FECUNDITY OF LARGEMOUTH BASS, *MICROPTERUS SALMOIDES*, LACEPEDE RECEIVING ARTIFICIAL FOOD[1]

by

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ABSTRACT

Fecundity of largemouth bass, *Micropterus salmoides*, Lac. reared and maintained on two diets was measured by use of a technique of collecting naturally-spawned eggs from nylon felt spawning mats. A volumetric measurement was made of the eggs in 10 spawns from Year Classes I, II and III pellet-fed fish for comparison with eggs from Year Class II bass fed forage fish.

Average eggs per spawn for the Year Class I fish was 9,551; for Year Class II pellet-fed, 21,744; for Year Class III, 15,223 and for Year Class II fish-fed, 19,410. The lower number of eggs produced by Year Class III fish than Year Class II is thought to be related to influence of the diet given during the first 14 months of feeding when a ration of dry trout feed and ground frozen fish was fed to this lot. Other than this, the artificial ration used was Oregon Moist Pellet.

Apparent viability of eggs from bass receiving artificial food was higher than that of eggs from those on a natural diet. This was not thought to be related to diet however. Egg size was comparable between the two diets, but color was better in eggs spawned by bass on a natural diet.

Measurements of ovaries removed from selected specimens paralleled those of sample spawns except that the number of ova per pound of body weight was highest in Year Class I pellet-fed specimens. A noticeable amount of fatty tissue was present in the ovaries taken from two- and three-year-old fish which had been fed artificial food.

INTRODUCTION

The largemouth bass, *Micropterus salmoides* Lac. has been propagated under hatchery conditions since 1890[2]. Although early workers provided artificial food for brood stock to some extent, a diet of natural food has been used almost exclusively during the last 25 years of culturing the species, (Topel, 1949, Blosz, 1952).

More recently, however, Snow (1965, 1968a, 1969) has developed a technique for growing two-inch or larger fingerling largemouth bass to adult size feeding artificial food. Oregon moist pellet (Hublou, 1963) has proven to be an effective production diet which gives predictable results, is reasonable as to production cost and appears to satisfy the nutritional needs of the species (Snow 1968b).

While reported work has demonstrated the suitability of artificial feed in rearing largemouth bass to sexual maturity, the effectiveness

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[2] Report of Commissioner of Fish and Fisheries for 1889 to 1891. Part XVII, U. S. Commission of Fish and Fisheries. Government Printing Office, Washington, D. C. 682 pp.

of this type diet in preparing adult fish for spawning has not been demonstrated under controlled conditions. Use of the technique at the Marion, Alabama National Fish Hatchery since 1967 to maintain experimental lots of adult fish made possible a study to evaluate an artificial feed as a ration for largemouth bass brood stock.

MATERIALS AND METHODS

Adult bass were available for use as brood stock as follows: Year Class I OMP - fish hatched the spring of 1969 and pond-reared to a size of two inches after which they were fed a diet of OMP in ponds. Year Class II OMP - fish hatched in the spring of 1968, reared to a size of about two inches on natural food, and later fed on OMP in ponds. Year Class II F - fish hatched in the spring of 1968 and reared and maintained on a diet of natural food, principally forage fishes - goldfish, *Tilapia* and possibly a few sunfish. Year Class III OMP - fish hatched in the spring of 1967, and reared to a size of two inches on natural food, and later fed an artificial diet of ground frozen fish and commercial trout pellets for the first four months of feeding. During the next 10 months they were fed a dry commercial trout pellet, followed by a 17-month period when OMP was fed.

All lots appeared to be sexually mature at one year of age and some spawned at that age. They were held prior to spawning in small earthen ponds at fairly dense rates and were accustomed to being hand-fed each day when water temperatures were such that feeding was practicable.

The test animals were removed from winter holding ponds in the early spring and placed at random in seven small earthen ponds approximating one-tenth acre each in surface area. These ponds were rectangular in shape and sloped from two to four and one-half feet in depth. Prior to filling they were equipped with rectangular mats of nylon felt material (spawning mats) as described by Chastain and Snow (1966).

These mats were located about nine feet apart around the perimeter of the ponds with the shallow end of each mat about one foot below the water surface. Filling the ponds with well water preceded introduction of the spawning fish by two or three days. No fertilization or weed control treatments were used. Feeding of OMP was continued although the bass reared on a diet of live fish were not fed during the spawning trials. Ten days before handling the fish for stocking into spawning ponds they were started on an oxytetracycline-treated ration in an effort to minimize disease outbreaks routinely encountered at this station. The drug was incorporated as a coating on the pellets at a rate to provide the amount suggested by Snieszko and Bullock (1962) of 50-75 mg of pure antibiotic activity per kg of fish per day. The bass accepted the medicated pellets readily and were fed the antibiotic for ten days prior to stocking. Midway in the spawning cycle another 10-day period of medicated feeding was instituted. After removal of the fish from the spawning ponds, medicated OMP was again fed daily for 10 days.

Each year class of pellet-fed fish was stocked in two ponds while the fish-fed lot was stocked in one. The number of brood fish stocked was established on the basis of size, 10 pairs per pond for two- and three-year-old fish and 20 pairs of one-year-old fish per pond. They were sexed according to the procedure described by Snow (1963) with equal numbers of males and females placed in each pond.

The pellet-fed bass were stocked on March 31, 1970 while the fish-fed

lot was stocked on April 1. Observations were made of the nesting sites each day, beginning the second day after stocking. The plan was to collect the first five spawns deposited on the spawning mats as a sample to indicate the fecundity of the fish stocked in the pond.

When a spawn was noted, the mat was removed before incubation was complete. Eggs were washed from the mat into a tub and as much silt and detritus was removed as possible by decanting and picking. The volume of eggs was then determined to the nearest milliliter and a two milliliter sample was removed and preserved in 10 percent formalin for actual count and sorting into viable and non-viable categories. The spawning mat was also examined within 48 hours of removal for eggs still adhering to the fabric.

The preserved sample was examined egg by egg to obtain the total number and the number of viable and non-viable eggs present at the time of preservation. Any discernable opaque spot on an egg was taken as the basis of non-viability. A hand lens of about four power magnification was used as an aid in this examination. Results of the sample count enabled an estimate of the number of eggs in the measured volume to be made. To this was added the number of eggs which adhered to the spawning mat after washing. The result gave an estimate of the total number of eggs in the spawn. This estimate is thought to be low, as some eggs were buried in the nylon felt and could not be seen from either side. Based on examination of several specimens in previous trials the buried eggs were thought to represent only a fraction of a percent of the total number however.

To provide further data, two or three female fish from each lot were killed and the gonads removed. They were then preserved in 10 percent formalin for later measurement. To estimate the number of ova per fish, the ovary was trimmed of adhering tissue, cut longitudinally, blotted and air-dried for 10 minutes. It was then weighed to + 0.02 gram, after which a random sample was weighed for separation and count. Size of this sample was approximately one seventieth of the total ovary weight. Weight of the sample was taken to the nearest milligram. Ova in the sample were sorted into "small" and "large" categories and counted. Those one millimeter or larger were assigned to the "large" category with the others counted as "small". The reason for this grouping will be discussed later. The number per gram of sample was then applied to the total weight of the ovary to obtain an estimate of the total number for the specimen. Table 1 shows the results of this count of "large" ova along with other data on the specimens. Figure 1 illustrates the number of large ova per pound of body weight for the specimens studied.

RESULTS AND DISCUSSION

The method outlined worked according to plan. The first spawns were noted on April 4 and collections were made rapidly in the six ponds stocked with artificially-fed bass. The forage-diet bass were disinclined to spawn on the nylon felt during the first ten days of observation. During this period at least two successful nests were established farther out in the pond than the mat locations. However when spawning on the mats began, all subsequent spawning was on or in the immediate vicinity of the established sites. In the ponds where artificially-fed fish were stocked, virtually all eggs observed were on the mats except in one pond where two nests were located midway between the prepared sites.

Oxytetracycline appeared to be highly effective in supressing skin infections which under similar conditions in previous years had been a major problem in bass spawning operations at the Marion station. No mortality was noted and no diseased fish were seen during the course of the study in ponds stocked with fish receiving the medicated feed.

Some mortality (5 of 17 fish stocked) occurred in the pond stocked with the fish-fed bass. Cause of this was thought to be hemorrhagic septicemia caused by *Aeromonas liquefaciens*. There is a possibility that viability of eggs produced by this diseased lot of fish was affected, especially in one instance where only 2.4 percent of the spawn was viable when collected.

Documented records for "normal" egg production by largemouth bass fed a live-fish diet are limited. Eddy and Surber (1943) reported 40,000 eggs from a three-pound female. Mraz, et. al. (1961) state that adult female bass in Wisconsin may carry from 2,000 to 20,000 eggs in the ovary. At Marion, a one-year-old female, weighing 1.2 pounds, carried 25,335 eggs (21,112 per lb. of body weight) by actual count. In another case, a female two years old, weighing 2.3 pounds was paired with a male in a 0.1-acre pond. A total of 18,845 one-inch fry was removed from the pond and the ovaries of the female still contained 38,271 eggs by actual count when she was killed later. Combining the fry production and the ova count gives an estimated egg production of at least 24,800 per pound of body weight.

TABLE 1

ESTIMATED EGG NUMBER IN OVARIES OF FEMALE BASS RECEIVING NATURAL AND ARTIFICIAL FOOD.

1	2	3	4	5	6
Year Class	Fish weight lb.	Weight ovary grams	Ova per [1]	Total ova per fish	Ova per lb. of fish
I OMP	0.35	12.00	1,508	18,096	51,703
I OMP	0.35	9.91	1,395	13,824	39,497
Average[2]	0.35	10.96	1,452	15,960	45,600
II F	2.50	94.69	896	84,842	33,937
II F	2.09	51.67	1,562	80,708	38,616
Average	2.30	73.18	1,229	82,776	36,068
II OMP	1.57	68.74	451	31,002	19,746
II OMP	1.13	49.24	1,045	51,456	45,536
II OMP	1.33	67.62	1,125	76,072	57,198
Average	1.34	61.87	874	52,843	39,337
III OMP	1.71	112.27	414	46,480	27,181
III OMP	1.68	91.43	651	59,521	35,429
III OMP	1.94	65.63	1,016	66,680	34,371
Average	1.78	89.78	694	57,560	32,398

[1]Includes ova one millimeter in diameter or larger. Average is unweighted.

[2]Column 6 average is weighted average obtained by dividing total ova for fish in lot by total weight of fish in lot.

When weighed samples of the ovary were taken and the contained ova counted as a basis for estimating the total eggs the number of eggs per pound was more variable as might be expected. Bass reared and maintained on a live-fish diet showed a range of egg numbers per pound of body weight from 13,100 to 79,500. In the specimen showing the high number of eggs, the sample indicated that only 42.5 percent of the ova were one millimeter or larger in diameter. Thus large eggs were estimated to be 33,900 per pound of body weight which is not considered to be unduly divergent from the low estimate (13,100) of the range. It is unlikely that the smaller eggs are released during the spawning season. Examination of spent or partially spent female bass by dissection on several occasions invariably has revealed a substantial number of eggs in the ovary. Bishop[3] counted the large ova remaining in the ovaries of several adult bass after they had been provided ideal hatchery conditions for spawning and found more than 50,000 per fish.

In this study, eggs from the ovary samples were arbitrarily divided into large and small categories with those one millimeter in size or greater designated as large and those less than one millimeter assigned to the small group. Table 1 lists the estimates of large eggs for the specimens selected from lots of different ages and rations. Highest production per pound of body weight was measured in the one year old OMP-fed fish. Year Class II OMP specimens had the next highest number followed by the Year Class II live-fish diet specimens. Lowest numbers were found in the Year Class III OMP fed specimens. A possible explanation as to the generally poorer performance of this lot of fish is the effect of 14 months of feeding an artificial ration (dry trout feed or trout feed and ground fish) which has given poorer results in our work than OMP.

Although the number of fish included here is low, the results are thought to be in harmony with the results of the spawning phase of the study and also relate well to other scattered data which are available for comparison. Two differences between the diets should be mentioned however. Color of the eggs from bass on a live diet was bright yellow, while that of eggs from pellet-fed fish was a lighter cream color. Also fatty tissue was prevalent in the ovaries of the pellet-fed fish to a noticeable extent. This is illustrated by the number of ova per gram. Year Class II OMP fish averaged 874 ova per gram, Year Class III fish averaged 694 ova per gram while the two females fed live fish averaged 1,229 ova per gram. Size of the individual ova were not this much different and the lower count per gram for samples from the pellet diet specimens is largely a reflection of non-egg tissue.

The actual number of eggs spawned (Figure 2) as indicated by sample spawns collected on the spawning mats paralleled the findings of the ovary counts except that the Year Class I fish produced the lowest number of eggs per spawn. The average number of eggs per spawn as shown in Table 2 was highest for the Year Class II OMP fish. Second highest was Year Class II fish-diet bass, third was Year Class III OMP-fed fish and lowest as might be expected, the Year Class I pellet-fed lot. These fish produced almost 10,000 eggs per spawn from fish averaging about 0.5 pound which is considered to be quite satisfactory. On a previous occasion however spawns from five, one-year-old fish receiving natural food averaged 22,500 eggs. Average size of the females in this latter instance was about 1.3 pounds.

Size of the eggs spawned by two- and three-year-old pellet-fed fish was somewhat comparable although our data suggest that the three-year-olds produced larger eggs followed by the two-year-old OMP-fed ones. Size of the eggs in spawns from fish-fed females ranked third with those from the one-year-olds being noticeably smaller in most instances and averaging at least 85 eggs per milliliter more than the average from samples from females on the live-fish diet.

[3]Bishop, Harry. 1968. Largemouth bass culture in the southwest. Proceedings of the North Central Warm-water Fish Culture Workshop sponsored by Iowa Cooperative Fishery Unit, Ames, Iowa. pp. 24-27.

Viability (Table 2, Figure 3) as indicated by apparent development of the embryo at time of collection of the spawns suggested that differences other than color existed between spawns from artificially and naturally fed bass. Only 63.5 percent of the embryos (78.8 percent excluding a very poor spawn) appeared to be viable in the spawns deposited by the fish receiving the natural ration. Viability of eggs from the one-year-old pellet-fed fish was higher, although still comparable while that of samples from the older pellet-fed bass was much better, averaging more than 90 percent viability.

In summing up the findings of this study it appears that largemouth bass reared and maintained on a diet of Oregon moist pellets are capable of equaling or even exceeding the reproductive performance of similar fish receiving a ration of live fish. Only when color of the egg was considered did the fish-diet eggs appear to be distinctly better. Other advantages of the artificial diet, particularly in relation to disease control, offset this characteristic, the value of which is undetermined in our case.

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TABLE 2

CHARACTERISTICS OF SPAWNS FROM FISH RECEIVING ARTIFICIAL OR NATURAL FOOD.

Year Class	I	II	II	III
Diet	OMP	Live fish	OMP	OMP
Spawns in sample	10	6	10	11
Average number of eggs per milliliter	571	486	392	374
Range of egg numbers per milliliter	444-674	470-504	320-505	319-422
Average number of eggs per spawn	9,551	19,410	21,744	15,223
Range in number of eggs per spawn	6,085-14,669	13,115-29,793	11,116-42,903	8,588-33,003
Percent of eggs viable, average	79.8	63.5[1]	91.0	92.1
Range of percentages eggs viable	35.0-97.0	2.3-92.1	73.2-98.1	51.9-99.1

[1]78.8 Percent excluding a spawn where only 2.3 percent were viable.

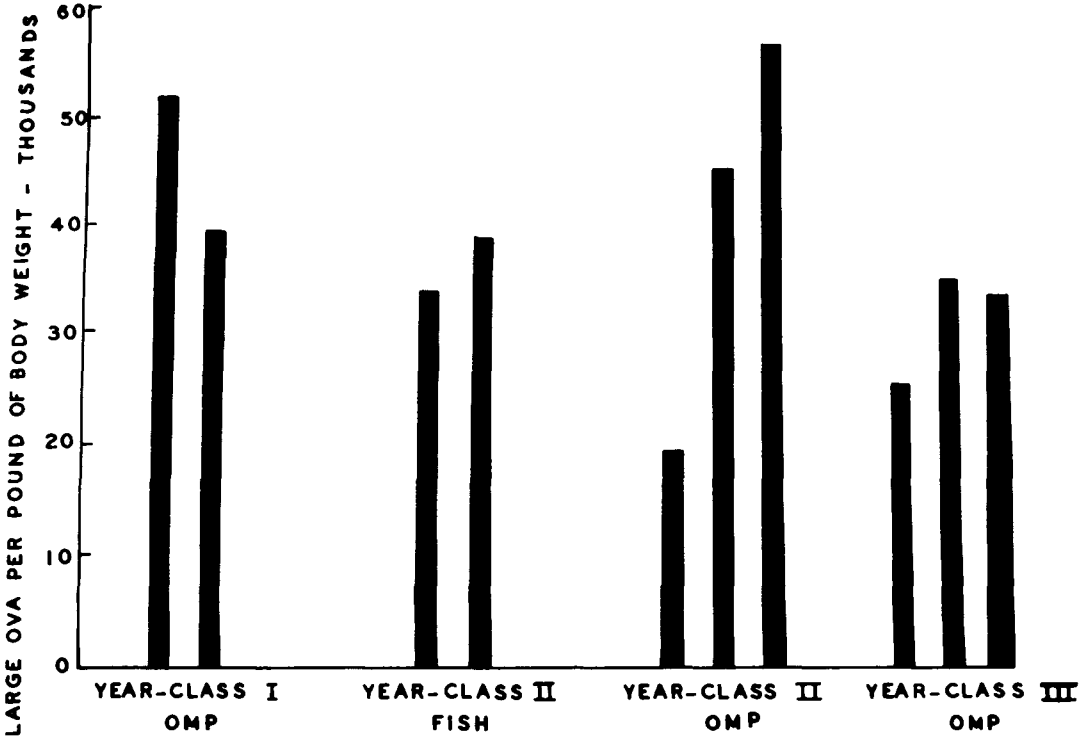

FIGURE 1. LARGE OVA PER POUND OF BODY WEIGHT FROM BASS FED TWO DIETS

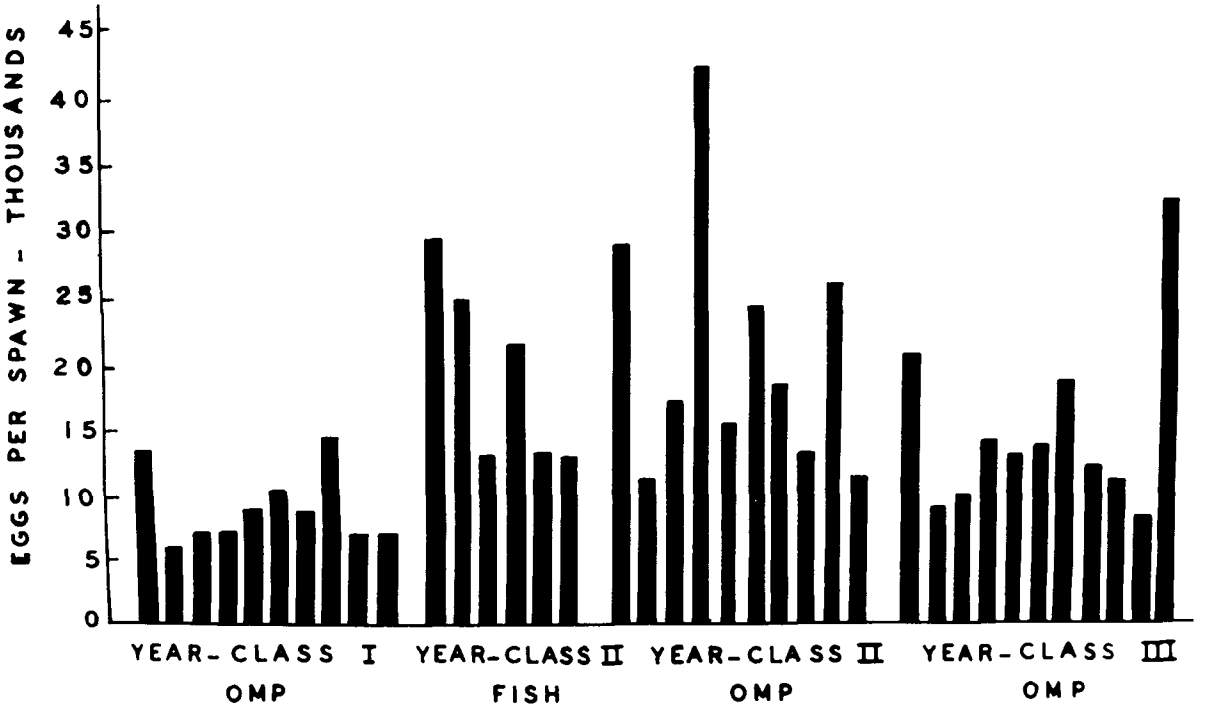

FIGURE 2. EGG NUMBERS PER SPAWN FROM BASS FED TWO DIETS

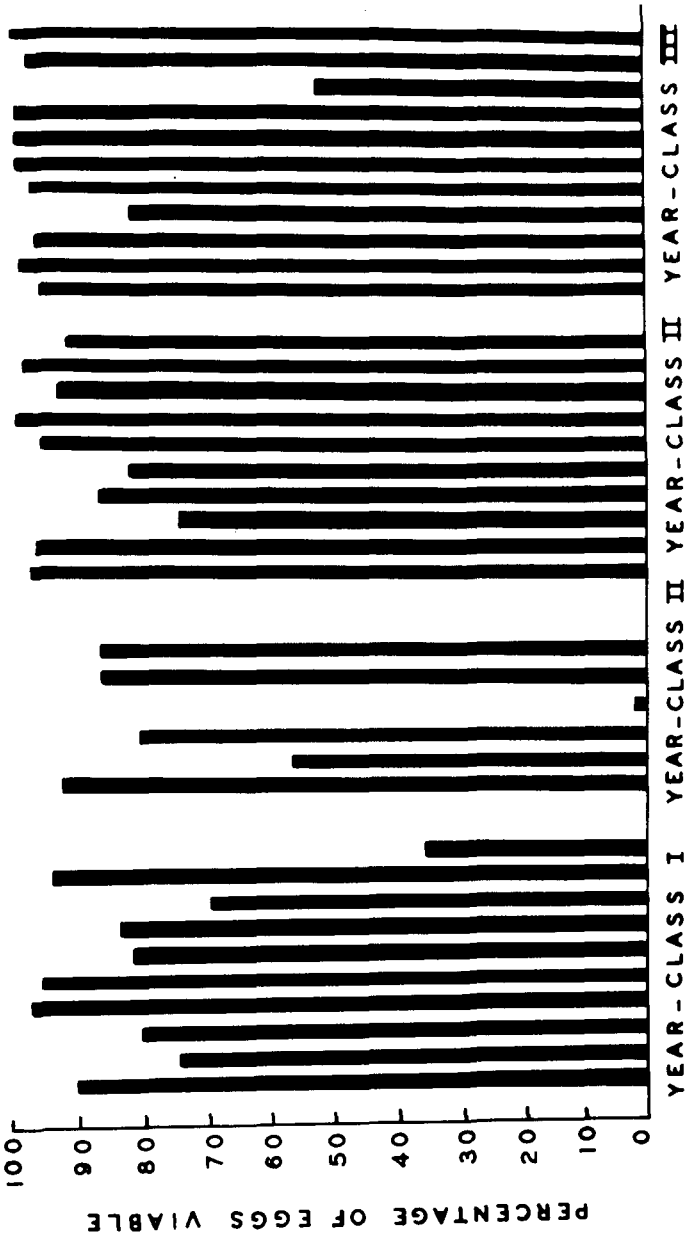

FIGURE 3. VIABILITY OF EGGS IN SPAWNS FROM BASS FED TWO DIETS

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