CONTROLLED CULTURE OF LARGEMOUTH BASS FRY[1]

J. R. Snow
Fishery Biologist (Mgt.)
Marion National Fish Hatchery
Marion, Alabama 36756

ABSTRACT

A method for the controlled production of largemouth bass, *Micropterus salmoides,* Lac. fry is described. The method was based upon use of artificially-fed brood fish which were stocked into small earthen ponds equipped with nylon felt spawning mats. Eggs deposited on the mats were separated, cleaned and incubated in a Heath Vertical Incubator. Fry hatched in one to two days and were held until swimup in holding troughs or shipped during the yolk sac absorption stage.

A trial of the technique in 1972 resulted in approximately 2,714,000 eggs being collected from 563 fish stocked in seven 0.1-acre ponds. From these eggs, 1,564,000 fry were hatched and survived (57.6 percent) to swimup or for shipment as sac fry.

Twenty-two percent of the eggs collected were infertile according to examination of samples removed during processing. Subtracting this percentage from the total number of eggs collected gives an estimated 2,117,000 which could have hatched. Usable fry production was 1,564,000 or 73.9 percent of the viable eggs incubated.

Five age classes of adults were included in the stocking. Best egg production was from five-year-old females, with an average of 2.0 spawns each, followed by two-year-olds with 1.9 spawns each. Three-, four- and one-year age classes produced 1.3, 0.9 and 0.8 spawns respectively per female stocked.

The advantages and disadvantages of the method are discussed along with some possible applications.

INTRODUCTION

The feasibility of rearing largemouth bass, *Micropterus salmoides,* Lacepede, on artificial food has been studied at this station for a number of years and results of the work reported in considerable detail (Snow, 1960, 1963, 1968a., 1968b., 1969, 1971a., 1971b.). While much of this study related to the culture of large fingerlings to a size of 6-8 inches total length, some attention was given to feeding sexually mature fish a pelleted ration (Snow, 1969). In the course of these investigations it was learned that adult bass could be maintained from year to year on a diet of Oregon Moist Pellet (OMP, Hublou, 1963). For several years heavy spawning was observed to occur when sexually mature artificially-fed bass were stocked in small earthen ponds at densities ranging from 200 to 2,500 fish per acre. When nylon felt spawning mats (Chastain and Snow, 1966) were installed in the ponds, many spawns were deposited on the artificial substrate and could be removed for artificial incubation (Snow, 1969, 1971a.).

Since it appeared that a substantial number of eggs could be obtained for controlled incubation, a study was initiated to test the feasibility of artificially hatching the embryos instead of leaving them in the care of the male parent. In preliminary work done in 1970 and 1971, a method was developed which

[1]Prepared for presentation at a meeting of the Southern Division of the American Fisheries Society, held in conjunction with the 26th Annual Meeting of the Southeastern Association of Game and Fish Commissioners, Knoxville, Tennessee, October 22-25, 1972.

appeared to have possibilities for the successful production of bass embryos in large numbers. This method was then further modified and applied in 1972 to attain a specific production objective.

The objective established was to collect three million eggs which would then be hatched to produce one and one-half million swimup fry. The fry were needed for stocking and rearing trials and for studies in handling and shipping during early stages of growth. A secondary objective was to make observations on the spawning of adult bass which had been maintained for periods of one to five years on a diet of OMP.

MATERIALS AND METHODS

The basic procedure was similar to that described previously by Snow, 1971a. Seven ponds of approximately 0.1-acre each were stocked with varying numbers of brood fish on March 26. Each pond was equipped with 30-32 spawning mats. Table I shows the stocking details. Beginning the day after stocking, the ponds were observed each day shortly after 7:00 a.m. for spawning activity. The location of spawns was noted and eggs were scheduled for removal according to the prevailing water temperatures as follows: 19°C. or lower, second day after observation; 19-22°C., day following observation; 23°C. and above, afternoon of day observed.

Table 1. Stocking details for 1972 controlled bass fry production trial.

Age class	Pond	Acres	No. and weight stocked	
			Males	Females
I	C-7	0.1	100 - 60.2 lbs.	125 - 72.5 lbs.
II	C-11	0.1	35 - 59.5	3t - 64.8
III	C-15	0.1	35 - 84.0	25 - 72.8
III	C-23	0.1	21 - 50.4	17 - 49.5
IV	C-25	0.1	26 - 69.9	45 162.0
V	C-27	0.1	18 - 48.2	20 - 68.4
Mixed*	C-13	0.1	30 - 26.8	30 - 37.7

*Age class I and II combined as follows: 22 class I males and 8 class II males, 14 class I females and 16 class II females.

Eggs were collected by detaching the spawning mat from the pond bottom, folding so that the egg mass was protected from dislodgment and clipping the folds together with a heavy duty spring-type paper clip. The mat was kept immersed in water of about the same temperature as the pond during transit to the separation station which was a rectangular tank in the fish holding house. Depending on the number of mats involved, the transport container was either a galvanized tub having a capacity of about eight gallons or a small stock tank with a capacity of about 50 gallons.

Eggs were washed from the spawning mats using a collecting basket made of nylon netting attached to a metal frame. The device was suspended in a 2' x 2.5' x 9.5' rectangular concrete tank which received a water flow of 10-15 gpm. To separate the eggs, the mat was unfolded, immersed in the basket so that the spawn was just below water level and then waved or swished vigorously 15-20 strokes. Freshly spawned eggs were found to be much more adhesive with this property diminishing as time after spawning increased. However, if eggs were too old when separated, the stress of removal caused premature hatching.

Following separation from the spawning mat, the eggs were transferred by siphon to a tub for cleaning of detritus and unwanted contaminants. A com-

bination of decanting, diluting and screening proved to be most successful. After cleaning, the eggs were transferred to a graduate for measurement of the settled volume. They were then given a 15-minute exposure to 50 ppm acriflavin for prophylaxis and a sample of about one milliliter was removed for counting and viability study. Incubation was then finished in a Heath Vertical Incubator where water flow of 1.5-2.0 gpm was maintained. The water supply was a reservoir pond receiving well water of good quality and a temperature of about 21.5°C. Temperature of the supply water was within 2°C. of the pond from which the eggs were removed.

After hatching, the fry dropped through the screen into the bottom of the tray. Cleaning was done as soon as hatching was complete to minimize losses from fungus development. Embryos were usually transferred from the tray 24-48 hours after hatching, either to a metal holding trough 0.5 x 1.1 x 8.0 feet or to a holding box made of saran fabric fine enough to retain the fish. The holding boxes were suspended in a concrete holding tank or set on the bottom of a shallow trough about one foot in depth.

The number of eggs was estimated by applying results of the sample count of the one milliliter removed during processing to the settled volume of the lot. The number of fry was estimated by a number-volume relationship of fry in a lot. According to McLeod[2] this method of estimating fry numbers gives an acceptable level of accuracy.

Routine cleaning of the holding container was done each day to minimize development of fungus. Oxygen levels were maintained with an appropriate flow of water.

The rate of stocking fry for holding during yolk sac absorption depended more on the numbers of fry in the lot than the maximum capacity of the containers. The greatest density held was about 23,000 per cubic foot of trough or 10,000 per cubic foot of holding box.

Holding time for yolk abosrption and swimup varied from 3 to 7 days. Except for one occasion when 50 ppm formalin was administered over a one-hour period as a continuous flow treatment, no therapy was deemed necessary during the holding period. Fry were ordinarily disposed of prior to swimup or within three days following swimup.

The eggs taken for the sample count were examined individually under low power magnification and separated into fertile and infertile categories. Presence of any discernible opaque areas at the time of examination classified the egg as infertile. The sample was then placed in a shallow pan and held in the laboratory until hatched. Each embryo was then enumerated along with the eggs which failed to hatch.

RESULTS AND DISCUSSION

Nesting activity began the day following the stocking of the spawning fish. No eggs were seen until March 30, the fourth day after stocking. The number of spawns per day (Figure I) gradually increased to a high of 25 on April 8, dropped to one on April 10, climbed to 27 on April 13 and showed several lesser peaks over the next 30 days. Egg collection was terminated on May 15 although an observation on May 22 revealed eight spawning mats with eggs in one pond. In another pond, where mats had been removed for storage, male fish were seen tending spawning sites on June 8. Figure I shows the number of spawns by dates along with prevailing water temperatures.

During the period, 314 spawns were observed on the spawning mats. Additionally, 46 were taken from another pond not included in this study where

[2]McLeod, B. M. Determining the accuracy of the settled volume method of enumerating largemouth bass fry. Unpublished report, Warm-water Inservice Training School, Marion, Alabama, 13 pp.

one-year-old fish were being held. Of this number, 351 were taken for separation and incubation. Several spawns were used for other studies and were not included in the measurements of eggs collected and fry hatched. A total of 9,662 ml (settled volume) of eggs was collected. Based upon our sample counts, the number of eggs was estimated to be 2,714,000. Although this was a quarter million less than our production objective, the hatching percentage of 57.6 was 7.6 percent higher than our estimate, enabling the goal of 1,500,000 fry to be attained with room to spare.

All of the mature age classes spawned fairly well except age class IV. This lot only produced 40 spawns, a rate of 0.9 spawns per female. The age class I fish did not perform as well in this trial as in the past. By early May, 97 spawns (0.76 per female stocked) had been obtained. The eggs taken were of poor quality, small and of low viability. Collections were stopped on May 4 because of these factors. The production of low quality eggs by age class I fish had been noted before and may be a characteristic of immaturity or a disease symptom. The number of spawns per female of the age classes stocked was as follows: age class I, 0.76; II, 1.90; III, 1.30; IV, 0.90; V, 2.0. Except for the class I and IV fish, the number of spawns per female and the number of eggs per spawn were considered to be equal to those examined in an earlier study (Snow, 1971a.). The percentage of infertile eggs was higher than we had noted in the earlier study, however. Table 2 shows the data on some typical samples taken prior to incubation. The difference between the hatching percentage of the sample and that of the lot from the incubator is a measure of the effectiveness of the incubator and the attention given shortly after hatching. Generally, a higher percent hatch was obtained in the small sample which incubated under less crowded conditions. No explanation can be given for the three instances where the percent hatch was better in the main lot.

A part of this study was to determine how well the older brood fish performed as compared to the younger ones. It appeared that the fish in age class V were equal to or superior to those younger. Not only did they deposit 2.0 spawns per female on the mats, but the eggs were large and the number per spawn equal to those produced by the younger fish. Age class II fish also spawned well but no

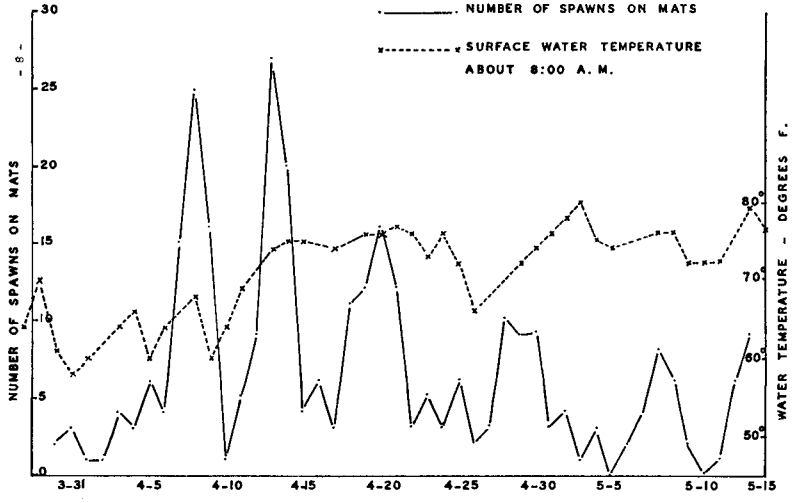

Figure I. Spawns noted on mats each day during the study period along with surface water temperature (6' below surface).

Table 2. Comparison between sample and entire lot hatching percentages.

Lot No.	Date collected	Age class represented	Percent viability	Percent hatch sample	Percent hatch lot
1	4-1	1, 2	72.0	46.9	48.0
2	4-2	2, 4	97.6	88.8	67.6
3	4-3	2	82.9	82.9	48.8
4	4-4	2	86.5	60.1	98.5
5	4-5	2, 4	98.3	79.0	63.8
Average			87.4	71.5	65.3
13	4-13	1, 2, 3, 5	96.2	96.0	67.1
27	4-28	5	81.2	29.2	22.4
30	4-30	1, 5	66.3	45.7	21.8
31	5-1	1, 2	72.7	72.7	51.9
33	5-3	5	88.3	80.2	52.1
Average			80.9	64.8	43.1
38	5-8	3, 4, 5	81.5	63.8	56.6
39	5-9	3, 4	63.0	33.6	34.4
40	5-10	5	88.5	88.1	86.2
42	5-13	3, 4	90.0	89.7	31.6
44	5-15	3, 4	62.0	57.4	38.8
Average			77.0	66.5	49.5

explanation for the low number of spawns produced by the age classes III and IV fish can be provided. In the pond where class I and II fish were mixed, the class II fish dominated the nesting sites. Only one spawn was noted which was tended by a class I male. This was placed off the spawning mat.

Trouble with disease developed in the age class II fish in early May as an outbreak of Trichodiniasis caused light mortality. A pond treatment with 25 ppm formalin appeared to clear up the infestation but no further spawning took place. It was suspected that the age class IV fish also were parasitized so a similar treatment was given this lot on May 16. Nesting activity dropped drastically following treatment but was resumed after a few days and eight new spawns were seen on May 22.

The 57.6 percent hatch of eggs collected does not appear to be as high as it could be based on the hatch obtained in the small samples. In the small-scale incubation environment used, average hatch was 63.5 percent based on the actual count of eggs and embryos noted in all of the samples. Considering the number of eggs which were obviously infertile or not viable at the time the sample was removed the percent hatch was much higher. The number of infertile eggs per sample at the time of collection averaged 22 percent in 28 samples. Applying this percentage to the 2,714,000 eggs collected gives 597,000 infertile at the time controlled incubation began. The percent hatch as adjusted to reflect infertile eggs at collection is then calculated to be 73.0 percent which puts the control technique in a more favorable light.

Treatment of the eggs with acriflavin at a rate of 50 ppm for 15 minutes (Wright[3]) greatly reduced the trouble with fungus during the incubation period. Minor losses were caused by fungus after hatching which would have been greater if a twice-a-day cleaning regime had not been followed.

[3]Wright, Lloyd D. Comparing the effect of four chemicals for disinfection of bass eggs. Unpublished report, Warmwater Inservice Training School, Marion, Alabama. 17 pp.

No difficulty was experienced in holding the sac fry for periods of 2-6 days in the hatching trays, metal holding troughs or cages made of saran fabric suspended in holding tanks. Handling was done within 24 hours of hatching and each day thereafter until 5 days after swimup and no evidence was noted of a period when the fry were susceptible to handling stress. Fry numbers were estimated before swimup using a number-volume relationship. There was no indication that this handling was harmful in the stage and quantity handled.

APPLICATIONS FOR THE TECHNIQUE

Several benefits from this technique have already resulted. Behavior of bass fry during folk sac absorption has been observed. Also, knowledge has been gained in handling embryos of this species in their earliest stages of development. Availability of abundant numbers of newly hatched bass fry over a period of five years has enabled studies on stocking and rearing of swimup fry to be conducted and to try to develop a method of training swimup fry to take artificial food. Although efforts to date have been unsuccessful, it is quite likely that a ration and feeding technique can be developed in the near future.

Controlled incubation of largemouth bass embryos may have production advantages great enough to make the technique profitable to the largemouth bass culturist. There are tangible values in bass rearing pond management to know to the day, when fry will be available for stocking along with a reasonably accurate prediction of how many will be available. The food chain in the rearing pond can then be developed so that it will be suitable for the fish being stocked.

Stocking rates can be determined with more precision where sac fry are involved than is possible where advanced fry are used. Prophylaxis and disease control can be given during the incubation and holding period. Predation losses do not occur in the egg or yolk sac absorption stages and cannibalism is less likely in rearing ponds because of size uniformity of fry at stocking.

Development of a reliable shipping technique would make it possible for bass fry to be produced in a central location for shipment to adjacent rearing stations either by common carrier or hatchery vehicle. Also the production season can be greatly lengthened by shipping fry both north and south.

Efforts to ship largemouth in sealed polyethylene containers were initiated in 1970 and continued intensively in 1971 and 1972. Results are encouraging and work on this phase can continue with an abundant supply of test animals available.

The major disadvantage of the technique to date appears to be the amount of time required. Eggs should be collected each day. Incubating eggs and developing fry should be cared for regularly, seven days a week. The production of 1,500,000 fry in this study required an average of six hours per day, seven days per week for a period of 50 days with supplemental help at peak spawning activity and to get ponds set up and stocked. Undoubtedly, the time demands could be reduced by putting the operation on a production basis and developing greater operational efficiency. Based on experience to date, it is estimated that two men could produce 3-6 million fry in less than 60 days. However, many small hatcheries do not have this much manpower to devote to all phases of fish culture during the bass spawning season. Increasing the volume of production could well result in less time required per thousand fry stocked than is presently expended by hatcheries producing fry by the conventional method.

Plans are to continue using the technique to provide test animals for shipping and feeding trials and to further refine the method for production purposes.

ACKNOWLEDGEMENT

The assistance of the trainees and staff of the Warm-water Inservice Training School in carrying out this study is gratefully acknowledged. Special recognition should be given to Mrs. Ava Dean Fowler for egg and fry counts and to James Maxwell, Charley Wright and Bruce McLeod for voluntary help at crucial times.

LITERATURE CITED

Chastain, G. A. and J. R. Snow. 1966. Nylon mats as spawning sites for largemouth bass *Micropterus salmoides,* Lac. Proceedings of the Nineteenth Annual Conference of the Southeastern Association of Game and Fish Commissioners. pp. 405-409.

Hublou, W. F. 1963. Oregon pellets. Progressive Fish-Culturist. 25(4):175-180.

Snow, J. R. 1960. An exploratory attempt to rear largemouth bass fingerlings in a controlled environment. Proceedings of the Fourteenth Annual Conference of the Southeastern Association of Game and Fish Commissioners. pp. 253-257.

_____ . 1963. Results of further experiments on rearing largemouth bass fingerlings under controlled conditions. Proceedings of the Seventeenth Annual Conference of the Southeastern Association of Game and Fish Commissioners. pp. 191-202.

_____ 1968a. Production of six- to eight-inch bass for special purposes. Progressive Fish-Culturist. 30(3):144-152.

_____ . 1968b. The Oregon Moist Pellet as a diet for largemouth bass. Progressive Fish-Culturist. 30(4):235.

_____ . 1969. Some progress in the controlled culture of the largemouth bass, *Micropterus salmoides.* Proceedings of the Twenty-second Annual Conference of the Southeastern Association of Game and Fish Commissioners. pp. 380-386.

_____ . 1971a. Fecundity of largemouth bass *Micropterus salmoides,* Lac. receiving artificial food. Proceedings of the Twenty-fourth Annual Conference of the Southeastern Association of Game and Fish Commissioners. pp. 550-559.

_____ . 1971b. Four years of feeding Oregon Moist Pellets to largemouth bass. Proceedings of the North Central Warm-water Fish Culture-Management Workshop, Ames, Iowa, January, 1971. pp. 195-198.