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ESTIMATED WEIGHTS OF THE ANGLERS'S CATCHES FROM THE
INTENSIVELY CENSUSED AREAS OF SEVEN TROUT
STREAMS COVERED IN 1939.

by

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Previous to the opening of the 1939 trout season it had been the hope of the Institute for Fisheries Research that measurements and weights of the complete catch of trout would be available from the various creel censuses in operation on sections of seven Michigan trout streams. Because of circumstances beyond our control, the scales for weighing fish were not available to the census clerks until about six weeks after the start of the season. Weights and measurements were made, however, on most fish recorded after June 15, 1939. Almost all fish captured previous to that date in the census areas were measured. This report will present an estimate of the total weight of trout removed by the anglers from the creel census areas, and also discuss a slightly different index to fishing quality which might be of use in future researches.

Methods

To obtain a reasonably accurate estimate of the total weight of the anglers' catch on the various stream areas under intensive census, the following procedure was used:

1. Weights and length measurements of all fish actually weighed were listed.
2. From a list of the fish measured and weighed, and for each species and each stream, a length-weight curve was constructed; since almost all fish were measured for total length the approximate weights of trout which were measured only could be determined from the length-weight curve for that species and stream. Where the length of the fish was not given, the average length of that species for the two week period in which it was caught

was used, and the corresponding weights for these lengths included in the calculation of the total weight.

3. To estimate the total weight of trout taken by anglers not contacted, the average time fished per angler contacted was multiplied by the total number of anglers not contacted which gave an estimate of the numbers of hours of fishing not already recorded. This latter figure was multiplied by the catch per hour as determined from the fishermen who had been contacted to obtain the estimated number of fish captured by the unrecorded anglers. The percentage of the various species in the recorded catch of fish for each stream was determined, and the number of fish of each species in the estimated catch of the unrecorded anglers was calculated by using the percentages. The average weights of the various species for each stream were applied to the estimated total catch, and the weights of the estimated catch by the unrecorded anglers thus was obtained.

The methods just described were very time-consuming, since the length-weight curves had to be built up for each species for each stream from the available data before the total weight of fish removed by angling could be estimated. It will be admitted that the yield estimates listed in the tables may be in error because of such factors as inaccurate measurements of weights or lengths by census clerks, or possible weight variation of the fish between late spring and fall. However, the figures given are certainly better than a simple guess. It was found also in a study of the literature on the general subject that very few yield statistics were available from other localities. Since 1939, data on the weight of the anglers catch has been taken in all intensive trout stream censuses, and where practicable is always included so that we may have this very understandable measure of the success of the fishermen in a given water area.

During the 1939 trout season the total acreage of trout water under intensive creel census was calculated to be 231.00 acres, and the total stream mileage to be 39.9. The areal and mileage data were determined either from plane-table maps of the several areas under study or from measurements obtained by chaining the length of the stream area under observation and also taking numerous width measurements (see table 1 for water acreages and stream miles under intensive creel census).

Yield to the anglers

The total estimated pounds of trout removed by anglers from the total area covered by the seven creel censuses amounted to 3,618.4 pounds, or 15.7 pounds per acre of stream under census, or 90.7 pounds of trout per mile of stream censused (Table 1). It will be noted by the reader that there is considerable variation in the productive capacities - as measured by the pounds of trout removed by angling from the areas under creel census on the several streams. The most productive area was the White River (30.59 pounds of trout per acre), followed by the Pine River (26.40 pounds), Hunt Creek (15.58 pounds), the Little Manistee River (14.09 pounds), the North Branch of the Au Sable River (12.35 pounds), the Pigeon River (11.09 pounds), and Canada Creek (3.19 pounds).

Tarzwell (1938) has reported that the per acre yield of rainbow trout in Tonto and Horton Creeks in Arizona to be from 29.5 to 54.2 pounds of fish in 1936 and 1937 under an angling pressure varying from 125 to 241 man-hours per acre per season. No data are given as to what percentage of this yield consisted of hatchery-reared fish although the author infers that hatchery trout were introduced in both streams. From data published by Surber (1940) it may be calculated that the yield per acre of brook and rainbow trout in 1938 and 1939 in the St. Mary River, in Virginia was 7.55 pounds and 9.64 pounds respectively under angling pressures varying from 103 to 130 man-hours per acre per season. Since all hatchery-reared trout in the catch on St. Mary River were marked it was possible to estimate from Surber's data that 5.03 pounds of 7.55 pounds (or 66.6 percent) caught in 1938 were native fish, while in 1939, a total of 6.14 pounds of 9.64 pounds (or 63.7 percent) were of natural origin. Surber's experimental work differed from that conducted in Michigan in that the hatchery fish were stocked as advanced fingerlings (3.75-6.00 inches). Compared with the results from the two localities mentioned above, the yields of Michigan streams are on the average intermediate in position.

Percentage of the total poundage of legal trout removed by anglers made up by pounds of hatchery-reared legal trout planted before and during the trout season.

In Table 2 are presented the pounds of hatchery-reared trout available to the anglers of portions of streams under creel census in 1939 and 1940, and also the number of pounds of hatchery-reared trout known or estimated to have been removed in those years. In 1939, all hatchery-reared trout planted as legal fish were either tagged or fin-clipped and could be distinguished readily from the wild stock by the census clerks. Some unmarked fish may have been from hatchery-reared stock which survived from previous plantings, but it has been demonstrated that this number is an insignificant portion of the total trout stream catch of any season (Shetter and Hazzard, 1942).

In 1940, only the brook trout released in the East Branch of the Tahquamenon river were marked (by tagging). The trout planted in the intensive creel census areas and available for the 1940 trout season in the North Branch of the Au Sable River, Fishdam and White Rivers were not marked. However, a fairly close estimate of the numbers of hatchery-reared trout caught in 1940 in those streams may be reached by applying the average recovery percentages for trout planted before or during the season as determined from previous researches (Shetter and Hazzard, 1942). After estimating the number of trout caught by this method, the total poundage of hatchery trout removed may be estimated by multiplying by the average weight of the particular species in question as determined from the weights taken in the course of the 1940 creel census. (Inst. Report No. 799).

From a study of Table 2 it will be noted that the percentage of the total weight of hatchery-reared trout released that was recovered later by anglers varied from a low of 12.5 percent (North Branch of the Au Sable River, 1939) to a high of 46.8 percent (East Branch of the Tahquamenon

River, 1940). Higher percentages of recovery were noted where less than 200 pounds, and more often less than 100 pounds of hatchery-reared fish were planted.

The percentage of hatchery-reared trout in the total poundage of legal trout taken in the several stream areas under creel census in the two years varied from 5.2 percent (Fishdam River, 1940) to 19.5 (Little Manistee River, 1939). Averaging the results from all the streams for which data were available in both years it was found that 11.4 percent of the total weight of legal trout removed by anglers in 1939 was made up of hatchery-reared trout, and that 9.9 percent of the poundage removed by anglers in 1940 consisted of artificially-raised fish. Factors which might affect these percentages are (1), the size and condition of the hatchery fish at the time of release and at subsequent capture; and (2), the size and condition of the native trout population. It was of interest to note the coincidence that the percentage of the total weight of the anglers' catch made up by hatchery trout parallels closely the percentage of the total number of anglers who catch hatchery trout (Shetter and Hazzard, 1942).

What index should be used in judging the quality
of the fishing between streams.

Two indices used in judging the quality of the fishing are presented below and in Table 3, and with the completion of the weight calculations the pounds of legal trout removed per hour of angling are included. Depending on which criterion is used the streams change position in the determination as to which offered the better fishing. This can be illustrated by the following listings:

Judged on the basis of catch per hour		Judged on the basis of pounds per hour	
Hunt Creek	(0.63)	Little Manistee	(0.13)
White River	(0.60)	N. Br. Au Sable	(0.11)
Pine River	(0.49)	Pigeon River	(0.11)
Pigeon River	(0.48)	White River	(0.11)
N. Br. Au Sable	(0.41)	Pine River	(0.10)
L. Manistee	(0.37)	Hunt Creek	(0.09)
Canada Creek	(0.32)	Canada Creek	(0.08)

The order of placement in the columns listed above depends on whether quality of angling is best offered by numbers or weight of fish taken per unit of effort. The varying average weights of the trout captured in the above streams contributed noticeably to the variations in the above comparisons. It now appears, after trials at computing several types of indices of angling quality, that the simplest and most accurate index to use is the pounds of trout taken per unit of effort. This index includes both factors which go to make up angling quality (according to the author's concepts), since if many fish of a moderate average weight or a few fish of exceptional weight are taken per unit of effort, the resulting indices will give a good indication of the angling quality.

Angling quality indices have been calculated in the manner just described for the several streams where intensive creel censuses were operated in 1939 and 1940, and are included in Table 3. The reader will note immediately that a different order of placement arises when angling quality is judged on the basis of pounds per hour of trout taken. The first three streams in their order of excellence, as determined by the catch in terms of pounds per hour are the Little Manistee River (0.132 lb/hr) N. Br. Au Sable River (0.113 lb/hr), and the Pigeon River (0.112 lb/hr). These indices are the result of a combination of fairly high catches per hour and somewhat higher average weights.

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INSTITUTE FOR FISHERIES RESEARCH

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Table 1

Estimated yield (in pounds) to the anglers of portions of seven
Michigan trout streams during the 1939 trout season.

Stream	Acreage under census (mi.)	Brook Trout		Brown Trout		Rainbow Trout		Totals	
		Total pounds	Pounds per acre	Total pounds	Pounds per acre	Total pounds	Pounds per acre	Total pounds	Pounds per acre
Pine River (Lake)	57.5 (9.5)	268.49	4.67	4.00	0.07	1,245.22	21.66	1,517.71	26.40
Pigeon River (Otsego)	65.4 (12.2)	480.67	7.35	73.15	1.12	171.56	2.62	725.38	11.09
N. Br. Au Sable (Crawford)	54.5 (4.6)	430.01	7.89	233.30	4.28	9.75	0.18	673.06	12.35
L. Manistee (Lake)	17.7 (3.6)	79.48	4.49	79.68	4.50	90.35	5.10	249.51	14.09
Canada Creek (Presque Isle)	21.2 (5.0)	63.92	3.02	0.27	0.01	3.45	0.16	67.64	3.19
White River (Newaygo)	10.4 (3.0)	318.11	30.59	....	....	....	....	318.11	30.59
Hunt Creek (Montmorency)	4.3 (2.0)	66.98	15.58	....	....	....	....	66.98	15.58
Totals or averages	231.0 (39.9)	1,707.66	7.39	390.40	1.69	1,520.33	6.58	3,618.39	15.66

Table 2. Comparison of the number of pounds of hatchery-reared trout planted as legal fish and the number of pounds of hatchery-reared trout removed by anglers, and the number of pounds of trout originating from native stock.

Stream	Pounds of hatchery-reared legal trout available			Estimated pound of hatchery-reared legal trout caught			Pounds of legal trout originating from native stock			Total catch of legal trout	Total Catch of legal fish of
	brook	brown	rainbow	brook	brown	rainbow	brook	brown	rainbow	in pounds	natural origin (in pounds)
Pine River (Lake)	777.20	....	170.6	126.2 (16.2)	....	65.6 (38.5)	142.3	4.0	1,179.6	1,517.7 (12.6)	1,325.9
N. Br. Au Sable (Crawford)	308.64	....	....	38.7 (12.5)	....	....	391.3	233.3	9.7	673.0 (5.8)	634.3
Little Manistee (Lake)	66.3	176.4	....	21.5 (32.4)	27.1 (15.4)	....	58.0	52.6	90.4	249.6 (19.5)	201.0
Totals or averages, 1939	1,152.1	176.4	170.6	186.4 (16.2)	27.1 (15.4)	65.6 (38.5)	591.6	289.9	1,279.7	2,440.3 (11.4)	2,161.2
N. Br. Au Sable (Crawford)	200.0	....	....	51.0 (25.5)	....	....	296.0	221.9	5.4	574.3 (8.8)	523.3
White River (Newaygo)	58.0	....	....	17.2 (29.6)	....	....	20.4	53.0	57.9	148.5 (11.6)	131.3
E. Br. Tahquamenon (Chippewa)	64.0	....	....	30.0 (46.8)	....	....	142.7	....	....	172.7 (17.3)	142.7
Fishdam River (Delta)	25.0	....	....	10.8 (43.2)	....	....	177.6	16.5	....	204.9 (5.2)	194.1
Totals or averages, 1940	347.0	....	....	109.0 (31.4)	....	....	636.7	291.4	63.3	1,100.4 (9.9)	991.4

✓ - Figures in parentheses indicate percentage of total planting taken by anglers.
 ✓ - Figures in parentheses indicate percentage of total catch made up by hatchery-reared trout.

Table 3. Summary of statistical criteria on which quality of angling may be judged for Michigan trout streams under intensive creel census, 1939 and 1940 seasons. (Figures include the estimated catches of anglers not contacted).

Stream	Water Acreage covered	Total hours of angling	Angling hours per acre per season	Total pounds of legal trout removed by anglers	Number of legal trout caught per hour	Pounds per hour of trout taken by angling	Pounds per acre of trout removed	Percentage of anglers unsuccessful
Pine River	57.5	15,226.50	265	1,517.71	0.49	0.10	26.4	48
Pigeon River	65.4	6,754.75	103	725.38	0.48	0.11	11.1	56
N. Br. Au Sable	54.5	7,050.00	129	673.06	0.41	0.11	12.4	63
Little Manistee	17.7	2,333.25	132	249.51	0.37	0.13	14.1	59
Canada Creek	21.2	873.00	41	67.64	0.32	0.08	3.2	57
White River	10.4	3,080.00	296	318.11	0.60	0.11	30.6	41
Hunt Creek	4.3	753.00	175	66.98	0.63	0.09	15.6	55

1940 trout season

N. Br. Au Sable	54.5	6,675.50	123	574.30	0.33	0.09	10.6	63
White River	17.5	2,131.75	122	148.50	0.22	0.07	8.5	79
E. Br. Tahquamenon	6.3	725.00	115	172.70	1.02	0.24	27.4	41
Fishdam River	3.0	589.50	197	204.90	0.80	0.35	68.3	42
Hunt Creek	4.6	901.25	189	60.35	0.45	0.07	12.8	66