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Artificial Breeding of African Cat Fish in the Guinea Savannah Zone of Nigeria

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ABSTRACT

The objective of the study was to determine the hatchability rate of African cat fish eggs under artificial condition in Adamawa State, the guinea savannah zone of Nigeria. The female fish was artificially induced using ovaprim at 0.2ml in the cool hours of evening. The eggs were stripped in the morning hours after 12 hours of stimulation and were fertilized externally with sperms collected from the male fish. Fifty percent (50%) of the eggs were observed to have hatched successfully within 12 hours though; the entire system ran out of water supply in the middle of the night. This led to the death of all the fry and prevented all the other eggs from hatching resulting to 0% fingerlings. The quality of water used was not ascertained because, it was not tested and the source unknown. The climatic conditions were observed to be favourable because, the work was performed during the raining season between August and September, 2017. It was observed that, in most of the African catfish hatcheries, fry 'come out' from eggs under an artificially controlled condition in commercial numbers. Water quality forms part of the most important factors in achieving high hatchery success rate. These fry grow into fingerlings and they later become juveniles. These fry need consistent good food provided in sufficient quantities at regular intervals for smooth transitional growth. A lot of uncertainties have been linked to the propagation of African Catfish and this may be probably due to inadequate knowledge of the fish. Therefore, a successful hatchery relies on efficient facilities and equipment that match excellent up to date technical know-how, standard procedures, and dedicated and skilled personnel.

Keywords: Artificial, Fertilization, Hatchability Rate, Fish Eggs, Guinea Savannah, Nigeria

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INTRODUCTION

The old way of hunting African catfish fingerlings or juveniles from the wild often encourages disease infested stocks and irregular supplies of the fingerlings in terms of number and consistency (Roosendaal, 2017). This practice has never been commercially reasonable since the man hours expended in catching the fishes are not commensurate with the fishes caught. The African catfish breeding season in the wild usually commences at the onset rains. The coming of the rains in tropical Africa is usually characterized with extreme temperature fluctuations. These fluctuations could prevent high survival of the African catfish fry. Because of the difficulties of getting consistent, fast growing, disease resistant and uniform sized catfish fingerlings and juveniles, the African Catfish Hatchery came into existence (Ogunsina, 2014). In addition to these limiting factors for securing viable and good catfish seeds, African catfish fingerlings caught from the wild could have in one way or the other experienced stunted growth due to lack of readily available good food. Runoff water from rainfall at times introduces polluted water into streams and rivers that house these fry and fingerlings. The African Catfish Hatchery therefore became pertinent to strategically address these shortcomings in the African catfish seed procurement. The objective of the study was to determine the fertilization, incubation period and hatchability rate of African cat fish eggs under artificial condition in Adamawa State, the guinea savannah zone of Nigeria.

MATERIALS AND METHODS

The Study Area

Adamawa State is located at the area where the River Benue enters Nigeria from Cameroon Republic and is one of the six states in the North-East geopolitical zone of Nigeria. It lies between latitudes 7^0 and 11^0 North of the Equator and between longitudes 11^0 and 14^0 East of the Greenwich Meridian (Mohammed, 1999). It shares an international boundary with the Republic of Cameroon to the East and interstate boundaries with Borno to the North, Gombe to the North-West and Taraba to the South-West (Adebayo, 1999; ASMLS, 2010a), as shown in Figure Ia.

According to Adebayo, and Tukur (1997), Adamawa State covers an area of land mass of about 38,741km². The state is divided into three Senatorial Zones (Northern, Central and Southern) which translates to three agricultural zones as defined by INEC (1996), which are further divided into 21 Local Government Areas (LGAs) for administrative convenience.

The State has a population of 2,102,053 persons (NPC, 1990). The main ethnic groups in the state are the Kilba, Higgi, Quadoquado, Lala, Yungur, Bwatiye, Chamba, Mbula, Margi, Ga'anda, Longuda, Kanakuru, Bille, Bura, Yandang, Fali, Gude, Verre, Fulani and Libo (Adebayo & Tukur, 1997; Adebayo, 1999; ASMLS, 2010b). The dominant religions are Christianity and Islam, although some of its inhabitants still practice traditional African religions.

The major occupation of Adamawa people is farming. The soil type is ferruginous tropical soils of Nigeria based on genetic classification of soils by the Food and Agricultural Organization of the United Nations (FAO, 1996).

The soils are a function of the underlying rocks, the seasonality of rainfall and the nature of the wood-land vegetation of the zone. The soils are derived from the basement complex, granite and gnesis that form the ranges of mountains. The mineral resources found in the state include iron, lead, zinc and limestone (Adebayo & Tukur, 1997).

The common relief features in the state are the Rivers Benue, Gongola, Yadzaram and Kiri Dam, Adamawa and Mandara mountains and Koma hills. The state has minimum and maximum rainfall of 750 and 1050 mm per annum and an average minimum and maximum

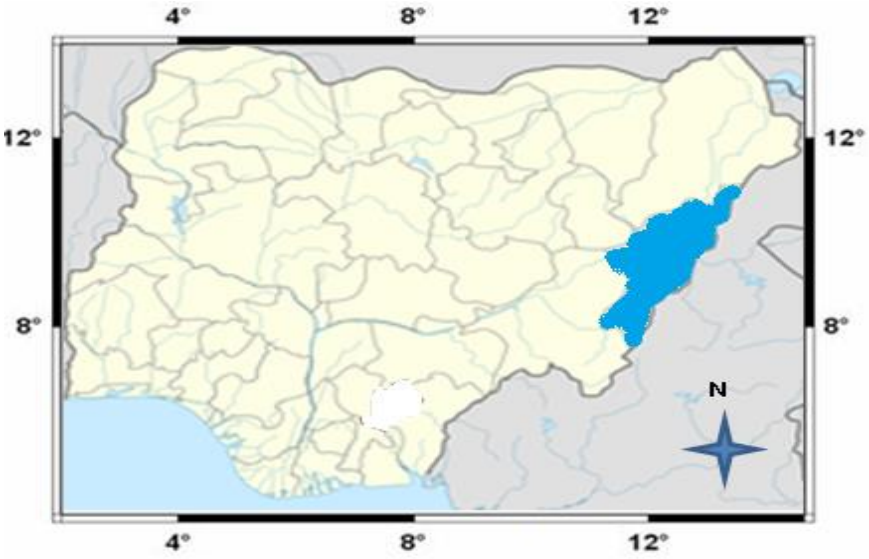

Figure Ia: Map of Nigeria Showing Adamawa State (source Wikipedia)

temperature of 15^{0}C and 32^{0}C, respectively. The relative humidity ranges between 20 and 30% with four distinct seasons that include early dry season (EDS, October – December); late dry season (LDS, January – March); early rainy season, (ERS, April – June) and late rainy season (LRS, July – September), according to Adebayo (1999). The vegetation type is best referred to as guinea savannah (Areola, 1983; Adebayo & Tukur, 1997). The vegetation is made up of mainly grasses, aquatic weeds along river valleys and dry land weeds inter-spersed with shrubs and woody plants. Plant heights ranges from few centimeters (Short grasses) to about one meter tall (tall grasses), which form the bulk of animal feeds.

Cash crops grown in the state include cotton and groundnuts, sugarcane, cowpea, benniseed, bambara nuts, tiger nuts, while food crops include maize, yam, cassava, sweet potatoes, guinea corn, millet and rice. The communities living on the banks of rivers engage in fishing, while the Fulani and other tribes who are not resident close to rivers are pastoralists who rear livestock such as cattle, sheep, goats, donkeys, few camels, horses and poultry for subsistence (Adebayo & Tukur, 1997; Adebayo, 1999).

The Study Site

The Federal Polytechnic Mubi Fisheries Technology Research Farm was established with the sole aim of providing facilities for research and learning purposes. It is located in Mubi-North LGA at the northern part of old Sardauna Province, which now forms Adamawa North Senatorial district as defined by INEC (1996) as shown in Figure Ib. The region lies between latitude 9^0 30´´ and 11^0 North of the equator and longitude 13^0 and 13^0 45´´ East of Greenwitch Meridian. It has an altitude of 696 meters above sea level with an annual mean rainfall of 1,220mm and a mean temperature of 15.2^{0}C during hamattan periods from November to February and 39.7^{0}C in April (ADADP, 1986). The town has essentially a mountainous landscape tranversed by river Yedzaram and many tributaries, Mandara and Adamawa Mountains form part of this undulating landscape (Mansir, 2006). The Gude, Fali, Fulani and other tribes dominate the area which has a lot of pasture land. Mubi region is bordered in the North by Borno State, in the West by Hong and Song LGAs and in the South and East by the Republic of Cameroon. It has a land area of about 4,728.77 km² and human population of about 759,045 going by NPC, (1991) census projected figure (Adebayo & Tukur, 1991). It has an international cattle market linking neighboring countries such as Cameroon, Chad, Central Africa, Niger, Mali and Senegal to Southern Nigeria where cattle are consumed.

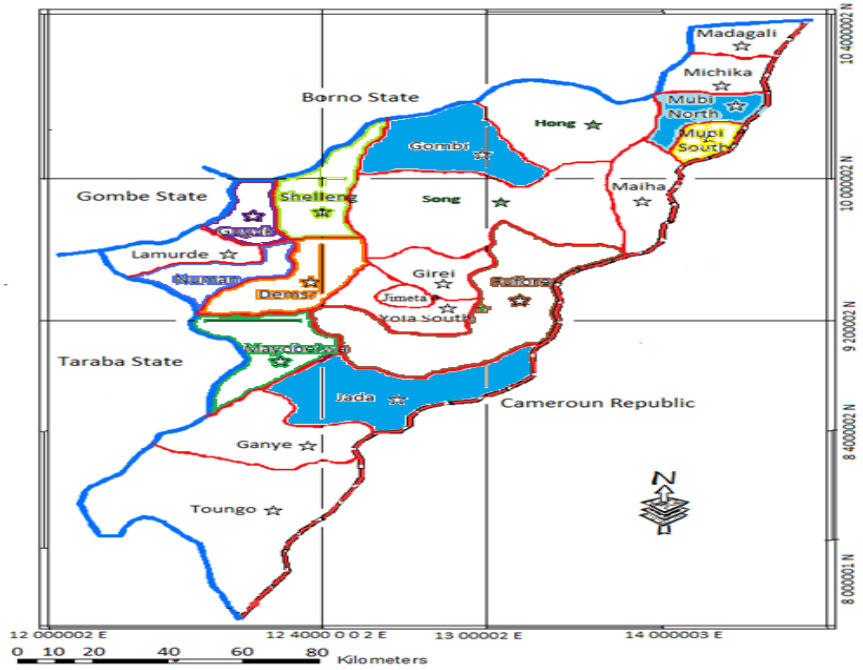

Figure Ib: Map of Adamawa State, Showing the Study Areas in Blue Color (source Wikipedia)

Selection and Management of Brood stock

The adult male (*Heterobranchus longifillis*) and female (*Clarias gariepinus*) African catfish were sourced from Yola. The male was identified through the distinct sexual papilla, elongated and located just behind the anus as described by Ogunsina (2014). This sexual papilla is usually red at the tip for sexually ready males which is absent in the female. A sexually ready female has a reddish genital opening with either side of the belly swollen. The brood stock was kept for 6months to acclimatize and fed commercial feeds, moringa leaves and grasses. Water supply was through the institution water tanker since the farm has no independent source of water.

Examination of the Female for Ripe Eggs

The examination was done by the fish breeder through a gentle press on belly of the female fish towards the genital opening which releases the ripe eggs indicating the readiness and viability of the female as described by Roosendaal (2017).

Weighing of the Female Fish

The female fish was weighed using a scale to have an idea of the weight of the egg inside the fish as described by Ogunsina (2014).

Injection of the Female Catfish with Synthetic Hormone (Ovaprim)

The female fish was injected with 0.2ml of synthetic hormone (Ovaprim) in the evening to induce her to release the eggs. The injection was done with the syringe pointing towards the tail above the lateral line at 45 degrees to body of the fish. The process was done while the fish's head had been covered with a moist towel. This allows the fish to remain calm throughout the entire process as described by Adeshina *et al*. (2016).

Striping of the Fish (Pressing Out the Eggs)

The female fish was brought out gently from the Pond after 10 to 12 hours of injection with Ovaprim (synthetic hormone) as shown in figure 1. The body of the fish was wiped using a dry soft towel and the head was covered with a clean and moist towel. The abdomen of the fish was gently pressed in the early hours of morning, the eggs collected and weighed to predict the expected fry as described by Roosendaal (2017).

Killing of the Male Fish to Remove the Milt (Sperm) Sac

The male fish was brought out of the brood stock pond, killed and the belly was cut open in order to remove the milt sac as shown in figure 2. The testicles were cut into bits to release the sperm into a container. Saline solution was then added to the milt (sperms) to keep them alive but not active. The saline solution and sperms were then mixed with stripped eggs and subsequently fresh, clean water was added to make the sperms active and motile as shown in figures 3 and 4. It was the addition of clean water that initiated the external fertilization process. This whole process of fertilization lasted for only about 60 seconds as described by Ogunsina (2014).

Spreading of the Eggs inside the Incubator on the Spawning net

The eggs were then spread on spawning net which was completely immersed and suspended in water using stones in the breeding tank as described by Roosendaal (2017). The system was left to stay for 12 to 36 hours as shown in figures 5 and 6. The system was then observed and results recorded as can be seen in figure 7.

Data Analysis

Data generated were subjected to descriptive statistics such as frequency distribution, percentages and means to explain the hatchability rates of African cat fish under guinea savannah zone of Nigeria.

RESULTS AND DISCUSSION

Characteristics of the Experimental Fish

The results show that, *Heterobranchus longifillis* male and *Clarias gariepinus* female spp were used for the study as shown in table 1. This is a crossbreeding between *Heterobranchus longifillis* male and *Clarias gariepinus* female. The age at maturity of pure *Heterobranchus longifillis* strain was estimated as 2 years, which is very late compared to *Clarias gariepinus* that matures at 1 year. The fish would have been the popular Heteroclarias because of the rearrangement of genetic material from both species in the offspring, the intergeneric hybrids show characteristics of both parental species.

According to Roosendaal (2017), the filet of Heteroclarias is white in comparison with the pink/reddish colour of Clarias gariepinus filets and contains 30% more fat than Clarias gariepinus filets, which improves the taste. The gonads of hybrids are almost absent and not active. For this reason the dressing percentage is relatively high compared to Clarias gariepinus. The Heteroclarias fish filet can be used as an alternative for white filets from marine fish species. Hybrid Heteroclarias juvenile showing characteristics of both Clarias (skin colour and body shape) and Heterobranchus (adipose fin)

In the tropics the Heteroclarias is considered superior over the Clarias gariepinus in growth in pond culture and is considered as better growing fish. For a fingerling producer hybridisation has a major benefit. The hybrids are infertile and it is not possible for customers to continue breeding with those fish. The pure parent stock is kept on farm and is never shared with other farmers.

Table 1: Breeding Rate of African Cat Fish in Adamawa State

Sex	Spp	Age (Years)	Weight (g)	Sperms/Eggs	Incubation (Hours)	Fry (%)	Fingerlings (%)
M	*H. longifillis*	2	1500	1000000/ml			
F	*C. gariepinus*	1	1000	70,000	12-36	50.0	0.00

Performance of the Experimental Fish

The Heterobranchus longifillis male and Clarias gariepinus female used for the study had an outstanding of male weighing 1500g while the female weighed 1000g even under poor management. The fish were fed barely two times a day with commercial feeds, moringa leaves

and grasses. The feed and water were not supplied at regular basis and not even at required quantity. The fish maintained themselves using natural phytoplankton and greed algae in the pond.

The Heterobranchus longifillis male had an estimated sperm cells of about 1000000/ml without treatment with hormones like many other fish species. This is not surprising looking at the correspondent weight and age of the fish. A matured male fish should have approximately 1000000 and above sperm cells per mil under good conditions. The Clarias gariepinus female also had the weight of 1000g with estimated correspondent eggs of 70,000. These results agree with the reference rates in the literature which show that, 8 -15% of the weight of a gravid female fish is the weight of the eggs. This implies that, a female catfish that weigh 1kg (1000grams) would have the weight of eggs to be 100 grams. If a gram of egg contains approximately 700 eggs. Thus a gravid female African catfish with a weight of 1000grams, would have estimated eggs of 70,000.

Studies have shown that, some commercial farms have productivity of female fish (fecundity) expressed as % of the body weight is between 5-15% (Ogunsina, 2014; Adeshina *et al*., 2016 and Roosendaal, 2017). The egg size tends to increase with the size of the female. In larger fish, the number of eggs per gram of eggs is lower than in smaller brood stock. On the average, 500 eggs per gram are common. The average females in some farms weigh up to 6 kg and produce 300-600 gram of eggs (150.000-300.000 eggs).

Incubation and the Emergence of Fry

The eggs and sperms were incubated for 12 to 36 hours for fertilization to take place. The system ran out of water supply within the first 12 hours of incubation. Fifty percent (50%) of the fry emerged successfully but died shortly afterwards as shown in table 1. The remaining eggs could no longer hatch as expected. These results show that, fresh, clean quality water is paramount in artificial fish hatchery system as water help to make the sperms active and motile. This also corroborates Qureshi and Ahmad (2017) who reported similar observations.

Research has shown that, addition of certain fertilizing solutions during fertilization is being very beneficial, because they are thought to extend the life span of the sperms in order to improve the fertilization rate (Roosendaal, 2017). Artificial propagation of African catfish is a relatively simple procedure and many farmers are very skillful in doing it. Millions of larvae are hatched weekly in a country like Nigeria but until today there still is a shortage of good quality fingerlings and juveniles. Reproduction of African catfish is following a certain procedure, but farming the larvae for 1 or 2 months to juvenile stage comes down to the capabilities of the individual farmer.

Studies have also shown that eggs sampled from the ovaries to check if the nucleus has migrated to the side and the egg size has a diameter of 1 mm or above have improved hatchability rate (Adeshina *et al*., 2016 and Roosendaal, 2017). The period between injection with hormones and stripping of the eggs also affect fry emergence greatly. It was established that, too early or to late stripping results in bad egg quality and thus poor spawning rate.

Research also shows that, good brood stock maintenance enhances good quality eggs and sperm (Ogunsina, 2014). Identification of brood stock individually has traceability qualities of each batch of offspring and having the possibility for a better breeding programme. Provision of enough time to brood stock to recover from spawning could help in proper record keeping.

CONCLUSION AND RECOMMENDATIONS

The fish industry is expanding on daily basis in Adamawa State and Nigeria as whole with the variety of fish species being produced. Availability of quality fish seed in adequate supply is the basic and high requirement for sustainable fish production in Nigeria.

Introduction of artificial breeding techniques and construction of modern hatchery facilities have helped to meet the demands of the fish farmers. Hatchery operators are looking for innovations and new ideas in brood stock management and rearing of spawn to improve quality to ensure desired growth in production and optimum survival. Existing institutions and private fish hatcheries should play a vital role in meeting for the emerging fish seed demands of the farmers in Adamawa State and Nigeria at large. Good quality water is fundamental to the success of fish hatchery industry in Nigeria and elsewhere in the world and should form priority of the farmers. Ideally, each fish hatchery should have a continuous supply of good quality water especially during its operations for induced spawning, rearing of fry, fingerlings and juveniles.

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Figure 1: Striping of the Fish (Pressing Out the Eggs) by the Research Assistants

Figure 2: Killed Male Fish to Remove the Milt (Sperm) Sac

Figure 3: Removing the Milt (Sperm) Sac and Mixing it with the Stripped Eggs

Figure 4: Mixing the Sperms and the Eggs with Normal Saline

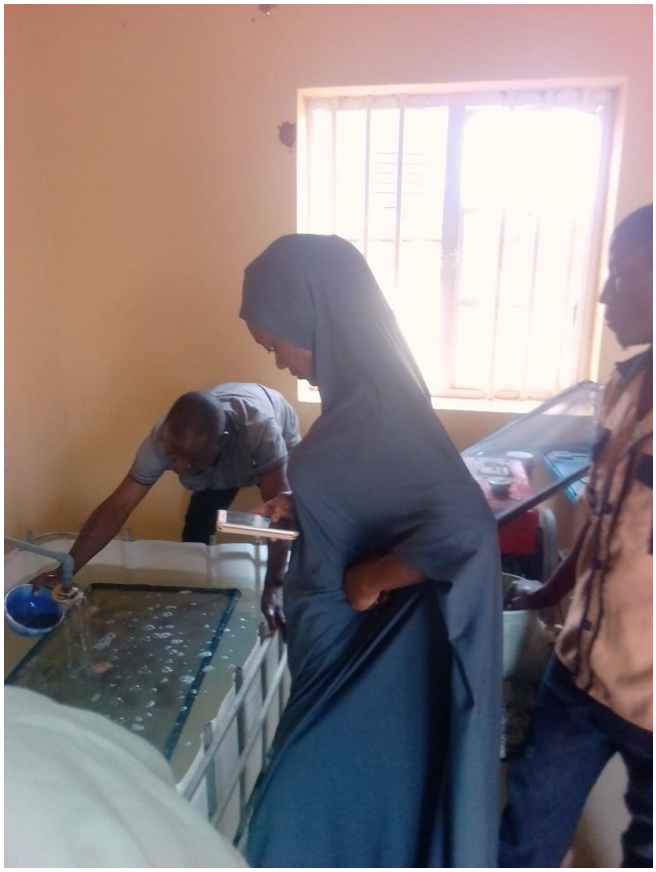

Figure 5: Spreading of the Eggs inside the Incubator on the Spawning net

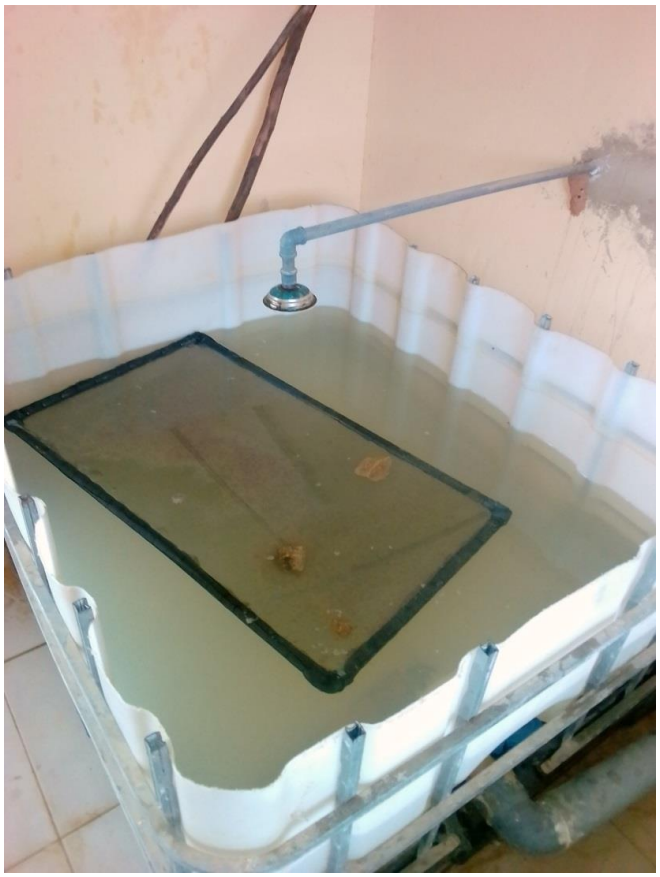

Figure 6: Already Set Spawning net with the Eggs Waiting for Fertilization to Take Place

Figure 7: Lead Researcher Adjusting the Spawning net and observing the Emergence of Fry