that the "averages" (or "means") are different. Statisticians usually don't consider differences of significance unless the 95 percent level is reached.

By application of the "t" test to the data in Table 2, the following can be demonstrated:

1. Angling quality, as measured by the catch per hour per angler, has been best in the 7-inch waters (P = 99.9 plus percent for comparison of restricted and nonrestricted waters in all years);
2. In the 7-inch water, the 1952 angling was significantly better

than in 1950 ($P = 96.5$ percent), but comparisons between other years were non-significant (1950 with 1951, $P = 76.2$ percent; 1951 with 1952, $P = 67.9$ percent).

3. In the 10-inch water, with the exception of the very slight superiority of 1952 over 1950, angling quality has not appeared to have varied to any great degree. (the P values for the various comparisons were 1950 with 1951, $P = 43.8$ percent; 1950 with 1952, $P = 84.4$ percent; 1951 with 1952, $P = 68.3$ percent).

As measured by the indices of angling quality--either simple catch per hour or catch per hour per angler--the restricted water has shown little improvement during the three years of sampling. The total catch per hour has ranged between 7 and 9 fish per 100 hours of fly-fishing. However, angling quality is the result of total catch divided by the total effort. It is possible to have an increase in the stock of fish available along with increasing fishing pressure with the resulting catch per hour showing little or no change. For example, if a given stock, say 100 fish, is subjected to 100 hours of fishing and 10 fish caught, the resulting catch per hour is 0.10 fish. Now if the stock increases to 200 fish and the angling pressure to 200 hours and the rate of capture remains the same, 20 fish will be caught, and the catch per hour is still 0.10 fish. Angling quality has not improved, yet the yield has doubled.

A somewhat comparable situation appears to have occurred in the 10-inch water. Angling pressure has increased from 1,055 hours in 1950 to 1,747 hours in 1952, and the catch has increased from 23 to 52 brook trout and from 50 to 105 brown trout; the catch per hour indices have ranged between 0.07 and 0.09 fish. The average size of the brook trout has increased about 0.1 inch each year to 10.4 inches in 1952 while the brown trout lengths have varied from a low of 11.9 inches in 1951 to a high of 12.5 inches in 1950.

Table 1. Creel Census Statistics for 1952, N. Branch Au Sable River, Crawford County, with comparative totals for 1950 and 1951. (Average total lengths are in parentheses and are given in inches)

Month	Number of trips contacted	Number of unsuccessful trips	Hours of fishing	Brook trout		Brown trout	Rainbow trout	Total catch observed	Catch per hour-- all trout
				wild	hatchery				
<u>10-inch water</u>									
April	56	50	205.5	5 (10.2)	...	4 (11.2)	...	9	0.04
May	99	66	315.5	23 (10.4)	...	45 (10.9)	...	68	0.22
June	158	123	467.5	14 (10.4)	...	33 (12.8)	...	47	0.10
July	124	108	353.0	5 (10.0)	...	13 (12.4)	...	18	0.05
August	102	90	305.0	4 (10.7)	...	10 (15.7)	...	14	0.05
September	35	34	101.0	1 (10.5)	...	...	...	1	0.01
Totals, 1952	574	471	1,747.5	52 (10.4)	...	105 (12.2)	...	157	0.09
Totals, 1951	530	451	1,605.5	36 (10.3)	...	76 (11.9)	...	112	0.07
Totals, 1950	404	362	1,055.5	23 (10.2)	...	50 (12.5)	...	73	0.07
<u>7-inch water</u>									
April	39	9	159.5	40	63 (8.0)✓	13 (10.4)	...	116	0.73
May	140	80	495.5	63	93 (8.2)	39 (9.8)	4 (8.6)	209	0.40
June	84	41	280.0	73	10 (7.5)	39 (9.0)	...	122	0.44
July	74	37	315.5	90	3 (7.4)	36 (8.4)	1 (12.1)	130	0.41
August	102	39	359.0	171	31 (7.4)	33 (8.4)	2 (9.7)	237	0.66
September	41	27	133.5	32	8 (7.3)	6 (8.6)	...	46	0.34
Totals, 1952	480	233	1,743.0	469	208 (7.7)	166 (9.0)	7 (9.4)	850	0.49
Totals, 1951	430	232	1,541.0	436	65 (7.5)	184 (8.4)	...	685	0.44
Totals, 1950	487	276	1,683.5	331	318 (7.7)	97 (8.7)	...	736	0.44

✓ On the 7-inch water, the average size listed under "Hatchery brook trout" is for the wild and hatchery fish combined. The measurements were not marked separately on the creel cards.

Table 2. The catch per hour per angler data for 1950, 1951, and 1952 on both restricted and open waters of the North Branch of the Au Sable River.

Year	Restricted water--10" limit, flies only					Non-restricted water--7" limit, any lure				
	Total trips	Percent successful trips	Total trout catch	Catch per hour/angler	Standard error	Total trips	Percent successful trips	Total trout catch	Catch per hour/angler	Standard error
1950	404	10.4	73	0.06	0.01	487	43.3	746	0.36	0.03
1951	530	14.9	112	0.07	0.01	430	46.0	685	0.41	0.03
1952	574	18.1	157	0.08	0.01	480	51.5	850	0.45	0.03

Formulas used were $M = \frac{\sum x}{n}$

$$\text{Standard deviation} = \sqrt{\frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n - 1}}$$

$$\text{Standard error} = \frac{\text{Std. deviation}}{\sqrt{n}}$$

$$\text{Standard error of the difference between means} = \sqrt{(SE_1)^2 + (SE_2)^2}$$

$$"t" = \frac{\text{Difference between means}}{\text{Standard error of the difference}}$$

On the 7-inch waters, angling pressure has ranged between 1,541 and 1,743 hours, a relatively small variation when compared with the variation in the 10-inch water. If the marked hatchery brook trout are excluded the catch of wild trout has increased from a low of 428 in 1950 to a high of 642 in 1952. Inclusion of the hatchery fish in the catch suggests a similar variation but not in the same ascending pattern. The simple catch per hour indices suggest less variation (0.44 to 0.49 fish per hour) than the catch per hour per angler indices (0.36 to 0.45 fish per hour per angler). The average size of the brook trout (both wild and hatchery fish combined) has varied between 7.5 and 7.7 inches; brown trout average total lengths in the three years have ranged between 8.4 (1950) and 9.0 inches (1952).

Studies with the electric shocker

The catch per hour of operation of the AC electric shocker furnishes a rough measure of the relative abundance of the various sizes of fish present. Some data are available for September, 1948, which give an idea of the size composition of the spawning population at the conclusion of the last angling season under a 7-inch minimum size regulation. The shocker collections listed in Table 3 portray the changes that have taken place since the minimum size limit was raised to 10 inches, both in numbers of fish and in the size composition of fish larger than 5 inches. These samples were collected in the Twin Bridge - Akron Club portion of the 10-inch water.

The data obtained from electro-fishing provide strong evidence that the angling restrictions have resulted in an increase in the brook trout population of the North Branch between the north County line and Eamon's Landing. Prior to establishment of the 10-inch limit, shocker sampling

Table 3. Size composition of brook trout captured by A.C. shocker, Twin Bridge to Akron Club, N. Branch Au Sable, 10-inch water, with catch per hour indices. (Percent of total sample in each size group is given in parentheses)

Size range in inches	September 1948	November 1949	October 1950	October 1951	September 1952
5.0-5.9	7 (8)	5 (5)	26 (27)	1 (1)	10 (6)
6.0-6.9	28 (30)	14 (14)	10 (11)	12 (9)	15 (9)
7.0-7.9	50 (54)	36 (35)	21 (22)	29 (22)	69 (41)
8.0-8.9	6 (6)	35 (34)	23 (24)	60 (47)	46 (27)
9.0-9.9	2 (2)	11 (10)	8 (9)	21 (16)	18 (11)
10.0-10.9	...	2 (2)	6 (6)	5 (4)	8 (5)
11.0-11.9	...	...	1 (1)	...	1 (1)
12.0-12.9	...	...	...	...	...
13.0-13.9	...	...	...	1 (1)	...
Total collected	93	103	95	129	167
Minutes shocked	120	40	44	23	38
Fish shocked/hr.	47	155	130	337	264

yielded about 47 brook trout per hour larger than 5 inches in September, 1948. Following the first season of restricted angling, brook trout of this category were taken at the rate of 155 fish per hour in November of 1949. After a slight drop in 1950 to 130 fish per hour, the rate of capture with the AC shocker increased in 1951 and 1952 to 337 and 264 brook trout per hour. The data obtained with the AC shocker in the fall of 1952 suggest that the brook trout population larger than 5.0 inches has increased over 5-fold when compared with the 1948 sample.

Chi-square tests following the method of Snedecor (1946, p. 197), were made to determine if the changes in the numbers of fish over 7 inches, in the annual fall shocker samples, were of significance, comparing the 1948 sample with samples obtained in 1949 and 1952. The figures were taken from Table 3. The tests provide evidence that the increases noted are real and not the result of chance. Chi-square values of 8.08 (1948-1949) and 16.04 (1948-1952) were found. Corresponding values of P are 99.6 and 99.9+.

It is a reasonable inference from the data that fish larger than 10 inches also have increased in numbers somewhat, both from the creel census records as well as the shocker data.

Some increase in average total length of the spawning population also has occurred. In 1948, 38 percent of the fish were between 5.0-6.9 inches and 62 percent fell in the 7.0-9.9 inch size group. Except for the 1950 sample, fish larger than 7 inches have made up 81 to 90 percent of the shocker-collected brook trout. Also it should be noted that there were no fish larger than 9.9 inches in the 1948 sample, but that each year since the inception of the restrictions fish larger than 10 inches have been collected (Table 3).

Table 4. The age composition and size range of brook trout from the restricted water of the N. Branch Au Sable River, fall populations, 1948 through 1951.

Age group	September, 1948			November, 1949			October, 1950			October, 1951		
	Number	Size range (inches)	Average total length (inches)	Number	Size range (inches)	Average total length (inches)	Number	Size range (inches)	Average total length (inches)	Number	Size range (inches)	Average total length (inches)
I	91	5.2-9.3	...	60	5.2-9.9	...	34	5.6-9.0	...	37	6.8-9.5	...
II	2	7.6-9.7	...	12	7.3-10.1	...	3	10.2-10.5	...	3	9.0-10.6	...
I + II	9	5.2-9.7	7.1	72	5.2-10.1	8.2	37	5.6-10.5	7.8	40	6.8-10.6	8.5

The data in Table 4, which shows the age composition and size range of the fall brook trout population 1948-1951 in the restricted water, also provides further evidence of an increase in average length of the spawning population remaining each year under the 10-inch restriction. Only those fish capable of spawning (i.e., those fish bearing one or more winter marks on their scales) are tabulated. Prior to the inception of the 10-inch regulation in September, 1948, spawning fish were of an average total length of 7.1 inches. Under the increased minimum size, the 1949, 1950 and 1951 populations had average sizes of 8.2, 7.8, and 8.5 inches.

The age composition of brook trout in the 1950 and 1951 anglers' catches, both from the 10-inch and 7-inch water is shown in Table 5. Note that the catch from the 7-inch water in 1950 consisted of 43 percent age I fish, 54 percent age II fish, and 3 percent of age III fish. In 1951, age I fish amounted to 82 percent of the catch sampled and only 18 percent of age II specimens with none in age III.

In the 10-inch water because of the size restrictions, no age I brook trout appear in the catch in either year. In 1950, the catch was about 97 percent age II brook and 3 percent age III brook trout, while in 1951, age II fish made up 74 percent and age III fish 26 percent of the catch. Age determinations have not yet been made on the 1952 scale samples.

General conclusions

Both the creel census samples and the data obtained from shocker studies and scale samples suggest strongly that the restrictions now in force are still causing an increase in the number of trout, both brook and brown, in the experimental portions of the North Branch of the Au Sable. Although angling quality in the 10-inch water, as measured

Table 5. Age composition of wild brook trout that were taken by anglers, N. Branch Au Sable River, 1950 and 1951. Range in total length in inches is given in parentheses. Scale samples were obtained from anglers other than those contacted in the 10-inch water; in the 7-inch water, not all trout were sampled, For these reasons totals do not agree with creel census tables.

Year and water sampled	Age group	Month of season						Totals	Percent of sample in age groups
		April	May	June	July	August	September		
1951, 10-inch	II	1 (10.1)	14 (10.0-10.6)	14 (10.0-11.0)	5 (10.0-10.4)	1 (9.7)	...	35	74
	III	3 (10.0-10.9)	4 (10.0-11.5)	3 (10.8-10.9)	1 (10.6)	1 (11.2)	...	12	26
1951, 7-inch	I	...	14 (6.7-7.7)	58 (6.8-8.4)	79 (6.7-8.2)	83 (6.9-8.9)	35 (7.1-8.9)	269	82
	II	6 (7.5-8.4)	44 (7.0-9.7)	6 (7.6-10.1)	3 (6.8-10.0)	1 (9.3)	...	60	18
1950, 10-inch	II	...	6 (10.0-10.5)	17 (9.6-10.5)	10 (10.0-10.5)	3 (10.1-10.2)	...	36	97
	III	...	...	1 (11.5)	...	...	...	1	3
1950, 7-inch	I	...	...	12 (7.0-7.5)	10 (7.0-7.6)	3 (8.3-8.7)	8 (7.0-8.6)	33	43
	II	...	28 (7.0-9.6)	8 (7.1-8.7)	3 (7.9-9.0)	2 (8.8-9.6)	1 (9.0)	42	54
	III	...	2 (9.3-9.6)	...	...	...	...	2	3

by the numbers caught per hour has not improved, there is some evidence at hand (based on the great differences in average sizes of fish in the restricted and non-restricted waters) which suggests that eventually a greater poundage of fish per unit area may be removed from the 10-inch waters than from the 7-inch portions of the stream. Although 850 wild brook and brown trout were observed from the 7-inch water during 1952, their average size was considerably less than the 157 wild brook and brown trout checked during an equal sampling period on the 10-inch portion of the stream.

Tody (1949) has reported on the length-weight relationship of North Branch brown trout, and Cooper (1949) has done similar work for Michigan brook trout, including many fish from the North Branch. Application of the average length data for 1952 to the length-weight curves mentioned provides estimates that the anglers contacted removed about 88 pounds of wild trout from the 10-inch water as against 129 pounds of wild trout from the 7-inch water during an equal amount of checking time. Studies of age and growth reveal no slowing of the rate of growth of brook trout in the 10-inch water, at least through 1951.

Recent findings concerning the comparative mortality of fly-hooked and bait-hooked brook trout show that about 2 percent of brook trout hooked with #12 fly are killed, whereas about 27 percent of brook trout hooked with worms on #2, #4, #6, and #8 long shank bait hooks were killed (Shetter, 1953, unpublished). These findings support the contention of many anglers that an appreciable number of small trout may be saved by a "flies only" restriction. Along with the minimum size regulation of 10 inches, the restriction of lures to flies only undoubtedly has contributed to an unknown degree to the build-up of the trout population of the restricted water.

It is recommended that the restrictions now in force between the Crawford Otsego county line and Eamon's Landing on the North Branch of the Au Sable River be continued for at least two more years. In order that we accumulate at least a minimum of information on possible changes in the angling, it is also recommended that the creel census sampling be continued through 1954. It is planned to conduct an adequate series of shocker studies and to collect scale samples each fall during the next two years.

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