HISTORICAL REVIEW OF THE BULL SHOALS DAM AND NORFORK DAM TAILWATER TROUT FISHERY

By ROBERT F. BAKER
Arkansas Game and Fish Commission
Mountain Home, Arkansas

ABSTRACT

Beginning with a stocking of 600 four- to six-inch rainbow trout in 1948 in the Norfork Dam tailwater located in North Central Arkansas, a fishery soon developed which was entirely new to the area.

With the completion of Bull Shoals Dam in 1952, investigations began which soon showed that the native fishery was destroyed for many miles below the high dams. A trout stocking program carried on in conjunction with an investigational project produced such excellent trout fishing that the area became nationally famous within a few years, and a modern trout hatchery was constructed just below Norfork Dam by the U. S. Fish and Wildlife Service for the purpose of producing trout for stocking the White River and its tributaries. By 1957 trout were being stocked in 91 miles of tailwater streams which supported 47,792 man days of fishing, generating $684,732.00 worth of business to the fishing service operators alone.

NORFOLK DAM TAILWATER

After the completion in 1944 of the 220-foot high Norfork Dam on the North Fork of White River in the Ozark mountain region of North Central Arkansas, it was obvious that the four and one-half mile tailwater section of stream from the dam to it's confluence with the White River would no longer support the native warm water species. This was due to the fact that the dam discharged abnormally cold water from the bottom stratum of the 22,000-acre lake.

In 1948 the possibility of establishing a trout fishery was investigated and 600 four- to six-inch rainbow trout, *Salmo gairderii*,* were obtained from the U. S. Fish and Wildlife Service Hatchery at Neosho, Missouri, and experimentally stocked in the Norfork tailwater.

The stocked fish showed excellent survival and growth, and within one year two- to three-pound trout were being caught, and by the end of the second year six- to eight-pound fish had been taken.

In 1949, brown trout, *Salmo trutta,* were introduced. From 1948 to 1951, a total of 19,400 brown and rainbow trout, ranging in size from four to nine inches, had been stocked.

In the fall of 1950, a rotenone sample was carried out by personnel of the U. S. Fish and Wildlife Service and the Arkansas Game and Fish Commission during a low water period when the turbines were shut down at the dam. The sample indicated that the stream population was made up of redhorse suckers, *Moxostoma* species; hog suckers, *Hypentelium nigricans;* bluegill sunfish, *Lepomis macrochirus;* green sunfish, *Lepomis cyanellus;* longear sunfish, *Lepomis megalotis;* miscellaneous minnows and trout. The trout, all rainbow, ranged in size from seven to twenty-six inches with the largest weighing eight pounds.

By 1952 North Fork River was becoming known throughout the area for its trout fishing and many resident and non-resident fishermen were observed on the stream.

The nature of the stream bottom varies from bedrock to boulders, small rock and gravel. Much of the bottom material is rubble or gravel which is ideal for the production of large quantities of aquatic insects, isopods, amphipods and crawfish.

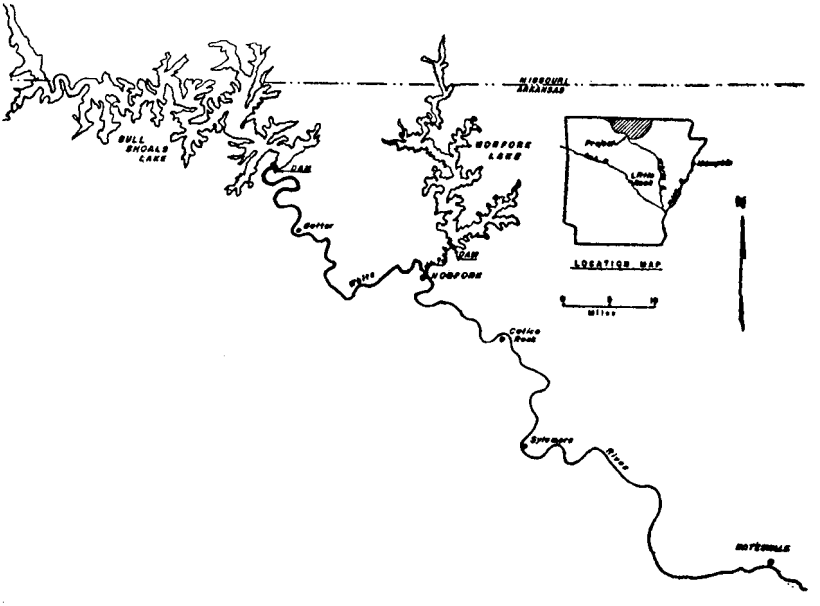
* Nomenclature recommended by the Committee on Common and Scientific Names of Fishes, Special Publication No. 1, American Fisheries Society, 1948.

The pools which compose about sixty percent (60%) of the stream are broken by extended rapids and riffles. Some of the rapids are very dangerous to fishermen that are not experienced in handling boats in fast water.

BULL SHOALS DAM TAILWATER

In 1951 Bull Shoals Dam, a 258-foot high dam impounding a 45,440-acre lake on the White River, located just twenty (20) miles northwest of Norfork Dam, was nearing completion (Figure 1), and since that stream was very similar but larger than the North Fork of White River, studies were begun on the tailwater to determine whether or not it would support trout, and to what disance downstream trout could be expected to survive.[2]

Seven stations were set up along the streams where chemical data and water temperatures were recorded twice each month from June, 1951, to January, 1958. Location of stations are: No. 1, immediately below Bull Shoals Dam; No. 2, Cotter, 17.7 miles below Bull Shoals Dam; No. 3, Shipps Ferry, 37.3 miles below Bull Shoals Dam; No. 4, immediately below Norfork Dam on the North Fork of White River; No. 5, Norfork, 4.5 miles downstream from Norfork Dam; No. 6, Calico Rock, 69.5 miles below Bull Shoals Dam; and No. 7, Sylamore, 86.5 miles below Bull Shoals Dam.



On January 1, 1958, temperature, and chemistry runs were reduced to once each month, and stations 1, 3, 4 and 7 were discontinued. Recording thermometers were installed at Cotter, Calico Rock and Batesville, 118.8 miles below Bull Shoals Dam.

DISCUSSION

Table I shows the average as well as maximum and minimum temperature and chemical data collected on White River from Bull Shoals Dam to Calico Rock prior to the impoundment of Bull Shoals Lake.

Table II shows the average as well as the maximum and minimum temperature and chemical data for North Fork River during the same period as in

† These studies were carried on as a part of Arkansas' Dingell-Johnson Project F-1-R until July 1, 1955, at which time D-J Project F-3-R, "A Survey of Possible Development of a Trout Fishery in Arkansas", was begun.

TABLE I

AVERAGE, MAXIMUM AND MINIMUM TEMPERATURE AND CHEMICAL DATA COLLECTED ON WHITE RIVER BELOW BULL SHOALS DAM FROM JULY, 1951 TO JANUARY, 1952

(This data reflects the normal stream situation before Bull Shoals Dam was put into operation.)

				Methyl Orange Alkalinity			*Oxygen*			*Carbon Dioxide*			*Temperature*		
	pH			*Parts Per Million*			*Parts Per Million*			*Parts Per Million*			*Degrees Farenheit*		
Station	*Avg.*	*Max.*	*Min.*	*Avg.*	*Max.*	*Min.*	*Avg.*	*Max.*	*Min.*	*Avg.*	*Max.*	*Min.*	*Avg.*	*Max.*	*Min.*
1	7.5	7.7	7.5	132	143	93	9.9	14.4	5.5	6.33	17.0	1.0	67.5	83	46
2	7.5	7.9	7.3	134	178	110	10.1	14.5	6.7	3.00	8.0	0.0	67.9	86	46
6	7.7	8.3	7.4	126	148	100	11.3	14.5	8.3	2.25	7.0	0.0	61.1	79*	44

* Temperature lowered by cold water entering from the North Fork of White River where Norfork Dam was in operation.

TABLE II

AVERAGE, MAXIMUM AND MINIMUM TEMPERATURE AND CHEMICAL DATA COLLECTED ON THE NORTH FORK OF WHITE RIVER FROM JULY, 1951 TO JANUARY, 1952

(This data reflects the abnormal situation resulting from cold water being released from the botton stratum of the lake.)

				Methyl Orange Alkalinity			*Oxygen*			*Carbon Dioxide*			*Temperature*		
	pH			*Parts Per Million*			*Parts Per Million*			*Parts Per Million*			*Degrees Farenheit*		
Station	*Avg.*	*Max.*	*Min.*	*Avg.*	*Max.*	*Min.*	*Avg.*	*Max.*	*Min.*	*Avg.*	*Max.*	*Min.*	*Avg.*	*Max.*	*Min.*
5	7.5	7.8	6.3	141	170	120	9.0	13.4	5.5	3.25	10.0	0.0	56.8	65	48

LEGEND: Station 1—Immediately below Bull Shoals Dam.
Station 2—Cotter, 17.7 miles below Bull Shoals Dam.
Station 5—Norfork, 4.5 miles below Norfork Dam.
Station 6—Calico Rock, 69.5 miles below Bull Shoals Dam.

TABLE III

POST-IMPOUNDMENT AVERAGE, MAXIMUM AND MINIMUM TEMPERATURE AND CHEMICAL DATA COLLECTED ON WHITE RIVER BELOW BULL SHOALS DAM AND ON THE NORTH FORK RIVER BELOW NORFORK DAM, FROM JULY, 1956 TO JULY, 1959

(This data reflects the situation as it now exists with both dams being routinely operated.)

				Methyl Orange Alkalinity			*Oxygen*			*Carbon Dioxide*			*Temperature*		
	pH			*Parts Per Million*			*Parts Per Million*			*Parts Per Million*			*Degrees Farenheit*		
Station	*Avg.*	*Max.*	*Min.*	*Avg.*	*Max.*	*Min.*	*Avg.*	*Max.*	*Min.*	*Avg.*	*Max.*	*Min.*	*Avg.*	*Max.*	*Min.*
2	8.0	8.2	7.5	126	150	76	12.3	19.3	7.7	3.25	10.0	0.0	54.0	67	42
5	8.0	8.2	7.5	162	198	98	11.1	17.8	6.5	3.50	14.0	0.0	53.2	75	46
6	8.0	8.2	7.0	131	160	76	12.7	18.6	8.5	2.44	10.0	0.0	56.5	74	40
*7	8.0	8.2	7.1	140	161	79	13.0	18.0	9.4	2.98	8.0	0.0	56.5	76	40

LEGEND: Station 2—Cotter, 17.7 miles below Bull Shoals Dam.
Station 5—Norfork, 4.5 miles below Norfork Dam.
Station 6—Calico Rock, 69.5 miles below Bull Shoals Dam.
Station 7—Sylamore, 86.5 miles below Bull Shoals Dam.

* Station 7 discontinued January, 1958.

Table I. The cold water discharged through Norfork Dam lowered the average and maximum temperatures of White River at Calico Rock, Station 6.

Table III shows post-impoundment average, maximum and minimum temperature and chemical data collected on White River from Bull Shoals Dam to Sylamore, and on North Fork River.

The maximum temperature of 75° Farenheit reached in North Fork River was due to several days of no power generation at the dam, and consequently caused higher maximum temperatures at Stations 6 and 7. After generation was continued, the temperatures again dropped to normal.

Backed with the experience gained on North Fork River and the information collected on White River, an experimental stocking of 1,800 brown and 16,156 rainbow trout, averaging six- to eight-inches, was made in White River from Bull Shoals Dam to Cotter in 1952. These fish showed exceptional growth and survival and by the following fall were producing some fair fishing. In 1953, a total of 17,610 brown and 15,750 rainbow trout, averaging six- to eight-inches, were stocked from Bull Shoals Dam to Norfork. Eight thousand three hundred and twenty (8,320) rainbow trout, averaging six- to eight-inches, were stocked in 1954.

During the three years (1952 through 1954), 59,636 trout had been experimentally stocked and White River was becoming widely known for its trout fishing. Many fish in the two- to five-pound class were being taken.

With the increased fishing pressure, it was evident that more fish would be needed to keep the streams stocked. Through contract with the U. S. Fish and Wildlife Service, the Arkansas Game and Fish Commission obtained 10,000 pounds of fingerling trout each year from July, 1955 to July, 1958 (Table IV).

TABLE IV

NUMBER OF TROUT STOCKED IN NORTH FORK AND WHITE RIVERS FROM JANUARY, 1955 TO JULY, 1958

(These fish varied from four to ten inches in length, but most of them were four to six inches in length)

Year	*Rainbow Trout*	*Brown Trout*	*Total*
1955	110,893	8,401	119,294
1956	232,358	22,097	254,455
1957	159,006	30,568	189,574
1958	157,420	.....	157,420

Spawning occurs in both tailwaters during December and January, but the success is limited. During the periods of low flow (dams not generating) redds are commonly seen in the shoal and riffle areas. These redds are repeatedly destroyed by fluctuating water levels and rolling gravel.

Mature trout, both brown and rainbow, ascend the smaller tributary streams, especially those that are fed by large springs, to spawn. In these tributary streams spawning is carried out successfully. A large spring at Cotter is one of the tributaries most used by the fish, and the Arkansas Game and Fish Commission has extended the spring branch along the gravel bar from about 300 feet to 2,500 feet. Spawning trout can be seen using the entire length of the Cotter Spring branch, and as a result, the spring has become quite a tourist attraction. To prevent interference with spawning fish, all fishing in the spawning area is prohibited.

Trout reproduction has been found in very limited numbers in both tailwaters. In early 1959 seining at intervals over an eight-mile stretch of White River in the vicinity of Cotter, 3,640 shiners, 2,250 stonerollers, 100 darters, 57 cottus, 20 hog suckers and eight rainbow trout were collected. The trout were much smaller than anything stocked and had to be the result of natural reproduction (probably occuring in the tributary streams). Since seining efforts covered an interval of eight miles, natural reproduction, although interesting, is believed to be insignificant as far as the fishery is concerned.

In order to gain information concerning survival, growth, age and migration, 7,772 trout have been tagged and released in the tailwaters since 1955. The monel metal strap tags, placed on the opercular, were used. Tag returns have been very good (considering the type of tag used) and revealed that rainbow trout have gained an average of 0.90 inches per month over the past years. Brown trout appear to grow slower, however, fewer brown trout were tagged and fewer returns were obtained. In 1958 the average gain fell to 0.65 inches per month. This retardation of growth is not exactly understood, but it is thought to be closely associated with the fact that most of the aquatic vegetation was washed out during a high water period in 1957 when flood waters were released over the dam as well as through the penstocks and flood conduits. The vegetation held hords of arthropods which are the primary food of the trout. The temporary loss of the aquatic vegetation then, in reality, has reduced the amount of available food. Since 1957 the dams have (more or less) been operated routinely (all released water coming through gates located at the base of the dams) and the vegetation is making a good comeback. It will be interesting to see if growth rate increases in direct proportion to the amount of vegetation, notwithstanding the fact that stocking rates are to be increased also.

Some of the stocked trout have traveled great distances. One fish was taken 76 miles downstream, but the majority have remained in the same general area where they were stocked. Data collected from tag returns reveal that most trout are caught within five miles up or down stream from the point of release.

The overall migration is slightly upstream, but varies somewhat from year to year.

With the construction of Norfork and Bull Shoals Dams, most of the warm water fishes which inhabited the streams have gradually disappeared. However, the suckers have adapted themselves to the cold water and are abundant in the streams.

Since the tailwaters have been stocked with trout, fishing pressure and fishing success have steadily increased. White River has been acclaimed one of the best trout streams in the country. Many trout in the eight- to twelve-pound class have been caught. The record rainbow trout (Arkansas record) weighing 15 pounds, 3 ounces, was taken this year as well as the record brown trout weighing 15 pounds, 9 ounces.

As fishing has increased on the streams so has the economic importance of the fishery to the surrounding area and to the state. Efforts were made to evaluate this fishery in 1955 and again in 1957. The method used was to contact each fishing service operator on the tailwaters and ask that he furnish the Game and Fish Commission with the number of boat rentals that he had made during the year concerned. Without fail, every owner or operator has freely given this information. Several of the operators were also asked if they would pull 100 sales tickets at random so we could arrive at some figure that would be representative of the expenditures made by the fishermen. Four operators were willing to cooperate with this phase of the study.

Considerable time has been spent on the tailwaters counting the number of bank fishermen, number of rented boats, number of private boats and the number of persons fishing from each boat. It was determined that there was an average of 2.5 persons per boat.

The fishermen have been divided into three categories in an effort to estimate expenditures per day. The expenditures are as follows:

Boat rentals and float trips	$16.27
Private boats	10.00
Bank fishermen	3.00

In 1955 there were an estimated 8,200 bank fishermen but the number dwindled to 3,500 for the year 1957. This can be explained as the White River carried a tremendous volume of water in 1957, whereas in 1955 the river was more nearly natural in size and the shoal and riffle areas could be reached by wading. The high water made the bank fishermen practically non-existent during the summer and early fall of 1957, but they returned in numbers during October after the excess water had been released and the river stages returned to normal.

As indicated in Table V, there has been a gradual increase in the number of people using the tailwater trout fishery, and as a result, the amount of money spent on fishing has also increased. These figures by no means represent the total expenditure of persons while in the area. They represent only the amount spent with the fishing service operators along the streams. No effort has been made to compute the total worth in terms of tackle, food, lodging, gasoline, etc., bought at other places. The total business generated by this fishery will exceed by far the figures presented here and, indeed, has been a boom to the economy of the surrounding area.

TABLE V

ESTIMATED NUMBER OF BOATS AND PEOPLE FISHING THE BULL SHOALS DAM AND NORFORK DAM TAILWATERS FOR THE YEARS 1955 AND 1957 AND THE ESTIMATED EXPENDITURES OF THE FISHERMEN

	Number Boats	*Number Persons*	*Estimated Expenditures*
		1955	
Boat Rentals and Float Trips	10,691	26,728	$434,864.56
Private Boats	2,140	5,350	53,500.00
Bank Fishermen	....	8,500	25,500.00
TOTALS	12,831	40,578	$513,864.56
		1957	
Boat Rentals and Float Trips	14,757	36,892	$600,232.84
Private Boats	2,960	7,400	74,000.00
Bank Fishermen	....	3,500	10,500.00
TOTALS	17,717	47,792	$684,732.84

CONCLUSION

Studies on the White and North Fork River below Bull Shoals and Norfork Dams, located in North Central Arkansas, indicate that temperature alone is the sole limiting factor as far as maintaining a tailwater trout fishery, dependent upon sustained annual stocking of fingerling trout, is concerned. The critical periods occurred in the summers when there was no power generation at the dams on weekends, holidays and during extended droughts.

Although not actually observed, it is believed that during the unprecedented drought year of 1954, trout were lost in White River due to a prolonged shutdown of the generating units. Temperatures were recorded beyond the lethal limits for trout at Cotter, 17.7 miles below Bull Shoals Dam.

In October, 1956, a survey, using an electric seine, was conducted on the tailwaters by the U. S. Fish and Wildlife Service in cooperation with the Arkansas Game and Fish Commission and the U. S. Corps of Engineers. Few trout were found which had been stocked earlier than the winter of 1954-55. North Fork River is not so seriously affected by shutdown periods because of a minimum flow feature of 20 c.f.s. and the waste water from the new Norfork Trout Hatchery located just below Norfork Dam.

The U. S. Corps of Engineers has recognized this problem of maintaining satisfactory temperatures, and there is a "gentlemen's" agreement with the Little Rock District, Corps of Engineers, that properly timed cold water releases will be made so the temperature will be held under 70° Farenheit at Cotter. It is our understanding that this can be done by using the generators for "peaking" purposes even during periods of low power demand. A similar cooperative effort was carried out during the summer of 1957 when warm flood water had to be released over the top of Bull Shoals Dam. The team work of the two agencies resulted in the preservation of the White River trout fishery during this emergency.

The fall turnover period brings about higher temperatures, lower oxygen tensions and high carbon dioxide concentrations in the tailwaters. On occasion fish have been noticed suffering immediately below the dams. These helpless

fish are soon swept downstream where they apparently recover completely. The chemical factors quickly improve as the water passes over the first riffle. To guard against loss, trout are never stocked near the dams during the fall turnover period.

The future of the Bull Shoals Dam and Norfork Dam tailwater trout fishery is dependent upon regular releases of cold water from the bottom stratum of the lakes during the summer months and substantial annual stocking of fingerling trout.

ACKNOWLEDGMENTS

The author wishes to acknowledge the assistance of Mr. Andrew Hulsey and Mrs. Betty Clement in the preparation of this paper.

LAW ENFORCEMENT SESSION

THE ENFORCEMENT OFFICER'S PLACE IN THE TECHNICAL PHASES OF GAME MANAGEMENT

By PARKER B. SMITH
U. S. Fish and Wildlife Service
Atlanta, Georgia

We are living today in a time when human population and land use dynamics are creating drastic changes in concepts of wildlife management. The results can be seen on every hand.

Just a few years ago, the number of hunters and fishermen were so small that anyone going into the field in pursuit of game or fish expected the entire day to be his without interference. Today it is practically impossible to spend such a day without encountering many others pursuing the same sport.

Then too, more and better information with regard to wildlife has resulted because of better trained wildlife personnel in larger numbers. Gone are the days when regulations were based entirely on "cracker barrel" discussions and guesswork. Though some guesswork is still used, due to inadequate information, great strides are being made to find the answers on which to base sound wildlife protection legislation.

At present, the conservation officer daily meets with problems of posted lands; losses of wildlife habitat to drainage, timber removal, urban development and highway construction; and the pressure of more and more people wanting to hunt and fish on less and less habitat.

A few years ago, his one job was enforcement of the game laws, plus perhaps, the sale and keeping of records for hunting and fishing licenses in his assigned district.

You men are familiar with the difference in duties which fall your lot today. To enumerate some of them the conservation officer today:

(1) Enforces wildlife laws.

(2) Cooperates with federal agents in enforcing federal regulations, which in most instances, are also state regulations.

(3) Carries on public relations programs consisting of contacts and talks with schools, sportsmens groups, civic clubs, radio and television programs, exhibits at fairs and by personal contact with individuals.

(4) Cooperates in wildlife surveys.

(5) Assists in operation of public managed hunting and fishing areas.

(6) Assists private landowners with enforcement of trespass laws.

(7) In some cases, enforces water safety regulations, and