

State agrees to construct and maintain a launching ramp on the land in question adjacent to _____

(name of waterway)

County agrees to construct and maintain an all-weather road to this boat launching area and to construct and maintain an adjacent parking area of at least two acres.

County affirms that it has title to the right-of-way needed for access to the boat launching area as well as title to the parking area in question, or in the alternative that said County has at least a twenty year lease on this right-of-way and parking area.

State and County both agree that this ramp, right-of-way, and parking area will remain open to the public free of charge.

Executed by the parties hereto this _____ day of _____, 19____

CHAIRMAN, BOARD OF COMMISSIONERS
OF _____ COUNTY

DIRECTOR, STATE GAME AND FISH
COMMISSION, STATE OF GEORGIA

EFFECTS OF A 12-INCH SIZE LIMIT ON SMALLMOUTH BASS POPULATIONS AND FISHING PRESSURE IN THE SHENANDOAH RIVER, VIRGINIA¹

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ABSTRACT

In 1964, five sections of the Shenandoah River ranging from 9.0 miles to 15.3 miles in length (average 11.4 miles) were selected for an airplane census of fishermen. The census was conducted on a randomized schedule² for both days of the week and time of day for the counts, with weekend days weighted because of heavier fishing pressure on those days. These data for 1964 through 1967 were used to compute the total fishing pressure in these sections.

Creel clerks were employed on a part-time basis in each of the five sections to gather information on the number of smallmouth bass, both undersize and legal size, as well as the number and sizes of channel catfish, sunfish, and other species caught. The number of hours each fisherman fished were also recorded. In three of the sections, mail boxes with measuring boards at hand were supplied at boat landings, or other points of access, so that voluntary reports could also be supplied by anglers.

In 1964, there was no size limit nor closed season on smallmouth bass. Fishermen kept bass as small as six inches in length. The result was a serious depletion of stocks of spawning size and many complaints by fishermen. In 1965, a 12-inch minimum length size was imposed on Shenandoah River bass with an almost immediate improvement in fishing. The number of 9, 10, and 11 inch bass increased substantially, and persons fishing for the sport of it with artificial lures have been very pleased with the results. One interesting feature of the study has been a gradual decline in the total fishing pressure in the five river sections totalling 56.8 miles in length. In 1964 the total fishing pressure was about 140,000; in 1965, 118,000;

¹Based on Virginia's Dingell-Johnson Project F-14-R, Smallmouth Bass Stream Investigations.

²Schedule furnished under contract by the Institute of Statistics, University of North Carolina, Raleigh.

100,000 in 1966; and 75,000 fishermen hours in 1967. The reason for this decline in fishing pressure is not fully understood, but it is probable that fishermen like to exhibit their success in the form of fish taken home. In 1935, the catch of legal smallmouth bass (under the 10-inch limit) ranged as high as 1.0 smallmouth bass per hour, whereas in 1965-67, it averaged about 0.06 smallmouth bass per hour. In other words, it required about 17 hours to catch a take-home bass. The current records show a decided increase in catches of smallmouth bass of all sizes, but only a moderate increase in number of legal fish caught. One possible conclusion is that some fishermen are taking out many of the edible-size fish before they reach 12 inches in length.

Bass nest counts indicate a substantial increase in fish of spawning size.

INTRODUCTION

The Shenandoah River drains generally northeastward through the fertile Valley of Virginia. The South Fork meanders through the upper valley, winding between the Massanutten and Blue Ridge Mountains while the smaller North Fork with its "Seven Bends" (plus) drains the main valley lying between the west side of the Massanutten and North Mountain. The average flow (Kapustka, 1957) of the South Fork at Front Royal 3.5 miles above its confluence with the North Fork is about 2,100 cubic feet per second. The drainage area of the South Fork is 1,638 square miles. The average flow of the North Fork at a point 10 miles above its mouth is about 580 c.f.s. and the total drainage area 772 square miles. Both forks receive the flows of many limestone springs in their valley floors, but both are fed by softwater streams descending from the mountains where hard sandstones and rocks of igneous origin predominate. The South Fork is characterized by extensive riffles flowing over limestone ledges. (Figure 1) The North Fork also has many limestone ledges exposed but is characterized by having more gravel in the riffles. Both streams have many long pools between these riffles. Both forks have moderately high calcium-magnesium hardness ranging from about 110 to 190 parts per million. Good bottom fauna



Figure 1. South Fork of the Shenandoah River at Carvel Road above Overall, Virginia.

populations characterize them. The Shenandoah River has been noted for many years for its fine smallmouth bass fishing. A study of fishing pressure on the South Fork and Main Stem was begun in 1964 with a combined air and ground census. Aerial observation of fishermen was so effective that beginning in 1965, about 10 flights per month were scheduled and the ground observation points used in 1964 were abandoned. The fishing pressure study is now in its fifth consecutive year. Throughout this period, part time creel clerks have been employed to obtain data on completed fishing trips as a basis for determining what species of fish were being caught and the catch per unit of effort. These data have been used to compute the total catches of fish in the sections of river studied. The North Fork of the Shenandoah was not included in this study because the bends of the river are too frequent and too short for complete aerial census.

The years 1964, 1965, and 1966 were severe drought years when float fishing for smallmouth bass was made very difficult by low flows, particularly in the late summer and fall.

METHODS

Fishing pressure was determined by aerial counts, made between May 1 and October 31, of fishermen fishing from boats, wading, or fishing from the bank within five sections of the river located as described in Table 1. The aerial surveys covered 35 miles (34.2 per cent) of the South Fork and 22 miles (62.8 per cent) of the Main Stem of the Shenandoah River in the Virginia portion of the river.

TABLE 1
Fishing Pressure Study Areas Sampled, Shenandoah River.

<i>Section</i>	<i>Location</i>	<i>Length in Miles</i>
A	South Fork of Shenandoah River Route 340 Bridge below Shenandoah, Va., to Route 340 Bridge above Alma.	9.0
B	South Fork of Shenandoah River Riffle at Golden Rock (Compton) to Bentonville Bridge (Rt. 613)	10.5
C	South Fork of Shenandoah River Bentonville Bridge to Riverside Bridge (Rts. 624 to 50)	15.3
D	Main Stem of Shenandoah River Morgan Ford Bridge to Byrd Bridge (Rts. 624 to 50)	11.0
E	Main Stem of Shenandoah River Byrd Bridge (Rt. 50) to Watermelon Park at Shepherds Ford	11.0
	Total	56.8

In 1965, 1966, and 1967, approximately ten airplane flights per month were made over these five sections of river to count fishermen. They were made on a statistically randomized schedule and according to a design¹ in which certain weekend days, including Wednesdays when many persons have half days off from work, as well as weekdays, were selected at random for the counting of fishermen. The time of day for making these counts were also selected randomly after taking into consideration the length of day and the time required to make a flight. Based on the number of fishermen observed from the air and the reports of creel clerks and

¹Furnished by Dr. Don Hayne, Institute of Statistics, North Carolina State University, Raleigh, North Carolina.

voluntary reports by interested fishermen, estimates of total hours of fishing and total catches of fish were made in each of the 1964, 1965, 1966, and 1967 seasons.

Part time creel clerks paid on an hourly basis for 3 hours work on Saturdays, Sundays and holidays and 2 hours on each week day were employed in each of the five sections to record the information on completed fishing trips.

In three of the river sections described in Table 1, Sections A, B, and E, red mail boxes, measuring boards, (Figure 2) and angler report cards were provided at access points for the use of those fishermen interested in helping out on a voluntary basis. Many took the time to fill out the cards which showed the kinds, sizes, and number of fish caught, as well as the number of hours fished. Their reports of kinds of fish caught and number of hours of fishing, together with that of the creel clerks were used for the estimation of total hours of fishing and total catch per hour. The



Figure 2.

cooperation of anglers has been outstanding and their help has been greatly appreciated by the Commission of Game and Inland Fisheries.

The time of spawning and the extent of natural reproduction as well as the success of natural reproduction of smallmouth bass has been followed each spring since 1964. Bass nest counts were made in Sections A and B of the South Fork, below Section E between Shepherds Ford and Castleman's Ferry bridge (Route 7), and on the North Fork of the Shenandoah River 5.2 miles downstream from Stonewall Mill (Artz Mill) in each of the years 1964-1967. In making nest counts the same procedure has been followed as was used during the period 1936-1941 (Surber, 1943). The method consisted of poling a boat down one bank of the river and noting the number of smallmouth bass nests with eggs, those without eggs, and nests with fry. A galvanized metal tube with handles and a 5-inch diameter magnifying lens, sealed in the bottom of the tube, was used to determine whether eggs or fry were present. Number of nests per mile was determined by multiplying the one bank count by two (for both sides of the river) and dividing by the number of miles of river bank counted. The number of miles counted in a given area varied from a minimum of 2.0 miles to a maximum of 5.2 miles.

Smallmouth bass spawn at about 63°F. However, they will not spawn unless the river water is quite clear, and unless the river stages have begun to stabilize. Generally, river stages are high in early April. River flows decrease rather rapidly through late April and begin to stabilize around the first of May about the time dogwoods begin to bloom. Heavy rains and muddy water have been known to delay the spawning season into early June.

In the evaluation of the 12-inch minimum size limit on bass in the Shenandoah, placed in effect in 1965 following a period of no size limit for several years, bass nest counts have been useful in showing a decided upward trend in stocks of smallmouth bass large enough to spawn.

In 1964 when there was no size limit, fishermen were observed keeping smallmouth bass as small as six inches in length, and local bass fishermen were generally opposed to a no size limit. Experiments in the hatchery ponds at Waterlick with bluegill sunfish-largemouth bass combination showed that ponds with a size limit of 14 inches, and later 12 inches, produced higher quality fishing (more bluegills seven inches or better in length) with more pounds of bluegills per acre in the Limit than in the No Limit ponds. Number of pounds of bass harvested, however, were less in the Limit Ponds than in the No Limit ponds.

A summary of fishing pressure trends; estimated total smallmouth bass, catfish, sunfish, and other fish caught; and catch per unit of effort follows:

FISHING PRESSURE

From May 1 through October 31, 1965, 1966, and 1967, approximately ten airplane flights per month were made over five sections of the South Fork and Main Stem of the Shenandoah River to count fishermen. In 1964, five flights per month and a ground man, counting fishermen from sight stations in the same sections, were used to determine fishing pressure.

The river sections, locations, and lengths are listed in Table 1.

Table 2, shows the estimated fishing pressure by months in the five sections of river sampled by plane flights.

Table 2 shows that May, June and July are the months of greatest fishing pressure. It also reflects declining fishing pressure for each of the years of record in the five river sections studied.

Table 3, provides estimates on total fishing pressure during the period 1964-1967 for the 102 miles of the South Fork from Port Republic to Riverton, and the Main Stem of the Shenandoah River within Virginia (34.8 miles).

An examination of the catch per hour records, Table 4, for the principal game fishes: smallmouth bass (all sizes), legal size smallmouth bass, 12 inches and more in length, channel catfish, and sunfish (mostly *Lepomis auritus*) affords a more encouraging picture. The catch per unit of effort for all of the above game species has not decreased significantly, and in some areas of the river has actually increased.

TABLE 2
Estimated Fishing Pressure on Shenandoah River Sections Sampled by Plane Flights.

Year	May	June	July	Aug.	Sept.	Oct.	Fishermen Hours	
							Total	per Mile
SOUTH FORK								
Section A-Above Alma (9.0 miles)								
1964 ¹	8,001	4,277	8,758	2,638	2,352	371	26,397	2,933
1965	5,621	5,251	8,704	1,453	1,457	908	23,394	2,599
1966	5,702	2,776	3,880	3,351	1,564	544	17,817	1,980
1967	1,347	3,959	2,948	2,105	412	389	11,160	1,240
Section B-Compton to Bentonville Bridge (10.5 miles)								
1964	6,587	6,147	6,554	5,663	4,351	189	29,491	2,809
1965	3,678	6,875	7,703	2,024	2,628	1,033	23,941	2,280
1966	5,070	4,003	3,926	6,639	2,876	482	22,996	2,190
1967	2,185	4,257	4,128	2,954	1,205	1,295	16,024	1,526
Section C-Bentonville Bridge (15.3 miles)								
1964	12,761	4,510	8,209	7,526	8,728	557	42,291	2,764
1965	9,697	10,460	9,548	3,745	4,480	1,707	39,637	2,591
1966	6,737	6,085	8,474	8,001	3,620	1,108	34,025	2,224
1967	2,897	6,873	8,019	4,588	1,700	2,094	26,171	1,711
MAIN STEM								
Section D-Morgan Ford to Byrd Bridge (11.0 miles)								
1964	6,272	2,623	3,808	3,078	2,119	371	18,271	1,661
1965	3,705	2,942	3,700	1,448	920	55	12,770	1,161
1966	2,672	2,004	3,115	3,823	1,416	0	13,030	1,185
1967	1,216	2,870	2,756	2,411	964	601	10,818	983
Section E-Byrd Bridge to Watermelon Park (11.0 miles)								
1964	10,192	2,319	3,371	4,139	2,488	742	23,251	2,114
1965	4,523	4,152	4,887	1,400	1,930	1,267	18,159	1,651
1966	2,229	1,809	3,241	3,502	1,269	289	12,340	1,122
1967	2,020	2,286	2,686	2,755	637	877	11,261	1,024

¹ In 1964, 5 flights per month and a ground man were used to obtain fishing pressure.

The catches per unit of effort and miles of river have been used to estimate the total catches of smallmouth bass, sunfish, channel catfish, and all species in the Shenandoah River, 1964 to 1967. All species include carp, white suckers, redhorse suckers, eels, and bullheads, as well as smallmouth bass, channel catfish and the sunfishes.

Table 5, provides estimates of the total smallmouth bass caught in the South Fork and Main Stem in the years 1964 to 1967, both all sizes and legal size.

Following 1964 when there was no size limit, the number of smallmouth bass of all sizes caught increased sharply. In the South Fork in 1966, for example, there was a threefold increase in number of smallmouth bass of all sizes caught.

Catches of legal smallmouth bass during 1965 through 1967 have declined in the South Fork. In the Main Stem, there has been a decided decline in legal size smallmouths caught in Section E and below in 1967. The statistics collected for Section D have been obtained at the lower end of the Morgan Ford to Byrd Bridge section, a section subject to periodic fish kills and biological degradation as a result of pollution originating in Front Royal.

Table 6 shows the estimated total catches of sunfish, channel catfish, and all species in the Shenandoah River from 1964 to 1967. In the upper South Fork, the

TABLE 3
Total Fishing Pressure-Shenandoah River. Based on Plane Flights, 1964-1967.

Section	Miles of River	Total fishermen hours			
		1964	1965	1966	1967
<i>South Fork</i>					
Port Republic to Hamburg-Luray	51	149,583	132,549	100,980	63,240
Hamburg-Luray to Riverton	51	142,137	125,664	112,710	83,385
Totals	102	291,720	258,213	213,690	146,625
<i>Main Stem</i>					
Riverton to Morgan Ford	6.9	11,461	8,011	4,092	6,783
Morgan Ford to Byrd Bridge	11.0	18,271	12,771	13,035	10,818
Byrd Bridge to Watermelon Park	11.0	23,254	18,161	12,342	11,261
Watermelon Park to Va.-W. Va. Line	5.9	12,473	9,741	6,620	6,042
Totals	34.8	65,459	48,684	36,089	34,940

TABLE 4
Catch per Hour-Shenandoah River, 1964-1967.

Section	Location	1964	1965	1966	1967
<i>Smallmouth Bass All Sizes</i>					
A	Above Alma	0.230	0.140	0.685	0.399
B	Compton	0.147	0.016	0.663	0.812
C	Bentonville Bridge	0.147	0.062	0.641	0.504
D	Morgan Ford	0.136	0.085	0.384	0.822
E	Byrd Bridge	0.127	0.703	0.705	1.044
<i>Smallmouth Bass Legal Size</i>					
A	Above Alma	---	0.048	0.071	0.048
B	Compton	---	0.010	0.016	0.042
C	Bentonville Bridge	---	0.037	0.033	0.012
D	Morgan Ford	---	0.085	0.144	0.233
E	Byrd Bridge	---	0.092	0.036	0.083
<i>Channel Catfish</i>					
A	Above Alma	0.164	0.067	0.081	0.111
B	Compton	0.196	0.241	0.160	0.118
C	Bentonville Bridge	0.196	0.181	0.122	0.091
D	Morgan Ford	0.909	1.592	1.986	1.103
E	Byrd Bridge	0.332	0.979	0.627	0.488
<i>Sunfish</i>					
A	Above Alma	0.270	0.051	0.387	0.258
B	Compton	0.110	0.172	0.295	0.442
C	Bentonville Bridge	0.110	0.155	0.232	0.255
D	Morgan Ford	0.247	0.901	0.954	0.845
E	Byrd Bridge	0.110	0.118	0.127	0.263

TABLE 5
Estimated Total Smallmouth Bass Caught in South Fork and Main Stem, 1964 to 1967.

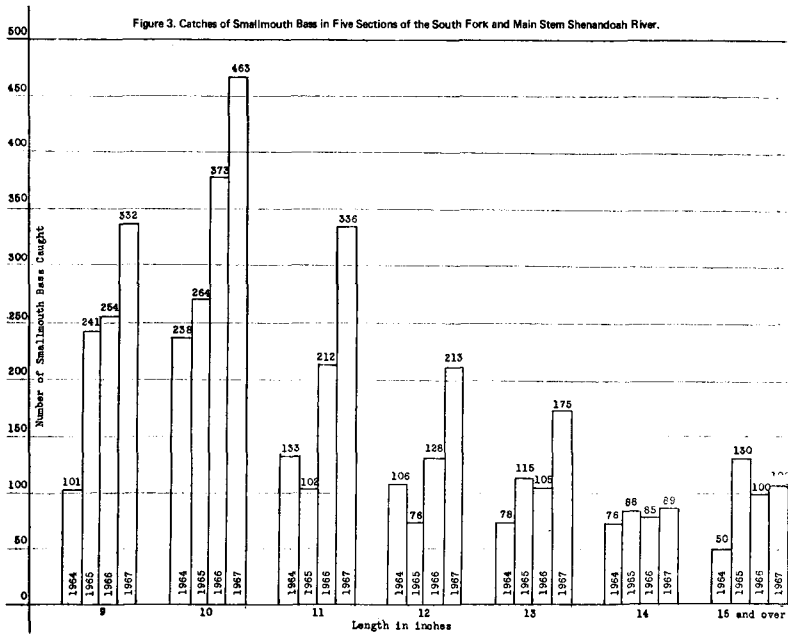
Section	Catch of Smallmouth Bass All Sizes			Catch of Smallmouth Bass Legal Size				
	1964	1965	1966	1967	1964	1965	1966	1967
<i>South Fork</i>								
Port Republic to Hamburg-Luray	43,707	29,824	70,988	25,233	—	7,824	7,170	3,036
Hamburg-Luray to Riverton	7,293	21,362	85,998	51,365	—	4,147	3,945	2,668
Total	51,010	51,186	156,986	76,589	—	11,971	11,110	5,704
<i>Main Stem</i>								
Riverton to Morgan Ford ²	9,522	6,889	1,575	5,576	—	6,889	597	1,580
Morgan Ford to Byrd Bridge ²	1,518	10,983	5,018	8,892	—	10,983	1,903	2,521
Byrd Bridge to Watermelon Park	2,178	11,133	10,009	11,756	—	1,796	4,690	957
Watermelon Park to Va.—W. Va. Line	1,168	5,971	5,369	6,308	—	964	2,516	514
Total	14,386	34,976	21,971	32,532	—	20,732	9,706	5,572

¹ No size limit on smallmouth bass in 1964.

² Undersized bass not recorded in Section D in 1965, hence all sizes include legal size and the duplication of figures in columns 2 and 5.

TABLE 6
 Catches of Sunfish, Channel Catfish, and All Species in the Shenandoah River, 1964 to 1967.

1964	Sunfish			Channel Catfish			All Species				
	1965	1966	1967	1964	1965	1966	1964	1965	1967		
41,055	20,675	39,786	16,253	26,010	10,736	9,189	7,020	118,116	87,482	142,483	59,509
South Fork											
Port Republic to Hamburg-Luray											
6,222	20,609	28,516	27,600	11,526	26,892	16,794	8,422	26,622	75,763	89,717	96,310
47,277	41,284	68,302	43,853	37,536	37,628	25,983	15,442	144,738	163,245	232,200	155,819
Main Stem											
Riverton to Morgan Ford											
2,180	7,209	3,904	5,732	6,900	12,722	8,127	7,482	10,350	23,203	14,621	19,203
Morgan Ford to Byrd Bridge											
3,476	11,516	12,435	9,141	12,947	20,321	25,888	11,932	21,263	37,065	46,574	30,626
Byrd Bridge to Watermelon Park											
3,883	3,506	1,617	2,962	9,889	8,919	9,121	54,954	29,459	32,696	22,820	21,328
Watermelon Park to Va.-W. Va. Line											
2,083	1,879	867	1,589	5,304	4,781	4,892	2,948	10,437	17,528	12,240	11,444
11,622	24,110	18,823	19,424	35,040	46,743	48,028	77,316	61,509	110,492	96,255	82,601
TOTALS											



data show declines in catches of sunfish, catfish, and all species. The lower South Fork exhibited a modest decline in catches of sunfish, a sharp decline in catches of channel catfish to about half of the 1966 catch, but an increase in catches of all species.

In the Main Stem, total catches of sunfish increased somewhat, and the catches of catfish, particularly in the lower Main Stem rose sharply. The catches of all species in the Main Stem have continued to decline since 1965, following the pattern of generally declining fishing pressure to which it appears directly related.

The following evidence is presented to show that fishing for smallmouth bass is in fact improving rather than declining in the Shenandoah River.

The Angler's Report Card used in this study provided spaces for recording the sizes and number of undersized as well as legal-size smallmouth bass caught. Many fishermen failed to record lengths, generally estimated, of undersized bass caught, but many fishermen recorded the sizes taken and these data were summarized. Figure 3 shows a definite upward trend in numbers of 9, 10, 11, and 12 inch bass caught.

Smallmouth bass nest counts have been increasing as illustrated by Table 7, which shows the results of bass nest counts during three successive years on the South Fork between Compton and Carvel Road when counts were made under satisfactory river conditions. An increasing adult smallmouth bass population is definitely indicated.

Finally, there is the evidence collected by hook and line catches of the writer and a companion on several fishing trips during the 1965, 1966, and 1967 seasons. Fishing was entirely with artificial lures. Too few fishing trips were made, but Table 8 furnishes the results of the fishing which in 1967, particularly, showed increases in the percentages of 10, 11, and 12 (and upward) inch bass caught. More of such practical data are needed, and similar data for purely live-bait fishing with comparisons of catch per unit of effort may prove valuable. We have been unable to get representative samples of smallmouth bass populations with a D.C. electric shocker because most of the larger fish leap entirely out of the electrical field.

TABLE 7

Smallmouth Bass Nest Counts. South Fork Shenandoah River, below Compton Pool to Carvel Road.

	May 20, 1965	May 18, 1966	May 29, 1967
Number nests with eggs	62	76	104
Number nests without eggs	14	50	104
Number nests with fry	4	0	74
Total number of nests	80	126	282
Number of nests per mile	40	63	141

TABLE 8

Hook and Line Catches of Smallmouth Bass 1965-1967. Shenandoah River

Inches	1965		1966		1967	
	Number	Per cent	Number	Per cent	Number	Per cent
5.0-5.9	0	0.0	0	0.0	0	0.0
6.0-6.9	5	4.0	8	14.3	0	0.0
7.0-7.9	20	16.3	1	1.8	5	4.2
8.0-8.9	25	20.3	19	33.9	10	8.4
9.0-9.9	32	26.0	15	26.8	43	36.1
10.0-10.9	29	23.6	7	12.5	30	25.2
11.0-11.9	7	5.6	6	10.7	13	10.9
12.0-	5	4.0	0	0.0	18	15.3
Total	123	99.8	56	100.0	119	100.1
Number of trips	5		4		8	
Per cent under 10"		56.6		76.8		48.7

CONCLUSIONS

1. There has been a consistent downward trend in total fishing pressure on the Virginia portion of the Shenandoah River in the period 1964 through 1967. On the 102 miles of the South Fork, total estimated fishermen hours amounted to 291,720 in 1964; 258,213 in 1965; and 146,625 in 1967. On the 34.8 miles of the Main Stem, the estimated total number of fishermen hours was 65,459 in 1964; 48,684 in 1965; 36,089 in 1966; and 34,940 in 1967.

2. The catches of legal smallmouth bass per hour have ranged from a minimum of 0.01 to a maximum of 0.233 per hour. The average time required to catch a legal-sized smallmouth bass is about 17-20 hours for the average angler.

3. Estimated total catch of legal smallmouth bass in the South Fork of the Shenandoah River dropped from 11,110 in 1966 to 5,704 in 1967. In the Main Stem, a drop from 9,706 in 1966 to 5,572 smallmouth bass was recorded.

4. The catches of channel catfish have declined in the South Fork (from 25,983 in 1966 to 15,442 in 1967), but they have increased steadily in the Main Stem since 1964. The estimated total catch has ranged from 35,040 in 1964 to 77,316 in 1967.

5. The estimated total catch of sunfish in the South Fork declined from 68,302 in 1966 to 43,853 in 1967. The catches during the period 1964-1967, have ranged from a minimum of 41,284 to a maximum of 68,302 in 1966.

In the Main Stem, estimated catches of sunfish have ranged from a minimum of 11,622 in 1964 to a maximum of 24,110 in 1965. The 1967 catch increased somewhat over 1966, with 19,424 sunfish in 1967 compared with 18,823 in 1966.

6. Bass nest count data indicate an increasing population of adult bass since restoration of a size limit (12 inches) on smallmouth bass in 1965.

7. Data collected by angling with artificial lures indicate an increasing number of 10, 11, and 12 inch smallmouth bass.

8. Data summarized from Angler's Report Cards show a definite upward trend of 9, 10, 11, and 12 inch smallmouth bass caught following the establishment of the 12-inch size limit.

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SOME EFFECTS OF SUPPLEMENTAL FEEDING AND CONTROLLED FISHING IN LARGEMOUTH BASS-BLUEGILL POPULATIONS

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ABSTRACT

The effects of supplemental feeding and controlled fishing in supplementally fed largemouth bass-bluegill populations were studied in one control pond and two treatment ponds. The ponds were stocked in March and April, 1963. One treatment and the control pond were drained in October, 1964. The objective of this phase of the study was to determine the effects of supplemental feeding on growth rate, condition index, and survival of bluegill, and on population balance and total production. A second phase of the experiment, restricting the harvest in a given time interval on a 3.5-acre pond, was begun in 1964 and terminated in October, 1967.

Bluegill in all ponds grew at comparable rates for the first 6 months after stocking. Seven months after stocking, bluegill in the treatment ponds were significantly heavier than those in the control pond. However, length-weight computations indicated that differences in condition indices between treatment and control ponds began to develop in the fifth month when the bluegill were in the 4-inch group. The two treatment pond populations were still expanding when the first phase of this study was terminated after 19 months of culture, but the control pond population had become static (i.e., no reproduction) by that time. When the control pond and treatment pond were drained in 1964, no significant difference between survivals of originally stocked bluegill in these ponds was found. The difference between total bluegill productions in those two ponds was 308 pounds per acre after 19 months. The difference between standing crops in the control pond at draining in 1964 and in the treatment pond drained in 1967 was 768 pounds. This difference was considered to be approximately equal to difference in carrying capacity between these two ponds since both populations were static when the ponds were drained.

Total production per acre in the fished treatment pond for the 4-year period was 2307 pounds including 2194 pounds of forage fish. The pond had a standing crop of 1129 pounds when drained. Conversion (S) of the 8766 pounds of feed used to produce the 2194 pounds of forage fish was 4.0 at a cost of \$0.22 per pound. Fishing success for the 4-year period averaged approximately 60 percent better than in 20 Alabama state-owned fertilized lakes over a 14-year period.

INTRODUCTION

The bluegill, *Lepomis macrochirus* Rafinesque, has been used extensively in ponds of the Southeast in combination with largemouth bass, *Micropterus salmoides* Lacepede, as recommended by Swingle and Smith (1940 and 1942) and Smith and