Original: Submitted to Trans. Amer. Fish Soc.
cc: Fish Division
Educ. -Game
Inst. for Fish. Research
J. W. Leonard
D. S. Shetter
J. A. Scully
~~C. T. Yoder~~
R. S. Marks

August 22, 1961

Report No. 1627

RECOVERIES BY ANGLERS OF LEGAL-SIZE TROUT STOCKED DURING DIFFERENT SEASONS OF THE YEAR IN MICHIGAN STREAMS

By

David S. Shetter

Experiments to determine angler returns of marked, hatchery-reared brook, brown, and rainbow trout released at various seasons have been described by Shetter and Hazzard (1941), Gee (1942), Smith (1941), Nesbit and Kitson (1937), and others. Most investigators concluded that, for legal-size trout planted in streams, plantings made shortly before or during the trout season gave significantly more returns to anglers than did plantings made in the fall.

Michigan anglers on the main Au Sable River between the Mio and McKinley bridges and on the Rifle River below M-55 claimed, however, that in 1947 they captured considerable numbers of fin-clipped brown and rainbow trout which had been planted in these streams in 1946. Some anglers concluded that the presence of these fin-clipped fish (which had

been planted between April 1 and September 15) in the 1947 catch was evidence in favor of fall planting. Other fishermen suggested that brown trout, if planted during the fall in the wide and deep portions of some of the major trout streams, might survive in sufficient numbers to justify costs.

Since answers to these questions are of vital importance to the trout management program, four major planting experiments with marked hatchery trout were conducted between 1947 and 1954 on five Michigan drainages. The purpose of these experiments was to determine what season of release would provide the most fish for the angler; and whether brown trout or rainbow trout would give better results.

Methods

The brown and rainbow trout (hatchery-reared) for the present test plantings were either tagged with a serially-numbered jaw-tag or each lot was fin-clipped distinctively for identification of planting date. In three of the four experiments discussed here, data on marked fish recaptured by anglers, during the first season that trout were available to them, were obtained by creel census clerks operating on sampling schedules. In the fourth experiment local guides and resort operators cooperated to obtain most of the recapture records. For all four experiments additional (voluntary) reports were obtained, as a result of widespread publicity which the planting experiments received in local newspapers, departmental posters and verbal communications.

In the present study of comparative returns to anglers of marked, hatchery trout, the assumptions are made that (1) the planted fish remained in the section of stream where they were planted and where the census was made, and (2) the planted fish retained their tags or fin-clip mark during the census. Michigan anglers are well "conditioned" to reporting tagged fish, and it is certainly true that their reporting would not be highly selective for the stream sections where the fish were planted. Practically all recoveries were reported to come from planted sections; the one exception was for the spring-fall plants of rainbow trout in the Au Sable River (1952-1953) for which about 10 percent of the recoveries were from outside the planted section. Such a small bias would not affect present interpretations of the results. Concerning the loss of jaw-tags, an extensive review of the literature on tagging experiments indicated that such loss would be very small during the one to eight months between planting and recovery. A strap tag with a locking device was used in the present tests. The fin-clipped fish were readily recognizable by the census clerks.

The creel census information in this study provided comparable data on relative returns from fall as compared to spring plantings for the various test waters individually. Fish planted in the fall after the close of the trout season, and those planted in the spring immediately prior to the opening of the next trout season, were first

available to anglers at the opening of the season, and angler recoveries from the two lots of fish in a given water had the same chance of appearing in the recovery records. On the other hand, certain possible comparisons of the returns are either not valid, or subject to question, for various reasons: Returns among different streams should not be compared because of variable intensity of census effort and degree of voluntary cooperation in reporting recoveries among the test waters. Returns from in-season plantings (May, June, July) do not provide a strictly valid comparison, because on most test waters a full-time census clerk operated only during the first year of any particular experiment, but not during the second and succeeding years, and only voluntary reports of recoveries were obtained in the second and later years. The important point here is that the rate of over-winter survival to the second year might have been quite different among plantings for different months, and the sampling for returns during the first versus subsequent seasons was not comparable. Comparison of returns for rainbow versus brown trout are made with some reservation, because of the probability of greater over-winter survival of the brown trout to the second and successive seasons when sampling for returns was less intensive. Furthermore, the study was not designed to give estimates of total fishing, total catch, or total angler returns from the various plantings.

For comparisons of returns, where comparisons are considered valid, differences in recapture rates were evaluated for statistical significance by the adjusted Chi-square test (Snedecor, 1956).

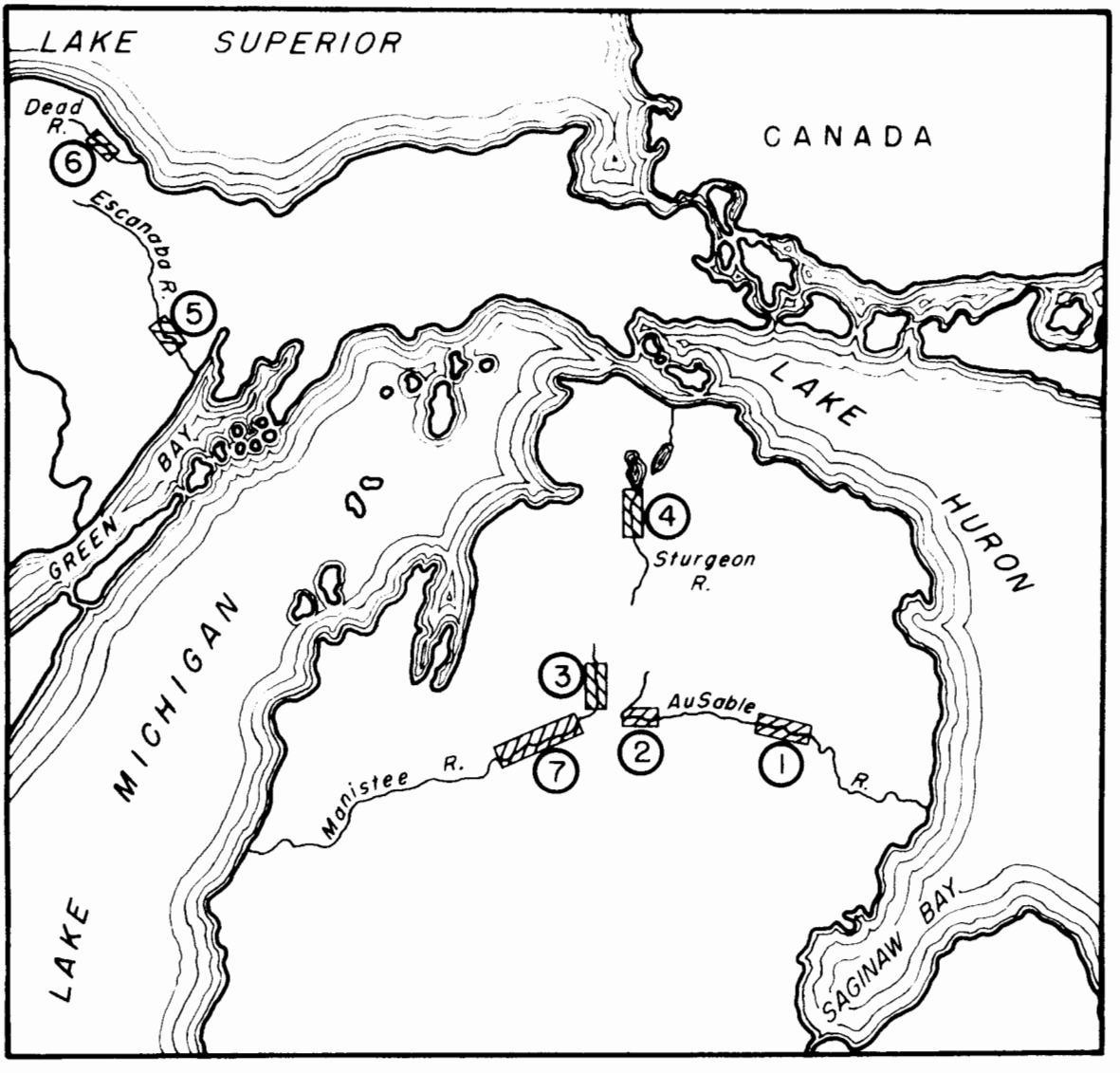
The locations of the experimental areas are shown in Figure 1. The four experiments are reviewed separately.

Brown trout in the Au Sable River below Mio, 1947-1948

This experiment involved 17 miles of the Au Sable River extending downstream from Mio to the site known as McKinley Bridge. Here the river is over 100 feet wide and has numerous pools deeper than 5 feet. The current varies from moderate to swift, depending on the operation of the spill gates in the Consumer Power Company dam at Mio. Underwater and bank cover at normal levels are good. Theoretically, this large stream should provide good wintering habitat for trout; also, over-wintering fish could take refuge in the lake-like backwater of the Consumer Power Company dam at Alcona, about seven miles downstream from McKinley Bridge.

Details of this experiment are given in Table 1. Approximately equal numbers of brown trout (992 to 1,000) were stocked in November, 1947, and April (prior to the opening day of trout season), May, June and October, 1948. The range in total length of the 4,972 fish released was 6.5-12.8 inches (16 fish of the October 1948 plant were less than

Figure 1. --Localities where test plantings were made.



1. Mio - McKinley Br. - Main AuSable River
2. Grayling - Pullover - Main AuSable River
3. M-72 - Bayou - Manistee River
4. Wolverine Dam - Burt Lake - Sturgeon River
5. Bony Falls - Cornell Br. - Escanaba River
6. Dead Stream Drainage - Dead River
7. Kalkaska County - Manistee River

Figure 1

Table 1. --Angler recoveries of tagged, hatchery-reared brown trout planted in the Mio-McKinley Bridge area of the main Au Sable River during fall, spring, and open season of 1947-1948

Planting records			Angler recoveries, by year*					Total recoveries	
Date	Number of trout	Total length range (inches)	1948	1949	1950	1951	1952	Number	Percentage
Nov. 26, 1947	992	7.3-12.8	2(0)	1	..	..	..	3	0.3
April 9, 1948	993	7.0-12.3	50(26)	11	3	..	..	69	6.9
May 24, 1948	992	7.0-11.3	17(4)	1	1	..	..	19	1.9
June 17, 1948	1,000	7.0-11.2	12(2)	1	1	..	2	16	1.6
Oct. 20, 1948	995	6.5-10.3**	..	11	4	3	2	20	2.0
Totals	4,972	6.5-12.8	81(32)	25	14	3	4	127(32)	2.6

* For 1948, numbers given are total returns by the creel census clerk plus voluntary reports and, in parentheses, the number of returns obtained by the census clerk only. Returns for 1949-1952 were voluntary reports only.

** Of 995 fish planted, 16 fish were less than the legal length of 7 inches.

the legal length of 7 inches; all others exceeded 7 inches). A creel census clerk checked anglers one day each weekend throughout the 1948 trout season between Mio Dam and McKinley Bridge.

In the weekend creel census during 1948, the clerk recorded 32 recoveries; the remaining 49 recoveries obtained during 1948 and all recovery records during 1949-1952 were voluntary reports received by mail or verbally. The one comparison of returns, that is entirely valid from the standpoint of comparable sampling for recoveries, is between the plantings of November 1947 and April 1948. The spring planting gave a much greater return (highly significant statistically) than the fall planting. In this experiment, where additional comparisons are made, the problem of differential "effort" in sampling for recoveries must be recognized. The better returns from May and June plantings than from the November 1947 planting is further evidence that the 1947 fall planting gave comparatively poor returns. On the other hand, the 1948 fall planting did much better than the 1947 fall planting even though there was less sampling effort (no census clerk on duty) to obtain records on the 1948 fall planting. In other words, the recoveries from the 1948 fall planting indicate that the very low returns from the 1947 fall planting were probably unusually low. The experiment, as a whole, still would indicate much better returns from spring planting than from fall planting.

Brown and rainbow trout in the Au Sable River below Grayling, 1952-1953

In approximately five miles of the main Au Sable River extending downstream from Grayling to the so-called "Pullover," equal numbers (1,250) of legal-size brown and rainbow trout were planted on October 29-30, 1952, and on April 13-14, 1953 (just prior to the opening of the trout season). All fish were jaw-tagged.

Recovery records of tagged fish were obtained in 1953 by partial creel census by one man on weekend days, which covered the Grayling-Wakeley Bridge section of the stream during the five weeks of the trout season up to Decoration Day, by reports turned in to Grayling Hatchery personnel, and by voluntary reports mailed in by anglers. Results of this experiment are presented in Table 2.

In this test the spring planting of brown trout gave only slightly better returns than the fall planting (11 percent versus 10 percent); the difference was not statistically different. On the other hand the spring planting of rainbow trout gave twice as good returns as the fall planting; the difference was highly significant.

It is not valid to combine total recovery records for the two species, or to compare total recovery records for the two, because the census clerk worked mainly during the daylight hours when rainbow trout are caught more readily than brown trout. However, it would

Table 2. --Angler recoveries of tagged, hatchery-reared brown and rainbow trout planted in the Grayling-"Pullover" area of the main Au Sable River during fall and spring of 1952-1953

Planting records				Angler recoveries**				
Date	Species of trout	Number	Average total length (inches)*	By year			Totals	
				1953	1954	1955	Number	Percentage
October 1952	Brown	1,250	8.3	124(21)	1	..	125	10.0
	Rainbow	1,250	8.0	97(25)	1	..	98	7.8
April 1953	Brown	1,250	8.2	135(11)	2	1	138	11.0
	Rainbow	1,250	8.0	172(37)	..	..	172	13.8
Totals		5,000	...	528(94)	4	1	533	10.7

* Based on a sample of 10 to 12 percent of the fish in each lot.

** For 1948, numbers given are total returns by the creel census clerk plus voluntary reports and, in parentheses, the number of returns obtained by the creel census clerk only. Returns for 1954-1955 were voluntary reports only.

appear to be valid to compare the two species from voluntary reports alone; practically all of these reports came during the first season. On the basis of voluntary reports alone, the brown trout gave better returns than the rainbow trout, when both were planted in the fall. For the spring planting the rainbow trout gave better returns than the brown trout but the difference was not statistically significant at the 95 percent confidence level.

Brown and rainbow trout in four streams,

1951-1952

This planting experiment involved two streams in the Lower Peninsula and two sites in the Upper Peninsula, utilizing fin-clipped and/or tagged brown and rainbow trout. The streams in the Lower Peninsula were: a 10-mile section of the Manistee River in Crawford and Kalkaska counties, from the Highway M-72 bridge downstream to the "Bayou," and a 25-mile section of the Sturgeon River in Cheboygan County, between the Sturgeon River Rearing Station and Burt Lake. The Upper Peninsula sites were: a 10-mile section of the Escanaba River in Delta County, from Bony Falls downstream to a point about one mile below Cornell Bridge; and the Dead River Storage Basin in Marquette County, a flooded river basin about 11 miles long and from 300 feet to 1 1/2 miles wide, which is more typical of a trout lake than a trout stream. The sites were chosen because they were thought

to provide superior over-wintering habitat for trout, with deep pools, deep runs, and good cover.

In the Lower Peninsula streams, the planted fish were fin-clipped. In the Upper Peninsula streams, one-half of the fish in each fall and April planting were fin-clipped and one-half were jaw-tagged, while fish released during the open trout season were fin-clipped. For each stream a different fin-clip was used for each planting.

Returns were obtained principally by creel census. One clerk, working a 40-hour week on a pre-arranged schedule, was assigned to each stream. Each clerk's schedule included all Saturdays, Sundays, and holidays plus at least one weekday, and was planned according to knowledge of local fishing pressure to obtain maximum returns of marked fish. On the Sturgeon River and Dead River Basin the census was continued through November, since the Conservation Commission had authorized an extended season for rainbow trout on these waters. The creel census clerks collected information on 4,027 angler trips during 1952 (Table 3). The various census schedules differed as to length of working day and numbers of weekdays, so the data of Table 3 cannot be translated into comparable indices of angling pressure on the different streams.

The tests (data in Table 4) made during 1951-1952 in the four streams involved 48,998 trout (half brown, half rainbow). There were 2,207 recorded recaptures in 1952, plus 43 during 1953-1955, giving a total of 2,250. Although there was considerable publicity given to the

Table 3. --Number of days of creel census and number of fishermen interviewed on sections of four Michigan rivers in 1952

Month (1952)	Manistee		Sturgeon		Escanaba		Dead	
	Days	Anglers	Days	Anglers	Days	Anglers	Days	Anglers
April	4	74	5	56	4	22	4	17
May	16	196	21	433	22	179	20	171
June	19	145	23	179	21	202	21	141
July	15	108	22	330	19	119	22	121
August	19	188	20	388	21	222	21	114
September	7	41	13	189	8	42	13	60
October	..	...	9	133	..	...	9	30
November	..	...	12	119	..	...	3	8
Totals	80	752	125	1,827	95	786	113	662

Table 4. --Angler recoveries of tagged or fin-clipped, hatchery-reared brown and rainbow trout planted in four Michigan streams during the fall, spring, and open season of 1951-1952

Stream	Planting records: Date	Species of trout	Number	Average total length (inches)	Angler recoveries: By year 1952	1953	1954	1955	Total: Number	Percentage
Manistee River	Nov. 9, 1951	Brown	500	8.1	11	..	..	..	11	2.2
		Rainbow	500	8.1	10	..	..	..	10	2.0
	April 10, 1952	Brown	500	8.3	31	..	..	..	31	6.2
		Rainbow	500	7.8	23	..	..	..	23	4.6
	May 27, 1952	Brown	3,500	9.0	121	..	..	..	121	3.5**
		Rainbow	3,500	8.2	195	..	..	..	195	5.6
	June 25, 1952	Brown	3,500	8.6	58	..	..	..	58	1.7**
		Rainbow	3,500	8.2	132	..	..	..	132	3.8
	July 23, 1952	Brown	3,500	8.8	82	..	..	..	82	2.3**
		Rainbow	3,500	7.8	244	..	..	..	244	7.0
Sturgeon River	Nov. 9, 1951	Brown	500	8.1	8	..	..	..	8	1.6
		Rainbow	500	8.3	8	..	..	..	8	1.6
	April 22, 1952	Brown	500	8.3	51	..	..	..	51	10.2**
		Rainbow	500	9.8	128	..	..	..	128	25.6
	May 27, 1952	Brown	2,000	8.4	123	..	..	..	123	6.1
		Rainbow	2,000	8.8	123	..	..	..	123	6.1
	June 25, 1952	Brown	2,000	8.6	76	..	..	..	76	3.8*
		Rainbow	2,000	8.9	104	..	..	..	104	5.2
	July 24, 25, 1952	Brown	2,000	8.7	84	..	..	..	84	4.2*
		Rainbow	2,000	8.7	117	..	..	..	117	5.8
Escanaba River	Oct. 29, 1951	Brown	500	7.9	1	..	..	1	2	0.4
		Rainbow	500	8.3	9	..	..	..	9	1.8
	April 25, 1952	Brown	500	8.6	60	1	3	..	64	12.8**
		Rainbow	500	8.6	89	7	1	..	97	19.4
	June 17, 1952	Brown	1,000	8.6	13	..	..	..	13	1.3**
		Rainbow	1,000	8.9	95	3	..	..	98	9.8
	July 18, 1952	Brown	1,000	8.9	7	..	..	..	7	0.7**
		Rainbow	1,000	9.0	81	6	..	..	87	8.7
Dead River	Oct. 29, 1951	Brown	500	7.8	11	4	1	..	16	3.2
		Rainbow	500	8.4	7	1	..	..	8	1.6
	April 25, 1952	Brown	499	8.6	15	8	2	..	25	5.0**
		Rainbow	499	8.6	53	..	..	..	53	10.6
	June 17, 1952	Brown	1,000	8.5	5	3	..	..	9	0.9**
		Rainbow	1,000	8.6	28	1	..	..	29	2.9
	July 18, 1952	Brown	1,000	9.0	1	1	..	..	2	0.2
		Rainbow	1,000	9.0	2	..	..	..	2	0.2
Totals, all streams	Fall	Brown	2,000	...	31	4	1	1	37	1.8
		Rainbow	2,000	...	34	1	..	..	35	1.7
	April	Brown	1,999	...	157	9	5	..	171	8.6**
		Rainbow	1,999	...	293	7	1	..	301	15.1
	May	Brown	5,500	...	244	..	..	..	244	4.4**
		Rainbow	5,500	...	318	..	..	..	318	5.8
	June	Brown	7,500	...	153	3	..	..	156	2.1**
		Rainbow	7,500	...	359	4	..	..	363	4.8
	July	Brown	7,500	...	174	1	..	..	175	2.3**
		Rainbow	7,500	...	444	6	..	..	450	5.9
Grand totals			48,998		2,207	35	7	1	2,250	4.6

* Difference between fraction of brown trout and rainbow trout recovered is significant at the 5-percent level.

** Difference between fraction of brown trout and rainbow trout recovered is significant at the 1-percent level.

fact that part of the fish were marked by fin-clipping, anglers failed almost completely to report recoveries of fin-clipped fish, whereas they did report many of the jaw-tagged fish. Thus, on the Manistee and Sturgeon rivers, where only fin-clipped fish were planted, virtually all of the recovery records were obtained by the census clerk; and on the Dead and Escanaba rivers, where both jaw-tagged and fin-clipped fish were planted, voluntary reports from anglers were for 56 tagged fish and only 1 fin-clipped fish. In contrast, on the Dead and Escanaba rivers, the census clerk checked 65 tagged fish and 123 fin-clipped fish. The preponderence of fin-clipped over tagged fish among recoveries observed by the census clerk (whereas equal numbers were planted) is attributed to a reduced susceptibility to capture by angling of jaw-tagged fish (as reported by Cooper, 1953). These problems of the failure of anglers to report fin-clipped fish, and the apparent reduced susceptibility to angling of jaw-tagged fish, do not invalidate a direct comparison of returns on fall versus spring plantings because equal numbers of jaw-tagged and fin-clipped fish were used in some of the tests, and only fin-clipped fish were used in others.

The records of recaptures (Table 4), for plantings in the four streams, brown and rainbow trout combined, show 6 1/2 times as many recoveries from spring (April) plants as from fall (October-November) plants. By individual species, spring plants of brown trout gave 4 1/2 times as good returns; spring plants of rainbow trout, 8 1/2 times. By

individual species and streams, spring plants were better at a statistically significant level in all instances except for the brown trout in the Dead River where 25 spring-planted and 16 fall-planted brown trout recoveries were recorded (the difference in the latter figures is appreciable percentagewise, but not statistically significant because of the small numbers involved).

Recorded recoveries on rainbow trout were generally higher than on brown trout, but it is questionable whether any valid comparisons between the two species can be made on the basis of these tests. The reason is that the census clerks, who obtained most of the recovery records, worked mostly during daylight hours, with minimum census effort at night when brown trout are more readily caught than rainbow trout. There is one fairly consistent relationship in the returns on brown versus rainbow trout from which some valid conclusion can be drawn. Among fall-planted fish the returns on the two species was practically the same (37 and 35 for the four streams). When allowances are made for (1) the fact that the brown is more difficult for anglers to catch, and (2) the census effort slighted the brown trout fishing somewhat, an obvious conclusion is that the brown trout had a better (although still poor) over-winter survival than the rainbow trout.

Returns on the plantings made during May, June and July were generally much higher than on plantings made the previous fall, and much lower than on plantings made in April. Returns on the May,

June and July plants may be regarded as minimum values, in comparison with the fall and spring plants, because less census effort was expended "over" the May-July fish. But even these "minimum" recoveries exceeded recoveries from the fall plants, emphasizing the relative ineffectiveness of fall planting. On the other hand, the May-July plants would not have given as good results as the spring plants even if a very generous allowance were made for survival of fish in the May-July plants to subsequent years.

Rainbow trout in the Manistee River, 1953-1954

The fourth series of test plantings was made in 62 miles of the Manistee River in Kalkaska County, where the river ranges from about 60 feet to over 100 feet wide and much of it is over six feet deep. This section of river was selected with the idea that it might be unusually favorable for over-winter survival. Jaw-tagged rainbow trout, 8 to 9 inches in length, were distributed by boat along the 62 miles of river--2,000 in November 1953, and 1,979 in April 1954. The test plantings were given much local publicity, and all records of recoveries were obtained from voluntary reports by anglers, guides, and resort operators (some reports by mail, others verbal to Department personnel).

The returns from this experiment are believed to be free of bias, and to represent the ratio of fall- to spring-planted fish present in the

stream during the 1954 and succeeding trout seasons. Only one species of trout was involved, and there is no reason to believe anglers would report fish planted at one season more frequently than from another, or fish caught at different times of the season, or during different hours of the day.

The April 1954 plant gave 18.8 percent returns; the November 1953 plant, 9.8 percent (Table 5). The difference was statistically significant beyond the 1 percent level.

Summary and discussion

The present tests provide 12 separate comparisons (6 for brown trout, 6 for rainbow) of returns from spring plants versus fall plants. In all 12 comparisons, spring plants gave better returns to anglers. The statistical probability that this could happen purely by chance is so small that it can be ignored. In other words, these tests, carried out on the large and deep sections of some of Michigan's best trout streams, show that spring plants of legal-size trout are superior over fall plants in such waters.

An obvious method of expressing the extent of superiority of spring plants is to compute the ratio of returns from spring plants to returns from fall plants (equal numbers of fish planted). For example there were 69 reported returns from the April 1948 plant of brown trout in the Au Sable, and 3 returns from the November 1947 plant, or 23 times (23:1) as many returns from the spring plant. For the six

Table 5. --Angler recoveries of tagged, hatchery-reared rainbow trout planted in the Manistee River, Kalkaska County, during fall and spring of 1953-1954

Planting records			Angler recoveries				
			By year			Total	
Date	Number of trout	Average total length (inches)	1954	1955	1956	Number	Percentage
Nov. 1953	2,000	8.5	192	2	3	197	9.8
April 1954	1,979	8.5	362	4	7	373	18.8
Totals	3,979	8.5	554	6	10	570	14.3

spring-fall plants of brown trout these ratios ranged from 1.1:1 to 32:1 and averaged 11:1; for the six plants of rainbow trout the range was 1.8:1 to 16:1, average 6.6:1. As indicated by these ranges, there are certain stream habitats and other conditions where fall plantings could be expected to give nearly as good numerical returns as spring plantings (and the fall-planted fish might be in better condition when caught the following season), but errors in judgment in the selection of such streams would be costly in the loss of fish, unless all streams were "screened" by planting experiments to be sure as to which streams would regularly give comparatively good returns from fall plantings.

As indicated under various discussions above, it is not valid to compare returns on brown trout versus rainbow trout for many of the separate planting experiments, because of sampling bias in obtaining the returns. However, there is the one set of data (the voluntary returns only, from the 1952-1953 plantings in the Au Sable River below Grayling) showing a significantly better return on brown trout than on rainbow trout when the two species were planted in the fall, but not a significant difference in returns when the two species were planted in the spring.

Acknowledgments

Many Department employees, in Fish and Field Administration divisions in Regions I and II, assisted in the tagging and fin-clipping of fish and in reporting records of the capture of marked fish by anglers. Creel census to obtain recovery records was done by

Fred Carr, A. J. Hammer, Jack Hammond, Robert Long, C. V. Reid, Robert Rogers, Robert Tiffin and H. J. Vondett. M. J. Whalls did most of the tabulation of records. Many anglers, especially members of the Manistee River Improvement Association and the Dead River Sports and Camping Association, put in considerable effort in reporting recoveries of planted fish. Suggestions on the manuscript were made by G. P. Cooper, P. H. Eschmeyer and D. W. Hayne.

INSTITUTE FOR FISHERIES RESEARCH

David S. Shetter

Report approved by G. P. Cooper

Typed by M. S. McClure

Literature cited

Cooper, Edwin L. 1953. Returns from plantings of legal-sized brook, brown and rainbow trout in the Pigeon River, Otsego County, Michigan. Trans. Am. Fish. Soc., Vol. 82 (1952), pp. 265-280.

Gee, Merle A. 1942. Success of planting legal sized trout in the southwest. Trans. Seventh N. A. Wildlife Conf., pp. 238-244.

Nesbit, Robert A., and J. Arthur Kitson. 1937. Some results of trout tagging in Massachusetts. Copeia, 1937, No. 3, pp. 168-172.

Shetter, David S., and Albert S. Hazzard. 1941. Results from plantings of marked trout of legal size in streams and lakes of Michigan. Trans. Am. Fish. Soc., Vol. 70 (1940), pp. 446-468.

Smith, Lloyd L., Jr. 1941. The results of planting brook trout of legal length in the Salmon Trout River, northern Michigan. Trans. Am. Fish. Soc., Vol. 70 (1940), pp. 249-258.

Snedecor, George W. 1956. Statistical methods applied to experiments in agriculture and biology, 5th Ed., The Iowa State College Press, xiii + 534 pp.