



Investigation into the Impacts of Varied Batches of Stripped Eggs on the Reproductive Success of *Clarias gariepinus*

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This study was conducted at the hatchery complex of Akwa Ibom State University to investigate the effects of different batches of stripped egg on reproductive performances of *Clarias gariepinus*. Nine brood stocks of *Clarias gariepinus* (six males and 3 females) with average body weight of 2.3kg and 64.2 cm were carefully selected for the study. Six matured males were euthanized for the removal of testis without hormonal inducements. The milt collected from the six males were pooled together

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and divided into 12 portions each diluted with 2mL of normal saline solution. Three female brood stocks were separately induced with hormone at single dosage of 0.5ml/kg body weight and allowed for a period of 10 hours before stripping. Stripping of eggs from each brood stock was in four batches, each batch measured 50g and labeled A, B, C and D. 3g of eggs containing approximately 2000 oocytes (eggs) were measured out from each batch and mixed with the diluted milt and incubated in a 2 x 1 x 10cm³ of water in a concrete pond at temperature of 26°C in three replicates. The result revealed that the reproductive performances considered in this study decreased as the batches of stripped eggs increased from 1–4 batches. The first batch of stripped eggs produced 87.69 ± 0.42, 97.06 ± 0.84, 84.29 ± 1.05 percentage fertilization, hatchability and survival rate respectively, while the least batch of stripped eggs (batch 4) produced the least value of fertilization 50.33 ± 1.67, 31.93 ± 4.94 hatchability and survival rate value of 42.69 ± 0.61. Therefore, from the above result, the least batch of stripped eggs should not be used for fertilization because the unhatched or dead eggs has a negative effect on the fertilized eggs including fry at the hatchery level.

Keywords: Batches of stripped eggs; reproductive performances; *Clarias gariepinus*; hatchability; fertilization.

1. INTRODUCTION

Fish remains a universal protein source acceptable at all ages of humanity, easily to come by at affordable cost compared to other sources of protein. Globally, the demand for fish is at daily increase as the world population continue to expand whereas the supply of fish and fish products from the wild is drastically reduced due to environmental challenges and degradations leaving behind aquaculture as the only alternative means to meet the global needs.

African cat-fishes such as *Heterobranchus* and *Clarias* species remains the most culturable species of significance in Nigeria and beyond [1,2,3,4]. This is due to the unique characteristic of the species such as fast growth rate, good taste, generally accepted for consumption, high market price and high resistance to disease and ability to reproduce in captivity [5,6,7,8,9,10,11]. Although, the growth of fish depends on availability of good feed of which a single feed stuff component cannot achieve [12]. *Heterobranchus* and *Clarias* readily accept any supplementary feed and their growth rate is unique within a short period of culture according to [5] compared to other species [13,14]. These species dominate fresh water setting such as streams, lakes and rivers [15] and has high commercial value [4,16].

Problems associated with fish seed at the natural environment necessitated artificial propagation technique (induced spawning) under more controlled conditions for a reliable source of fingerlings [17]. To obtain larvae of acceptable quality during artificial propagation, depends

mostly on quality gamete which is at times difficult to achieve [18,19,20]. This situation called for intervention of bio technologist for the collection of high-quality gametes, short term gamete storage [21] and fertilization [22].

Catfish had gained huge recognition in our society hence the need for intensification of breeding technique for mass production of fish seed needed for farm stocks. Low survival of fry at the hatcheries level could be attributed to unidentified factors [13] of which differences in the batches of stripped egg from the brood stocks might not be exceptional hence the focus of this study. This study is vital for understanding the potential influence of different batches of stripped eggs on the reproductive performance of *Clarias gariepinus*, a species of great economic and ecological importance in aquaculture. By examining how varying batches affects reproductive success, we can optimize breeding practices, enhance hatchery efficiency, and contribute to the sustainable management of *C. gariepinus* populations. Additionally, insights gained from this research can inform strategies for maintaining genetic diversity and resilience within aquaculture systems, ultimately supporting the long-term viability of this species.

2. MATERIALS AND METHODS

2.1 Study Area

This research study was carried out in Akwa Ibom State University (AKSU) fish farm complex, Obio Akpa Campus, Akwa Ibom State, which is located between latitude 5°17'N and 7°27'N, Longitude 7°27'E and 7°58'E. The study area

has an annual rainfall ranging from 3500 mm to 5000 mm and average monthly temperature of 25°C. Akwa Ibom State is a coastal state, between latitude 4°28'N and 5°3'N and between longitude 7°27'E and 8°20'E with a relative humidity between 60 and 70%. It is in the tropical rainforest zone of Nigeria [13].

2.2 Acquisition and Care of Brood Stocks

Nine matured brood stocks (six males and three females) were separately stocked at average body weight of 2.3kg and a length of 64.2cm in a concrete pond at the rate of two fishes/m² and fed at 5% body weight twice daily for three months using Coppens commercial feed [7]. Twelve indoor breeding tanks of equal dimension 1x1x1cm were used for the study. Water levels and temperature in each breeding tank were maintained at 30cm³ and 26°C, respectively.

2.3 Hormone Induced Spawning

Six matured male brood stocks were euthanized for sperm removal without hormonal inducement. The milt collected from the three samples were pooled together in a plastic container and divided

into twelve portions, each diluted with 2mL of normal saline solution and preserved separately. Three female breeders were separately transferred to hatcheries for inducement with ovaprim hormone at single dosage of 0.5mL/kg body weight and allowed for a period of 10 hours under the same temperature before stripping manually to obtain eggs [7,11].

2.4 Eggs Stripping and Fertilization

Four batches of stripped eggs (50g each) were separately obtained from each of the three breeders through gentle pressing of the abdominal region ventrally and labeled A, B, C, and D, respectively. 3g of eggs containing about 2000 oocytes were measured out of each of the A, B, C, and D each mixed with a portion of the diluted milt for artificial fertilization and activated with 100mL of normal saline solution. After three minutes, the saline solution was decanted while the fertilized eggs were uniformly spread on the Kakaban (shredded nylon sack) and incubated in aerated indoor concrete breeding tanks 1x1x1cm at temperature of 26 °C and replicated three times. During incubation, water levels were maintained at 30cm³ depth.

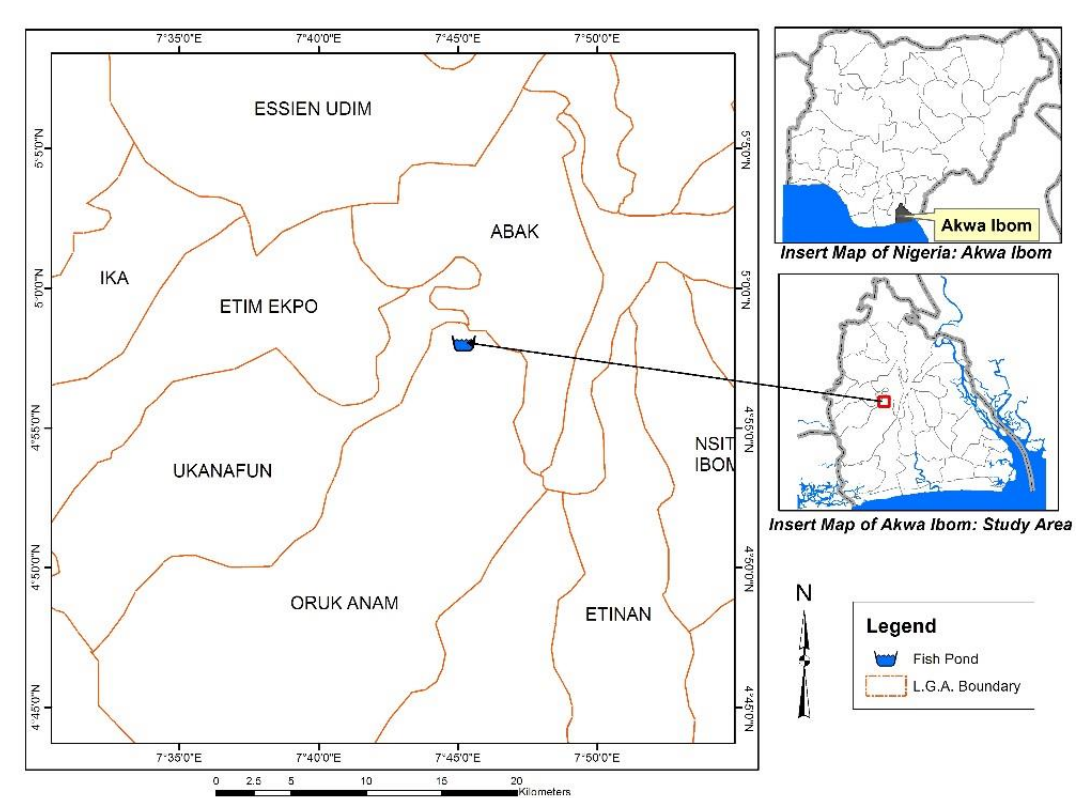


Fig. 1. Map showing the location of the Akwa Ibom State University fish farm complex

2.5 Fertilization

The colour variations in eggs was observed with eggs considered as fertilized and white and opaque ones was regarded as unfertilized [23,10]. Based on the counts, the reproductive performances of different stripped eggs were observed, such as percentages of fertilization, hatchability, survival and fry production success. Efficiency of these productions was evaluated following the method of Rana [24].

$$Fs (\%) = Kf.Kh.Ks/10,000$$

Where;

Fs = Success rate (%) of fry production at 10-day post hatching.

Kf = Fertilization rate (%) of eggs

Kh = Hatching rate (%) of fry

Ks= survival rate (%) of 10-day-old swim-up fry

Percentage hatchability was obtained by direct counting of unhatched eggs as well as the numbers of eggs hatched in each incubating tank.

Hatching rate = (No of healthy fertilized eggs/ No of fertilized eggs used) x 10 [25]

Survival rate (Ks) were calculated during initial feeding according to the following formula

Survival rate = (number of live larvae/ total number of larvae hatched) x 100 [25]

2.6 Determination Water Quality Parameters

Dissolved oxygen and pH of the water were monitored daily using pH meter (VIVOSUN pH Meter) and dissolve oxygen meter (Extech 407510 Dissolved Oxygen Meter) while mercury in glass thermometer was used to take temperature readings.

2.7 Statistical Methods

Data were processed using Microsoft Excel 2010 for their mean values and standard deviations. The Data was analyzed using one-way ANOVA at 0.05 significant levels to check the significant difference in fertilization, hatchability and survival.

3. RESULTS

3.1 Physico-Chemical Parameters of Culture Media

The water parameters considered in this study, showed no significance ($P>0.05$) difference among the treatments. Dissolved oxygen, temperature and pH measurements ranged between 5.21 ± 0.20 - 5.66 ± 0.20 , (ML), 26.25 ± 0.05 - 26.82 ± 0.04 ($^{\circ}\text{C}$) and 6.90 ± 0.02 - 6.95 ± 0.01 , respectively.

3.2 Effect of Different Batches of Stripped Eggs on the Reproductive Performances of *Clarias gariepinus*

The results on the effect of different batches of stripped eggs from the brood stock on reproductive performances of *Clarias gariepinus* revealed that the percentage in fertilization of the first batch of stripped eggs was 87.69 ± 0.42 significantly ($P<0.05$) higher than the 85.38 ± 0.60 observed in the second batch of stripped eggs, which significantly ($P<0.05$) increased more than the third and last batches of stripped eggs, with the least value of percentage fertilization of 50.33 ± 1.67 recorded for batch 4 (Table 2). The percentage fertilization of different batches of stripped eggs decreased in the order of A, B, C, and D.

The result on the percentage hatchability of the stripped eggs equally decreases significantly ($P<0.05$) from the first to the least in the order of 97.06 ± 0.84 , 93.87 ± 0.80 , 68.85 ± 1.89 and 31.93 ± 4.94 (Table 3).

The result of different batches of stripped eggs from the brood stock on the percentage survival of the fry is presented in Table 4. The percentage survival of fry obtained from the first batch of stripped eggs was 84.29 ± 1.05 significantly ($P<0.05$) higher than 76.93 ± 1.76 percentage survival obtained from the second batch of stripped eggs. The percentage survival of eggs 56.21 ± 0.67 obtained from the third batch of stripped eggs was significantly ($P<0.05$) higher than the least value of percentage survival recorded for the last batch of stripped eggs with a percentage survival rate of 42.69 ± 0.61 .

The result of this study revealed that the entire reproductive parameters considered in this study significantly ($P<0.05$) decrease from the first batch of stripped eggs to the lasts batch as shown in Tables (2-4).

Table 1. Mean water quality parameters of the incubating tanks

	Stripped egg stages			
	Stage 1	Stage 2	Stage 3	Stage 4
Temperature (°C)	26.24 ± 0.05	26.40 ± 0.01	26.80 ± 0.02	26.81 ± 0.04
pH	6.90 ± 0.01	6.92 ± 0.01	6.94 ± 0.25	6.94 ± 0.01
Dissolved oxygen (mg/L)	5.21 ± 0.20	5.62 ± 0.40	5.64 ± 0.150	5.65 ± 0.20

Table 2. The percentage fertilization of different batches of stripped eggs of *Clarias gariepinus* reared in concrete fish ponds

	Batches of stripped eggs.			
	Batch 1	Batch 2	Batch 3	Batch 4
Total Weight (kg)	66.00 ± 0.00 ^a	66.00 ± 0.00 ^a	66.00 ± 0.00 ^a	66.00 ± 0.00 ^a
Total Length (cm)	2.23 ± 0.00 ^a	2.23 ± 0.00 ^a	2.23 ± 0.00 ^a	2.23 ± 0.00 ^a
No. of eggs used	200.00 ± 0.00 ^a	200.00 ± 0.00 ^a	200.00 ± 0.00 ^a	200.00 ± 0.00 ^a
No. of whitish (dead) eggs	24.62 ± 0.84 ^a	29.23 ± 1.20 ^b	64.65 ± 2.19 ^c	99.33 ± 3.34 ^d
No. of brown (fertilized) eggs	175.38 ± 0.84 ^a	170.77 ± 1.20 ^b	134.35 ± 2.19 ^c	100.67 ± 3.34 ^d
Fertilization (%)	87.69 ± 0.42 ^a	85.38 ± 0.60 ^b	67.17 ± 1.09 ^c	50.33 ± 1.67 ^d

Table3. The percentage hatchability of different batches of stripped eggs of *Clarias gariepinus* reared in concrete fish ponds

	Batches of stripped eggs.			
	1	2	3	4
Total Weight (kg)	66.00 ± 0.00 ^a	66.00 ± 0.00 ^a	66.00 ± 0.00 ^a	66.00 ± 0.00 ^a
Total Length (cm)	2.23 ± 0.00 ^a	2.23 ± 0.00 ^a	2.23 ± 0.00 ^a	2.23 ± 0.00 ^a
No. of eggs used	200.00 ± 0.00 ^a	200.00 ± 0.00 ^a	200.00 ± 0.00 ^a	200.00 ± 0.00 ^a
No. of whitish (dead) eggs	24.62 ± 0.84 ^a	29.23 ± 1.20 ^b	64.65 ± 2.19 ^c	99.33 ± 3.34 ^d
No. of brown (fertilized) eggs	175.38 ± 0.84 ^a	170.77 ± 1.20 ^b	134.35 ± 2.19 ^c	100.67 ± 3.34 ^d
No. of eggs hatched	170.23 ± 2.16 ^a	160.31 ± 0.68	92.51 ± 2.41	32.15 ± 3.52
Hatchability (%)	97.06 ± 0.84 ^a	93.87 ± 0.80 ^b	68.85 ± 1.89 ^c	31.93 ± 4.94 ^d

*Means with the same superscript within the same row are significantly different (p<0.05)

Table 4. The percentage survival Rate of different batches of stripped eggs of *Clarias gariepinus* reared in concrete fish ponds

	Batches of stripped eggs			
	Batch 1	Batch 2	Batch 3	Batch 4
Total length (cm)	65.00 ± 0.00 ^a	65.00 ± 0.00 ^a	65.00 ± 0.00 ^a	65.00 ± 0.00 ^a
Total weight (kg)	2.3 ± 0.00 ^a	2.3 ± 0.00 ^a	2.3 ± 0.00 ^a	2.3 ± 0.00 ^a
No. of eggs hatched	170.23 ± 2.16 ^a	160.31 ± 0.68 ^b	92.51 ± 2.41 ^c	32.15 ± 3.51 ^d
Survival after 10 days	152.00 ± 2.00 ^a	123.33 ± 2.84 ^b	52.00 ± 0.58 ^c	13.32 ± 1.86 ^d
Percentage Survival (%)	84.29 ± 1.05 ^a	76.93 ± 1.76 ^b	56.21 ± 0.67 ^c	42.69 ± 0.61 ^d

*Means with the same superscript within the same row are significantly different (p<0.05)

4. DISCUSSION

The experimental water quality parameters were in line with the recommended standard for aquaculture operation for catfish breeding [26,27,28] as significant differences in water quality parameters were not observed in all the batches throughout the duration of study.

This study stem from the fact that all eggs in the gonad do not mature at the same time. Though, through human interference with the use of artificial hormones maturity of entire eggs occur

at the same time and the need to consider if all the mature eggs through human interference do fertilize, hatched and survived as expected remained very crucial for a successful breeding program. This is to overcome the danger of mass mortality since the unhealthy eggs are primarily responsible for the mortality observed at the early stage of fry development.

Considering the gonad development of catfish, like *Clarias gariepinus* species, it has been observed that all eggs in the gonad do not mature at the same time in their natural

environment but in artificial environment under aquaculture system entire eggs in the gonad mature at the same time through human intervention using artificial hormone. In a natural environmental condition, entire eggs are not released at the same time rather in batches based on the stages or levels of maturity. 100% fertilization and hatchability are certain in a natural environment based on the viability of the eggs released, sufficient sperm for fertilization and conducive environmental conditions. This is because breeders in the wild do not release immature eggs. Under artificial propagation (forceful maturity of eggs) achievement of 100% fertilization and hatchability is doubtful. This study reveals that first batch of stripped eggs show percentage fertilization that was significantly higher than the value obtained for the second batch of stripped eggs, third batch and fourth batch respectively. This result reveals that the percentage fertilization of stripped eggs decreased as the batches of stripped eggs shifted from the first to the least. This result could be as a result of maturity stage and viability of the eggs.

The percentage hatchability observed from the different batch of stripped eggs showed similar pattern of results with decreasing order from the first to the last batch. This result could be attributed to different levels or stages of eggs maturity. It is observed that although all eggs matured through artificial inducement of hormones, the level of egg maturity differs.

The percentage survival rate of the fry production success of stripped eggs reduced significantly as the batches increased from batch 1-4 in the order A<B<C<D. This study revealed that the first batch of stripped eggs during artificial spawning produced excellent reproductive performances followed by the second batch while the least and the poor reproductive performance was observed in the least batch of stripped eggs.

Overall, the observed differences in reproductive performance between the first and second batches compared to the third and fourth batches may be attributed to a combination of factors including the age and condition of the brood stock, timing of egg stripping, environmental conditions and genetic variability.

5. CONCLUSION

The research investigated the impacts of different batches of stripped eggs on the reproductive performance of *Clarias gariepinus*.

Results showed that the first and second batches exhibited better reproductive performance compared to the third and fourth batches. This suggests that the timing or quality of egg stripping may influence the reproductive success of the species. The success recorded by the first and second batches of stripped eggs when compared to the third and fourth batches could be attributed to timing of stripping and environmental conditions during egg collection. Higher quality eggs and optimal timing of stripping may have led to better reproductive success, while eggs from the later batches may have been of lower quality or collected under less favorable conditions, impacting their viability and subsequent reproductive performance.

6. RECOMMENDATIONS

Further research is needed to fully understand the underlying mechanisms driving these differences and to optimize egg collection practices for enhanced reproductive success in *Clarias gariepinus* aquaculture.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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