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# A COMPARISON OF SPAWNING ENVIRONMENTS FOR THE CHANNEL CATFISH, "ICTALURUS PUNCTATUS" (RAFINESQUE)

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## ABSTRACT

During the spawning seasons of 1958 and 1959 an experiment was conducted to compare the spawning success of channel catfish in three types of environments. The environments employed included a 0.6-acre pond, 16 concrete block holding pens 6 feet wide, 12 feet long and up to 3½ feet deep, and six aquaria of 50 gallon capacity along with four concrete holding house tanks.

The spawning fish were from three to four years old and were in what was considered to be average flesh. The highest percentage of spawning fish was noted in the pond environment both years. Spawning success was noticeably less in the spawning pens and was lowest in the aquaria or holding tanks. A few fish in the pens were injected with a hormone preparation, chorionic gonadotropin, while all fish held in the aquaria or holding tanks were treated with either fish pituitary or chorionic gonadotropin injections.

Results of the experiment indicated that the least restrictive environment gave the highest percentage of spawning success for the brood stock employed. Also, hormone injections during the spawning season did not appear to be a substitute for the development of a brood stock of mature, well-fed and healthy fish prior to spawning time.

## INTRODUCTION

Interest in the channel catfish, *Ictalurus punctatus* (Rafinesque), as a sport and food fish has increased greatly in recent years. Long a popular fish in west-central states and in the southwest, the species has caught the attention of fish culturists in the southeast of late. Swingle (1958) and Prather (1959) have pointed to some of the possibilities of channel catfish as a commercial species or as a combination sport and commercial fish. Johnson (1959) states that in ricefield culture of fresh-water fishes, the channel catfish is in the greatest demand and commands the highest price of any species being cultured in these waters.

Methods of propagating the channel catfish have been known to fish culturists for more than thirty years (Doze, 1925). Since this early description of propagation, other workers have described findings that contributed to the development of hatchery techniques of propagating channel catfish (Clapp, 1929; Mobley, 1931; Morris, 1939; Lenz, 1947, and Toole, 1951). While differing as to details, these workers followed a basic concept of pairing spawning fish either in a spawning pond or a spawning pen to obtain eggs which were then incubated by the fish or by a mechanical device.

Only recently have there been new developments in improving spawning techniques for channel catfish. Clemens and Sneed (1957) were successful in spawning channel catfish under controlled conditions in glass aquaria by the

injection of fish pituitaries. Their methods were further refined by later work * which provided more detailed information on the basic technique employed and further verified pituitary materials giving successful results. Later work (Sneed and Clemens, 1959) described successful techniques of applying dosages of human chorionic gonadotropin to spawn channel catfish.

These contributions greatly stimulated interest in channel catfish culture and opened new avenues for the development of a cultural program for supplying fingerling fish for both food and sport fish demands.

As a result of the increased demand for channel catfish fingerlings in the southeast, federal hatcheries in this area began efforts to include catfish propagation in their production program wherever it appeared feasible to do so. Since warm-water hatcheries in the southeast are generally small with most of their pond acreage being needed for the production of largemouth bass and bluegill fingerlings, use of an intensive method of propagation as described by Clemens and Sneed (*op. cit.*) appeared desirable. However, several hatcheries had pond area that could be made available for channel catfish culture by employing more intensive methods of culture for supplying bass and bluegill needs.

Consequently, an experiment was conducted at the National Fish Hatchery, Marion, Alabama, to obtain comparative data on the three methods of spawning channel catfish which have been described in the literature, *i. e.,* the utilization of a spawning pond, use of spawning pens and controlled spawning using hormone injected brood fish held in aquaria.

## FIRST-YEAR EXPERIMENT

The initial experiment in comparing spawning environments for channel catfish was conducted during the late spring and early summer of 1958. A brood stock of 140 fish was available for spawning, one-third of which were females. This stock was augmented by the purchase of 25 small females and 15 males from a commercial source in mid-June. The resident stock was mostly 3-year-old fish and were in what was considered to be about average condition in regard to body flesh. Since the previous season they had been fed a dry pelleted † ration at a rate of 4 percent of their body weight daily for the months when water temperatures were 55°F. or above. In addition, scrap fingerling fish such as goldfish and green sunfish along with odd lots of bluegills were placed in the holding ponds. From the condition of the catfish at the end of the holding period, it appeared that a substantial quantity of the artificial food was eaten by the forage fish present while the catfish did not consume an appreciable amount of the forage fish.

Four of the 25 fishes purchased appeared to have spawned prior to their acquisition and seven potential spawners were lost from fighting injuries and other causes during and shortly after delivery.

Three types of spawning environments were employed. The first environment was a 0.6-acre pond used previously to hold part of the resident catfish brood stock. The water level was lowered to a depth of about one foot and the catfish removed by seining on May 15. Forage fish were eliminated with rotenone, the pond was refilled with water and stocked with eleven male and ten female catfish averaging one and one-half pounds each on May 21. Previously, the pond had been equipped with five, 10-gallon milk cans and three oblong wooden boxes open at one end for use as spawning containers. These containers were distributed around the edges of the pond in water 18 to 30 inches in depth. The closed end was partially embedded in the dike and the open end was toward the middle of the pond. The pond was fertilized for vegetation control and artificial feeding at a four percent level carried on three times weekly. The spawning containers were inspected three times weekly on Monday, Wednesday and Friday. Any eggs noted were collected as soon as possible for artificial incubation. Observations were stopped on July 14.

The second type of environment was a series of 16 concrete block pens six feet wide and 12 feet long, extending from the shore of a long narrow pond

* Clemens, H. P., and K. E. Sneed. M. S. The bioassay and use of pituitary materials to spawn warm-water fishes with notes relative to fish-cultural practices.

† Consisted of 28 percent fish meal, 24 percent wheat middlings, 24 per cent cottonseed meal, 10 percent yeast, 10 percent distillers solubles and 4 percent salt.

out to water approximately 3½ feet deep. Four pens were equipped with a 10-gallon milk can for use as a spawning container and 12 pens had a rectangular box made of marine plywood open at one end. The containers were embedded in the bank with the opening toward the deep water and were placed at a depth of about eighteen inches below the water surface. An opening for inspection of the interior was located on the upper side and was normally closed using a concrete block which also served as a weight and prevented the boxes from floating. During the course of the experiment, 32 female fish were rotated through the spawning pens. Most of the fish were untreated but late in the spawning season several fish were injected with dosages of chorionic gonadotropin in an effort to stimulate spawning as it appeared that the recipients would not spawn otherwise.

The third type of environment was a series of six 50-gallon glass aquaria and four concrete holding tanks containing about 380 gallons of water each. Fish in this treatment were injected with either acetone-dried catfish pituitary material at the approximate daily rate of two or three milligrams of material per pound of body weight or chorionic gonadotropin at several dosage levels. The total number of fish treated in this manner was 26.

The selection of spawning pairs was made using sexual characteristics described by Toole (*op. cit.*). An effort was made to supply some of the best quality fish to all treatments. The injected fish used in the aquaria and tanks as a whole were judged to be of better quality than those of the pen treatment. A few fish were held in the aquaria until it appeared that no spawn would occur. They were then transferred to a spawning pen for further observation. One such fish spawned in the pen seven days after being removed from an aquarium where she had received a series of 12 daily injections of fish pituitary administered at a rate of 2 milligrams of material per pound of body weight.

The spawning success of fish in the three treatments is shown in Table I. The female catfish in the pond had a much higher percentage of spawning success than did those subjected to the more restrictive environmental conditions. The fifty percent spawning figure did not include one or two unobserved spawns that were apparently deposited in a can that was inadvertently overlooked in making the inspections for spawns. Examination of the pond by seining in September following the spawning season revealed the presence of fingerling catfish of two distinct sizes. While both sizes could have been from the same spawn, the difference was marked enough for them to have been from two different spawns.

TABLE I

SPAWNING PERCENTAGES FOR ENVIRONMENTS STUDIED

| *Environment* | *No. Treated* | | *No. Spawning* | | *% Spawning* | |
|---|---|---|---|---|---|---|
| | *1958* | *1959* | *1958* | *1959* | *1958* | *1959* |
| Pond F (0.6-Acre) | 10 | 13 | 5* | 6† | 50.0 | 46.2 |
| Spawning Pens | 32 | 32 | 10 | 14 | 31.2 | 43.7 |
| Aquaria or Holding Tanks | 26 | 17 | 1 | 6‡ | 3.8 | 35.2 |

* At least one other spawn took place which was unnoticed until fingerling fish were collected by seining in late summer.
† One spawn was limited to about 500 eggs.
‡ Five of these spawns were incomplete, *i. e.*, less than 500 eggs.

The results obtained in the pen environment were about what could be expected from average quality brood fish. While Crawford (1957) has reported a spawning percentage as high as 90-95 percent of the female fish penned, the average for all catfish hatcheries would be substantially lower as indicated by data obtained by Swingle.‡ (Fish culturists interviewed reported successful spawning of 50-70 percent of the earliest maturing females and 20-50 percent of the late maturing ones.)

The spawning success of the fish held in aquaria and tanks was much less than that of the other treatments. Treatment data for fish in the aquarium environment are shown in Table II.

‡ Swingle, H. S. A report to the Ida Cason Calloway Foundation on commercial catfish production. Unpublished M. S.

TABLE II

RECORD OF TREATMENT OF CATFISH IN AQUARIA AND TANKS IN 1958

| *Environment* | *Date Started* | *Treatment** | *Duration (No. of Days)* | *Results* |
|---|---|---|---|---|
| Aquarium | 5/2 | 2 mg. F. Pit./lb. | 8 | Negative |
| " | 5/2 | 2 mg. F. Pit./lb. | 8 | Negative |
| " | 5/3 | 500 units CG/lb. | 10† | Positive |
| " | 5/21 | 2 mg. F. Pit. | 12‡ | Negative |
| " | 5/21 | 2 mg. F. Pit. | 21 | Negative |
| " | 5/21 | 2 mg. F. Pit. | 24 | Negative |
| " | 5/21 | 2 mg. F. Pit. | 24 | Negative |
| " | 5/21 | 2 mg. F. Pit. | 22 | Fish Lost¶ |
| " | 6/2 | 2 mg. F. Pit. | 25 | Negative |
| " | 6/5 | 2 mg. F. Pit. | 29 | Negative |
| " | 6/16 | 2 mg. F. Pit. | 29 | Negative |
| " | 6/16 | 2 mg. F. Pit. | 11 | Negative |
| " | 6/16 | 2 mg. F. Pit. | 11 | Negative |
| " | 6/20 | 250 units CG/lb. | 25 | Negative |
| Tank | 6/20 | 2 mg. F. Pit. | 21 | Negative |
| " | 6/20 | 500 units CG | 14 | Negative |
| " | 6/20 | 2 mg. F. Pit. | 24 | Negative |
| " | 6/20 | 400 units CG | 24 | Negative |
| Aquarium | 6/27 | 2 mg. F. Pit. | 7 | Negative |
| " | 6/27 | 2 mg. F. Pit. (7 days) plus 500 units CG on 7/4 | 7 | Negative |
| " | 6/27 | 3 mg. F. Pit. | 18 | Negative |
| " | 6/27 | 3 mg. F. Pit. | 18 | Negative |
| " | 7/4 | 500 units CG | 4 | Negative |
| " | 7/4 | 500 units CG | 11 | Negative |
| " | 7/8 | 500 units CG | 7 | Negative |
| Tank | 7/8 | 500 units CG | 6 | Negative |

* Treatments were given daily with fish pituitary at a rate of 2 and 3 mg. per pound and chorionic gonadotropin at rates of from 250-500 international units per pound being used.

† Seven daily injections were given followed by a 12-day lapse in treating, after which three additional injections were given.

‡ This female was transferred to a spawning pen where she spawned seven days after injections were stopped.

¶ Water supply went off and fish died from low oxygen levels after 22 days of treatment.

Several of the female catfish injected released a few eggs during handling and pairs of fish were occasionally noted engaging in pre-spawning activity, but none injected with fish pituitary spawned.

Results of injecting chorionic gonadotropin¶ to aquarium and tank held fish were only slightly better. In this instance eight female fish were injected with daily doses of chorionic gonadotropin at rates ranging from 250 I. U. per pound of body weight for 25 days to 500 I. U per pound for four days. From the eight fish, one successful spawn was obtained.

## SECOND-YEAR EXPERIMENT

Approximately 20 female catfish were available the following year for a continuation of the spawning experiment described above. Another lot of fifty females about three years of age were obtained from a commercial source on December 16, 1958. At the time of acquisition these fish averaged 2.2 pounds each and had a size range of 1.3 to 3.3 pounds.

The brood stock was fed a ⅜-inch pellet made up from the Auburn No. 2 formula (Swingle, *op. cit.*) at a rate of two percent of their body weight daily with the weekly ration being divided into three equal portions and fed Monday, Wednesday and Friday during the winter months. As the water temperature rose above 60° F. pellets were increased and beef liver was added. The liver was fed two days each week at the rate of 4 percent of the body weight of

¶ This product was the A. P. L. brand manufactured by Ayerst Laboratories. Dosages were suggested by K. E. Sneed in an oral communication.

fish present in the pond. The meat was chopped into 1-1½-inch cubes and

scattered over a wide area of the holding pond. For the remaining five days, pellets were supplied at a rate of 4 percent of the body weight.

The same types of spawning environments were used that had been employed the previous year. The 0.6-acre pond was stocked with 16 females and 15 male channel catfish from the lot of brood fish carried over from the previous year. Stocking was done on March 11, 1959. The female fish averaged 3.2 pounds while the male fish averaged 3.6 pounds. At the time of stocking the fish were in average condition but did not have any noticeable abdominal development that would indicate advanced ovary development. Feeding of this lot of fish was continued at the rate described above.

The spawning containers were left in the pond from the previous year. The first inspection was made on May 6. At that time, 3 spawns were noted, one of which was 6-7 days old and near hatching. The containers were inspected following the same schedule used the previous year. During the 1959 spawning period, six spawns were noted including one which was incomplete, containing only a few hundred eggs. Based on the number of females stocked, a spawning percentage of 46.2 percent was obtained. This percentage conformed rather closely to the 50 percent figure obtained the previous year under similar circumstances.

The concrete block spawning pens were stocked with brood catfish on May 12. Fish for later stocking were held in two holding ponds, one for male and another for female fish. The first spawn was noted on May 18. During the period May 18-June 19, 14 spawns were obtained from 32 female fish which were given an opportunity to spawn. This is a spawning percentage of 43.7 percent, about the same as that obtained from the pond environment. Of the initial stocking of 16 females made on May 12, eight had spawned by June 5. Two of the non-spawners were then injected with chorionic gonadotropin at a rate of 300 I. U. per pound of body weight. One of the injected fish spawned three days later but the second failed to spawn although another injection of 600 I. U. of chorionic gonadotropin per pound was given a week after the first. One fish was lost, it was suspected that spawns were missed from three fish, and two females were removed after one month in the pens without spawning.

Subsequent pen stocking of 16 female fish which ripened later and probably were of inferior quality resulted in six spawns, two of which occurred within three days after administration of a 600 I. U. dose of chorionic gonadotropin. Eight of the fish stocked failed to spawn prior to the termination of the experiment on June 19, while two fish died from injuries inflicted by the male fish or from handling. One of the non-spawning fish was treated with a single injection of 600 units of chorionic gonadotropin per pound of body weight with negative results.

Success of the aquarium treatment was improved over that of the previous year in that more fish spawned. Increased success was of value experimentally rather than from a production standpoint, as all of the spawns obtained except one were incomplete and consisted of only a few eggs, sometimes less than a hundred. One pair of fish produced a normal sized spawn which was later abandoned by the parent fish upon completion of spawning.

Three levels of chorionic gonadotropin were used. A rate of 300 I. U. per pound of body weight administered for three successive days and repeated after four days was applied to three fish. It resulted in two partial spawns and one failure over the two-week observation period. A dosage of 600 I. U per pound of body weight administered three times weekly was used for seven fish. One incomplete spawn was noted, three fish failed to spawn over a three-week period and three fish were injured by the male fish and had to be removed from the experiment.

A third dosage rate of 900 I. U. of chorionic gonadotropin was given once weekly to seven fish. One complete spawn was obtained along with two incomplete spawns of 50-100 eggs. Two females were incompatible and required removal to prevent injury. Results with two fish were negative.

Of the 17 females held in the aquarium environment and treated with chorionic gonadotropin one complete and five incomplete spawns were obtained for a spawning percentage of 35.2 percent. As only one incomplete spawn was noted among the 26 spawns collected in the other environments studied, it would appear that incomplete spawning is much more characteristic of the aquarium habitat than of pond or pen.

## SUMMARY AND CONCLUSIONS

The comparative success of the pond environment is not surprising when reports of the early catfish culturists are considered (Doze, Morris and Lenz, *op. cit.*). Channel catfish eggs were obtained from spawning ponds until Murphee (Mobley, 1931) devised the pen type spawning facility. Where the brood fish are of marginal quality because of immaturity, poor flesh or a combination of causes, as may have been the case with fish used in this experiment, much more difficulty is encountered in determining sexually ripe fish that are at a proper stage of development for spawning. Since the brood fish pair themselves when the spawning pond is used, mistakes in pairing fish in pens or aquaria by the fish culturist are avoided.

This failure to select fish that were ready for spawning may account in part for the low spawning percentage obtained in the aquarium environment. According to Clemens and Sneed (*op. cit.*) an essential feature of the successful spawning of channel catfish in aquaria under the stimulus of hormone injection is the treatment of mature, ripe females.

Results of this study suggest that use of the more artificial spawning environment such as an aquarium or fish holding tank is not desirable if the brood fish are marginal as to immaturity or physical condition.

The data also indicate that numerous injections of acetone-dried fish pituitaries or chorionic gonadotropin are ineffective in inducing spawning in fish that are marginal in quality or maturity and may actually reduce spawning success. Thus these aids cannot be used as a substitute for a mature and properly cared for stock of brood fish.

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