AN EVALUATION OF HALF-LOGS TO IMPROVE BROWN TROUT HABITAT IN EMMONS CREEK

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ABSTRACT

Sixty half-log structures were installed on Emmons Creek, Waupaca County, in a 0.19-mile-long Treatment Zone in April 1978. The wild brown trout (Salmo trutta) populations in this zone and in an adjacent upstream Reference Zone (0.34-mile-long) were monitored with electrofishing gear 5 times prior to installation and 6 times thereafter to assess benefits of half-logs to trout carrying capacity.

The number of trout in spring and fall, total biomass, number of legal sized trout (6 inches) and number over 10 inches were the four population characteristics focused on to detect response. Only the number of trout over 10 inches in October showed a positive postinstallation change that may have been influenced by half-logs in the Treatment Zone. Other characteristics of the trout population in the Treatment Zone varied seasonally and year to year seemingly independent of the addition of half-logs.

Angler harvest, both legal and illegal, was speculated to have increased during the postinstallation period which could have negated, in part, increases in the number and biomass of trout that might have occurred if angling mortality had not increased.

Only 1 of the 60 half-logs failed to function at least partially as expected. Average functional utility based on measurements made 48 months after installation was 83%.

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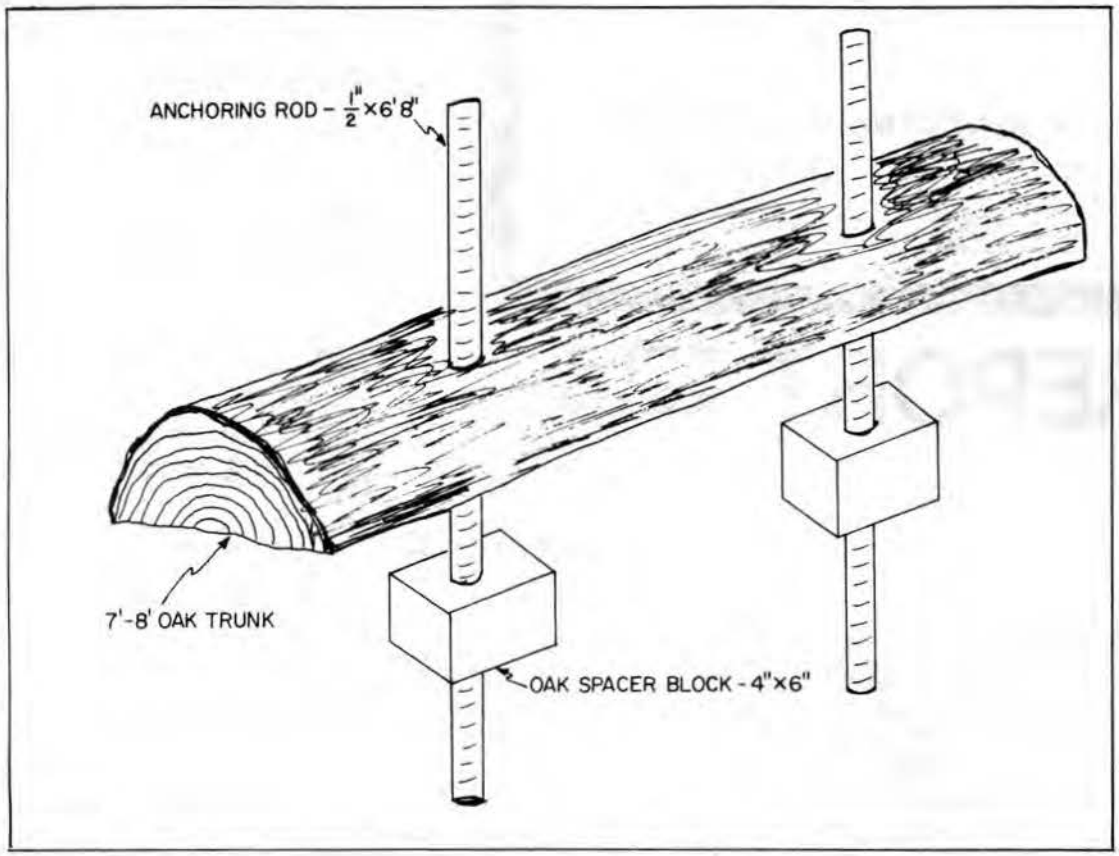


FIGURE 1. Component parts of a half-log structure used to provide hiding cover for trout.

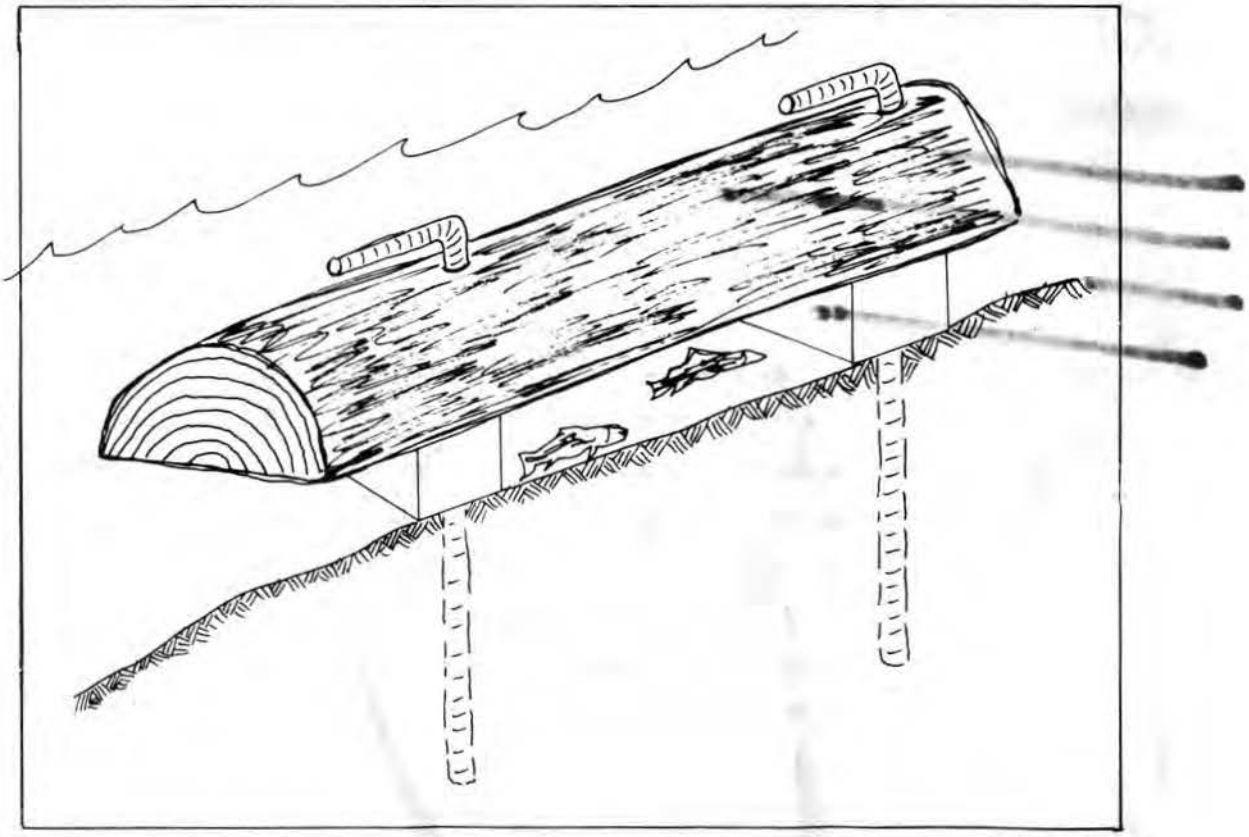


FIGURE 2. Appearance of a half-log structure after installation.

INTRODUCTION

During the past decade installation of half-log structures (Fig. 1 and 2) has become an increasingly popular technique for improving carrying capacity of Wisconsin trout streams. Their popularity has been enhanced by their ease of installation, by their relatively low cost compared to other habitat improvement techniques, by the logical function that half-logs are designed to fulfill, and by the dramatic benefits that half-logs had on trout carrying capacity in a portion of the West Branch of the White River in Waushara County (Hunt 1978 and unpubl. data).

During the 3 years following installation of 142 half-logs in an 800-yd portion of that stream, biomass of brown trout (Salmo trutta) in April increased an average of 188%, the number of trout increased an average of 76%, the number over 6 inches increased an average of 194%, and the number over 10 inches increased by an average of 533%.

That evaluation was the first of its kind, and it was carried out under exceptionally favorable environmental conditions. Abundance of ages 0 and 1 trout was high and their growth rates were excellent for a trout stream in central Wisconsin, but there was little hiding-resting cover for trout over 10 inches. Half-logs were installed primarily to provide more cover, especially for age II and older trout (trout 10 inches or larger). More of these trout subsequently remained as year-round residents rather than migrating downstream in search of more suitable habitat. Also favoring the opportunity for more large trout to accumulate was the probability that angler harvest was inconsequential throughout the study. The study zone constituted a formerly ditched and straightened headwaters segment that had a reputation for poor fishing quality, a reputation that probably persisted despite the improving quantity and quality of trout available during the postinstallation years of the evaluation.

The present study was initiated to provide a second field evaluation of half-logs. It was hypothesized that placement of half-logs in this portion of Emmons Creek in Waupaca County would also benefit its trout carrying capacity but not to the degree that occurred in the West Branch of the White River. Several factors contributed to selection of an evaluation site on Emmons Creek: (1) Trout population data were available for 1976-78 as part of a study to assess trout population dynamics and the impacts of sport fishing on this stream and three other central Wisconsin streams (Avery and Hunt 1981). Data from Emmons Creek during 1976-78 could be used to represent the preinstallation characteristics of the trout population. (2) The study area was conveniently located only a few miles away from the headquarters of the Cold Water Group. (3) Physical qualities of the stream were conducive to installation of half-logs. (4) The portion of stream chosen as the Treatment Zone flowed through DNR-owned land. And (5) volunteer manpower was locally available to help install the half-logs.

DESCRIPTION OF THE STUDY SITE

Emmons Creek is a Class I trout stream approximately 6 miles long. It originates as the outlet of 16-acre Fountain Lake in southwestern Portage County and flows east into Waupaca County, terminating at Long Lake. Brook trout (Salvelinus fontinalis) are sparsely present. Brown trout are the dominant sport fish. An unknown proportion of the brown trout population emigrates to Long Lake and survivors return as adults to spawn. Most of the land along the stream is DNR-owned, thus assuring public access for anglers. It is one of the most popular trout streams in central Wisconsin. Angling effort during the 1976-77 trout fishing seasons averaged 344 hours/acre (Avery and Hunt 1981). Most of the stream flows through a hardwood and conifer forest; in some stretches alder is the most prominent streambank vegetation. Few stretches of the stream are conducive to fly fishing. During the 1976-77 fishing seasons more than 70% of the trout anglers interviewed fished with live bait.

Two study zones were established to assess potential benefits of half-logs on trout carrying capacity. The Treatment Zone, where half-logs would be placed, had a midchannel length of 1,003 ft (0.19 mile), an average depth of 1.1 ft, an average width of 19.0 ft, and a surface area of 0.43 acres. The adjacent upstream Reference Zone had a midchannel length of 2,055 ft (0.39 mile), an average depth of 0.9 ft, an average width of 21.2 ft, and a surface area of 0.99 acre.

Public land bordered all of the Treatment Zone and a parking lot for anglers was located near the downstream boundary. Land along the Reference Zone was privately owned but the land was not posted to discourage trespass by anglers. A road bridge constituted the upstream boundary of this zone. A fringe of woody shrubs and a few trees characterized streambank vegetation along both study zones.

METHODS

Double-run electrofishing inventories of trout in the study zones were made each April and October starting in April 1976 and terminating in April 1981. Numbers of trout/inch group were estimated using the Bailey modification of the Petersen mark and recapture formula.

Lengths of trout collected during the electrofishing were recorded to the nearest 0.1 inch. Weights were recorded to the nearest gram. Estimates of the number of trout/inch group were multiplied by average weights/inch group. These products were summed to derive estimates of trout biomass in each study zone. Additional procedural details relating to collection and processing of trout population data are presented in Avery and Hunt (1981).

Field measurements to ascertain physical dimensions of the study zones were made in June

and July 1976. A 100-ft steel tape was used to determine midchannel length along a traverse of temporarily positioned rods. Stream channel widths were recorded at 20-yd intervals and averaged for each study zone. Water depths were recorded at 1-ft intervals across each channel width transect and average depth was calculated for each transect. These averages, in turn, were averaged to derive a value for each study zone.

On 29 April 1978, the volunteer crew of students from the University of Wisconsin-Stevens Point and members of the Fox Valley Chapter of Trout Unlimited installed 60 half-logs in the Treatment Zone under my supervision, which included selection of installation points and positioning of the half-logs. Half-logs were placed in water sufficiently deep to cover the logs over gravel and/or rubble stream bottom substrate. Average length of the half-logs was 9.6 ft with a range of 7.3-12.5 ft. Density of placement was equivalent to 330/mile or 140/acre.

Subsequent assessment of the functional capacity of the half-logs was based on measuring the portion of each log that provided at least 3 inches of clear space beneath each of its longest edges.

RESULTS AND DISCUSSION

Half-logs

Most of the half-logs functioned properly throughout the postinstallation period. All 60 structures were still in place 15 months after being installed but 16 were then either repositioned in relation to stream flow or had additional spacer blocks placed beneath them to increase the amount of hiding-resting space for trout. Approximately 48 months after the logs had been in place a final inspection was made. One of the half-logs was not located; it may have been completely buried by sand-silt deposition. Of the 59 structures located, 27 were judged to be 100% functional. Only 3 of 59 provided less than 25% usefulness. The average functional capacity was 83%, including a value of 0 for the half-log not located.

These results are encouraging in view of the dynamic nature of stream flow and characteristics of channel morphometry. Functioning of a well-positioned half-log could be later disrupted, for example, by accidental lodging of a fallen tree, limb, or accumulation of debris that would divert streamflow from the half-log and allow deposition around and under the structure. Unforeseen growth of aquatic weedbeds could cause similar disruptions. Therefore, annual inspection of half-log structures to check on their functional value is recommended. Fortunately, because of their anchoring design, they can be easily reoriented or relocated by prying up one or both of the reinforcement rods in each log.

The most important factor contributing to long-term utility of half-log structures, however, is not their precise angle of installation but the quality of substrate on which they are placed. Gravel or rubble substrate is essential to long-term utility.

Trout Population Dynamics

Five inventories were made of the brown trout populations in the study zones prior to placement of half-logs in the Treatment Zone. Six trout population inventories were made in each zone during the postinstallation period (Table 1). The preinstallation estimates included 3 in April and 2 in October (April 1976-April 1978). The postinstallation series included 3 in April and 3 in October (October 1978-April 1981).

During the preinstallation phase the Reference Zone held an average of 2,979 trout/mile and the Treatment Zone held an average of 2,514/mile, 16% fewer than in the Reference Zone (Table 2). During the postinstallation period, average abundance of brown trout in the Reference Zone declined to 2,610/mile, 12% fewer than the preinstallation average. Despite the presence of half-logs in the Treatment Zone, abundance of brown trout also declined there during the postinstallation period--to an average of 1,749/mile, 30% less than the preinstallation average for the Treatment Zone and 33% less than postinstallation average for the Reference Zone (Table 2).

Fluctuations in the number of trout/mile in the two study zones from April to April or from October to October followed similar trends seemingly independent of the presence of half-logs in one of the study zones (Fig. 3). The Reference Zone held more trout/mile 2 out of 3 times in April during the preinstallation period. The Reference Zone also held more trout during all 6 October inventories.

Biomass of brown trout in the Treatment Zone also failed to show a positive response that could be associated with half-logs placed in this study zone. During the preinstallation period average biomass was about the same in both study zones (110.3 lb/acre in the Reference Zone and 111.0 lb/acre in the Treatment Zone). During the postinstallation period average biomass declined in both study zones to 83.1 lb/acre in the Reference Zone and to 77.1 lb/acre in the Treatment Zone (Table 2). April-to-April and October-to-October trends in biomass, like the trends in total number of trout/zone, were similar in both zones during the 6-year study period (Fig. 4).

Legal-sized brown trout (6 inches or larger) were 5% less abundant in the Treatment Zone than in the Reference Zone during the preinstallation phase (1,105/mile vs. 1,159/mile). During the postinstallation phase the Treatment Zone held an average of 16% fewer legal-sized trout compared to the Reference Zone average (603/mile vs. 719/mile). The Reference Zone held more legal trout/mile 4 out of 5 times that population estimates were made during the preinstallation period, and all 6 times estimates were carried out during the postinstallation period. There was nothing evident in the seasonal or year-to-year trends in abundance of legal trout/zone to suggest that half-logs increased the capability of the Treatment Zone to support more legal-sized trout (Fig. 5).

Brown trout over 10 inches were relatively more abundant in the Reference Zone than in the Treatment Zone during the preinstallation period (138/mile vs. 105/mile), although during 2 of the

TABLE 1. Population statistics for standing stocks of brown trout in the Reference Zone and Treatment Zone of Emmons Creek during the evaluation period.*

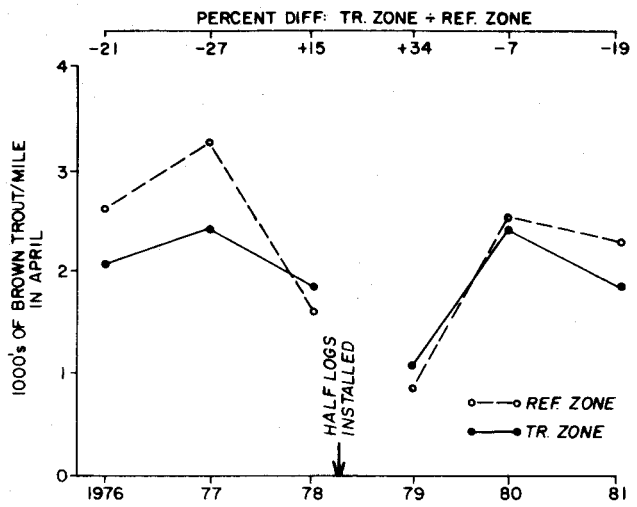
	1976	1977	1978	1979	1980	1981
Trout/mile in April (1+)						
Ref. Zone	2,643	3,320	1,628	815	2,561	2,339
Tr. Zone	2,079	2,437	1,868	1,090	2,395	1,884
Trout/mile in October (0+)						
Ref. Zone	3,980	3,323	2,844	2,474	2,828	
Tr. Zone	3,426	2,758	1,779	1,937	1,411	
Pounds/acre in April (1+)						
Ref. Zone	108.9	110.0	61.3	34.0	76.8	94.2
Tr. Zone	110.2	101.4	78.8	33.5	75.8	85.3
Pounds/acre in October (0+)						
Ref. Zone	134.9	136.3	94.4	93.9	105.3	
Tr. Zone	130.9	133.5	89.1	83.7	95.3	
Trout/mile > 6 inches in April						
Ref. Zone	950	970	690	280	560	1,040
Tr. Zone	850	800	780	180	370	970
Trout/mile > 6 inches in October						
Ref. Zone	1,450	1,750	970	540	920	
Tr. Zone	1,390	1,700	850	470	770	
Trout/mile > 10 inches in April						
Ref. Zone	159	121	39	46	74	72
Tr. Zone	179	105	53	32	26	32
Trout/mile > 10 inches in October						
Ref. Zone	185	185	126	118	154	
Tr. Zone	74	116	163	142	189	

*Ref. Zone = 0.39 mile and 0.99 acre
Tr. Zone = 0.19 mile and 0.43 acre

TABLE 2. Summaries of the preinstallation and postinstallation estimates of brown trout populations in the Reference Zone and Treatment Zone of Emmons Creek based on averages.

	Preinstallation Period*						Postinstallation Period**					
	Reference Zone			Treatment Zone			Reference Zone			Treatment Zone		
Population Parameter	Apr Avg.	Oct Avg.	Apr & Oct Avg.	Apr Avg.	Oct Avg.	Apr & Oct Avg.	Apr Avg.	Oct Avg.	Apr & Oct Avg.	Apr Avg.	Oct Avg.	Apr & Oct Avg.
Trout/mile	2530	3652	2979	2128	3092	2514	1905	2715	2610	1790	1709	1749
Pounds/acre	93.4	135.6	110.3	96.8	132.2	111.0	68.3	97.9	83.1	64.9	89.4	77.1
Trout/mile > 6 inches	870	1600	1159	810	1545	1105	627	810	719	507	697	603
Trout/mile > 10 inches	106	185	138	112	95	105	64	133	98	30	165	97

*Preinstallation Period = April 1976 - April 1978.
**Postinstallation Period = October 1978 - April 1981.



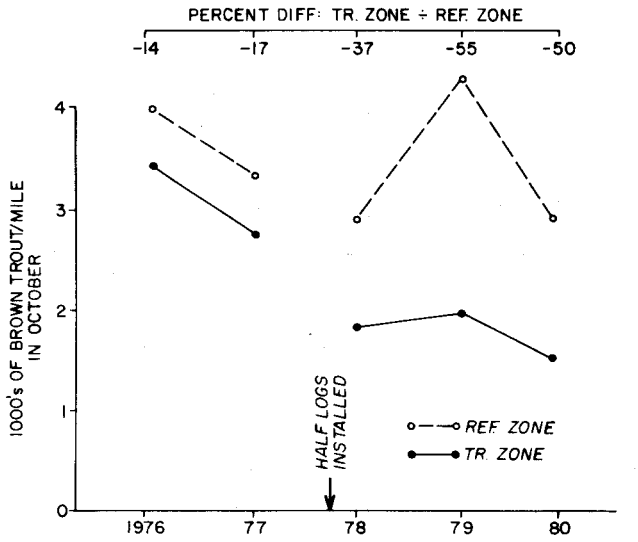
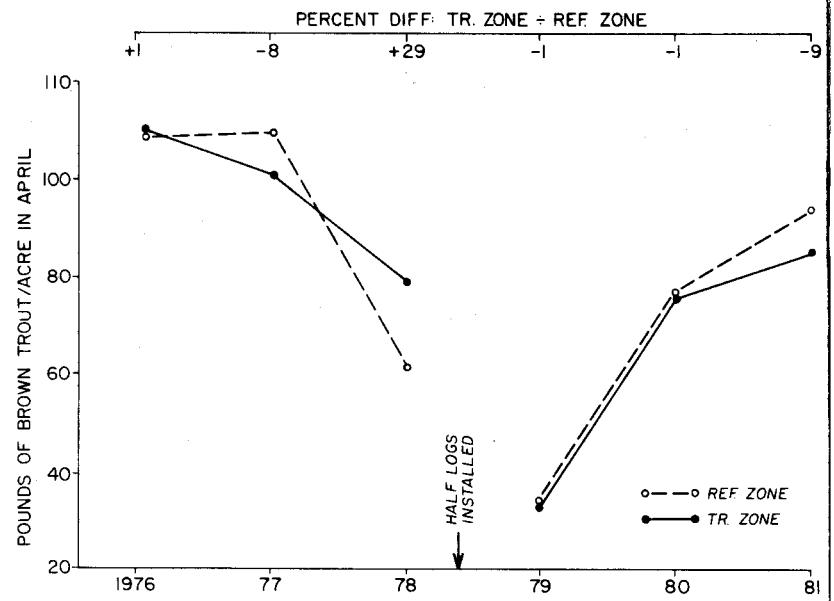


FIGURE 3. Number of brown trout/mile in the Reference Zone and Treatment Zone of Emmons Creek in April 1976-81 and in October of 1976-80..



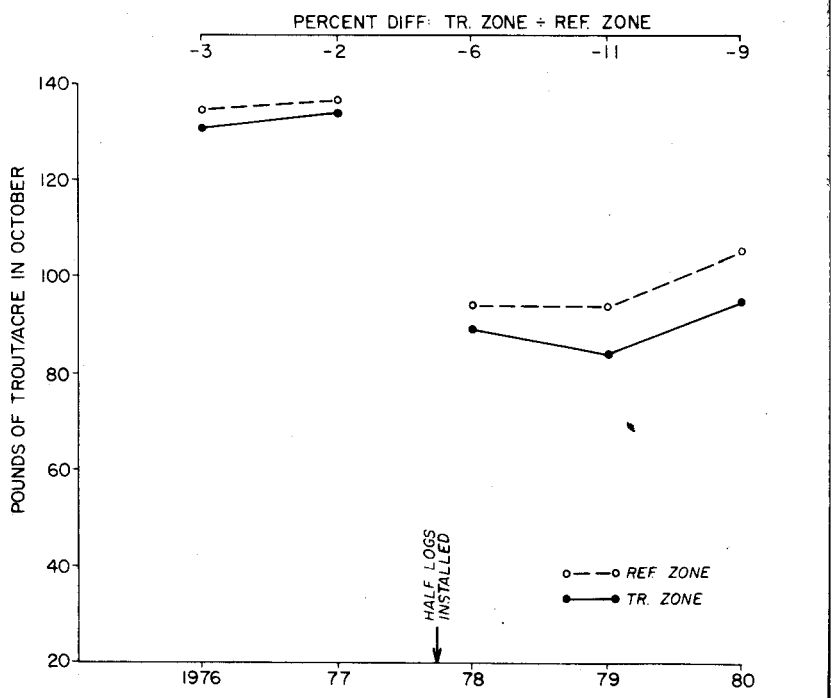


FIGURE 4. Pounds/acre of brown trout in the Reference Zone and Treatment Zone of Emmons Creek in April of 1976-81 and in October of 1976-80.

5 electrofishing assessments more trout over 10 inches were found in the Treatment Zone (Table 1). During the postinstallation period, average abundance of such trout declined in both zones, to 98/mile in the Reference Zone and to 97/mile in the Treatment Zone, declines equivalent to 29% fewer in the Reference Zone and 8% fewer in the Treatment Zone. However, the Treatment Zone held proportionately more trout over 10 inches than did the Reference Zone at the time of all 3 October inventories made during the postinstallation period (Fig. 6). This contrast was not characteristic of the pretreatment period. Brown trout exceeding 10 inches may have benefitted from the half-logs in the Treatment Zone to the extent that their abundance was maintained at a higher level than would have been the case if half-logs had not been available for their use.

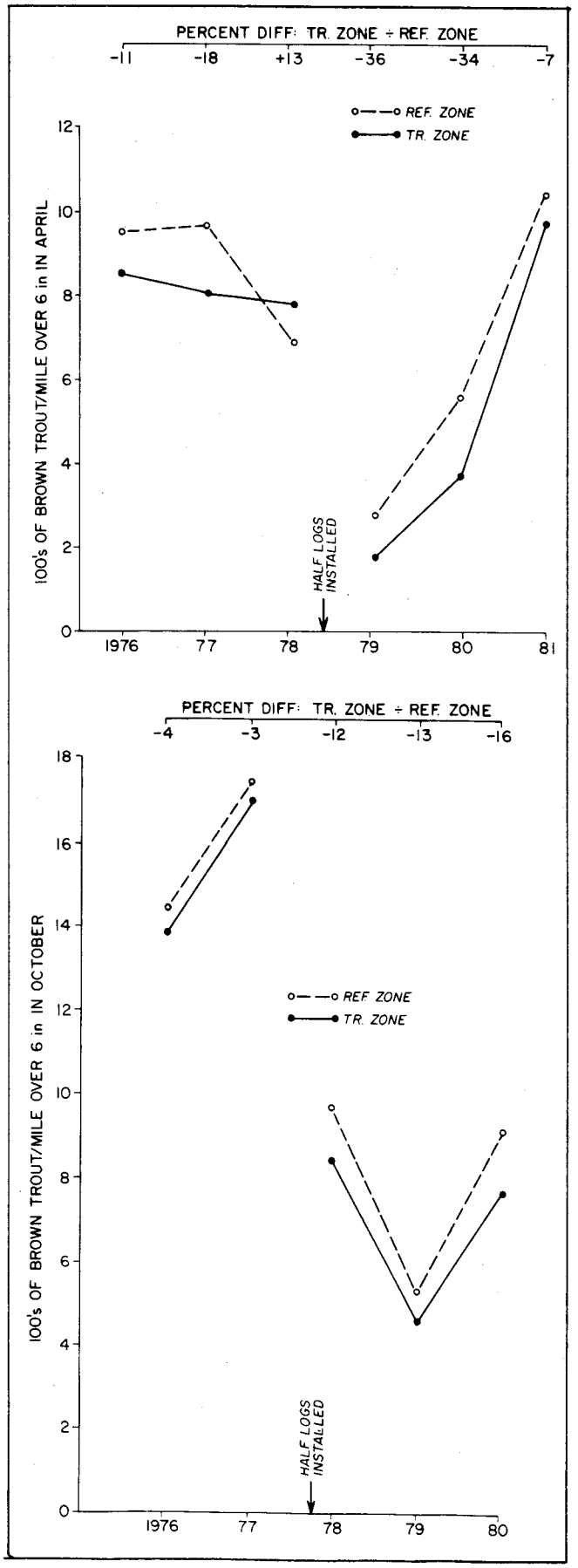


FIGURE 5. Number of brown trout/mile that were 6 inches or larger in the Reference Zone and Treatment Zone of Emmons Creek in April of 1976-81 and in October of 1976-80.

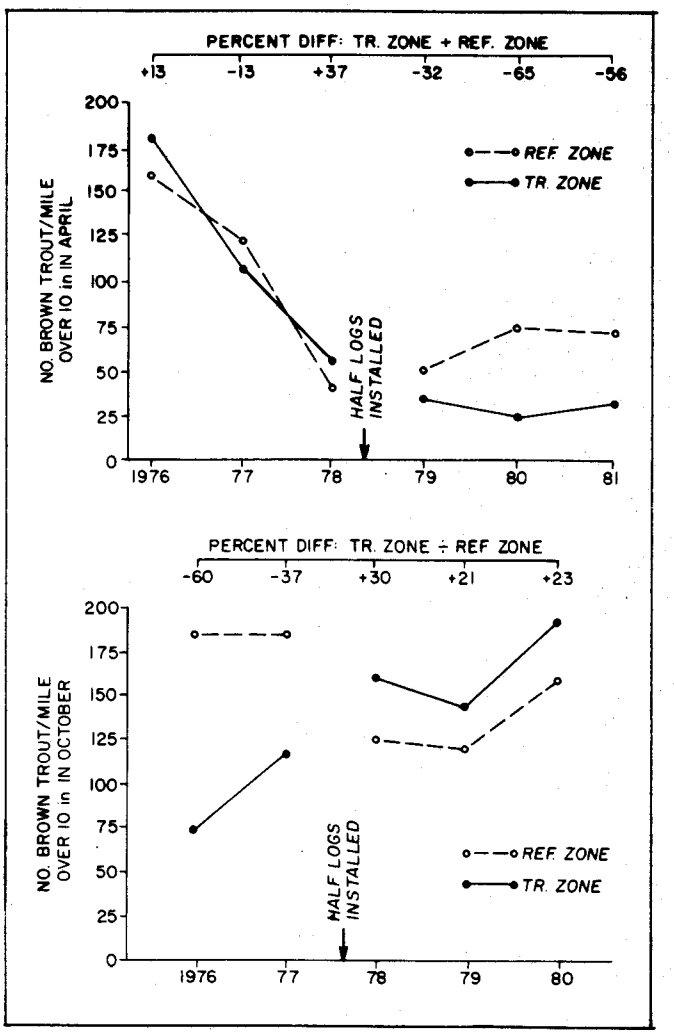


FIGURE 6. Number of brown trout/mile that were 10 inches or larger in the Reference Zone and Treatment Zone of Emmons Creek in April of 1976-81 and in October of 1976-80.

SUMMARY AND MANAGEMENT CONSIDERATIONS

Despite the presence of good gravel-rubble substrate and water depth conducive to installation of half-logs, there was little evidence gathered during this evaluation indicating that half-logs improved the trout carrying capacity of the Treatment Zone. Of the 4 trout population characteristics assessed each spring and fall, only the number of brown trout over 10 inches in October showed a positive change that might be correlated with the installation of half-logs in the Treatment Zone.

These results are greatly different from those observed after half-logs were placed in a portion of the West Branch of the White River where the total number of trout, total over 6 inches, total over 10 inches, and total biomass all increased substantially during the postinstallation period.

Failure of the half-logs to elicit similar changes in the trout populations in Emmons Creek cannot be attributed to improper installation or malfunctions thereafter. Most of the half-logs provided the kind of additions to the total trout habitat that they were designed to achieve, the same additions as those installed in the White River.

One factor that may have negated detection of positive changes in trout population parameters in the Treatment Zone was angler harvest. It was unmeasured but it is reasonable to assume that harvest increased during the postinstallation period as a result of publicity about the study area and the evaluation project underway there, along with a general upward trend in trout angling from year to year throughout Wisconsin.

Accurate assessments of angler harvest are expensive procedures but more consideration needs to be given to including them in future evaluations of trout habitat enhancement projects. Procurement of harvest data could mean the difference between being able to show positive cost:benefit results to support the practice of trout habitat improvement or not being able to do so. More information from creel census procedures is also needed to substantiate the premise and observation (Hunt 1971) that anglers are attracted to trout streams where habitat improvement projects have been done.

A site-specific but unmeasured variable in this study that also had a negative impact during the postinstallation period is illegal fishing in the study area, particularly during the springs of 1980 and 1981. Evidence of poaching was apparent from the monofilament lines and hooks attached to the branches of trees and shrubs hanging over the water. The frequency of such evidence of preseason angling greatly exceeded any I have ever encountered on a Wisconsin trout stream.

Despite the unknown impacts of both legal and illegal harvest, the tendency for trout populations in both the Treatment and Reference zones to vary similarly from spring to fall and year to year must be viewed as a major management disappointment. The half-logs in the Treatment Zone will probably continue to be underutilized by legal-sized trout throughout the year until other constraints on trout population recruitment, growth, and mortality are reduced.

With one marked success (West Branch of the White River) and one apparent failure (Emmons Creek), it is evident that additional field evaluations of the use of half-logs to enhance trout carrying capacity are needed, and under a wider variety of environmental conditions and angler harvest. Although I advise caution in anticipating likely consequences of installing half-logs until more evaluations are completed, I also advise against a pendulum swing to pessimism. The strong potential of this technique to enlarge a stream's capacity to hold more large trout, based on the findings of the earlier study, should not be written off simply because similar positive impacts were not evident at Emmons Creek.

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