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GROWTH AND SURVIVAL OF WILD *SAROTHERODON GALILAEUS* AND *COPTODON ZILLII* RAISED IN A HAPAS-IN-POND SYSTEM

By

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ABSTRACT

Growth and survival of the Cichlids: S. galilaeus and Tilapia zillii (weighing: 14.10 -110.00 g and 71.10 - 80.70 g) recruited from Tagwai dam were studied in a hapas-in-concrete pond culture system for 24 week, with a view to adapting the wild specimens for aquaculture. Thirty samples of S. galilaeus and C. zillii (15 samples for each species) were studied. The species had no significant difference (p>0.05) in survival rates (27% and 33% for S. galilaeus and C. zillii). Growth patterns were positively allometry (b>3.0) with correlation coefficients (r) > 0.9 for both species, indicating strong length-weight relationship. Also, K. factor was > 3.0 g/cm³ for both species. The study identified the stress sensitivity of the species to handling and pond condition. The positive allometry growth pattern exhibited by the specie is ideal for their fusiform shape. However, greater growth performance (weight gain) was recorded with S. galilaeus at 5% confidence level (p<0.05). Furthermore, the growth responses are indices of their differential aquaculture potentials for sustainable fisheries. Nevertheless, the need to devote researches to effective management of natural fishery resource as well as a holistic management study of the growth, survival, breeding and feeding of the species under pond condition were recommended to provide comprehensive information on the species .

KEYWORDS: Growth, Survival, wild, *Sarotherodon galilaeus, Coptodon zillii* and Hapa-in pond System

INTRODUCTION

Tilapias are indigenous to Africa, however, interest in their aquaculture potentiality made their distribution virtually worldwide in the last five decades. Initial enthusiasm for the species was due to their suitable for subsistence fish farming in developing countries: several species are herbivorous, easily breed in small ponds, for their all-devouring feeding habit and for being sufficiently sturdy species for culture and are highly resistant to poor water quality variation (Meyer, 2002; Atama, *et al*., 2013). They have however, become important components in subsistence fisheries for hundreds of decades, and are being reported as the most important aquaculture species in the world today, next only to carps, and also as the most important aquaculture species of the twenty-first century (Shelton, 2002; WorldFish, 2003; Gupta and Acosta, 2004). Furthermore, Tilapias are regarded as mouldable fish species because their growth and maximum obtainable size can be seriously influenced by the physical and biological composition of their environment (Olurin and Aderibigbe, 2006).

Several works have explored the Cichlid species including the aspects of the ecology and biology (Ikomi and Jessa, 2003; Olukolajo and Ayo-Olalusi, 2009) growth, mortality and age (Faunce *et al.*, 2002), ponderal index (Fagade, 1983; Arawomo, 1982; Anene, 2005) among others. Nevertheless, the growth and survival of wild *S. galilaeus* and *C. zillii* in pond (especially those from the Tagwai dam) has remained a dream to be realized. According to Telethon (2014), the emerging acceptance of tilapia among people and the ever-growing need for increased food production, calls for alternative in inter-specific diversification of aquaculture through the incorporation of wild native tilapia species in aquaculture. moreover, the declining supply from capture fisheries and the ever-increasing demand for fish have further buoyed the need for inquest into the cultural potentials of these species from the local river system. On this note therefore, this study was an attempt to bridge the knowledge gap with regard the growth and survival of native *S. galilaeus and C. zillii* from Tagwai Dam Reservoir in pond so as to provide useful information for proper management of the strains.

Materials and Methods

Recruitment site: Fish samples were recruited from Tagwai dam (Figure 1), in Tagwai village, Niger State, northcentral Nigeria. The dam lies between latitudes 9° 33'N and 9° 37'N and longitudes 6° 39'E and 9°42'E (Akinrinmade, *et al.*, 2012). It is an earth filled dam, initiated by the Niger State Government to augment the source of raw water supply for the Chanchaga water treatment plant (Minna Water Supply Scheme, 1992). The dam has a crest height of 25m and it is 1.8km long with 28.3 million cubic meter volume, and serves for fisheries, recreation, wild life conservation and social upgrading purposes. Inhabitants around the Dam are predominantly artisanal Fishermen.

Experimental site, facilities and design:
The experiment was conducted at the Water Resources, Aquaculture and Fisheries Technology, Department Teaching and Research Farm, Federal University of Technology, Minna, Nigeria. It was conducted in hapas-in-concrete pond system. The system comprised a concrete pond and six (6) net hapas made of 0.5″ mesh size net woven on a square cylindrical plastic pipe. The pond and hapas were of 10 x 5 x 1.5m and 1 x 1 x 1m dimensions respectively.

The study was conducted using a completely randomized block design. The design comprised two experimental units: *S. galilaeus* and *C. zillii* and each combination of a single factor was repeated in triplicates.

Pond fertilization: This was done in accordance with the methods adopted by the National Agricultural Extension Liaison Services (2003) and Adigun (2005) to stimulate the production of natural fish food, using organic manure (poultry droppings) in pond at 0.1kg/m^2. Thereafter, the same rate was applied for weekly fertilization throughout the 24-week experimentation.

Recruitment and transportation of experimental fishes

A total of thirty (15 samples each for *S. galilaeus and T. zilli)* were recruited in the morning from Tagwai Dam, using Malian trap. The fishes were held in two separate hapas in the dam: one Hapa for each species until evening when they were removed and transferred to the experimental site. The samples were transported to the experimental site in oxygenated transparent polythene bags with water. Transportation water was prepared with addition of 8 g/L (0.8 %) salt as adopted by (William, 2014).

Analysis of water quality parameters

Water samples collected from Tagwai dam during recruitment and the biweekly samples from the experimental pond were analyzed for temperature, dissolved oxygen (DO) concentration, pH and conductivity using mercury-in-glass Mercury bulb thermometer (Gallenkamp, England) 0-100, DO meter (Model YSI 54A), pH meter (Hannah model) and Conductivity Meter (WPACMD200) respectively. The transparency of the water samples was also monitored using secchi disc as adopted by Adigun (2005).

Stocking of experimental fish samples

Stocking of the experimental fishes was done between 17:30 hrs and 18:30 hrs. Thirty tilapia samples (fifteen specimens for each species) were randomly distributed into six hapas in triplicates each (five specimens per hapa).

Feeding of experimental fishes
Supplemental feed: "MULTI FEED" was provided by manual feeding at 10 % body weight twice daily (morning and afternoon) throughout the 24week study.

Cumulative survival
The cumulative survival and survival rate were calculated as follows:
Cumulative survival was computed as:
Survival = $N_0 - N_1$
Where N_0 = Number alive initially (at time t_0) and N_1 = Number alive at time t

Morphometric measurement of the experimental fishes
Morphometric parameters of the experimental fishes were measured on alternate weeks (every 2week). Samples from each hapa were sampled by taking their body weight, total length and standard length. The total length of each fish (distance from the tip of snout to the tip of the caudal fin) and the standard length (distance from the tip of snout to the posterior end of the caudal peduncle) were read to the closest 0.1 cm with a meter rule. Weight of each sample was read to the closest 1.0 g using top-loading Metler balance.

Growth performance of experimental fishes
Growth performance of the experimental fishes were determined through: growth rate, growth pattern and condition factor as indices.

Growth
The growth rate of the specimen was calculated as:

$$\% GR = \frac{WF - W1}{W1} \times 100$$

Where, % GR = percentage growth rate, WF = final weight and W1 = initial weight

Growth pattern and condition factor

Growth pattern was estimated by the equation:
W = aLb (Pauly, 1983)
Where, W = weight (g), L= standard length (cm).
The length-weight relationship (LWR) was expressed by the equation:
Log weight = Log a + b Log length
Where 'a' and 'b' are constants of regression.
The condition factor was compute applying the Formula:
$K = [100\,W] / L^3$ (Bannister, 1976).
Where K = condition factor, W =weight (g), and L = standard length (cm)

Data analysis

Weight gain, increase in lengths were analyzed via paired T-Test analysis with IBM SPSS Statistics 23. The relationship between pairs of variables (length-weight relationship) and their linear equation were analyzed with Linear regression for each species. The significance of the relationship was determined with regression table.

RESULTS

Water quality parameters of Tagwai dam reservoir and the experimental pond

The results of the quality parameters of water samples taken from Tagwai Dam during recruitment and the experimental pond during stocking and sampling are presented in table 1. In the results, the temperature and dissolved oxygen of water samples from Tagwai dam and the experimental pond vary slightly. The variations were however, not significant ($P > 0.05$) between the sites. Only pH in the experimental was significantly higher ($p < 0.05$).

Growth performance and survival of *S. galilaeus* and *C. zilli*

Introduction of wild samples of the species into captivity caused low weight gain, although, their lengths continued to increase (Table 1). Analysis of variance revealed no significant difference in initial weight (P>0.05), weight gain (p>0.05) standard length (P>0.005) and mean percentage survival (p>0.05) between the species. Nevertheless, after 24 weeks in pond condition (hapas-in-pond), the mean final weights of the fishes were observed to be significantly different (P>0.05) (Table 1).

Growth pattern and condition factor of *S. galilaeus* and *C. zilli*

The growth pattern of *S. galilaeus* and *C. zillii* inferred from the regression of natural logs of the weights plotted against the natural log of the lengths showed positive allometric exponent 'b' (b>3.0) values 5.5044 and 3.19 with correlation co-efficient values: 0.93 and 0.97 for *S. galilaeus* and *C. zillii* respectively (Table 3). The correlation coefficient (r^2) indicated strong length-weight relationship of the both species.

The table also showed 3.07 and 3.45 as values of the condition factor which are positive allometric values for *S. galilaeus* and *C. zillii,* indicating positive conditions of the species.

Discussion

The dissolved oxygen, pH, conductivity, transparency and temperature of water in Tagwai dam and the experimental pond were found to be within the benchmark standard ranges for fish culture (Costa-Pierce, 2003; Fish Base, 2008; Bhatnagar and Devi, 2013). Despite significant variability ($P < 0.05$) in the quality parameters water samples from the two sites, the levels remain within acceptable ranges (Bhatnagar and Devi, 2013). This emphasis is crucial in the face of verifiable assertions such as the one of Bhatnagar and Devi (2013), who maintained that Fishes are not resistant to every change in their surroundings. A sudden fluctuation above or below allowable levels would have physiological consequences. Such fluctuation makes fish vulnerable to stress and, the greater and faster the intensity, the greater the stress.

The low percentage survival of the experimental fishes is an index of the stress sensitivity of the species. This is evident in the occurrence of mortality just few days after introduction of the samples into the experimental facility. This agrees with Liao and Huang (2000), in their report that, some sensitive species are not easily adaptable to culture environment because, a composite of nutritional, immunity and endocrine disorder may cause serious stress and eventual death of sensitive species. However, the degree of susceptibility to stress varied amongst the species. In this regard *C. zillii* performed better than *S. galilaeus* and this may be attributed to restiveness of the *S. galilaeus* during introduction to the pond. Restiveness, as reported by Zeder (2012), has the greatest and general impact on domestic animals selected for manipulation to increase adaptability of wild species to artificial conditions.

Growth in fish is a trait of economic importance in aquaculture. Hence, growth was taken as a major factor of comparison of the two species. In this regard the species showed differential responses to pond condition. This is expressed in the mean weight gain of *S. galilaeus* (76.62±26.48) and *C. zillii* (43.92±17.08) and may attributable to genetic variation, response to feed and differential response to pond environment.

The growth pattern of *S. galilaeus* and *C. zillii* in this study were positive correlation coefficient (r = 0.93, r = 0.97 and r = 0.98 and 0.95). That is, weight increase was positively correlated to length. Exponents of regression (b > 3.0) shows allometric growth pattern for *S. galilaeus* and *C. zillii*. This is a signifies that, the tilapias got heavier for their length as they grow (Oniye, *et al.*, 2006). Positive allometric growth was considered an ideal growth pattern for the tilapia species owing to their fusiform body shape. It is ideal, when isometric value of b=3 for fishes that maintain three-dimensional equivalences (Oniye, *et al.*, 2006). The variation in the regression exponent b of the species has confirmed the report of Saha, *et al.*, (2009) that 'b' value dissimilarities between fishes is dependent on their species, sex, food habits and level of maturity.

Variation in the values of condition factor (K) between *S. galilaeus* and *T. zilli* indicated that the species responded somewhat differently to the same condition. The variation may have been influenced by the species genetic variability in response to the pond environment. Atama, *et at.* (2013) noted that condition factor is not constant for species or population over a time interval and might be influenced by both biotic and abiotic factors such as phytoplankton abundance, predation, water temperature and dissolve oxygen concentrations, feeding regime and state of gonadal development among others which may not equally favour the survival of all the species in the ecosystem.

Conclusion

Sequel to the findings of the study, the following conclusions were drawn:

S. *galilaeus* and *C. zillii* survived below average in the experimental facility. Comparatively, *C. zillii* showed better adaptability with respect to survival in captivity. In growth performance (weight gain), the species recorded varying degrees of successes with *S. galilaeus* showing better response. The index for the well being of the samples showed that the experimental condition was favourable to both species.

Therefore, the research established that both *S. galilaeus* and *C. zillii* from Tagwai dam adapted to the pond culture environment at varying degrees of successes in growth (weight gain and growth pattern) and survivorship.

Recommendation

This study only assessed the growth performance and survival of wild *S. galilaeus* and *C. zillii* strains from Tagwai Dam Reservoir under pond condition. It may be interesting if further study is conducted to also include their feeding behaviours (with respect to artificial feeds) and breeding. More researches towards effective management of the natural fisheries resources should be encouraged to safeguard the resource and enhance sustainability of production, supply and availability of fish to local consumers.

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