research management

# findings

Number 30 • June 1991

## IMPACT OF BEAVER DAM REMOVAL ON SUMMER WATER TEMPERATURES IN A NORTHEASTERN WISCONSIN TROUT STREAM

by Ed L. Avery

Beaver populations in northern Wisconsin burgeoned in the late 1970s and early 1980s, creating unprecedented densities of >1 beaver dam/mile on many area trout streams. Beaver dams constructed on low- to moderate-gradient streams typical of those in this region cause changes in stream habitat that often adversely affect resident trout populations. One such change is an increase in summer water temperatures (Patterson 1950, Reid 1952).

In 1982 I initiated a study to test the hypothesis that removal of beaver dams on a brook trout (*Salvelinus fontinalis*) stream and subsequent maintenance of free-flowing conditions would result in: (1) improved living conditions for trout, especially water temperature, (2) an increased trout population, and (3) a higher quality trout fishery. Baseline data collected the year prior to initial dam removal were compared to data from 3 follow-up years. This Findings article examines one facet of this 5-year study—the impact of removing beaver dams on summer water temperatures. Other facets will be reported in an upcoming Findings and a more detailed final report.

### Study Area

The study area was composed of a section of the North Branch of the Pemebonwon River (PR) and its tributaries, in northeastern Marinette County. The study area included 10 miles of Class II trout water on the PR plus 23 miles on 14 tributaries. The PR averaged 24 ft wide, with a gradient of <15 ft/mile, a discharge of 14 cfs, and light brown, medium-hard, slightly alkaline water. Where free-flowing, tributaries were 4-10 ft wide, with summer flows generally <0.5 cfs. Gradients were generally <50 ft/mile. When my study began, numerous segments of the PR were impounded by beaver dams, and several tributaries were little more than a series of impoundments from headwater to mouth.

### Methods

Ground reconnaissance of all study area waters was made in early November 1982 to locate beaver dams. DNR blasting crews using "Kenepak" explosive removed all obstructions to stream flow between mid-November 1982 and early May 1983. Of all obstructions, 178 were beaver dams and 41 were log and debris jams, many of which either had been or were currently occupied by beaver. The number of obstructions removed from the PR and tributaries approximated 3.5/mile and 8/mile, respectively.

Following the initial 6-month removal period, the study area was reconnoitered at least once per month throughout the remaining 3.5 years of study. New obstructions—all beaver dams—were removed by blasting within 5 days of discovery. This eliminated an additional 327 beaver dams.

Accumulative removal of obstructions from the PR during November 1982-November 1986 was 11/mile. Accumulative removal from tributaries ranged from

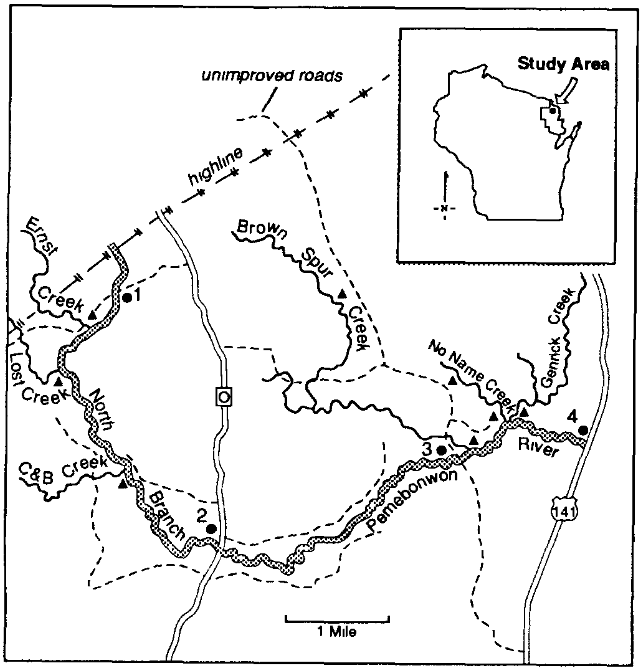


FIGURE 1. Study area on the North Branch Pemebonwon River showing water temperature recording sites on the main stem ● and 6 largest tributaries ▲. (Eight other tributaries within the study area are not shown.)

1/mile on Lost Creek to 50/mile on Genrick Creek and averaged 19/mile. Removal costs during the 4-year period totaled $33,820 and therefore averaged $62/obstruction.

Stream temperatures were collected for one year (1982) prior to initial removal of all obstructions from the study area and during the first, second, and fourth years (1983-84 and 1986) following the initial removal period. Temperatures were recorded by continuous-recording Ryan thermographs installed in the PR at the upper and lower ends of the study area and at 2 road crossings in between (Fig. 1). In addition, the 6 largest tributaries within the study area were identified, and thermographs were installed just above their confluences with the PR. On 2 of the 6 tributaries, No Name Creek (NNC) and Brown Spur Creek, a thermograph was also placed upstream to measure possible temperature changes between the headwater and mouth.

Thermographs at the 12 monitoring sites were in place from January 1982-December 1984 and from January-December 1986. They provided usable data with several exceptions. Temporary equipment failures resulted in loss of data from Lost Creek in 1983 and the upper site on NNC in 1984. In addition, data from 2 sites in 3 years were not used: beaver dams impacted thermograph readings at the upper site on Brown Spur Creek in 1983 and 1984, and sediment covered the equipment on C & B Creek in 1986.

Local air temperatures and precipitation were recorded during the same years of the study for which water temperature data were collected. Maximum and minimum daily air temperatures were recorded by DNR personnel at the Ranger Station in Wausaukee (25 miles south of the study area). Daily precipitation was recorded there, too.

In this study, water temperatures in the PR and tributaries peaked each year during July or early August. Data from these months were therefore used to compare differences in water temperatures before and after obstruction removal. Comparisons were based on highest mean weekly water temperatures. I felt these were better indicators of potential stress on trout than highest daily temperatures which are short term in nature. In this Findings, all references to "summer" data (i.e., water temperatures, air temperatures, and rainfall) refer to data from July-August. Likewise "peak" water temperatures are used to refer to highest mean weekly water temperatures.

## Results and Discussion

During summer 1983, the first year after initial removal of all obstructions, peak water temperatures on the PR were 0.5-3.2 C warmer than during summer 1982 (Table 1). Similarly, peak water temperatures in 3 of 5 tributaries were 0.6-5.4 C warmer than in 1982 (Table 2). Average maximum daily air temperature during summer 1983 was 5.0 C warmer than during the same period in 1982. Rainfall during summer 1983 was 4.7 inches less than in the same period in 1982. Together, higher air temperatures and lower rainfall during summer 1983 had a net warming effect on stream temperatures, even though obstructions had been removed.

TABLE 1. Peak water temperatures (C) during summer 1982 at 4 locations on the North Branch Pemebonwon River and changes in peak temperatures after intensive removal of beaver dams and log jams.

| Station No. | Peak Temp. in 1982 | Changes 1983 vs. 1982 | 1984 vs. 1982 | 1986 vs. 1982 |
|---|---|---|---|---|
| 1 | 20.3 | +1.5 | -2.0 | -0.6 |
| 2 | 19.8 | +2.5 | -1.1 | -0.4 |
| 3 | 19.2 | +0.5 | -1.1 | +0.5 |
| 4 | 19.8 | +3.2 | -0.7 | +1.2 |

TABLE 2. Peak water temperatures (C) during summer 1982 at the mouths of 6 tributaries to the North Branch Pemebonwon River and changes in peak temperatures after intensive removal of beaver dams and log jams.

| Creek | Peak Temp. in 1982 | Changes 1983 vs. 1982 | 1984 vs. 1982 | 1986 vs. 1982 |
|---|---|---|---|---|
| Ernst | 19.6 | +3.6 | -0.7 | -1.2 |
| Lost | 15.8 | – | -1.8 | -2.4 |
| C & B | 18.7 | -2.1 | -3.6 | – |
| Brown Spur | 20.1 | +0.6 | -1.6 | +0.8 |
| No Name | 23.8 | -1.2 | -4.5 | -4.3 |
| Genrick | 18.4 | +5.4 | +1.4 | +2.5 |

During summer 1984, the second year after initial removal of obstructions, peak water temperatures on the PR were 0.7-2.0 C cooler than in summer 1982 (Table 1). Peak water temperatures in 5 of 6 tributaries monitored were also 0.7-4.5 C cooler in 1984 than in 1982 (Table 2). Average maximum daily air temperature in summer 1984 was 2.0 C warmer than in 1982, and summer rainfall was 3.3 inches less than in 1982. Even though summer 1984 was warmer and dryer than in 1982, the absence of beaver dams in 1984 resulted in a net reduction in stream temperatures.

Peak water temperatures in 1986, the fourth year after initial removal of obstructions, were 0.4-0.6 C cooler at the upper 2 thermograph sites on the PR and 0.5-1.2 C warmer at the 2 lower thermograph sites than in 1982 (Table 1). Peak water temperatures in 3 of 5 tributaries monitored during 1986 were 1.2-4.3 C cooler than in 1982 (Table 2). Average maximum daily air temperature during summer 1986 was 1.4 C warmer than during the same period in 1982 and summer rainfall was 4.7 inches less than in 1982. Although summer 1986 was warmer and dryer than summer 1982, a reduction in stream temperatures at 5 of the 9 sites monitored again suggests a net cooling effect due to the removal of obstructions.

The best measure of the impact of beaver dam removal on stream temperature was on NNC, where thermographs were installed near the headwater and at the stream mouth. Forty-eight beaver dams (40/mile) were initially removed from NNC, which remained free-flowing throughout the remainder of the study period. Air temperature and precipitation affected both thermograph sites similarly, since total stream length was only 1.2 miles. Variation in peak summer water temperatures at the upper and lower thermographs thus reflected the net effect of removing beaver dams.

Accordingly, removal of beaver dams in NNC reduced peak temperatures 0.6 C in summer 1983 and 2.5 C in 1986 (Table 3). These reductions are conservative since 2 of the 48 dams initially present were above the upper thermograph. More importantly, the reductions in water temperature occurred during years when summer air temperatures were higher and precipitation amounts lower than in the year before removal of beaver dams. If summer air temperatures and precipitation in 1983 and 1986 had been similar to those occurring in 1982, I believe greater reductions in stream temperatures would likely have occurred.

TABLE 3. Peak water temperatures (C) during summer 1982 at 2 locations on No Name Creek, changes between years, and interstation differences in these changes before (1982) and after intensive removal of beaver dams.

| Location | Peak Temp. in 1982 | Changes 1983 vs. 1982 | 1986 vs. 1982 |
|---|---|---|---|
| Headwater | 19.0 | -0.6 | -1.8 |
| Stream mouth | 23.8 | -1.2 | -4.3 |
| | Difference | -0.6 | -2.5 |

## Upshot

Deliberate removal of beaver dams and log jams and subsequent maintenance of free-flowing conditions appeared to affect stream temperature. Peak summer water temperatures were lower in 2 of 3 follow-up years at most sites on both the PR and tributaries. A combination of higher than normal air temperatures and lower than normal rainfall after removal of obstructions reduced the magnitude of improvement in water temperature. Conservative reductions in peak summer temperature in 1 tributary ranged from 0.6 C during the first year to 2.5 C during the fourth year after initial removal of obstructions.

Under natural conditions, brook trout are not found regularly in waters with temperatures much above 20 C. Their optimum temperature range is generally considered to be 12.8-18.9 C (Bridges and Mullan 1958). Reductions in peak summer water temperatures of the magnitude observed in this study may seem rather small, but they can make the difference between the presence or absence of viable brook trout populations. This is especially true in streams like the PR where peak summer water temperatures often approximate or exceed 20 C.

Improving summer water temperatures is, however, only one part of a bigger picture. How has removal of beaver dams and log jams affected brook trout populations and the sport fishery? This question will be the focus of a future Findings article. Has removal affected other parts of the stream community such as nontrout fishes and macroinvertebrates? This question and others will be discussed in the final report on this study.

## References


Bridges, C. H. and J. W. Mullan. 1958. A compendium of the life history and ecology of the Eastern brook trout, Salvelinus fontinalis (Mitchill). Mass. Div. Fish. and Game. Fish. Bull. No. 23. 37 pp.

Patterson, D. 1950. Beaver-trout relationships. Wis. Conserv. Bull. 15(3):2-4.

Reid, K. A. 1952. Effects of beaver on trout waters. Md. Conserv. 29(4):21-23.


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Ed Avery is a research biologist for the Wisconsin Department of Natural Resources. He is a project leader for research on trout throughout the state. Address: 11084 Stratton Lake Road, Waupaca, WI 54981. Phone: (715) 258-3430.


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Funding for this project was provided in part by the Sport Fish Restoration Program.


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Edited by Susan Nehls

*Bureau of Research*
*Wisconsin Department of Natural Resources*
*P.O. Box 7921*
*Madison, WI 53707*

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