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Results of demonstration creel censuses and volunteer

creel census on various trout streams

during the 1946 trout season

by

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In the conduct of experiments to determine the effects of releasing legal-sized hatchery-reared trout, comparatively limited numbers of marked trout (from 250 to 3,000 fish) were released in short stretches of stream which varied from 2 to 10 miles in length. For obvious reasons many anglers never caught any marked hatchery trout, since there are approximately 15,000 miles of trout streams in Michigan, and plantings of marked trout in previous years rarely were present in over 50 miles of trout streams.

It was decided late in 1945 that a large-scale demonstration of the results that are obtained from releases of hatchery trout just prior to and during the open season would be of educational value to Department personnel as well as to the trout fishermen. Accordingly, it was planned to mark all legal trout released in the Rifle, Au Sable, and Fox River drainages during 1946 so that any angler on those streams and their tributaries could determine the composition of his catch in terms of naturally-spawned or hatchery-reared trout.

During the 1946 trout season (actually from April 12 to August 15) a total of 104,170 marked legal trout¹ were planted as follows (Table 1): Fox River drainage, 14,895 brook trout; Au Sable River drainage, 18,500 brook trout, 28,450 brown trout, 20,475 rainbow trout; Rifle River drainage, 8,000 brook trout, 7,150 brown trout, 6,700 rainbow trout.

In 1945 in these three drainages a total of 60,029 legal trout were released. The composition of the 1945 plantings was: Fox River drainage, 4,275 brook trout; Au Sable River drainage, 14,800 brook trout, 23,800 brown trout, 4,600 rainbow trout; Rifle River drainage, 3,413 brook trout, 4,315 brown trout, and 4,826 rainbow trout.

So that all the hatchery trout released in 1946 could be recognized easily, all fish planted in the Au Sable and Fox River drainages were marked by removing the right pectoral fin; in the Rifle River drainage, the left pelvic fin was removed in order to distinguish these fish from possible recoveries from plantings of rainbow fingerlings which had been marked by removal of one of the pectoral fins, and from the 1945 releases of legal trout marked by clipping the right pelvic fin. The clipping operation was performed with curved-blade surgical shears after anesthesia in a slightly less than 1 percent solution of ether (1 ounce of ether to 1 gallon of water). Clipping was done usually a week or more prior to planting and the marked fish held in separate ponds until release. Where

¹ This total does not include 5,850 marked legal brook trout and 1,000 marked legal rainbow trout planted in the Pine River and tributaries in Alcona County. Technically the Pine River is part of the Au Sable drainage, but from a practical viewpoint is separated from the Au Sable drainage by Van Ettan Lake.

Table 1.--Number of trout and species of legal trout planted by months during 1946 in the Au Sable, Rifle and Fox River drainages (with average sizes in parentheses).

Month planted	Brook trout released			Brown trout released			Rainbow trout released			Total planted
	Au Sable	Rifle	Fox	Au Sable	Rifle	Fox	Au Sable	Rifle	Fox	
April	7,800 (9.2)	2,500 (9.4)	4,895 (7.7)	5,950 (9.2)	1,000 (8.8)	...	6,200 (9.2)	1,000 (8.8)	...	29,345
May	...	200 (9.1)	2,500 (8.5)	4,350 (9.0)	800 (9.1)	...	4,350 (9.0)	...	...	12,200
June	7,500 (9.8)	1,700 (9.2)	2,500 (9.1)	4,050 (10.0)	1,650 (9.2)	...	4,050 (7.8)	750 (9.2)	...	22,200
July	1,500 (9.8)	1,600 (8.1)	2,500 (8.3)	10,300 (9.0)	2,050 (8.6)	...	1,200 (9.7)	2,650 (9.3)	...	21,800
August	1,700 (8.0)	2,000 (8.6)	2,500 (8.4)	3,800 (9.1)	1,650 (8.6)	..	4,675 (7.2)	2,300 (8.6)	...	18,625
Totals	18,500	8,000	14,895	28,450	7,150		20,475	6,700		104,170

it was possible to use a planting boat, the fish were released from a drifting boat. On the smaller tributaries, the marked fish were planted by the usual method of release at as many sites as could be reached with tank trucks.

Mortality resulting from the marking and handling rarely amounted to $1/2$ of 1 percent. Certain plantings marked for the Fox River had as high as 10 percent mortality or possibly higher, but this excessive loss appears to have been the result of a minor disease epidemic and was not ascribable to the marking procedure.

A small number of anglers objected to fin-clipping on various grounds. In answer to their objections it may be pointed out that fin-clipping, as a means of identification both on trout and other fishes, has been used widely in other parts of the United States and Europe for the past 50 years. Control experiments involving fin-clipped brook trout and unmarked brook trout held in the same hatchery pond showed a somewhat higher mortality among marked legal-sized fish between October, 1938, and April, 1940. However, marked fish grew as rapidly and as well as unmarked fish. The results of the control experiment indicated that interpretation of the data obtained by the use of fin-clipping was unlikely to be influenced by the variation in the mortality rates of marked and unmarked fish (Shetter and Hazzard, 1941). Past experience, plus the need for using a simple marking method applicable to large numbers of legal trout, led to the choice of fin-clipping as the mode of marking. It would have been a physical impossibility to tag 104,000 legal trout for release during the season without increasing the staff of the Fish Division.

Incidental to the demonstration data on the success of the plantings of marked hatchery fish were obtained in three ways. One method involved a spot census on each Sunday of the trout season by checking parties composed usually of one individual from the Institute for Fisheries Research, another from the cultural Branch of the Fish Division, and a third from the Division of Field Administration. This party would cover as much of a given drainage as possible either by car and on foot or by canoe, contacting all fishermen encountered.

On the two smaller drainages (the Rifle and the Fox Rivers) the checking parties felt that they contacted a majority of the anglers on the days they operated, and the angling data obtained by them probably represents fishing conditions on those days in a reasonably accurate manner. The Au Sable drainage, however, is much larger than the other two, and the checking party seldom examined more than a short portion of one or two streams in the drainage, and it is doubtful if the catch records are representative for the entire stream system. It is our feeling that the volunteer census is the more reliable index to fishing in the Au Sable drainage.

The second and third methods were through the submission of voluntary reports by interested anglers, either by mail, or in the case of the Au Sable River drainage, by means of the volunteer creel census. All three drainages were posted with placards explaining the experiment and inviting all anglers to send in records of their fishing results. The number of fishing days for which reports were obtained by the various methods were: spot census, 1169; reports by mail, 319; Au Sable volunteer creel census, 4,564. Complete records of the Sunday fishing on the Rifle River

Area on the headwaters of the Rifle River are available also for purposes of comparison. A summary of the results of the Au Sable volunteer creel census is given first, followed by the data collected on that and the other streams on the random Sunday censuses and by mail.

AU SABLE VOLUNTEER CREEL CENSUS, 1946

Volunteer creel census records for the Au Sable drainage were kept in a manner similar to that employed in 1945. Through the cooperation of the Crawford County Sportsmen's League, mimeographed record sheets were distributed to individuals, cabin owners, guides and fishing clubs who recorded the results of angling done on the Au Sable and its tributaries. Except for providing columns for listing the marked fish, the sheets were the same as in 1945 (See sample at end of report).

For the entire drainage (Table 2) almost three times as much fishing was recorded in 1946 as in 1945 (4,564 angling days compared with 1,644 angling days). During 1946, a recorded total of 4,564 anglers fished 21,314.75 hours and caught a total of 18,771 trout, or 0.88 legal trout per hour of fishing, slightly less than during 1945, when the catch per hour for the entire drainage was 1.08 legal fish. The catch consisted of hatchery trout (recognizable by the missing right pectoral fin) in the following numbers: brook trout, 1,240; brown trout, 2,626; and rainbow trout, 1,287; and unmarked wild trout as follows: brook trout, 5,049; brown trout 7,124; and rainbow trout, 1,445. The ratio of the species in the catch of marked hatchery trout was 1 rainbow trout to 2 brown trout to 1 brook trout (approximately the same as the planting ratio), and for wild fish the ratio was 1 rainbow trout to 5 brown trout to 3 brook trout.

Table 2.--Au Sable Drainage Volunteer Creel Census, 1946 trout season, by months, for all fishing

(↓ - numbers in carets indicate numbers of legal fish released).

Month	Number of anglers	Anglers taking no legal fish	Total hours of fishing	Marked trout caught			Unmarked trout caught			Total catch	Catch per hour	Catch per angler
				Brook	Brown	Rainbow	Brook	Brown	Rainbow			
April	484	62	2,194.50	225	278	115	765	831	192	2,406	1.10	5.0
May	1,087	148	4,673.75	380	664 ²⁸ ↓	323 ¹¹ ↓	1,135	1,802	401	4,705 ¹² ↓	1.01	4.3
June	1,182	202	5,242.25	384	575 ¹⁰ ↓	266 ¹⁰ ↓	1,028	1,809	304	4,366 ²⁰ ↓	0.83	3.7
July	916	229	4,324.25	239	613 ³ ↓	317 ⁴ ↓	1,090	1,399	307	3,965 ⁷ ↓	0.92	4.3
August	824	326	4,426.00	12	417 ³ ↓	229	967	1,188	214	3,027 ³ ↓	0.68	3.7
September	71	3	454.00	...	79	37	64	95	27	302	0.67	4.2
Totals	4,564	970	21,314.75	1,240	2,626 ¹¹¹ ↓	1,287 ²⁸ ↓	5,049	7,124	1,445	18,771 ⁷² ↓	0.88	4.1

The percentage of unsuccessful anglers in 1946 was 21 (970 of 4,564 fishermen reported taking no fish).

Angling quality was best during the last four days of April (1.10 legal fish per hour), but exhibited a steady decline during May and June. In the latter month it dropped to 0.83 legal fish per hour, but rose during July to 0.92 legal fish per hour. During August and September it dropped sharply to $2/3$ of a legal fish per hour of angling .

Comparison of the angling data in the different parts of the Au Sable system indicates a wide variation in angling quality (Table 3.) On the main stream, 2,307 anglers, of whom 249 (or 10.8 percent) caught no legal fish, spent 10,147.50 hours in fishing. They caught 10,053 legal trout at the rate of 0.99 legal fish per hour or 4.4 legal trout per angler. The most hours were recorded for June (2,964.25), but the most fish were caught in May (2,620). The best fishing was in April when the catch per hour was 1.18 legal trout, and September was poorest (catch per hour, 0.64 legal trout). The percentage of marked hatchery fish in the legal catch was: brook trout, 10.9 percent, brown trout, 29.2 percent; rainbow trout 46.6 percent; all trout, 30.6 percent.

On the South Branch, 284 anglers fished 1,657.00 hours and caught 2,211 legal trout. Only 12 anglers from the South Branch (4.2 percent) reported unsuccessful trips. For the entire season, the catch per hour on the South Branch was 1.33 legal trout, or 7.8 legal trout per angler, the best of any of the streams of the drainage. The most hours were recorded for May (444.00) and also the most fish (662). Angling quality was highest in August when 361 legal trout were captured in 215.00 hours for a catch per hour of 1.68 fish. Only during April was the quality index lower than 1.00 fish per hour, and in that month it was 0.82 legal

Table 3.--Au Sable Volunteer Creel Census, 1946 trout season, by streams and months, for all fishing.

(↓ - numbers in carets indicate numbers of legal fish released)

Stream and month	Total angling days	Number catching no fish	Total hours of angling	Marked trout caught			Unmarked trout caught			Total catch	Catch per hour	Catch per angler
				Brook	Brown	Rainbow	Brook	Brown	Rainbow			
Main stream												
April	268	23	1,136.00	33	137	86	239	670	174	1,339	1.18	5.0 -
May	660	79	2,593.50	45	469 ²⁸	250 ¹⁴	317	1,202	337	2,620 ⁴²	1.01	4.0 -
June	707	107	2,964.25	23	408 ¹⁰	234 ¹⁰	236	1,182	240	2,323 ¹⁰	0.78	3.3
July	346	19	1,656.75	54	423 ³	259 ⁴	232	702	261	1,931 ⁷	1.17	5.6
August	266	18	1,388.00	...	341 ³	198	216	646	178	1,579 ³	1.14	5.9
September	60	3	409.00	...	79	37	36	82	27	261	0.64	4.3
Totals	2,307	249	10,147.50	155	1,857 ⁴⁴	1064 ²⁸	1,276	4,484	1,217	10,053 ⁷²	0.99	4.4
South Branch												
April	37	8	184.50	1	12	29	32	60	17	151	0.82	4.1
May	74	0	444.00	6	157	69	96	272	62	662	1.49	8.9
June	69	3	393.50	...	93	32	51	206	59	441	1.12	6.4
July	65	0	420.00	3	186	58	102	201	46	596	1.42	9.2
August	39	1	215.00	...	76	30	106	114	35	361	1.68	9.3
Totals	284	12	1,657.00	10	524	218	387	853	219	2,211	1.33	7.8
North Branch and Big Creek												
April	173	31	854.50	160	128	...	484	100	1	873	1.02	5.0
May	353	69	1,636.25	329	38	4	722	328	2	1,423	0.87	4.0
June	406	92	1,884.50	361	74	...	741	421	5	1,602	0.85	3.9
July	505	210	2,247.50	182	4	...	756	496	...	1,438	0.64	2.8
August	518	307	2,819.00	9	...	1	643	424	...	1,077	0.38	2.1
September	11	0	45.00	...	...	...	28	13	...	41	0.91	3.7
Totals	1,966	709	9,486.75	1041	244	5	3,374	1,782	8	6,454	0.68	3.3
East Branch												
April	6	0	19.50	31	1	...	10	1	...	43	2.21	7.2
August	1	0	4.00	3	...	...	2	4	1	10	2.50	10.0
Totals	7	0	23.50	34	1	...	12	5	1	53	2.26	7.6
GRAND TOTALS	4,564	970	21,314.75	1,240	2,626 ⁴⁴	1,287 ²⁸	5,049	7,124	1,445	18,771 ⁷²	0.88	4.1

fish per hour. The percentage of marked hatchery trout in the catch for the South Branch was as follows: brook trout, 2.5 percent; brown trout, 38.0 percent; rainbow trout, 49.8 percent; all trout, 34.0 percent.

Records for the North Branch of the Au Sable and Big Creek, one of its tributaries, have been combined because of the manner in which numerous angling data for these two streams were listed together. A total of 1,966 fishermen used these streams; 709 or 36.0 percent were unsuccessful. These anglers spent a total of 9,486.75 hours in catching 6,454 legal trout at the rate of 0.68 legal fish per hour or 3.3 per angler. The North Branch and Big Creek were used most heavily in August (2,819.00 hours), the most fish were caught in May (1,602). Angling quality was best in April (1.02 trout per hour) when 873 legal trout were taken in 854.50 hours of fishing.

The percentage of marked hatchery-reared trout in the catch was as follows: brook trout, 23.6 percent; brown trout, 12.0 percent; rainbow trout, 38.4 percent; all trout, 19.9 percent.

Only seven records were reported for the East Branch of the Au Sable, probably too few to indicate the actual conditions there. Six of the records were for April and one for August. All were successful in taking fish. These anglers fished a total of 23.50 hours and captured 53 legal trout at the rate of 2.26 legal trout per hour, or 7.6 fish per angler. The percentage of marked hatchery trout in the catch was: brook trout, 73.9; brown trout, 16.2 percent; rainbow trout, 0.0 percent; all trout, 66.0 percent.

For all records listed for the entire drainage the percentage of marked hatchery trout in the catch was: brook trout, 19.7 percent;

brown trout, 26.9 percent; rainbow trout, 47.1 percent; all trout, 27.7 percent.

A more nearly adequate series of records for night fishing were reported during 1946 (Table 4). A total of 412 anglers listed the results of after-dark fishing, spending a total of 1,507.75 hours on various parts of the Au Sable drainage after sunset. Their total catch consisted of 1,084 legal trout, for a catch per hour of 0.72 legal fish, or 2.6 fish per angler. Unsuccessful anglers among the night fishermen amounted to 77, or 18.6 percent. Their catch consisted of the following: marked brook trout, 15; unmarked brook trout, 117; marked brown trout, 147; unmarked brown trout, 600; marked rainbow trout, 84; unmarked rainbow trout, 121.

In night fishing, the percentage of marked hatchery trout in the catch was: brook trout, 11.3 percent; brown trout, 19.6 percent; rainbow trout, 40.9 percent; all trout, 22.7 percent. Comparison of the results of night fishing with all fishing indicates that angling after dark took a noticeably higher proportion of wild unmarked trout than did daytime angling (Table 4).

For the records obtained, night-fishing anglers constituted 9.0 percent of the total number listed (412/4,564), and the after-dark angling hours made up 7.5 percent of the total hours recorded (1,507.75/21,314.75). For the second successive year, the records turned in indicate that night fishing is less productive than day-time fishing as far as numbers of fish are concerned. Although there are no data available at present to compare the size of fish taken during daylight and after dark, it is well known that one of the chief attractions of night fishing is the possibility

Table 4.--Night fishing data, Au Sable Volunteer Creel Census, 1946 trout season. (↓ - numbers in carets indicate numbers of legal fish released)

Month	Number of anglers	Anglers taking no legal fish	Total hours of fishing	Marked trout taken			Unmarked trout taken			Total catch	Catch per hour	Catch per angler
				Brook	Brown	Rainbow	Brook	Brown	Rainbow			
April	1	0	6.50	...	4	...	8	18	...	30	4.61	30.0
May	15	9	20.25	...	...	...	...	6	1	7	0.35	0.5
June	284	49	991.00	11	99	62↓	43	375	73	663↓	0.67	2.3
July	95	11	447.00	1	42↓	22	63	187	43	358↓	0.80	3.8
August	17	8	43.00	3	2	...	3	14	4	26	0.60	1.5
Totals	412	77	1,507.75	15	147↓	84↓	117	600	121	1,084↓	0.72	2.6

of capturing larger-than-average trout, particularly brown trout. On the basis of the 1946 records, the night fishermen are not taking more than their numerical share of the trout. Their total catch after dark amounted to 5.9 percent of the entire catch (1,084/18,771). Until it can be demonstrated that the nocturnal anglers remove a disproportionate share of the total catch, any restrictions on anglers who desire to flounder among the sunken tree tops during the dark of the June moon appear unwarranted.

As judged by the catch per hour, the best night fishing was to be obtained on the South Branch, (Table 5), where, over the entire season, 39 night anglers fished 143.50 hours and took 223 legal trout at the rate of 1.54 legal trout per hour. On the main stream, 328 anglers fished 1,232.25 hours after dark and caught 774 legal trout at the rate of 0.63 legal trout per hour, and on the North Branch, 44 anglers fished 128 hours after sunset, caught 77 legal trout at the rate of 0.60 legal trout per hour. One record (obviously not enough to judge) from the East Branch listed 10 trout caught after dark in 4 hours of fishing, or 2.50 trout per hour.

Voluntary records were returned by 54 individuals during 1946 as compared with 15 recorders during 1945, a definite increase in the number of persons sending in fishing data from the Au Sable drainage. A list of these individuals is appended. Especial credit must be given to Franklin Hills for his interest in this project, and who devoted much time to obtain angling records for analysis. The cooperation and assistance of the Grayling Sportsman's Club is also gratefully acknowledged.

Table 5.--Night fishing records by streams, Au Sable drainage, 1946 trout season--Volunteer Creel Census

(↓ - Number in caret indicates number of trout released.)

Stream and month	Number of anglers	Anglers taking no fish	Total hours of night fishing	Marked trout caught			Unmarked trout caught			Total catch	Catch per hour	Catch per angler
				Brook	Brown	Rainbow	Brook	Brown	Rainbow			
Main Stream												
April	...	...	...	...	...	...	...	...	...	...	...	...
May	9	5	12.25	...	...	...	...	3	1	4	0.33	0.4
June	231	42	858.50	...	85	55↓	26	283	59	508↓	0.59	2.2
July	75	5	333.00	1	35↓	19	21	136	35	247↓	0.74	3.3
August	13	6	28.50	...	2	...	1	9	3	15	0.53	1.2
Totals	328	58	1,232.25	1	122↓	74↓	48	431	98	774↓	0.63	2.3
North Branch												
April	...	...	...	...	...	...	...	...	...	...	...	...
May	6	4	8.00	...	...	...	...	3	...	3	0.38	0.50
June	28	4	80.50	11	8	...	16	35	...	70	0.84	2.50
July	7	6	29.00	...	...	...	...	3	...	3	0.11	0.42
August	3	2	10.50	...	...	...	...	1	...	1	0.10	0.33
Total	44	16	128.00	11	8	...	16	42	...	77	0.60	1.80
South Branch												
April	1	0	6.50	...	4	...	8	18	...	30	0.46	30.0
May	...	...	...	...	...	...	...	...	...	...	...	...
June	25	3	52.00	...	6	7	1	57	14	85	1.63	3.4
July	13	0	85.00	...	7	3	42	48	8	108	1.27	8.3
Total	39	3	143.50	...	17	10	51	123	22	223	1.54	5.7
East Branch												
August	1	0	4.00	3	...	...	2	4	1	10	2.50	10.0
Grand totals	412	77	1,507.75	15	147↓	84↓	117	600	121	1,084↓	0.72	2.6

List of individuals sending in angling data for

Au Sable Volunteer Census

Grayling - A. Hubbell, C. B. Parks, J. Glen Day, H. Deckrow, Mr. Burrus, G. Brelski, Jr., T. Stephan, N. Stephan, J. Stephan, L. Stephan, G. Stephan, M. Stephan, G. A. Griffin, Mrs. G. Stephan, A. Borchers, Mrs. J. Knecht, Dan Babbitt, E. H. Hoffman, Major Hawkhurst, D. Henderson, C. Feldman, Dr. S. L. Ballard, F. Hills, M. W. Burtch, Ed. Rieth, C. Welch, E. G. Shaw, D. J. Wightman, F. Carr, R. Milnes, Jr., E. Borchers, Mr. Pocock, W. E. Myers, L. H. Richards, Penrod's Cabins, Vassar Club, B. Saunders, D. J. O'Brien, Oxbow Club, A. G. Scott, Mr. McCain, M. G. Vallad, E. Madsen, Mr. Neff, C. P. Ismon, R. Wright.

Lovells - W. T. Miller, R. Duby, R. Steckling, E. Caid, J. Hirschfield, F. E. Wood.

Gaylord - P. Galvin

Lewiston - R. Lloyd

Ohio (Lakewood) - K. E. Harris

Spot Creel Census

Au Sable River Drainage - The Fisheries Biologist stationed at the State Fish Hatchery, Grayling, Michigan, was in charge of the spot census on the Au Sable drainage. Dr. Allison was assisted by various members of the Fish Division and Field Administration Division as assigned by the Regional Supervisors of the respective Divisions. Nineteen Sundays and the opening Saturday were spent on the stream system. On 13 of these days, the water chosen was covered by canoe or boat; on the other 7 days, checking was done by driving a car to various landings and searching out

the stream on foot. The various branches were visited as follows: Main stream, 9 days; East Branch, 3 days; South Branch, 3 days; North Branch, 5 days; Big Creek (Crawford County), 2 days; Big Creek (Oscoda County), 1 day. Records of all anglers contacted were written up on census blanks designed for this type of census (see sample form), the angling data was taken regardless of whether the fishermen were just starting, half completed, or about to stop fishing.

On the Au Sable, as elsewhere in the trout country, the "luck of the draw" as far as weather was concerned, influenced the number of anglers to be found in the stream on Sunday. Particularly in the fore part of the season, the weather was cold and rainy or snowy. It rained or snowed or hailed on 8 of the 20 days the creel census operations were attempted on the Au Sable, and during the first three weekends the water temperature did not rise above 50° F. at any time. The number of anglers contacted ranged between 5 and 100, and the number of legal trout examined ran from 0 to 164.

For the 20 weekend days on the Au Sable drainage (Table 6) 458 anglers were contacted and 210, or 46 percent had caught no legal fish. A total of 1,187.25 hours of fishing were recorded, during which time a total of 823 legal trout had been caught for a catch per hour of 0.69 legal fish. The catch per hour on the various weekends ranged between 0.00 and 1.46 legal trout.

The legal catch consisted of the following species and types: brook trout, marked hatchery fish - 206, unmarked fish - 263; brown trout, marked hatchery fish - 44, unmarked fish - 150; rainbow trout, marked hatchery fish - 101, unmarked fish - 59.

Table 6.--Summary of results by various methods of creel census on the Fox, Rifle, and Au Sable River drainages during the 1946 trout season (Percentages are given in parentheses) M = marked U = unmarked.

Drainage and census method	Number of anglers	Number of anglers taking no legal trout	Number of anglers catching marked trout	Hours of fishing	Legal trout caught								Total catch	Catch per hour	Catch per angler
					Brook		Brown		Rainbow		All				
					M	U	M	U	M	U	M	U			
Fox River Sundays	262	125 (47.7)	84 (32.0)	820.75	278 (36.3)	485	...	1	...	...	278 (36.3)	486	764	0.93	2.9
Rifle River Sundays	449	322 (72.0)	50 (11.1)	1116.50	11 (40.7)	16	68 (25.2)	202	61 (53.0)	54	140 (34.0)	272	412	0.37	0.9
AuSable River Sundays	458	210 (46.0)	134 (29.2)	1187.25	206 (43.9)	263	44 (227)	150	101 (63.1)	59	351 (43.0)	472	823	0.69	1.8
Sunday totals	1169	657 (56.7)	268 (22.9)	3124.50	495 (39.3)	764	112 (24.0)	353	162 (58.8)	113	769 (38.4)	1230	1999	0.64	1.7
Fox River Letters	90	0 (0.0)	73 (81.1)	... ¹	500 (41.6)	702	...	...	...	...	500 (41.6)	702	1202	...	13.4
Rifle River ² Letters	55	0 (0.0)	46 (83.6)	...	25 (73.2)	9	69 (37.9)	113	76 (60.8)	49	208 (54.8)	171	379	...	6.9
AuSable River ³ Letters	174	21 (13.2)	98 (56.3)	...	120 (37.6)	199	77 (40.1)	115	81 (84.3)	15	345 (41.0)	496	841	...	4.8
Letter totals	319	21 (6.6)	217 (68.0)	...	645 (41.5)	910	146 (39.0)	228	157 (71.0)	64	1053 (43.5)	1369	2422	...	7.6
AuSable River Volunteer census	4564	970 (21.0)	2044 ³ (44.7)	21314.75	1240 (19.7)	5049	2626 (26.9)	7124	1287 (47.1)	1445	5153 (27.7)	13618	18771	0.88	4.1
Rifle River Area Sunday data	447	366 (81.8)	4 (0.9)	1167.50	... (0.0)	2	4 (1.8)	214	2 (11.8)	15	6 (2.5)	231	237	0.20	0.5

¹ Hours not given in numerous reports by mail, so no totals are given

² In certain reports, angling results were given merely in terms of marked or unmarked trout, so totals by species will not add up to correct sum under all trout.

³ This figure is probably too high because of the impossibility of determining the exact number of anglers catching marked fish due to the set-up on the recording sheets.

According to the spot census, the percentage of the catch of the various species consisting of marked hatchery fish was as follows:

brook trout, 43.9; brown trout, 22.7; rainbow trout, 63.1; all trout, 43.0 percent. The number of anglers catching marked fish was 134, or 29.2 percent of the total contacted.

Rifle River - The spot creel census on the Rifle River was supervised by Basil Hughes, who also was in charge of creel census activities in the Rifle River Area. He was furnished assistance from the Fish and Field Administration Divisions in the same manner as Allison. Random creel census operations were conducted on the Rifle River drainage entirely by car and on foot.

Anglers were checked on 19 Sundays and the opening Saturday. On 6 of these days the water temperature was below 50° F. and on 6 Sundays there was rain. The number of anglers contacted on any day varied between 9 and 39, and the number of fish observed ranged between 4 and 52. The following streams in the drainage were checked: Main Rifle, 20 days; Houghton, Klacking and Prior Creeks, 16 days each; Wilkins Creek, 13 days; Silver Creek, 4 days.

In the 20 days of random census operations on the Rifle River drainage 449 anglers were contacted, of whom 322, or 72 percent, caught legal no₁ fish. A total of 1,116.50 hours of angling time was recorded, and the total catch listed was 412 legal trout, caught at the rate of 0.37 legal trout per hour (Table 6). The range in angling quality, as measured by the catch per hour, varied between 0.13 to 1.39 legal trout.

The legal catch was composed of the following species and types of fish: brook trout, marked hatchery fish - 11, unmarked fish - 16; brown trout, marked hatchery fish - 68, unmarked fish - 202; rainbow trout, marked hatchery fish - 61, unmarked fish - 54.

The percentage of marked hatchery fish in the catch of the various species in the Rifle River drainage was: brook trout, 40.7 percent; brown trout, 25.2 percent; rainbow trout 53.0 percent; all trout, 34.0 percent. The number of fishermen catching marked hatchery fish was 50, or 11.1 percent of the total number of anglers.

Fox River Drainage - The census work on the Fox River drainage in Schoolcraft County was supervised by Hugo L. Kilpela of Newberry, Michigan. He was assisted by Fish Division and Field Administration personnel in a manner similar to that previously described. Creel census records were obtained by cruising the drainage north of Seney by car and foot, or by establishing road blocks in the vicinity of Seney.

Kilpela and his assistants took random creel census on the 19 Sundays during the 1946 trout season. It either snowed or rained on six of these days, and on five Sundays water temperatures were still below 50° F. at noon. The number of fishermen contacted on any Sunday varied between 2 and 27, and the number of fish checked ranged between 0 and 83.

Totalling the data collected on the Fox River drainage for the 19 Sundays reveals that 262 anglers were contacted, of whom 125, or 47.7 percent were unsuccessful. A total of 820.75 hours were spent in catching 764 legal trout for a catch per hour of 0.93 legal trout, the best catch per hour of any of the three streams. The range in angling quality varied between 0.0 and 1.59 legal trout per hour on the various Sundays.

The legal catch in the Fox River drainage consisted of the following: brook trout, marked hatchery fish - 278, unmarked fish - 485; brown trout, unmarked fish - 1.

The percentage of marked hatchery fish in the catch on the Fox River drainage was 36.3, and consisted entirely of brook trout. The number of anglers catching marked fish was 84, or 32 percent of the total.

AVERAGE SIZE OF TROUT CHECKED (Table 7)

In the course of the spot census work, length measurements on 681 marked hatchery trout and 961 unmarked trout were taken. In the Au Sable drainage, hatchery brook trout were of a larger average size than the unmarked brook trout (8.6 inches as compared with 8.2 inches). However, unmarked brown and rainbow trout averaged almost an inch larger than marked hatchery fish of the same species. As a whole, marked fish averaged 0.1 inch shorter than unmarked fish for the Au Sable drainage (8.6 inches as compared with 8.7 inches).

On the Rifle River stream system, marked brook trout averaged 8.6 inches in length as compared with 8.7 inches for unmarked brook trout. Again, unmarked brown trout and rainbow trout were of considerably larger size than marked brown and rainbow trout. Combining data for all species demonstrates that unmarked fish in the Rifle drainage averaged 9.4 inches as compared with 8.4 inches for marked trout.

Length measurements from the Fox River drainage indicate that both hatchery brook and unmarked brook trout in the catches were of the same average size--8.4 inches. The one brown trout caught was 16.6 inches long.

Combining the data for all three stream systems, marked hatchery brook trout were of an average length of 8.5 inches, while unmarked brook

Table 7.--Average lengths of marked and unmarked trout checked in the course of the 1946 Random Creel Census on AuSable, Rifle and Fox River drainages.

Measurements are given in inches. Numbers in parentheses are total numbers of trout of each size from the drainages indicated.

Drainage system	Average size of various species and types of trout caught							
	Brook trout		Brown trout		Rainbow trout		All trout	
	Marked	Unmarked	Marked	Unmarked	Marked	Unmarked	Marked	Unmarked
Au Sable	8.6 (197)	8.2 (215)	8.8 (48)	9.7 (102)	8.5 (102)	9.3 (42)	8.6 (347)	8.7 (359)
Rifle	8.6 (11)	8.7 (16)	8.6 (68)	9.4 (199)	8.1 (61)	9.6 (51)	8.4 (140)	9.4 (266)
Fox	8.4 (194)	8.4 (335)	...	16.6 (1)	...	...	8.4 (194)	8.4 (336)
Totals and averages	8.5 (402)	8.3 (566)	8.7 (116)	9.5 (302)	8.4 (163)	9.5 (93)	8.5 (681)	8.8 (961)

trout averaged 8.3 inches, marked hatchery brown trout were almost an inch shorter than unmarked fish (8.7 inches compared with 9.5 inches), and marked hatchery rainbow trout were slightly over an inch shorter than the unmarked rainbow trout (8.4 inches as compared with 9.5 inches). In general, marked trout were of an average length of 8.5 inches, while unmarked trout averaged 8.8 inches in length.

If one compares the average lengths of the marked trout at the time of release (Table 1) with the average size of the marked trout in the catches (Table 6) it will be noted that the average size at capture is less than the average size at planting. This variance suggests three possibilities: (1) that a greater proportion of the planted trout which are smaller than the average planting size are captured than of the larger hatchery fish; or (2) that the samples of 50 or 100 trout taken for measurement before release are not adequate for determining the average size; or (3) there is a loss in length after release in the streams.

OTHER DATA AVAILABLE ON THE 1946 FISHING SEASON ON THE
AU SABLE, FOX AND RIFLE RIVER DRAINAGES

Further information on the angling in these streams and the proportion of marked hatchery trout in the anglers' catch is available from letters written by anglers in response to the numerous posters placed along the three streams. These posters illustrated the various fins, described the mark used in that stream, and asked anglers to write to the Fish Division, listing the numbers of marked and unmarked

fish by species which they caught. Records of 90 days of angling was reported by mail for the Fox River system, 55 days for the Rifle, and 174 days for the Au Sable River drainage[↓] (Table 6).

On the Fox River system, of the 90 angling days reported in by mail, 73 or 81.1 percent had caught marked brook trout. The total catch exceeded that listed for the random census on Sundays, and amounted to 1,202 brook trout, consisted of 500 marked brook trout and 702 unmarked brook trout. Marked hatchery fish made up 41.6 percent of the total catch.

On the Rifle River drainage, 55 angling reports indicated that 46 or 83.6 percent caught marked trout. The total catch of those reporting by letter was 379 legal trout, distributed as follows: brook trout, marked hatchery fish - 25, unmarked fish - 9; brown trout, marked hatchery fish - 69, unmarked fish - 113; rainbow trout, marked hatchery fish - 76, unmarked fish - 49.

The percentage of the catch of each species consisting of marked hatchery trout was: brook trout, 73.2 percent; brown trout, 37.9 percent; rainbow trout, 60.8 percent; all trout, 54.8 percent.

Anglers reporting by letter on the Au Sable drainage listed 174 days of angling, of which on 98 days or 56.3 percent, marked trout were caught. The total catch was trout made up of 120 marked brook trout,

[↓]To simplify tabulations, creel census data obtained by or reported to Department personnel on days other than Sundays or the opening day has been included in the returns by mail.

199 unmarked brook trout, 77 marked brown trout, 115 unmarked brown trout, 81 marked rainbow trout and 15 unmarked rainbow trout. The percentage of marked hatchery trout in the catch was: brook trout, 37.6 percent; brown trout, 40.1 percent; rainbow trout, 84.3 percent; all trout, 43.5² percent.

It appears that the angling reported by mail constitutes a rather biased sample, since for all streams the percentage of marked fish in the total catch, and the percentage of anglers catching marked fish is much higher than observed during the spot census on weekends. The great majority of anglers reporting by mail were those who had caught marked fish, and in the Fox and Rifle drainages, the only anglers reporting by mail were those who had caught some marked legal trout.

DISCUSSION

Based on the creel census data obtained by the spot checks on the weekends, the 1946 planting program for the three stream systems under discussion produced the following effects on the angling in those waters:

On the Fox River drainage, the release of 14,895 legal brook trout influenced the total catch to the extent that slightly more than 1/3 of the catch consisted of hatchery fish; almost 1/3 of the anglers caught marked trout; however, almost 48 percent of the anglers caught no legal trout.

² For 234 fish, the species was not given, only data as to whether they were marked or unmarked. Using only the figures given in the species columns the percentage of all trout consisting of marked hatchery fish is 278/607 or 45.8 percent.

On the Rifle River stream system, slightly over $1/3$ of the total trout catch consisted of marked hatchery fish with an introduction of 21,850 marked legal-sized trout; $1/9$ of the total anglers took marked fish, and 72 percent of the total anglers caught no legal trout. Comparison of the Sunday fishing on the Rifle River Area with the Sunday census indicates that 447 Sunday anglers on the Rifle River Area took 237 legal trout in 1,167.50 hours of fishing, at the rate of 0.20 fish per hour, and 366, or 81.8 percent of the fishermen took no fish. The catch per hour in the unstocked water of the Rifle River area was 54 percent as good as the general areas where stocking had been carried out. Also the percentage of unsuccessful anglers was 10 percent less in the areas which had been stocked. It should be mentioned here that no reports were received during 1946 of recoveries of the 1945-marked legal trout (right pelvic clipped) planted in the Rifle River drainage. One 1944-marked rainbow trout (left pectoral clipped) was caught in the Rifle River Area.

On the Au Sable drainage, 67,425 marked legal trout were planted; hatchery-reared fish made up 43.0 of the total catch, and about 3 anglers in 10 caught marked trout, while 46 percent caught no legal trout.

If the results of the spot creel census data from the three drainages are combined, 38.4 percent of the total catch consisted of marked hatchery trout; 23 anglers out of 100 caught marked trout, and 56 percent of the total anglers caught no legal fish.

The one species of hatchery-reared trout, ^{which} showed up to particular advantage in the Rifle and Au Sable drainages was the rainbow trout. In

both stream systems from 53 to 63 percent of the rainbow trout catch consisted of marked fish. However, where brook and brown trout are concerned, natural reproduction is furnished from 56 to 77 percent of the total catch, despite the intensity of the plantings of these species in 1946. The number of anglers benefitted, i.e., the number catching marked fish from these plantings, while larger than that observed in previous experiments (Shetter and Hazzard, 1941), average for the three stream systems studied slightly more than one angler in five (229 percent, range 11.1 to 32.0 percent). It would therefore appear that any gains in angling quality ascribable to the large-scale planting of the present are enjoyed by only a minority of the anglers.

It will be noted that there is considerable variation between results obtained by the three methods of collecting information on the angling. It would appear that the records reported by mail for any of the three streams are not representative, since over 87 to 100 percent were successful anglers, which is not normal for trout stream angling. Also, anglers reporting by mail usually were those who had caught some marked trout rather than those who had caught no trout or unmarked trout only as indicated by the high percentage of anglers catching marked trout (of the total reporting by mail, 68.0 percent).

As indicated earlier in the paper, the spot censuses on the weekends for the Fox and Rifle River drainages probably represent the angling picture as it was on those days because of the ability of the checking crews to cover a major portion of the fishing, since the trout waters in those

drainages were comparatively small in area. The opposite was true of the Au Sable drainage. In that stream system more records from more widely dispersed parts of the drainage were obtained through the Volunteer Creel Census and from days in the week other than Sunday. However, the volunteer records are open to possible criticism on the grounds that they were only as accurate and reliable as the individuals who kept them. No matter which of the latter two sets of angling data for the Au Sable drainage (Sunday spot, volunteer) as regarded as the representative, one is led to the conclusions that on the Au Sable drainage in 1946 from 28 to 38 percent of the total catch consisted of planted trout, and that these hatchery fish were captured by 29 to 45 percent of the anglers.

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