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BETSIE RIVER WATER TEMPERATURE STUDY

GRASS LAKE WILDLIFE FLOODING

Melvin Bonham, Fisheries Habitat Biologist

SUMMARY

In 1973 and 1974, temperature conditions in the Betsie River were monitored to determine what effect, if any, the Grass Lake Wildlife Flooding has on the upper river. Although some differences were noted, it was concluded that modifications in the release from the flooding (or draining the flooding) would not be worthwhile because of already high temperatures where the river leaves Green Lake.

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INTRODUCTION

Duck and Green Lakes, Grand Traverse County, 1,900 and 2,000 acres respectively, form the headwaters of the Betsie River. From Green Lake, the Betsie River flows westerly into Benzie County, then south-westerly into Manistee County, and eventually enters Lake Michigan at Frankfort.

In 1951, the Grass Lake Dam (T25N, R13W, Sec. 2) was constructed in Benzie County approximately four stream miles below Green Lake. The resulting 1,145-acre impoundment, Grass Lake Wildlife Flooding, was formed to improve habitat conditions for waterfowl. Approximately 1,000 acres of the impoundment are less than two feet deep.

In the early 1970's, the Wildlife Division proposed that a complete drawdown of the impoundment, and habitat improvement work for waterfowl should be considered. This project would also make possible studies to determine the thermal effect of the flooding on brown trout populations in the Betsie River. As a result, Department Field Order No. 323 was issued in 1972 to authorize a drawdown for water temperature studies and habitat improvement work.

METHODS

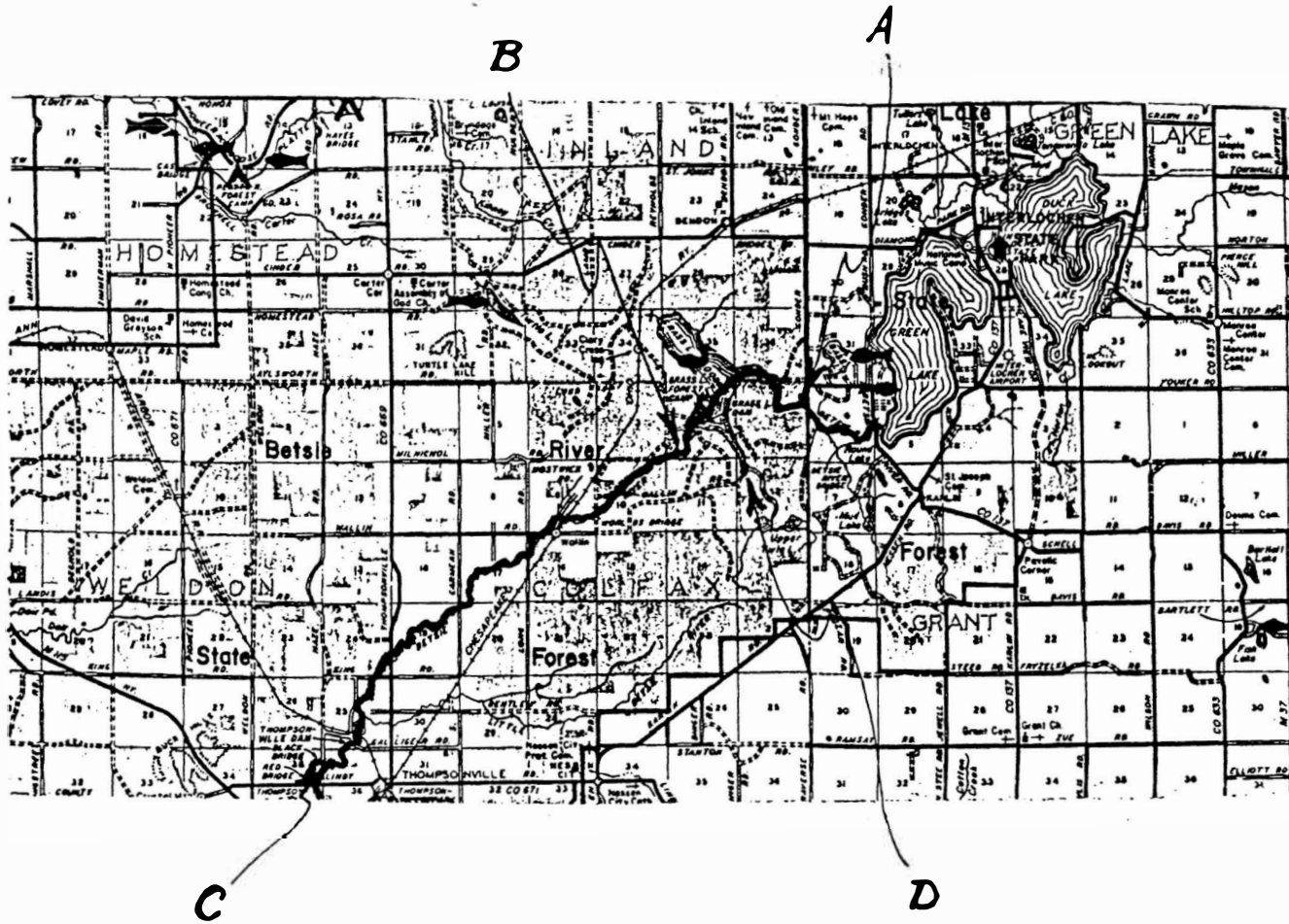
Water temperature studies were conducted in 1973 with the impoundment at full pool. In December, 1973, a slow drawdown began, making possible water temperature studies at low pool during the summer of 1974.

Taylor Recording Thermographs were used throughout this study to collect water temperature data. Field trips were required at approximately one week intervals to change thermograph charts and make the necessary temperature calibrations to the equipment.

Thermographs were located (Figure 1) above the Grass Lake Flooding and below the Grass Lake Dam throughout the summers of 1973 and 1974. In the early summer of 1973, one thermograph was located below the Thompsonville Dam. In August and September of 1974, another thermograph was located on Pickerel Creek, a tributary which has its confluence with the Betsie River just upstream of the Grass Lake Dam.

Methods used in this report for determining lethal temperature conditions for brown trout are derived from the report entitled "Water Quality Criteria 1972, Ecological Research Series, EPA. R-3.73 .033 March, 1973".

FIG. I. THERMOGRAPH LOCATIONS
 Betsie River Water Temperature Study
 Benzie County - 1973 & 1974



- A. Above Grass Lake Flooding - 1973 & 1974
- B. Below Grass Lake Dam - 1973 & 1974
- C. Below Thompsonville Dam - 1973
- D. Pickernel Creek - 1974

The report establishes that a brown trout population exposed to a seven-day average temperature of 74.3°F will have 50% of its members survive. This threshold temperature is referred to as the ultimate upper incipient lethal temperature.

The length of time that 50% of a brown trout population will survive temperatures above 74.3°F is the basis for determining short-term lethal temperature conditions.

RESULTS

Average evening high temperatures (Table I) at the station above Grass Lake Flooding did not differ significantly during the summers of 1973 and 1974. Below Grass Lake Dam, average evening high temperatures were also found to be quite similar in 1973 and 1974, although cooler (1.44°F lower in 1973 and 1.27°F lower in 1974) than those recorded at the upper station.

In 1973, with impoundment at full pool, average morning low temperatures were 2.51°F higher at the station below Grass Lake Dam than at the upper station. In 1974, with impoundment at low pool, average morning lows were only .5°F higher below Grass Lake Dam.

Average weekly stream temperatures below Grass Lake Dam exceeded the ultimate upper incipient lethal temperature given for brown trout once in 1973 and twice in 1974 (Table IIa - IIb).

In 1973, during the period of June 3 - July 7, the average water temperature at the station below Thompsonville Dam was 3.1°F cooler than the average temperature below Grass Lake Dam.

For the period of August 4 - September 4, 1974, average weekly stream temperatures on Pickerel Creek were identical to those calculated for the station below Grass Lake Dam.

Short-term exposure values (Table III) were exceeded 43 times in 1973 and 29 times in 1974 at the station below Grass Lake Dam.

CONCLUSIONS

Average evening high temperatures are not significantly increased by the presence of Grass Lake Flooding. Maximum heating of Betsie River water occurs in Duck and Green Lakes prior to reaching the impoundment.

The presence of Grass Lake Flooding maintains morning low temperatures in the Betsie River at an average of approximately 2°F higher than would otherwise be normal.

With the Grass Lake Flooding in both full pool and low pool conditions, values which exceeded the ultimate upper incipient lethal temperature and the criteria for short-term exposure were obtained.

It is felt that unless water temperatures can be reduced in the area above Grass Lake Flooding, alterations to the impoundment would have little value in relieving lethal temperature conditions.

TABLE I

COMPARISON OF AVERAGE EVENING HIGH
AND AVERAGE MORNING LOW TEMPERATURES
July 1 - August 31, 1973 & 1974

	Above Grass Lake Dam		Below Grass Lake Dam	
	1973 (Full Pool)	1974 (Low Pool)	1973 (Full Pool)	1974 (Low Pool)
Average Evening Highs	76.71°F	76.74°F	75.27°F	75.47°F
Average Morning Lows	67.56°F	67.90°F	70.07°F	68.40°F

TABLE IIa

AVERAGE WEEKLY STREAM TEMPERATURES
Betsie River
1973

PERIOD	ABOVE GRASS LAKE FLOODING	BELOW GRASS LAKE DAM	BELOW THOMPSONVILLE DAM
06/08-06/09		67.5	65.0
06/10-06/16		73.2	69.2
06/17-06/23		69.1	66.0
06/24-06/30		67.8	64.5
07/01-07/07		72.0	69.4
07/08-07/14	72.49	73.3	
07/15-07/21	72.0	73.1	
07/22-07/28	71.72	73.0	
07/29-08/04	70.18	69.8	
08/05-08/11	73.53	74.18	
08/12-08/18	73.5	73.8	
08/19-08/25	69.07	68.5	
08/26-09/01	75.07*	76.86*	
09/02-09/08	72.15	72.4	
09/09-09/15	64.93	64.2	
09/16-09/22	56.43	54.7	

*Equals or exceeds ultimate upper incipient lethal temperature.

TABLE IIb

AVERAGE WEEKLY STREAM TEMPERATURES
 Betsie River
 1974

PERIOD	ABOVE GRASS LAKE FLOODING	BELOW GRASS LAKE DAM	PICKEREL CREEK
06/09-06/15	64.36	64.5	
06/16-06/22	65.07	65.0	
06/23-06/29	67.93	67.3	
06/30-07/06	69.14	70.1	
07/07-07/13	74.36*	75.3*	
07/14-07/20	74.86*	75.2*	
07/21-07/27	72.58	72.7	
07/28-08/03	72.14	71.4	
08/04-08/10	72.15	70.9	70.79
08/11-08/17	72.22	71.5	71.43
08/18-08/24	72.86	72.1	72.0
08/25-08/31	70.21	67.8	67.86
09/01-09/07	65.57	60.7	60.72
09/08-09/14	66.57	66.1	66.15

*Equals or exceeds ultimate upper incipient lethal temperature.

TABLE III

SHORT-TERM EXPOSURE
OF TWO-YEAR OLD BROWN TROUT
TO EXTREME TEMPERATURES*

TEMPERATURE	LENGTH OF TIME IN MINUTES THAT 50% OF THE POPULATION WILL SURVIVE
75 °F	346.7
76 °F	151.4
77 °F	62.9
78 °F	26.6
79 °F	11.5
80 °F	4.8

*From Report Entitled "Water Quality Criteria 1972, Ecological Research Series,
EPA. R-3.73 .033 March, 1973"