EXPERIMENTS ON COMMERCIAL FISH PRODUCTION IN PONDS

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Commercial production of fish in ponds appears feasible and highly desirable as a method of water and land utilization in many parts of the Southeast. Drought in this area during the past few years has stimulated interest in impounding additional water for irrigation, for city and industrial uses, and for various purposes on farms. Some of these water areas will be devoted in part to sport fish production, but others could be better used for commercial fish production because of water level fluctuation or the need for annual or biennial draining.

Preliminary experiments on the production of various species of fish on a commercial basis were begun at Auburn in 1948. The species tested for this purpose included the round flier *(Centrarchus macropterus),* the bluegill *(Lepomis macrochirus),* the speckled bullhead *(Ameiurus nebulosus marmoratus),* the channel catfish *(Ictalurus punctatus),* the common carp *(Cyprinis carpio),* the bigmouth buffalo *(Megastomatobus cyprinella),* the smallmouth buffalo *(Ictiobus bubalus),* and the flathead catfish *(Pilodictis olivaris).*

The experiments herein reported were conducted by the fisheries research staff including E. E. Prather, J. R. Fielding, M. C. Johnson and J. H. Padfield.

ROUND FLIER

This first appears to have no commercial possibilities. It gave very low production (32 pounds per acre) and high mortality (89%) when feeding was used in a 3-month experiment.

BLUEGILLS

This species also appears to have practically no commercial possibilities. In a bluegill-largemouth bass combination with fertilization alone, approximately 200 pounds of fish of harvestable size may be obtained in 1 year, the cost of fertilization approximating 10 to 15 cents per pound of fish.

Ponds stocked with 1,500 bluegills plus 100 largemouth bass per acre and with 2,000 bluegills plus 200 largemouth bass per acre were fertilized from January, 1950, to April 17, 1951, and fed 20 pounds of soybean meal per acre per day from October 1, 1950, to March 15 and from March 30 to April 16, 1951. The results are summarized in Table 1.

In this case, the cost per pound was too high largely because of a high rate of feeding used to get an estimate of the highest production that might be obtained. The production of large numbers of small bluegills, which were worthless from a commercial standpoint, contributed to the high cost.

In order to obtain fuller utilization of the supplemental food by large fish, ponds were stocked with 1,500 bluegills per acre averaging 0.10 pound on

Table 1. Fish growth under two stocking regiemes.

Stocking	Average pounds per acre		Cost per lb. of harvestable fish
	Harvestable size	Total	
1,500 bluegill + 100 bass	222.7	400.3	$1.05
2,000 bluegill + 200 bass	498.0	650.6	0.47

November 4 and fed soybean meal at the rate of 20 pounds per acre per day from November 27 to May 16, a total of 4,040 pounds of soybean meal per acre. The ponds were drained May 24 so no spawning could occur. An average of 370.0 pounds of fish was recovered per acre, an increase of 212.7 pounds. The average size of the bluegills was 0.33 pound, but the cost of producing this growth was excessive — approximately 98 cents per pound. The experiment, however, was not designed to determine efficient rates of feeding, but to determine the maximum growth that might be expected during this period. Lower rates of feeding and better balanced feeds should result in more economical growth, but, since the bluegill does not have carbohydrate-splitting enzymes, high efficiency in food conversion can hardly be expected from this fish (Lawrence 1950).

SPECKLED BULLHEAD

This species spawns more or less readily in ponds. In 1-year experiments, results with speckled bullheads were as follows:

Pond treatment	Pounds fish per acre
Unfertilized	49.4
Fertilization, inorganic	191.2 to 284.6
Fertilization plus supplemental feeding with soybean meal or cake	1,474.8[a] to 1,725.1[b]

Supplemental feeding resulted in very high annual production per acre. However, since this fish reproduces in ponds, 54.2 to 71.6 percent of the total weight produced was in the form of young bullheads 3 to 6 inches in length. The problem with this species is how to control reproduction so that most of the food will be utilized in producing large fish.

Three methods of controlling reproduction were tried: (1) stocking with fingerling largemouth bass along with fingerling bullheads in the fall or winter; (2) stocking with fingerling largemouth bass and fingerling bullheads in late spring, with feeding added the following fall after danger of reproduction was past, and draining the following spring before reproduction could occur; and (3) stocking with bullhead fry in May, followed by fertilization only until fall and supplemental feeding from early fall until the following April, and draining the pond in May before reproduction could occur.

[a] Rates of feeding ranged from 11 to 50 pounds of soybean cake per acre per day: total of 8,345.5 per acre per year.

[b] Rates of feeding ranged from 16 to 130 pounds of soybean cake per acre per day from October 20, 1951, to August 9, 1952; total of 13,402 pounds per acre per year.

The first method, depending upon either 100 or 200 bass per acre to eliminate most of the small bullheads as they hatched was a failure where feeding was practiced during the spring, summer and fall. Very few bass survived the low oxygen condition caused by feeding, with the result that the ponds were overcrowded with small bullheads when drained the following fall or spring.

The second method, depending upon stocking in the spring with 3- to 6-inch fingerling bullheads that were too small to spawn, plus fertilization only during spring and summer to prevent rapid growth to spawning size and plus stocking 200 largemouth bass per acre to eliminate any small fish hatched in the pond, was relatively successful in controlling the number of small fish present.

The records on three experiments were as follows:

1. Stocking with 3- to 6-inch fingerling speckled bullheads plus 2- to 3-inch largemouth bass.
   a. Stocked, April 20, 1953, with 1,000 fingerling bullheads (3 to 6 inch) per acre, weighing 97.2 pounds, and May 30, 1953, with 200 largemouth bass (2 to 3 inch) per acre.
   b. Fertilized with 8-8-2 from April, 1953, to April, 1954, costing $27.22 per acre.
   c. Fed 2,240 pounds of peanut meal per acre as supplemental feed plus 1,280 pounds of fish meal plus 3,660 pounds of soybean cake, costing $376.60.

   Recovered per acre on draining pond in April, 1954:

520 speckled bullheads (10" - 13")	526.8 lbs.
76 fingerling sp. bullheads (5" - 6")	5.6 lbs.
152 largemouth bass (9" - 11")	80.0 lbs.
Total	612.4 lbs.
Wild fish (minnows)	142.8 lbs.
Grand total of all fish	755.2 lbs.
Production of salable fish (606.8 - 97.2) = costing $0.79 per pound.	509.6 lbs.,

2. Stocking 3- to 4-inch speckled bullhead fingerlings plus 2- to 3-inch largemouth bass.
   a. Stocked April 20, 1953, with 1,000 speckled bullheads (3 to 4 inch) weighing 74.4 pounds and on May 30, 1953, with 200 largemouth bass (2 to 3 inch) per acre.
   b. Fertilized with 8-8-4 from April 20, 1953, until April, 1954. Cost per acre $27.22.
   c. Supplemental feeding per acre with 3,660 pounds of soybean cake plus 1,280 pounds of fish meal plus 2,240 pounds of peanut meal, costing $376.60.

   Recovered per acre by draining on April 14, 1954:

800 speckled bullheads (9" - 13")	678.4 lbs.
192 largemouth bass (6" - 10")	35.6 lbs.
Total	714.0 lbs.
Wild fish (minnows)	137.2 lbs.
Total all fish	851.2 lbs.
Production of speckled bullhead (678.4 - 74.4) = costing $403.82 per acre. Cost per pound = 67 cents.	604.0 lbs.,

3. Stocking with 9-inch speckled bullheads plus 2- to 3-inch largemouth bass fingerlings.
   a. Stocked June 13, 1952, with 500 speckled bullheads (9 inch) weighing 213.6 pounds and 48 largemouth bass fingerlings (1 inch) per acre.
   b. Fertilized with inorganic 8-8-4 from June, 1952, until April, 1954. Cost $21.92.
   b. Supplemental feeding with soybean cake, 3,430 pounds per acre, costing $176.28.

   Recovered per acre by draining on March 24, 1953:

460 speckled bullheads (10" - 13")	460.4 lbs.
69,839 speckled bullheads fingerlings (4")	1,383.2 lbs.
44 largemouth bass (8" - 10")	20.4 lbs.
Total	1,864.0 lbs.

   Production of harvestable fish per acre (480.8 - 231.6) = 267.2 lbs., costing 76 cents per pound.

The foregoing experiments were not designed to obtain most efficient production but, by means of heavy feeding, to arrive at the maximum production that may be expected per acre. In these experiments, stocking with 1,000 speckled bullhead fingerlings not over 6 inches in length and 200 largemouth bass fingerlings per acre in April, with feeding postponed until August 15, gave an average production of approximately 600 pounds fish of salable size per acre and very few small fish when ponds were drained 1 year later. When larger bullheads (0.4 pound) and fewer bass (48 per acre) were used, small fish made up most of the weight.

The third method, depending upon stocking recently hatched bullheads in April or May and draining the pond the following April before spawning could occur, was also relatively successful unless large numbers of wild fish entered the pond. Results from this procedure were as follows:

1. Stocked 1,000 speckled bullhead fry per acre on June 12, 1952.
2. Fertilized with 8-8-2 from June to October, 1952, costing $14.72 per acre.
3. Fed soybean cake: 15 pounds per acre per day September 16 to October 15, 1952; 30 pounds per acre per day October 16 to December 2, 1952, and February 11 to March 19, 1953.

   Total — 3,062 pounds, costing $153.40.

   Recovered per acre on draining:

   900 speckled bullheads (7" - 11") — 487.6 pounds

   Average cost per pound of fish = 34.5 cents.

Another pond was stocked with 2,000 speckled bullhead fry per acre plus 50 bass fry on May 30, 1951, with fertilization until September and supplemental feeding with soybean cake at the following rates:

Lbs./AC/day	Date
14	Oct. 18 to Nov. 10
28	Nov. 11 to Dec. 5
56	Dec. 6 to Jan. 12
50	Feb. 15 to Apr. 15

This gave a total of 5,964 pounds of soybean cake per acre, costing $304.16 plus $45.80 per acre for fertilization.

Upon draining on June 13, 1952, the following were recovered per acre:

1,303	speckled bullheads	745.9 lbs.
5	largemouth bass	2.3 lbs.
15,000	small bullheads (1")	0.34 lbs.

The cost per pound of salable fish was 48 cents because of the attempt to obtain maximum growth by heavy feeding. As a result, low oxygen in the pond water caused 90 percent mortality of the bass.

Increasing the rate of stocking of speckled bullhead fry from 1,000 to 2,000 per acre resulted in an increase in production from approximately 500 to 745 pounds of harvestable fish per acre.

Feeding: In none of the above experiments was the cost per pounds of fish low enough for commercial production. This was largely because of lack of information on the pounds of fish to be expected under various cultural conditions and the fact that nothing was known regarding desirable rates of feeding at various water temperatures. In the above experiments, feeding was practiced throughout the fall, winter and spring months.

It was observed that food utilization apparently was low and that the food accumulated unused during the winter months. Consequently, feeding tests were conducted in ponds to determine the months during which feeding was beneficial.

From these tests, therefore, it appeared that the speckled bullhead did not utilize food when the water temperatures dropped below 60°F (Table 2). At Auburn, Alabama, this means that feeding should stop between the first and middle of November and should not begin until March. Also, it appeared that feeding in excess of 2 to 3 times the total expected pounds of fish per acre resulted in inefficient utilization of the food. Supplemental feeding appears best used at rates not exceeding 2 to 3 percent of the body weight of the fish per day during the period when the water temperatures are above 60°F during the middle of the day.

Table 2. Effect of water temperature on speckled bullhead growth.

Feeding period[a]	Water Temp. (°F)			Ave. Wt. Fish		% Gain
	Ave.	Max.	Min.	Initial	Final	or loss
10/02/51 - 04/09/52	57.3	83[b]	45	0.35	0.92	+ 162.8%
11/19/51 - 12/19/51	49.6	54	45	0.38	0.366	− 4.3%
01/14/52 - 02/12/52	53.3	64[c]	48	0.35	0.28	− 20.0%

[a] Feeding rates:

Test 1 — 10 - 15% of body weight per day of soybean cake.

Test 2 — 3% of body weight per day of either fish meal, soybean meal or calf feed pellets.

Test 3 — 3.5% of body weight per day of soybean cake.

[b] Days in the feeding period with maximum water temperatures of 60°F or above, October — 30 days; November — 10 days; March — 14 days; April — 8 days.

[c] Days in the feeding period with maximum water temperatures of 60°F or above, January — 1 day.

Suggested Procedure for Commercial Production of Speckled Bullhead

While experiments are still incomplete, those cited here indicate that the following procedure appears at present to be the most promising for commercial production of speckled bullheads:

1. Stock 2,000 speckled bullheads (1" - 3") in May.
2. Fertilize monthly, using 100 pounds 8-8-2 per acre per application from May until September.
3. Feed a mixture of 6 parts soybean meal or peanut meal to 1 part fish meal as follows:

Date	Lbs./AC/day	Lbs.
August	5	155
September	10	300
October	10	310
March	10	310
April	20	600

4. Drain the pond early in May and sell the fish before reproduction occurs, or drain in late May or early June just after reproduction occurs and use the small, newly hatched bullheads to stock ponds for the next crop.
5. This should result in production of approximately 600 pounds per acre of 0.5- to 1-pound bullheads at a cost of approximately 15 cents per pound.

Disadvantages of the above method are that the growing period is short, including the coldest months of the year, and that it necessitates draining ponds late in the spring after the period of heavy rainfall is past.

CHANNEL CATFISH

Insufficient work has been done at this Station to determine the commercial possibilities of the channel catfish. Production figures from experiments were as follows:

Treatment	Pounds per acre
Fertilization with 8-8-2	71.4 to 92.3
Fertilization plus feeding	230.4 to 246.8

In the feeding experiment, ponds were stocked with 400 fingerling channel cats per acre on December 15, 1949. The ponds received the regular rate of fertilization until September and soybean cake was fed at the following rates:

Lbs./AC/day	Date
5	Jan. 1 to Jan. 31
10	Feb. 1 to Oct. 10

This resulted in channel cats weighing an average of 0.6 to 0.9 pound each and a total average production of 238 pounds of fish per acre. This appears too low for successful commercial production, but higher production possibly could be obtained with higher rates of stocking.

Feeding experiments during the period of December 8 to March 10, 1951, indicated that this species did not utilize feed efficiently during these months. The pond was stocked with 500 channel cats per acre weighing 150 pounds. Ten pounds of soybean cake per day was fed until draining on March 10. At that time, there were 420 channel cats per acre weighing 150 pounds. A mortality of 16 percent occurred during this period, with no increase in total pounds per acre but an increase of approximately 20 percent in average weight of the survivors.

Additional experiments on rates of stocking and methods of feeding will be needed to determine the commercial possibilities of this species.

CARP

The common or European carp is the most important commercial pond fish over the world in general. In the United States, it has limited sales at relatively low prices since it is not generally considered a desirable fish. However, when raised in ponds and well fed, its flavor compares favorably with that of other species. The presence of numerous small bones limits its usefulness in the restaurant trade.

Results of experiments on production were as follows:

Treatment	Pounds carp per acre
Fertilization with 8-8-4	280.0
Fertilization with cottonseed meal plus superphosphate (3-1)	435.0
Fertilization (8-8-4) plus feeding	700.0 to 1,733.0

Inorganic fertilization with 8-8-4 gives relatively low production because carp muddy the ponds, resulting in very low phytoplankton growth. Organic fertilization using a cottonseed meal-superphosphate mixture of 3 to 1 gave higher production because the cottonseed meal tends to precipitate the suspended mud and clear the water. Highest production came with various rates of feeding combined with fertilization. Although production as high as 1,733 pounds per acre was achieved, the rates of feeding required were too high for economical production.

Because of the small bones present in the flesh, carp must be raised to sizes in excess of 2 pounds to be salable; a 5-pound size would be preferable.

Production of the 2-pound size requires that the young carp be hatched in the spring and raised to fingerling size of 3 to 5 inches by fall, when they should be stocked in the large rearing ponds. With fertilization and feeding, they will reach a 2-pound size 1 year later.

To produce a 5-pound size, the 2-pound fish must be restocked in ponds and fertilized and fed for an additional year.

Supplemental feeding, of turkey growing pellets or soybean meal or cake was used to obtain 400 to 700 pounds of carp per acre at costs of 9 to 10 cents per pound. Increased rates of feeding would make possible the production of approximately 1,000 pounds carp per acre at estimated cost of 15 to 18 cents per pound. At the present time, it is doubtful that adequate profit could be obtained even at costs of 10 cents per pound.

From all experiments conducted at this Station, the following procedure appears usable for carp production:

1. Carry brood carp through the winter in ponds stocked at rates up to 2,000 pounds carp per acre. Provide feed equal to 2 percent of their body weight per day during the period while the water temperature is above 50°F. Feed soybean meal or peanut meal plus 20 percent fish meal.
2. In March fill a 0.05- to 0.10-acre brood pond with water from a stream or pond that does not contain carp. When the water temperature reaches 65° to 70°F, stock with 2 male and 2 female brood carp. Eggs are usually laid the following morning on grass or on dirt sides of the pond. Eggs hatch in 3 to 5 days.
3. Two to four weeks after hatching, transfer carp fry to nursery ponds (0.25- to 1.0-acre) at rate of 10,000 per acre.
4. Fertilize until October, using 100 pounds of 8-8-4 per acre per application. The carp should then be 4 to 5 inches long and survival ranges from 50 to 90 percent. The cost of fertilizer per fingerling produced is approximately 1 cent per fish.
5. Stock 200 carp per acre in the large rearing ponds during October to January.
6. Fertilize with 8-8-4 at the rate of 100 pounds per acre, using one application in March, one in April, one in May, and one in June.
7. Feed 5 pounds per acre per day of a mixture of 6 parts peanut meal or soybean meal plus 1 part fish meal from July 1 to September 30.
8. Drain the following October. These fish should weigh approximately 2 pounds each.
9. If larger fish are desired, restock the above fish into large rearing ponds at rates of between 100 and 200 per acre, fertilize as above and feed 5 to 8 pounds per acre per day for another year.
10. The above procedure resulted in approximately 400 pounds per acre of 2-pound fish at a cost of between 7 and 10 cents per pound. By increasing the feeding rate to 10 pounds per acre per day, 700 pounds of carp per acre was obtained, but the cost per pound of carp was approximately 15 cents.

BUFFALO

Experiments have been conducted at this Station on commercial production of bigmouth and smallmouth buffalo fishes. The productions obtained from 1-year experiments were:

Pond treatment	Pounds buffalo per acre
Fertilization with 8-8-4	611.0 to 666.0
Fertilization plus feeding	853.0 to 1,163.0

The production of 1,163 pounds of buffalo per acre resulted from feeding soybean cake at the rate of 5 percent of the body weight per day with a stocking rate of 4,000 buffalo per acre. The average size of fish produced in this experiment

was from 0.3 to 0.5 pound. This is too small for sale because the small bones present in the flesh make these fish undesirable for table use. The buffaloes should be raised to sizes of 2 to 5 pounds or larger to command good prices on the market. When larger sizes must be raised, fewer pounds can be produced per acre.

Experiments dealing with production of buffalo fry, fingerlings and marketable sized fish will be briefly summarized.

Production of Buffalo Fry

The buffalo fishes are river species that normally spawn in the spring when rivers are at flood stage. Canfield (1922) reported that these fishes could be induced to spawn by placing them in ponds one-fourth full of water and rapidly filling the pond when the water temperatures reach 60 - 62°F. Walker and Frank (1952) found the same procedure successful in producing smallmouth buffalo and also reported stripping and hatching eggs of both bigmouth and smallmouth buffalo fishes in hatching jars.

At this Station, smallmouth buffalo stocked in ponds during the winter always failed to spawn the following spring. Also, the procedure of flooding ponds used by Canfield and by Walker and Frank was tried unsuccessfully in 1946 and 1952. Sowing the pond bottom to rye grass and flooding also failed. Further work indicated that both the bigmouth and smallmouth buffalo fishes excreted into the water a repressive factor that prevented reproduction (Swingle 1953). Consequently, the presence of brood fish in the water for a long period prior to the proper spawning temperature or the filling of the pond with water from sources containing these fishes could prevent reproduction. It was not found necessary to flood the pond to induce spawning. A better procedure was to maintain the brood fish in wintering ponds and keep them well fed until water temperatures reached 60 to 70°F. At that time another pond was filled with water from a pond or stream that did not contain buffalo fishes. The brood buffalo were then stocked at the rate of 50 per acre and spawning usually occurred the following day. Bigmouth buffalo reproduced more readily than the smallmouth and in much greater numbers. Chaudhuri, in current work at this Station, was able to induce the bigmouth to spawn even in small concrete ponds 12 feet in diameter by using the above technique. Delayed spawning was obtained by holding the brood fish crowded in the wintering ponds for 1 to 2 months after the normal spawning period and then transferring them into fresh water.

From the standpoint of ease of production of fry and rapidity of growth, the bigmouth buffalo appeared the most desirable for pond culture.

Production of Fingerlings

A 50 percent mortality within 12 hours or less always resulted when buffalo fry were seined from ponds. The remaining fish appeared to live well and relatively low additional losses were suffered in transportation from Auburn, Alabama, to commercial ponds in Arkansas. It appears desirable, however, to raise fry to a fingerling size before stocking in large rearing ponds for commercial production.

By stocking 10,000 fry per acre in nursery ponds in May and fertilizing each month from May to October with 200 pounds of 8-8-2 per acre per application, the buffalo fish were raised to a size of 4 to 5 inches by October, with a survival of over 90 percent. The cost of fertilization was approximately 1 cent for each fingerling produced.

It would also be possible to raise the fry to a fingerling stage without their removal to nursery ponds, provided the brood fish were stocked in larger ponds for reproduction. This system would be undesirable if the brood fish had diseases or parasites that could be transmitted to the young.

Production of Marketable Sized Fish

The buffalo fishes are capable of rapid growth in ponds. Where only 3 or 4 were present per acre, they have gained 3 to 6 pounds per year, and in one case over 12 pounds in 18 months. Under such conditions, the harvestable yield per acre is too low. Higher rates of stocking and slower growth must be used for commercial production.

Feeding, although giving higher production than fertilization alone, does not appear profitable. Table 3 summarizes results from six 1-year experiments in half of which feeding was used.

Table 3. Comparison of buffalo production under two production treatments.

Stocked per acre[a]	Total lbs. soybean meal fed	Cost			Buffalo produced per acre		Cost per pound
		Feed	Fertilizer	Total	No.	Lbs.	Cents
1,890	7,625	$381.25	$19.70	$400.95	1,860	828.0	48.0
2,000	8,838	430.40	29.84	460.24	1,900	899.0	51.0
3,000	8,520	413.30	21.90	435.20	2,860	1,122.0	39.0
432			21.92	21.92	432	632.8	5.1
432			29.12	29.12	428	612.4	6.8
432			21.92	21.92	432	513.6	6.6

[a] Mixture of bigmouth and smallmouth buffalo.

It is evident that although feeding gave high production, fertilization alone was more economical and produced fish at costs for the fertilizer used of 5 to 6.8 cents per pound of fish. This cost is sufficiently low to make buffalo production a commercial possibility. Further experiments may develop economical feeding rates that can be used to increase production. The survival of the stocked fish during the 1-year experiments was excellent, averaging 96.2 percent in the feeding tests and 99.7 in the ponds receiving fertilization alone. The buffalo fishes gave higher production with inorganic fertilization alone than was obtained with the common carp — an average of 586 pounds per acre for the former and 280 pounds for the latter. The carp, however, responded better to supplemental feeding.

From all the above experiments, it appears that a suitable procedure for commercial production of the bigmouth buffalo is as follows:

1. Hold brood bigmouth buffalo (2 to 3 pounds in size) in wintering ponds and feed them while water temperatures are above 55°F at the rate of 1 to 2 percent of their body weight per day, using a mixture of 80 parts peanut meal or soybean meal and 20 parts fish meal.
2. When water temperatures rise in the spring to between 65° and 70°F, fill a 0.25- to 1-acre brood pond with fresh water from a pond or stream that does not contain buffalo fishes. A more suitable condition exists if weeds or grasses are growing in the pond before it is flooded because buffalo prefer to lay eggs on vegetation. However, they will lay if vegetation is absent.
3. Stock 50 brood buffalo per acre as soon as the brood pond is filled. Eggs are usually laid the following day and hatch in about 5 days. From 30,000 to 292,000 fry have been obtained per acre.
4. The fry may be left in the brood pond with the brood fish until fall or stocked into nursery ponds at the rate of 10,000 per acre.
5. Fertilize the nursery pond (or the brood pond if fry are left there) with 200 pounds per acre 8-8-2 once a month until October. The fingerlings should then be 4 to 5 inches in length and ready to stock into large raising ponds.
6. Stock as soon after October 1 as possible into the large commercial production ponds, using 250 buffalo per acre. This number should result in fish between 2 and 3 pounds 1 year later.
7. Fertilize the commercial pond with 200 pounds of 8-8-2 per acre in October, or as soon as the pond is stocked.
8. Continue the fertilization, beginning February 1. Use 100 pounds of 8-8-2 per acre per application. (If the pond receives large amounts of flood water, postpone the first application until March.) Make the first 3 applications at 2-week intervals and follow with subsequent applications at 3- to 4-week intervals as needed until October.
9. Stock 100 largemouth bass fry per acre in May to feed upon any wild fish present.
10. Drain in fall or winter. This procedure resulted in approximately 500 to 600 pounds per acre of approximately 2-pound fish at a cost of 6 to 8 cents per pound for the fertilizer used.
11. If 5-pound fish are to be raised, restock in large ponds the 2-pound fish at a rate of 125 per acre and continue the fertilization for another year. (Apparently, it would also be possible to raise fish of this size by stocking under Section 6 with 125 buffalo per acre and continuing the fertilization for a 2-year period before draining.)

Smallmouth buffalo may be raised in a similar manner. Greater difficulty, however, was experienced in inducing spawning.

FLATHEAD CAT

These fish spawn in the large rivers. Attempts to get them to spawn in ponds, in pools with running water, and by hormone injection were all without success (Johnson 1950).

Flatheads placed in ponds have grown at the rate of 2 pounds per year. They were of excellent flavor and appear promising as a commercial species if methods of obtaining fry can be devised.

SUMMARY

Round flier and bluegills appear to have little or no possibilities for commercial production because of low production per acre and high price per pound.

Speckled bullheads offer some promise as a commercial species. With summer feeding, yields as high as 1,725 pounds fish per acre were obtained, but due to heavy reproduction, most of this weight was in the form of small fish. Yields of 500 to 745 pounds per acre of bullheads of salable size were obtained by stocking fry in May, fertilizing with inorganic materials until September, and feeding, as a supplement, soybean meal or peanut meal when water temperatures were above 60° from August until the following April. The ponds were drained in May before reproduction could occur.

Channel catfish may prove to be of value as a commercial species but it gave low yields per acre in preliminary experiments. The maximum production with feeding was 246 pounds per acre.

The European or common carp sells at such a low price that its commercial possibilities as a pond fish appear limited. With fertilization, yields of 200 to 435 pounds fish per acre were obtained. Supplemental feeding raised yields to as high as 1,733 pounds of fish per acre, but the cost per pound was too high where heavy feeding was used. A procedure using light rates of feeding yielded 400 pounds per acre of 2-pound fish at a cost of from 7 to 10 cents per pound.

The bigmouth buffalo and smallmouth buffalo appear to be promising commercial pond fishes. The former appeared more promising because the young were easier to produce in ponds, and they appeared to grow at the more rapid rate. Production of 500 to 600 pounds buffalo per acre was obtained with fertilization alone at costs of 6 to 7 cents per pound of fish. With feeding, a maximum of 1,122 pounds buffalo per acre was obtained, but the cost per pound of fish was then 39 cents. Methods are given for inducing spawning in ponds and rearing the fry to fingerling and market sizes.

Flathead cats grew well in ponds, but failure to induce spawning in ponds or in running water has prevented extensive tests with this species.

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