Original Research Article

Egg Quality and Fecundity of *Clarias gariepinus* Broodstock Cultured at Different Water Depths in Indoor Concrete Tanks

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ABSTRACT

Aims: To investigate the fecundity and egg quality of *C. gariepinus* broodstock raised at 0.50 m, 0.75 m and 1.0 m pond water depth.
Study design: Treatments were assigned using complete randomized design.
Place and Duration of Study: Fish Farm Complex of the Akwa Ibom State University (AKSU), Nigeria.
Methodology: Nine female broodstock of *C. gariepinus* averaging 2.51 – 2.53 kg and 64.30 – 67.24 cm were raised for six months at 0.50 m, 0.75 m and 1.0 m pond water depth; referred to as treatments A, B and C, respectively Experimental fish were fed 42% crude protein commercial feed. The fecundity, relative fecundity, gonadosomatic index (GSI), egg weight and size were assessed.
Results: The results revealed that the egg quality significantly (P<0.05) increased with water depth of the broodstock culture tank. Egg weight and GSI values from treatment C (363.40±0.57 g and 14.40±0.01 %, respectively) were significantly (P<0.05) higher than those of treatment A (267.30±0.06 g and 10.66± 0.06 %, respectively) but showed no significant difference with those of Treatment B (331.07±1.20; 13.09±0.04 %). The corresponding egg diameter (1.01±00; 1.08±0.03 and 1.21± 0.01g), fecundity and relative fecundity of broodstock also increased with pond water depth (P<0.05): 182,120.0±503.67, 72.66±0.40 > 185,618.3± 745.98, 73.37±0.18 > 188, 967.1± 295.19, 74.89±0.18, respectively.
Conclusion: The water depth of broodstock maintenance pond enhances fecundity and egg quality; better at 1.0 m depth for successful fry production. Broodstock may be maintained at lower pond water depths for growth purposes; prior to breeding.

Keywords: Artificial fertilization, breeding, fish stress, hatchery production

1. INTRODUCTION

In Nigeria, the African catfish of the family Clariidae are prominent cultured species. This is due to their unique characteristics: fast growth rate, good taste, high stocking density, reproduced in captivity, high resistance to disease and efficient breeding organs. (1,2,3,4,5,6,7) Although the growth of fish depends on availability of good feed of which a single feed stuff component cannot achieve. According to [8,9] *Heterobranchus* and *Clarias* readily accept supplementary feed and their growth rate is unique within a short period of culture [10]. The success of aquaculture begins at the hatchery level where expectation of fish farmers will be determined. This could be achieved through good quality gametes and effective management system at the hatchery level because “no seeds, no stocking”. The use of high quality gametes (eggs and milt) for breeding is of essence to the efficiency of artificial fertilization, successful fish breeding and production of viable larvae from captive fish broodstock [3,7,11,12] defined gamete quality as the capacity of eggs and sperm to fertilize and produce viable offspring. Historically, fish egg quality is considered paramount in hatchery operations. Like eggs, the quantity and quality of male gamete are highly variable and can be assessed, based on quality of spawners such as physical attributes, nutritional status, stress exposure, egg maturation and sperm structure [4,7]. The idea of water management for various agricultural purposes was initiated following inadequate supply of water at different localities around the world. Equally, water scarcity influences pond culture practices such as water depth for fish culture [5]. Water is an essential natural resource, and prominent constituent in every living organism. It is the natural habitat for aquatic organisms, including fish. Fish are cold blooded aquatic organism exploited by man for food. The huge demand for animal protein to feed the growing human population has been adduced as a strong reason for overfishing of fisheries resources in the wild. Experts advance aquaculture as a reliable alternative to meeting the high fish demand while reducing effort in capture fisheries [8,10,13,14].

The success of aquaculture is unequivocally linked to hatchery management and practices. Key to successful hatchery production is sourcing good quality gametes and provision of sufficient water supply. Research show that older brooders, offered better fecundity and egg quality [2,3,15,16]. *Clarias* species mature between 5 to 9 months while *Heterobranchus* species takes a longer period; 18 months in females and 12 months in males [7,8,17]. Broodstock maintenance is very crucial mostly in terms of good quality feeds, water parameters and culture environment to achieve the best gametes and success at the hatchery level. Since adequate care must be given to broodstock, the need to detect the best level or pond depth of water for the maintenance of broodstock becomes necessary, especially considering instances of inadequate supply of water. Although several investigations had been carried out on the reproductive performance of African catfish especially as it concerns feed types, age of broodstock and use of F1 offspring of *H. longifilis* [2,3,18,19]. This study seeks to enrich information on maintenance of spawners by elucidating the effects of pond water depth of broodstock holding tanks on the egg quality of *Clarias gariepinus.*

2. MATERIAL AND METHODS

2.1 Study Area

The research was conducted at the Fish Farm Complex of Akwa Ibom State University, Obio Akpa campus in southeast Nigeria. The farm is between latitude 5º17'N and 7º27'N, Longitude 7º27'E and 7º58'E with an annual rainfall ranging from 3500mm-5000mm and average monthly temperature of 25º C. Akwa Ibom State is a coastal state lying between latitude 4º28'N and 5º3'N and between longitude 7º27'E and 8º20'E with a relative humidity `between 60-70%. It is in the tropical rain forest rainforest zone of Nigeria [10,19,20,21].

2.2 Acquisition of broodstock

Nine female broodstock of *C. gariepinus* averaging 2.51 – 2.53 kg and 64.30 – 67.24 cm were acquired from the fish farm complex of the Akwa Ibom State University (AKSU), Nigeria for this study. The broodstock were raised under similar condition (and feeding with 42% crude protein commercial feed) for six months; but at different pond water depths: at 0.50 m, 0.75 m and 1.0 m, designated as treatments A, B and C, respectively.

Three (3) female broodstock per treatment were carefully sampled for determination of fecundity and egg parameters. Sampled spawners were separately transferred to the hatchery and gametes extracted without hormonal inducement [22].

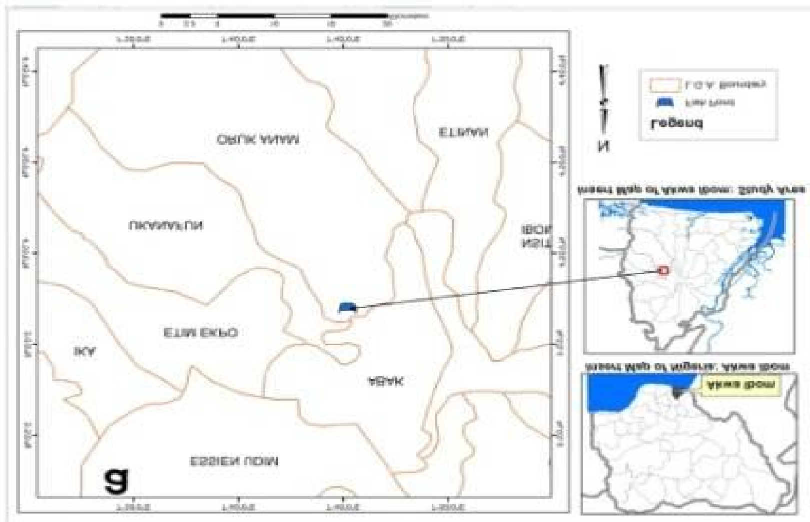

Fig. 1. Map showing the location of the Akwa Ibom State University fish farm complex

2.3 Extraction and preparation of eggs

Eggs from each gravid fish were removed by cutting open the abdomen with a pair of scissors. Eggs were washed in distilled water and weighed on an electronic weighing balance to the nearest 0.1g. The eggs were fixed in Gilson's fluid in sample bottles for 48 hours before estimation [5,9]. Fecundity and weight of egg were determined by weighing method [23] and egg size was measured using Vernier caliper (at 0.02 mm sensitivity). Relative fecundity was calculated as the number of eggs per gram body weight of the fish (= total egg number/total body weight) and number of egg per gram ovary weight. Gonadosomatic index (GS1) = gonad weight / whole fish weight (x100) [2,3,9]

2.4 Water Quality Parameters

pH (Vivosun pH meter) and dissolve oxygen (Extech 407510) and temperature (mercury in glass thermometer) readings were taken during the study

2.5 Statistical Analysis

Statistical analyses of egg quality data were analysed using one-way ANOVA at 0.05 significant level to check the significant differences among the egg quality values
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3. RESULTS AND DISCUSSION

3.1 Physiochemical Parameters of the Cultured Water

The water parameters considered in this study showed no significant (P<0.05) difference among the treatments. Dissolved oxygen, temperature and pH measurements ranged between 5.22±0.20 - 5.65±0.20 mg l^{-1}; 26.24±0.05 - 26.83±0.04 ^{0}C and 6.90± 0.02 - 6.95± 0.02, respectively.

3.2 Effect of different water level of broodstock on fecundity and egg quality of *C. gariepinus*

Table 1 reveal the effect of different broodstock pond water levels of on fecundity and egg quality of *C. gariepinus*. Table 1 reveal egg weight produced by the broodstock from treatment C (the highest level of water) was 363.40±0.57 significantly (P<0.05) higher than 267.30±0.66 observed in the broodstock in treatment A (the least water level) but showed no significant (P>0.05) difference with the egg weight from treatment B with the weight value of 331.07±1.20 g.

Table 1. Fecundity and egg quality of *Clarias gariepinus* broodstock reared in concrete aquaculture ponds for six months at different water levels, Mean ± SE *(min-max)*

Broodstock and Egg Characteristics	Water level of broodstock tank during six			*F*-Test	*P*
	0.50m	0.75m	1.0m		
Total Length (cm)	64.27±0.0^{a} (64.2-64.3)	64.30± 0.01^{a} (64.2-64.4)	64.27±0.00^{a} (64.0-64.6)	0.031	0.97
Body Weight (kg)	2.51± 0.03^{a} (2.48-2.53)	2.53±0.06^{a} (2.52-2.54)	2.52±0.18^{a} (2.52-2.54)	1.696	0.26
Weight of Eggs (g)	267.30±0.06^{a} (267.2-267.4)	331.07±1.20^{b} (328.8-332.9)	363.40±0.57$^{b.c}$ (362.6-364.5)	043	0.00*
Gonadosomatic Index (%)	10.66±0.06^{a} (10.57-10.77)	13.09±0.04^{b} (13.05-13.16)	14.40±0.01^{b,c} (14.39-14.41)	24265	0.00*
No of Eggs Per Gram	681.33±1.86^{a} (679-685)	560.67±0.67^{b} (560-562)	520.00±1.15^{b,c} (518-522)	4045	0.00*
Egg Diameter (mm)	1.01±0.00^{a} (1.01-1.02)	1.08±0.03^{b} (1.01-1.11)	1.21±0.01^{c} (1.2-1.22)	26.16	0.001*
Fecundity	182,120.4±503.67^{a} (181.43 -183.10)	185,618.3±745.98^{b} (181.43 -183.10)	188,967.1±295.19^{b,c} (188.55-189.54)	39.19	0.00*
Relative Fecundity	72.66±0.40^{a} (71.87-73.16)	73.37±0.18^{b} (73.07-73.69)	74.89±0.18^{b,c} (74.63-75.21)	17.66	0.003*

a,b,c, values with same superscript in each row are not significantly different, *P*> 0.05 by Turkey pairwise comparison *Significant difference (*P*< 0.05)

The gonadosomatic index (G.S.I.) values of the experimental broodstock increased with the water depth of broodstock culture tank. The highest being 14.40±0.01 % in treatment C; significantly (P<0.05) higher than 10.66±0.06 % obtained for treatment A. While the egg diameter (egg size) increased significantly (P<0.05) with water depth (1.01±0.00 - 1.21±0.01 mm)**,** the number of eggs per gram weight decreased significantly (P<0.05) with water depth of broodstock tank (681.33±1.86 - 520.00±1.15).

Fecundity and relative fecundity of the broodstock also increased significantly ($P<0.05$) with pond water depth. The fecundity and relative fecundity of broodstock from the highest water level (treatment C) were 188,967.1±295.19 and 74.89±0.18 significantly ($P<0.05$) higher than the corresponding values (182,120±3.67 and 72.66±0.44 respectively) obtained for Treatment A. However, the corresponding values were not significantly ($P>0.05$) different between treatments B and C.

3.3 Discussion

Catfish of equal body weight at different levels of culture water require different amounts of energy for survival due to variations in upthrust effects and energy needed for buoyancy mostly during feeding on floating feeds [5]. In certain parts of the world the issue of aquaculture is not practicable owing to the water scarcity. The idea of water management was initiated as a result of insufficient supply of water in certain location of the world leading to the use of lower levels of water in an enclosure for catfish culture which is equally successful.

The continuity and success of aquaculture lie in the availability of quality fish seeds (fingerling); which is an antecedent of good quality gametes. In the light of this, investigations into the effects of water levels of broodstock on fecundity and eggs quality of *C. gariepinus* remain very crucial.

Water parameters considered in this study were not significantly different among treatments, despite the depth variations [17,19,20,21,24]. This study reveals pond water depth of broodstock elicited significant changes in egg quality with reduction in water level of culture tank. This could be attributed to physical stress and energy loss as a result of swimming to surface for feed [5].

Fecundity, relative fecundity and egg weight produced by the broodstock increased significantly ($P = 0.00$) with level of water in broodstock culture tank (Table 1). Fecundity, relative fecundity and egg weight were highest (188,967.1±295.19, 74.89±0.18 and 363.40±0.5, respectively) at 1.0 m broodstock pond water depth and least at 0.5 m pond depth. This could be attributed to conducive environment afforded the broodstock at deeper water depth [2]. Similar results were obtained for other parameters considered (Table 1).

4. CONCLUSION

This research investigated the effects of different levels of broodstock on the fecundity and egg quality of *C. gariepinus.* The result revealed broodstock conditioned for six months at pond water depth of 1.0 m (treatment C) elicited the best egg quality; followed by broodstock maintained at 0.75 m pond water depth(treatment B). In the event of water scarcity, *C. gariepinus* may be cultured at pond water depth of 0.5 m for table size fish. However, for the purpose of hatchery production of fingerlings maintaining at pond water depth of 1.0 m is preferable to achieve best gametes for artificial propagation.

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