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GROWTH PERFORMANCE AND SURVIVAL OF *Liza falcipinnis* CULTURED IN BRACKISH WATER AT DIFFERENT STOCKING DENSITIES

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ABSTRACT

Growth performance and survival of grey mullet (*Liza falcipinnis*) cultured in brackish water was carried out with the aim of providing information on the growth response and survival of *L. falcipinnis* under different stocking densities. Four different stocking densities 15, 30,60, and 90 fish per 65 liters plastic tank. Twelve plastic tanks each measuring 0.60mx0.36m was used for the culture arranged in a randomized complete block design with each treatment replicated three times. Data collected were subjected to one way analysis of variance and means were separated using Duncan multiple range test at 5% probability level. The result obtained indicated mean total weight gain decreased with increasing stocking density. The higher mean weight gains were recorded in T1 and T2, respectively. Absolute growth rate and yield showed significant difference ($p<0.05$) among the treatment. The best absolute growth rate was in T3 1.04±0.01g which is similar in performance with T2 0.76±0.23g and T1 0.54±0.12g and yield was observed to be significantly different ($p<0.05$) between T1 1265±13.9, T2 1960±27.3, T3 2677±60.1g and T4 1645±31.2g but similarity was observed between T2 and T3. The feed conversion ratio (FCR) showed no significant difference with increasing stocking density. There was significant difference among the treatments in terms of survival rate with T1 (90%) and T2 (84.3%) having ststistically higher survival percentage, while T4 (34.4%) recording the least survival rate percentage. Water quality did not exceed the suitable and acceptable range for fish throughout the experiment. Therefore, it can be concluded that *L. falcipinnis* culture is best achievable with stocking density ranging from 15 to 60 fish per 65 litre of water with considerable growth, yield and survival under culture environment.

Keywords: Growth; brackish water; *Liza falcipinnis*; Stocking density

INTRODUCTION

Brackish water fish farming is a veritable tool that can provide some of the numerous aquaculture benefits in the country to augment fresh water aquaculture. Nigeria is naturally endowed with a long coast line bordering the Atlantic Ocean and extensive

network of inland river system (Okorie, 2003). Mullets are cultured in many countries of the world, usually in extensive and semi-intensive pond systems (Pilly and Kutty, 2005). Egypt has a long history of mullet aquaculture (Saleh, 2008). Mullets are members of the Order Mugiliformes, Family Mugilidae. Mullets are ray-finned fish found worldwide in coastal temperate and tropical waters. Some species are also in freshwater. Taxonomically the family is usually treated as the sole member of the order Mugiliformes (Saleh 2008). Mullet is an extremely important fish cultured in many countries particularly Mediterranean. It has a worldwide distribution and they feed at the lowest trophic level (i.e plants, detritus and algae) (Smith and Swart, 1998).

According to Edwards *et al*. (2001) many species of Mullet enter fresh water and they generally swim in large schools. Currently there are 25 recognized species in this genus. Liza is the largest genus of mugilidae. Currently 16 species are recognized in this genus (Menezes *et al*., 2015). Mullets can be found in the western part of Africa from Senegal to Angola. *Liza falcippinis* is probably the dominant mullet in West Africa coast and contribute significantly to the mullet fishery in Nigeria (Payne, 1976, king 1988). The species is mainly diurnal and feeds on zooplankton, benthic organisms and detritus. Adult fish tend to feed mainly on algae. The success of mullet aquaculture is also a result of its feeding habits. Mullet are usually farmed in polyculture with other fish speciesin earthen ponds (Saleh, 2008). In countries where most cultured mullet are produced; pre-farming preparation of ponds is of great importance prior to stocking. Culture ponds are prepared by drying, ploughing and fertilization. Ponds are then filled to depth of 25-30cm kept at this level and is then increased to 1.5 -1.75m and the fingerlings are stocked (Saleh, 2008). Grey mullet reach an individual weight of 0.74-1kg after an on-growing season of 7-8 month. The choice of rearing depends on market demand and economics (Saleh, 2008).

In Nigeria, several trials of polyculture of mullet were carried out such as Ezenwa (1977) (polyculture trial of mullet) and (common carp) and Anyanwu and Awa (1988). (Mullet, Tilapia, Hemichromis and *Elops* spp.). In Nigeria mullets are very important to commercial fishery as they form major constituent of the fish landing of artisanal fishermen in the Niger Delta region (Akpan and Ubak, 2005). Brackish water fish species propagation in this part of the world (Africa, Nigeria) is still at its embryonic stage. Many fish species are in abundance in brackish water zone of the coastal areas of Nigeria (King, 1988). They can be cultured with minimal capital input in most of the coastal communities. Hence the need to focus more on this area so as to enhance food security and employment opportunities in the region cannot be over emphasized. Nigeria's aquaculture is presently more on freshwater. Currently, brackish water aquaculture is very minimal. Increase in production activity in brackish water culture will increase fish yield and bridge the gap between fish supply and demand. Mullet fetch the best price when marketed fresh than when processed into dried, salted product. It is relatively highly valued. The aim of this study was to determine the survival and growth performance of grey mullet cultured in brackish water at different stocking densities.

MATERIALS AND METHODS

Study Area

The study was conducted at Nigeria Institute for Oceanography and Marine Research (NIOMR), Shrimp Hatchery complex, located on Latitude $6^0$25'13.58"N and

Longitude $3^0$24'26.02"E Lagos, South West, Nigeria, with average temperature of 27^0C, average annual rainfall of 1673mm and relative humidity of 84.7% (NIMET). Brackish water is readily available in this study location

Experimental fish

Liza falcippinis fry were collected from Lagos Lagoon using scoop net. The fish samples were transported immediately to the experimental site using plastic bowl (65 litres) with aeration device. This was followed by acclimatization for two weeks in 0.5m^3 plastic tank before stocking. During acclimatization, the fish were fed 37% crude protein commercial diet (Aller Aqua).

Feeding

Commercial diet of 37% crude protein was used to feed the fish. The fish were fed for a period of 16 weeks. Feeding was carried out twice every day at 9:00 hr and 17.00 hr. Feeding was done at a feeding rate of 3% body weight.

Table1: Nutrient composition of experimental diet (Aller Aqua Tilapia Feed)

Ingredient composition (%)	Feed composition (%)
Crude protein	37
Crude fat	10
NFE	38.5
Ash	6
Fibre	3.5
Phosphorus	1
Gross energy (MJ)	19.9
Digestible Energy (MJ)	16.8

Source: Product Label

Determination of Growth and Feed Utilization

The growth performance was determined using:

Fish survival = $\frac{\text{total No harvested} - \text{No stocked}}{Totalnostocked} \times 100$,

Total weight gain= final total weight-total initial weight

Absolute growth rate = $\frac{\text{Final wt} - \text{Initial wt}}{cultureperiod\ (days)}$

Feed Conversion (FCR) = $\frac{\text{Total weight of feed}}{\text{final weight at harvest}}$

Water Quality Monitoring

Some water quality parameters such as Temperature, pH, Dissolved Oxygen, Nitrite, Ammonia and salinity were measured from each of the treatments. The water temperature was determined using mercury in glass thermometer, while pH, Nitrite and Ammonia were tested using Lamotte test kit. Salinity was measured with Salininometer. All parameters measured were within the suitable range for fish growth.

Experimental Design

Four (4) different stocking densities 15, 30, 60and 90 fish per 65 liters of culture water, which make up the dietary treatments, were considered in this study. The experiment was arranged in a randomized complete block design (RCBD). Each treatment was replicated thrice. Twelve (12) plastic tanks each measuring 0.60 x 0.36 m were used for the culture. The tanks were fitted with both inlet and outlet pipes. The tanks were properly washed and impounded with well oxygenated water before stocking. Sampling was done bi-monthly for each treatment.

Data Collection and Analysis

During the culture period, growth parameter such as length, weight, survival, feed intake, data were collected bi-monthly bases in all the tanks. About 20% of the stocked fish in each tank were randomly selected for morphmetric measurement of individuals of the different treatment and length was measured to the nearest 1.0 cm, and the weight to the nearest 0.1 g using a measuring board and sensitive weighing scale, respectively subjected to one-way analysis of variance, and the differences between the means were separated using Duncan multiple range test at 5%probability level.

RESULTS

The results of growth performance, feed utilization and survival of *L. falcipinnis* cultured in brackish water at different stocking densities are presented in Table 2.

Table 2: Growth parameters and survival of *L. falcipinnis* cultured under different stocking densities

	Treatments			
Parameters	T1	T2	T3	T4
AIW (g)	3.6±00	3.6±00	3.6±00	3.6±00
AWG (g)	7.60 ± 0.89^{a}	7.13 ± 0.67^{a}	6.56 ± 0.75^{b}	6.05 ± 1.06^{c}
AGR (g/days)	0.54 ± 0.12^{ab}	0.76 ± 0.23^{a}	1.04 ± 0.01^{a}	0.05 ± 0.26^{b}
Yield/g/m^3	1265 ± 13.9^{c}	1960 ± 27.3^{ab}	2677 ± 60.1^{a}	1645 ± 31.2^{b}
Feed intake (g)	47.00 ± 18.5^{c}	74.68 ± 23.1^{b}	104.8 ± 39.0^{a}	65.30 ± 19.0^{b}
FCR	1.48	1.56	1.42	1.62
Survival (%)	90.0 ± 6.51^{a}	84.3 ± 10.1^{a}	72.0 ± 17.9^{b}	34.4 ± 20.8^{c}

AIW = Average initial weight; AWG = Average weight gain; AGR = Absolute growth rate
*Means with same superscript along the row are not significantly different at 5% probability

Table 3: Mean Water quality parameter values recorded during cultured period

Parameter	Mean	Minimum	Maximum
Ammonia (mg/l)	0.14±0.34	0.03	1.50
Nitrate (mg/l)	2.04±0.45	0.25	10.0
Nitrite (mg/l)	0.40±0.45	0.02	1.00
PH	7.78±0.65	9.00	6.50
Salinity (ppt)	7.00±2.64	5.00	14.0
Temperature (^{o}C)	28.7±1.49	25.0	30.0

The result for growth indicated that, average total weight gain decreased with increasing stocking density. The highest average weight gain (7.6±0.89g) was recorded in T1 which was not different from T2 (7.1±0.67g) while the lowest average weight gain was recorded in T4. Absolute growth rate showed significant difference ($p<0.05$) among the treatments. The result further indicated that, the highest absolute growth rate (1.037±0.01g/day) was recorded in T3 while the lowest (0.05g/day) was recorded in T4. Thus, the growth rate decreased with increasing stocking rate. The results on yield indicated significant difference among the different treatments ($p<0.05$). The highest yield (2677±60.1g) was recorded in T3 while the lowest yield (1265±31.2g) was in T4.

Feed conversion ratio (FCR) showed no significant difference with increasing stocking density, however, the best FCR was recorded in T3while the worst was recorded in T4.

Survival results indicated that, there was significant difference among the stocking density. Fish survival decreased with stocking density. The highest fish survival (90%) rate was recorded in the treatment 1, while the lowest (34.4%) survival was recorded in the highest stocking density treatment 4.

The result of water quality parameter (Table 3) did not exceed the acceptable range for coastal water fish culture throughout the culture period. The mean ammonia concentration was (0.14±0.34), Nitrite (0.40±0.45), nitrate (2.042±3.50), pH had mean value of (7.7±0.65), Salinity mean value (7.00±2.64ppt) and temperature had average range of 25-30^{0}C with mean value of 28.7±1.49.

DISCUSSION

The growth performance decreased significantly with increasing stocking density. Thus low stocking density (T1 and T2) recorded higher growth performance for weight gain. This may be attributed to reduced or less competition for space and food. The results are in agreement with those reported by Abdel-Hakim *et.al.* (2005), Bakeer (2006) and Eid (2006), who reported that growth of grey mullet was influenced by the different stocking densities, fertilization and supplementary feeding. Essa (1996), reported that, the mean individual growth rate of *M. cephalus* were highest for the lower stocking density and lowest for the higher stocking density.

Optimum absolute growth rate and yield was obtained in T3 stocking density compared to other treatments, which may be due to considerable feed intake in (T3) while the poor absolute growth rate was in T4, this may be due to high mortality recorded as a result of overcrowded population and competition for food and space in T4 This is similar to the finding of Green (1992) and Esaa (1996).

Feed intake increased as stocking density increased, the highest feed intake was observed in T3. This lead to higher yield recorded during the culture period. This may be attributed to higher survival rate compared to T4. This is in agreement with Abdel-Ghany *et al*. (1996) who reported that digestion and utilization of artificial diet depend on the quality and quantity of food presented to *M. cephalus*.

Feed conversion ratio (FCR) was generally poor in this study for all the treatment. This may be attributed to higher protein content of the supplementary diet, food and feeding habit of *L falcipinnis* which is placed at the lower level of aquatic food chain, L. falcipinnis is more of a filter feeding herbivores. This is similar to Abdel-Hakim *et.al*. (2014), who reported that, the worst FCR value was recorded by the treatment that received artificial feed only, while the best FCR was in treatment that received both fertilization and artificial feed for period of study.

Water quality parameters were all within the required range for fish culture. The mean of unionized ammonia, nitrate and nitrite did not exceed acceptable range for fish culture. Mean value for pH range from 6.5 to 9.00 was recorded during the cultured period with average range of (7.7). Generally the values recorded were acceptable based on the finding of Boyd and lickpoppler (1979), Alabaster andLioyd (1984), Boyd (1990) and Bhatnagar and Devi (2013). Andem *et al*. (2012) reported that, water having pH between 6.5 to 9.0 is the most suitable for the fish production. Salinity mean value was 7ppt and this fall within the desirable range for mullet cultured in ponds and tanks as reported by Oren (1981). Temperature was adequate for mullet cultured. The overall mean temperature was 28.7 ^{0}C. This is suitable for all physical, chemical and biological process in pond waters as reported by Boyd (1979), Boyd (1992) and Ugwumba *et al.* (2011).

CONCLUSION

Based on the findings of this study, it can be concluded that *L. falcipinni*s culture is best achievable with stocking density ranging from 15 to 60 fish per 65 litre of water with considerable growth, yield and survival under culture environment.Thus, with salinity of as low as 7-5ppt and all other water quality conditions maintained within the acceptable range, *L. falcipinni*s can be cultured at density of 15 to 60 fish/65L culture water.

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