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An inventory of fishing on Norris, a storage reservoir, was begun in 1938. The following year it was extended to Wheeler, a run-of-the-river reservoir, and to the tailwater area below Wilson Dam. This inventory, therefore, covered each of the three general types of fish habitats created by the TVA dams. This discussion is a summary of the 1939 fishing data, together with recommendations for fish management based on the creel census information. The data collected totaled 34,270 usable fishing records, representing a catch of 98,495 fishes.

An estimate of the amount and value of fishing in the Tennessee Valley is not available, but this resource obviously constitutes an important asset to the region. The total number of man-days of fishing on Norris is roughly calculated to be 125,000; on Wheeler it is estimated to be about 200,000; and in the Wilson Dam tailwater approximately 32,000. Fishing on these three waters alone, therefore, represents about one-third of a million man-days. In addition, fishing is known to have been heavy on Wilson Reservoir and in the tailwaters below Guntersville and Wheeler Dams. The catch in 1939 in the major waters of the Valley probably exceeded a million fishes.

In 1939 Pickwick and Guntersville Reservoirs were too new to have a reasonably large fish population, and Hiwassee and Chickamauga Reservoirs were not yet impounded. On several other projects, dam construction has been started only recently. When these reservoirs are completed and their fish populations have had an opportunity to become well established, the total catch for the Tennessee River and its tributaries will undoubtedly be much greater than it is at present.

Reliable data are not available on the extent of fishing before impoundment, but the catch in the reservoirs is now undoubtedly far greater than it was in the river before the dams were built. There is little reason to believe that these impoundments will tend to become "biological deserts" after a few seasons. Wilson Reservoir has been in existence for fifteen years but is still fished intensively, and the tailwater immediately below the dam yielded about 125,000 pounds of fish in 1939.

Purpose of the Creel Census

This inventory of the fishing is taken to provide information needed to manage properly the fishing resources. Regulation is thought to be the major tool in the management of large waters, with environmental improvement and stocking probably of secondary importance. The specific purpose of the inventory, therefore, is to obtain information on which to base recommendations for regulations. These regulations would presumably maintain a desired balance among the various species so that the coarse fishes do not increase in numbers and become dominant at the expense of

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the more valuable pan and game fishes. The laws are, of course, made and enforced by the States in which the waters are located.

The data will indicate the relative abundance of game, pan, food, and coarse fishes in the catch and, over a period of years, will tend to show the evolution and trend of the fish population in these new waters, making it possible to anticipate needed regulations. Another purpose of the census is to evaluate the fishery by learning the amount, kind, quality, and economic value of the fishing. The 1939 creel census is to be regarded as a preliminary step in the general inventory for it covers only three waters and, on two of these, only one major kind of fishing.

KINDS OF HABITATS

The three general types of fish environments created by impoundment in the Valley are distinctly different. Their major characteristics are briefly as follows:

Norris. The storage reservoirs are located on tributary streams near the upper part of the Valley. That under consideration, Norris, has one major fluctuation each year, the water level being high in summer and low in winter. This reservoir, which is in rugged terrain, has an irregular shoreline, much of which is steep. It has an area of 34,200 acres and a shoreline of 705 miles when at elevation 1,020. The water is generally clear, but coarse vegetation is absent and bottom organisms are few due to the annual fluctuation of fifty or more feet and because of bottom stagnation. There is a decided thermal and chemical stratification and little river influence, because of the relatively large storage volume in comparison to the inflow. Hiwassee Reservoir is of this same general type.

Wheeler. Wheeler, like the other run-of-the-river reservoirs, is on the main channel of the Tennessee River. Although it resembles Norris in having an irregular shoreline, it is decidedly different in most other respects. The surrounding country, which is largely farm land, is fairly flat and shoal areas are very extensive in some parts of the reservoir. There is a major river influence and, therefore, no stratification. A definite current is present in the former river channel for over two-thirds the length of the impoundment, and in time of flood the entire reservoir becomes a river with a perceptible current in the backwaters and a fairly rapid flow in the channel.

The water is generally murky, becoming muddy throughout the reservoir at times of increased flow. In summer there are frequent minor fluctuations in water level coupled with a gradual drawdown. In winter the level is several feet below normal summer level. Flood control is a function of this and other reservoirs, hence the low early winter level. These drawdowns and the high turbidity are probably responsible for the absence of submerged aquatics.

Unlike Norris Reservoir, Wheeler offers considerable diversity of fish habitats and can be divided into three more or less distinct sections: an upper third where water is confined primarily to the original channel; a middle third where water overflows the banks of the stream; and a lower third where the lake extends to the fairly steep margin of the flood plain.

River conditions prevail in the upper

third which differ from those before impoundment chiefly in greater depth of water. Shoal areas are largely lacking, the water being confined to the former channel where the flow is not as fast as it was prior to damming, but a perceptible current is always present. The water is more turbid in this upper portion than in the lower reaches of the reservoir, but there is little silt deposition and the original bottom materials are still present. Fishing here has changed little from that practiced before impoundment except, of course, in the tailwater below Guntersville Dam. Setline fishing is practiced extensively and the take by this method consists mainly of catfishes and drums. Bank fishing with cane poles is second in importance, and sport fishing is of minor significance. Most of the fishing is done by plantation workers and its intensity depends considerably on the extent to which these laborers are needed in the cotton fields. Fishing here is chiefly to provide food and, to some degree, to supplement the income received from farming.

The upper portion of the reservoir merges gradually into the middle section where, due to the gentle slope of the valley, the water spreads over the adjoining flats on both sides of the channel. This area is characterized by wide, shallow-water areas that are separated from the main channel by natural levees which become shallowly submerged toward the lower end of the section so that the flats are confluent with the channel. The shoreline in this area is very irregular and there are many protected coves where shrubs and trees are abundant. Here the tributary streams have extensive flats where swamp conditions formerly prevailed. Much of the water in these latter areas is less than three feet deep and the frequent small fluctuations alternately expose and cover some thousands of acres that have been invaded by such plants as spiny waterleaf (*Nama quadrivalve*), water purslane (*Isnardia palustris*), and lizardstail (*Saururus cernuus*). The flats exposed by the drawdown are colonized by such plants as cocklebur (*Xanthium americanum*) and other land annuals. When the water rises in the spring, these plants enrich it by the addition of organic material.

In the lower part of this section the backwater is deeper and the channel loses its identity when the flow is normal. Silting takes place here even in the original channel. Much of the fishing is concentrated in this rich mid-portion of the reservoir, and angling for pan and game fishes has increased many fold since impoundment.

The middle section grades into the lower, which is characterized by lake conditions as there are wide stretches of deep, open water that extend to the moderately steep edges of the flood plain. The water is much clearer in this section than in the upper portions of the reservoir. Wave action is more pronounced and beaches are being formed. Silting takes place in this area and the original bottom material has been covered, causing the mollusks to disappear and mollusk-eating fishes, such as the drum, to be in poor condition and perhaps decreasing in abundance. Bass are common here and catfishes are taken in considerable numbers. The mooneye, gizzard-shad, and open-water species are plentiful.

All major reservoirs on the Tennessee

River proper are of the run-of-the-river type and the conditions described for Wheeler prevail also on the other impoundments.

Wilson Dam Tailwater. Wilson Dam tailwater is actually part of Pickwick Lake. It differs from the lake proper primarily in that rapid water continues for a mile or more downstream. The area is really a large, rapid, turbulent, well-aerated river attracting fishes that show a preference for, or at least a tolerance to, fast river conditions. The deep pool and the large rocks immediately below the dam are apparently very attractive to the fishes, for a majority of them are taken in this moderately small area.

Each of the three habitats briefly discussed above has management problems peculiar to itself and, for this reason, the creel census and the management suggestions for each are presented separately.

NORRIS RESERVOIR FISHING INVENTORY

General Creel Census. Information on the fishing and fish catch on Norris Reservoir in 1939 is based on 7,392 fisherman-days, about half of them from Norris Dock and the remainder from Stiners, Cedar Grove, Andersonville, and Hickory Star Docks. At Norris Dock the census was taken by CCC personnel from TVA Camp No. 45, and does not include fishing on Saturday afternoons and Sundays. At the other docks the operators cooperated directly with the Foestry Relations Department in taking the census. At Stiners and Cedar Grove Docks, records were obtained for most of the fishing, but at the other two docks for a smaller proportion. The data are for the period from June 1, opening day of the season, to late November.

In the 7,392 fisherman-days listed 8,641 fishes were caught in 40,623 hours (Table 1). Five major game fishes constituted 91 per cent of the catch taken by anglers fishing out of the five docks. General data on the fishing for all docks combined are presented in Table 1, where the information is compared for 1938 and 1939. Table 2 shows the relative abundance of the several species in the catch. Eighty per cent of all the fishes taken were bass—50 per cent largemouth, 24 per cent smallmouth, and 6 per cent Kentucky. Walleyes constituted 9 per cent of the total catch and saugers 2 per cent.

Data for 1938, August to November, and for the same period in 1939 show similar catches per hour. Actually, however, fishing was considerably better during the 1939 period, because 91 per cent of the fishes taken then were major game species, whereas in 1938 these made up only 66 per cent. The largest of the game fishes, the walleye, was three times as well represented in the 1939, as in the 1938, take. Observation indicates, too, that the game fishes averaged larger in size in 1939.

In a new reservoir, alterations in the fish population are sometimes rapid. Two rather decided changes in the trend are suggested by a comparison of the information for the two seasons. Walleyes are apparently very much on the increase and bluegills of catchable size are rapidly decreasing in number. The increase of walleyes from about 3 per cent to 9 per cent, and the decrease of bluegills from 30 per cent to 6 per cent in the catch, are significant. Crap-

TABLE 1

SUMMARY OF FISHING ON NORRIS RESERVOIR FOR 1938 AND 1939

Year	*Month*	*Number of anglers*	*Fishes caught*	*Hours fished*	*Catch per hour*
1938	August	411	654	2,615	0.3
	September	1,079	1,628	6,591	0.2
	October	1,432	2,794	8,472	0.3
	November	577	1,394	3,327	0.4
1939	June	2,658	3,635	14,643	0.2
	July	1,271	729	6,875	0.1
	August	1,345	727	6,600	0.1
	September	1,061	1,543	6,033	0.3
	October	1,011	1,937	6,201	0.3
	November	46	70	271	0.3
					Average 0.2
Totals (1939)		7,392	8,641	40,623	

pies are fairly well established in a few localities, but their distribution through the reservoir has not yet become general. Except for one specimen, all of 114 crappies were reported from one of the five docks.

An interesting correlation exists between the position of the docks on the lake and the relative abundance of largemouth and smallmouth basses in the catch from different parts of the reservoir.

1. At the dock farthest up the arm receiving the major inflow of water, the ratio of largemouth to smallmouth was 7:1.

2. At a dock some miles downstream on the same arm, the ratio was 5:1.

TABLE 2

RELATIVE ABUNDANCE IN THE CATCH OF THE VARIOUS SPECIES, EXPRESSED AS A PERCENTAGE OF THE TOTAL CATCH, BY MONTHS. NORRIS RESERVOIR 1939[1]

Month	Black Bass			Wall-eye	Sauger	Blue-gill	Crap-pie[3]	Carp	Miscel-laneous[4]
	Large-mouth	Small-mouth	Ken-tucky[2]						
June	53	21	6	11	1	4	3	1	—
July	58	16	4	6	1	9	—	3	1
August	45	29	2	5	1	15	—	1	3
September	43	30	6	9	3	7	—	—	1
October	50	26	8	6	3	5	—	—	—
November	41	23	31	3	1	—	—	—	—
Averages (1939)	50	24	6	9	2	6	1	1	1
Averages[5] (1938)	39	24	—[6]	3	—[7]	30	—	1	3

[1] The total number of fishes on which the percentages are based is listed in Table 1.
[2] Some Kentucky bass were probably included in the largemouth.
[3] Black Crappie (*Pomoxis sparoides*).
[4] Includes rock bass, catfishes, suckers, drum, and sunfishes.
[5] August to November only.
[6] Included with the largemouth bass.
[7] Included with the walleyes.

3. At another dock still farther downstream, on a large expanse of water on the same arm, the ratio was 1.5:1.

4. The catch from the dock at the dam had a ratio of 1:1, with the smallmouth slightly predominating.

5. At a dock far up the arm receiving the second greatest inflow, the ratio was 3:1.

Reasons for this correlation are considered later under a discussion of chemical conditions (pp. 23–24).

Except for this relationship between the most common bass species, the catch was relatively similar at each of the several docks. The percentage of game fishes in the total fish take at each of the five docks was 92, 89, 88, 96, and 96, respectively. The catch per angler was similar at Cedar Grove and Stiners Docks, the management of which returned cards for almost all fishing and apparently showed no inclination to forget to report on fishermen taking no fish. One had a catch of 1.2, and the other 1.4, game fishes per angler. At Norris Dock, where the census was taken by the CCC and was almost complete for five and one-half days of each week, the catch per angler was only 0.8. The reason for this difference is explained later under the discussion of chemical data.

The total amount of fishing on Norris can be estimated only roughly. Between July 28 and August 14 anglers along the entire shoreline were counted, except in the extreme upper portions of several of the arms where travel by outboard was hazardous or impossible. The count, made on week days, totaled 117 anglers in boats, and 111 bank fishermen. These data are exclusive of anglers in boats out of the docks. In making the count all points were passed only once. Because the average fisherman-day is only about 5 to 6 hours, either morning or afternoon, the actual number of fishermen each day for the period was probably twice the number seen, or about 400. Earlier in the season the number of fishermen was undoubtedly greater. By October, when another count was made, the number had declined to 44 bank, and 92 boat, fishermen. About 100 and 200 bank and boat fishermen, respectively, are considered to have been fishing per day.

On the basis of an estimate of 400 anglers a day for the months of May to September inclusive, and 300 for March, April, and October, the total number of fishermen other than those operating from the docks is estimated at about 87,000. The August count showed that in addition to boats located at the docks there were 678 crafts along the shore, all or almost all of which were used for fishing. Perhaps half of these were employed in setline fishing and the other half for casting, still-fishing, and trolling. In the October count the number of boat fishermen who hired boats at the docks was about equal to all the others, the counts being 86 and 92, respectively. In August no count was made of the fishermen in the first group. On the basis of this rather meager information, it is estimated that the total amount of fishing on Norris in 1939 was about 125,000 fisherman-days.

The game fishes caught were of large average size. Where more than two of one species were caught per boat, the range, rather than the individual lengths, was frequently listed and information on size is therefore available for only a part of the catch (Table 3).

The most common size was fourteen inches for each of the three species of bass.

TABLE 3

RECORDED LENGTHS OF BASS AND WALLEYES IN THE CATCH FROM NORRIS LAKE, 1939

Lengths in inches[1]	Number of fishes			
	Large-mouth	Small-mouth	Ken-tucky	Wall-eye
11	85	71	19	—
12	202	154	31	—
13	185	174	62	—
14	361	277	89	—
15	183	191	55	21
16	179	201	31	54
17	62	100	7	43
18	51	56	2	56
19	20	21	1	32
20	9	9	1	34
21	—	—	—	32
22	—	—	—	37
23	—	—	—	34
24	—	—	—	53
25	—	—	—	59
26	—	—	—	45

[1] Including also fractions; for example, all fishes between 14 and 15 inches in lengths were listed as 14.

Two size groups are indicated for walleyes, one at sixteen to eighteen inches, the other at twenty-four to twenty-six inches.

Average lengths of the principal game species at the end of the 1938 growing season (Eschmeyer 1940) were as follows:

Age in years	Average length in inches			
	Large-mouth	Small-mouth	Ken-tucky	Wall-eye
2	13.0	12.5	11.5	17.2
3	—	14.5	14.0	22.1

The largemouths caught were mostly in their third year (2+); the other two basses were represented by both age groups (2+ and 3+). The tendency for the size curve of walleyes to be bimodal is explained by the catch of both year classes (2+ and 3+). The lengths recorded in Table 3 cover the entire growing season for bass and most of the growing season for walleyes. For this reason, the age groups can not generally be distinguished in the table.

Special Creel Census. Special census cards calling for more information than the regular blanks were distributed to about 200 fishermen who would presumably fish twenty times per year or more, and who would submit reports on all of their fishing trips. For the June fishing 607 cards were received, and for the next four months the numbers were 193, 83, 109, and 51, respectively. In 1,043 trips these anglers took 1,970 fishes, almost all of which were of game species. This represents almost two game fishes per trip as compared with only 0.8 game fish per trip for all fishing out of the Norris Dock. Most of the fishing for the special census was in the lower portion of the reservoir.

Those who fished most frequently were more successful than the average, although they also were unsuccessful in almost a third of their trips. Had the summer of 1939 been rainy instead of exceptionally dry, these consistent fishermen would probably have had a much better average catch, as indicated under a discussion of chemical and thermal conditions.

A tabulation of the kinds of bait and methods of fishing used (Table 4) shows that most of these anglers employed artificial bait and that casting was the most common fishing method in June and July, with trolling predominating for the remainder of the season. The kind of bait and method of fishing which

TABLE 4

EXTENT USED AND EFFECTIVENESS OF THE DIFFERENT BAITS AND THE VARIOUS METHODS OF FISHING, SPECIAL 1939 CREEL CENSUS,[1] NORRIS RESERVOIR

Month	Bait or method	Number of records	Number of fishes	Catch per angler	Species					
					L.M.B.	S.M.B.	Ky.B.	Walleye	Sauger	Miscellaneous[2]
June	Natural Bait[3]	25	36	1.4	13	11	9	—	—	3
	Artificial Bait[4]	465	1,068	2.3	682	228	44	82	10	22
July	Natural Bait	18	20	1.1	2	11	1	—	—	6
	Artificial Bait	161	182	1.1	108	43	16	13	—	2
August	Natural Bait	6	4	0.7	—	—	3	—	—	1
	Artificial Bait	65	99	1.5	27	41	16	11	1	3
September	Natural Bait	1	1	—	—	—	1	—	—	—
	Artificial Bait	107	169	1.6	43	78	27	15	6	—
October	Artificial	48	98	2.0	37	36	15	6	2	2
June	Still Fishing	25	37	1.5	12	11	11	—	—	3
	Casting	336	840	2.5	575	186	36	30	3	10
	Trolling	59	123	2.1	46	32	5	34	3	3
July	Still Fishing	13	10	0.8	2	1	1	—	—	6
	Casting	93	113	1.2	80	23	9	—	—	1
	Trolling	25	36	1.4	14	12	6	4	—	—
August	Still Fishing	9	5	0.6	1	—	3	—	—	1
	Casting	24	20	0.8	9	5	1	1	—	4
	Trolling	45	103	2.3	27	44	16	12	1	3
September	Still Fishing	1	1	—	—	—	1	—	—	—
	Casting	20	18	0.9	8	8	—	—	2	—
	Trolling	69	125	1.8	26	61	23	12	3	—
October	Casting	17	25	1.5	18	7	—	—	—	1
	Trolling	19	39	2.1	22	15	6	3	2	1

[1] Not including records where several kinds of bait or several methods are indicated.
[2] Chiefly bluegills and crappies.
[3] Chiefly minnows.
[4] Chiefly plugs.

took the most fish per angler were those used by most of the fishermen.

In June, fishing was mostly by casting and trolling, with the former slightly more effective. In July, casting still led, but trolling was slightly more productive. Trolling predominated during the next month and was decidedly the most effective way of fishing for this and the following months. In this connection, an important point not indicated by the data is that in June most of the trolling was shallow, but by August it was almost all with metal lines in about twenty to twenty-five feet of water. The latter method was very effective throughout late summer and fall and probably would have been effective in June and early July had it been used at that time. The deep trolling with plugs took the larger smallmouth bass (of the 3+ age group) and was undoubtedly the most successful method of fishing.

Effect of Chemical and Thermal Conditions on Fishing. Limnological data have frequently been of little value to the fisheries worker because of the inability to interpret these data in terms of fish populations or fishing. Extensive data collected by Dr. A. H. Wiebe on Norris Reservoir, however, explain the success or failure of several fishing methods at various localities and at different seasons. His finding of major interest to fishermen is illustrated diagrammatically in Figure 1. He noted a decided difference in the vertical distribution of oxygen during wet and dry seasons, and found these differences to be due to the volume, temperature, and turbidity of the incoming water (Wiebe 1940).

Because water naturally seeks its own density level, during spring, summer, and fall the incoming water moves as a layer between the warmer circulating surface layer, the epilimnion, and the deeper, cooler, non-circulating portion, the hypolimnion. During a wet year this silt-laden stratum goes all the way to Norris Dam, a distance by channel of 73 miles. Due to the silt and other materials in this water, it loses its oxygen through decay and becomes an oxygenless[2] stratum between two aerated layers. Fish can live above or below this layer of water (Figure 1), but not in it. This situation explains a number of occurrences relative to the fishing.

It is known that the smallmouth bass prefers clear, cool water, and that the largemouth is more tolerant of warm, silty water. In the upper part of the reservoir the water is not as clear as at the dam, and the cool, deeper water is generally without sufficient oxygen during the fishing season. This explains why the ratio of largemouth to smallmouth ranges from 7:1 some distance up the Clinch arm to 1:1 near the dam where clear, cool, aerated water is generally available.

In 1939 the middle, oxygenless layer on the Clinch arm extended only about to the portion known as Loyston Sea (relative position indicated by the arrow in Figure 1). Above this arm the fish tended to be concentrated in the warm, upper layer. Below that point they could live at all depths and apparently preferred to be in the cool water immediately below the warm, upper layer. Deep trolling was, therefore, by far the most effective method of fishing

[2] Oxygen is either entirely lacking, or is present in quantities too small to support fish life.

in the lower part of the lake, but was very ineffective in the upper portion because the bait, at a depth of about twenty-five feet, was traveling in the silty, oxygenless layer. Casting and shallow trolling were probably much more productive in the upper reaches, even though in warm water in midsummer, bass and walleyes are not as readily taken as at other seasons. During a rainy summer, the fishes throughout the lake are concentrated near the surface and casting, shallow trolling, and still fishing can be expected to be more successful than deep trolling, unless possibly the trolling is very deep, below the oxygenless layer.

Because the vertical distribution of the fishes depends on the length and thickness of the oxygenless layer, and the movement and mass of this layer depend on the amount of inflowing water, the amount of rainfall determines the location of the fishes with reference to depth. Suggestions for fishing, based on the chemical data and supported to some degree by fishing records, may be summarized as follows:

In early June, casting and shallow trolling are best if the spawning season was late; deeper fishing is best if the spawning season was early.

In midsummer, deep fishing is recommended in the lower part of the reservoir; shallow fishing (surface to about 5 feet) in the upper end.

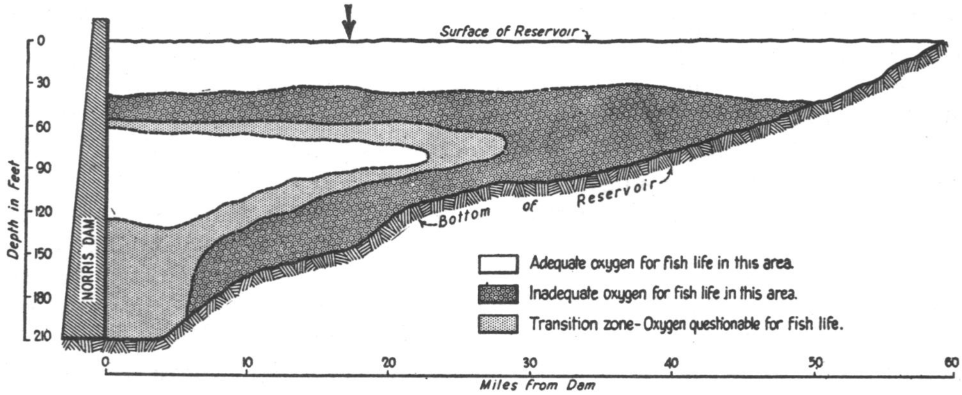

Fig. 1. The oxygen profile of the Clinch arm of Norris Reservoir for September 1937. In 1939, an exceptionally dry season, the layer with inadequate oxygen extended only about to the point indicated by the arrow. For explanation see text.

In late summer and fall the best methods are deep trolling in the lower end of the reservoir if the season was fairly dry; shallow fishing if rainfall was heavy during earlier summer; and shallow fishing in the upper end regardless of rainfall.

The catch per angler would probably have been much better early in 1939 had the fishermen known how and where to fish. Because of the absence of lakes in this general area, few of them had fished in such waters before the construction of Norris Reservoir. However, even previous experience would probably have been of little value to those fishing in Norris because the oxygen conditions here are different from those generally found, due to the unusual shape of the reservoir.

Management Suggestions. Except as indicated earlier, the catch appears to be similar throughout Norris Reservoir. No one dock has decidedly better fishing than others. More than half of the anglers fishing from the five docks were from Knoxville, and proximity and accessibility of the docks to this city is probably of considerable importance. It happens, however, that a number of the docks are about the same general distance from Knoxville. The relative success of any one of the docks of about equal distance from Knoxville, therefore, may depend on scenic aspects, road conditions, quality of service rendered, personality of the operators, the catching of an exceptionally large fish, advertising, or any other of a number of factors which might not be of very great significance if distances from Knoxville or the quality of fishing differed decidedly for the various docks.

Eventually, nearness to a major highway may be of more importance than at present, especially if sportsmen enroute to and from Florida in winter learn that fishing tends to be good in late fall and early spring. These comments can hardly be considered as contributions to fish management, but the number and location of docks is determined by the Authority and information on the residence of the anglers and on the quality of the fishing in various localities may be of some significance.

Bluegill (bream) fishing has declined decidedly since 1938. The percentage of this fish in the total catch from the docks dropped from 30 per cent in 1938 to only 6 per cent for the next season. The fishes are small in size and stunted in growth. Stringent regulations might be suggested if it were not known that the small bream are relatively old, that growth of these insect-eaters is very slow and that, because of the annual drawdown, these fishes cannot be expected to be both large and abundant. Any regulations made to protect the bluegill would be of little value.

The crappie, now common only in some portions of the lake, is gaining rapidly and may eventually be the chief pan fish. It should be given protection during the spawning season and its spread should be encouraged by introducing it in various localities in which it is now absent or at least too rare to be caught by the anglers.

In 1939 there was a closed season on the major game fishes, but not for all fishing. Examination of the evidence indicates that a closed season on all fishing is desirable for there is no unfavorable balance between the game fishes and coarse or undesirable species. Census records show that most of the fishes taken, even with live bait, are of game species. The growth of the fishes is very rapid, suggesting that the game fish population has not yet reached its peak and that food is plentiful. In addition, the closed season can be better enforced if the lake is closed to all fishing. Spawning is generally near shore and only a very narrow belt around the lake is of suitable depth. The fishes are, therefore, concentrated at spawning time. The shoreline is long, irregular, and mostly wooded, making enforcement difficult. The ease with which game fishes can be caught at bass spawning time is indicated by the special creel census cards prepared by anglers who assisted in obtaining specimens for growth-rate studies in May 1939 under our immediate supervision. The three most successful of the half dozen or so who assisted have records as follows:

Angler	*Number of trips*	*Total hours fished*	*Catch of game fish per trip*	*Catch of game fish per hour*
1	3	24	18.3	2.3
2	8	54½	15.9	2.3
3	7	50½	10.3	1.4

The number taken by the average angler would be lower per trip, but some hundreds of anglers could readily deplete the bass supply if allowed to fish during the spawning season. The Tennessee Conservation Department has recently decided to close Norris to all fishing during the bass spawning period.

WHEELER RESERVOIR FISHING INVENTORY

Wheeler, which is a run-of-the-river reservoir, has a length of seventy-four miles, an area of 67,100 acres, and a shoreline, including islands, of over 1,000 miles. Here fishing is of three types: sport fishing, meat or subsistence fishing, and commercial fishing. Sport fishermen generally troll or cast from boats, or wade and cast from the bank. The most sought for species are the black basses, the crappie, the white or striped bass, and the sauger.

Over the reservoir as a whole, the subsistence fishing is chiefly by negroes. This type of fishing is mainly from the bank, each angler using from 2 to 8 cane poles. The common earthworm ranks first in importance as bait, with cut bait second. The catch is chiefly carp and dogfish but also includes bluegills, sunfishes, suckers, buffalo fishes, drum, catfishes, in fact any species that can be caught. Here, as in the southwest, the carp seems to take bait more readily than in the north. The dogfish, locally known as "scaly cat," is highly esteemed by the negroes and is not regarded as an undesirable predator as it is in some other localities. Subsistence fishing is heaviest in March and April. The extent of this kind of fishing depends on the amount of time the men can be spared from the cotton fields.

Commercial fishing is by setline only, as nets are prohibited. Food fishes (catfishes and drum) are predominant in the catch, but carp are important in some localities. The species taken depends somewhat upon the bait used. It is judged that commercial fishing accounts for a good proportion of the total fishes taken. Our data for 1939 are confined to the first two types of angling, but it is planned to collect records of commercial fishing during 1940.

Information on the fishing in this reservoir was obtained largely by the operators of six boat docks that were opened in April 1939. The TVA leases these dock sites to individuals and enforces the necessary regulations. On Wheeler, William Rice who is in immediate charge of the Wheeler Reservoir properties, greatly aided the project by requiring the boat dock operators to keep the census records. Five of these docks were in the central section of the reservoir where pan fishes predominated in the catch; the other was in the lower section, presumably the better habitat for bass. Some data were also taken at four docks that began operation late in the season, and by one of the Alabama game wardens. The data from these latter sources are recorded as "miscellaneous."

Fishing records for the dock immediately below Guntersville Dam are discussed with those from the Wilson Dam tailwater.

Information on the fishing and fish catch on Wheeler for 1939 is based on the recorded catch for 8,045 fisherman-days. The fishermen took 20,781 fishes in 48,793 hours, an average of 0.4 fish per hour and of 2.6 fishes per trip. Twenty-eight per cent of all the fishes taken were game fishes (25 per cent bass and 3 per cent white bass); forty-two per cent pan fishes (16 per cent bluegills and 26 per cent crappies); fourteen per cent food fishes; and sixteen per cent coarse fishes. General data for the fishing for each month are presented in Table 5. Table 6 shows the relative proportion of each species in the catch and the abundance of the different types.

TABLE 5

SUMMARY BY MONTHS OF SPORT FISHING ON WHEELER RESERVOIR DURING 1939

Month	*Number of fishermen*	*Fishes caught*	*Hours fished*	*Catch per angler*	*Catch per hour*	*Fisherman-day in hours*
April	1,880	4,508	10,602	2.4	.4	5.6
May	2,131	5,117	12,833	2.4	.4	6.0
June	1,510	3,957	9,155	2.6	.4	6.1
July	1,283	4,183	8,011	3.2	.5	6.2
August	491	1,314	3,285	2.7	.4	6.7
September	474	1,138	3,228	2.4	.4	6.8
October	247	467	1,526	1.9	.3	6.6
November	29	97	153	3.3	.6	2.3
Totals and Averages	8,045	20,781	48,793	2.6	.4	6.0

Certain definite trends are noted in the catch (Table 6), including the usual crappie-bluegill relationship. The crappie catch is bimodal, the peaks coming in spring and fall while the mode of the bluegill catch comes in midsummer when the crappie catch is low. This relationship was found at all docks and has been noted in other waters where these two fishes are represented. The crappies presumably move to deeper water in midsummer and failure to take them at that time in appreciable number may be partly attributed to the anglers' lack of knowledge regarding their habits. The changes in the relative abundance of bass in the catch are partially due to a difference in the number of records from various docks. A high percentage of bass was taken at one dock, and on months when this dock submitted a large number of records the relative abundance of bass noticeably increased in the combined returns for all docks. During the period of the census the average catch and the average fisherman-day, as well as the average catch per hour, varied only slightly from month to month. In November the catch increased to 0.6 fish per hour, and the time spent fishing dropped to an average of 2.3 hours. This may be explained by the factor of cooler weather and more expert fishermen. As indicated in Table 5, fishing was heaviest in May, declining as the season advanced.

The catch in different parts of Wheeler Reservoir varies considerably. This is probably due to the difference in habitats. The take in the middle portion of the reservoir is somewhat dissimilar at the various docks, but on the whole dif-

TABLE 6

RELATIVE MONTHLY ABUNDANCE OF THE DIFFERENT SPECIES IN THE CATCH EXPRESSED AS A PERCENTAGE OF THE TOTAL CATCH FROM WHEELER RESERVOIR DURING 1939

Month	Game fishes				Pan fishes				Food fishes						Coarse fishes			
	White bass	Bass	Sauger	Total	Blue-gill	Crap-pie	Sun-fish	Total	Chan-nel cat	Blue-cat	Yel-low cat	Bull-head	Drum	Total	Carp	Dog-fish	Mis-cella-neous[1]	Total
April	2	15	1	18	11	55	—	66	—	1	3	1	1	6	7	3	—	10
May	4	26	—	30	10	38	—	48	1	6	2	1	2	12	6	4	—	10
June	8	34	—	42	14	14	1	29	2	5	3	2	2	14	10	4	1	15
July	—	22	—	22	26	4	—	30	1	7	8	2	3	21	22	2	1	25
August	1	14	1	16	21	1	—	22	6	6	24	—	2	38	20	2	1	23
September	—	27	—	27	23	17	—	40	—	1	4	2	3	10	16	3	4	23
October	—	52	—	52	14	8	1	23	—	—	3	4	—	7	8	3	7	18
November	—	26	—	26	1	72	—	73	—	—	—	—	—	—	—	—	—	—
Per cent of total	3	25	—	28	16	26	—	42	1	5	5	1	2	14	12	3	1	16

[1] Mostly Buffalo.

fers considerably from that in the lower portion of the reservoir where game and pan fishes constituted almost the entire catch. The percentages of game fishes in the total catch at each of the six docks having the best records were 64, 9, 30, 32, 42, and 11 per cent, respectively. Listed in the same order, with the catch at the dock in the lower section first, the percentages of pan fishes were 34, 66, 26, 48, 42, and 62; those of food fishes 0, 9, 21, 6, 4, and 14; and of coarse fishes 1, 15, 22, 14, 11, and 13. The catch per hour and the catch per angler differed considerably at the several docks, varying from 0.9 fish per angler and 0.1 fish per hour to 5.5 fishes per angler and 0.9 fish per hour. The better catches were made in the middle reaches of the reservoir where pan fishing was dominant, and the poorer fishing was in the lower section where bass predominated. A comparison of the fishing at three docks is made in Table 7. Dock A is in the lower third of the reservoir, and Docks B and C are in the middle portion where most of the docks are located. Dock B is in the shallow backwater area where cover is abundant and where minor water fluctuations exert a considerable influence. Dock C is on the backwater of a tributary stream some distance from the main river. Dock A is located on a large open bay having deep water and a restricted connection with the main reservoir. Largemouth bass were predominant in the catch at this dock. Because many large fishes were taken, a great number of fishermen came here and this operator did more business than all the others combined, even though the catch per hour and the catch per angler (Table 7) were lower than at any other dock. Pan fishes were dominant in the catch at Dock B, being 66 per cent of the total catch, while game fishes constituted only 9 per cent. Food and coarse fishes were well represented, but were not nearly as abundant as at Dock C where the food fishes represented 21 per cent of the catch and coarse fishes 22 per cent. The catch of game and pan fishes was accordingly lower at Dock C than at any of the other docks, being only 56 per cent of the total, while at the other docks the proportion of these fishes ranged from 75 to 98 per cent of the entire take.

Dock B was more readily accessible than Dock A and the catch per hour was twice as great but its gross income from fishing was, nevertheless, poor compared with that of Dock A. Dock C, with the highest catch per hour and per angler, was discontinued in August because it was an economic failure. Catch per hour and accessibility are apparently of secondary importance on Wheeler. Docks in the area where game fishes rank high in the catch may be expected to be the most successful. Pan, food, and coarse fishes can be taken by bank fishing since renting boats from the docks is unnecessary. The game fishes, chiefly largemouth bass, are obviously more sought for and of more value to the dock operators than the other species and should be given special consideration in any management program.

The total amount of fishing on Wheeler can be only roughly estimated. Early in October, during the cotton picking season when fishing is light, anglers along the entire shoreline were counted. The count, which was made on week days, revealed the presence of 294 fishermen. Because each part of the shore was passed only once and the average

TABLE 7

A COMPARISON OF THE FISHING AT THREE BOAT DOCKS ON WHEELER RESERVOIR DURING 1939

Month	Dock	Number of fishermen	Number of fishes	Number of hours fished	Catch per angler	Catch per hour	Hours per fisherman-day	Percentage of each type of fishes			
								Game	Pan	Food	Coarse
April	A	379	1,071	2,452	2.8	.4	6.5	26	73	—	—
May		338	825	2,732	2.4	.3	8.1	86	13	—	1
June		481	464	3,502	.9	.1	7.2	77	18	1	4
July		299	278	2,171	.9	.1	7.2	83	15	—	1
August		173	86	1,187	.5	.1	6.8	84	15	—	—
September		213	189	1,668	.9	.1	7.8	91	8	—	—
October		147	170	1,006	1.2	.2	6.8	98	2	—	—
Totals and averages		2,030	3,083	14,718	1.5	.2	7.2	64	34	—	1
April	B	605	1,479	3,831	2.4	.4	6.3	8	83	4	5
May		306	819	2,480	2.7	.3	8.1	9	83	2	5
June		77	389	504	5.0	.8	6.5	14	70	4	12
July		225	1,229	1,320	5.5	.9	5.8	4	64	16	16
August		156	604	1,085	3.9	.5	6.9	8	36	20	36
September		202	823	1,242	4.1	.7	6.1	12	49	11	27
October		76	246	375	3.2	.7	4.9	19	36	14	30
November		23	97	119	4.2	.8	5.2	26	73	—	—
Totals and averages		1,670	5,686	10,956	3.4	.5	6.5	9	66	9	15
April	C	107	500	733	4.7	.7	6.8	14	25	23	37
May		636	1,791	3,099	2.8	.6	4.8	18	38	27	17
June		500	2,466	2,726	4.9	.9	5.4	40	23	19	18
July		349	1,491	1,972	4.2	.7	5.7	36	15	19	30
Totals and averages		1,592	6,248	8,530	3.9	.7	5.3	30	26	21	22

angler fishes only a half day (either morning or afternoon), the number of fishermen at this time was estimated at about 500 per day. The number fishing from April to September averaged much higher, possibly twice as many. On the basis of this meager information, the total number of fisherman-days is roughly estimated at about 200,000 for the year. At the time of the fishermen censuses, boats were also counted. Eight hundred and eighty-five boats were noted along the banks of the reservoir. These are all used for fishing. Possibly half of them are employed for setline fishing.

Management Suggestions. On the basis of present incomplete knowledge of the fishing and fish conditions in Wheeler Reservoir, only a few recommendations can be made for the management of the water. The introduction of white and yellow basses has been successful, but the stocking of other species appears to be undesirable at this time. Environmental improvement in such large waters is necessarily limited, but spawning facilities for catfishes have been locally increased by putting out cans to serve as nests. This work should probably be extended to other localities in the reservoir.

A constant water level would be desirable for the establishment of aquatic vegetation, for food production, and the spawning of certain species of fishes, but constant levels cannot be maintained because functions such as flood control, which require fluctuations, must be given priority. Efforts have been made, however, by the Water Control Board to maintain constant pool levels during the spawning time of the game fishes. Stabilization of water levels during this period, when even small fluctuations may be disastrous to the year's hatch, should be especially beneficial to the bass. Another factor tending to limit productivity is the muddy water entering the reservoir. Not only does this limit the plankton, but it also has an adverse effect on bottom organisms. Reduction of the amount of mud entering the reservoir is a long-time project as it depends on controlling erosion on the watershed. This work is now being promoted by the TVA under its forestry and agricultural programs.

The reservoir should be closed to bass fishing during the bass spawning season, but can perhaps remain open to fishing for most of the other species. Bass fishing has been especially heavy during the spawning season and there is reason to believe that this is at least partly responsible for the low percentage of bass in the catch. Population studies in various portions of the reservoir indicate that bass comprise only about 4 per cent of the total fish population, exclusive of the abundant gizzard-shad and gambusia. Stocking as now practiced can be expected to be of little benefit in such large waters, and any appreciable increase in the abundance of bass must result from natural reproduction.

Eventually, management will consist primarily of controlling, through regulation, the fish population in order to maintain a desirable balance between the game, pan, food, and coarse fishes. When fishing is concentrated on the more popular species, and when these may be taken during their most vulnerable season, this fishing tends to reduce the numbers of the preferred, and to favor the less desired, species. When such conditions exist, it may be wise eventually to have fewer restrictions on commercial fishing in order to control the coarse fishes. At present coarse fishes can be taken only by hook and line or by setline. In some localities, as indicated by the census returns, coarse fishes may already be far more abundant than some of the more valuable species. At one of the docks ninety-five setline lifts yielded 2,699 fishes, 93 per cent of which were carp. Continued studies to determine trends of population and relative abundance of the different species from year to year are essential for the formulation of regulations needed to maintain a desirable balance among the different species. In addition, growth-rate studies and censuses to determine quality and quantity of fishing furnish information basic to fish management. The problem of commercial fishing would be less difficult if all commercial fishermen were required to submit monthly records of their catch as is done in some other localities. A more thorough creel census covering commercial and subsistence fishing, as well as sport fishing, is now in progress, and some information on the trends will be available in 1940. Once the trends in fishing are known, further management suggestions can undoubtedly be made.

WILSON DAM TAILWATER FISHING INVENTORY

Wilson Dam, which was built by the War Department, is the oldest dam in the TVA chain. Water was impounded in April 1924. Inquiry regarding the fishing below the dam indicates that sport fishing was negligible prior to 1932, though bank and setline fishing such as had been practiced in the river for many years were common. Saugers are reported to have entered the catch in 1928 and 1929, and to have reached their maximum abundance in 1932. They have declined since 1935 and in 1939 represented only 5 per cent of the total catch. White and yellow basses, according to our sources of information, were first introduced into the Tennessee River in Wilson Reservoir in 1926. They entered the catch at Town and Big Nance Creeks, tributaries of Wilson Reservoir, in 1932 and reached their maximum there about three years later. They appeared in the catch below Wilson Dam in 1936 and since that time have rapidly increased, representing 40 per cent of the take in 1939. White bass were prominent in the catch below Wheeler Dam shortly after impoundment, and were immediately taken below Guntersville and Hales Bar Dams. The white bass is already one of the most important fishes in the Valley and it may be expected to spread to all run-of-the-river reservoirs. It will probably become the most commonly caught species in the tailwaters, although the sauger may exceed it in abundance for the first few years after a dam has been completed.

The 1939 creel census for the Wilson Dam tailwater was taken by CCC Camp TVA No. 13 under the general supervision of the Biological Readjustment Division. The entire area covered by the census is from Wilson Dam down stream to the railroad bridge, a distance of about two miles. However, most of the fishing was done in a small area of about 110 acres immediately below the dam. Boats were used by most of the fishermen and were rented from liveries some distance below the dam. This simplified the census, as men stationed at these liveries could get records of the catch as the fishermen returned. The census was gathered at four points by two shifts of four men each who were on duty from 7:00 A.M. to 6:00 P.M. each day. These men were engaged in the census continuously from April 11 to December 31, with the exception of two days in July and five days in December. It is estimated that they interviewed about 60 per cent of the anglers for the period of the census and about half of the fishermen for the entire year. Their records cover 16,094 fisherman-days of sport fishing representing a catch of 50,013 fishes in 73,401 hours, and 1,198 setline "lifts" by commercial fishermen with a take of 14,334 fishes. The commercial fishes weighed more than 25,000 pounds and the sport fishes more than 56,000 pounds. As only about half of the sport fishermen were questioned, it is estimated that the sport catch was over 100,000 pounds. It should be noted in this instance that no distinction is drawn between sport and subsistence fishing. Data given for the commercial fishing are somewhat lower than the actual catch because the census was not begun until April 11.

Sport Fishing. Information collected on the sport fishing in 1939 is summarized in Table 8. Each angler took on the average 3.1 fishes weighing 3.4 pounds in an average fishing day of four and one-half hours. This is at the rate of 0.7 fish per hour. Fishing was heaviest in May, declining somewhat each month for the remainder of the year. While the catch varied somewhat from month to month, on the whole it was fairly uniform. The average catch, the catch per hour, and the average weight of the catch were greatest in November. The data on the relative abundance of the different species of fish are summarized in Table 9. The white bass is the dominant species in the tailwater, as it comprised 40 per cent of the total catch for the period of the census; and it made up 53 per cent of the total catch in November. More than half, or 54 per cent, of the fishes taken were of game species, the percentage being lowest in August (38 per cent) and highest in November (75 per cent). Many of the

TABLE 8

SUMMARY, BY MONTHS, OF GENERAL DATA ON SPORT FISHING FOR 1939, WILSON DAM TAILWATER

Month	*Number of fishermen*	*Catch*	*Hours fished*	*Per cent weighed*	*Average weight per fish*	*Average number caught per angler*	*Catch per hour*	*Average weight of catch*	*Total weight of fish*	*Hours per fisherman-day*
April	1,867	5,303	7,984	53	1.1	2.8	.7	3.1	5,772	4.3
May	3,490	11,384	15,647	70	1.0	3.3	.7	3.3	11,951	4.5
June	2,313	7,398	10,745	79	1.0	3.2	.7	3.2	7,616	4.6
July	2,185	6,563	10,772	96	1.1	3.0	.6	3.3	7,058	4.9
August	2,196	7,450	10,727	95	1.1	3.4	.7	3.7	8,469	4.9
September	1,711	4,775	7,976	98	1.4	2.8	.6	3.9	6,389	4.7
October	963	2,546	4,398	100	1.4	2.6	.6	3.6	3,575	4.6
November	731	2,688	2,932	90	1.3	3.7	.9	4.8	3,416	4.0
December	638	1,906	2,220	100	1.3	3.0	.9	3.9	2,519	3.5
Totals and averages	16,094	50,013	73,401	84	1.1	3.1	.7	3.4	56,765	4.5

TABLE 9

RELATIVE MONTHLY ABUNDANCE OF THE DIFFERENT SPECIES OF FISHES TAKEN FROM THE WILSON DAM TAILWATER DURING 1939 EXPRESSED AS A PERCENTAGE OF THE TOTAL NON-COMMERCIAL CATCH

Month	Game fishes				Pan fishes				Food fishes					Coarse fishes			
	White bass	Black bass	Sauger	Total	Blue-gill	Crap-pie	Sun-fish	Total	Channel cat	Blue cat	Yellow cat	Drum	Total	Buf-falo	Carp	Miscel-laneous	Total
April	32	12	10	54	12	13	3	28	1	2	1	7	11	1	3	1	5
May	46	9	9	64	10	5	3	18	1	3	1	9	14	—	3	2	5
June	34	3	4	41	21	6	3	30	2	5	2	14	23	—	4	2	6
July	37	3	2	42	26	2	1	29	1	6	1	16	24	—	3	1	4
August	31	6	2	39	21	—	4	25	1	7	1	25	34	—	2	1	3
September	51	13	2	66	11	1	1	13	—	2	1	11	14	1	6	—	7
October	42	24	2	68	7	5	—	12	1	1	—	9	11	—	8	—	8
November	53	18	4	75	4	6	1	11	1	4	1	1	7	—	7	—	7
December	51	9	12	72	5	6	1	12	—	6	1	4	11	1	4	—	5
Averages	40	9	5	54	15	5	2	22	1	5	1	12	19	—	4	1	5

TABLE 10

SUMMARY, BY MONTHS, OF COMMERCIAL FISHING FOR 1939 IN WILSON DAM TAILWATER

Month	*Number of fishermen*	*Number of fishes*	*Total weight in pounds*	*Per cent of fishes weighed*	*Catch per angler*	*Weight of average catch*	*Average weight per fish*
April	141	1,073	1,824	64	7.6	13	1.7
May	242	2,619	3,929	82	10.8	16	1.5
June	179	3,000	5,700	99	16.8	32	1.9
July	118	1,684	3,180	87	14.3	27	1.9
August	117	1,296	2,270	100	11.1	20	1.8
September	154	2,197	3,946	91	14.3	26	1.8
October	92	905	1,655	100	10.0	18	1.8
November	99	1,092	1,845	100	11.0	19	1.7
December	56	468	798	100	8.4	14	1.7
Totals and averages	1,198	14,334	25,147	—	12.0	22	1.8

bass caught in this area are the Kentucky bass which is seldom taken elsewhere in these run-of-the-river reservoirs. Saugers are reported to have formerly been much more abundant in the catch.

Pan fishes represented 22 per cent of the entire take. The catch of these fishes was highest in June and lowest in November. The bluegill-crappie relationship was not as pronounced as in Wheeler. The bluegills were three times as abundant as the crappies, and were especially prominent in the catch for July. Food fishes comprised 19 per cent of the catch, with drum and blue cat predominating. Most of the drum were taken by bank fishermen and were very small. Coarse fishes, mostly carp, represented only 5 per cent of the catch. These were taken by bank or subsistence fishermen.

Commercial Fishing. Commercial fishing was by setline. Records obtained on this type of fishing show that 14,334 fishes were taken in 1,198 lifts. The average catch was 12 fishes weighing in all 22 pounds. The total weight for all fishes recorded was 25,147 pounds, which had a value to the fishermen of about $2,500.00 The average haul was, therefore, worth about $2.20 and, as setlines are generally lifted twice a day, the gross daily income per fisherman was about $4.40. The catch varies decidedly from day to day and many commercial fishermen tend their lines irregularly.

The data suggest that fishing was best in June, when the average haul weighed 32 pounds. General fishing data, by months, are listed in Table 10; the catch by species is shown in Table 11.

The fish catch consisted primarily of catfishes and drum (food fish), as these represent 83 per cent of the take compared with only 11 per cent coarse fishes and 5 per cent game fishes. The game fishes were presumably used by the fishermen for their own consumption because they could not be legally sold. Drum comprised almost half the catch, and nearly a fourth of all the fishes taken were blue catfish.

Comparison of the Fishing. A comparison of the catches of sport fishermen and commercial fishermen (Tables 9 and 11) shows that the two differ decidedly, and that the fishes primarily taken by one group are of secondary importance to the other. Game and pan fishes represented 76 per cent of the catch of the sport fishermen and only 5 per cent of the take of the commercial fishermen. For food fishes the percentages were 18 and 83 per cent, respectively, and for coarse fishes 5 and 11 per cent.

Because commercial fishing removes some fishes that are competitors of the young of game species, there is a possibility that the commercial fishing is definitely beneficial to the sport fishing, provided, of course, that the regulations pertaining to the taking of game fishes by commercial fishermen are rigidly enforced.

The catch of about 125,000 pounds of fish from this one locality suggests that fishes are concentrated in large numbers immediately below the dam.

Guntersville Tailwater. Data taken at the dock below Guntersville Dam in Wheeler Reservoir, representing fishing immediately below the dam, differ decidedly from those taken below Wilson Dam. Guntersville was impounded in

TABLE 11

RELATIVE MONTHLY ABUNDANCE OF THE VARIOUS SPECIES IN THE CATCH, EXPRESSED AS A PERCENTAGE OF THE TOTAL COMMERCIAL CATCH, WILSON DAM TAILWATER, 1939

Month	Game fishes				Pan fishes			Food fishes						Coarse fishes			
	White bass	Black bass	Sauger	Total	Bream	Crappie	Total	Channel cat	Blue cat	Yellow cat	Willow cat	Drum	Total	Buffalo	Carp	Miscellaneous	Total
April	12	1	6	19	1	2	3	9	9	1	—	52	71	—	7	1	8
May	5	1	1	7	—	—	—	6	11	3	1	67	88	—	3	3	6
June	1	1	—	2	1	—	1	7	29	12	1	39	88	1	8	1	10
July	1	—	—	1	—	—	—	25	26	13	—	26	90	—	7	—	7
August	2	—	—	2	—	—	—	6	29	6	1	47	89	1	6	—	7
September	1	—	—	1	—	—	—	2	19	6	1	44	72	4	24	—	28
October	—	5	—	5	—	1	1	4	9	3	1	62	79	2	13	—	15
November	5	2	4	11	—	—	—	1	46	9	—	23	79	1	7	—	8
December	3	—	3	6	2	—	2	1	39	13	—	36	89	2	1	—	3
Averages	3	1	1	5	—	—	—	7	22	7	1	46	83	1	9	1	11

January 1939, and fishing below the dam was exceptionally good during part of the first year. Information on the fishing is rather fragmentary, but some data (Table 12) are available on the relative abundance of various species in the catch for part of the 1939 season. In midsummer, game fishes comprised only a small percentage of the recorded catch. Much of the fishing at that time was some distance below the dam and some of it was with setlines. After September, game fishes comprised almost the entire catch. More than half the fishes recorded for October were white bass. Saugers increased from less than half of one per cent in August to 87 per cent of the catch in December. Apparently, the saugers in the water below a dam are attracted to the tailwater soon after the dam is operative. White bass, too, tend to concentrate in waters immediately below a dam. Records for the catch per angler and the catch per hour are not available except for 487 collected during November and December. These records indicate a catch of 2,722 fishes in 2,621 hours, an average of more than one game fish per hour. If fishing below Guntersville follows the usual trend for the tailwaters, sauger fishing may be expected to be good for several seasons after which it will be largely replaced by white bass fishing.

TABLE 12

RELATIVE ABUNDANCE OF THE VARIOUS SPECIES OF FISHES, EXPRESSED AS A PERCENTAGE OF THE TOTAL CATCH FROM GUNTERSVILLE TAILWATER AND VICINITY, 1939

Month	*Total number of fishes*	*White bass*	*Bass*	*Sauger*	*Bream*	*Crappie*	*Blue cat*	*Yellow cat*	*Drum*	*Buffalo*	*Carp*	*Scaly cat*
August	932	1	5	—	15	4	4	1	33	3	30	3
September	494	6	11	1	7	29	1	—	4	2	30	8
October	814	57	5	16	1	17	1	—	1	—	2	—
November	1,993	10	2	85	—	2	—	—	—	—	—	—
December	1,475	7	4	87	—	2	—	—	—	—	—	—
Totals and averages	5,708	14	4	54	3	7	1	—	6	1	8	1

Norris Dam Tailwater. The tailwaters in the Valley are of two distinct types. Below the run-of-the-river dams the water is warm, but the release for some distance below the storage dams is cold in summer as well as in winter, generally between 45° and 55° Fahrenheit, a temperature suitable for trout. The Clinch River below Norris contains trout though it cannot be regarded, for the present at least, as a good trout stream.

The number of trout caught below Norris Dam in 1939 probably did not exceed a few hundreds. These were rainbow trout varying between 14 and 20 inches in length, almost all of which were taken at very low water level. One of the most regular and successful fishermen at Norris took 23 rainbows, averaging almost 17 inches in length, in 11 fishing trips totaling 42½ hours, an average of one fish every two hours.

Management. As the run-of-the-river reservoir tailwaters attract fishes that tend to be poorly represented in the catch in the reservoir proper, there is no assurance that closing the tailwaters to fishing would improve the catch in the reservoirs. Fishing in the tailwaters may be expected to provide a yearly revenue of about \$30,000 to \$50,000 at each dam, assuming that the value per pound for fish taken by sport fishermen is \$0.50 and assuming that fishing below other reservoirs will be about equal to that below Wilson Dam. Closing the tailwaters would, therefore, tend to waste an asset having a potential income of several hundred thousand dollars per year. From a biological viewpoint, such closing could not be recommended. Fishing in the tailwaters by boat is hazardous, however, and the development of safety regulations, which would drastically curtail the fishing, may become necesssary.

To date the saugers have declined in abundance within a few years in each case after a dam has been installed. Whether this decline is due to fishing or to biological changes is not known, but the restriction of ten per day placed on saugers by the State of Alabama seems to be a very desirable one. Enough is not yet known about the sauger to determine whether or not a closed season would be beneficial.

The white bass appears to be "holding its own" below Wilson Dam, even though fishing for that species is intensive. Restrictions other than those now in effect are apparently not needed. Commercial fishing should be regarded as second in importance to sport fishing and should be curtailed when and if definite evidence becomes available, suggesting that commercial fishing has a deleterious effect on the abundance of game fishes. Certain methods of commercial fishing, such as "snatching," should preferably not be permitted. Thirty fisherman-days of snatching yielded 46 spoonbills and 55 yellow cats having a total weight of 1,305 pounds. It is possible that many fishes are removed by illegal means and that the commercial take, including the catch of game fishes, may therefore be higher than our records indicate. A rather strict regulation of the commercial fishing here is desirable, because this fishing is secondary in importance to the sport fishing.

The Clinch River below Norris Dam produces a limited number of trout that are generally taken during low water. Large plantings have been made, but to date the results are uncertain. Because of the migratory tendency of the rainbow, brown trout were stocked in 1939. Both gigging and setline fishing are practiced in this stream at present. The desirability of using these methods of fishing in a trout stream is open to serious question. The major impediments in establishing a good trout supply, however, are probably the decided and relatively sudden fluctuations in flow and the resulting considerable changes in water temperature. These cannot be controlled by fish management as fishing in the Clinch is obviously secondary in importance to flood control and navigation. A good large trout stream would be a very important asset to the area, but whether or not any practicable management program could change the Clinch into a good trout stream must still be determined.

DISCUSSION

Our information shows that the catch differed decidedly in the waters under consideration. In the storage reservoirs and the tailwaters game fishes predominated, but in the run-of-the-river reservoir pan fishes outnumbered the game fishes. The data suggest that the sauger is the most important species in the tail-

TABLE 13

RELATIVE ABUNDANCE OF FISHES DURING 1939,[1] EXPRESSED AS A PERCENTAGE OF THE TOTAL CATCH, IN EACH OF THE MAJOR KINDS OF FISH HABITAT

	Reservoirs		Dams		
	Norris	Wheeler	Guntersville	Wilson (Sport)	Wilson (Commercial)
Type of water:	*Storage*	*Run-of-the-river*	*Tailwater*	*Tailwater*	*Tailwater*
Game fishes					
White bass	—	3	14	40	3
Bass	80	25	4	9	1
Walleye	9	—	—	—	—
Sauger	2	—	54	5	1
Totals	91	28	72	54	5[3]
Pan fishes					
Bluegill	6	16	3	15	—
Crappie	1	26	7	5	—
Sunfish	—	—	—	2	—
Totals	7	42	10	22	—
Food fishes					
Channel cat	—	1	—	1	7
Blue cat	—	5	1	4	22
Yellow cat	—	5	—	1	7
Bullhead	—	1	—	—	1
Drum	—	2	6	12	46
Totals	—	14	7	18	83
Coarse fishes					
Carp	1	12	8	4	9
Dogfish	—	3	1	—	—
Miscellaneous[2]	—	1	1	1	2
Totals	1	16	10	5	11

[1] Percentages based on total recorded catch for 1939.
[2] Includes a few fishes of other groups.
[3] Presumably not sold; may be taken by the fishermen for their own use.

Note: In the text the species are referred to by common name only. Scientific names are as follows: Basses: All three species of black basses—the largemouth, *Huro salmoides;* smallmouth, *Micropterus d. dolomieu;* and the Kentucky, *Micropterus p. punctulatus;* White bass: Chiefly *Lepibema chrysops* but including also the yellow bass, *Morone interrupta.* The two were grouped under one form because of some census taker's inability to differentiate between the two; Walleye: *Stizostedion vitreum.* Reported taken only in one of the three waters (Norris Lake). Sauger: Locally called Jack salmon, *Stizostedion c. canadense;* Bluegill: Locally called bream, *Lepomis m. macrochirus;* Crappies: Both *Pomoxis nigro-maculatus* and *Pomoxis annularis.* The former only is taken in Norris; both occur in the other two waters. Warmouth Bass: *Chaenobryttus gulosus;* Sunfishes: Locally called sunperch, include several species of *Lepomis* (*cyanellus, microlophus, megalotis megalotis,* and *punctatus miniatus*); Channel cat: *Ictalurus lacustris punctatus;* Blue cat: *Ictalurus furcatus furcatus;* Yellow cat: *Pilodictis olivaris;* Bullhead: Locally called willow cat, includes three species of *Ameiurus; melas catulus, natalis natalis,* and *nebulosus marmoratus;* Carp: *Cyprinus carpio;* Drum: *Aplodinotus grunniens;* Dogfish: Locally called scaly cat, *Amia calva;* Miscellaneous includes buffalo fishes (*Ictiobus niger, Ictiobus bubalus,* and *Megastomatobus cyprinella*), pike (*Esox niger*), rock bass (*Ambloplites rupestris*), and several genera of suckers including *Catostomus, Minytrema,* and *Moxostoma.*

water of a relatively new dam, and that in time this fish is replaced by the white bass. The differences in the recorded catch for the three different habitats are shown in Table 13.

Fishing is similar in the various parts of a storage reservoir and the degree to which an area is fished depends primarily on accessibility. In the run-of-the-river reservoir, the catch varies in different localities. White bass and saugers are taken mostly in the tailwaters; pan fishes tend to be abundant in the wide, shallow areas of the middle section of a reservoir; and the largemouth bass appears to be most common in the deep, clear water found in the lower third of an impoundment. Species that are common in the catch from the tailwater below a dam are not abundant in the reservoir proper, and those which are most prominent in the catch in the reservoir are generally not taken in the tailwater. Regulations on fishing in the tailwaters should preferably be made for the benefit of fishing in that area only, and should not be expected to influence fishing in the reservoir below.

The creel census information suggests that storage reservoirs should preferably be closed to all fishing during the spawning season, but that on the run-of-the-river reservoirs year-round fishing should be permitted for most of the species, with a closed season placed only on those that prove most desirable and which are declining in the catch. Restrictions will be of little value if the reasons for decline are biological; for example, no kind or amount of legislation will make Norris a good bream fishing lake or will greatly increase the drum in the lower third of the run-of-the-river reservoirs.

Coarse fishes are not abundant in the catch in the storage reservoirs and will probably not be of much significance there, but on the run-of-the-river reservoirs some restrictions on commercial fishing may need to be removed if the coarse fishes are to be kept within bounds. Commercial fishing should probably be encouraged in the run-of-the-river reservoirs, but any fishing other than with hook and line should be discouraged in storage reservoirs unless kept under close control.

The construction of more dams will tend to improve fish conditions in the water below, because silt is deposited in the lower parts of each reservoir and the water becomes clearer as more reservoirs are created. Erosion control, too, has a beneficial influence on the fishing. Muddy water not only makes the water less productive by keeping out the light needed for plant photosynthesis, but gives an advantage to the carp and other less valuable species that tend to thrive better than bass under those conditions.

Fishing has very decidedly increased since the TVA impoundments have been made and the Tennessee and its tributary, the Clinch, are yielding many times the fishes produced prior to impoundment.

The more extensive 1940 census, covering most of the major impoundments, will probably provide more detailed information of value to the management of the fisheries in the Valley. A knowledge of the trend of the fishing is needed to solve many of the problems, and this information obviously cannot be obtained from data for a single year.

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