A PRELIMINARY REPORT ON THE INVESTIGATIONS OF WATERS BELOW STORAGE RESERVOIRS

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The present investigation of waters below storage reservoirs began in January, 1951. At that time Dr. Willis King, former Chief of Fish Management Section of the Tennessee State Game and Fish Commission undertook, through the present project leader, the preliminary studies. On July 1, 1951 this investigation became one of the Dingell-Johnson projects and is being continued in its entirety with very few changes. The project is now in its second year.

This paper is presented at this time for the purpose of bringing to the attention of fisheries workers in the Southeast the unique problems involved in waters below high, tributary stream dams. The Tennessee Valley Authority has constructed a large number of these reservoirs and as has been expected, changes have taken place that have had considerable effect on the ecology of the streams. The changes that have taken place on the reservoir side of the dams are familiar enough to everyone. The changes down stream from the dams have been just as pronounced but far less understood. The object then of this project is to bring to light all of the facts possible on the water below the dams, or the tailwaters.

At the present time ten tailwaters are being studied. Some are receiving more attention than others but all have had some special attention. The areas under investigation are:

1) South Holston Dam on the South Fork of the Holston River
2) Watauga Dam on the Watauga River
3) Wilbur Dam on the Watauga River
4) Cherokee Dam on the Holston River
5) Norris Dam on the Clinch River
6) Calderwood Dam on the Little Tennessee River
7) Apalachia Dam on the Hiwassee River
8) Douglas Dam on the French Broad River
9) Dale Hollow Dam on the Obey River
10) Center Hill Dam on the Cancy Fork River

Within a year two additional dams will be completed on the South Fork of the Holston River, the tailwaters of which will fall into the same category as the dams mentioned above.

Prior to the construction of these dams the rivers were warm-water streams. They varied considerably in character but most of them were made up of much turbulent water. They supported the usual populations of warm water species of fish. Most were excellent small-mouth bass waters. Large-mouth bass existed in all of them in good to fair populations. Some of them were outstanding for the catches of walleye. Little Tennessee River was a noted walleye stream. Rock bass were abundant in the streams in East Tennessee. Cat fish were important in all of the streams. The streams also supported a large and varied minnow population.

After construction of the dams none of these fish found conditions suitable for spawning. The individuals that were present remained for varying lengths of time and eventually died out as a fishable population. Certain migratory species continue to return to the tailwaters during their spawning runs, providing some fishing, but these are periodic at best. For the fisherman then, the tributary stream dam reduces the available fishing water within about five years after the dam is constructed. Therefore it behooves the Game and Fish Commission to restore a suitable fishery to this water. This is, then, the ultimate purpose of this project.

The first and most pronounced effect the dam has on its tailwater is a general lowering of the temperature of the water. This is made evident by a reduction of the extremes of temperature range. Where the water at one time reached a maximum of 80 - 85°F and a minimum of 32 - 34°F, it now has an average range from 39 - 65°. The annual average is usually between 50° and 55°F.

The second noticeable effect is in the more uniform monthly water flow. The tailwaters no longer have the normal prolonged low water periods of late summer and fall. The controlled discharge from the dam produces about the same average cubic foot seconds of water in one month as another. Actually the smallest discharge occurs during the periods of greatest precipitation. This in spring for most TVA tailwaters. In direct contrast to this, however, is the daily fluctuations that may occur. The water can be controlled to such an extent that within a few seconds the discharge can be changed from several thousand cfs to no discharge at all or vice versa. Usually this change takes place over a period of several hours.

Let me illustrate with one example what actually takes place periodically and is typical at all TVA powerhouses. At Cherokee Dam the maximum discharge is 9500 cfs. When this powerhouse is shut off there is no flow except that small amount that seeps through the dam, about 20 to 30 cfs. If a sudden load of electricity is needed due to a failure at some other dam, Cherokee will automatically begin discharging a full load, 9500 cfs. The total load is picked up in eight seconds. If all of this load is not needed then a gradual reduction in volume takes place. Imagine, if you will, what 9500 cfs of water looks like when it is discharged in eight seconds. It is not only disastrous to fish eggs and has a tendency to relocate fish populations but it can also be annoying to fisheries biologists who may be in the river at the time or have nets set in the river.

The powerhouses are usually shut off at night and on weekends when the electrical demand is low. This weekend shut-down is important to the fisherman since the low water has a tendency to concentrate the fish and the river is more easily fished during low water conditions. Much of the biological work that is done on the tailwaters has to be accomplished during these low water periods and it is extremely important to both fisherman and biologist to keep a weather eye out for those sudden discharges.

Some of the ecological changes have already been mentioned in the fish populations. Other changes are just as drastic, for example, whole insect populations are changed. Here the effect is somewhat different. When one species of insect disappears another may take its place. This is, of course, a result of the greater adaptability of the insects over that of the fish. It has been possible to follow only one tailwater from pre-impoundment to post-impoundment conditions as far as insect populations are concerned. This has taken place below South Holston dam where it was possible to make collections before water was discharged from the dam. The effect has not yet run its full course, but more definite changes have already been noticed. The most outstanding change is the disappearance of hellgramites and the appearance of simuliids and chironomids. This change has been noticed throughout all of the study areas. In the case of the truly aquatic orders of insects there have been species changes with little effect in the overall individual count. This effect will never be fully understood, but by comparing species compositions of waters that have not been altered with those in nearby tailwaters, this has been the case.

In order to understand the present ecological conditions in the tailwaters, the following investigational procedure has been followed. Monthly readings were taken at each tailwater to determine the dissolved oxygen content, the alkalinity, dissolved carbon dioxide content, pH, water color, and temperatures. Quarterly determinations have been made on the fish populations, insect and other invertebrate populations and plant populations. Daily and monthly water flow data have been recorded. Data have been collected and analyzed from other agencies such as the TVA Water Sanitation Division and water works plants. These have all been in the nature of water chemical data. Stratification determinations have been made on some of the reservoirs above the tailwaters in order to more fully understand the reasons for conditions existing in the tailwaters. These stratification determinations have been very enlightening but time on the project has prohibited further studies in this direction.

Progress on this project has been both encouraging and very discouraging. The drastic flucuations and, at times, prolonged discharges of water make routine work impossible. One must work when conditions are right and take advantage of every opportunity or the opportunity may not present itself again for another year. This is true, of course, in any biological work but it seems to the project leader, at least, that it is more pronounced in tailwaters work. Time will not permit a detailed account of the progress and findings, but since it will be presented in full later it is felt necessary to limit it here.

Along with the fish population studies, experimental management and stocking has been undertaken. It has been pointed out that the tailwaters have become colder and it was only natural that trout be considered as a possible species to establish in the tailwaters. Trout have already been stocked and with great success. All three species of trout normally carried in hatcheries in this section of the country have been used. To date the rainbow trout has been most successful. This success can best be illustrated by the following. In 1948, prior to the time of this project, more than 100,000 fingerling rainbow trout were planted in Little Tennessee River below Calderwood Dam. In the spring of 1950, limits (10 trout) of two and one-half- to four-pound trout were being caught. Again, rainbow trout stocked in Dale Hollow tailwater in August 1950, at a maximum length of 6 inches grew to a maximum length of 20 inches (4.0 pounds) by November 1951 and a maximum length of 22½ inches (5.25 pounds) by May 1952, a total time period of 21 months. The same results have occurred in several other tailwaters. There are some tailwaters which have not produced such excellent growth but it has still been greater than that of the average small mountain trout stream. All of the trout stocked prior to the beginning of this project were unmarked, and it was hard to believe that such phenomenal growth actually occurred. Today, however, as many trout as possible are being marked by tagging and fin clipping. By this practice, much more concrete data will be obtained. Plans for next spring have been made to mark 200,000 trout for release in the tailwaters.

Since the size of trout taken from the tailwaters are large and since natural reproduction at present is believed to be limited, it is feasible that a lower limit in numbers should be placed on the trout in some of the areas. This can be accomplished in two ways. One is by establishing a weight limit and the other is to simply establish the limit at a figure lower than the present ten fish. In some tailwaters the trout can be harvested rapidly while in others it will not be necessary to have a reduction in limit since it will be impossible to take a major percentage of the stocked population in any one or two years.

It must be remembered that even though the water chemical and temperature are quite uniform throughout the tailwaters, each is an individual and should be treated as such.