AN EXAMPLE OF STATE AND FEDERAL COOPERATION IN ESTABLISHING WATER CONTROL FOR FISHERIES MANAGEMENT PURPOSES

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It is the purpose of this paper to set forth additional fishery values that can be obtained from multi-purpose projects through the cooperative efforts of the fish technicians on the staff of the Tennessee Game and Fish Commission and the representatives of the Corps of Engineers who built and operates Dale Hollow Dam on the Obey River and the Center Hill Dam on the Caney Fork River. Both of these projects located astride tributaries of the Cumberland River in north central Tennessee were built to control flood waters, to generate electric power, and to provide minimum flows in the Cumberland River at Nashville as a pollution abatement assurance. It must be remembered that Congress authorized expenditures for these projects based upon benefits that exceeded the costs. Dale Hollow and Center Hill Dams must be operated for the primary purposes of FLOOD CONTROL and POWER. Fishery benefits were not included in the justification before Congress and must be considered as secondary benefits. To the extent that secondary benefits can be adjudged compatible with the primary purpose then, and only then, can such benefits be captured. This paper explains how valuable public benefits were obtained from the impoundments above the dams and from the streams below each dam through close cooperation of state and federal agencies.

Dale Hollow Dam is located 7.3 miles above the mouth of the Obey River where it debouches into the Cumberland River. The Obey drains the dissected edge of the Highland Rim physiographic province and prior to the construction of the dam was generally clear stream but with very extreme flows—minimum flow of 14 cfs and a maximum of 50,000 cfs.

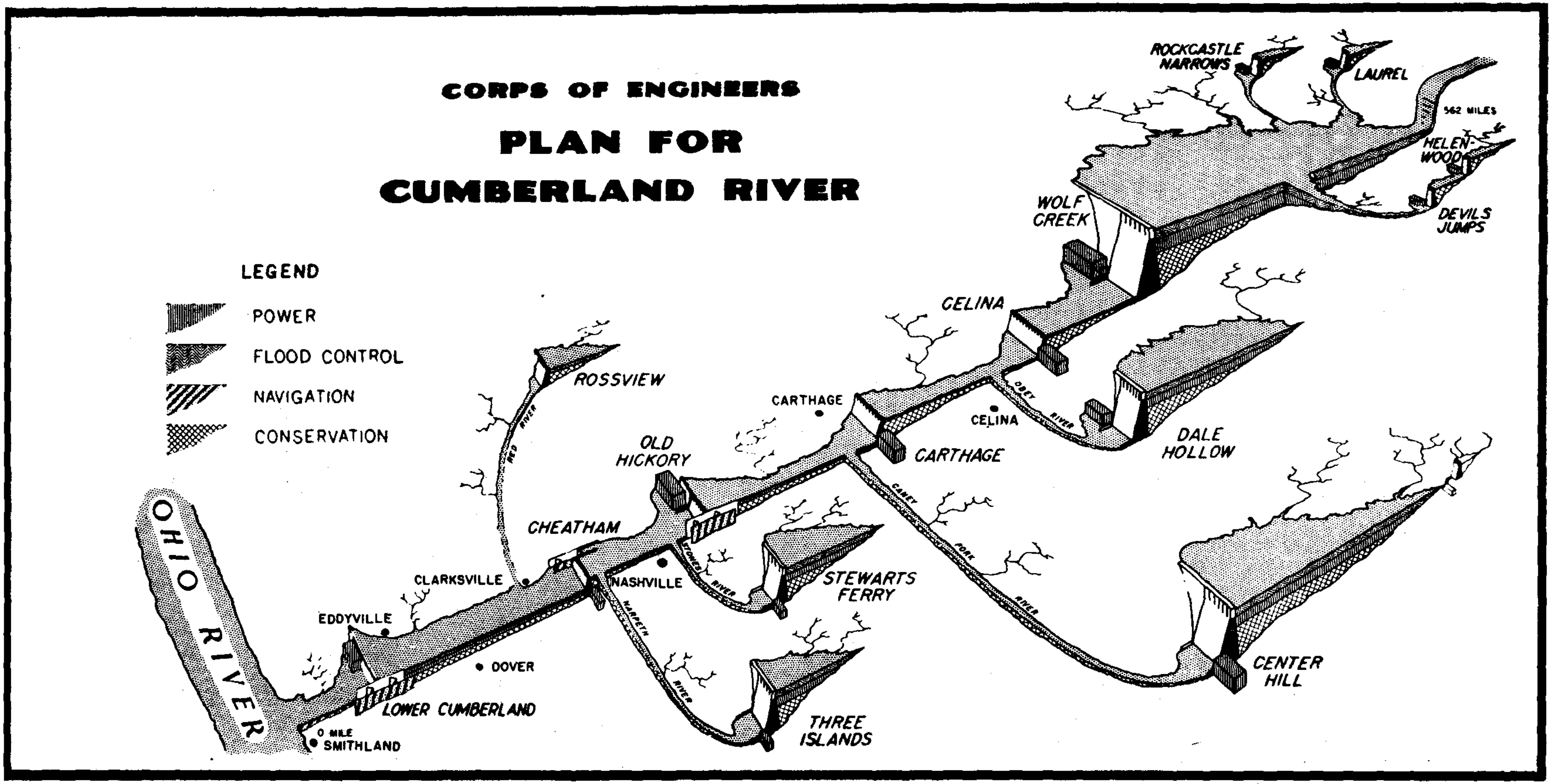
Center Hill Dam is located 26.6 miles above the mouth of the Caney Fork River where it empties into the Cumberland River. Like the Obey, the Caney Fork's drainage basin lies within the Highland Rim, but its flow is very much more erratic. The estimated minimum flow of record is 26 cfs with the maximum flow of approximately 178,000 cfs!

The erection of the dams eliminated the dangers of the very extreme flood flows and offered the opportunity to increase the minimum flows. The dams also changed drastically the temperature characteristics of both rivers below the structures.

A three-year fishery investigation on both Dale Hollow and Center Hill Reservoirs indicated that any new advances in fisheries management could best be obtained by water control or water management. This was demonstrated by two conditions that were created by usage of the reservoir water for hydroelectric power.

First, each year it as found that rapid draw downs of the pool level of Dale Hollow and Center Hill Reservoirs in June often left many bass nests stranded in shallow water or on dry land. Through the cooperative efforts of the Tennessee Game and Fish Commission, U. S. Army Corps of Engineers, and T. V. A., an annual water stabilization period was put into effect in 1953 in order that the draw down of the reservoir levels would be limited to a maximum of two feet during the principal bass spawning period.

Secondly, it was found that the discharge of water through Dale Hollow and Center Hill Dams was so infrequent in the summer and fall that suitable conditions for trout in the tailwaters below the dams were not generally maintained. The temperature of water discharged below both dams ranges from 46° to 57° F. Water shut-down periods of several days during the summer months below Center Hill Dam have allowed water temperatures to exceed


CORPS OF ENGINEERS
PLAN FOR
CUMBERLAND RIVER
LEGEND
POWER
FLOOD CONTROL
NAVIGATION
CONSERVATION
ROCKCASTLE NARROWS
LAUREL
562 MILES
HELEN-WOOD
DEVILS JUMPS
WOLF CREEK
CELINA
DALE HOLLOW
OBEY RIVER
CELINA
CARTHAGE
CARTHAGE
CANEY FORK RIVER
CENTER HILL
ROSSVIEW
RED RIVER
OLD HICKORY
CHEATHAM
STONES RIVER
STEWARTS FERRY
NASHVILLE
HARPETH RIVER
THREE ISLANDS
CLARKSVILLE
EDDYVILLE
DOVER
LOWER CUMBERLAND
0 MILE
SMITHLAND
OHIO RIVER

the trout tolerance level. Prior to 1954, stockings of trout in the 25-mile tailwater on the Caney Fork River have been unsuccessful. Water shut-downs from normal operations during the summer months below Dale Hollow Dam have resulted in water temperatures too high for trout in the lower half of the 7.3-mile tailwater. Through the cooperative efforts of the Tennessee Game and Fish Commission, the U. S. Army Corps of Engineers, and T. V. A., a minimum water discharge schedule was established below Dale Hollow and Center Hill Dams in 1955. The established minimum water discharges for each 48-hour period are 5 and 7 million cubic feet below Dale Hollow and Center Hill Dams, respectively.

The minimum water discharge made through the powerhouses to avoid waste of water has produced some of the results for which it was intended. The preliminary stocking of rainbow trout below Center Hill Dam in the fall of 1954 and spring of 1955 has provided for a sizeable fishery. Comparable fishermen counts have shown a fishing pressure increase of fifteen fold between 1952 and 1955. Based upon existing data, the Center Hill tailwater should support a minimum of 20,000 fishing trips per year.

The minimum discharge below Dale Hollow Dam has increased the available trout fishing waters by 100 percent. Based upon existing data, the Dale Hollow tailwater fishery should increase from 3,000 to 7,000 fishing trips annually.

The cold water discharge from Dale Hollow and Center Hill Reservoirs in Tennessee and Lake Cumberland in Kentucky have changed the Cumberland River upstream from Old Hickory Reservoir from a warm to a cold water stream. The minimum water discharge schedules below Dale Hollow and Center Hill Dams may provide the added advantage of establishing a trout fishery in certain portions of the Cumberland River as shown in the schematic sketch plan for development of the Cumberland River.

Although the values of the fisheries management brought about by the water control are important, great significance can be placed upon the cooperative efforts of the three agencies in determining and acting upon the critical features of water control. For this reason the basic problems concerning the control of reservoir water for fisheries management purposes will be discussed.

Reservoir pool stabilization and the realization of a great trout fishery potential in the tailwaters below Dale Hollow and Center Hill Dams were dependent upon the control of water at the times and as specified by the Tennessee Game and Fish Commission. The control of the water for these projects was possible only if the demands were consistent with the primary purposes of the reservoirs, *i. e.,* flood control and hydroelectric power. Hydroelectric power generated at Dale Hollow and Center Hill Dams is marketed by the Tennessee Valley Authority and they regulate the release of water for power purposes. Impounded water, therefore, has a very real dollars and cents value.

The fisheries management problems were presented to the U. S. Army Corps of Engineers by representatives of the Tennessee Game and Fish Commission and a solution was proposed. The proposals were found to be in harmony with the primary purposes of the reservoirs. The U. S. Army Corps of Engineers in cooperation with the Tennessee Valley Authority decided that the pool stabilization and minimum water discharges below the dams could be effectuated without waste of valuable water.

The U. S. Army Corps of Engineers is now cooperating with the Tennessee Game and Fish Commission in evaluating the fisheries benefits of the water control schedules. Further water control recommendations for fisheries management purposes and public benefits will be given consideration as they are proposed.

It is not easy to find a solution to all water control and fisheries management problems on Dale Hollow and Center Hill Reservoirs. However, we and the agencies we represent believe that a sincere desire on the part of all agencies concerned will often produce the desired public benefits.

THE INFLUENCE OF CERTAIN ENVIRONMENTAL FACTORS ON THE GROWTH OF NORRIS RESERVOIR SAUGER, "Stizostedion Canadense Canadense" (SMITH)

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INTRODUCTION

The influence of natural conditions upon the growth and abundance of fish populations is seldom evaluated. The lack of such information results usually from the fact that few research projects are continued long enough to collect sufficient data on fluctuating environmental conditions. In other instances an insufficient amount of limnological and meteorological data have been recorded on projects of long duration. In other cases the environmental data have only been recorded during the summer months.

The current use of fishery management techniques such as population manipulation or environmental alteration also increases the need for more information about the effects of variable environmental factors on fish growth and abundance. Valid conclusions from these techniques require that other sources of variation be recognized and estimated. Otherwise, management techniques may be deemed responsible for effects which resulted primarily from environmental changes.

In this paper a few of the factors which the field biologist may have to contend with are discussed. The discussion is, for the most part, incomplete. However, the main purpose of the paper is to create an awareness of these factors.

FIRST-YEAR GROWTH OF SAUGER IN NORRIS RESERVOIR

An age and growth study of 3,393 Norris Reservoir sauger taken over a 13-year period revealed different rates of growth for the various calendar years (Table I). In an effort to determine possible causes for these variations, the limnological and meteorological data which were available for the 13-year span were examined. These data were evaluated in respect to the first-year growth rates of the sauger by means of correlation analysis. The first-year growth rates of the sauger were selected for the following reasons:

(1) The greatest increments in length occurred during the first year of life and it was believed that these increments would best indicate any changes in the annual growing conditions. The multiple effects of several years of growth are also avoided.

(2) These increments were independent of growth incurred in other years. It was found that the growth of the second year was inversely correlated with the growth of the first year.

(3) There was no statistical difference in the standard length of the males and females for the first year of life. The first-year growth rates were similar in the various regions of the reservoir. Genetic differences were not apparent.

THIRTEEN YEAR WATER TEMPERATURE RECORD OF NORRIS RESERVOIR, TENNESSEE

Water temperature data for the 13 years of Norris Reservoir history investigated in this paper were available from the Hydraulic Data Division and the Fish and Game Branch of the Tennessee Valley Authority. Water temperatures of 60° F. were used to demarcate the length of the sauger growing season. Table II gives the approximate date in the spring when the water in the upper part of Norris Lake first attained a temperature of 60° F. at a depth of 0.5 foot. Similar information is presented in this table for the fall season. The elapsed time in days between these two dates is also given for each year.

It was surprising to find that a temperature of 60° F. or higher (at 0.5 foot) occurred in Norris Lake for an average of 30½ weeks a year for the 13 year