

This apparently indicated a preference for larger fish as the flatheads increased in size, and suggests that the large flathead may be expected to compete with fishermen for fish of harvestable size.

These experiments indicate that flathead catfish of all sizes should be listed as a "C" or piscivorous species in population analysis. The smallest fish would eat any other fish small enough to be swallowed. Where they could not swallow another of their own species, they often severely wounded them by biting. This resulted in severe sores, greatly weakened fish, and probably resulted in higher mortality.

Further experiments are in progress to more fully evaluate usefulness of the flathead catfish as a predator to supplement largemouth bass in bluegill-bass populations and to evaluate their usefulness for controlling overcrowded bluegill populations.

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EXPERIMENTS WITH WHITE CATFISH AS A SPORT FISH

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The range of white catfish, *Ictalurus catus* (Linnaeus), was originally in the Atlantic Coastal areas of the United States from Delaware to Florida. However, it has been introduced in many parts of the Middle West and even into Nevada and California. It has successfully adapted to a variety of different habitats but seems to prefer slower or standing waters, either fresh or brackish. This species has supported a commercial fishery in several areas and, in addition, has provided considerable sport fishing in certain large reservoirs where it was abundant. However, there are little data relating to the value of the white catfish as a sport fish for smaller ponds and lakes. This species was placed in experiments at the Auburn University Agricultural Experiment Station in 1958, and Prather and Swingle reported results on production and spawning in ponds (1960). It spawned readily in ponds, responded favorably to supplemental feeding, gave high production per acre, and the quality of the meat was considered equal to that of channel catfish. Therefore, it appeared to be a promising species

that warranted further testing to determine its value as a sport fish for ponds.

In the first experiment, a 2.5-acre pond was stocked per acre on January 26, 1962, with 1,000 fathead minnows, on January 31 with 2,000 white catfish fingerlings (3 to 6 inches in length) and on May 17 with 100 largemouth bass fingerlings. No fertilizer was used but the fish were fed Auburn No. 2 pellets daily except Sunday at rates varying from 1.6 pounds to 30.0 pounds per acre from February 5 to November 10. A total of 3,370 pounds feed was used per acre during this period. Seining during the summer showed that the pond had become contaminated with green sunfish but the bass kept them from becoming too numerous. The white catfish grew at a satisfactory rate and samples indicated they averaged 0.56 pound by July 15, with the largest ones weighing 0.8 pound.

The pond was opened to public fishing daily except Sunday from July 16 to October 22, 1962. Fishing permits were \$1.00 each with a limit of 5 white catfish and/or bass per permit. Fishermen found these white catfish difficult to catch and poor fishing success combined with small size of the fish failed to attract many fishermen. It should be noted, however, that an adjacent pond containing channel catfish and bass, averaging between 1 and 2 pounds each, was also open to fishing at the same time, and most fishermen preferred to fish the latter pond where fishing success was better and the fish larger.

Thus fishing effort for the white catfish was very low. Over the entire fishing period, per acre, 54 fishermen caught only 86 white catfish weighing 49.8 pounds, 16 bass weighing 3.1 pounds, plus 1.4 pounds miscellaneous fish. On the average 3.1 hours were required to catch each white catfish, and 5.3 hours to catch one pound of white catfish.

Because of the very poor fishing and the difficulty in catching many of the white catfish by seining, it was feared that the survival of the white catfish was low. Therefore, the pond was drained November 15, 1962, to determine what fish remained. A total of 1,642 white catfish weighing 1411.5 pounds was recovered per acre, indicating a survival of 86.4 per cent, including the catch. Therefore excessive mortality was not an important problem in this pond. It is believed that the small size of the catfish contributed to the poor fishing success, and it certainly contributed to the low fishing effort. In addition, the availability of better fishing and larger fish in the adjacent pond contributed to the low fishing effort for the white catfish.

In the second experiment, the same 2.5-acre pond was stocked per acre February 20-21, 1963, with 3,000 white catfish fingerlings plus 1,000 fathead minnows, April 15 with 100 largemouth bass fingerlings and July 17 with 742 Nile tilapia, *Tilapia nilotica*. The pond was fertilized once with superphosphate only on April 16. Auburn No. 2 pellets were fed daily except Sunday from February 25 to November 5, 1963, at rates from 2.0 to 25.0 pounds per acre per day. Samples of the catfish were obtained by seining at monthly intervals and the feeding was increased by approximately 5 pounds/A/day each month until the maximum rate was reached during September. Feeding was resumed February 13, 1964, at a maintenance level of 2.0 pounds/A/day; the rate was increased to 25 pounds/A/day March 16-August 8 and reduced to 16 pounds/A/day from August 10-September 19. A total of 6,357 pounds was fed per acre during both years. Samples of catfish were also checked periodically for parasites but no difficulty was encountered with this problem. Plankton blooms of *Microcystis* became objectionably heavy during July, 1963, but were thinned adequately by 4 weekly treatments each consisting of 0.8 pound copper sulfate per acre. The chemical was placed in a cloth bag and staked just under the surface where wave action slowly dispersed it throughout the pond.

The pond was open to public fishing from September 24 to December 5, 1963; by that time fishing success had declined because of

TABLE I

Date	No. of Fishermen	Number of Fishermen and Catch Per Acre									
		No.	White Catfish Pounds	No.	Bass Pounds	No.	Tilapia Pounds	Misc. Pounds	Total Pounds		
1963											
September	18.0	58.8	46.5	12.8	7.8	48	18.2	0.2	72.7		
October	55.2	86.8	79.6	21.6	12.5	21	6.8	0.2	99.1		
November	8.8	8.0	9.0	0.8	0.4			0.0	9.4		
December	0.0	0.0	0.0	0.0	0.0			0.0	0.0		
1964											
March	10.0	12.0	11.7	0.8	0.6			0.2	12.5		
April	12.4	26.8	30.8	0.4	0.2			0.0	31.0		
May	18.4	25.6	33.9	1.6	0.8			0.4	35.1		
June	51.2	109.2	152.2	0.4	0.2			0.7	153.1		
July	300.4	742.4	950.0	0.4	0.2			2.8	953.0		
August	149.2	241.6	324.6	3.6	1.2			1.1	326.9		
September	39.2	48.0	64.0	6.8	3.4			0.0	68.3		
Totals	662.8	1859.2	1703.2	49.2	27.3	69	25.0	5.6	1761.1		

cold weather and the pond was closed to fishing. Fishing began again March 16, 1964, and continued through September 16. The charge for fishing permits was \$1.00 each with limits of 5 catfish and/or bass per permit. An additional 5 fish could be caught on each permit by paying \$0.30 for each fish.

The catch per acre is given by months in Table 1. Fishing success was good during the first month of fishing but declined as the weather became colder in the fall. Fishing remained poor when the pond was reopened in March, improved during April, was only fair in May, good in June and excellent in July. A total of 55.8 per cent of all catfish caught was removed during this month, and 19.2 per cent were caught during August.

Per acre, 663 fishermen caught 1359 white catfish weighing 1703.2 pounds, 49 bass weighing 27.3 pounds, 69 tilapia weighing 25.0 pounds plus 5.6 pounds miscellaneous fish, or a total of 1761.1 pounds. Fishermen caught 45.3 per cent of the catfish stocked, and 32.4 per cent were recovered when the pond was drained September 29, giving a recovery of 77.7 per cent of the total number stocked. There were 935.6 pounds white catfish, 31.8 pounds bass, 62.0 pounds fatheads, plus 63.5 pounds miscellaneous fish recovered per acre on draining, giving a total production of 2,854.0 pounds per acre including the catch. The white catfish reproduced during 1964 but only 200 fingerlings per acre were present when the pond was drained.

In the third experiment, a 22-acre pond was stocked per acre March 1, 1963, with 1600 channel catfish fingerlings, March 5 with 400 white catfish fingerlings and 1000 fathead minnows, April 15 with 100 largemouth bass fingerlings and July 1 with 1000 Java tilapia fingerlings. This pond received only two applications of triple superphosphate in March and April, but Auburn No. 2 pellets were fed daily at rates per acre of 2 pounds March 4-April 1; 5 pounds April 2-May 6; 10 pounds May 7-June 1; 15 pounds June 3-August 3; 20 pounds August 5-August 21; 25 pounds August 22-September 28; 18.2 pounds September 30-October 12; 13.6 pounds October 14-November 2; 9.1 pounds November 4-7; 4.5 pounds November 8-December 30. In 1964, the daily feeding rates per acre used were 4.5 pounds January 6-25; 5 pounds March 16-21; 10 pounds March 23-July 4; 8 pounds July 6-September 5; and 5 pounds September 8-September 16. A total of 4164.9 pounds per acre was used during the entire experiment.

Examination of a sample of the channel catfish on May 20, 1963, showed that an infestation of gill flukes was present on the channel catfish so a pond treatment with 10 ppm formalin was applied to control this parasite. On May 23, the dissolved oxygen in the pond water decreased to a low of 1.1 ppm at the 4-foot level but never went low enough to kill any fish.

The pond was opened to public fishing September 6-December 4, 1963, and March 16-September 16, 1964. Permits were sold for \$1.00 each and entitled the fishermen to a limit of 5 catfish and/or bass with extra fish costing \$0.30 each. The number of fishermen and catch per acre are given by months in Table II. One of the objectives in this experiment was to compare fishing success for these two species of catfish when stocked in a ratio of 4 channel catfish to 1 white catfish, with a total of 2000 per acre. Per acre, 559 fishermen caught a total of 1340.6 pounds, consisting of 981.3 pounds channel catfish, 264.2 pounds white catfish, 44.4 pounds bass, 37.7 pounds tilapia, and 13.0 pounds miscellaneous fish.

The total catch by fishermen in this pond was about the same as that obtained in previous experiments where 2000 channel catfish alone were stocked per acre and fed at similar rates. Fishermen caught 5 channel catfish for every white catfish although the ratio stocked was 4:1. Fishermen harvested 65 per cent of the channel catfish stocked but only 52 per cent of the white catfish. This pond will be drained at an early date to determine what fish are left.

TABLE II
Number of Fishermen and Catch Per Acre

Date	No. of Fishermen	Channel Catfish		White Catfish		Bass		Java Tilapia		Misc.		Total Pounds
		No. Pounds	No. Pounds	No. Pounds	No. Pounds	No. Pounds	No. Pounds	No. Pounds	No. Pounds			
1963												
September	86.1	284.2	197.0	42.1	39.5	52.3	26.0	114.2	28.6	0.3	0.1	291.2
October	60.5	140.5	111.5	21.3	22.3	2.8	1.8	31.5	9.0	2.5	0.3	144.9
November	24.6	44.1	36.0	3.5	3.8	0.3	0.2	0.4	0.1	0.2	0.0	40.1
December	0.3	0.1	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3
1964												
March	39.5	36.9	33.0	15.4	20.5	4.6	4.7	0.0	0.0	1.9	1.0	59.2
April	74.7	207.1	184.8	28.9	36.2	2.5	2.6	0.0	0.0	16.8	3.2	226.8
May	87.0	157.6	162.7	34.9	47.1	0.7	0.7	0.0	0.0	6.8	3.4	213.9
June	66.0	76.9	97.0	32.7	49.5	3.6	3.6	0.0	0.0	1.5	2.1	152.2
July	58.4	58.6	90.7	10.6	16.2	1.2	1.3	0.0	0.0	0.5	1.1	109.3
August	41.5	27.1	45.8	11.3	17.6	3.4	1.8	0.0	0.0	0.8	1.5	66.7
September	20.3	11.6	22.6	6.3	11.4	3.7	1.7	0.0	0.0	0.1	0.3	36.0
Totals	558.9	1044.8	981.3	207.1	264.2	75.1	44.4	146.1	37.7	31.4	13.0	1340.6

CONCLUSIONS

1. White catfish were more difficult to catch than channel catfish, but fishing success for white catfish was quite satisfactory.
2. The presence of white catfish in combination with channel catfish appeared desirable and might extend the period of good fishing since they are less readily caught.
3. Although most fishermen agreed that the white catfish tastes as good as the channel catfish, a majority preferred the latter since it bites better, fights harder, and gives about 5 per cent higher dressed weight because of its smaller head.
4. Effective baits for white catfish included large pinkworms, chicken and beef liver, catalpa worms, live minnows and cut fish, plus commercially prepared blood and cheese bait. Artificial lures were seldom used and appeared ineffective in these waters that were highly colored with plankton as a result of daily feeding.

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TRENDS IN COMMERCIAL FISH FARMING PRACTICES IN ARKANSAS*

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ABSTRACT

If trout farms are excluded, commercial fish farming, per se, in Arkansas, is only about fifteen years old. This neophyte industry has already progressed through several phases of development to the more mature and studied practices found today, from the haphazard period when many thought they could get rich quickly without much work and with little management. Each farmer or reservoir owner tends to analyze his own resources and follows the practices which will make him the most profit. Although there is no "patented medicine practice," current fish farming activity can be classed under several headings, i.e., bait minnows, channel catfish production, controlled food fish reservoirs, multiple purpose reservoirs and surface water storage reservoirs.

INTRODUCTION

For all practical purposes, warm water commercial fish farming did not get started in Arkansas until after World War II. It began essen-

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¹ Nomenclature recommended by the committee on common and scientific names of fishes, Spl. Publ. No. 2, American Fisheries Society, 1960.

² Most wells vary from 75 to 175 feet deep and pump from 500 to about 1,500 gallons of water per minute. The average well probably is 125 feet deep and pumps 1,000 gallons of water per minute.