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REVIEW OF COLDWATER FISH MANAGEMENT IN TAILWATERS

by

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ABSTRACT

A trend in the stocking procedure of trout in tailwaters has developed as an outcome of increasing fishing pressure. Fingerling stocking of trout was initially recommended in tailwaters where an adequate food supply was available, and predation by predatory fish was not considered a problem. Eventually, fishing pressure increased and the fingerling trout were harvested before reaching a desirable size necessary to maintain a quality put-grow-and-take fishery. Consequently, stocking of larger catchable-size trout was resorted to; this procedure resulted in a quality put-and-take fishery. Several basic concepts pertaining to the development of trout fisheries in tailwaters were conceived after intensive investigation. The fishing pressure and harvest must first be known in order to stock trout at a proper rate and at the proper time to sustain a quality fishery. One technique that has had a great impact on the harvest in tailwaters that are relatively inaccessible to bank and wading anglers is the development of boat fishing. The major problem of most tailwater trout fisheries is that of erratic flow; a more sustained flow would provide better fishing conditions, alleviate periods of low-dissolved-oxygen levels and elevated water temperatures that are detrimental to trout, and prevent periods of high flow that can retard bottom fauna productivity and consequent trout growth.

INTRODUCTION

With the advent of multilevel intake structures in dams, the tailwater fishery can be manipulated by the selection of desirable water temperatures for the discharge, whether it be for the management of warmwater fishes, or coldwater fishes, or both. One of the first dams to be constructed (by the U. S. Corps of Engineers, Louisville District) with the capabilities of selective withdrawal was Nolin Dam, in 1963, on the Nolin

River in Kentucky. The Nolin tailwater is presently being managed for a put-and-take rainbow trout *(Salmo gairdneri)* fishery. Such an intake system has allowed states the opportunity to create a trout fishery in areas that previously had no trout habitat. Prior to 1963, tailwaters that were suitable for trout resulted from high dams, the construction of which restricted withdrawal from low depths in the lake. Several Tennessee Valley Authority (TVA) dams in Tennessee were built with a low-level intake that caused a drastic change in aquatic life downstream. A trout fishery was developed below these dams to replace the warmwater fishery that could not tolerate the cooler water termperatures. Knowledge of the intricacies involved in developing a coldwater fishery in a tailwater to its ultimate potential has expanded tremendously in recent years. It is the purpose of this paper to present some of this knowledge and provide a means to acquire additional information by those who are involved with management of salmonids in tailwaters.

DISCUSSION

Since the construction of Norris Dam (the first high dam with a low-level discharge) in 1937 by the TVA on the Clinch River in Tennessee, the development of a trout fishery in tailwaters has expanded throughout the country to become a vital part of the coldwater fishery program in many states, particularly in the Southeast. In coexistance with this growth, tailwater management concepts of salmonids have evolved. Recent findings, in fact, have been produced from a study that is currently in progress on a 22.5-km (14-mi) section of the Clinch River below Norris Dam.

A cooperative study involving the Tennessee Wildlife Resources Agency, TVA, and the U. S. Fish and Wildlife Service was initiated in 1971 to evaluate the potential of the Norris tailwater as a trout fishery. During the past 3 years, allotments of trout averaging 96 (3.8), 239 (9.4), 152 (6.0), 150 (5.9) and 198 mm (7.8 in) (fork length) have been released into the Norris tailwater with various rates of success. Results of the 97-mm (3.8-in) fingerlings stocked in March 1971, indicate that this particular group of fish better utilized the resources in regard to growth and condition than catchable-size trout that were stocked in July (Boles, 1974*). The 1971 fingerling stocking also contributed appreciably to the 1973 catch to signify good survival. Predation on fingerling trout was not a significant problem, apparently.

It has often been assumed that by uniformly distributing trout in a tailwater, rather than stocking all of the trout at a single site, a more evenly distributed catch throughout the tailwater over a longer period of time would result. However, Boles reported that a group of trout stocked at a single site 8.4 km (5.2 mi) below Norris Dam and the dispersal of another group over the entire length (14 mi) of that tailwater provided a similar distribution of catch.

Trout in the Norris tailwater fed primarily on aquatic insects, but algae was also contained in all of the trout stomachs sampled (Boles, 1974). Pfitzer (1965) stated that algae was very abundant below TVA dams having a coldwater discharge, including the Norris tailwater. Pfitzer also stated that if it were not for the success of rainbow trout, the tailwaters below these dams would be very unproductive. The trout fishery below Norris Dam has a greater potential but is presently limited by the fact that no provision for uniform releases is scheduled for fish management. Frequent, high flows discourage fishing for trout and decrease benthos productivity (Hill, TVA*), while low-oxygenated water during the fall months retards trout growth and lowers their condition. The oxygen problem could be corrected by any of several methods which are described by Ruane (1972) if any were economically feasible. Reaeration experimentation is underway by the TVA Hydraulics Branch, the results of which may be applicable in the Norris tailwater situation and in other tailwaters having a similar oxygen problem.

*Personal communication

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Another tailwater trout fishery that has been developed by stocking primarily fingerling and subcatchable rainbow trout, in addition to some adults, is located below Dale Hollow Dam on the Obey River in Tennessee. Growth potential was utilized by stocking fingerlings which were reported to have had an average growth rate of 18 mm (0.70 in) and 23 g (0.05 lb) per month in 1964 (Little, 1967). Trout stocked as catchables were being caught as such a rapid rate that their monthly growth rate could not be determined. Cladocera coming through Dale Hollow Dam were the main food of trout, occurring in 90.1% of all trout examined.

High water temperatures that would have been detrimental to trout were of concern during prolonged shutoff periods in the summer, but an agreement with the U. S. Army Corps of Engineering assured a release of at least 177 million m^3 (4 million cf) during an 48-hour period to maintain suitable temperatures in the Dale Hollow tailwater. During these shut-down periods when the water was very low, the entire tailwater could be fished from the bank or by wading. Trout were released when generators in the dam were in operation, to aid in trout dispersal. Returns of fingerling stockings from 1964-1967 were 60.7%, compared to 77.0% return from adult stockings. A 90% increase in fisherman trips was recorded from 1964-65 to 1965-66, explained by the fact that comparatively more trout were stocked the second year to improve fishing quality. Recommendations were to annually stock 90,000 fingerling rainbow trout during every third month, beginning in March, with a maintenance stocking of 500 catchable-size trout between May and August to lessen the fishing pressure on fingerlings. A net economic gain of $161,367.72 was generated by the fishery during the 1964-1967 study.

The study is being reactivated in 1974 to determine the influence that Cordell Hull Lake will have on the Dale Hollow tailwater, which is now completely inundated when the lake is at summer pool. Most of the lake, which impounds a 117.5-km (73-mi) section of the Cumberland River, is coldwater fishery habitat all year due to coldwater releases from Dale Hollow Lake and Lake Cumberland. To more fully utilize this newly-created coldwater environment, a coho salmon *(Oncorhynchus kisutch)* stocking program was initiated in 1973, during which time 25,000 127-mm (5-in) coho were released into the Dale Hollow tailwater. It is hoped that coho will mature in Cordell Hull and, at maturity, return to the tailwater where they were imprinted, providing a short-but-spectacular fishery in the fall and winter months.

A tailwater fishery that was established by stocking 152-203-mm (6- to 8-in) brown and rainbow trout, but is now being necessarily stocked with 229-mm (9-in) trout to sustain the fishery, is the White River below Bull Shoals Dam in Arkansas. Trout grew at the phenomenal rate of 23 mm (0.90 in) per month during 1955 to 1958 (Baker, 1959). Water temperatures were then considered the limiting factor until the U. S. Corps of Engineers agreed to provide water temperatures below 21.1°C (70°F) for the tailwater. Later, another factor that had a great impact on the fishery was fishing pressure. Approximately 95% of the trout that are annually stocked are caught. Most of the pressure is exerted by boat fishermen: 79% in 1955 and 93% in 1957. Because of heavy usage, the trout fishery is presently being bolstered by stocking 229-mm (9-in) trout. A larger-size fish was essential to withstand increased fishing pressure and maintain a quality fishery. What once was a put-grow-and-take trout fishery is now virtually a put-and-take fishery. A greater-than-usual number of residual trout began to appear in the creel in 1974; they were suspected to have escaped from Bull Shoals Lake, when their habitat became restricted in the late summer of 1973.

The Lower Willow River, below an impoundment in Wisconsin, is another example where adult trout were eventually stocked in place of fingerlings. Fingerling brown trout *(salmo trutta)* were stocked in the fall for several years, but evaluation of the fingerling stocking resulted in a recommendation to spring-stock legal-size (152 mm) brown trout (Frankenberger, 1969). Larger trout were preferred because they would be less expensive to provide, considering the low survival (11.6 - 40.1%) of fingerlings overwinter, and would offer the angler a larger fish.

Fingerling stocking is not feasible in certain tailwaters because predation losses result in a low survival rate. The Little Tennessee River below Chilowee Dam in Tennessee is a tailwater where this is true. From a fingerling plant of 104-mm (4.1-in) (fork length) rainbow trout during June and July 1964, only 0.18% were creeled (Boles, 1968). The disappearance of these fish coincided with the sauger run which began in November. A better return (20.3%) was experienced from a second group of fingerlings that averaged 122 mm (4.8 in) when stocked in April and May 1965. By releasing fingerlings into the tailwater earlier in the year, these fish were vulnerable to angling pressure over a longer period of time and more time was allowed for them to grow before the sauger run; even so, the harvest did not compare favorably with the harvest from stocking catchable-size rainbows. Plantings of 208- to 221-mm (8.2- to 8.7-in) trout in February, April, and June 1965 resulted in different rates of harvest. The February stocking had a return of 86.2% in 224 days; the April group returned 73.3% for the first 38 days and 4.4% during the following 121 days; trout stocked in June were creeled at a rate of 66.4% after 17 days and 29.3% during the next 91 days. Additional stockings in the late fall or winter were deemed unwarranted because of subsiding fishing pressure and inefficient harvest. Boat fishing was more popular than was bank fishing or wading. During the 1964-65 creel survey, boat fishermen expended 53% of the effort and they caught 55% of the fish. The trout fishery during the survey period was credited with contributing $70,646.30 to the economy.

A stocking program on the Chilhowee tailwater was recommended as a result of the success of catchable-size trout in 1965, which included monthly introductions of catchable rainbows from February through July. It was believed that more frequent releases of trout during the summer months would provide a better distribution of catch to the fishermen.

Stocking of fingerling and subcatchable rainbow trout was also reported to have little impact on the harvest below Glen Canyon Dam in Arizona (Stone, 1971; 1972). The fishery was primarily supported by releases of 229- to 267-mm (9- to 10.5-in) trout. A 44% reduction in catch was observed in 1972, although fishing pressure had increased and the stocking schedule that year was nearly the same as in 1971. The drastic decline in trout harvest was attributed to the lack of trout recruitment into the tailwater from Lake Powell. Trout were not stocked into the lake in 1970. A similar instance where a tailwater fishery relied on recruitment of trout from the dam was reported by Hanson (1969) when describing the Lake Taneycomo tailwater in Missouri.

The establishment of a put-and-take trout fishery is being considered below a dam that is to be constructed in the near future on the West Fork River, tributary to the Monongahela River, in West Virginia. A good population of warmwater fishes that includes muskellunge *(Esox masquinongy)* now exits in the river. With the inclusion of a multilevel intake in the dam, it may be possible to create suitable habitat for trout immediately below the dam without having a detrimental effect on the warmwater fishery.

In some southeastern states, public trout fishing would be non-existent were it not for tailwaters below high dams. The state of Texas did not have a coldwater fishery open to the public until 1966, when rainbow trout were initially stocked below Canyon Dam to provide a put-and-take fishery (White, 1968; 1969). There is no tailwater management of salmonids in Alaska because, as was stated in reply to my questionnaire, Alaska is "blessed without dams." However, Alaska may in the future be involved with the tailwater management of Arctic grayling *(Thymallus arcticus)* at a proposed U. S. Corps of Engineers project near Fairbanks.

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FACTORS AFFECTING THE VERTICAL DISTRIBUTION OF WHITE CRAPPIE *(POMOXIS ANNULARIS)* IN TWO OKLAHOMA RESERVOIRS

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ABSTRACT

Mean depth of capture of the white crappie in horizontal, bottom set gill nets in Arbuckle Reservoir in 1973 was not statistically different from that in this reservoir in 1974, or from that in Eufaula Reservoir (determined by collection in vertical gill nets) in 1968. The white crappie depth distribution was generally similar in these two reservoirs, and there was a seasonal cycle of distribution related primarily to changes in temperature and dissolved oxygen. Lake Arbuckle was acutely stratified by midsummer of both years. Stratification in this reservoir appeared to force white crappie into the thermocline but anoxic conditions excluded them from the hypolimnion. In Eufaula Reservoir, white crappie were distributed deeper when surface temperatures increased but their depth distribution was not limited by anoxic water. White crappie were found nearer the surface in the fall when surface water cooled.

INTRODUCTION

The white crappie *(Pomoxis annularis)* is a valuable game fish in reservoirs of the southeastern U.S. In Oklahoma it has been more widely sought after than any other Oklahoma fish (Wilson 1951). Various aspects of the biology and depth distribution of the white crappie in Oklahoma reservoirs were reported by Carter (1967), Dowell (1956), Grinstead (1969), Whiteside (1964) and Wilson (1951). In Tennessee, studies by Dendy (1945, 1946) indicated that the depth distribution of fish appeared related to dissolved oxygen and temperature profiles. In the Tennessee study, the publication in local newspapers of current information on fish depth distribution (Dendy 1948), apparently helped sport fishermen increase their catches. Some observers reported that white crappies congregate in loose aggregations at certain depths at various times of the year (e.g., Grinstead 1969).

[1]Cooperators are the Oklahoma Department of Wildlife Conservation, the Oklahoma State University and the U.S. Fish and Wildlife Service.