Ref ID: 71739

MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

FISHERIES DIVISION

JOB PROGRESS REPORT

State: Montana Title: Southwest Montana Fisheries Studies

Project No.: F-9-R-35 Title: Madison River Temperature Study

Job No.: IIb

Period Covered: July 1, 1986 through June 30, 1987

ABSTRACT

Comparison of water temperature data above and below Ennis reservoir shows the average April through September water temperature to be 6.1 F higher in the Norris section versus the Varney section for 1986. The mean water temperature for the primary growth period (June-August) was 57.1 F in Varney versus 65.1 F for Norris. Total numbers of 16.0 inch and larger wild brown and rainbow trout were 238% higher in the Varney section while total numbers of wild two-year-old and older trout were 149% higher in the Norris section.

BACKGROUND

The Madison River is formed by the Gibbon and Firehole Rivers in Yellowstone National Park and flows in a northwesterly direction to join the Jefferson and Gallatin Rivers to form the Missouri River at Three Forks. Two major reservoirs were built on the Madison River-Hebgen, which is located 1.5 miles west of Yellowstone National Park, and Ennis, which is located seven miles north of the town of Ennis (Figure 1).

In 1900, the Madison Dam at Ennis was constructed to provide electrical power for southwestern Montana. Since Ennis Reservoir is located in a naturally shallow basin with a small dam, the reservoir itself is very shallow with an average depth of less than nine feet. This shallow reservoir has led to some warming of the Madison River below the dam which may endanger the "Blue Ribbon" fisheries in the last 35 miles of the river. There has been periodic fish kills in this area in the last 25 years which may have been caused by the warmer water. In 1961, a Montana Fish and Game study showed the Madison River was 10 to 15 degrees warmer below the reservoir than above (Heaton, 1962).

OBJECTIVES AND DEGREE OF ATTAINMENT

1. To determine if higher water temperatures below Ennis Reservoir are having detrimental effects on wild trout populations through changes in age structure, size composition, species composition and growth rates (data included in report).

2. To obtain wild trout population estimates to include age structure, size composition, species composition and condition factors (data included in report).

3. To gather water temperature data above and below Ennis Reservoir from April through September (data included in report).

PROCEDURES

Electrofishing gear was used to sample fish populations in two sections of the Madison River (Norris and Varney). Electrofishing was carried out while floating through the section in a fiberglass boat. Population estimates were made using the Peterson-type mark-and-recapture method. Two or more "marking" and/or "recapture" trips were necessary where sample sizes were

small and/or efficiencies were low. Usually a 10-14 day period was allowed between marking and recapture trips. Scales were taken to determine age and growth rates. Actual mathematical computations were made by a computer program using methods described by Vincent (1971,1974, 1983).

FINDINGS

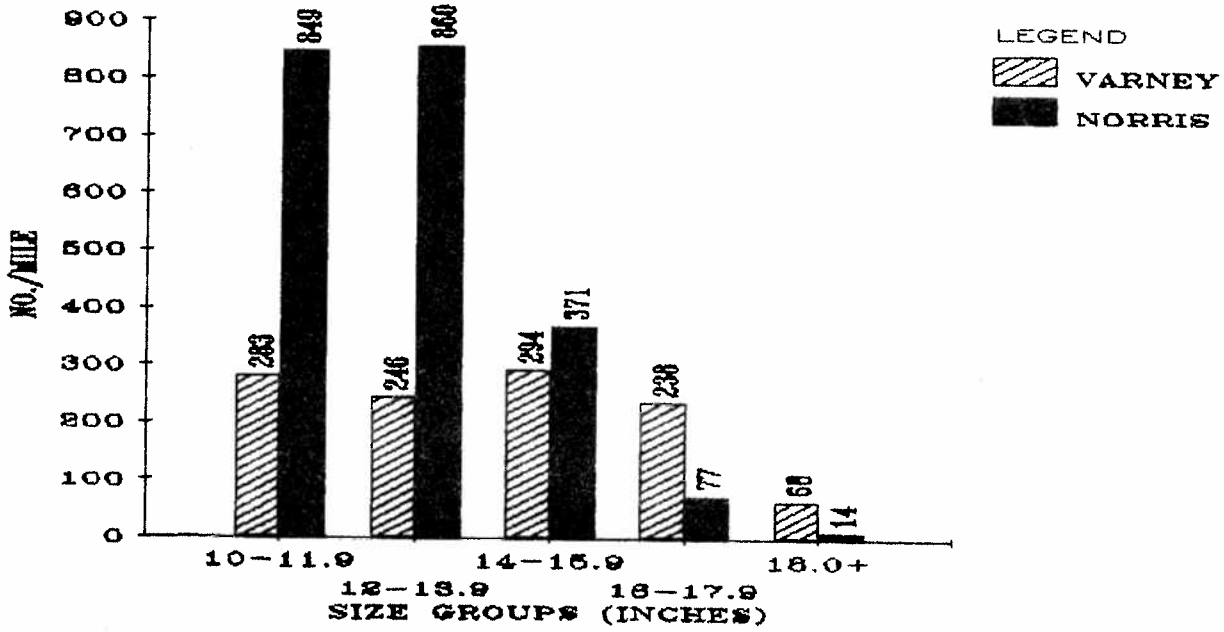
Comparison of water temperatures at stations above and below Ennis Reservoir for the April 1, 1986 through September 30, 1986 period showed that the lower study section (Norris) averaged 6.1 F higher than the upper Varney study section (Table 1). Vincent

Table 1. Comparison of average maximum, minimum and mean water temperatures for the April 1,1986 through September 30, 1986 period at the Varney and Norris thermograph stations(F).

Month	VARNEY			NORRIS		
	Maximum	Minimum	Mean	Maximum	Minimum	Mean
APRIL	45.7	38.2	42.0	48.8	44.5	46.7
MAY	50.1	41.6	45.9	54.8	48.5	51.7
JUNE	57.1	48.6	52.9	64.4	59.2	61.8
JULY	62.1	53.7	57.9	69.3	61.8	65.6
AUGUST	64.7	56.2	60.5	72.2	63.3	67.8
SEPTEMBER	55.0	49.5	52.3	56.6	51.8	54.2
AVERAGE	55.8	48.0	51.9	61.0	54.9	58.0

(1981) found the summer growth rates (inches) for the April-August period were 50% slower for 3-year-old and older brown trout and 57% slower for 3-year-old and older rainbow trout in the Norris section when compared with the Varney section rates Brett (1956) and (1967) determined that water temperatures above 65F and below 45F inhibited salmonid growth. The average temperature in the Norris section for the primary growth period (June-August) was 65.1 F versus 57.1 F for the Varney section. Some of the differences in the water temperatures above and below Ennis Reservoir was due to the reservoir's inhibiting the natural night cooling, thus passing on of higher than normal minimum temperatures.

Figure 2. Comparison of wild brown and rainbow trout sizes between the Varney and Norris sections using the 1986 population estimates. Size groups shown in inches.



Comparison of various sizes groups of wild brown and rainbow trout show that while the warmer Norris section had more smaller trout (<15.9"), the cooler Varney section had more larger trout (>16.0") with 18.0 inch and larger trout being 5 times more numerous (Figure 2). This difference in size composition was primarily due to the better growth rates in the Varney section as the Norris section had more brown and rainbow trout in every age group from two-years-old through five-years-old and older (Table 2). In 1986, the total number of two-year-old and older rainbow trout were 123% higher in the Norris section, while brown trout were 149% higher. Total pounds of wild two-year-old and older rainbow and brown trout were 42% and 39% higher respectively, in the Norris section. Although the Norris section had a larger number of wild trout in 1986, poorer growth rates reulted in less large wild trout than in the Varney section.

Table 2. Comparison of wild brown and rainbow trout populations between the Varney and Norris sections for 1986. The Varney section estimate was made in Sept. and the Norris section estimate in April. Section lengths were both 4 miles. Confidence intervals at the 80% level are shown in parentheses.

AGE GROUP	Rainbow Trout		Brown Trout	
	Varney	Norris	Varney	Norris
I	4314	---1	3660	---1
II	830	973	1304	1031
III	593	1394	943	1867
IV	276	1362	477	2009
V& older	195	495	254	2510
TOTAL NO	6208	4734	6638	7417
	(1097)	(835)	(1045)	(1128)
TOTAL WT (lbs)	2455	2503	4320	4905
	(444)	(500)	(932)	(741)

1 No yearling estimate due to insufficient sample size.

LITERATURE CITED

Brett, J.R. 1956. Some principles in the thermal requirements fishes. Quarterly Res. Biol., 31:75.

Brett, J.R., E. Shelbourn and C.T. Shoup. 1967. The relation of of temperatures and food ration to the growth rate of young sockeye salmon. Abstracts of paper at the Amer. Fish. Soc. 97th Annual Meeting, Sept. 13-15, 1967. Toronto, Canada. pp. 9-10.

Vincent, E.R. 1971. River electrofishing and fish population estimates. Prog. Fish. Cult. 33(3): 163-167.

Vincent, E.R. 1974. Addendum to river electrofishing and fish population estimates Prog. Fish. Cult.

Vincent, E.R. 1983. Madison River temperature study. Job progress report, Federal Aid in Fish and Wildlife Restoration Acts. Progress report F-9-R-30, Job II-c.

Prepared by: E. Richard Vincent.

Date: June 22, 1987

Waters Referred to: Madison River, 12-3440-01
Ennis Reservoir