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EFFECT OF BROOD STOCK SIZE ON EGG FERTILIZATION, HATCHABILITY AND FRY SURVIVAL RATE OF AFRICAN CATFISH (*CLARIAS GARIEPINUS*)

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ABSTRACT

This experiment was conducted to investigate the effect of size of brood stock on egg fertilization, hatchability and fry survival rate of Clarias gariepinus in an intensive culture system, for a period of four weeks. Larger brood stock size (1200-1500g) produced larger eggs and bigger fry while moderate brood stock size (795-1000)g produced moderate eggs and moderate fry. The mean size of eggs produced and the size of brood stock was however not significantly different (p > 0.05). In addition, larger eggs resulted in larger fry. The survival rate of fry after starvation increased with increase in parent brood stock size. Best on this study it was recommended that for larger eggs and fry production, brood stock of Clarias gariepinus, of average size of (1200-1500g) should be selected for use in fish hatchery operation in Nigeria. There was no significant difference (p> 0.05) in the physiochemical parameters.

Keywords: Broodstock, Egg fertilization, Hatchability, Clarias gariepinus

INTRODUCTION

As the world population increases, the demand for fish in the world also grow, in spite of high preference for fish and fisheries products in Africa, the per capita consumption of fish in this part of the world is still very low FAO (2000). *Clarias gariepinus* and *Heterobranchus* species are the two commonly cultured Clariid fish (Vanden and Bernacsek, 1990; Ojutiku, 2008). They are reared all-over the country especially in the south and have very good commercial value in Nigeria markets (Adewolu and Adoti, 2010; Owodeinde and Ndimele, 2011). Methods of artificial seed propagation of African catfish (*Clarias gariepinus*) are very expensive in Nigeria and hatchery operators are usually scared of big size of brood stock not just because of the large quantities of spawning hormone that will be required for induced breeding exercise, but also because of their high price Sule and Adikwu (2004). The species in this family do not breed readily in captivity and productivity in the wild is usually very low, thus making fingerling collection from the wild not only time consuming and labour intensive but also very uncertain. Therefore, there has been a particular interest in examining the effect of brood stock and egg size of fry and fingerling since it affects fecundity of fish species (McGinley and Charvon, 1988). *Clarias gariepinus* exhibit considerable variability in egg size, both within and among populations. This is accounted for by female age and size (Richter and VandenHurk 1982) inter population variability in egg size could be due to environmental differences with large egg size of female fish. The reproductive strategies that concern offspring size and number could vary among population while differences in parental size could also account for some variations in the fry development process. Though, several authors have studied feeding effects on fecundity in fishes (Bagenal; 1969a; Knox *et al.* 1998, Sule and Adikwu 1999) however, the range of brood stock sizes that will produce maximum size of good quality eggs and larvae high survival rate has not been extensively investigated. The aim of this research is to identify the effect of brood stock size on egg fertilization, hatchability and fry survival rate of *C. gariepinus*.

MATERIALS AND METHODS

Experimental Fish and Hormone Injection

The experiment was conducted at Fangam integrated Fish farm at Mariri in Kumbotso Local Government area, Kano State. Matured Males and Females of *C. gariepinus* sizes range from (700-1500)g were procured for the experiment from fangam integrated farm and stock in concrete tanks size of 2m^2 at the hatchery complex. 15Males and Females fish were selected eachand group into two according to sizes and the females brooder were injected with Human Gonadotropin hormone (trade mark: Ovaprim) at dosage of 0.5ml per kilogram (kg) of fish body weight and the injection was done intramuscularly under the pectoral fin or at the neck. The injected area was rubbed with a finger in order to distribute the Ovaprim hormone evenly throughout the muscle and to prevent backflow of the Ovaprim hormone. The injected fish were kept in well aerated water in a small tank. The temperature of the water holding the fish was measured with mercury in glass thermometer and the corresponding latency times were taken and the milt used was collected by sacrificing the males. The male was dissected using a sharp razor blade and the testes were removed, cleaned off the blood with a tissue-paper and kept in a plastic bowl with a saline solution until needed. Incision was made into the creamy coloured lobes of the testes and the milt was squeezed out of the testes sac with physiological solution. The injection took place between 8.00pm and 9.00pm.

Stripping and Egg size Determination
At the expiration of the latency period, the females were carefully removed and hand stripped manually for eggs. The body of the female brooder was moped with a towel; this was done to prevent the eggs from coming in contact with water, which may consequently seal up micropyle and prevent fertilization. Slight pressure was applied on the abdomen of the female brooder, and this led to the ovulated eggs oozed out easily from the genital opening which were collected in plastic bowl. A sample of 20 unfertilized eggs from each Female size class was taken to determine egg sizes. Measurement of diameter of egg was made to the nearest 0.01mm with a microscope with an ocular micrometer. The mean weight of egg batches of eggs and the mean weight of 150 fry from the brood stock sizes were determined.

Egg size relationship
Fertilized egg batches from both large brood stock size(1200-1500)g and small brood stocd size (795-1000) were reared separately in tanks of (300 x 300 x 400)cm with from through system starting from the third day after hatching. The fry were fed with Atermia three times daily for three weeks

Performance of starved fry
Trials to assess how starvation affected the survival of fry were conducted in replicate after the absorption of egg yolk for 150 fry from each brood stock size group. The fry were starved for seven days and the percentage survival of fry after starvation was determined for each size group.

Physiochemical parameters
The surface water temperature was determined using mercury in glass thermometer. The thermometer was placed vertically until the bulb containing the mercury is inside the water, for about five minutes the reading was taken and recorded in degree centigrade (APHA, 1992).

The PH of water was determined using PH digital meter model Ts^{-l}jafan before starting the measurement the meter was standardized with potassium hydrogen titrate buffer solution then the PH meter was switched on and the electrodes were dipped inside the sampled water and readings were taken (Ademorati, 1996)

This was carried out by the use of Winkler's titration method (Ademorati, 1996). At the experimental site water was sampled into a 300ml bottle and 2ml of manganoustetraoxosulphate vi ($MnSo_4$) solution was added and 2ml of alkali Iodine-azide reagent well below the surface were added, a stopper was put this was to exclude air bubbles. On reaching the laboratory, this was mixed by inverting the bottle many times later clear supernatant water was obtained and this was allowed to settle. After 2minutes, 2ml of concentrated tetraoxosulphatevi was added and this mixed until dissolution was completed. A total of 250ml was titrated against 0.012ml Sodium thiosulphate until a pale straw colour lead paint was observed. Then 1ml starch solution was added the colour becomes blue. The titration was continued by the addition of the Sodium thiosulphate solution in drops, until the blue colour disappeared. The dissolve oxygen was then calculated using the following formular:

$$DOmg/l = \frac{1600xmxv}{(v-2.0)}$$

Statistical analysis: The data collected were analyzed for significant differences (P<0.05) by Analysis of variance (ANOVA) and Pearson Correlation using computer statistical package for social sciences (SPSS) for windows (V.15.0).

RESULTS
The effect of brood stock size on egg and larval size of *C. gariepinus* is show in Table 1. The weight of eggs produced increased with increase in brood stock sizes. The lowest weight of egg production was from brood stock size of 795g while the highest weight of egg production was recorded from of (1200-1500)g size range. There was however, no significant difference (P>0.05) between the mean weight of eggs produced from the brood stock size range. The size of fry produced also increased with increase in brood stock sizes. The smallest fry was produced by the smallest brood stock size range(795 -1000)g, while the largest fry size was produced by the largest brood stock size range (1200-1500)g. There was however a significant differences (P<0.05) between the fry size produced by small brood stock size range (795- 1000)g and the large brood stock size (1200-1500)g of *C. gariepinus*. In addition, larger eggs resulted in larger fry. The size fry increased with corresponding increase in brood stock size.

Table2, Shows the effect of egg size on survival potential of *Clariasgariepinus* fry starved for one week. The size of the parent brood stock varies from 795-1500g while the corresponding mean egg size range from 1.00 – 1.6mm while the mean weight of eggs batches obtained from the female brood stock ranged from 14.4 – 30.1g. The survival rate of fry after starvation increased with increase in parent brood stock size. The highest fry survival (60- 90%) was recorded for the highest brood stock size (1200 – 1500)g while the lowest fry survival rate (50%) was recorded for the lowest brood stock size (795g). Table 3, shows that laboratory water temperature ranged from 25.9^{0}c– 30^{0}c with mean of 27.93$\pm$1.49 during the period of the experiment. The dissolved oxygen (DO) ranged between 5.0mg/1-5.6mg/l with mean of 5.24 ± 0.62. The pH ranged between 6.10/7.0 with mean 6.5 $\pm$0.35.

Table 1: Effect of varying egg size on percentage fertilization and Hatchability of *Clariasgariepinus*

Mean size of Egg (mm)	Mean wt. of female spawner (g)	Mean Latency Time (h)	Mean water Tempt. (^{O}C)	Mean wt. of eggs stripped (g)	Mean no. of Est. eggs milt (1g=700)	Mean no. of eggs fertilized	Mean % of eggs fertilized	Mean no. of fry hatch out	Mean % hatchability
1.1	800	7	28.9	14.4	10080	6575	65.2	6355	96.7
1.6	1447	8	29.1	17.8	12460	8244	66.2	6117	74.2
1.2	899	9	29.4	20.3	14187	10221	72.1	8567	83.8
1.6	1499	10	29.8	28.1	19647	14895	75.7	13200	88.8
1.4	1299	11	29.8	26.3	18387	9952	54.1	8583	86.3
1.2	1098	12	29.6	24.3	16987	8302	48.9	7000	84.6
1.3	1198	13	29.3	25.1	17547	6983	39.8	6183	88.6
1.2	1000	14	29.7	22.9	16053	3693	23.0	2867	77.7
1.5	1401	15	29.8	30.1	21047	4533	21.5	3950	87.1
1.3	1249	16	29.6	27.5	19227	0.00	0.00	0.00	0.00

Table 2: Showing effect of Egg size on survival potential of *Clariasgariepinus* fry starved for one week

S/NO	Size range of broodstock (g)	mean egg size (mm)	Mean wt. of egg batches (g)	No of fry starved	%survival after one week
1	800-900	1.1±0.21	14.4±0.82	150	50
2	1000-1090	1.2±0.18	24.3±0.50	150	55
3	1100-1190	1.3±0.16	25.1±0.40	150	60
4	1200-1290	1.4±0.13	26.3±0.36	150	70
5	1400-1500	1.6±0.10	28.1±0.22	150	90

Table 3. Water quality parameters in the experimental fish holding facilities

	Temperature (^{O}C)	Dissolved Oxygen (mg/l)	P^{H}
	25.9	5.0	6.10
	26.2	5.1	6.17
	26.6	5.2	6.20
	27.1	5.4	6.36
	27.4	5.2	6.19
	28.4	5.3	6.40
	28.6	5.5	6.45
	29.4	5.0	6.82
	29.6	5.1	6.98
	30.0	5.6	7.00
Total	279.2	52.4	65.0
Mean	27.92±1.49	5.24±0.62	6.5±0.35

DISCUSSION

The result of brood stock, egg and fry size relationship from this investigation shows that the weight of eggs produced increased with increase in brood stock size. Larger eggs were produced by larger brood stock, while small eggs came from smaller females of *C. gariepinus*. Roff, (1992) reported similar results from his study of brood stock and egg relationship in *Clarias gariepinus*, in fact, egg size determined most of the variation in final juvenile fitness, as larger eggs came from larger females. This could be due to larger yolk reserve or they could also have inherited higher growth rates from the start of external feeding.

The size of fry produced from this study increased with increase in brood stock size. The smallest size of fry was produced by the smallest brood stock size while larger eggs resulted in larger fry. The size of fry increased with corresponding increase in egg size. This could be due to large egg yolk reserve in large eggs and this is in line with Size of fry at hatching been reported to be positively correlated with egg size in most of the studies fish species (Bagenal,1969b; Spingate and Bromage, 1985; Marsh, 1986 and Hutching's; 1991).

As shown in the result, the survival rate of fry of *C. gariepinus* after starvation increased with increase in parent brood stock size. The survival rate of fry was high in large brood stock size while the lowest survival rate of frywas obtained for the small brood stock size. This was supported by an earlier study by Marsh, (1986), and Miller et al. 1988 where larger fry at hatching were noted to have some advantages in survival and fitness.

The physico-chemical parameters of a body of water is very important to the productivity, growth and survival of the aquatic organisms that are living in the water and thus play an important role in the biology and physiology of the fishes which are part of the organisms living in water (Adebisi, 1981).

Temperature (^{0}C) values ranged between 25.9 and 30^{0}C were recorded in the experiment and this is in line with (Ayinla, 1988), which reported that the time of interval between the start of embryonic development (fertilization) and hatching, (incubation period) changes with the increase in temperature, Adeniji and Ovie (1982) and Madu (1989), reported that the best temperature range for optimum production of Clarias species is 25-31^{O}C, Afzal et al., (2007) recommended a temperature range of between 25to32^{O}C for good performance of fishes. The PH of the water ranged from 6.1to7.6PH and this is in agreement with the world health organization. International standard for the fresh water is of 7.0-8.PH. It also corresponds with works ofHuet (1972), USDA, (1996), and Robert, (2007), which indicate that the best water for cultivation is that which is neutral or slightly alkaline with a PH range of 7 to 8.

The value for dissolved Oxygen content of water ranged from 5.0mg/l and these agreed with those Ufodike and Garba (1992) a minimum constant value of 4.0mg/l DO is adequate for most species and stages of aquatic life and Brain (2006) and Ita et al., (1995), that reported increased DO level is needed to support an increase in metabolic rates and reproduction.

SUMMARY AND CONCLUSION

In practicing fish breeding therefore, it is better to select brood stock of average size of 0.8-1.6kg. This is due to the fact that female*Clariasgariepinus* in this range could produce larger eggs whose larvae could endure starvation better and reach a point of return later than species that below 0.5kg which produce smaller eggs and subsequent smaller larvae. Catfish farming has continued to attract private sector initiative compared to earlier public or government sponsored programmed and if the associated problems of production, especially the twin issue of feeds production and fingerling supply are tackled, Nigeria will soon become a world exporter of Catfish.

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