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Sibling Cannibalism of African Catfish *Clarias gariepinus* (Burchell, 1822) Fingerlings Cultured Under Different Photoperiod Conditions

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Abstract
Study was carried out to investigate sibling cannibalism in African catfish (*Clarias gariepinus*) fingerlings reared under different photoperiods. Experiments were conducted, in Adamawa State University Mubi Teaching and Research fish farm using fingerlings of ten weeks old from the same sibling obtained through artificial breeding. Fingerlings of average initial weight (4.81±0.00g) and (2.80±0.30cm) length were stocked at 40, 60, 80 and 100 fingerlings per 100 litre of water each in three replicates using flow-through system. They were fed with Coppens feed three times a day to satiation. They were cultured under four different photoperiodic regimes (24hours, 12hour, 6hours, and total darkness). The experiment lasted for 30 days. Water quality parameters were monitored weekly. Data generated on percentage cannibalism, mortality, survival rate, growth parameters and water quality parameters were analysed using one way Analysis of Variance (ANOVA) using statistical analysis for social science. The result shows that fingerlings cultured under dark environment and feed to satiation had the least percentage cannibalism of 2.33±0.00% and 2.004±0.00%. Also low mortality rate, high survival rate, and high specific growth ratest was observed under the same treatment. Based on the results from the experiments, sibling cannibalism in *Clarias gariepinus* can be reduce up to 2.00% at fingerlings stage when cultured under dark environment and at density of 50 per 100 litres with proper feeding at satiation.

Keywords: Cannibalism, *Clarias gariepinus*, Sibling, Photoperiod, Mubi

Introduction

Cannibalism can be defined as: "the act of killing and consuming the whole or major part, of an individual belonging to the same species, irrespective of its stage of development" (Yang *et al.*, 2015). To consume the same species or show cannibalism is a common ecological interaction in the animal kingdom and has been recorded for more than 1,500 species. It has been documented in a wide range of taxa, including Pisces. Cannibalism is encountered among most of the well-studied teleost families, and is classified according to the developmental stage of prey, genetic relationship of cannibal to prey, and/or the age relationship of cannibal and prey (Sallehudin and Mukai 2014). Environmental and nutritional factors as well as genetic parameters notably influence fish growth. In addition to temperature and other environmental factors, photoperiod is an important factor that affects living organisms including fish. Effects of photoperiod on growth rate and other variables have been studied in various species (Almaza-Rueda *et al.*, 2005). Light and dark alternation is generally thought to be the main synchronizer of feeding activity (Hseu, 2002). Photoperiod not only affects feeding activity, but also plays a decisive role in growth, survival and social behaviour (Jesu *et al.*, 2011). Such influences are caused by physiological mechanisms; such as altered hormone production, which may improve feed conversion efficiency (Sallehudin and Mukai 2014). However, photoperiod requirements are species specific and may vary for each developmental stage (Hseu, 2002). Stocking density of African catfish has for long been considered the most important factor affecting cannibalism and aggression (Kaiser *et al.*, 1995; Almanza -Rueda *et al.*, 2005).

In African catfish, aggressive behaviours are also affected by factors other than stocking density such as photoperiod (Almanza - Rueda *et al.*, 2005). As the growing awareness in Nigeria about fish farming puts increasing demands on the culture

environment, more information is needed on the social behaviours and the factors that can affect the social interactions in fishes, especially in species that exhibit aggressive behaviour and cannibalism. All these factors are crucial in intensive culture. Thus, understanding the parameters of optimum light intensity is an important prerequisite in ensuring sustainable development of, *Clarias gariepinus* culture. Several studies related to optimal light intensities such as (Mukai and Lim, 2011, Sallehudin , and Mukai, 2014) have been conducted to investigate the growth and survival of particular species of fish. Solomon and Okomoda (2012) also noted that high light intensities can increase the feeding time and improve growth and survival of *Clarias gariepinus*,.

Materials and Methods

African catfish (*Clarias gariepinus*) fingerlings from the same sibling were obtained through artificial breeding in the Department of Fisheries and Aquaculture Adamawa State University Mubi hatchery complex. Fingerlings with mean initial weight of 4.81±0.00g and 2.80±0.60cm length were used. Four different Photoperiod regimes (24hours, 12hour, 6hours, and total darkness) with four treatments and three replications were used simultaneously with the same stocking density of 50 fingerlings per 100 litres of water using Completely Randomised Design (CRD). They were fed with Coppens feed three times a day at 10% body weight and the quantity of feed were adjusted based according to their growth to avoid under feeding. Artificial light was provided continuously in the hatchery at low power mode 25lumens using solar lantern (Sunking Pro2). Light period was adjusted by the height of the light from the water surface for all treatments except for control. Black box was used to provide 24 hours darkness during the course of the research. The experiments lasted for the period of six weeks. Water quality parameters were monitored three times a week for each of the experiments. Data were collected on percentage cannibalism, mortality, survival rate, growth parameters and water quality parameter

Determination of Cannibalism Rate

Cannibalism Rate was determined by counting the number of missing fingerlings excluding natural mortality. All live individuals fingerlings in each rearing tank were counted before and after each the experiment to determine the number of missing fingerlings. The rate of cannibalism was calculated using the method described by Solomon and Okomoda (2012).

$$C_{\%} = \frac{F_m - F_d}{F_i} \times 100 \quad (1)$$

Where, $C_{\%}$ is percentage of cannibalism; F_m is number of missing fish; F_d is number of observed dead whole fish; and F_i is initial number of fish stocked. Dead fish due to cannibalism was determined based on physical appearance such as scars and wounds, while dead fish due to natural mortality were observed to be whole fish

Determination of Mortality Rate

Observed mortality was recorded daily from each experiment. Observed dead whole fish, not caused by cannibalism, were counted and recorded as mortality which was calculated using the methods described by Olufeagba and Okomoda (2016).

$$M_{\%} = \frac{F_d}{F_i} \times 100 \quad (2)$$

Where, $M_{\%}$ is percentage mortality; F_d is number of observed dead whole fish; andF_i is initial number of fish stocked.

Determination of Survival Rate

This was determined at the end of the experiment by counting the number of fingerlings at the end of the experiment and the number of fingerlings stocked at the beginning of the experiment the difference between the two were determined using the formula described by Solomon and Okomoda (2012).

$$Sv_{\%} = \frac{S_i - M}{F_i} \times 100 \quad (3)$$

Where, $Sv_{\%}$ is percentage survival; S_i is Initial stocking density; M is Mortality due to natural and Cannibalism; and F_i Initial number of fish stocked

Feed intake

Daily quantity of feed given for fingerlings will be weighed and recorded to determine the daily feed intake.

Feed conversion ratio

Daily amount of feed provided and weight gain of fingerlings for the period of six weeks were

recorded to determine the feed conversion ratio of each experiment according to the method described by Edwin *et al.,* (2015).

$$R_{fc} = \frac{P_f}{w} \quad (4)$$

Where, R_{fc} is feed conversion ratio; P_f is amount of feed provided (g); and w is weight gain (g).

Growth parameters

The mean weight and length of each treatment was taken at the beginning and at the end of the experiment and record to determine the growth parameters. Meter rule was used to measure the length while an electronic sensitive scale (Model ANDEK – 4100i) was used to measure the weight, after given them anaesthetic *Tricanmethane sulfonate* (MS-222) at the dose of 1,000ml /litre of water through immersion , to reduce stress. Length gain, weight gain and specific growth rate (SGR) was determine by formula;

$$SGR = \frac{LinFW - LinIW}{t(days)} \times 100 \quad (5)$$

Where, *SGR* is Specific Growth Rate ; *FW* is final body weight of fish; *IW* is initial body weight of fish; and *t* is time in days.

Condition factor

Condition factor of the experimental fingerlings was determined using the formula;

$$K = \frac{W}{L^3} \times 100 \quad (6)$$

Where, *K* is Condition factor; *W* is weight in grams; and *L* is standard length in cm.

Water Quality Parameters

Water quality parameters such as dissolved oxygen; pH, conductivity, ammonia and temperature required for growth and other biological processes were monitored and recorded every two days and weekly.

Results and Discussion

The results show that, fingerlings cultured for 24 hours darkness had the least percentage cannibalism of 6.66±0.60%, and high percentage survival rate of 85.00±0.00% respectively table 1. From the research, percentage cannibalism reduced as the fish grows. The present study agreed with the findings of Mukai and Lim (2011) which reviles that increased cannibalism among catfish was observed during the period of light and reduced during dark periods. Sallehudin and Mukai (2014) in their study on cannibalistic behaviour of African catfish juveniles, *Clarias gariepinus* under different photoperiod wavelengths and intensities found up 20% reduction in cannibalism when cultured under total darkness. Jesu and Appelbaum (2011) stated that African catfish fingerlings exhibit high levels of cannibalism; however, their findings revealed that cannibalism can be reduced if sufficient food is provided or if the fingerlings are cultured under dark or dim light conditions. Low percentage mortality of 8.33±0.00% was recorded under 24hours darkness table1. High mortality rate was recorded with increased in rate of photoperiod exposure. The work of Tamazouzt *et al.,* (2000) also shows high mortality rate of up to 30% in *Eurasian perch* larvae cultured under 24 hours photoperiod in their study on tank wall colour and photoperiod level affect growth and survival of *Eurasian perch* larvae (*Perca fluviatilis*). The reason for low cannibalism and mortality among fingerlings cultured under 24 hours darkness is attributed due to alteration of light intensity. Species that prefer darkness (such as African catfish—which finds food mainly with chemoreceptors and sensor organs) react to excessively intense light with intensified behaviour associated with chasing resting individuals, searching for refuges, gathering at the bottom of a tank and increased territorial aggression associated with locally increased stock density. According to Baras and Jobling (2002), long periods of good visibility translate into long periods for contact between a potential cannibal and its prey, which may contribute to an increased frequency of cannibalistic behaviour and higher heterogeneity in a stock, representing a positive feedback mechanism.

Fingerlings culture under 24 hour light had 33.33±0.30% cannibalism and 13.33±0.30% mortality respectively table 1. This shows that high exposure to photoperiod causes high mortality and cannibalism in catfishes. Alteration of this environmental factor influences the organisms' feeding behaviour by altering visual cues used to recognize and capture prey consequently; cannibalistic behaviour also will be altered. Fingerlings cultured under 24 hour light had low

survival rate during the course of the research. Fingerlings cultured for 24 hours darkness had the highest weight and length gain of 38.75±0.00g and 4.02±0.67cm respectively, while low weight and length gain were recorded in fingerlings cultured for 24 hours light with 27.78±0.00g and 3.50±0.00cm table1. This is in line with what Abdelhamid (1996) observed, that *Clarias gariepinus* cultured under total darkness were larger than those cultured under 24 hours light, also Almanzan-Rueda *et al.*, (2005) reported that *Clarias gariepinus* cultured under darkness resulted in an increase growth. Britz and Pienaar (1992) also reported high growth rate of *Clarias gariepinus* juveniles when cultured under continuous darkness. Significant differences were recorded in the growth and feed conversion efficiency of *Clarias gariepinus* cultured under the four different photoperiods.

The results also show high specific growth rate of 3.48±0.00/day for fingerlings in treatment that were cultured under 24 hour's darkness, while treatment with 24 hour light had the least value of 3.25±0.33/day for fingerlings table 1. The high specific growth rate under total darkness in this study were as result of complete feeding and utilization of the feed in the dark, more so because these fishes are nocturnal feeders.

Table1: Effects of different photoperiods on cannibalism of *Clarias gariepinus* fingerlings cultured under 24 hour's darkness.

Parameters	24 hours Photoperiod	12 hours Photoperiod	6 hours Photoperiod	24 hours darkness
Initial weight(g)	3.28±0.00^{a}	3.35±0.67^{a}	3.49±0.30^{a}	4.15±0.33^{a}
Final weight (g)	31.07±0.00^{d}	31.11±0.70^{c}	38.02±0.30^{b}	42.90±0.30^{a}
Weight gain(g)	27.78±0.00^{c}	27.74±0.30^{c}	34.53±0.30^{b}	38.75±0.00^{a}
Initial length(cm)	2.62±0.67^{b}	2.93±0.33^{b}	3.05±0.33^{a}	3.14±0.00^{a}
Final length(cm)	6.12±0.67^{c}	6.32±0.67^{c}	6.81±0.67^{b}	7.16±0.67^{a}
Increase in length (cm)	3.50±0.00^{c}	3.39±0.33^{c}	3.76±0.67^{b}	4.02±0.67^{a}
Feed Intake (g)	30.28±0.00^{a}	30.35±0.00^{a}	30.49±0.00^{a}	40.15±0.00^{a}
Feed conversion ratio (FCR)	1.08±0.64^{a}	1.09±0.33^{a}	0.88±0.33^{b}	1.03±0.00^{b}
Specific Growth Rate (SGR)(%day)	3.25±0.33^{c}	3.22±0.33^{b}	3.45±0.67^{a}	3.48±0.00^{a}
Condition Factor(K)	0.84±0.97^{b}	0.89±0.60^{b}	1.02±0.40^{a}	1.10±0.17^{a}
Survival Rate (%)	53.34±0.33^{c}	85.01±0.00^{a}	79.67±0.70^{b}	88.34±0.00^{a}
Mortality Rate (%)	13.33±0.30^{a}	6.66±90^{c}	7.00±0.00^{b}	8.33±0.00^{b}
Cannibalism Rate (%)	33.33±0.30^{a}	8.33±0.30^{c}	13.33±0.30^{b}	3.33±0.60^{d}

Mean in the same row with the same superscript do not differ significantly (p>0.05)

Table 2: Water quality parameters of fingerlings cultured at different photoperiods

Parameters	**24hours Photoperiod**	**12hours Photoperiod**	**6 hours Photoperiod**	**24hours Darkness**
Ammonia (mg/l)	0.21±0.00^{a}	0.22±0.67^{a}	0.22±0.33^{a}	0.22±0.33^{a}
Temperature (^{0}C)	27.10±0.00^{a}	27.30±0.00^{a}	27.57±0.67^{a}	26.57±0.67^{a}
Conductivity (mho/cm)	0.52±0.33^{a}	0.56±0.33^{a}	0.57±0.33^{a}	0.52±0.33^{a}
Dissolved Oxygen (mg/l)	6.91±0.00^{a}	6.03±0.67^{b}	6.93±0.33^{a}	5.93±0.33^{a}
pH	7.23±0.30^{a}	7.30±0.00^{a}	7.46±0.00^{a}	7.46±0.00^{a}

Mean in the same row with the same superscript do not differ significantly (p>0.05)

There are slight differences in terms of dissolved oxygen in this experiment. Fingerlings with 24hours light had high dissolved oxygen value of 7.6.91±0.00 table 2. There are slight different that occurs in dissolve oxygen content this is due to the exposure of the experiment to 24hour light. For fish to be able to live there must be enough oxygen for them to use. The level of dissolved oxygen greater than 100% should not be less than 45mg/l (called 60% saturation) if it falls below 4.5mg/l, then the fish will probably die (Akinwole *et al.*, 2006). Edward, (2000) stated that inadequate

dissolved oxygen has many effects on fish: fish stops feeding, growth is impaired and fish become stressed thereby becoming more susceptible to diseases, parasites and easy preys. Findings from this research reviled that, sibling cannibalism in *Clarias gariepinus* can be reduce up to 2.00% at fingerlings stage when cultured under dark environment and at density of 50 per 100litres of water for fingerlings with feeding to satiation and, grade them by size at interval of every two days to remove shooters.

Conclusion

Based from the results of the experiment carried out, it will be conclude that fingerlings should not be exposed to high Photoperiodism because high exposure to photoperiod during *Clarias gariepinus* seed production causes high mortality and cannibalism in catfishes.

Recommendation

I therefore recommend that sibling cannibalism in *Clarias gariepinus* can be reduce up to 2.00% at fingerlings stage when cultured under dark environment and at density of 50 per 100litres of water for fingerlings with feeding to satiation and, grade them by size at interval of every two days to remove shooters.

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