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Site Specific Assessment of Three Sets of Angling Regulations Designed to Improve Stream Trout Fisheries

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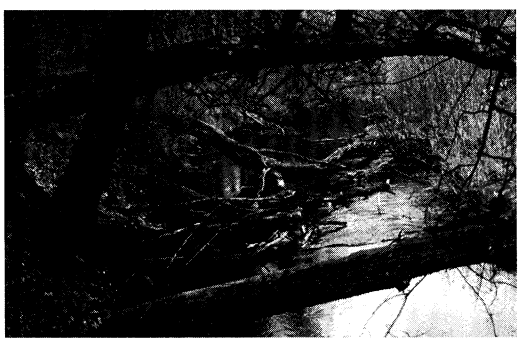

Abstract

Before 1990, bag and size restrictions on most Wisconsin trout waters included a 6-inch minimum size, a daily bag of 10 trout in May (only 5 browns and rainbows), and a daily bag of 10 trout of any species from June through September. A daily bag of 3 trout and a minimum size of 9 inches applied to parts of 29 southern Wisconsin counties (Southern Zone) from May through September. Angler complaints concerning a decline in the average size of trout being caught throughout Wisconsin precipitated a major change in the inland trout fishing regulations. In 1990, all Wisconsin trout waters were placed into one of five new regulation categories, each category with a different set of angling regulations. This study determined impacts of 3 sets of angling regulations, i.e., categories 2,4, and 5, on brown trout populations and sport fisheries in 2 streams. Spring and fall trout population estimates were made in two 1.1-mile reaches of Radley Creek (Waupaca Co.) in 1989-90 and 1992-93. Spring population estimates were made in 3 stream reaches totaling 2.5 miles of the White River (Bayfield Co.) in 1988-89 and 1992-93. Stratified, partial creel surveys were conducted in the 3 study zones throughout the 1992 trout fishing season and during the first 2 months of the 1993 fishing season. Results of similar creel surveys made in 1976-77 on Radley Creek and during 1984-85 on the White River were used for comparative purposes.

The average spring trout population declined in Radley Creek following a Category 2 classification (7-inch minimum size; 5 daily bag) in the upper half of the stream; fishing pressure and trout harvest also declined significantly. In the lower reach of Radley Creek, classified as Category 4 (12-inch minimum size; 3 daily bag), the average spring trout population increased, while fishing pressure and trout harvest declined. Average spring trout populations in the White River remained stable under a Category 5 classification (9-inch minimum size; 3 daily bag; only one > 15 inches), although a declining trend in numbers of sublegal trout was evident. Fishing pressure increased, while harvest declined. Biotic and abiotic factors associated with a 1988-89 drought negatively impacted trout populations and sport fisheries in Radley Creek and complicated management assessment of the 2 regulation categories. However, two of the most important objectives of the new trout regulation categories were achieved in all 3 study zones on both streams: reduced exploitation and increased average size of trout creeled. Maintenance of the Category 2 classification on upper Radley Creek and the Category 5 classification on the White River is recommended. Changing the classification of lower Radley Creek from Category 4 to Category 3 (9-inch minimum size; 3 daily bag) is recommended to stimulate greater angler use of the sport fishery while still providing adequate protection against overexploitation of the trout population.

Contents

Introduction

In May 1987, the Wisconsin Department of Natural Resources (DNR) established an ad hoc "Statewide Trout Regulations Committee" to examine the need for changes in Wisconsin's inland trout fishing regulations and to make recommended changes. The committee was formed in response to widespread complaints from anglers about declines in the average size of trout being caught. The committee was chaired and facilitated by L.E. Claggett, Coldwater Fishery Ecologist, Bureau of Fisheries Management and Habitat Protection, and included representative fisheries managers from all 5 field districts as well as salmonid research scientists from the Bureau of Research. I was one of two salmonid research scientists appointed to this committee.

In early 1988, the Trout Regulations Committee proposed a new 5-category classification system (Table 1). A different set of minimum size limit and daily bag limit regulations applied to each of 4 categories while a 5th category included a variety of "special" regulations designed to substantially reduce or eliminate harvest and further increase the diversity of angling opportunities. The 5-category system was designed to (1) better integrate the biological potential of individual trout streams with their inherent capability for sustaining a trout fishery, (2) reduce the harvest on streams where the fishery had been overexploited, (3) expand opportunities for catching larger trout, (4) increase the average size of trout caught, and (5) provide a greater diversity of fishing experiences for the public. All of Wisconsin's 2,674 trout streams (9,561 miles of water), 575 trout lakes, and several hundred spring ponds would be placed in one or more of the 5 categories based on recommendations of district and area fisheries management personnel.

The new biologically based classification system was ultimately approved by the Conservation Congress, Department of Natural Resources Board, and Wisconsin legislature in 1989 with implementation scheduled to begin in 1990. Prior to 1990, Wisconsin's general inland trout fishing season opened the first Saturday in May and ended September 30. Bag and size restrictions on most waters included a 6-inch minimum size, a daily bag of 10 trout in May (only 5 browns and rainbows), and a daily bag of 10 trout of any species from June through September (Wisconsin DNR 1989). A daily bag of 3 trout and a minimum size of 9 inches applied to parts of 29 southern Wisconsin counties (Southern Zone). There were less than 2 dozen special opportunity waters statewide, e.g., catch and release only, fly fishing only, slot size limits, etc. Only the fishing season length would remain the same under the 5-category classification system.

Systematic evaluation of the new trout fishing regulations was given high priority by the DNR's Bureau of Fisheries Management and Habitat Protection and Bureau of Research. A statewide joint management/research evaluation plan was initiated by Cold Water Research Group Leader Robert L. Hunt[1] in 1989, which placed primary shared responsibility among fisheries managers for data collection. Data synthesis, analyses, and write-up was delegated to the Cold Water Research Group.

[1] Robert L. Hunt retired from state service in July 1992. Reorganization within the Department of Natural Resources eliminated the Cold Water Research Group in 1993 and placed remaining salmonid research scientists in the Aquatic Ecological Systems Section of the Bureau of Integrated Science Services.

Table 1. *Regulation categories for trout waters.*

Category	Regulations	
	Minimum Size Limit	**Daily Bag Limit**
1	None	10 (only 5 brown and rainbow trout)
2	7 inches	5
3	9 inches	3
4	12 inches, brown and rainbow trout; 8 inches, brook trout	3
5[a]	Special regulations—size and bag limits vary by specific water (Wisconsin DNR 1990)	

[a] All such regulations are intended to substantially reduce or eliminate harvest and frequently include restrictions on bait types as well as higher minimum size limits and lower bag limits than those used in the other categories.

Table 2. *Desired management objectives commensurate with the trout regulation categories.*

Category	Objectives
1	Improve growth rate in abundant trout populations; provide anglers with fish to eat
2	Maximize harvest weight; increase number of trout > 7 inches
3	Improve fishing late in season, especially in stocked waters; increase number of trout > 9 inches
4	Increase catch and harvest of brown trout > 12 inches and brook trout > 8 inches; improve reproduction
5	Increase catch of trophy fish; produce maximum fish population size
1-5	Increase the average size of trout caught in all waters

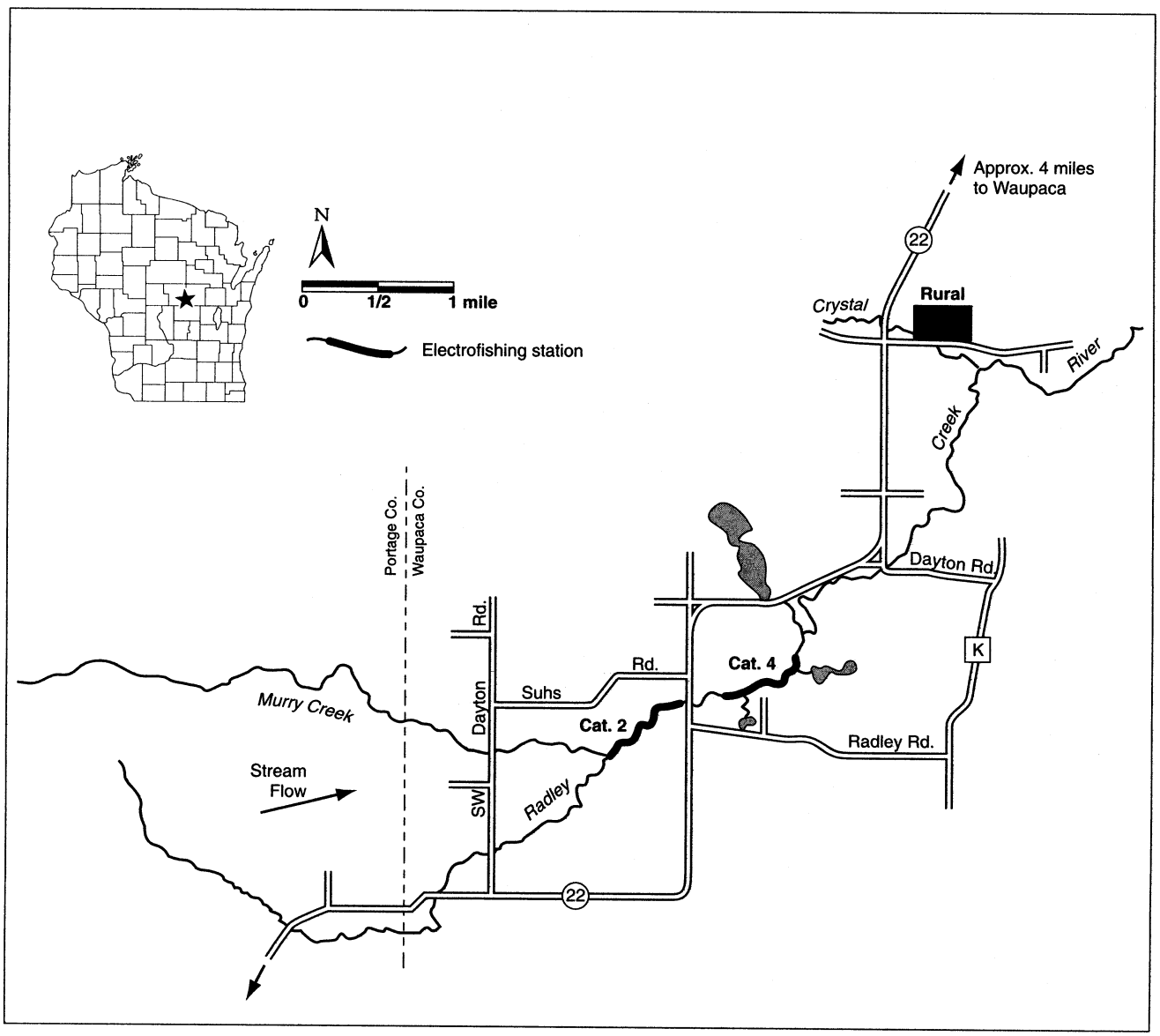

Figure 1. *Radley Creek study area in Portage and Waupaca counties.*

In 1988, I initiated site specific evaluations of 3 of the 5 proposed regulation categories to run concurrently with studies by fisheries managers. The primary purpose of this report is to summarize these completed evaluations of Category 2, Category 4, and Category 5 regulations in 3 study zones on 2 streams where they were applied and determine whether or not desired management objectives were achieved (Table 2).

In 1990, a guide (Wisconsin DNR) was published to familiarize anglers with the new trout fishing regulations. This excellent guide includes (1) instructions for using the guide, (2) a trout regulation key describing each of the 5 regulation categories and assigning a color code to each category, (3) a listing of each Wisconsin county and the base regulation category applicable to most trout waters in each county, (4) a listing of trout waters and regulations in each county that deviate from the base regulation, and (5) 16 pages of color-coded county maps showing the location and category of named trout waters. This publication has been updated and prepared annually by L.E. Claggett, Bureau of Fisheries Management and Habitat Protection, and has been well received by both resident and nonresident anglers.

Statewide assessment and recommended changes (if any) in the 5-category classification system as a whole will be completed by the year 2000 by the Trout Regulations Committee, which has evolved into a standing committee called the "Trout Team." The purpose of the Trout Team is to make policy recommendations on all aspects of trout management to the Director of the Bureau of Fisheries Management and Habitat Protection.

PHOTO: E. AVERY

Figure 2. *Woody debris in Radley Creek.*

Study Streams

Radley Creek

Radley Creek originates in southwestern Portage County and flows 8.7 miles northeast into Waupaca County where it joins the Crystal River near Rural, Wisconsin (Figure 1). The entire stream is Class I trout water (Wisconsin DNR 1980*a*) and sustains wild populations of brown trout *(Salmo trutta)* and brook trout *(Salvelinus fontinalis).* Brown trout is the dominant species; brook trout are common only in extreme headwater reaches.

Woody debris provides abundant instream habitat in Radley Creek (Figure 2). Sand is the prevailing substrate, but gravel is common upstream of the lower State Highway 22 bridge in Waupaca County. Stream gradient is less than 15 ft/mile. Maximum summer water temperatures rarely exceed 18.4 C, and minimum winter temperatures range from 0.5 to 1.1 C (Avery and Hunt 1981). Total alkalinity ranges from 135 to 157 mg/L $CaCO_3$, and pH ranges from 7.5 to 8.0. Stream discharge averages 17 cfs. Mottled sculpin *(Cottus bairdi)* is the primary nontrout species present. Approximately two-thirds of the stream frontage is in public ownership or long-term lease by the DNR and is open to public fishing. Speckled alder *(Alnus rugosa),* ninebark *(Physocarpus opulifolius),* dogwood (*Cornus* L.), and blackberry (*Rubus* L.) dominate the riparian understory and make streambank fishing challenging.

In 1990, the lower State Highway 22 bridge across Radley Creek became the dividing line between Category 2 trout regulations upstream and Category 4 trout regulations downstream (Figure 1). In 1989, a 0.5-mile reach upstream from the lower State Highway 22 bridge was selected to evaluate the Category 2 classification. This reach was extended another 0.6 mile upstream to the junction of Murry Creek in April 1990, thus establishing a 1.1-mile study zone. Beginning approxi-

mately 0.40 mile below State Highway 22 and proceeding downstream, a 1.1-mile reach was selected in 1989 for evaluating the Category 4 classification.

White River

The White River in the Chequamegon National Forest in central Bayfield County flows east 32 miles before entering the White River Flowage just inside Ashland County. The entire reach is either Class 1 or Class 2 trout water (Wisconsin DNR 1980*a*). A 49-ft high power dam creates the White River Flowage and prevents upstream movement of fishes. The river averages 44 ft in width, with an average discharge of 234 cfs (Johannes et al. 1971). Stream gradient averages 10 ft/mile, while pH and alkalinity average 7.4 and 88 mg/L $CaCO_3$, respectively. Below the power dam, the White River flows northeast 14 miles to its junction with the Bad River, which flows another 4 miles into Lake Superior.

The White River from Pike's Bridge downstream to the White River Flowage has a reputation for producing large brown trout, including occasional fish in excess of 20 inches (Wisconsin DNR 1980*b*). There are few walk-in access points in the lower 20 miles of this river reach because it flows through the Bibon Swamp Natural Area. Motors are prohibited on the river above U.S. Highway 63, and more than 40% of the fishing from Pike's bridge down to U.S. Highway 63 is done from canoe.

In the mid-1980s, Avery (1990*a*) documented excessive exploitation of the spring population of brown trout > 15 inches in a 21.3-mile reach of the White River from Pike's Bridge downstream to the Bibon Bridge (Figure 3). In 1990, Pike's Bridge became the dividing line between Category 2 trout regulations upstream and Category 5 trout regulations downstream. Bag and size restrictions imposed with the Category 5 designation included a minimum size of 9 inches and 3 trout per day with not more than 1 trout > 15 inches.

The 21.3-mile reach of the White River between Pike's Bridge and the Bibon Bridge was selected to evaluate the Category 5 regulations (Figure 3). The same 3 representative stations studied in the mid-1980s were chosen to monitor trout populations. Station 1 included a 0.5-mile reach immediately below Sutherland Bridge on Townline Road.

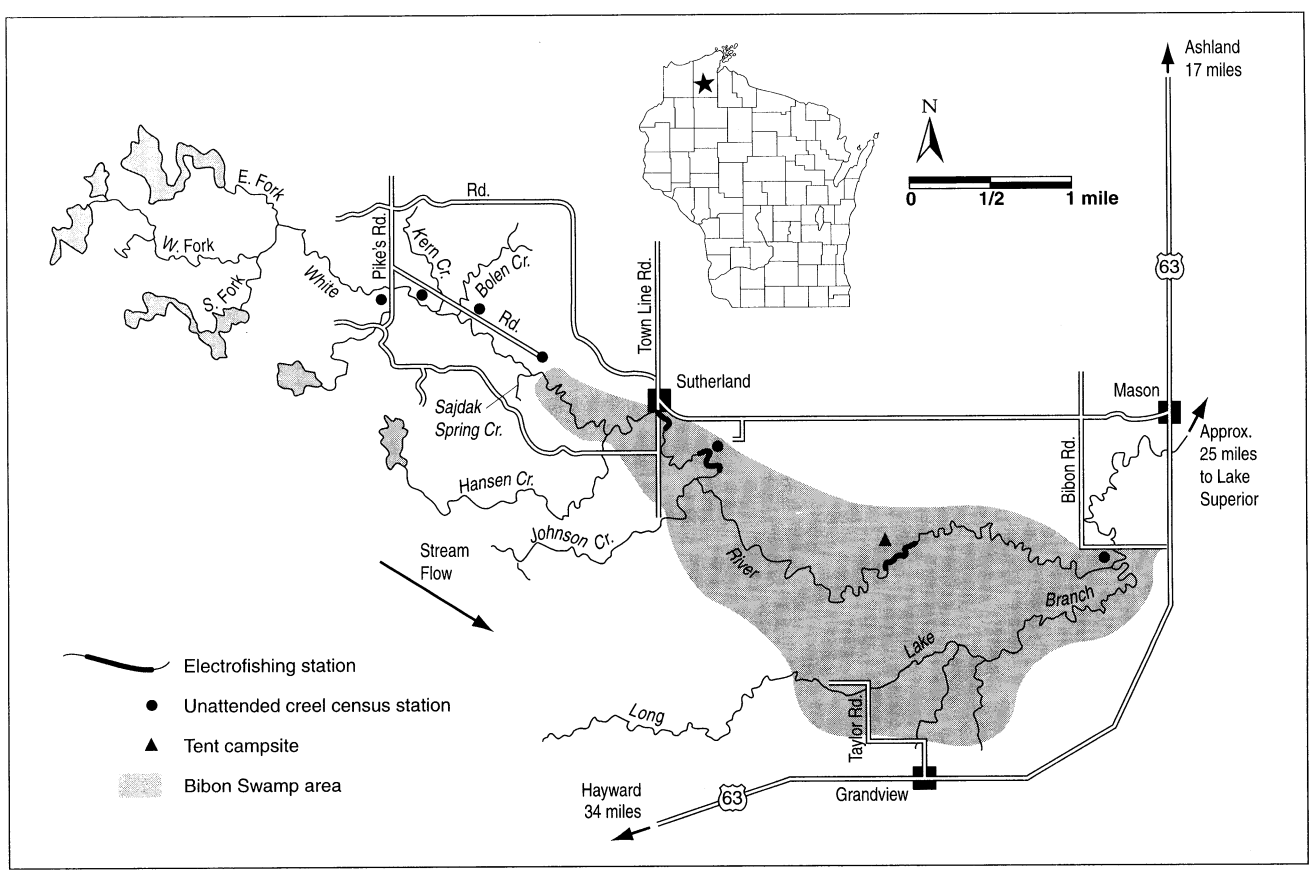

Figure 3. *White River study area in Bayfield County; Category 5 regulations in effect below Pike's Road.*

PHOTO: E. AVERY

Figure 4. *Lower end of station 2 on the White River (Bayfield County).*

Station 2 began approximately 1.75 miles below Sutherland Bridge and extended 1 mile downstream (Figure 4). A private access (Robert Stanley property) bisected this station.[2] Station 3 was located several miles below Station 2, deep in the Bibon Swamp, and extended 0.5 mile above and below an undeveloped tent campsite often used by overnight anglers. Additional characteristics of the study zone are provided in Avery (1990*a*).

Methods

Assessment of Trout Populations

Mark and recapture electrofishing surveys were made in the Category 2 and Category 4 study zones on Radley Creek in April and October 1989, in April 1990, and in April and October of 1992 and 1993. Stream electrofishing gear included a towed stream shocker boat equipped with a 220 V DC generator, 3 anodes, and a cathode of sheet metal, which also protected the boat bottom from abrasion.

Mark and recapture electrofishing surveys were separated by approximately 2 days. Trout captured on each marking survey were measured to the nearest 0.1 inch, weighed to the nearest gram, and given a caudal finclip. Captured trout were processed every 100–200 yds of streamthread and released near the midpoint of each portion of the stream sampled. Trout captured on the recapture surveys were measured to within inch groups, checked for finclips, and also released near the midpoint of each portion of stream sampled. Since only a 0.5-mile reach of Category 2 water was inventoried in 1989, subsequent trout population comparisons were confined to this segment of the 1.1-mile study zone. Trout population comparisons in the Category 4 water were made for the entire 1.1-mile study zone.

Numbers of trout in each inch group were estimated, and variances were determined using the Bailey modification of the Petersen mark-recapture formula and the large-scale sampling variance formula, respectively (Ricker 1958). Estimates and their variances were combined to determine total population parameters. Differences between population estimates were considered significant when 95% confidence intervals did not overlap. Confidence intervals for average populations (before vs. after regulatory changes) were computed using a formula for the standard error of a mean, assuming individual observations were independent (p. 80, Ostle 1963). This was necessary because the small sample size, normally 2 estimates, precluded estimating the correlation between years.

Trout populations in the White River were assessed during April 1988 and May 1989 (Avery 1990*b*) to provide baseline population data prior to implementation of Category 5 regulations. Identical sampling protocols were maintained during the post-treatment phase of study, i.e., during 1992–93, and are summarized below.

Mark and recapture electrofishing surveys were made in 3 representative stations during April in 1992 and 1993. Two electrofishing boats were used on each occasion: an 18-ft or 20-ft boom shocker followed closely by a 14-ft miniboom shocker. All electrofishing surveys progressed downstream during daylight hours using DC electricity. Two electrofishing passes were made through each station during both the mark and recapture surveys. Half-mile reaches of each station were sampled at a time. Trout captured on the first pass were held until completion of the second pass, at which time the fish were pro-

[2] The Robert Stanley property is now owned by the Wisconsin Department of Natural Resources.

cessed using methods identical to those used on Radley Creek. Mark and recapture surveys were separated by 1–2 days to allow fish to redistribute themselves.

Population estimates of trout ≥ 6 inches and corresponding sampling variances were computed in each of the 3 representative stations on the White River using formula previously described. Trout < 6 inches were not effectively sampled, and abundance could not be estimated. Population estimates were apportioned to inch groups based on the relative proportions of unmarked trout captured in the various inch groups during both electrofishing runs. Average lengths and weights of trout were determined based on length and weight measurements recorded in all 3 stations. Confidence intervals for average trout populations (before vs. after regulatory changes) were also determined using methods previously described.

Assessment of Sport Fisheries

The sport fishery of a 1.5-mile reach of Radley Creek (which included the current 1.1-mile Category 2 study zone and a 0.4-mile reach of Category 4 water below State Highway 22) was assessed during the 1976–77 fishing seasons (Avery and Hunt 1981). Similarly, the sport fishery of the 21.3-mile study zone of the White River was assessed during the 1984–85 fishing seasons (Avery 1990*a*). These studies provide baseline sport fishery data prior to implementation of the new 5-category classification system in 1990. Sampling protocols were duplicated in the post-treatment phase of study, i.e., during 1992–93, and are summarized below.

Stratified, partial creel surveys were conducted in the Category 2 and Category 4 study zones on Radley Creek throughout the 1992 trout season and during May and June of the 1993 trout season. An identical creel survey was conducted in the Category 5 study zone on the White River throughout the 1992 trout season and during May through 15 July 1993. Survey effort was stratified so that 50% occurred on weekends and holidays and 50% occurred on weekdays. Creel clerks normally worked one of two 8-hour shifts each work day (5:30 a.m. to 1:30 p.m. or 1:30 p.m. to 9:30 p.m.) and averaged 40 hours/week on the stream. Double shifts (16-hour days) were conducted on opening weekend to achieve as nearly as possible a complete census. Thereafter, census days and 8-hour shifts were selected randomly within the constraints of a 40-hour workweek to best represent all days as well as a.m. and p.m. shifts.

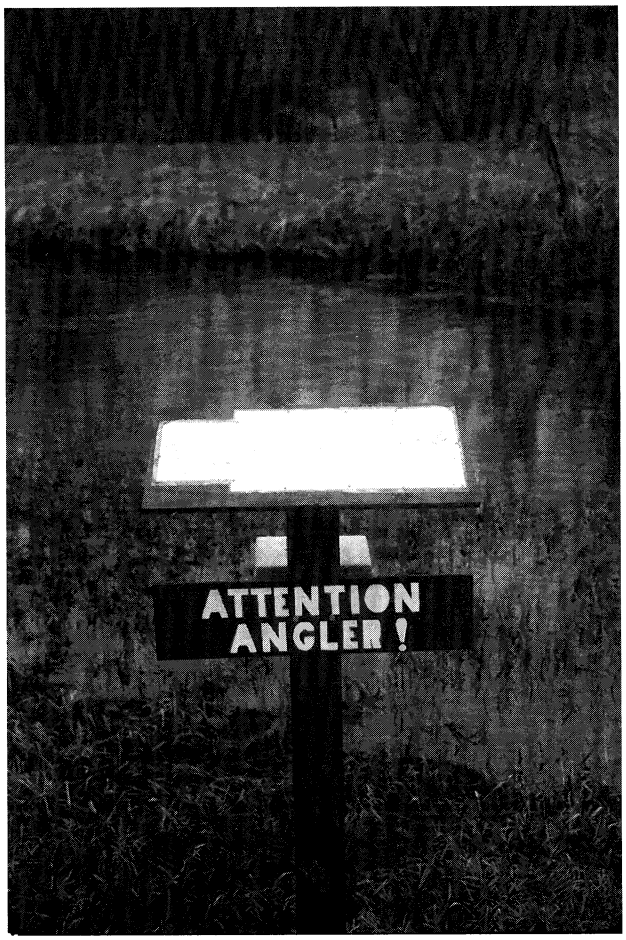

PHOTO: E. AVERY

Figure 5. *Volunteer creel survey station on the White River (Bayfield County).*

Creel surveys consisted of 2 main parts: estimates of fishing pressure and catch statistics. Estimates of fishing pressure were based on vehicle counts made at all access points at approximately 2-hour intervals between 6:30 a.m. and 8:30 p.m. Between vehicle counts, anglers were interviewed to determine the number in their fishing party, the distance traveled to fish, the length of time fished, fishing methods, and the nature of their catch. Most anglers were interviewed as they returned to their vehicles in order to gather as much information from completed trips as possible. Creeled trout were measured to the nearest 0.1 inch, and a scale sample was taken to facilitate aging.

A significant mayfly *(Hexagenia limbata)* hatch on the White River from late June to early July attracts fly fishers and stimulates a resurgence of fishing pressure. The hatch begins at dusk and continues well after dark. During this 1–3 week period, the scheduled p.m. creel survey shifts began 2 hours later and extended 2 hours later

(3:30 p.m. to 11:30 p.m.) to better represent the fishing pressure and associated angler catch and angler harvest statistics.

In addition to angler interviews on the White River, 7 unattended creel survey stations were established at prominent access points within the study zone to collect voluntary information (Figure 5). Pencils and specially designed creel survey cards were provided at each of these sites, along with a map of the study zone and an explanation of the purpose of the requested information. In addition, fishing diaries were distributed to anglers who fished the river often or who were going to fish by canoe and camp overnight within the study area. Completed census cards and diaries could be left in a drop box at any of the 7 survey stations or mailed to a DNR address provided.

Estimated fishing pressure and harvest statistics on Radley Creek and the White River were determined following protocols described by Avery and Hunt (1981) and Avery (1990*a*), respectively. Fishing pressure and trout harvest data for the final 2–2.5 months of the 1993 fishing season in all 3 study zones were extrapolated based on corresponding ratios computed for the 1992 fishing season.

Results

Trout Populations

During spring and fall electrofishing surveys of the Category 2 and Category 4 study zones on Radley Creek, an average of 1 and 2 brook trout, respectively, were captured. Similarly, an average of 1 brook trout per station was captured in the Category 5 zone on the White River during spring electrofishing surveys. Since brook trout were rare in the study zones on both streams, they will not be included in subsequent discussion. Trout will refer only to brown trout, the dominant species in both streams.

Radley Creek

Category 2. The average spring trout population in Radley Creek declined 21% (494 fewer trout/mile) following implementation of Category 2 angling regulations and was significantly different from the average spring population present before Category 2 regulations (Table 3). Spring trout populations didn't differ significantly from one another in 1989 and 1990 before Category 2 regulations were implemented, nor did they differ significantly in 1992 and 1993 after the regulations were implemented. Both spring trout estimates prior to Category 2 regulations were, however, greater than and significantly different from the 2 spring trout estimates following implementation of Category 2 angling regulations.

About 70% of the decline in the average spring trout population in Radley Creek was in the 6-inch and larger size component (Table 3). Average densities of trout ≥ 6 inches before and after implementation of Category 2 regulations were significantly different from one another, and individual populations in 1992 and 1993 were less than and significantly different from their corresponding counterparts in 1989 and 1990. Trout < 6 inches accounted for the remaining 30% of the

Table 3. *Spring trout population estimates (no./mile)[a] in Radley Creek before (1989–90) and after (1992–93) implementation of Category 2 angling regulations.*

	Size Categories			
Year	**Total**	**<6 inch**	**≥6 inch**	**≥7 inch**
Before				
1989	2,381 ± 198	1,157 ± 191	1,224 ± 55	1,000 ± 43
1990	2,245 ± 142	1,238 ± 128	1,008 ± 60	817 ± 42
Average	2,313 ± 121	1,198 ± 57	1,116 ± 20	908 ± 15
After				
1992	1,789 ± 153	1,085 ± 149	704 ± 32	579 ± 25
1993	1,849 ± 234	1,011 ± 226	838 ± 58	691 ± 51
Average	1,819 ± 70	1,048 ± 68	771 ± 17	635 ± 14

[a] 95% confidence intervals.

spring population decline. Average densities before and after Category 2 regulations were significantly different, but individual populations in 1989–90 and 1992–93 did not differ significantly.

An increase in the minimum legal size from 6 to 7 inches, commensurate with Category 2 regulations, lends particular importance to examining the 7-inch and larger size component of spring trout populations. Approximately 55% of the decline in the average spring trout population following the regulation change occurred in the 7-inch and larger size component (Table 3). Not only were average densities before and after the regulatory change significantly different from one another, but also individual populations in 1992 and 1993 were less than and significantly different from their corresponding counterparts in 1989 and 1990.

In contrast to the significant declines in spring trout populations following Category 2 regulations, trout populations in the fall exhibited little change (Table 4). Average trout abundance during the fall in 1992 and 1993 was only 10% greater than the fall 1989 estimate, and there were no significant differences between any of the 3 fall populations.

Although total fall abundance of trout in Radley Creek showed no significant change after initiation of Category 2 regulations, average density of trout ≥ 6 inches exhibited a significant gain of 14% (Table 4). Since fall population data prior to the regulation change spanned only 1 year (1989) compared to 2 years after the change (1992–93), the higher probability of variation during the latter period may explain the apparent increase. For example, the fall 1993 density of trout ≥ 6 inches was not only greater than but also significantly different from fall densities of similar size trout present in both 1989 and 1992. Fall densities in 1989 and 1992, i.e., the fall before and the 3rd fall after the regulations change, were not significantly different. The 3 fall cohorts of trout < 6 inches were not significantly different from one another; neither was there a significant difference between the fall 1989 population before the regulation change and the 1992–93 average density following the regulation change.

Little relationship was apparent between fall populations of 7-inch and larger trout and the increase in minimum legal size from 6 to 7 inches and reduction in daily bag from 10 to 5 fish mandated by Category 2 regulations. Average abundance of trout ≥ 7 inches during the fall in 1992 and 1993 was greater than but not significantly different from the fall 1989 population (Table 4). The fall 1989 density was significantly greater than in 1992 but significantly less than in 1993. The fall 1992 and fall 1993 populations were significantly different from one another too.

Category 4. The average spring trout population in the Category 4 zone on Radley Creek increased 18% (321 additional trout/mile) after implementation of Category 4 regulations and was significantly different from the average spring population present before the regulations change (Table 5). Neither of the 2 spring trout populations present before nor the 2 spring trout populations present after implementation of Category 4 regulations were significantly different from one another. Spring populations in 1992 and 1993, however, were both greater than either spring population present in 1989 and 1990 and were both significantly different from the spring 1990 population.

Approximately 98% of the increase in the average spring trout population following Category 4 regulations was in fish < 6 inches in size (Table 5). Average density of trout < 6 inches increased 46% and was significantly different from the average density present before the regulatory change. Spring density in 1992 was not only greater than but also significantly different from spring densities in both 1989 and 1990. Spring density in 1993 was greater than but not significantly different from either spring density in 1989 or 1990. Average spring density of trout ≥ 6 inches and ≥ 12 inches increased 1% and 29%, respectively, following implementation of Category 4 regulations. Only the average density of trout ≥ 12 inches was significantly greater following the regulations change.

The average fall trout population in Radley Creek increased a significant 35% (555 additional trout/mile) following implementation of Category 4 regulations (Table 6). Fall densities in both 1992 and 1993 exceeded the fall 1989 population; however, only the fall 1992 population was significantly greater than the fall 1989 population. Again, since fall population data prior to the regulation change spanned only 1 year (1989) compared to 2 years after the change (1992–93), the higher probability of variation during the latter period could explain the apparent increase in fall trout populations. Significant increases in trout < 6 inches, ≥ 6 inches, and ≥ 12 inches were all part of the fall population increases.

White River

Category 5. In general, populations of trout ≥ 6 inches in the 3 stations on the White River

Table 4. *Fall trout population estimates (no./mile)[a] in Radley Creek before (1989) and after (1992–93) implementation of Category 2 angling regulations.*

	Size Categories			
Year	**Total**	**<6 inch**	**≥6 inch**	**≥7 inch**
Before				
1989	2,596 ± 150	1,143 ± 145	1,453 ± 42	1,085 ± 36
After				
1992	2,694 ± 264	1,194 ± 255	1,500 ± 68	987 ± 49
1993	3,019 ± 402	1,204 ± 385	1,815 ± 113	1,268 ± 70
Average	2,856 ± 120	1,199 ± 115	1,658 ± 33	1,128 ± 21

[a] 95% confidence intervals.

Table 5. *Spring trout population estimates (no./mile)[a] in Radley Creek before (1989–90) and after (1992–93) implementation of Category 4 angling regulations.*

	Size Categories			
Year	**Total**	**<6 inch**	**≥6 inch**	**≥12 inch**
Before				
1989	1,817 ± 131	735 ± 107	1,082 ± 76	57 ± 4
1990	1,757 ± 105	641 ± 73	1,116 ± 76	44 ± 6
Average	1,787 ± 84	688 ± 65	1,099 ± 54	51 ± 3
After				
1992	2,083 ± 211	1,089 ± 190	994 ± 61	63 ± 8
1993	2,134 ± 252	915 ± 220	1,219 ± 123	68 ± 17
Average	2,108 ± 161	1,002 ± 145	1,106 ± 69	66 ± 9

[a] 95% confidence intervals.

Table 6. *Fall trout population estimates (no./mile)[a] in Radley Creek before (1989) and after (1992–93) implementation of Category 4 angling regulations.*

	Size Categories			
Year	**Total**	**<6 inch**	**≥6 inch**	**≥12 inch**
Before				
1989	1,569 ± 57	186 ± 39	1,383 ±40	82 ± 6
After				
1992	2,556 ± 167	558 ± 136	1,998 ± 97	126 ± 24
1993	1,692 ± 157	480 ± 130	1,211 ± 89	141 ± 30
Average	2,124 ± 115	519 ± 94	1,604 ± 66	134 ± 19

[a] 95% confidence intervals.

fluctuated widely during the 2 years of study before (1988–89) and after (1992–93) Category 5 regulations were implemented (Figure 6, Table 7). In Station 1, trout populations were significantly different during both years before and during both years after the regulatory change. The average spring trout population increased 9% following Category 5 regulations but was not a significant change. In Station 2, trout populations were significantly different during the 2 years before the regulatory change but were not significantly different in the 2 years after the regulatory change. The average spring trout population in Station 2 declined 40% (278 fewer trout/mile) after the regulatory change and represented a significant decline. In Station 3, trout populations were not significantly different during the 2 years before the regulatory change but were significantly different in the 2 years after the regulatory change. The average spring trout population in Station 3 declined 23% following Category 5 regulations and represented a significant change.

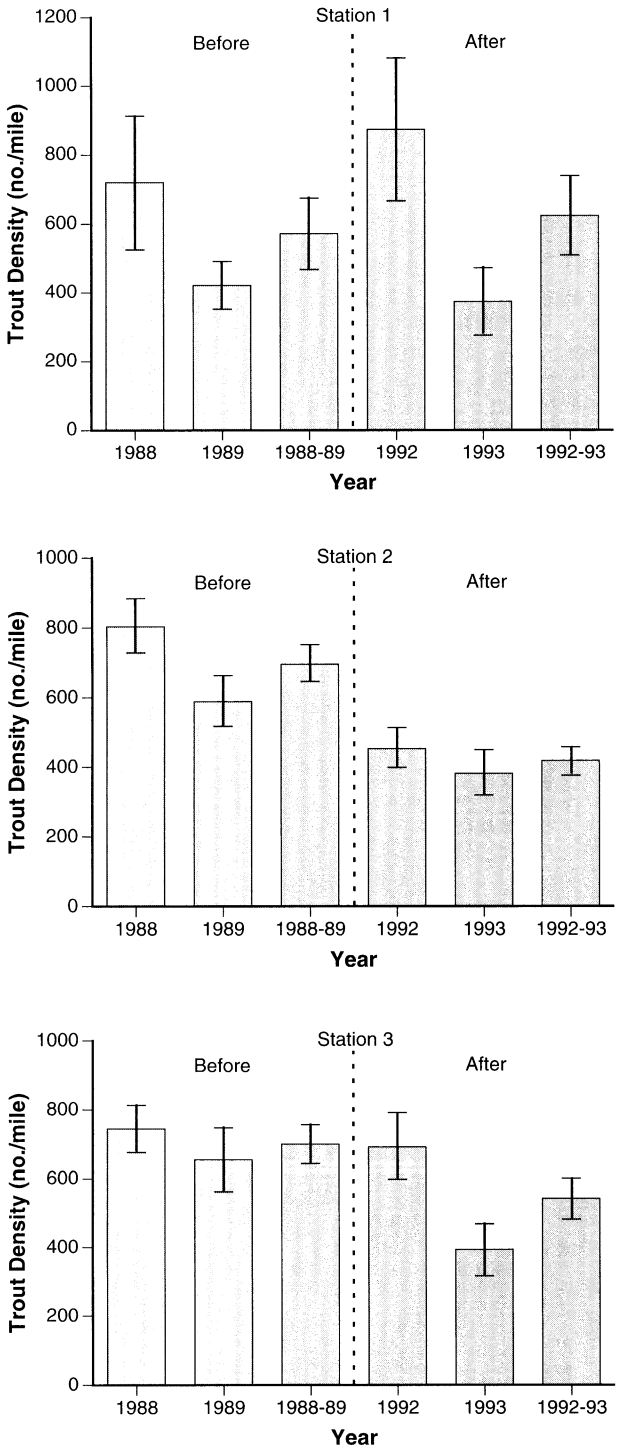

Figure 6. *Spring estimates and 95% confidence intervals of trout ≥ 6 inches in the White River before (1988–89) and after (1992–93) implementation of Category 5 angling regulations.*

The 2-year averages of trout ≥ 6.0 inches present in all 3 stations before and after implementation of Category 5 regulations declined 20% and were significantly different (Table 7). Intrapopulation changes in size structure suggested a 71% decline in trout < 9 inches (sublegal trout under new Category 5 regulations), no change in trout 9.9–14.9 inches, and a 12% increase in trout ≥ 15 inches. The decline in trout < 9 inches represented a loss of 134 trout/mile while the increase in trout ≥ 15 inches, i.e., quality-size fish, represented a gain of 7 trout/mile.

Sport Fisheries

Fishing Pressure and Harvest. Average annual fishing pressure on Radley Creek declined 59% (195 hour/acre) following implementation of Category 2 angling regulations (Table 8). Number and biomass of trout creeled also declined an average of 49% (171 trout/mile) and 23% (10.8 lb/acre), respectively (Table 9). Although fewer trout were creeled, average size of creeled trout increased 1.3 inches, from 8.8 inches to 10.1 inches. Approximately 61% of trout creeled before Category 2 regulations were in the 7.0–9.9 inch size range while 71% of creeled trout following the regulation change were in the 8.0–10.9 inch size range. Not only were creeled trout larger following the regulations change, but they were also older (Table 10). Age I and II trout comprised 89% of the trout harvest before Category 2 regulations, but age II and age III and older trout accounted for 91% of the harvest following the regulations change. Raising the minimum legal size from 6 inches to 7 inches reduced angler harvest of age I trout by 71% and for the most part protected this age group.

Following implementation of Category 4 angling regulations on Radley Creek, annual fishing pressure declined an average of 73% (243 hour/acre; Table 8). Number and biomass of trout creeled also declined an average of 96% (338/mile) and 89% (41.9 lb/acre), respectively (Table 9). Although harvest was substantially reduced, both the average size and age of creeled trout were much greater. Average size of trout creeled increased 4 inches, from 8.8 inches to 12.8 inches. Age I and II trout comprised 89% of the harvest before Category 4 regulations, but both age groups were completely protected under the 12-inch minimum size mandated by the Category 4 designation (Table 10). All trout creeled following the regulatory change were age III and older.

Average fishing pressure on the White River increased 20% (19 hour/acre) following implementation of Category 5 regulations (Table 11). Number and biomass of trout creeled, however, declined an average of 51% (99/mile) and 43% (11.1 lb/acre), respectively (Table 12). Angler harvest of trout 9.0–14.9 inches declined an average of 40% (55/mile). Likewise, angler harvest of quality-size trout, i.e., trout ≥ 15 inches, declined 55% (17/mile).

Although trout harvest declined, both the average size and age of creeled trout from the White River increased following Category 5 regulations. Average size increased 0.9 inch, from 12.0 inches in 1984–85 to 12.9 inches in 1992–93

Table 7. *Average spring trout populations (no./mile)[a] and apportionment by size intervals in the White River before (1988–89) and after (1992–93) implementation of Category 5 angling regulations.*

Population Parameter	Before (1988–89) Stations				After (1992–93) Stations			
	1	2	3	Avg.	1	2	3	Avg.
<9 inch	134	176	260	190	75	42	51	56
9-14.9 inch	409	461	357	409	514	328	383	408
>15 inch	28	60	84	57	35	49	109	64
Total[b]	571	697	701	656	624	419	543	528
	±103	±50	±57	±15	±115	±41	±60	±15

[a] Includes only trout ≥ 6.0 inches.

[b] 95% confidence intervals.

Table 8. *Chronology of estimated fishing pressure (hours) on Radley Creek before and after implementation of Category 2 and Category 4 angling regulations.*

Month	Before		After Category 2		After Category 4	
	1976	1977	1992	1993	1992	1993
May	357	278	33	76	140	46
Jun	60	233	60	68	84	5
Jul	91	178	39	—[a]	38	—[a]
Aug	167	225	54	—[a]	55	—[a]
Sep	135	100	59	—[a]	26	—[a]
Totals	810	1,014	245	379[b]	343	78[b]
Hours/acre	324	337	107	165[b]	143	33[b]
Average	331		136		88	

[a] No creel survey.

[b] Expanded total based on the ratio of the May and June subtotal:total season estimate in 1992.

Table 9. *Angler harvest of trout from Radley Creek before and after implementation of Category 2 and Category 4 angling regulations.*

Inch Group	Before				After Category 2				After Category 4[a]			
	Density (no./mile)			Biomass	Density (no./mile)			Biomass	Density (no./mile)			Biomass
	1976	1977	Avg.	(lb/acre)	1992	1993[b]	Avg.	(lb/acre)	1992	1993[b]	Avg.	(lb/acre)
6	49	42	45	2.1	0	0	0	0	0	0	0	0
7	112	46	79	5.8	3	0\7	5	0.4	0	0	0	0
8	94	59	76	7.9	25	3\48	37	3.8	0	0	0	0
9	57	59	58	8.6	19	27\50	34	5.1	0	0	0	0
10	61	34	48	9.6	33	21\81	57	11.4	0	0	0	0
11	41	25	33	8.6	11	18\34	22	5.7	0	0	0	0
12	6	17	12	4	2	17\25	14	4.7	13	2\3	8	2.3
13	0	0	0	0	8	0\14	11	4.7	2	0	1	0.4
14	0	0	0	0	0	0	0	0	6	0	3	1.4
15	0	0	0	0	0	0	0	0	2	0	1	0.6
Total	420	282	351	46.6	101	86\259	180	35.8	23	2\3	13	4.7
Average Length	8.7	8.8	8.8	0	10	10.2	10.1	0	13.2	12.3	12.8	0

[a] Trout < 12 inches protected under Category 4.

[b] May and June trout harvest\expanded total harvest based on the harvest ratio of May and June:total season estimate in 1992.

(Table 12). An average of 59% of the trout creeled in 1984–85 were age III or older while 67% of trout creeled in 1992–93 were age III or older (Table 13).

Angler Characteristics. Trout creeled per hour of fishing (i.e., harvest rate) in Radley Creek remained at or about 0.5 trout/hour before and after the change to Category 2 regulations. In the Category 4 reach, harvest rate declined from 0.5 trout/hour before the regulations change to 0.1 trout/hour in 1992 and to 0.04 trout/hour in 1993. Harvest rate in the White River declined from an average of 0.4 trout/hour before Category 5 regulations to an average of 0.2 trout/hour following the regulations change.

Successful anglers, i.e., those who caught at least 1 trout/trip whether creeled or released, comprised an average of 38% (range 36–41%) of anglers interviewed on Radley Creek in 1976–77. In 1992, 73% of the anglers in the Category 2 reach and 72% of the anglers in the Category 4 reach on Radley Creek were successful. On the White River, an average of 77% (range 76–78%) of anglers interviewed in 1984–85 were successful. In 1992, 60% were successful.

If angler success is defined as keeping at least 1 legal trout/trip, then an average of 30% (range 27–33%) of anglers were successful in Radley Creek in 1976–77. In 1992, only 10% were successful in both the Category 2 and Category 4 reaches of Radley Creek. In the White River, an average of 60% (range 58–61%) of the anglers were successful in 1984–85 but only 36% were successful in 1992.

Reducing daily bag limits and increasing minimum size limits under Category 2, Category 4, and Category 5 regulations had little effect on how far anglers traveled to fish. In 1976–77, an average of 65% of

Table 10. *Age composition (percent) of the season harvest of trout from Radley Creek before and after implementation of Category 2 and Category 4 angling regulations.*

Age Group	Before			After Category 2	After Category 4
	1976	1977	Avg.	1992	1993
I	41	21	31	9	0[a]
II	55	61	58	48	0[a]
III+	4	18	11	43	100[b]

[a] Age I and II trout are protected by Category 4.

[b] Approximately 40% were age IV+.

anglers fishing Radley Creek traveled less than 50 miles one-way, and 35% traveled 50 miles or more. In 1994, corresponding values in the Category 2 and Category 4 reaches on Radley Creek were 68% and 32% and 67% and 33%, respectively. In 1984–85, an average of 66% of anglers fishing the White River traveled 50 miles or more to the river, and 46% traveled at least 100 miles. In 1992, 71% of White River anglers traveled 50 miles or more, and 55% traveled at least 100 miles.

Worms, spinners, and flies were the 3 principle bait choices of anglers fishing both Radley Creek and the White River during this study (Table 14). A shift in the number one preference, i.e., from worms to spinners, occurred in Radley Creek following Category 2 regulations. This change is hard to rationalize as being due to the Category 2 regulations. I suspect it is just a coincidence. Worms, spinners, and flies (in order of decreasing importance) remained the primary bait choices in the Category 4 reach of Radley Creek. In the White River, worms, flies, and spinners (in order of decreasing importance) were the preferred bait choices both before and after Category 5 regulations.

Discussion

Radley Creek

Desired management objectives commensurate with the Category 2 classification of upper Radley Creek were to increase the numbers of 7 inch and larger, i.e., legal-size trout, to increase the average size of trout creeled, and to maximize the biomass of trout creeled. Spring density of legal-size trout, fishing pressure, and trout harvest declined substantially, however. Several factors other than the new Category 2 angling regulations are believed to be responsible for these declines. Primary among these factors was a severe statewide drought that occurred in 1988 and 1989. To illustrate the severity of the drought, annual discharge of the Oconto River in northeastern Wisconsin (Oconto Co.) during 1988–89 averaged only 66% of the previous 72-year average (Holmstrom et al. 1989, Holmstrom and Erickson 1990). Partial or complete year class failures occurred in many Wisconsin trout streams in 1989 and 1990 as a result of the drought, including a 41% reduction in average year class strength within the Category 2 reach on Radley Creek (Avery, unpubl. data). Survivors of the weak 1989 and 1990 year classes were legal-size trout during 1992 (ages II and III) and 1993

Table 11. *Chronology of estimated fishing pressure (hours) on the White River before and after implementation of Category 5 angling regulations.*

	Before		After	
Time Period	**1984**	**1985**	**1992**	**1993**
May	4,524	5,861	5,673	5,367
June[a]	1,436	2,382	1,570	1,627
H. limbata hatch[b]	1,610	2,080	3,469	4,312
Subtotal	7,570	10,323	10,712	11,306
July[a]	564	553	392	—[c]
August	479	583	639	—[c]
September	1,147	628	930	—[c]
Total	9,760	12,087	12,673	13,377[d]
Hours/acre	86	106	112	118[d]
Average	96		115	

[a] Excludes *Hexagenia limbata* hatch.

[b] Peak *H. limbata* hatch occurred 1–7 July 1984; 28 June–9 July 1985; 20 June–12 July 1992; 20 June–15 July 1993.

[c] No creel survey.

[d] Expanded total based on the ratio of the subtotal:total season estimate in 1992.

(ages III and IV) and comprised a substantial component of the legal-size trout present (see average size/age class; Avery and Hunt 1981). This, in large part, explains the decline in abundance of legal-size trout in 1992–93.

The DNR imposed unprecedented emergency angling restrictions in 1989, 1990, and 1991 on streams of southwestern and northeastern Wisconsin where the effects of the 1988–89 drought were most severe. These restrictions included (1) catch and release fishing only and use of only artificial lures in 12 southwestern Wisconsin counties and 10 northeastern counties from 28 July through 30 September 1989; (2) closure of the early (1 January–4 May) 1990 trout fishing season in 12 southwestern Wisconsin counties; (3) catch-and-release fishing only and use of only artificial lures in 12 southwestern counties during the regular fishing season (5 May–30 September 1990) plus closure of the fishing season in 11 northeastern Wisconsin counties; and (4) catch-and-release fishing with artificial lures only in 6 southwestern counties and 11 northeastern counties during the regular 1991 trout fishing season (Wisconsin DNR 1989, 1990, 1991). Licensed trout anglers (as measured by trout stamp sales) for the 1990–91 period declined more than 30% (compared to the previous 5-year average) as a result of the reduced fishing opportunities associated with the drought (Wisconsin DNR 1985–1991). In 1992, when creel surveys began in

Table 12. *Angler harvest of trout from the White River before and after implementation of Category 5 angling regulations.*

	Before				After			
	Density (no./mile)				Density (no./mile)			
Inch Group	1984	1985	Avg.	Biomass (lb/acre)	1992	1993[a]	Avg.	Biomass (lb/acre)
6	4	1	2	<.1	0	0	0	0
7	7	6	7	0.2	0	0\0	0	0
8	11	25	18	0.7	<1	0\0	<1	<.1
9	12	29	21	1.2	7	7\9	7	0.5
10	30	36	33	2.5	14	10\12	13	1
11	17	24	20	2	17	12\15	16	1.6
12	25	28	26	3.3	20	13\15	18	2.3
13	17	16	16	2.6	17	12\13	15	2.5
14	21	19	20	3.9	9	14\15	12	2.3
15	12	12	12	2.9	3	4\4	3	0.7
16	7	8	8	2.3	4	5\5	4	1.1
17	6	6	6	2	2	3\3	3	1
18	2	3	3	1.2	2	<1\<1	1	0.4
19	2	1	1	0.5	1	1\1	1	0.5
20	<1	<1	<1	0.2	1	<1\<1	1	0.5
21	<1	<1	<1	0.2	<1	<1\<1	<1	0.2
22	<1	<1	<1	0.1	0	0\0	0	0
23	0	0	0	0	<1	0\0	<1	0.1
Total	173	215	194	25.8	97	82\93	95	14.7
Average Length	12.2	11.8	12.0	—	12.8	12.9\12.9	12.9	—

[a] May through 15 July trout harvest\expanded total harvest based on the harvest ratio from May through 12 July:total season estimate in 1992.

conjunction with the current study, all Wisconsin trout waters were open to trout fishing for the first time since the new 5-category classification system was adopted. In a bit of unfortunate timing, the cost of the Wisconsin trout stamp more than doubled in 1992, from $3.25 to $7.25. The decline in fishing pressure on Radley Creek during 1992–93 was therefore not so much a response to the regulatory change but reflected a statewide loss of angler interest during the drought that was exacerbated by the 123% increase in the price of a trout stamp. Declines in trout biomass harvested in 1992–93 reflected both the substantial decline in fishing pressure and the lower availability of legal-size trout.

The Category 4 designation implemented on lower Radley Creek in 1990 was designed to increase the trout population present, to increase the catch of trout > 12 inches, to increase the average size of creeled trout, and to improve natural reproduction by increasing the proportion of larger, older spawners in the population. Spring populations of trout, including trout ≥ 12 inches, increased following the regulations change. Angler harvest of trout ≥ 12 inches, however, exhibited little change. Fall trout populations in all size groups also increased. Significant increases in trout < 6 inches in the spring (age I fish) and fall (age 0 fish) of 1992 confirmed increased natural reproduction. Trade-offs, however, included a 73% decline in fishing pressure, a 96% decline in total number of trout creeled, and a 89% decline in total biomass creeled. Some of the decline in fishing pressure was undoubtedly due to the same reasons discussed previously for the decline in fishing pressure in the Category 2 reach on Radley Creek.

Table 13. *Percent age composition of angler-caught trout from the White River before and after implementation of Category 5 angling regulations.*

	Before			After		
Age Group	1984	1985	Avg.	1992	1993[a]	Avg.
I	5	5	5	1	0	<1
II	25	46	36	31	32	32
III	43	31	37	46	47	46
IV	21	14	18	15	14	14
V	5	4	4	5	6	6
VI	1	<1	<1	2	<1	1

[a] Age composition is based on angler-caught trout sampled during the 1992 fishing season and the first 2 months of the 1993 fishing season.

In addition, the high minimum size of 12 inches created essentially a catch-and-release fishery on a stream where 97% of the average spring population was sublegal, and the majority of the angling clientele used worms for bait and fished for the pot. Many bait anglers no doubt abandoned this reach of Radley Creek because the odds of catching a legal-size fish were low while the odds of inflicting unnecessary hooking mortality on sublegal trout were unacceptably high.

White River

Management objectives of the set of regulations imposed with the Category 5 classification on the White River were to increase the trout population present and to sustain and possibly improve various "quality" aspects of the sport fishery. A 20% decline in the average spring trout population occurred instead, but all of the decline occurred in the sublegal component of the population, e.g., trout 6.0–8.9 inches. Poor year classes and/or abnormally high overwinter mortalities of age 0 trout during 1990–92 in the headwater reaches and major tributaries (where most spawning occurs) could explain this decline. Stream flows had recovered from the 1988–89 drought by this time, however, and leave little explanation for year class failures or excessive overwinter mortalities.

Abundance of legal-size trout (≥ 9 inches) remained basically the same (409/mile vs. 408/mile) following Category 5 angling restrictions and included a slight increase (7/mile) in numbers of trout > 15 inches. Reasons for the lack of significant positive response in the legal-size component

Table 14. *Percentage of anglers using various bait types in Radley Creek and the White River before and after changes in angling regulations.*

	Radley Creek			White River	
Bait Category	1976-77	Cat. 2 1992	Cat. 4 1993	1984-85	Cat. 5 1992
Worms	59	33	41	41	44
Spinners	16	45	15	12	11
Flies	10	5	7	27	24
Other	—	2	4	—	—
Multiple	14	15	32	19	21

of the population are speculative. Increased angler harvest was not responsible because both angler harvest of trout 9.0–14.9 inches and trout ≥ 15 inches declined significantly. Poor year classes of trout during the 1988–89 drought were documented in many Wisconsin trout streams and if they occurred in the White River watershed would help explain the lack of recruitment into the legal-size range. Whatever the cause of the trout population decline, the Category 5 regulations were not responsible.

The popularity of the White River sport fishery continued to grow under Category 5 regulations even though angler success, harvest rate, and total season harvest of trout all declined. Two important factors contributing to the popularity of this fishery are the density of large trout present and the high average size of creeled trout. Compared with 18 other well-known trout streams located throughout Wisconsin, the White River ranks first in abundance of trout > 15 inches (Table 15). Likewise, the 12.9 inch average size of creeled trout from the White River in 1992–93 is the largest thus far recorded from Wisconsin streams. An average size of 10.5 inches for creeled trout from Timber Coulee Creek (Hunt 1985) and the North Branch of Beaver Creek (Avery 1983) tie for second place. Although difficult to substantiate, the absence of a bait restriction on the White River may also contribute to the popularity of the sport fishery. No other stream in Wisconsin offers anglers using natural baits equal opportunity with anglers using artificial lures to fish over a trout population comprised of so many large trout. Finally, the special regulations placed on the White River under the Category 5 classification may have attracted additional anglers to the stream.

Table 15. *Brown trout population data from the White River and 18 other Wisconsin streams.*

Stream	County	Region of State	Month/Year	Miles Surveyed	Brown Trout/Mile	
					>6 inches	>15 inches
White River	Bayfield	NW	Apr 92-93	2.5	528	64
Eighteen Mile Creek	Bayfield	NW	Sep-79	5.3	836	33
Yellow River	Barron	NW	Jun-78	0.8	683	9
N. Br. Beaver Creek	Marinette	NE	Sep-79	3.4	461	21
Race Branch[a]	St. Croix	WC	Sep 76-79	1	1,878	14
Willow Branch	St. Croix	WC	Sep 76-79	1	853	11
Kinnickinnic River	St. Croix	WC	Apr 73-77	1	3,126	1
Trempealeau River[b]	Jackson	WC	Aug-77	0.8	87	5
Beef River	Jackson	WC	Aug-77	1	95	7
Emmons Creek	Waupaca	C	Sep 75-77	1.2	1,548	6
Radley Creek	Waupaca	C	Sep 75-77	1.5	1,126	6
Lunch Creek	Waushara	C	Sep 73-76	1.3	726	2
S. Br. Wedde Creek	Waushara	C	Sep 75-77	1.1	955	1
Mecan River	Waushara	C	Sep 75-77	1.4	772	6
Castle Rock Creek[c]	Grant	SW	Oct-79	2.4	570	31
Big Green River	Grant	SW	Nov-79	8.6	103	8
Trout Creek	Iowa	SW	Sep 78-79	5.2	498	5
Timber Coulee Creek	Vernon	SW	Spring 83	—	2,336	24
Mt. Vernon Creek	Dane	S	Sep 78-79	6.1	559	30

[a] The survey on the Race Branch of the Willow River was through a special regulation zone.

[b] The Trempealeau River and Beef River have more brook trout than brown trout.

[c] The survey on Castle Rock Creek was through a "no kill" zone.

Management Implications

Radley Creek

Category 2 is the correct classification for upper Radley Creek even though all desired objectives were not achieved due to mitigating factors associated with the 1988–89 drought. Category 2 regulations protect the trout through their first 2 growing seasons and should ultimately increase the numbers of legal-size (≥ 7 inches) trout present and maximize the biomass creeled. Maintaining the Category 2 classification in this reach of stream is recommended. Lower Radley Creek, however, should be reclassified from Category 4 to Category 3 (9-inch minimum size; 3 daily bag). This change would reduce the minimum legal size from 12 inches to 9 inches and substantially increase the number of legal-size trout available for harvest. The sport fishery will become more attractive to anglers, and both numbers and biomass of trout harvested should increase. The 9-inch minimum size will also be adequate to sustain a multi-aged spawning population that will provide a buffer against catastrophic population declines should successive year class failures occur. An acceptable alternative to dual categories on Radley Creek would be to classify the entire stream as Category 3. This would be a more conservative approach, would simplify regulations and law enforcement, and would still provide a better quality sport fishery than that which existed prior to 1990.[3]

White River

Maintenance of the current set of regulations associated with the Category 5 classification on the White River is recommended. These regulations are adequate to sustain the legal-size trout population and possibly encourage further increases in fish > 15 inches, assuming no major increases in fishing pressure and harvest and that natural recruitment returns to its former level. The unexpected decline in numbers of trout < 9 inches observed in this study was unrelated to the regulatory changes. However, immediate efforts should be taken by the DNR to determine if reduced recruitment and associated declines in the adult trout population continue in the White River. If so, an intensive effort should be made to identify and correct the factors responsible. The White River and its tributaries represent some of the best trout water in northwest Wisconsin and deserve high priority when it comes to maintaining the DNR's substantial public investment in the watershed.

Finally, in field studies such as this one, investigators must assume that biotic and abiotic variables will remain static throughout the study period and will not interfere with the interpretation of whatever "treatment" being evaluated. Unfortunately, the severe drought that occurred during this study and the substantial increase in the price of a trout stamp invalidated this assumption and compromised the study design. Nonetheless, 2 of the most important objectives of the new 5-category classification system were achieved in all 3 classification categories assessed: reduced exploitation and increased average size of trout creeled.

Because events beyond experimental control are often the rule rather than the exception in short-term field studies like those discussed in this report, the need for long-term trout population assessments and creel surveys to assist the DNR in managing the trout resource cannot be overemphasized. Long-term follow-up surveys on Radley Creek, the White River, and other trout streams evaluated by fisheries managers during the 1988–89 drought are needed to document trout populations and sport fisheries under more normal streamflow and static fishing license costs. Technologies to better analyze and communicate raw data are increasing exponentially, but it is imperative to maintain equal if not greater emphasis (and fiscal commitment) on the collection of current, long term data bases that will enable the DNR to correctly evaluate their management strategies.

[3] This option was preferred by fisheries management personnel and was put into effect on Radley Creek beginning in 1996.

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